KIPS

ENTRY TESTS SERIES

PRACTICE BOOK

PHYSICS

NATIONAL MDCAT

- Topic-wise Practice MCQs'
- Answer Keys
- Explanatory Notes

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1 FORCE AND MOTION

TOPIC » PRACTICE EXERCISE

TOPIC-WISE MCQ's

DISPLACEMENT, VELOCITY, DISPLACEMENT-TIME GRAPH, ACCELERATION

Q.1 A Body moves 6 m north. 8 m east and 10m vertically upwards, what is its resultant displacement from initial position

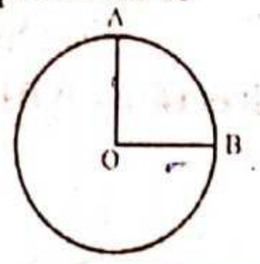
A) $10\sqrt{2}m$

B) 10 m

C) $\frac{10}{\sqrt{2}}m$

D) $10\times 2m$

Q.2 A particle starts from center O towards A then moves along AB and stop at B. if R=100m then displacement of the particle is



A) 100 m

B) $\frac{100}{\sqrt{2}}$m

C) $100\sqrt{2}$ m

D) None

Q.3 The instantaneous acceleration is the limit of average acceleration as $\Delta t \to 0$ is given by

A) $\vec{a}_{ins} = \lim_{\Delta t\to 0} \frac{\Delta \vec{d}}{\Delta t}$

B) $\vec{a}_{ins} = \lim_{\Delta t\to 0} \frac{\Delta \vec{v}}{\Delta t}$

C) $\vec{a}_{ins} = \lim_{\Delta t\to 0} \frac{\Delta t}{\Delta \vec{v}}$

D) $\vec{a}_{ins} = \lim_{\Delta t\to 0} \frac{\Delta \vec{a}}{\Delta t}$

Q.4 If an object is moving with constant velocity of $20ms^{-1}$ towards north then its acceleration will be

A) 5 m s^{-2}

B) 9 m s^{-2}

C) 10 m s^{-2}

D) 0 m s^{-2}

Q.5 The retardation is defined as

A) Increase in velocity per unit time

B) Decrease in speed per unit time

C) Decrease in velocity per unit time

D) Increase in speed per unit time

Q.6 Consider the acceleration, velocity and displacement of a tennis ball as it falls to the ground and bounces back. Directions of which of these changes in the process

A) Velocity only

B) Displacement and velocity

C) Acceleration, velocity and displacement

D) Displacement and acceleration

Q.7 A particle goes from x = −2m, y = 3m, z = 1m to x = 3m, y = −1m, z = 4m. Its displacement is:

A) $(1m)\hat{i}+(2m)\hat{j}+(5m)\hat{k}$

B) $-(5m)\hat{i}+(4m)\hat{j}-(3m)\hat{k}$

C) $(5m)\hat{i}-(4m)\hat{j}+(3m)\hat{k}$

D) $-(1m)\hat{i}-(2m)\hat{j}-(5m)\hat{k}$

Q.8 Length of the path of a particle is equal to the magnitude of the displacement of that particle. Shape of the path possible

A) Circle

B) Parabola

C) Arc of a circle

D) Straight line

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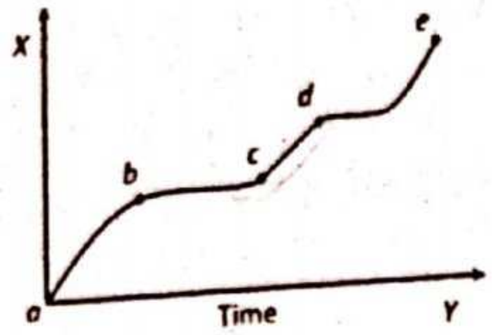
Topic-1

★ **Q.9 The displacement versus time graph for a body moving in a straight line is shown in figure. Which of the following regions represents the motion when no force is acting on the body?**



A) ab
B) bc
C) cd
D) de

Q.10 The shortest distance between two points is called

A) Acceleration
B) Speed
C) Velocity
D) Displacement

Q.11 Two cars are moving in opposite directions with speed v. What is the magnitude of their relative velocity?

A) 0
B) v/2
C) v
D) 2v

Q.12 A man in a car moving with velocity of 36 km/hr. His speed with respect to the car is

A) 10 m/s
B) 36 m/s
C) Zero
D) Infinite

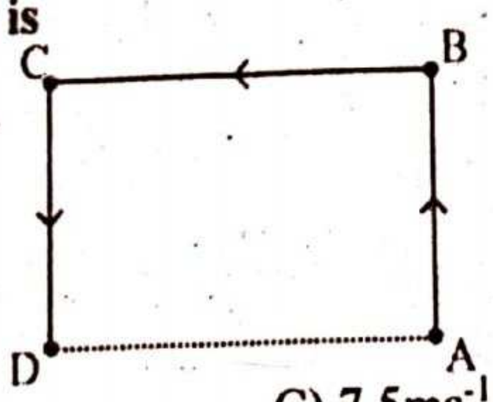
Q.13 A body can have constant velocity when it follows a.

A) Elliptical path
B) Circular path
C) Parabolic path
D) Rectilinear path

Q.14 A man leaves his house for a cycle ride. He comes back to his house after half an hour after covering a distance of one km. What is his average velocity for the ride?

A) 2 km per hour
B) 1/2 km per hour
C) 0
D) 1/2 km per second

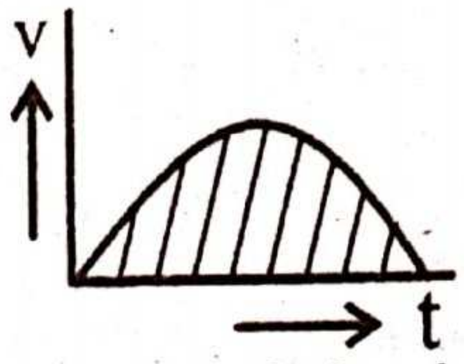
Q.15 A particle moves along the sides AB, BC and CD of a square of side 25m with a velocity of $15ms^{-1}$. Its average velocity is



A) $15ms^{-1}$
B) $10ms^{-1}$
C) $7.5ms^{-1}$
D) $5ms^{-1}$

GRAPHICAL REPRESENTATION OF ACCELERATION WITH VELOCITY–TIME GRAPH

Q.16 The Figure shows the velocity time graph of a one dimensional motion. Which of the following characteristic of the particle is represented by the shaded area?



A) Distance covered
B) Momentum
C) Speed
D) Acceleration

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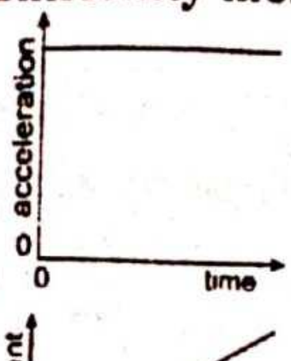
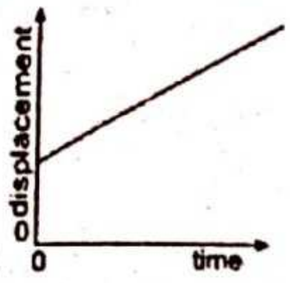
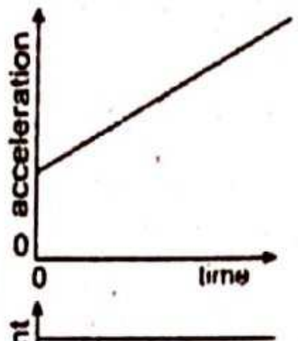
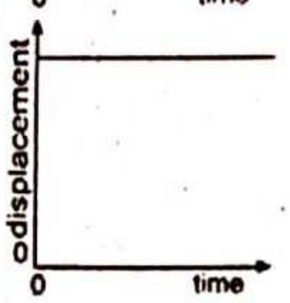
Q.17 Which graph represents the motion of a car that is travelling along a straight road with a uniformly increasing speed?

A) 

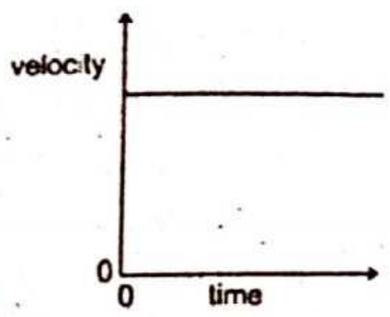
B) 

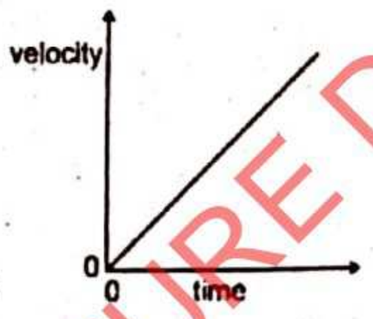
C) 

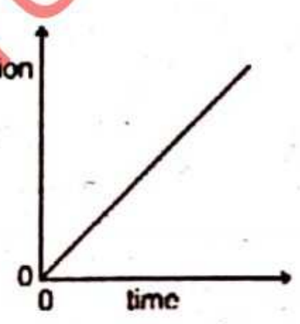
D) 

Q.18 A particle is moving in a straight line with uniform acceleration. Which graph represents the motion of the particle?

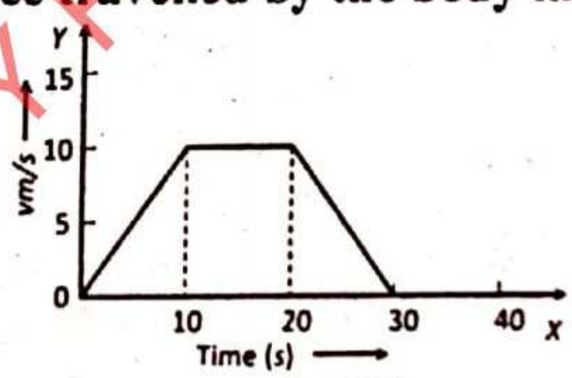
A)

B) 

C) 

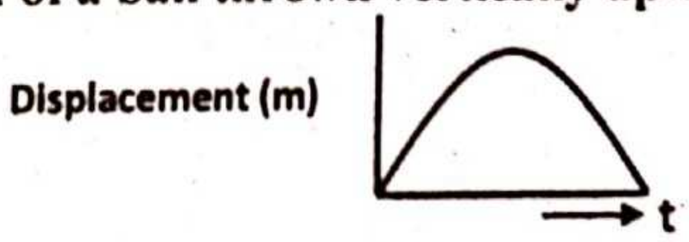
D) 

Q.19 In the following graph, distance travelled by the body in metres is

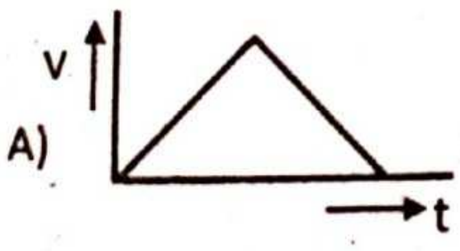


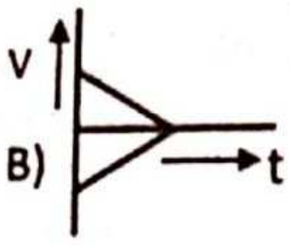
A) 200
B) 250
C) 300
D) 400

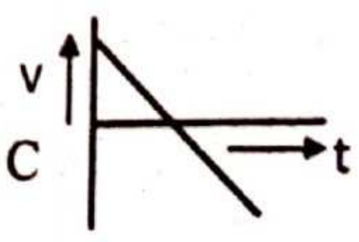
Q.20 Displacement time graph of a ball thrown vertically upward is shown in figure

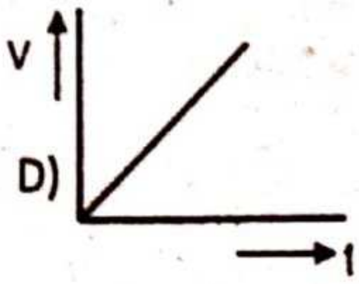


Which of the following represents v-t graph?

A) 

B) 

C 

D) 

Q.21 If the slope of a velocity time graph gradually decreases, then the body is said to be moving with

A) Positive acceleration
B) Uniform velocity
C) Negative acceleration
D) None of these

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NEWTON'S LAWS OF MOTION

Q.22 If the force acting on a body is doubled, then acceleration becomes

A) Half
B) One fourth
C) Doubled
D) Constant

Q.23 When force of 1 N is applied on a body of mass 100 g then the acceleration would be

A) 5 m s^{-2}
B) 10 m s^{-2}
C) 0.5 m s^{-2}
D) 0.1 m s^{-2}

Q.24 A mass of 10 kg moves with an acceleration of 10 m s^{-2}, the force on it is

A) 5 N
B) 50 N
C) 100 N
D) 25 N

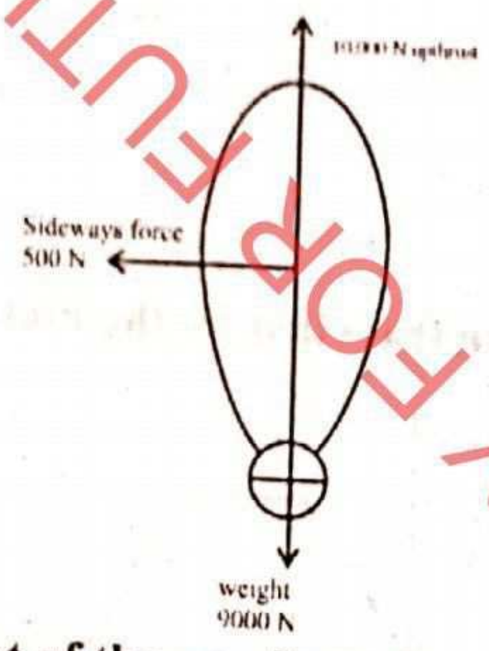
Q.25 Which law of motion defines force?

A) 1st law
B) 3rd law
C) 2nd law
D) All of these

Q.26 A Force of 12 N gives an object an acceleration of 4 m/s². The force required to give it an acceleration of 10 m s^{-2} is

A) 15 N
B) 20 N
C) 25 N
D) 30 N

Q.27 A balloon is acted upon by three force, weight, upthrust and sideway force due to the wind, as shown in the diagram



What is the vertical component of the resultant force on the balloon?

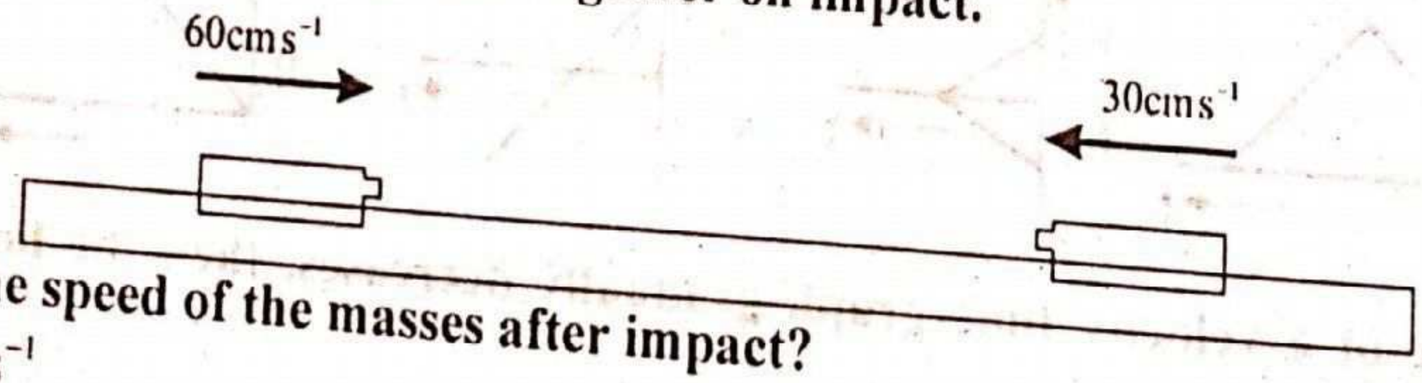
A) 500 N
B) 10000 N
C) 1000 N
D) 10500 N

LINEAR MOMENTUM AND LAW OF CONSERVATION OF MOMENTUM

Q.28 When a force of 4 N acts on a mass of 2 kg for a time of 2 sec, what is the rate of change of momentum?

A) 2 kg m s^{-2}
B) 8 kg m s^{-2}
C) 4 kg m s^{-2}
D) 16 kg m s^{-2}

Q.29 Two equal masses travel towards each other on a frictionless air track at speeds of 60 cm s^{-1} and 30 cm s^{-1}. They stick together on impact.



What is the speed of the masses after impact?

A) 15 cm s^{-1}
B) 20 cm s^{-1}
C) 30 cm s^{-1}
D) 45 cm s^{-1}

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Q.30 Which is a statement of the principle of conservation of momentum?

A) A force is equal to the rate of change of momentum of the body upon which it acts.
B) In a perfectly elastic collision, the relative momentum of the bodies before impact is equal to their relative momentum after impact
C) The momentum of a body is the product of the mass of the body and its velocity
D) The total momentum of a system of interacting bodies remains constants, providing no external force acts

Q.31 The average force necessary to stop a hammer with 25 N s momentum in 0.05 s expressed in 'N' is

A) 500
B) 50
C) 125
D) 25

Q.32 In which of the following cases forces may not be required to keep the

A) Particle going in a circle
B) Particle going along a straight line
C) The momentum of the particle constant
D) Acceleration of the particle constant

Q.33 A force of 6 N acts on a mass of 1kg which acquire velocity of $30ms^{-1}$. The time for which the force acts is

A) 26 s
B) 5 s
C) 6 s
D) 2 s

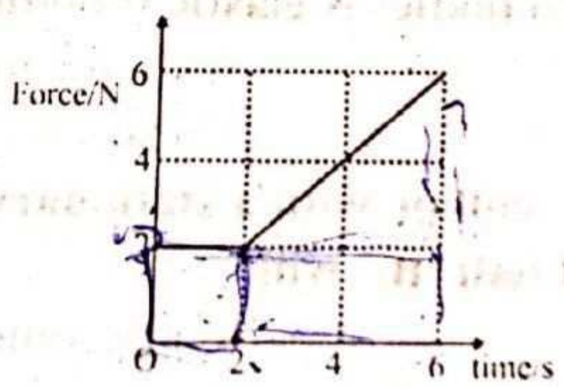
Q.34 A force of 100 Dynes acts on mass of 5g for 10 sec. The velocity produced is_____

A) 2 cm/sec
B) 20 cm/sec
C) 200 cm/sec
D) 2000 cm/sec

Q.35 When a force of 5 N acts on a mass of 3 Kg for a time of 2 sec. What is the rate of change of momentum?

A) 5 Kg m/sec^2
B) 410 Kg m/sec^2
C) 2.5 Kg m/sec^2
D) 6 Kg m/sec^2

Q.36 The graph shows how the force acting on a body varies with time. Assuming that the body is moving in a straight line, by how much does its momentum change?



A) $40\,kg\,ms^{-1}$
B) $20\,kg\,ms^{-1}$
C) $36\,kg\,ms^{-1}$
D) $16\,kg\,ms^{-1}$

Q.37 A gun after firing recoils due to

A) Conservation of energy
B) Backward thrust of gases produced
C) Conservation of momentum
D) Newton's first law of motion

Q.38 A player takes 0.1 s in catching a ball of mass 150 g moving with velocity of 20 m/s. The force imparted by the ball on the hands of the player is:

A) 0.3 N
B) 300N
C) 3 N
D) 30 N

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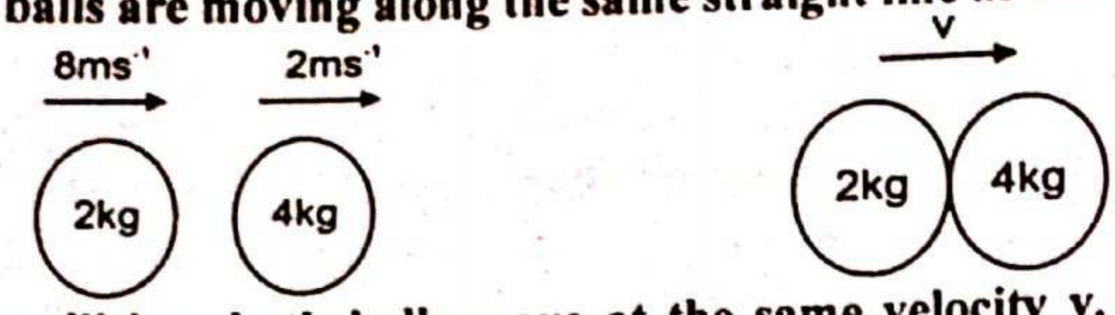
COLLISION, ELASTIC COLLISION, ELASTIC COLLISION IN ONE DIMENSION

Q.39 A ball of mass 2 kg travelling at 8 ms^{-1} strikes a ball of mass 4 kg travelling at 2 ms^{-1}. Both balls are moving along the same straight line as shown



After collision, both balls move at the same velocity v. What is the magnitude of the velocity v?

A) 4 ms^{-1}
B) 5 ms^{-1}
C) 6 ms^{-1}
D) 8 ms^{-1}

Q.40 Two similar spheres, each of mass m and travelling with speed v, are moving towards each other.

The spheres have a head on elastic collision. Which statement is correct?

A) The spheres stick together on impact
B) The total kinetic energy after impact is mv^2
C) The total kinetic energy before impact is zero
D) The total momentum before impact is 2 mv

Q.41 Two railway trucks of masses m and 3m move towards each other in opposite directions with speeds 2v and v respectively. These trucks collide and stick together. What is the speed of the trucks after the collision?

A) $\frac{v}{4}$
B) $\frac{v}{2}$
C) v
D) $\frac{5v}{4}$

Q.42 The collision between the two bodies is elastic if bodies are?

A) Solid and soft
B) Hard and elastic
C) Solid and hard
D) Soft and elastic

Q.43 When a very heavy ball 'B_1' collide with a stationary target 'B_2' of negligible mass, after collision the final velocity of ball 'B_2' will

A) Become zero
B) Become doubled as compared to B_1
C) Become half
D) Same as the B_1

Q.44 A shell explodes into four unequal parts. Which one of the following is conserved?

A) Potential energy
B) Momentum
C) Kinetic energy
D) Both potential and kinetic energy

PROJECTILE MOTION, CHARACTERISTICS OF PROJECTILE MOTION, EFFECT OF AIR RESISTANCE IN PROJECTILE MOTION

Q.45 A handball is tossed vertically upward with a velocity of 19.6 meters per second. Approximately how high will it rise?

A) 15 m
B) 25 m
C) 20 m
D) 30 m

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Q.46 Which shows the correct relation between time of flight T and maximum height H?

A) $H = \frac{gT^2}{8}$

B) $H = \frac{8T^2}{g}$

C) $H = \frac{8g}{T^2}$

D) $H = \frac{8}{gT^2}$

Q.47 At maximum height on the trajectory which of projectile becomes zero

A) Acceleration
B) Velocity
C) Vertical velocity
D) Horizontal velocity

Q.48 Time taken by a projectile to reach maximum height is t =

A) $\frac{v_i \sin\theta}{2g}$

B) $\frac{v_i \sin 2\theta}{g}$

C) $\frac{v_i \sin\theta}{g}$

D) $\frac{2v_i \sin 0}{g}$

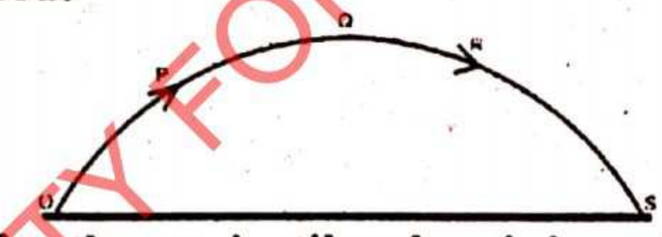
Q.49 Two projectiles are projected at angle of 20^0 and 70^0 with same velocity which one have longer range.

A) Which is fired at 20^0
B) Which is fired at 70^0
C) Both have same range
D) None of these

Q.50 The path followed by a projectile is known as its

A) Range
B) Cycle
C) Trajectory
D) Height

Q.51 A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.



Which statement is true for the projectile when it is at the highest point Q of its path?

A) The horizontal component of the projectile's acceleration is zero
B) The horizontal component of the projectile's velocity is zero
C) The kinetic energy of the projectile is zero
D) The momentum of the projectile is zero

Q.52 A projectile is fired horizontally with an initial speed of 20 m/s. Its horizontal speed 3s later is

A) 20 m/s
B) 60 m/s
C) 6.67 m/s
D) 29.4 m/s

Q.53 For which of the following angles range is maximum?

A) 43°
B) 60°
C) 30°
D) None

Q.54 A bullet is fired horizontally from a rifle at a distant target. Ignoring the effect of air resistance, what is the horizontal and vertical acceleration of the bullet?

	Horizontal	Vertical
A)	$9.8\ ms^{-2}$	$9.8\ ms^{-2}$
B)	$9.8\ ms^{-2}$	$0\ ms^{-2}$
C)	0	$9.8\ ms^{-2}$
D)	0	0

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Q.55 An aeroplane is flying horizontally at a velocity v. It drops a packet from a height h, the time taken by the packet to reach the ground will be

A) $\sqrt{\frac{2h}{g}}$

B) $\sqrt{\frac{h}{2g}}$

C) $\sqrt{\frac{2v}{g}}$

D) $\sqrt{\frac{v}{h}}$

Q.56 A ball is thrown at the angle of 45° with the horizontal: Then

A) The path of the ball is parabola and horizontal range in maximum
B) The path of the ball is a parabola and horizontal range is minimum
C) The path of ball is straight line and horizontal range is maximum
D) The path of the ball is semi-circle having maximum diameter

Q.57 Two stones A and B are thrown at angle of θ and $(90° - \theta)$ with the horizontal. The ratio of their time of flight is

A) 1 : 1

B) $\tan\theta$: 1

C) $\tan^2\theta$: 1

D) 1 : $\tan\theta$

Q.58 At which angle range of projectile will be half of its maximum value?

A) 15°

B) 30°

C) 60°

D) 90°

Q.59 What is the angle of projection for which the range and maximum height become equal?

A) $\tan^{-1}\frac{1}{4}$

B) $\tan^{-1} 4$

C) $\cos^{-1}\frac{1}{4}$

D) $\sin^{-1}\frac{1}{4}$

Q.60 Air resistance affects both the horizontal component and vertical component of velocity so the range of the projectile is

A) Increases

B) Decreases

C) Remain same

D) None of these

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ANSWER KEY

1	A	11	D	21	A	31	A	41	A	51	A
2	A	12	C	22	C	32	C	42	C	52	A
3	B	13	D	23	B	33	B	43	B	53	A
4	D	14	C	24	C	34	C	44	B	54	C
5	C	15	D	25	A	35	A	45	C	55	A
6	B	16	A	26	D	36	B	46	A	56	A
7	C	17	A	27	C	37	C	47	C	57	B
8	D	18	C	28	C	38	D	48	C	58	A
9	C	19	A	29	A	39	A	49	C	59	B
10	D	20	C	30	D	40	B	50	C	60	B

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EXPLANATORY NOTES

Q.1 $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k} \quad \therefore \; r = \sqrt{x^2 + y^2 + z^2}$

$r = \sqrt{6^2 + 8^2 + 10^2} = 10\sqrt{2}\ m$

Q.2 Displacement is the shortest distance between initial and final positions of the body.

$\vec{d} = oB = 100m$

Q.3 $\vec{a}_{in} = \lim_{\Delta t \to 0} \dfrac{\Delta \vec{v}}{\Delta t}$

Q.4 Since velocity is constant so acceleration is zero.

Q.5 Definition of retardation.

Q.6 Only direction of displacement and velocity gets changed, acceleration is always directed vertically downward.

Q.7 $\vec{A} = -2\hat{i} + 3\hat{j} + \hat{k}$, $\vec{B} = 3\hat{i} - \hat{j} + 4\hat{k}$

Displacement $= \vec{d} = \vec{B} - \vec{A}$

$\vec{d} = 3\hat{i} - \hat{j} + 4\hat{k} + 2\hat{i} - 3\hat{j} - \hat{k}$

$\vec{d} = 5\hat{i} - 4\hat{j} + 3\hat{k}$

Q.8 When length of the path of a particle is equal to the magnitude of the displacement of that particle, shape of the path possible is Straight-line.

Q.9 In part *cd* displacement-time graph shows constant slope *i.e.* velocity is constant. It means no acceleration or no force is acting on the body.

Q.10 The shortest distance between two points is called displacement

Q.11 For bodies moving in opposite direction, relative velocity is given by $v_r = v_1 + v_2 \Rightarrow v_r = v + v = 2v$

Q.12 In this case, man is at rest with respect to car.

Q.13 At straight path, body can have constant velocity because direction of motion will remain same.

Q.14 Displacement covered is zero so average velocity will be zero in this case.

Q.15 $s = 75\,m,\ v = 15\,ms^{-1} \Rightarrow t = \dfrac{s}{v} = \dfrac{75}{15} = 5\,s$, Now $\vec{v}_{avg} = \dfrac{\vec{d}}{t} = \dfrac{25}{5} = 5\,ms^{-1}$

Q.16 Area under v-t graph represents distance covered by the body.

Q.17 As velocity of an object is increasing uniformly so it's acceleration is constant.

Q.18 When change in velocity is uniform then uniform acceleration will be produced.

Q.19 Distance = Area covered between graph and displacement axis $= \dfrac{1}{2}(30+10)10 = 200$ meter.

Q.20 In this case, initial velocity will be maximum, velocity will be zero at highest position, then velocity will increase when body comes back.

Q.21 If the slope of velocity time graph gradually decreases, then the body is said to be moving with positive acceleration. i.e (graph is in 1st quadrant)

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Q.22 $F = ma \Rightarrow a \propto F$

Q.23 $a = \frac{F}{m} = \frac{1}{0.1} = 10\ m\ s^{-2}$

Q.24 $F = ma = 10 \times 10 = 100\ N$

Q.25 Newton's 1st law of motion defines force.

Q.26 $\frac{F'}{F} \propto \frac{a'}{a} \Rightarrow F' \propto \frac{10}{4} \times 12 = 30N$

Q.27 Since forces are antiparallel

$F = F_{upthrust} - F_{weight}$

so $= 10000 - 9000 \Rightarrow F = 1000\ N$

Q.28 Rate of change of momentum is equal to applied force. So, $F = \frac{\Delta p}{\Delta t}$

Q.29 $m_1 v_1 + m_2 v_2 = (m_1 + m_2)\ v$

$(m)(60) + m(-30) = (m + m)v$

$30m = 2mv \Rightarrow v = 15\ cm\ s^{-1}$

Q.30 Statement of law of conservation of momentum.

Q.31 $\Delta p = F \times t \Rightarrow F = \frac{\Delta p}{t} = \frac{25}{0.05} = 500\ N$

Q.32 If momentum remains constant then force will be zero because $F = \frac{dP}{dt}$

Q.33 $F = \frac{\Delta p}{t} \Rightarrow t = \frac{mv}{F} = \frac{1 \times 30}{6} = 5s$

Q.34 $F = \frac{mv}{t} \Rightarrow v = \frac{F \times t}{m} = \frac{100 \times 10}{5} \Rightarrow v = 200\,cms^{-1}$

Q.35 Rate of change of momentum is equal to force i.e $F = \frac{\Delta P}{\Delta t}$

Q.36 Area under "F - t" graph represents change in momentum.

ΔP = area of triangle + area of trapezium.

$\Delta P = 2 \times 2 + \frac{1}{2}(6+2) \times (4) \Rightarrow \Delta P = 20\,kgms^{-1}$

Q.37 A gun after firing recoils due to conservation of momentum.

Q.38 $F = \frac{mv}{t} = \frac{0.15 \times 20}{0.1} = 30\,N$

Q.39 For inelastic collision, momentum is still conserved.

Momentum before collision = momentum after collision

$m_1 u_1 + m_2 u_2 = (m_1 + m_2)\ v$

$(2)(8) + (4)(2) = (2+4)v$

$v = 4\,ms^{-1}$

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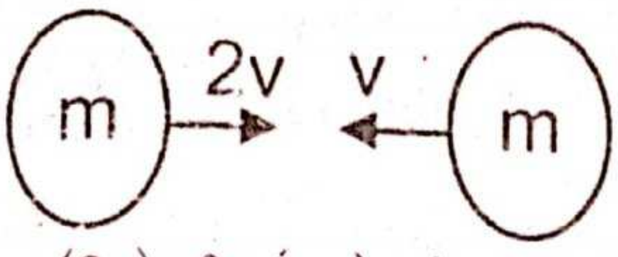
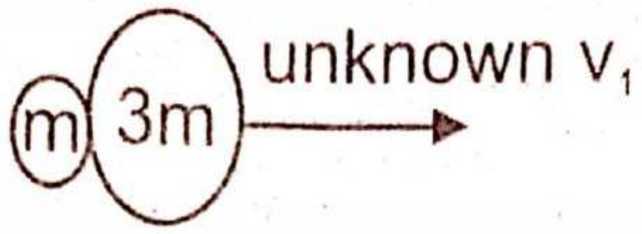
Q.40 Kinetic energy is conserved for elastic collision.

$$\frac{1}{2}mv^2 + \frac{1}{2}mv^2 = mv^2$$

Q.41 This is a perfectly inelastic collision.





$$m(2v) + 3m(-v) = (m + 3m)v_1$$

$$-mv = 4mv_1$$

$$v_1 = -\frac{1}{4}v$$

Q.42 Kinetic energy will remain conserved if energy loss due to compression is zero. It is possible in case of solid and hard object.

Q.43 In this case

$m_1 >> m_2$ and $v_2 = 0$

so $v_2' \simeq 2v_1$

Q.44 Momentum will be conserved.

Q.45 $h = \frac{v_i^2}{2g}$

Q.46 $H = \frac{v_i^2 \sin^2 0}{2g} \Rightarrow H = \frac{4g}{4g} \frac{v_i^2 \sin^2 0}{2g}$

$$H = \left(\frac{2v_i \sin 0}{g}\right)^2 \times \frac{g}{8} \Rightarrow H = \frac{gT^2}{8}$$

Q.47 At maximum height projectile have minimum velocity as $v_y = 0$

Q.48 $T = \frac{v_i \sin 0}{g}$ is the time taken to reach maximum height?

Q.49 For complementary angles ranges are same.

If $0_1 + 0_2 = 90°$, then $R_1 = R_2$

Q.50 Path followed by projectile is known as its trajectory.

Q.51 The horizontal component of the projectile's acceleration is zero

Q.52 Horizontal component of projectiles' velocity remains same.

Q.53 For an angle closer to 45°, range will be maximum; so in this case at 0 = 43°; rang will be maximum as compared to range at other angles.

Q.54 For the projectile's, horizontal acceleration will be zero and vertical acceleration = 9.8 ms^{-2}

Q.55 $h = v_i t + \frac{1}{2}gt^2$, $v_i = 0$. $h = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2h}{g}}$

Q.56 Path of ball will be parabola and at 0 = 45° the horizontal range will be maximum.

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Q.57 $T=\dfrac{2v_i \sin\theta}{g} \Rightarrow T \propto \sin\theta$

$$\frac{T_1}{T_2}=\frac{\sin\theta}{\sin\left(90^\circ-\theta\right)} \Rightarrow \frac{T_1}{T_2}=\frac{\sin\theta}{\cos\theta}=\frac{\tan\theta}{1}$$

Q.58 $R=\dfrac{v_i^2 \sin 2\theta}{g}$

$$R=R_{max}\sin 2\theta$$

$$\frac{R_{max}}{2}=R_{max}\sin 2\theta$$

$$\sin 2\theta=\frac{1}{2}$$

$$2\theta=\sin^{-1}\left(\frac{1}{2}\right)$$

$$2\theta=30^\circ \Rightarrow \theta=15^\circ$$

Q.59 As, $R\tan\theta=4H \rightarrow$ if $R=H$ then $H\tan\theta=4H \rightarrow \theta=\tan^{-1}(4)$

Q.60 Air resistance affects both the horizontal component and vertical component of velocity so the range of the projectile decreases.

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2 TOPIC WORK AND ENERGY

PRACTICE EXERCISE

TOPIC-WISE MCQ's

WORK

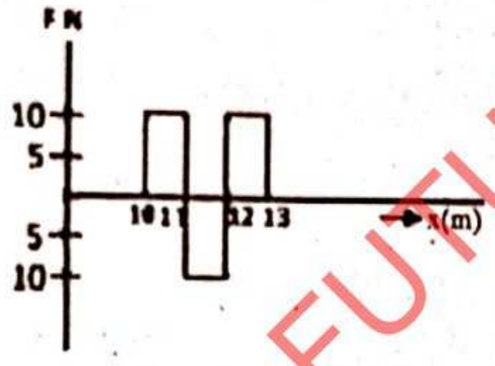
Q.1 At what angle work done will be maximum?

A) 0°
B) 90°
C) 45°
D) 30°

Q.2 Which one of the following is a greater work?

A) +100 J
B) –100 J
C) –1000 J
D) +200 J

Q.3 The figure shows the force distance curve of a body moving along a straight line. The work done by the force:



A) 10 J
B) 20 J
C) 30 J
D) 40 J

Q.4 Work done will be zero if angle between Force and displacement is:

A) 0°
B) 60°
C) 270°
D) 360°

Q.5 A force 2i + j has moved its point of application from (2,3) to (6,5). What is work done?

A) –10
B) +10
C) –18
D) +18

Q.6 At what angle the work done will be half of its maximum value

A) 0°
B) 45°
C) 30°
D) 60°

Q.7 A man pushes a wall with 50 (N) and it displaces it zero (m), his work is

A) Negative
B) Positive
C) No work
D) May all possible

Q.8 If a mass of 5 Kg is lifted upto 5m height, what will be the work done against the gravitational field

A) 245 J
B) 49 J
C) 25 J
D) 98 J

Q.9 A person walks 2 m with an acceleration of 5 m s^{-2}, holding an object of mass 2 kg. The net work done on the object is

A) 20 J
B) 5 J
C) 10 J
D) 0 J

Q.10 A force of $3\hat{i}+2\hat{j}+4\hat{k}$ N gives displacement of 10 $\hat{j}$ m. The work done is

A) 20 J
B) 32 J
C) 26 J
D) Zero

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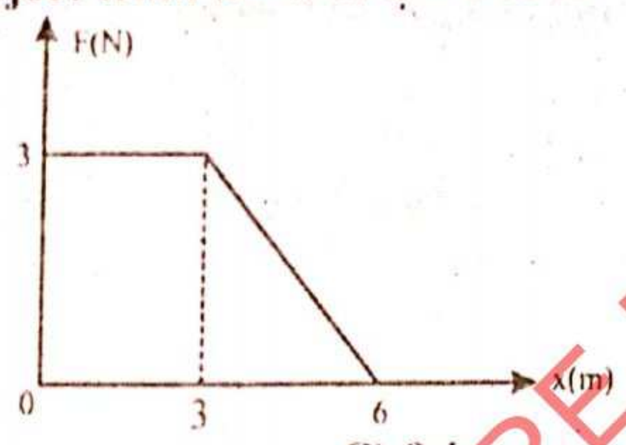
Q.11 A body travels displacement of 10 m by force of 5 N If work done is 25 J then angle between $\vec{F}$ and $\vec{d}$ is

A) 0° C) 45°
B) 30° D) 60°

Q.12 A person holds a bucket of weight 60 N. He walks 7 m along the horizontal path and then climbs up a vertical distance of 5 m. The work done by the gravity is:

A) 300 N-m C) 720 N-m
B) 420 N-m D) None of these

Q.13 A force F acting on an object varies with distance x as shown in fig. The work done by the force in moving the object from x = 0 to x = 6 m is



A) 18 J C) 9 J
B) 13.5 J D) 4.5 J

Q.14 If force and displacement of particle in direction of force are doubled. Work would be

A) double C) 1/4 times
B) half D) 4 times

Q.15 A person is holding a bucket by applying a force of 10N. He moves a horizontal distance of 5m and then climbs up a vertical distance of 10m. Find the total work done by him?

A) 50J C) 100J
B) 150J D) 200J

Q.16 A gardener pushes a lawn roller through a distance of 20m. If he applies a force of 20kg weight in a direction inclined at 60° to the ground, find the work done by him. ($g=9.8m/s^2$)

A) 400J C) 250J
B) 1960J D) 2514J

KINTEIC ENERGY

Q.17 If velocity is double, then.

A) Momentum increase 4 times and K.E increases 2 times
B) Momentum and K.E remain same
C) Momentum increases 2 times and K.E increase constant
D) Momentum increases 2 times and K.E increases 4 times

Q.18 What will be the ratio of kinetic energies of alpha particle and proton if their linear momentum will be same

A) 18 : 1 C) 4 : 1
B) 1 : 4 D) 10^4 : 1

Q.19 The Bodies of one kg and four kg have same kinetic energy. The ratio in their moment will be

A) 1 : 2 C) 1 : 4
B) 1 : 16 D) 1 : 1

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Q.20 The velocity and momentum of a moving body are 10,000 cm s^{-1} and 10,000 g cm s^{-1} respectively. The K.E will be

A) 5×10^{7} J
B) 5×10^{-2} J
C) 5×10^{8} J
D) 5×10^{0} J

Q.21 If momentum of a moving object is doubled then its kinetic energy will be

A) Doubled
B) Halved
C) Four times
D) Same

Q.22 The momentum and kinetic energy of a ball is numerically equal. The numerical value of velocity is

A) 1 m s^{-1}
B) 2 m s^{-1}
C) 3 m s^{-1}
D) 4 m s^{-1}

Q.23 Kinetic energy of a body moving with speed of 10 m s^{-1} is 30 J. If its speed becomes 30 m/s its K.E will be

A) 10 J
B) 180 J
C) 90 J
D) 270 J

Q.24 Car X is traveling at half the speed of car Y. Car X has twice mass of car Y. Which statement is correct?

A) Car X has half the kinetic energy of car Y
B) Car X has one quarter of the kinetic energy of car Y
C) Car X has twice the kinetic energy of car Y
D) The two cars have the same kinetic energy

Q.25 A ball of mass 2 kg and another of mass 4 kg are dropped together from a 60 feet tall building. After a fall of 30 feet each towards earth, their respective kinetic energies will be in the ratio of:

A) $\sqrt{2}:1$
B) 1 : 4
C) 1 : 2
D) $1:\sqrt{2}$

Q.26 A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is 6 m s^{-1}. The K.E of other mass is

A) 324 J
B) 486 J
C) 256 J
D) 524 J

Q.27 The kinetic energy acquired by a body of mass m is travelling some distance s, starting from rest under the actions of a constant force, is directly proportional to

A) m^{o}
B) m^{2}
C) m
D) $m^{1/2}$

Q.28 When force and displacement are in the same direction, the kinetic energy of the body

A) Increases
B) Decreases
C) Remains constant
D) Becomes zero

Q.29 A truck and a car are moving with equal velocity. On applying brakes, both will stop after a certain distance, then?

A) Truck will cover less distance before stopping
B) Car will cover less distance before stopping
C) Both will cover equal distance
D) None of the mentioned

POTENTIAL ENERGY AND GRAVITATIONAL POTENTIAL ENERGY

Q.30 Potential energy per unit volume is given by

A) mgh
B) $\frac{mgh}{\rho}$
C) gh
D) ρgh

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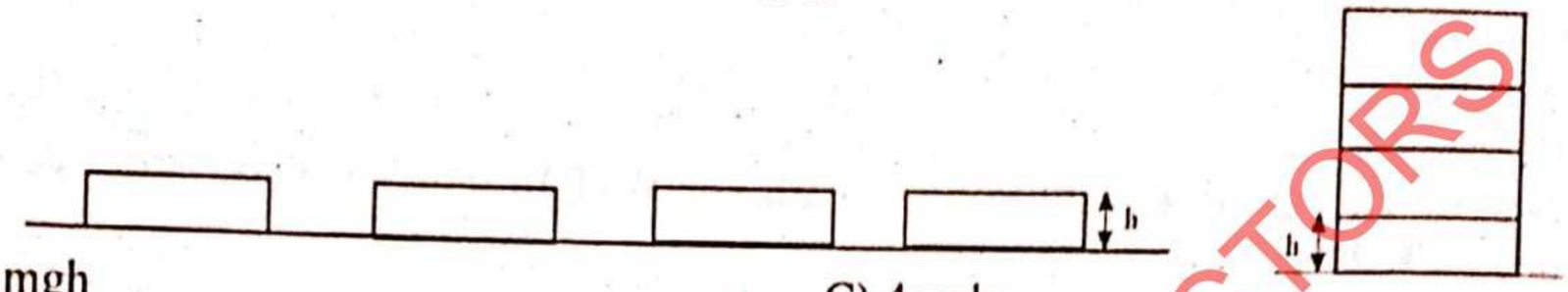
Q.31 A body is falling from a height h. After it has fallen a height h/2, it will possess

A) Only potential energy
B) Only kinetic energy
C) Half potential and half kinetic energy
D) More kinetic and less potential energy

Q.32 Energy stored in the spring of watch is

A) Electrical energy
B) Kinetic energy
C) potential energy
D) Elastic potential energy

Q.33 Initially four identical uniform block, each of mass m and thickness h, are spread on a tabl work require to stack them on one another is



A) mgh
B) 3mgh
C) 4mgh
D) 6mgh

Q.34 A stone is thrown up from the surface of earth when it reaches at maximum height, h total energy is equal to

A) mgh
B) zero
C) $\frac{1}{2}mv^2$
D) 2mgh

POWER

Q.35 Energy consumed by 60-watt bulb in 2 minutes is equal to

A) 7.2 kilo joules
B) 720 joules
C) 120 joules
D) 72000 joules

Q.36 The consumption of energy by 60-watt bulb in 2 seconds is:

A) 20J
B) 120 J
C) 30J
D) 0.02 J

Q.37 100 joules work has been done by an agency in 10 seconds. What is power of agency?

A) 1000 watt
B) 100
C) 10 watt
D) 0.10 watt

Q.38 A 500N force is applied on an object and it moves with velocity $10ms^{-1}$. If value of powe is 2500 watt. Then what will be the angle between force and displacement

A) 0°
B) 60°
C) 90°
D) 23°

Q.39 The time taken by an engine of power 10 kW to lift a mass of 200 kg to the height of 40 m is

A) 2 s
B) 4 s
C) 8 s
D) 16 s

Q.40 To travel at a constant speed, a car engine provides 24 kW of useful power. The drivin force on the car is 600 N. At what speed does it travel?

A) 25 ms^{-1}
B) 4.0 ms^{-1}
C) 2.5 ms^{-1}
D) 40 ms^{-1}

Q.41 A force of 1000 N is needed to lift the hook of a crane at a steady velocity. The crane i then used to lift a load of mass 1000 kg at a velocity of $0.50\,m\,s^{-1}$. How much of the power developed by the motor of the crane is used in lifting the hook and the load? (Take g as $10\,m\,s^{-2}$).

A) 5.0 kW
B) 20 kW
C) 5.5 kW
D) 22 kW

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Q.42 The power output of a lamp is 6W. How much energy does the lamp give out in 2 minutes?
A) 3 J
B) 120 J
C) 720 J
D) 430 J

Q.43 A man M_1 of mass 80 kg runs up a staircase in 15 s. Another man M_2 also of mass 80 kg runs up the same staircase in 20 s. The ratio of the power developed by them will be:
A) 1
B) 4/3
C) 16/9
D) none of these

Q.44 An engine pumps up 100 kg of water through a height of 10 m in 5s. Given that the efficiency of the engine is 60%, what is the power of the engine? (Take $g = 10\ m\ s^{-2}$)
A) 33 kW
B) 3.3 kW
C) 0.33 kW
D) 0.033 kW

Q.45 An engine pumps out 40 kg of water in one second. The water comes out vertically upwards with a velocity of 3 $m\ s^{-1}$. What is the power of engine in kilowatt?
A) 1.2 kW
B) 12 kW
C) 120 kW
D) 1200 Kw

Q.46 An elevator's motor produces 3000 W power. The speed with which it can lift a 1000 kg load is:
A) 30.6 $m\ s^{-1}$
B) 3.06 $m\ s^{-1}$
C) 0.306 $m\ s^{-1}$
D) 300.6 $m\ s^{-1}$

Q.47 The power needed to lift a mass of 5000g to height of 1 m in 2 second is
A) 2.45-watt
B) 245-watt
C) 24.5 watt
D) 2.45 k watt

Q.48 An engine pulls a car of mass 1500 kg on a level road at a constant speed of 5 ms^{-1}. If the frictional force is 500 N, what power does the engine generate?
A) 5.0 kW
B) 2.5 kW
C) 10 kW
D) 12.5 kW

WORK ENERGY PRINCIPLE

Q.49 Work done on a body equals change in its _____ energy.
A) Total
B) Potential
C) Kinetic
D) All of these

Q.50 If a certain force acts on an object and changes its kinetic energy from 65 J to 130 J, then work done by the force will be:
A) 92.5 J
B) 97.5 J
C) 65J
D) 130 J

Q.51 The amount of work required to stop a moving object is equal to:
A) The velocity of the object
B) The mass of the object times its velocity
C) The kinetic energy of the object
D) The mass of the object times its acceleration

Q.52 The work energy principle is valid for
A) change in K.E
B) Change in P.E
C) change in E.P.E
D) All type of energies

Q.53 Mathematical form of work energy principle is
A) $Fd = \frac{1}{2}mv_i^2 - \frac{1}{2}mv_f^2$
B) $Fd = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
C) $Fd = \frac{1}{2}mv_f - \frac{1}{2}mv_i$
D) $Fd = \frac{1}{2}mv_f^2 + \frac{1}{2}mv_i^2$

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IMPLICATION OF ENERGY LOSSES IN PRACTICAL DEVICES

Q.54 Effort × distance through which effort acts =

A) Output of machine
B) Efficiency
C) Input of machine
D) Work

Q.55 Load × distance covered by the load =

A) Output of machine
B) Efficiency
C) Intput of machine
D) Work

Q.56 Ratio of output to the input of machine is called:

A) Work
B) Energy
C) Efficiency
D) Mechanical advantage

Q.57 Unit of Efficiency is

A) Watt
B) Joule
C) hp
D) No unit

INTER-CONVERSION OF KINETIC ENERGY AND POTENTIAL ENERGY IN GRAVITATIONAL FIELD

Q.58 If 10 kg mass is dropped from a certain height, hits the ground with speed 10 ms^{-1}. Th height will be

A) 100 m
B) 10 m
C) 50 m
D) 5 m

Q.59 In freely falling system, if potential energy is equal to kinetic energy. Then force friction of air will

A) Be negligible
B) Be maximum
C) Be zero
D) Not be predicted

Q.60 In the presence of air friction, the relation for free falling body is

A) $mgh = \frac{1}{2}mv^2 - fh$
B) $mgh = fh - \frac{1}{2}mv^2$
C) $mgh = \frac{1}{2}mv^2 + fh$
D) $mgh = fg + \frac{1}{2}mv^2$

ANSWER KEY

1	A	14	D	27	A	40	D	53	B
2	C	15	C	28	A	41	C	54	C
3	A	16	B	29	B	42	C	55	A
4	C	17	D	30	D	43	B	56	C
5	B	18	B	31	C	44	B	57	D
6	D	19	A	32	D	45	A	58	D
7	C	20	D	33	D	46	C	59	C
8	A	21	C	34	A	47	C	60	C
9	A	22	B	35	A	48	B		
10	A	23	D	36	B	49	A		
11	D	24	A	37	C	50	C		
12	A	25	C	38	B	51	C		
13	B	26	B	39	C	52	D		

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EXPLANATORY NOTES

Q.1 $W = Fd\cos 0$

$0 = 0^\circ$

$w = Fd\cos(0) \Rightarrow w = Fd$

Q.2 –1000 J is a greater work in given options.

Q.3 $W = (10)(1) - (10)(1) + (10)(1) = 10\ J$

Q.4 $W = Fd\cos\theta = Fd\cos 270^\circ = 0$

Q.5 $\vec{d} = (6-2)\hat{i} + (5-3)\hat{j}$

$\vec{d} = 4\hat{i} + 2\hat{j}$

$W = \vec{F}.\vec{d}$

$= (2i + \hat{j}).(4\hat{i} + 2\hat{j}) = 8(\hat{i}.\hat{i}) + 2(\hat{j}.\hat{j})$ $\quad \hat{i}.\hat{i} = \hat{j}.\hat{j} = 1$

$= 8 + 2 = 10$

Q.6 $W = \frac{W_{max}}{2} \Rightarrow W = Fd\cos\theta$

$W = W_{max}\cos\theta \Rightarrow \frac{W_{max}}{2} = W_{max}\cos\theta \Rightarrow \theta = \cos^{-1}\left(\frac{1}{2}\right) = 60^\circ$

Q.7 $W = Fd\cos 0$

since $d = 0 \Rightarrow W = 0$

Q.8 $0 = 0^\circ \Rightarrow W = mgh \Rightarrow W = 245J$

Q.9 $W = Fd = (ma)d = 2\times 5\times 2 = 20\,J$

Q.10 $W = \vec{F}.\vec{d}$

$= (3\hat{i} + 2\hat{j} + 4\hat{k}).(10\hat{j}) \Rightarrow W = 20J$

Q.11 $W = Fd\cos 0$

$0 = \cos^{-1}\left(\frac{W}{Fd}\right) = \cos^{-1}\left(\frac{25}{10\times 5}\right) = \cos^{-1}\left(\frac{1}{2}\right) \Rightarrow 0 = 60^\circ$

Q.12 $W_T = W_{horizontal} + W_{verticle}$

$W_T = 0 + 60\times 5$

$W_T = 300\,N\,m$

Q.13 W = Area under F – x graph

$W = \frac{1}{2}$ (Sum of parallel sides) (Perpendicular distance between parallel sides)

$= \frac{1}{2}(6+3)(3) = 13.5\,J$

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Q.14 Work = Force × Displacement. If force and displacement both are doubled then work would be four times.

Q.15 $F = 10N, s = 5m, \theta = 90°$

Work done, $W_1 = Fscos\theta = 10 \times 5 \times cos90° = 0$

For vertical motion, the angle between force and displacement is 0°.

Here, $F = 10N, s = 10m, \theta = 0°$

Work done, $W_2 = 10 \times 10 \times cos0 = 100J$

Total work done $= W_1 + W_2 = 100J$.

Q.16 $F = w = mg = 20 \times 9.8N$

$s = 20m \quad . \quad \theta = 60°$

$W = Fscos\theta = 20 \times 9.8 \times 20 \times cos\theta\ 60°$

$W = 1960J$

Q.17 If velocity is doubled then $v' = 2v$

$$K.E = \frac{1}{2}mv^2$$

$P = mv$

$P' = m(2v) = 2mv$

$P' = 2p$

$$K.E' = \frac{1}{2}m(2v)^2$$

$$= 4\left[\frac{1}{2}mv^2\right]$$

$K.E' = 4K.E$

Q.18 Mass of α – paricle $= 6.644 \times 10^{-27}$ kg

mass of proton $= 1.672 \times 10^{-27}$ kg

$p_\alpha = p_p$

$$K.E = \frac{p^2}{2m} \qquad K.E \propto \frac{1}{m}$$

$$\frac{K.E_\alpha}{K.E_p} = \frac{m_p}{m_\alpha} = \frac{1.672 \times 10^{-27}}{4(1.672 \times 10^{-27})} = \frac{1}{4}$$

Q.19 $K.E_1 = K.E_2$

$p_1^2 \propto m$

$$\frac{p_1^2}{p_2^2} = \frac{m_1}{m_2} \Rightarrow \frac{p_1}{p_2} = \sqrt{\frac{m_1}{m_2}} \Rightarrow \frac{p_1}{p_2} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

Q.20 $$K.E = \frac{1}{2}pv \Rightarrow K.E = \frac{1}{2}\left(\frac{10{,}000 \times 10^{-2}}{1000}\right)(10{,}000 \times 10^{-2})$$

$$= \frac{1}{2}\left(\frac{10000}{1000}\right) = 5J \Rightarrow K.E = 5 \times 10^{\circ}\ J$$

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Q.21 $K.E=\frac{p^2}{2m}$, if $p'=2p$

$$K.E=\frac{(2p)^2}{2m}=\frac{4p^2}{2m}=4\,K.E \Rightarrow K.E'=4\,K.E$$

Q.22 $P=K.E$

$$\cancel{m}v=\frac{1}{2}\cancel{m}v^2$$

$$2v=v^2 \Rightarrow v=2\,m\,s^{-1}$$

Q.23 $\frac{K.E_1}{K.E_2}=\frac{v_1^2}{v_2^2}$

$$K.E_2=K.E_1\frac{v_2^2}{v_1^2} \Rightarrow K.E_2=30\times\frac{900}{100}=270\,J$$

Q.24 $v_x=\frac{v_y}{2}, m_x=2m_y$

$$K.E_x=\frac{1}{2}m_x v_x^2=\frac{1}{2}(2m_y)\left(\frac{v_y}{2}\right)^2=\frac{1}{2}(2m_y)\left(\frac{v_y^2}{4}\right)=\left(\frac{1}{2}m_y v_y^2\right)\frac{1}{2}=\frac{K.E_y}{2}$$

Q.25 As both balls falling from same height so speed is same $v=\sqrt{2g(h_1-h_2)}$

$$\frac{K.E_1}{K.E_2}=\frac{\frac{1}{2}m_1v^2}{\frac{1}{2}m_2v^2}=\frac{2}{4}=\frac{1}{2}$$

Q.26 $m_1v_1=m_2v_2 \;\therefore v_2=\frac{18\times6}{12}=9\,m\,s^{-1} \Rightarrow KE=\frac{1}{2}\times12(9)^2=486\,J$

Q.27 $K.E=\frac{1}{2}mv^2 \Rightarrow K.E\propto v^2$ $\therefore$ does not depend upon mass for a single body (As mass is constant)

Q.28 When force and displacement are in the same direction, the kinetic energy of the body increases. The increase in kinetic energy is equal to the work done on the body.

Q.29 Being lighter than a truck, the car has less kinetic energy. On applying brakes with the same force, the car will cover less distance before coming to rest.

Q.30 $\frac{P.E}{V}=\frac{mgh}{V}=\rho gh$

Q.31 $P.E=mgh$

$$P.E'=\frac{mgh}{2} \quad \left(\because h'=\frac{h}{2}\right) \Rightarrow P.E'=\frac{P.E}{2}$$

So at h/2, body has half P.E and half K.E.

Q.32 Spring has elastic potential energy.

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3 TOPIC ROTATIONAL & CIRCULAR MOTION

PRACTICE EXERCISE

TOPIC-WISE MCQ's

ANGULAR DISPLACEMENT, ANGULAR VELOCITY AND ANGULAR ACCELERATION

Q.1 The racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same length of time. The ratio of the angular speed of the first car to that of the second car is

A) $m_1 : m_2$
B) $r_1 : r_2$
C) 1:1
D) $m_1 r_1 : m_2 r_2$

Q.2 The ratio of angular speeds of minute hand and hour hand of a watch is

A) 6 : 1
B) 1 : 12
C) 12 : 1
D) 1 : 6

Q.3 The angular velocity of a particle rotating in a circular orbit 100 times per minute is

A) 1.66 rad/s
B) 10.47 deg/s
C) 10.47 rad/s
D) 60 deg/s

Q.4 Angular speed of a particle increases from 2rads^{-1} to 4 rads^{-1} across any two diametrically opposite positions. Its angular acceleration will be?

A) 6 rads^{-2}
B) $\frac{6}{\pi}$ rads^{-2}
C) $\frac{\pi}{6}$ 5rads^{-2}
D) π rads^{-2}

Q.5 Radian is a unit of angular displacement which can also be measured in degrees. How many radians are equal to one degree?

A) $\frac{180}{\pi}$
B) $\frac{\pi}{180}$
C) $\frac{2\pi}{180}$
D) $\frac{\pi}{57.3}$

Q.6 If a rotating body is moving counter clockwise, direction of angular velocity will be

A) Along linear velocity
B) Along the axis of rotation
C) Towards the center
D) Away from center

Q.7 The ratio of angular frequency and linear frequency is

A) 2π
B) $\frac{1}{2\pi}$
C) π
D) $\frac{\pi}{2}$

Q.8 A flywheel gains a speed of 540 rpm in 6 second. Its angular acceleration is

A) 3 π rad s^{-2}
B) 9 π rad s^{-2}
C) 6 π rad s^{-2}
D) 12 π rad s^{-2}

Q.9 The angular speed of a fly wheel making 120 revolutions/minute is

A) 2π rad/s
B) $4\pi^2$rad/s
C) 4π rad/s
D) π rad/s

Q.10 For positive angular displacement the rotation would be

A) Clockwise
B) Parallel
C) Anti-clockwise
D) Perpendicular

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Q.11 Ten seconds after an electric fan is turned on, the fan rotates at 300rev/min. Its average angular acceleration is

A) 30 rad/s^2
B) 3.14 rad/s^2
C) 30 rev/s^2
D) 500 rev/s^2

Q.12 The angular speed in radian/hour for daily rotation of the earth is

A) 2π
B) $\frac{\pi}{6}$
C) 4π
D) $\frac{\pi}{12}$

Q.13 The shaft of a motor rotates at a constant angular speed of 360rev/min. Angle turned through in 1 sec in radian is

A) π
B) 3π
C) 6π
D) 12π

Q.14 The angular velocity of the minute hand of a clock is

A) $\frac{2\pi}{60}\text{rad s}^{-1}$
B) $\frac{2\pi}{3600}\text{rad s}^{-1}$
C) $\frac{\pi}{24}\text{rad s}^{-1}$
D) $\frac{\pi}{3600}\text{rad s}^{-1}$

RELATION BETWEEN LINEAR AND ANGULAR DISPLACEMENT, VELOCITY AND ACCELERATION

Q.15 When a body moves in a circle, the angle between its velocity $\vec{v}$ and angular velocity $\vec{\omega}$ is always

A) 0°
B) 360°
C) 180°
D) 90°

Q.16 An object is moving along a circular path of radius 4m. What will be its angular displacement if it moves 14m on this circular path?

A) 5.5 radians
B) 3.5 radians
C) 5.0 radians
D) 4.5 radians

Q.17 Which of the following gives the relationship between linear velocity and angular velocity?

A) $v = r\omega$
B) $v = r\theta$
C) $v = s\omega$
D) $v = s\theta$

Q.18 A body moves in a circle with increasing angular velocity. At time t= 6sec, the angular velocity is 27rad/s. What is the radius of circle made by the body where linear velocity is 81cm/s?

A) 6cm
B) 3cm
C) 9cm
D) 7cm

Q.19 A wheel of radius 1 m covers an angular displacement of 180. Its linear displacement is

A) 3.14 m
B) π rad
C) 6.28 m
D) 0.157 m

Q.20 Linear velocity or tangential velocity of any particle moving in a circular path of radius 2 m with angular velocity 8 rads^{-1} will be:

A) 16 ms^{-1}
B) 4 ms^{-1}
C) 10 ms^{-1}
D) 6 ms^{-1}

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Q.21 The linear and angular velocities of a particle moving about the centre of a circle of radius r, are related by

A) $\vec{v} = \vec{\omega} \times \vec{r}$

B) $\vec{v} \times \vec{\omega} = \vec{r}$

C) $\vec{v} = \vec{r} \times \vec{\omega}$

D) $\vec{\omega} \times \vec{v} = \vec{r}$

Q.22 If a car moves with a uniform speed of 2 m s^{-1} in a circle of radius 0.4 m. Its angular speed is

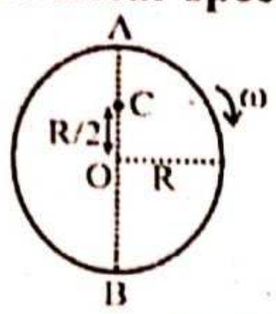
A) 4 rad s^{-1}

B) 5 rad s^{-1}

C) 1.6 rad s^{-1}

D) 2.8 m s^{-1}

Q.23 A disc of radius R=20 cm is rotating about its axis with an angular velocity $\omega = 20\,rad\,s^{-1}$ on a horizontal smooth surface. The linear speed of point. C on the disc is



A) $1 m s^{-1}$

B) $2 m s^{-1}$

C) $4 m s^{-1}$

D) $4\pi m s^{-1}$

Q.24 The length of the second hand of a watch is 1 cm. The velocity vector of the tip of the second hand in cm per second is

A) 2π

B) $\frac{2\pi}{12\times 60}$

C) $\frac{2\pi}{60}$

D) $\frac{2\pi}{24\times 60}$

Q.25 If the position vector of a particle is $\vec{r} = \left(3\hat{i} + 4\hat{j}\right)$ meter and its angular velocity is $\vec{\omega} = \left(\hat{j} + 2\hat{k}\right)$ rad/sec then its linear velocity is (in m/s).

A) $-\left(8\vec{i} - 6\vec{j} + 3\vec{k}\right)$

B) $-\left(3\vec{i} - 6\vec{j} + 6\vec{k}\right)$

C) $\left(3\vec{i} - 6\vec{j} + 8\vec{k}\right)$

D) $\left(6\vec{i} - 8\vec{j} + 3\vec{k}\right)$

Q.26 For a particle in uniform circular motion the relation $a = r\alpha$ of accelerations hold. The acceleration 'a'

A) Is centripetal acceleration

B) Is radial acceleration

C) Is tangential acceleration

D) Both A and B

Q.27 A point on the rim of a wheel 4 m in diameter has a velocity of 1600 cm s^{-1}. The angular velocity of the wheel is

A) 2 rad s^{-1}

B) 6 rad s^{-1}

C) 4 rad s^{-1}

D) 8 rad s^{-1}

Q.28 The acceleration of a motor car is 8 m/s^2. If the diameter of its wheel be 2m. It's angular acceleration will be

A) 8 rad/s^2

B) 16 rad/s^2

C) 10 m/s^2

D) 10 rad/s^2

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Q.29 When a wheel 1m in diameter makes 30 rev/min, the linear speed of point on it's rim in $m\ s^{-1}$ is

A) 2π
B) 3π
C) $\frac{\pi}{2}$
D) 4π

CENTRIPETAL FORCE AND CENTRIPETAL ACCELERATION

Q.30 A body is moving in a circular path with constant speed. The magnitude of tangential and centripetal acceleration are:

	Tangetial	Centripetal
A)	rv^2	0
B)	0	0
C)	0	v^2/r
D)	v^2/r	v^2/r

Q.31 Work done due to centripetal force for circular motion will be:

A) reduced
B) maximum
C) half
D) zero

Q.32 A 500 *kg* car takes a round turn of radius 50 *m* with a velocity of 36 *km/hr*. The centripetal force is

A) 250 N
B) 750 N
C) 1000 N
D) 1200 N

Q.33 A cycle wheel of radius 0.4 *m* completes one revolution in one *second* then the acceleration of a point on the cycle wheel will be

A) $0.8\ m/s^2$
B) $0.4\ m/s^2$
C) $1.6\pi^2\ m/s^2$
D) $0.4\pi^2\ m/s^2$

Q.34 A stone of mass m tied to a string of length *l* is rotated in a circle with the other end of the string as the centre. The speed of the stone is v. If the string breaks, the stone will move

A) Toward the centre of circle
B) Along the tangent
C) Away from centre of circle
D) All of these

Q.35 The mud flies off the tyre of a fast moving car in the direction

A) Parallel to the moving tyre
B) Tangent to the moving tyre
C) Anti parallel to the moving tyre
D) None of these

Q.36 Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r such that their periods are the same. Then the ratio between their centripetal acceleration is

A) R/r
B) r/R
C) R^2/r^2
D) r^2/R^2

Q.37 The force required to bend the normally straight path of a particle into a circular path is called _____ force.

A) Traveling
B) Bending
C) Centrifugal
D) Centripetal

Q.38 Which of the following is the correct vector form of centripetal force?

A) $m\omega\vec{r}$
B) $-\frac{m\omega^2}{r}\hat{r}$
C) $m\omega^2\vec{r}$
D) $-m\omega^2\vec{r}$

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Q.39 A body rotates with uniform speed in a circle of radius r and takes time T to complete one revolution. What are the magnitudes of the angular velocity ω, the linear velocity v and the acceleration a?

	Angular velocity, ω	Linear velocity, v	Acceleration, α
A)	$\frac{1}{T}$	$\frac{4\pi r}{T}$	$\frac{2\pi r}{T^2}$
B)	$\frac{2\pi}{T}$	$\frac{2\pi r}{T}$	$\frac{2\pi r}{T^2}$
C)	$\frac{2\pi}{T}$	$\frac{2\pi r}{T}$	$\frac{4\pi^2 r}{T^2}$
D)	$\frac{2\pi}{T}$	$\frac{4\pi r}{T}$	$\frac{4\pi^2 r}{T^2}$

Q.40 A particle revolves round a circular path with a constant speed. The acceleration of the particle is

A) Along the circumference of the circle
B) Along the tangent
C) Along the radius
D) Zero

Q.41 The force which can do no work on the body on which it acts:

A) Frictional force
B) Gravitational force
C) Elastic force
D) Centripetal force

Q.42 A car is moving with high velocity when it has a turn. A force acts on it outwardly because of

A) Centripetal force
B) Centrifugal force
C) Gravitational force
D) All the above

Q.43 A cyclist turns around a curve at 15 miles/hour. If he turns at double the speed, the tendency to overturn is

A) Quadrupled
B) Unchanged
C) Halved
D) Doubled

Q.44 A string breaks if its tension exceeds 10 newtons. A stone of mass 250 gm tied to this string of length 10 cm is rotated in a horizontal circle. The maximum angular velocity of rotation can be

A) 20 rad/s
B) 100 rad/s
C) 40 rad/s
D) 200 rad/s

Q.45 An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 r.p.m. The acceleration of a point on the tip of the blade is about

A) 1600 m/sec^2
B) 2370 m/sec^2
C) 4740 m/sec^2
D) 5055 m/sec^2

Q.46 A body of mass 5 kg is moving in a circle of radius 1m with an angular velocity of 2 radian/sec. The centripetal force is

A) 10 N
B) 30 N
C) 20 N
D) 40 N

Q.47 The direction of centripetal force is

A) Towards the center
B) Away from center
C) Along the tangential velocity
D) Along the axis of rotation

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Q.48 The expression for centripetal force is given by:

A) $mr\omega^2$

B) $\frac{m^2v^2}{r}$

C) $\frac{m^2v^2}{r^2}$

D) $\frac{mv^2}{r^2}$

Q.49 The period of circular motion is

A) $T = \frac{2\pi}{\omega}$

B) $T = \frac{\omega}{2\pi}$

C) $T = 2\pi\omega$

D) $T = \frac{\pi\omega}{2}$

Q.50 A car of mass 1000kg traveling at 40 ms^{-1} rounds a curve of radius 100m. what is the Fc

A) 100 N

B) 1.6×10^4N

C) 1.6×10^6N

D) 8×10^4N

Q.51 If the radius of the circular path of a moving body is half without changing speed of rotation then the Fc becomes

A) Half

B) Doubled

C) One third

D) One forth

Q.52 The curved flight of fighter planes at high speed requires a large

A) Gravitational force

B) Centripetal force

C) Frictional force

D) Centrifugal acceleration

Q.53 The centripetal force has the same dimension as the

A) Angular acceleration

B) Centrifugal force

C) Centripetal acceleration

D) Centrifugal acceleration

Q.54 A 500 *kg* crane takes a turn of radius 50 *m* with velocity of 36 *km/hr*. The centripetal force is

A) 1200 N

B) 1000 N

C) 750 N

D) 250 N

Q.55 The dimensions of centripetal force is

A) $[MLT^{-2}]$

B) $[MLT^{-1}]$

C) $[LT^{-2}]$

D) $[LT^{-1}]$

ANSWER KEY

1	C	12	D	23	B	34	B	45	C
2	C	13	D	24	C	35	B	46	C
3	C	14	B	25	A	36	A	47	A
4	B	15	D	26	C	37	D	48	A
5	B	16	B	27	D	38	D	49	A
6	B	17	A	28	A	39	D	50	B
7	A	18	B	29	C	40	C	51	B
8	A	19	A	30	C	41	D	52	B
9	C	20	A	31	D	42	B	53	B
10	C	21	A	32	C	43	A	54	B
11	B	22	B	33	C	44	A	55	A

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EXPLANATORY NOTES

Q.1 Both cars complete one rotation after same time interval so have same angular velocity.

Hence $\frac{\omega_1}{\omega_2} = 1:1$

Q.2 $\frac{\omega_{min\,hand}}{\omega_{hour\,hand}} = \frac{\frac{hour}{1rot}}{\frac{12hours}{1rot}} = 12:1$

Q.3 $\omega = \frac{100rot}{1minute} = \frac{100(2\pi)rad}{60s} = 10.47 rads^{-2}$

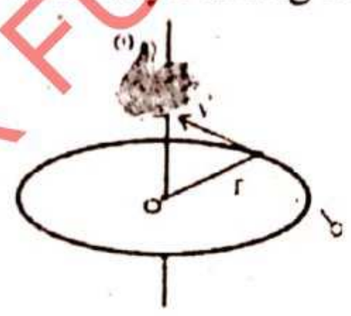
Q.4 For semicircle angle covered must be π rad

$2\alpha\theta = \omega_f^2 - \omega_i^2 \Rightarrow \alpha = \frac{4^2 - 2^2}{2(\pi)} = \frac{12}{2\pi} = \frac{6}{\pi} rads^{-1}$

Q.5 $2\pi rad = 360^\circ$

$1^\circ = \frac{2\pi}{360} rad \Rightarrow 1^\circ = \frac{\pi}{180} rad$

Q.6 Angular velocity is a axial vector so it is always along the axis of rotation



Q.7 $\frac{\omega}{f} = \frac{2\pi f}{f} = 2\pi$

Q.8 $\alpha = \frac{\Delta\omega}{\Delta t} = \frac{540\times 2\pi}{60\times 6} = \frac{540\times 2\pi}{360} = 3\pi \text{ rad/s}$

Q.9 $120 \text{ rev/min} = 120\times\frac{2\pi}{60} \text{ rad/sec} = 4\pi \text{ rad/sec}$

Q.10 According to convention in anti-clock wise rotation angular displacement is taken as positive.

Q.11 $\omega_i = 0 \text{ rad s}^{-1}$

$\omega_f = 300 \text{ rev/min} = 10\pi \text{ rads}^{-1}$

$\alpha = \frac{\omega_f - \omega_i}{t} = \frac{10\pi}{10} \Rightarrow \alpha = 3.14 \text{ rads}^{-2}$

Q.12 $\omega = \frac{\theta}{t} = \frac{2\pi}{24} = \frac{\pi}{12}$

Q.13 $\theta = \omega t = \frac{360\times 2\pi}{60}\times 1 \Rightarrow \theta = 12\pi \text{ radian}$

Q.14 $\theta = \frac{2\pi}{T} = \frac{2\pi}{60\times 60} \Rightarrow \theta = \frac{2\pi}{3600} rads^{-1}$

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Q.15 $\vec{v}$ and $\vec{\omega}$ always perpendicular to each other

Q.16 $S = r\theta \Rightarrow \theta = \frac{S}{r} = \frac{14}{4} = 3.5\,\text{rad}$

Q.17 $v = r\omega$

Q.18 $v = r\omega \Rightarrow r = \frac{v}{\omega} = \frac{81}{27} = 3\text{cm}$

Q.19 $S = r\theta$ $\qquad \theta = 180^\circ$

$= 1 \times \pi$ $\qquad 0 = 180^\circ \times \frac{\pi}{180^\circ} = \pi\,\text{rad}$

$= \pi\text{m} = 3.14\text{m}$

Q.20 $V = r\omega = 2 \times 8 = 16\text{m/s}$

Q.21 Relation between linear and angular velocity in vector form is $\vec{v} = \vec{\omega} \times \vec{r}$

Q.22 $\omega = \frac{v}{r} = \frac{2}{0.4} = 5\,\text{rads}^{-1}$

Q.23 $v = r\omega \quad \because \quad r = \frac{R}{2}$

$= 10 \times 10^{-2} \times 20 \Rightarrow v = 2\,\text{ms}^{-1}$

Q.24 $v = r\omega$

$\because \omega = \frac{2\pi}{60}\,\text{rad s}^{-1}$

$v = 1\,\text{cm} \times \frac{2\pi}{60} = \frac{2\pi}{60}\,\text{cm s}^{-1}$

Q.25 $\vec{v} = \vec{\omega} \times \vec{r} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 1 & 2 \\ 3 & 4 & 0 \end{vmatrix} = -8\hat{i} + 6\hat{j} - 3\hat{k} = -\left(8\hat{i} - 6\hat{j} + 3\hat{k}\right)$

Q.26 $a_t = r\alpha$

Here a_t is tangential acceleration

Q.27 $\omega = \frac{v}{r} = \frac{16}{2} = 8\,\text{rad s}^{-1}$

Q.28 $a = r\alpha$ $\qquad \because r = \frac{d}{2} = \frac{2}{2} = 1\text{m}$

$\alpha = \frac{a}{r} = \frac{8}{1} \Rightarrow \alpha = \frac{\text{rad}}{\text{sec}} = 8\,\text{rad/sec}^2$

Q.29 $v = r\omega \Rightarrow v = \frac{1}{2} \times \frac{30 \times 2\pi}{60} \Rightarrow v = \frac{\pi}{2}\,\text{m s}^{-1}$

Q.30 For constant speed $\Delta v = 0$, $\qquad a_t = \frac{\Delta v}{\Delta t} = 0 \Rightarrow a_c = \frac{v^2}{r}$

Q.31 $W = Fd\cos\theta$

$\theta = 90^\circ \Rightarrow W = Fd\cos 90^\circ = 0$

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Q.32 $v = 36\frac{km}{h} = 10\frac{m}{s} \therefore F = \frac{mv^2}{r} = \frac{500\times100}{50} = 1000N.$

Q.33 Adhesion is clinging of unlike molecules.

Q.34 When centripetal force vanishes objects moves along straight path i.e along tangent to circle.

Q.35 The mud's flies off the tyre of a fast moving car in the direction tangent to the moving car.

Q.36 $\frac{a_R}{a_T} = \frac{\omega_R^2 \times R}{\omega_T^2 \times r} = \frac{T_T^2}{T_R^2} \times \frac{R}{r} = \frac{R}{r} [As\ T_T = T_R]$

Q.37 Definition of centripetal force.

Q.38 $\bar{F} = -mr\omega^2\hat{r} = -mr\omega^2(\frac{\bar{r}}{r}) = -m\omega^2\bar{r}$

Q.39 As we know, $\omega = \frac{2\pi}{T}$ Also, $v = r\omega = r(\frac{2\pi}{T}) = \frac{2\pi r}{T}$. And, $a = r\omega^2 = r(\frac{2\pi}{T})^2 = \frac{4\pi^2 r}{T^2}$

Q.40 When body revolve with uniform speed then a_t and α remain zero. Only centripetal acceleration present in the body which is directed along the center of the circle.

Q.41 Centripetal force remains perpendicular to the displacement during circular motion. So,
$W = Fd\cos 90^0 = 0$

Q.42 A car is moving with high velocity when it has a turn. A force acts on it outwardly because of Centrifugal force

Q.43 $F_c = \frac{mv^2}{r}$, So, $F_c \alpha v^2$

If v increases to double then tendency to overturn will become four times

Q.44 $F_c = mr\omega^2 \Rightarrow \omega^2 = \frac{10}{(\frac{250}{1000})(\frac{10}{100})} = \frac{1000000}{2500} = 400 \Rightarrow \omega = 20 rads^{-1}$

Q.45 $a_c = r\omega^2$ here $\omega = \frac{1200(2\pi)}{60} = 40\pi$

$a_c = \frac{30(40\pi)^2}{100} = 4740 ms^{-2}$

Q.46 $F_c = mr\omega^2 = 5(1)(2)^2 = 20N$

Q.47 Centripetal force is towards the centre of circle.

Q.48 $F_c = \frac{mv^2}{r} = mr\omega^2$

Q.49 As we know $\omega = \frac{\Delta\theta}{\Delta t}$

For one rotation
$\Delta\theta = 2\pi rad \Rightarrow \Delta t = T$

So, $\omega = \frac{2\pi}{T} \rightarrow T = \frac{2\pi}{\omega}$

Q.50 $F_c = \frac{mv^2}{r} = \frac{1000(40)^2}{100} = 1.6\times10^4 N$

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Q.51 $F_c = mr\omega^2$ here ω is constant

So. $F_c \alpha r$

Q.52 Curved flight is possible in the presence of centripetal force.

Q.53 All kinds of forces have same dimensions $[MLT^{-2}]$

So centripetal and centrifugal force have same dimensions.

Q.54 $F = \frac{mv^2}{r} = \frac{500 \times 100}{50} = 10^3\ N$

Q.55 It is a force so has dimensions as follows $[MLT^{-2}]$

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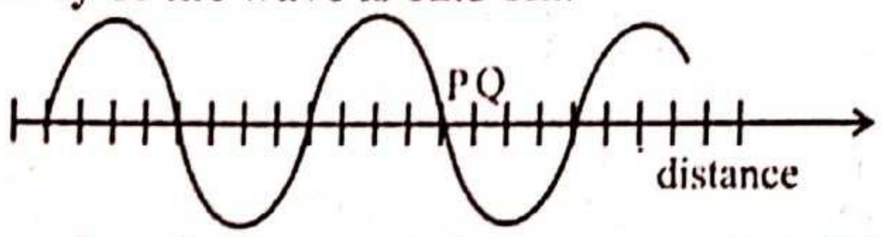
4 TOPIC WAVES

PRACTICE EXERCISE

TOPIC-WISE MCQ's

PROGRESSIVE WAVES, PERIODIC WAVES (TRANSVERSE AND LONGITUDINAL WAVES)

Q.1 **The diagram shows a transverse wave at a particular instant. The wave is traveling to the right. The frequency of the wave is 12.5 Hz.**



At the instant shown the displacement is zero at point 'P'. What is shortest time to elapse before the displacement is zero at point 'Q'?

A) 0.01 s
B) 0.08 s
C) 0.03 s
D) 0.10 s

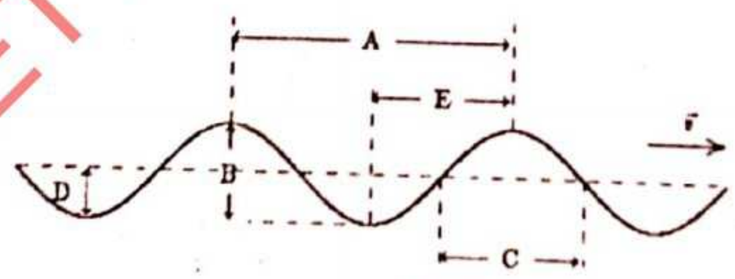
Q.2 **In a transverse wave the distance between a crest and a trough is equal to**

A) $\frac{\lambda}{2}$
B) λ
C) $\frac{\lambda}{4}$
D) 2λ

Q.3 **If a wave travelling at a speed of 130 m/s and has a wavelength of 5m. Then find out the frequency of the wave?**

A) 650 Hz
B) 20 Hz
C) 3.8×10^2 Hz
D) 26 Hz

Q.4 **A sinusoidal wave is traveling toward the right as shown. Which letter correctly labels the amplitude of the wave?**



A) A
B) D
C) B
D) C

Q.5 **The sound of lightning flash is heard 3 second after the flash is seen. The distance of the lightning is 1020 metre. The speed of sound is:**

A) 340 m/s
B) 332 m/s
C) 1400 m/s
D) none of these

Q.6 **When water waves pass from deep water into shallow water how do the frequency, wave length and speed change**

Frequency	Wavelength	Speed
A) Increases	Decreases	No change
B) No change	Decreases	Decreases
C) No change	Increases	Increases
D) None of these		

Q.7 **Which of the following waves can be transmitted through solids, liquids and gases?**

A) Transverse waves
B) Electromagnetic waves
C) Mechanical waves
D) Longitudinal waves

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Q.8 If two sound waves having a phase difference of 60°, then they will have a path difference of

A) $\frac{\lambda}{6}$ C) λ

B) $\lambda/3$ D) 3λ

WAVE MOTION AS ILLUSTRATED BY THE VIBRATION IN ROPES, SPRINGS AND RIPPLE TANK.

Q.9 A device to produce water waves and to study their characteristics is known as

A) Screw gauge C) Ripple tank

B) Michelson interferometer D) Wave container

Q.10 At one end of a ripple tank 90 cm across, a 6 Hz vibrator produces waves whose wavelength is 30 mm. The time needed to cross the waves is

A) 3 sec C) 10 sec

B) 7 sec D) 5 sec

SPEED OF SOUND IN AIR.

Q.11 Velocity of sound in vacuum is:

A) 332 ms^{-1} C) Zero

B) 320 ms^{-1} D) 224 ms^{-1}

Q.12 Increase in velocity of sound in the air for 1°C rise in temperature is:

A) 1.61 ms^{-1} C) 0.61 ms^{-1}

B) 61.0 ms^{-1} D) 2.00ms^{-1}

Q.13 The velocity of sound in air would become double than its velocity at 0°C at temperature:

A) 313°C C) 819°C

B) 586°C D) 1172°C

Q.14 Laplace found that the alternate compressions and rarefactions produced in sound waves follow:

A) Isothermal law C) Isochoric law

B) Adiabatic law D) All of the above

PRINCIPLE OF SUPERPOSITION (SUPERPOSITIONS OF SOUND WAVES).

Q.15 What is added when two waves superimpose?

A) Amplitude C) Wavelength

B) Velocities D) None of these

Q.16 Which parameter get affected after superposition?

A) Amplitude C) Wavelength

B) Frequency D) Direction

STATIONARY WAVES AND STATIONARY WAVE IN A STRETCHED STRING

Q.17 The frequency of the first harmonic of a string stretched between two points is 100 Hz. The frequency of the third overtone is

A) 200 Hz C) 400 Hz

B) 300 Hz D) 600 Hz

Q.18 "Stationary waves" are so called because in them

A) The particles of the medium are not disturbed

B) The particles of the medium do not execute SHM

C) There occurs no flow of energy along the wave

D) The interference effect can't be observed

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Q.19 The frequency of the nth mode of vibration of a string stretched by a tension T and having mass m and length is given by

A) $f_n = \frac{n}{2}\sqrt{\frac{T}{m\ell}}$

B) $f_n = \frac{n}{2}\sqrt{\frac{\ell T}{m}}$

C) $f_n = \frac{n}{2\ell}\sqrt{\frac{T}{m}}$

D) $f_n = \frac{n}{2}\sqrt{\frac{T}{m}}$

Q.20 If the string vibrates in 'n' loops, the wavelength is given by

A) $\lambda_n = \frac{2}{nl}$

B) $\lambda_n = \frac{2l}{n}$

C) $\lambda_n = \frac{l}{2n}$

D) None of these

Q.21 If the successive overtones of a vibrating string clamped at its ends are 280 Hz and 350 Hz, the frequency of fundamental is:

A) 350 Hz

B) 280 Hz

C) 140 Hz

D) 70 Hz

Q.22 If the number of loops of a stationary wave are increasing, then

A) λ increases

B) λ decreases

C) λ remains same

D) λ may increase or decrease

Q.23 A string of length 2m fixed between two supports vibrates in two loops. The distance between node and antinode is:

A) 50 cm

B) 200 cm

C) 100 cm

D) 10 cm

Q.24 The distance between two particles in a wave motion in the same phase is

A) $\frac{\lambda}{4}$

B) $\frac{3\lambda}{4}$

C) $\frac{\lambda}{2}$

D) λ

Q.25 The phase between two consecutive antinodes is:

A) $\frac{\pi}{4}$

B) π

C) $\frac{\pi}{2}$

D) 2π

Q.26 When the string vibrates in three loops then the length 'l' of the string is expressed as

A) $l = \frac{3\lambda}{4}$

B) $l = \frac{\lambda}{2}$

C) $l = \frac{3\lambda}{2}$

D) $l = \frac{2\lambda}{3}$

Q.27 Consider a stretched string under tension and fixed at both ends. If the tension is doubled and the cross-sectional area halved, then the frequency becomes

A) Twice

B) Four times

C) Half

D) Eight times

Q.28 When the antinodes are all at their extreme displacements, the energy stored is

A) K.E

B) Thermal energy

C) P.E

D) All of these

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DOPPLER'S EFFECT

Q.29 When an observer moves towards source with a velocity u_o, then the modified frequency 'f_A' becomes

A) $f_A = f(v - u_o)$

B) $f_A = \left(\frac{v + u_o}{2}\right) f$

C) $f_A = f\left(\frac{v + u_o}{v}\right)$

D) $f_A = \left(\frac{v - u_o}{V}\right) f$

Q.30 Doppler's effect is not applicable for:

A) Microwaves

B) Electromagnetic waves

C) Ultrasonic

D) Standing waves

Q.31 Doppler shift in frequency does not depend upon

A) The actual frequency of the wave

B) The distance of the source from the listener

C) The velocity of the source

D) The velocity of the observer

Q.32 The source is moving towards a stationary observer then the pitch of the sound will

A) Sometimes increases and sometimes decreases

B) Remains constant

C) Decrease

D) Increase

Q.33 The apparent frequency of the whistle of an engine changes in the ratio 6:5 as engine passes a stationary observer. If the speed of sound is 352 m/s. Then the speed of engine will be

A) 22 m/s

B) 32 m/s

C) 27 m/s

D) 36 m/s

Q.34 A source of sound moves towards a stationary observer with a speed one third that of sound. If the frequency of the sound from the source is 100 Hz, the apparent frequency of the sound heard by the observer is

A) 67 Hz

B) 150 Hz

C) 100 Hz

D) 75 Hz

Q.35 If a Radar system designed in accordance with the Doppler's effect, if an airplane is moving away from a Radar, the wavelength of the reflected wave from the air plane would be:

A) Smaller than the transmitting wave

B) Larger than the transmitting wave

C) Same as that of the transmitting wave

D) Either smaller or larger than the transmitting wave

Q.36 Stars moving towards earth shows

A) blue shift

B) no shift

C) red shift

D) may be 'a' may be 'b' depending upon speed of stars

Q.37 Bats navigate and find food by

A) Ultrasonic

B) Amplitude

C) Echo location

D) Refraction

Q.38 Which one of the following explains that all the galaxies are receding from us?

A) White shift

B) Neutrons stars

C) Black holes

D) Red shift

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Q.39 A whistle giving out 450Hz approaches a stationary observer at a speed of 33m/s. The frequency heard by the observer in Hz is (speed of sound = 330m/s).

A) 409
B) 429
C) 517
D) 500

Q.40 The source of sound generating of a frequency of 3 kHz reaches an observer with a speed of 0.5 times the velocity of sound in air. The frequency heard by the observer is?

A) 1 kHz
B) 3 kHz
C) 4 kHz
D) 6 kHz

Q.41 A whistle producing sound waves of frequencies 9500 Hz and it is approaching a stationary person with speed v ms^{-1}. The velocity of sound in air is 300 ms^{-1}. If the person can hear frequencies upto a maximum of 10,000 Hz, the maximum value of v upto which he can hear the whistle is

A) 30 m s^{-1}
B) 15 m s^{-1}
C) 10 m s^{-1}
D) 20 m s^{-1}

SIMPLE HARMONIC MOTION(SHM) AND CHARACTORISTICS OF SIMPLE HARMONIC MOTION (INSTANTANIOUS DISPLACEMENT, VIBRATION, TIME PERIOD, FREQUENCY AND ANGULAR FREQUENCY).

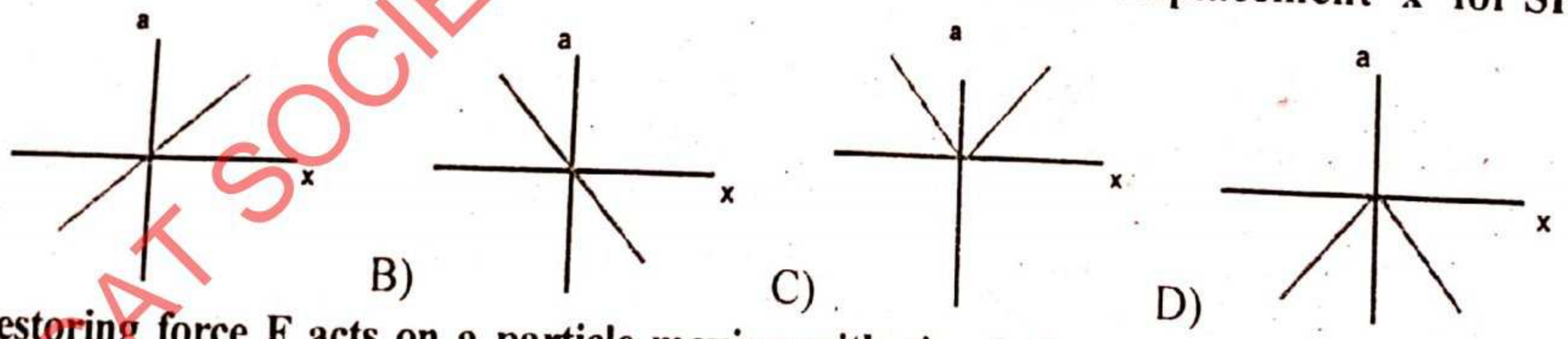
Q.42 Total distance traveled by bob of simple pendulum in one vibration is equal to:

A) A
B) 2A
C) 4A
D) Zero

Q.43 A particle oscillating in simple harmonic motion is:

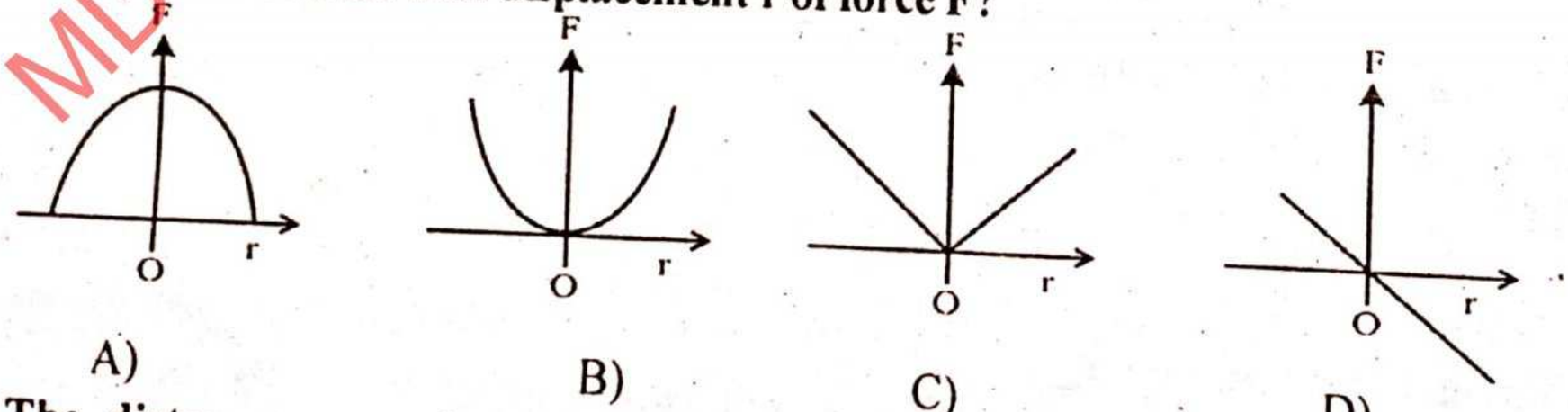
A) Never in equilibrium because there is always a force
B) Never in equilibrium because it is in motion
C) In equilibrium at the center of its path because the acceleration is zero there
D) In equilibrium at the ends of its path because its velocity is zero there

Q.44 Which one is the correct graph between acceleration 'a' and displacement 'x' for SHM?



A) B) C) D)

Q.45 A restoring force F acts on a particle moving with simple harmonic motion. Which graph shows the variation with displacement r of force F?



A) B) C) D)

Q.46 The distance covered by a body in one complete vibration is 20 cm. What is the amplitude of body?

A) 10 cm
B) 5 cm
C) 15 cm
D) 7.5 cm

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Q.47 A body moves with simple harmonic motion and makes *n*-complete oscillations in one second. What is its angular frequency?

A) $n\,rad\,s^{-1}$

B) $2\pi n\,rad\,s^{-1}$

C) $\frac{1}{n}\,rad\,s^{-1}$

D) $\frac{2\pi}{n}\,rad\,s^{-1}$

SIMPLE PENDULUM

Q.48 A simple pendulum is executing S.H.M. with a time period T. if the length of the pendulum is increased by 21% the percentage increase in the time period of the pendulum is

A) 10%

B) 21%

C) 30%

D) 50%

Q.49 A particle executes S.H.M. with a period of 6 second and amplitude of 3 cm its maximum speed in cm/sec is

A) $\pi/2$

B) π

C) 2π

D) 3π

Q.50 A simple pendulum swings about the vertical equilibrium position with a maximum angular displacement of 3° and period T. If the same pendulum is given a maximum angular displacement of 5°, then which of the following best gives the period of the oscillations?

A) $\frac{T}{2}$

B) $\frac{T}{\sqrt{2}}$

C) T

D) $T\sqrt{2}$

Q.51 The length of second's pendulum on the surface of earth is 1 m, its length on the surface of the moon, where g is 1/6th value of g on the earth is:

A) Remain same

B) 6 m

C) 1/6 m

D) 1/36 m

Q.52 If length of a pendulum becomes four times, then its time period will become:

A) Four times

B) Six times

C) Eight time

D) Two times

Q.53 The force responsible for the vibratory motion of the simple pendulum is:

A) $mg\sin\theta$

B) $mg\cos\theta$

C) $mg\tan 0$

D) mg

Q.54 The tension in the string of simple pendulum is:

A) Constant

B) Maximum at the extreme position

C) Maximum at the mean position

D) Zero at the mean position

Q.55 If a hollow bob of a simple pendulum be filled with mercury that drains out slowly, its time period:

A) Increases continuously

B) Decreases continuously

C) Remain same

D) First increases then decreases

Q.56 A simple pendulum of length *L* and mass *m* swings about the vertical equilibrium position ($\theta = 0$) with a maximum angular displacement of θ_{max}. What is the tension in the connecting rod when the pendulum's angular displacement is $\theta = \theta_{max}$?

A) Zero

B) $mg \sin \theta_{max}$

C) $mg \cos\theta_{max}$

D) $mg \tan \theta_{max}$

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Q.57 The time taken for a pendulum to swing from X to Y 1.5, then its frequency is:

A) $\frac{1}{1.5}$ Hz

B) $\frac{1}{3}$ Hz

C) $\frac{1}{6}$ Hz

D) $\frac{1}{4}$ Hz

ENERGY CONSERVATION IN SHM.

Q.58 When the amplitude of a SHM become double, its energy become:

A) Double

B) Four times

C) One half

D) None time

Q.59 For what displacement the P.E of SHM becomes 1/4 of its maximum value?

A) $x = x_0$

B) $x = x_0/2$

C) $x = x_0/4$

D) $x = x_0^2/2$

Q.60 K.E and P.E of a spring mass system executing SHM become equal at which displacement? (A being the amplitude).

A) $\sqrt{2}A$

B) $\frac{1}{\sqrt{2}}A$

C) $\frac{1}{2}A$

D) $\sqrt{2A}$

ANSWER KEY

1	A	11	C	21	D	31	B	41	B	51	C
2	A	12	C	22	B	32	D	42	C	52	D
3	D	13	C	23	A	33	B	43	C	53	A
4	D	14	B	24	D	34	B	44	B	54	C
5	A	15	A	25	B	35	B	45	D	55	D
6	B	16	A	26	C	36	A	46	B	56	C
7	D	17	C	27	A	37	C	47	B	57	C
8	A	18	C	28	C	38	D	48	A	58	B
9	C	19	C	29	C	39	D	49	B	59	B
10	D	20	B	30	D	40	D	50	C	60	B

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EXPLANATORY NOTES

Q.1 $T = \frac{1}{12.5} = 0.08\,s$

for shortest time $= \frac{0.08}{8} = 0.01\,s$

Q.2 Distance between two consecutive crests = λ

Distance between consecutive crests and trough = $\frac{\lambda}{2}$

Q.3 $v = f\lambda \Rightarrow f = \frac{v}{\lambda} = \frac{130}{5} = 26Hz$

Q.4 Maximum displacement from mean position

Q.5 Speed $= \frac{\text{distance}}{\text{time}}$

$= \frac{1020}{3} = 340\,m\,s^{-1}$

Q.6 Frequency does not depend upon nature of material.

Q.7 Longitudinal waves can be transmitted through all the three types of media

Q.8 $\Delta\varphi = 60° = \pi/3$

$\Delta x = \lambda/2\pi \times \Delta\varphi = \frac{\lambda}{2\pi} \times \frac{\pi}{3} = \frac{\lambda}{6}$

Q.9 A device to produced water wave and to study its characteristics is known as ripple tank.

Q.10 $v = f\lambda = 6 \times \frac{30}{1000} = 0.18\,ms^{-1} \Rightarrow t = \frac{s}{v} = \frac{0.9}{0.18} = 5s$

Q.11 (Because speed of sound depends on medium).

Q.12 $v_t = v_o + 0.61t$

So 1°C rise in temperature, velocity increases to 0.61 m/s.

Q.13 $\frac{v_t}{v_o} = \sqrt{\frac{T}{273}} \Rightarrow 2\frac{v_o}{v_o} = \sqrt{\frac{T}{273}}$

$4 = \frac{T}{273}$

$T = 1092K = 1092 - 273 = 819C^o$

Q.14 According to Laplace, compression & rarefactions of sound waves follow adiabatic law.

Q.15 When two waves super impose, amplitude is added.

Q.16 After super position, amplitude is added.

Q.17 Third over tone mean fourth harmonic $f_4 = 4f_1$

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Q.18 Energy in a wave moves because of the motion of particle of the medium. The node always remains at rest so energy cannot flow past these point.

Q.19 $f_n = \frac{n}{2\ell}\sqrt{\frac{T}{m}}$

Q.20 $\lambda_n = \frac{2\ell}{n}$

Q.21 $f' = f_2 - f_1$

Q.22 $\lambda_n = \frac{2\ell}{n}$

$\lambda_n \propto \frac{1}{n}$

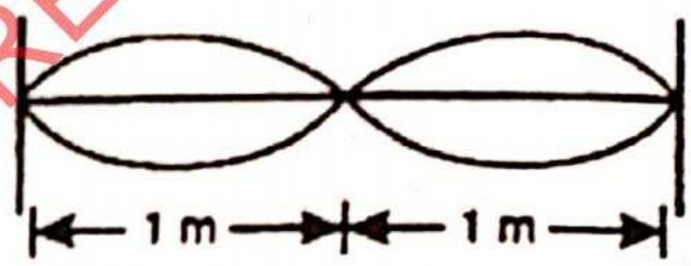
Q.23

$\frac{\lambda}{2} = l$

$\lambda = 2\,\text{metre}$

Distance between nearest node and antinode is

$\frac{\lambda}{4} = \frac{2}{4} = 0.5\,\text{m} = 50\,\text{cm}$



Q.24 Phase difference between two in phase points is $\lambda, 2\lambda, 3\lambda, \ldots\ldots$

Q.25 Distance between two consecutive antinodes is $\frac{\lambda}{2} = x$ and phase different $= \frac{2\pi x}{\lambda} = \frac{2\pi}{\lambda}\cdot\frac{\lambda}{2} = \pi$

Q.26 $\lambda_n = \frac{2\ell}{n} \Rightarrow n = 3$

Q.27 $f = \frac{1}{2l}\sqrt{\frac{T}{m}}$ where $m = \frac{\rho V}{l} = \frac{\rho(Al)}{l} = \rho A$

So, $f \propto \sqrt{\frac{T}{A}}$ and $f' \propto \sqrt{\frac{2T}{\frac{A}{2}}} \Rightarrow \frac{f'}{f} = 2$ OR $f' = 2f$

Q.28 At extreme point energy stored is P.E.

Q.29 $f_A = \left(\frac{v + u_o}{v}\right) f$

Q.30 Doppler's effect is applicable on light and sound waves.

Q.31 Doppler shift in frequency does not depend upon distance of the source from listener.

Q.32 As source is moving towards stationary observe.

$\because f' = \frac{v}{v - v_s} f \Rightarrow f' > f$ so pitch will increase.

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Q.33 $\frac{f'}{f''} = \frac{v+u}{v-u} = \frac{352+u}{352-u} = \frac{6}{5}$

$5(352+U) = 6(352-U)$

$1760+5U = 2112-6U$

$11U = 352 \Rightarrow U = 32\,\text{ms}^{-1}$

Q.34 $f_A = \left(\frac{v}{v-u_s}\right)f$

$f_A = \left(\frac{v}{v-\frac{v}{3}}\right)100 \Rightarrow f_A = \frac{3}{2}\times 100 = 150\,\text{Hz}$

Q.35 Source is moving away from observer so apparent frequency decreases and wavelength increases.

Q.36 When star is moving towards earth, according to Doppler's shift wavelength decreases, as blue light has smaller wavelength so blue shift appears.

Q.37 Bats use echolocation to navigate and find food in the dark. To echolocate, bats sends out sound waves from their mouth or nose. When sound waves hit an object they produce echoes. Bats use this, to avoid flying into objects.

Q.38 When galaxies or stars are receding from us its emitted light wavelength increase. So last colour of spectrum is red.

Q.39 $v' = v/(v - v_s) \times v$

$v' = 330/(330 - 33) \times 450 = 500\text{Hz}$

Q.40 $f' = v/(v - v_s)\times f = v/(v-0.5v)\times 3\text{kHz} = 6\text{kHz}$

Q.41 $f_A = \left(\frac{v}{v-u_s}\right)f$

$10,000 = \left(\frac{300}{300-v}\right)9500$

$v = 15\,\text{m s}^{-1}$

Q.42 Total distance in one vibration =4A as A+A+A+A in complete vibration

Q.43 At center of its path, no net force acts on it has, so weight = Tension

Q.44 $a \propto -x$, So graph lies in 2nd and 4th quadrant.

Q.45 $F \propto -x$

Q.46 $S = \frac{20}{4} = 5cm$

Q.47 $\omega = 2\pi f \qquad \because f = n$

$\omega = 2\pi n\,\frac{\text{rad}}{s}$

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Q.48 As, $T \propto \sqrt{\ell}$ $\therefore \frac{T_2}{T_1} = \sqrt{\frac{\ell_2}{\ell_1}} = \sqrt{1.21} \Rightarrow T_2 = 1.1T$

$$\%\text{ increase in } T = \frac{1.1T - T}{T} \times \frac{100}{100} = \frac{(1.1-1)T}{T} \times \frac{100}{100} = 10\%$$

Q.49 $v_{max} = x_o\omega = x_o \frac{2\pi}{T} = 3\frac{2\pi}{6} \Rightarrow v_{max} = \pi$

Q.50 $T = 2\pi\sqrt{\frac{\ell}{g}}$

If $0 \leq 5°$ time period is not affected by change in angular displacement. Because for smaller angular displacement, the period is essentially independent amplitudes.

Q.51 $T = 2\pi\sqrt{\frac{\ell}{g}}$

T=2s which is constant. So $\sqrt{g} \propto \sqrt{\ell}$. So length will be $\frac{1}{6}$m.

Q.52 $T = 2\pi\sqrt{\frac{\ell}{g}}$

$\ell' = 4\ell$

$T' = 2\pi\sqrt{\frac{4\ell}{g}} = 2T$

Q.53 F is broken into two components.

$T = mg\cos\theta$ $F = mg\sin\theta$

$mg\sin\theta$ provides restoring force.

Q.54 Tension is maximum at mean position because it is equal to weight.

Q.55 $T = 2\pi\sqrt{\frac{\ell}{g}}$

When mercury drains out center of gravity changes and length increases so time period increases after when mercury is completely drained out length decreases and time period decreases.

Q.56 At extreme position $T = mg\cos\theta$ so when $\theta = \theta_{max}$ T is given by $mg\cos\theta$.

Q.57 $\frac{T}{4} = 1.5 \Rightarrow T = 6s$

$f = \frac{1}{T} = \frac{1}{6}$Hz

Q.58 $E = \frac{1}{2}kx_0^2$

$x_0' = 2x_0$

$E' = 4\left(\frac{1}{2}kx_0^2\right) = 4E$

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Q.59 $P.E = \frac{P.E_{max}}{4}$

$$\frac{1}{2}kx^2 = \frac{1}{4}\left(\frac{1}{2}kx_o^2\right)$$

$$x = \frac{x_o}{2}$$

Q.60 K.E = P.E

$$\frac{1}{2}kx_0^2\left(1-\frac{x^2}{x_0^2}\right) = \frac{1}{2}kx^2$$

$$x_0^2 - x^2 = x^2$$

$$x_0^2 = 2x^2$$

$$x = \pm\frac{x_o}{\sqrt{2}}(x_o = A)$$

$$x = \pm\frac{A}{\sqrt{2}}$$

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5 THERMODYNAMICS

TOPIC PRACTICE EXERCISE

TOPIC-WISE MCQ's

FIRST LAW OF THERMODYNAMICS

Q.1 The relation for the 1st law of thermodynamics can be expressed as:

A) $\Delta Q = \Delta W$

B) $\Delta Q = \Delta U$

C) $\Delta Q = \Delta U + \Delta W$

D) $\Delta Q = \frac{\Delta U}{\Delta W}$

Q.2 Examples of first law of thermodynamics are

A) Working of bicycle pump
B) Human metabolism
C) Brakes applied by an automobile
D) All of these

Q.3 1st law of thermodynamics is consequence of conservation of

A) Work
B) Energy
C) Heat
D) All of these

Q.4 Which statement about the first law of thermodynamics is correct?

A) The heating of a system equal to the increase of its internal energy plus the work done on the system
B) The increase in the internal energy of system equal the heating of the system plus the work done by the system
C) The increase in the internal energy of a system equal the heating of the system minus the work done by the system
D) The work done on a system equals the increase of its thermal energy plus the heating of the system

Q.5 The first law of thermodynamics may be expressed as shown.

$$\Delta U = Q + W$$

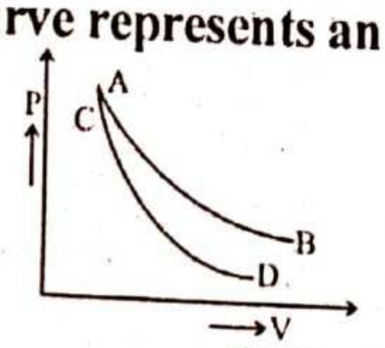
Where ΔU is the change in internal energy, Q is the heating of the system, W is the work done on the system. A fixed mass of ideal gas at high pressure is contained in a balloon. The balloon suddenly bursts, causing the gas to expand and cool.

In this situation, which row describes the values of ΔU, Q and W?

	ΔU	Q	W
A)	negative	negative	positive
B)	negative	zero	negative
C)	positive	zero	negative
D)	positive	negative	positive

ISOTHERMAL PROCESS, ADIABATIC PROCESS, ISOBARIC PROCESS AND ISOCHORIC PROCESS

Q.6 In the figure curves AB and CD represent the relation between pressure P and volume V of an ideal gas. One of the curves represents on isothermal expansion and the other represents an adiabatic expansion. Which curve represents an adiabatic expansion?



A) Curve AB
B) Curve CD
C) Both "a" and "b"
D) None of these

Q.7 Heat added at constant volume of a gas is used to

A) To do external work
B) Either "A" or "C"
C) To increase its internal energy
D) Both "A" and "C"

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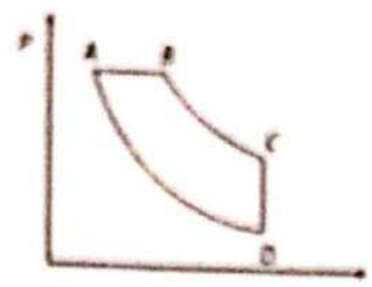
Q.8 When heat is given to a gas in an isobaric process then
A) The work is done by the gas
B) Internal energy of the gas increases
C) Both (A) and (B)
D) None from (A) and (B)

Q.9 Graph between pressure and temperature for an ideal gas at constant volume is
A) Straight line
B) Ellipse
C) Parabola
D) Sinusoidal

Q.10 If the volume of a gas is deceased by 10% during isothermal process than its pressure will
A) Decrease by 10%
B) Increase by 10%
C) Decrease by 11.11%
D) Increase by 11.11%

Q.11 During which process the volume of system remains constant
A) Isothermal
B) Isobaric
C) Isochoric
D) Adiabatic

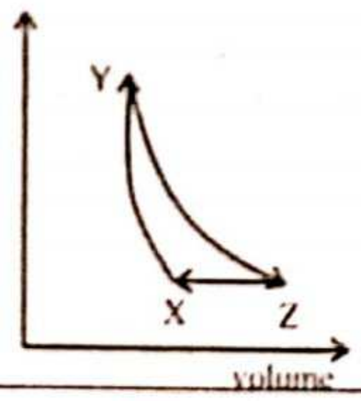
Q.12 In pressure-volume diagram given below, the isochoric, isothermal, and isobaric parts respectively, are



A) AB, BC, CD
B) CD, DA, AB
C) DC, CB, BA
D) BA, AD, DC

Q.13 A gas does 10J of external work in adiabatic process while expanding, then the change in internal energy is:
A) 10 J
B) 20 J
C) – 10 J
D) 0 J

Q.14 A fixed mass of an ideal gas undergoes the changes represented by $X \rightarrow Y \rightarrow Z \rightarrow X$ as shown below



	XY	YZ	ZX
A)	Isothermal compression	Adiabatic expansion	Pressure reduction at constant volume
B)	Isothermal compression	Adiabatic expansion	Compression at constant pressure
C)	Adiabatic compression	Isothermal expansion	Pressure reduction at constant volume
D)	Adiabatic compression	Isothermal expansion	Compression at constant pressure

Q.15 During the adiabatic expansion of 2 moles of a gas, the internal energy of the gas is found to decrease by 2 joules, the work done during the process on the gas will be equal to
A) 2 J
B) –2 J
C) 1 J
D) –1 J

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Q.16 According to the Boyles law, the pressure of a gas is expressed as

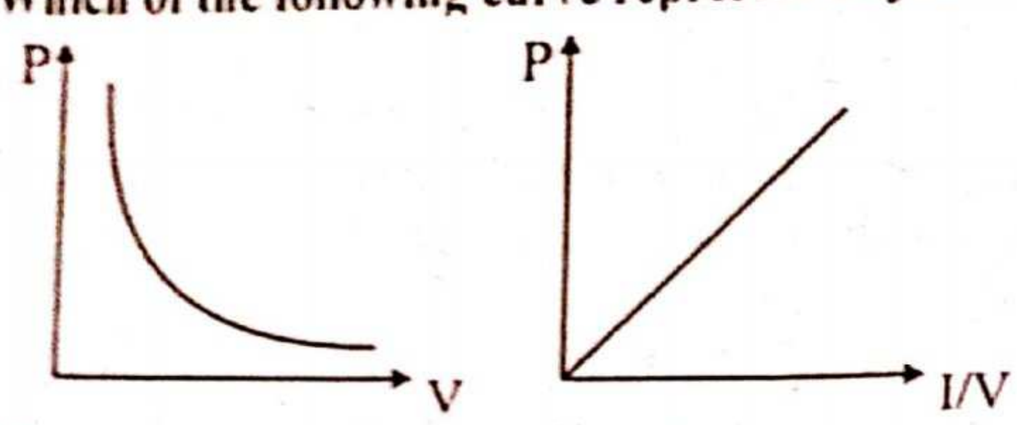
A) $P = \frac{1}{V}$

B) $PV = 0$

C) $P \propto \frac{(\text{constant})}{V}$

D) $P \propto \frac{1}{V}$

Q.17 Which of the following curve represent Boyles law?



A) B) C) D) All

Q.18 Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1, if the process is purely isothermal. W_2 if purely isobaric and W_3 if purely adiabatic then

A) $W_2 > W_1 > W_3$

B) $W_2 > W_3 > W_1$

C) $W_1 > W_2 > W_3$

D) $W_1 > W_3 > W_2$

SPECIFIC HEAT AND MOLAR SPECIFIC HEAT/SPECIFIC HEAT CAPACITY

Q.19 If 1 mole of an ideal gas is heated at constant pressure, then:

A) $Q_p = C_v \Delta T$

B) $Q_p = C_p \Delta T$

C) $Q_v = C_v \Delta T$

D) $Q_v = C_p \Delta T$

Q.20 The amount of heat energy required to raise the temperature of a body of mass 1 kg through 1 k is called:

A) Specific heat

B) Heat capacity

C) Molar specific heat

D) Heat of vaporization

RELATION $C_P - C_V = R$

Q.21 The molar specific heat constant pressure of an ideal gas is 7R/2. The ratio of specific heat at constant pressure to that at constant volume is?

A) 9/7

B) 8/7

C) 7/5

D) 5/7

Q.22 $C_p - C_v$ and $\frac{C_v}{C_p}$ are respectively equal to

A) $\left(\frac{1}{R}, \gamma^{-1}\right)$

B) (R, g)

C) $\left(\frac{1}{R}, \gamma\right)$

D) (R, γ^{-1})

Q.23 Which one is correct relation?

A) $C_p + C_v = \gamma$

B) $C_p = 1 + \frac{R}{C_v}$

C) $\gamma = \frac{C_p}{C_v}$

D) $C_p = 1 - \frac{R}{C_v}$

Q.24 Four students found set of C_P and C_V (in cal/deg mole) as given below. Which of the following set is correct?

A) $C_V = 4, C_P = 2$

B) $C_V = 2, C_P = 1$

C) $C_V = 3, C_P = 3$

D) $C_P = 5, C_V = 3$

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INTERNAL ENERGY

Q.25 In a thermodynamic system working substance is ideal gas, its internal energy is in the form of

A) Kinetic energy only
B) Kinetic and potential energy
C) Potential energy
D) None of these

Q.26 In an ideal gas, the molecules possess

A) Only K.E
B) K.E and P.E both
C) Only P.E
D) Only gravitational energy

Q.27 Which one is true for internal energy?

A) it is sum of all forms of molecular energies of a system
B) it is a state function of a system
C) it is proportional to transnational K.E of the molecules
D) all are correct

Q.28 If two system X and Y are in thermal equilibrium. If X is heated at constant volume and Y is heated at constant pressure, and again finally maintained at thermal equilibrium, then heat Q given to the systems X and Y and internal energy U stored in the systems X and Y are

A) $Q_x = Q_y$ and $U_x = U_y$
B) $Q_x < Q_y$ and $U_x < U_y$
C) $Q_x = Q_y$ and $U_x < U_y$
D) $Q_x < Q_y$ and $U_x = U_y$

Q.29 The internal energy of a body is maximum when its temperature is

A) 0 K
B) –273 K
C) 273 K
D) –273 °C

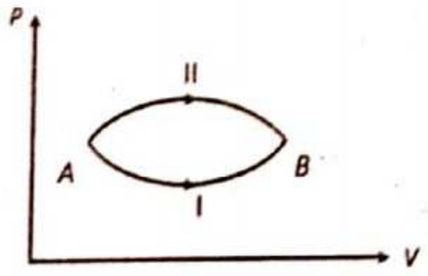
Q.30 An ideal gas is pressed at a constant temperature. Its internal energy

A) Decreases
B) Increases
C) First increases and then decreases
D) Remains the same

Q.31 When 20 J of work was done on a gas, 40J of heat energy was released. If the initial internal energy of the gas was 70J, what is the final internal energy?

A) 50J
B) 60J
C) 90J
D) 110J

Q.32 A system goes from *A* to *B* via two processes I and II as shown in figure. If ΔU_1 and ΔU_2 are the changes in internal energies in the processes I and II respectively, then



A) $\Delta U_{II} > \Delta U_I$
B) $\Delta U_{II} < \Delta U_I$
C) $\Delta U_I = \Delta U_{II}$
D) Relation between ΔU_I and ΔU_{II} cannot be determined

Q.33 By rubbing the objects together, their internal energy:

A) Increases
B) Decreases
C) Remains constant
D) Becomes zero

Q.34 The internal energy of an ideal gas depends upon only:

A) Pressure
B) Temperature
C) Volume
D) All of these

HEAT AND WORK

Q.35 If a system undergoes contraction of volume, then the work done by the system will be

A) Zero
B) Negligible
C) Negative
D) Positive

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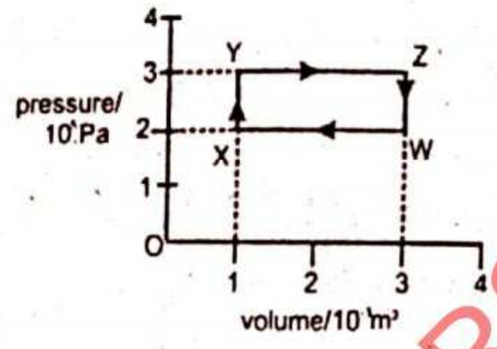
Q.36 The work done in the isochoric process is

A) Constant
B) Variable
C) Zero
D) Depends on situation

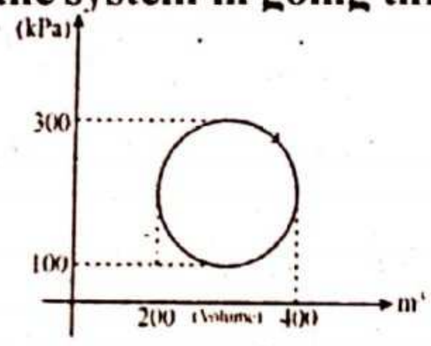
Q.37 A gas undergoes the cycle of pressure and volume changes W → X → Y → Z → W shown in the diagram.



What is the net work done by the gas?

A) –600 J
B) 200 J
C) 0 J
D) -200 J

Q.38 Calculate the heat absorbed by the system in going through the process as shown in figure.

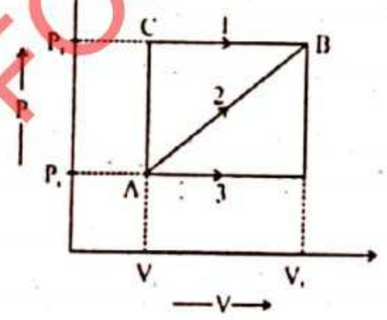


A) 31.4 J
B) 3.14 J
C) 31.4×10^6 J
D) none

Q.39 Work done by air when it expands from 50 litres to 150 litres at a constant pressure of 2 atmospheres is

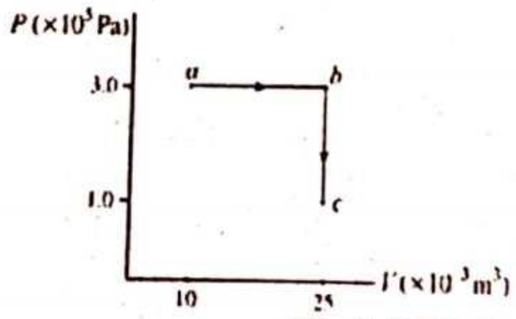
A) 2×10^4 joules
B) 2×100 joules
C) $2\times10^5\times100$ joules
D) $2\times10^{-5}\times100$ joules

Q.40 A system is taken from state A to B through three different paths 1, 2, 3. The work done is maximum in



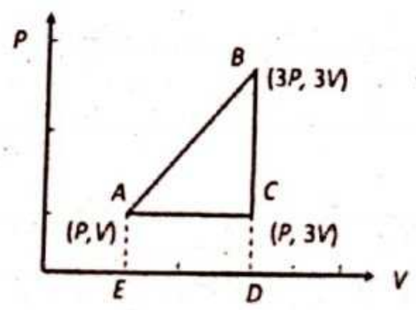
A) process 3
B) process 1
C) process 2
D) equal in all processes

Q.41 What's the total work performed on the gas as it's transformed from state *a* to state *c*, along the path indicated?



A) 1,500 J
B) 3,000 J
C) 4,500 J
D) 5,000 J

Q.42 An ideal gas is taken around *ABCA* as shown in the above *P-V* diagram. The work done during a cycle is



A) 2PV
B) PV
C) 1/2PV
D) Zero

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THERMODYANMICS SYSTEM

Q.43 The system in which there is transfer of mass across its boundary is called
A) Open system
B) Closed system
C) Isolated system
D) Thermal system

Q.44 The system in which there is no transfer of mass and heat energy across its boundary is called:
A) Isolated system
B) Closed system
C) Open system
D) Equilibrium system

Q.45 A system is described in terms of thermodynamics variables
A) Pressure (P)
B) Volume (V)
C) Temperature (T)
D) All of these

Q.46 The concept of temperature is related to
A) Zeroth law of thermodynamics
B) First law of thermodynamics
C) Second law of thermodynamics
D) Third law of thermodynamics

Q.47 Which of the following statement is correct for any thermodynamic system?
A) The internal energy changes in all processes
B) Internal energy and entropy are state functions
C) The change in entropy can never be zero
D) The work done in an adiabatic process is always zero

SECOND LAW OF THERMODYNAMICS

Q.48 "It is impossible to cause heat to flow from a cold body to a hot body without the expenditure of work," this statement is given by:
A) Lord Kelvin
B) Rudolf Clausius
C) Newton
D) Pascal

Q.49 Which statement of second law of thermodynamics is based on heat engine
A) Clauses statement
B) Kelvin statement
C) Carnot statement
D) Boyles statement

Q.50 The second law of thermodynamics implies:
A) Whole of heat can be converted into mechanical energy
B) No heat engine can have efficiency 100%
C) Some heat engines working in reversible process can have efficiency 100%
D) A refrigerator can reduce the temperature to absolute zero

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ANSWER KEY

1	C	11	C	21	C	31	A	41	C
2	D	12	C	22	D	32	C	42	A
3	B	13	C	23	C	33	A	43	A
4	C	14	D	24	D	34	B	44	A
5	B	15	A	25	A	35	C	45	D
6	B	16	D	26	A	36	C	46	A
7	C	17	D	27	D	37	B	47	B
8	C	18	A	28	D	38	C	48	B
9	A	19	B	29	C	39	A	49	B
10	D	20	A	30	D	40	B	50	B

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EXPLANATORY NOTES

Q.1 Thermodynamic equation $\Delta Q = \Delta U + \Delta W$

Q.2 Examples of 1st law of thermodynamics.

Q.3 Fact.

Q.4 Statement of 1st law of thermodynamics.

Q.5 As the gas expands, W is negative, also ΔU decreases and gas expand. There is no heat supplied to the system. The cooling occurs because of expansion.

Q.6 Adiabatic process.

Q.7 Isochoric process.

Q.8 Properties of isobaric process.

Q.9 $P \propto T$

Q.10 $\because P \propto \frac{1}{V} \Rightarrow p_1V_1 = p_2V_2 \Rightarrow V_2 = V - 10\% = \frac{9V}{10}$

$$p_1 = p_2\frac{9}{10} \Rightarrow p_2 = \frac{10p}{9}$$

$$\%P = \frac{P_2 - P}{P} \times 100 = \frac{\frac{10P}{9} - P}{P} \times 100 = \frac{1}{9} \times 100 = 11\%.$$

Q.11 Definition of isochoric process.

Q.12 Graph of isochoric, isothermal and isobaric process.

Q.13 $\Delta Q = \Delta U + W \Rightarrow 0 = \Delta U + W \Rightarrow -\Delta U = W \Rightarrow \Delta U = -10J$

Q.14 During $X \longrightarrow Y$, $V\downarrow, P\uparrow$ During $Y \longrightarrow Z$ $P \propto \frac{1}{V}$

During $Z \longrightarrow X$ P = constant $V\downarrow$

Q.15 $Q = \Delta U + W$

$0 = -2 + W \Rightarrow W = +2J$

Q.16 Boyle's law definition.

Q.17 Boyle's law graphs.

Q.18 $W_{isobaric} > W_{isothermal} > W_{adiabatic}$

Q.19 Molar specific heat at constant pressure.

Q.20 Definition of specific heat.

Q.21 $C_p = \frac{7R}{2} \Rightarrow C_p - C_v = R \Rightarrow \frac{7R}{2} - C_v = R$

$$\frac{7R-2R}{2} = C_v \Rightarrow \frac{5R}{2} = C_v \Rightarrow \frac{C_p}{C_v} = \frac{7R/2}{5R/2} = \frac{7}{5}$$

Q.22 $C_p - C_v = R$, $\frac{C_p}{C_v} = \gamma$

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Q.23 $\frac{C_p}{C_v} = \gamma$

Q.24 $C_p - C_v = R,\ C_p > C_v$

Q.25 Ideal gas possess only kinetic energy.

Q.26 Ideal gas molecules only possess K.E.

Q.27 All options are related to internal energy.

Q.28 Internal energy is same and $Q_p > Q_v$ so $Q_y > Q_x$

Q.29 $K = C + 273$

Q.30 $U \propto T$

Q.31 $\Delta U = Q - W$

$= -40 - (-20) = -20J$, $\Delta U = U_2 - U_1$

$U_2 = \Delta U + U_1$, $= -20 + 70 = 50J$

Q.32 As internal energy is a point function therefore change in internal energy does not depends upon the path followed i.e. $\Delta U_I = \Delta U_{II}$

Q.33 By rubbing objects, temperature increases hence internal energy increases.

Q.34 $U \propto T$

Q.35 $\Delta W = P\Delta V$: here ΔV is negative so ΔW will be negative

Q.36 $W = P\Delta V = P(0) = 0$

Q.37 $W = \Delta P \Delta V = 1 \times 10^5 \times 2 \times 10^{-3} = 2 \times 10^2 = 200J$ W = positive because work done by yz path is more than xw path.

Q.38 $Q = \Delta U + W$

In cyclic process i.e $\Delta U = 0$

$Q = W = Area\ of\ P - V\ graph = \pi r^2$

$= \pi (P_r)(V_r)$

$= 3.14(100 \times 10^3)(100) \Rightarrow 31.4 \times 10^6 J$

Q.39 $W = P\Delta V = 2atm \times (150 - 50)\,litre = 2 \times 1.01 \times 10^5\ Pa \times 100 \times \frac{1}{1000} m^3 \Rightarrow W = 2 \times 10^4 J$

Q.40 Area of PV graph = W

Area under process 1 > area under process 2 > area under process 3

Q.41 $W = p\Delta V = 3 \times 10^5 \times 15 \times 10^{-3} = 4500J$

Q.42 Work done = Area enclosed by triangle $ABC = \frac{1}{2} AC \times BC = \frac{1}{2} \times (3V - V) \times (3P - P) = 2PV$

Q.43 Definition of open system.

Q.44 Definition of isolated system.

Q.45 Thermodynamics variables.

Q.46 Zeroth law of thermodynamics describes temperature.

Q.47 U and S are state functions.

Q.48 Clausius statement.

Q.49 Kelvin statement describes heat engine.

Q.50 Statement of 2nd law of thermodynamics.

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6 ELECTROSTATICS

TOPIC PRACTICE EXERCISE

TOPIC-WISE MCQ's

COULOMB'S LAW

Q.1 If F is the force between two point charges submerged in a medium of dielectric constant K, then on removing the medium, the force between the charges becomes

A) $F\sqrt{K}$

B) FK

C) $\frac{F}{\sqrt{K}}$

D) $\frac{F}{K}$

Q.2 If the distance between two-point charges to becomes double then the coulomb's force will be

A) $\frac{F}{2}$

B) 2F

C) 4F

D) $\frac{F}{4}$

Q.3 The force between two point charges placed in air is F. If air is replaced by a medium of relative permittivity ε_r, the force is reduced to

A) $\varepsilon_r F$

B) $\frac{F}{\varepsilon_r}$

C) $\frac{\varepsilon_r}{F}$

D) ε_r

Q.4 Two point charges are separated by a distance of 4 m. The force between them is 4 N. What is the force between the charges, when the distance between them is 1 m

A) 16 N

B) 1 N

C) 64 N

D) 32 N

Q.5 Two identical metal balls with charges + 2Q and –Q are separated by some distance, and exert a force F on each other. They are joined by a conducting wire, which is then removed. The force between them will now be.

A) F

B) F/4

C) F/2

D) F/8

Q.6 When 10^{19} electrons are removed from a neutral metal plate, the electric charge on it is in (coulomb)

A) 10^{+19}

B) +1.6

C) –1.6

D) 10^{-19}

Q.7 Two point charges +3μC and + 8μC repel each other with a force of 40N. If a charge of -5μC is added to each of the, then the force between them will become:

A) –10 N

B) +10 N

C) +20 N

D) –20 N

Q.8 Two point charges +2 C and +6 C repel each other with a force of 12 N. If a charge of -2 C is given to each of these charges, the force will now be

A) Zero

B) 8 N (attractive)

C) 8 N (repulsive)

D) 16 N (attractive)

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Q.9 Relative permittivity of a material is 10. It's absolute or actual permittivity is
A) 8.85×10^{-12} F/m
B) 8.85×10^{-11} F/m
C) 9×10^{9} F/m
D) 10 F/m

Q.10 Two electrons are removed from a conductor the charge on it is
A) 1.6×10^{-19} C
B) 3.2×10^{-19} C
C) -3.2×10^{-19} C
D) neutral

ELECTRIC FIELD AND ITS INTENSITY

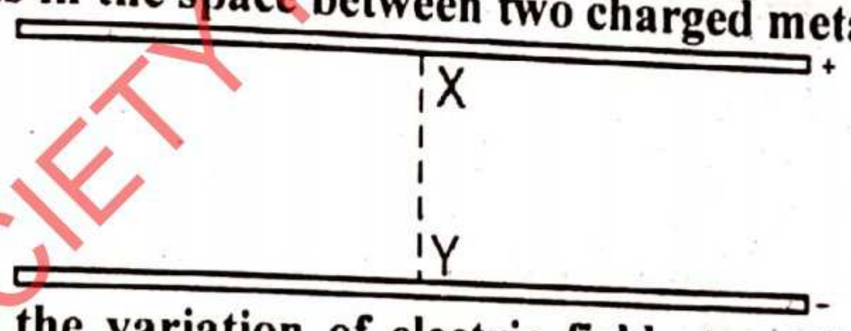
Q.11 A positive charge is moved against an electric field. Its P.E
A) Increases
B) Decreases
C) Remains same
D) May increase or decrease depending upon magnitude of charge

Q.12 An electric field can deflect _____
A) Neutrons
B) γ-rays
C) X-rays
D) None

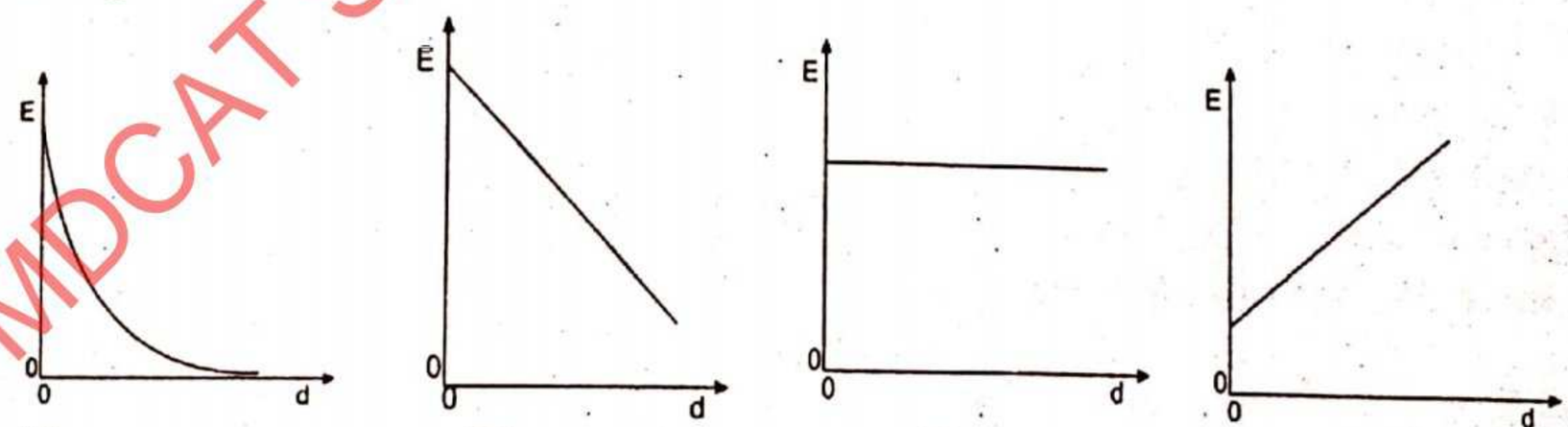
Q.13 Which of given is not the unit of electric intensity
A) NC^{-1}
B) Vm^{-1}
C) NV^{-1}
D) None of these

Q.14 The magnitude of electric intensity E is such that an electron placed in it would experience an electrical force equal to its weight. E is given by
A) mge
B) $\frac{e}{mg}$
C) $\frac{mg}{e}$
D) $\frac{e^2g}{m^2}$

Q.15 An electric field exists in the space between two charged metal plates.



Which graph shows the variation of electric field strength *E* with distance *d* from X along the line XY?



A) B) C) D)

Q.16 The electric field intensity at a point 20 cm away from a charge of 2×10^{-5}C is
A) 4.5×10^{6} N/C
B) 3.5×10^{6} N/C
C) 3.5×10^{5} N/C
D) 4.5×10^{5} N/C

Q.17 The weight of proton (mass = 1.67×10^{-27} kg) on entering in a vertical electric field E is balanced by electric force. Then the electric field strength is
A) 10^{-9} V m^{-1}
B) 10^{+7} V m^{-1}
C) 10^{-7} V m^{-1}
D) 10^{-8} V m^{-1}

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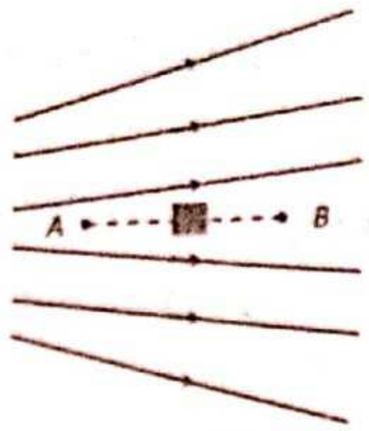
Q.18 Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are E_A and E_B respectively and if the displacement between A and B is r then



A) $E_A < E_B$
B) $E_A > E_B$
C) $E_A = E_B$
D) none of these

Q.19 Two metal plates have potential difference of 300 V and are 0.01 m apart. A charged particle of mass 1.96×10^{-15} kg is held in equilibrium between the plates of the capacitor. Then the electric field is

A) 3×10^2 V m^{-1}
B) 3 V m^{-1}
C) 3×10^4 V m^{-1}
D) 3×10^{-4} V m^{-1}

Q.20 The electric field strength between a pair of parallel plates is E. The separation of the plates is doubled and the potential difference between the plates is increased by a factor of four. What is the new electric field strength?

A) E
B) 2 E
C) 4 E
D) 8 E

APPLICATION OF GAUSS'S LAW

Q.21 Two thin infinite parallel plates have uniform charge densities + σ and -σ . The electric field in the space between them is

A) $\sigma/2\varepsilon_0$
B) σ/ε_0
C) σ
D) zero

Q.22 Gauss's law is applied to calculate the

A) Electric intensity due to different charge configuration
B) Electric intensity due to negative charges only
C) Electric intensity due to positive charges only
D) None of these

Q.23 Gaussian surface is

A) An imaginary surface
B) An open surface
C) A curved surface
D) A plane surface

Q.24 Electric intensity due to an infinite sheet of positive charge is given by

A) $\vec{E} = \frac{\sigma}{2\epsilon_o}\hat{r}$
B) $\vec{E} = \frac{\sigma}{\epsilon_o}\hat{r}$
C) $\vec{E} = \frac{2\epsilon_o}{\sigma}\hat{r}$
D) $\vec{E} = \frac{q}{\epsilon_o}\hat{r}$

ELECTRIC POTENTIAL

Q.25 The capacity of a parallel plate capacitor is $5\mu F$. When a glass plate is placed between the plates of the capacitor, its potential becomes 1/8 of the original value. The value of dielectric constant will be

A) 1.6
B) 5
C) 8
D) 40

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Q.26 Two charged spheres of radii 10 cm and 15 cm are connected by a thin wire. No current will flow, if they have:

A) The same charge on each
B) The same potential
C) The same energy
D) The same field on their surface

Q.27 12 J of work is to be done against an existing electric field to take a charge of 0.01 C from A to B. Find The potential difference between B and A.

A) 120 V
B) 1200 V
C) 1.2 V
D) 12 V

Q.28 A and B are two points in an electric field. If the work done in carrying 4.0 coulomb of electric charge from A to B is 16.0 joule the potential difference between A and B is

A) Zero
B) 2.0 V
C) 4 V
D) 16V

Q.29 Potential due to charge q at distance 1m is 5V, at distance 3m will be

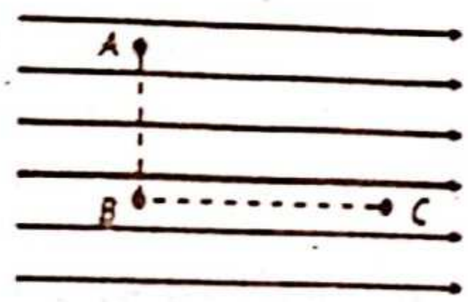
A) $\frac{5}{3}$ V
B) $\frac{3}{5}$ V
C) $\frac{7}{3}$ V
D) $\frac{3}{7}$ V

Q.30 The electric potential at the surface of an atomic nucleus (Z = 50) of radius 9.0×10^{-15} m is

A) 9 V
B) 9×10^5 V
C) 8×10^6 V
D) 80 V

Q.31 A capacitor with air as the dielectric is charged to a potential of 100 volts. If the space between the plate is now filled with a dielectric of dielectric constant 10, the potential difference between the plates will be

A) 1000 V
B) 100 V
C) 10 V
D) 0 V

Q.32 Figure shows three points A, B and C in a region of uniform electric field E. The line AB is perpendicular and BC is parallel to the field lines. Then which of the following holds good. Where V_A, V_B and V_C represent the electric potential at points A, B and C respectively

A) $V_A = V_B = V_C$
B) $V_A = V_B > V_C$
C) $V_A = V_B < V_C$
D) $V_A > V_B = V_C$

Q.33 Value of potential at a point due to a point charge is

A) A Inversely proportional to square of the distance
B) Directly proportional to square of the distance
C) Inversely proportional to the distance
D) Directly proportional to the distance

Q.34 When one electron is taken towards the other electron, then the electric potential energy of the system

A) Decreases
B) Increases
C) Remains unchanged
D) Becomes zero

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Q.35 Equal amount of charge is given to two sphere A and B of radii 2cm and 3cm respectively. The potential V_A and V_B

A) $V_A = V_B$
B) $V_A < V_B$
C) $V_A > V_B$
D) depend upon number of material of sphere

Q.36 Two charge +q and –q are situated at a certain distance. At the point exactly midway between them

A) Electric field and potential both are zero
B) Electric field is zero but potential is not zero
C) Electric field is not zero but potential is zero
D) Electric field is not zero but potential is zero

Q.37 An-α-particle is accelerated through a potential difference of 10^6 V. Its K.E will be

A) 1 MeV
B) 2MeV
C) 4 MeV
D) 8MeV

CAPACITOR

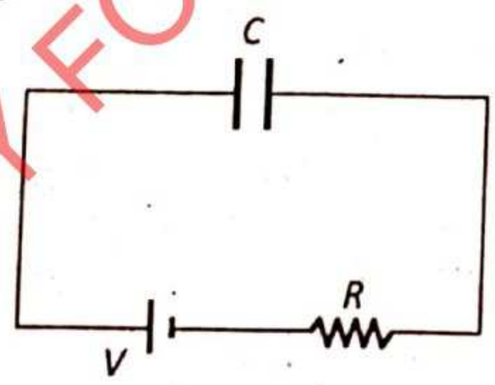
Q.38 A capacitor C "has a charge Q". The actual charges on its plates are

A) Q, −Q
B) Q, Q
C) Q/2, −Q/2
D) Q, 0

Q.39 A Capacitor which has a capacitance of 1 farad will

A) Be fully charged in 1 second by a current of 1 ampere
B) Store 1 coulomb of charge at a potential difference of 1 volt
C) Gain 1 joule of energy when 1 coulomb of charge is stored on it
D) Discharge in 1 second when connected across a resistor of resistance 1 ohm

Q.40 As in figure shown, if a capacitor C is charged by connecting it with resistance R, then energy is given by the battery will be



A) $\frac{1}{2}CV^2$
B) More than $\frac{1}{2}CV^2$
C) Less than $\frac{1}{2}CV^2$
D) Zero

Q.41 A capacitor of capacitance 2μF is connected with a battery of 12 volt, the charge stored is equal to:

A) 2.5×10^{-5} C
B) 2.4×10^{-5} C
C) 2.4×10^{-6} C
D) 2.5×10^{5} C

Q.42 If a 2 μF capacitor has a charge of 20 μC, the potential difference between the plates is:

A) 10 V
B) 40 V
C) 20 V
D) 50 V

CAPACITANCE OF A PARALLEL PLATE CAPACITOR

Q.43 What is the area of the plates of a 3*F* parallel plate capacitor, if the separation between the plates is 5mm?

A) $1.694 \times 10^9\ m^2$
B) $4.529 \times 10^9\ m^2$
C) $9.281 \times 10^9\ m^2$
D) 12.981×10^9 m

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Q.44 The capacity of a condenser in which a dielectric of dielectric constant 5 has been used, is *C*. If the dielectric is replaced by another with dielectric constant 20, the capacity will become

A) $\frac{C}{4}$
C) $\frac{C}{2}$
B) $4C$
D) $2C$

Q.45 A capacitor of capacitance C is connected to battery of emf V_0. Without removing the battery, a dielectric of strength ε_r is inserted between the parallel plates of the capacitor C, then the charge on the capacitor is

A) CV_0
C) $\frac{CV_0}{\varepsilon_r}$
B) $\varepsilon_r CV_0$
D) None of these

Q.46 The space between the plates of a capacitor is filled by a dielectric constant k. The capacitance of the capacitor

A) Increases by a factor k
C) Decreases by a factor k
B) Increases by a factor k^2
D) Decreases by a factor k^2

Q.47 If an insulating material called dielectric is introduced between the plates, the capacitance of capacitor is:

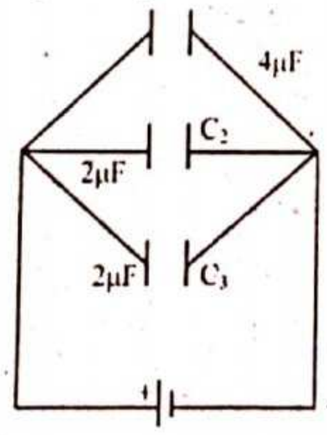
A) $\frac{A\varepsilon_o\varepsilon_r}{2d}$
C) $\frac{A\varepsilon_o\varepsilon_r}{d}$
B) $\frac{Ad}{\varepsilon_o\varepsilon_r}$
D) $\frac{2Ad\varepsilon_o\varepsilon_r}{d}$

Q.48 Capacitance with air is 10F, if a dielectric of $\varepsilon_r = 100$ is inserted then new capacitance

A) 1000 F
C) 10 μF
B) 10 F
D) 100 F

COMBINATION OF CAPACITORS

Q.49 Three capacitors C_1, C_2 and C_3 are connected in parallel as in the Fig. The equivalent capacitance will be



A) 8μF
C) 1μF
B) 0.8μF
D) 16μF

Q.50 Two capacitor of capacitances 1 μF and 2μF are connected in series with a D.C source of 300 volt. Charge stored by each capacitor

A) 100 μC, 200 μC
C) 200 μC, 200 μC
B) 200 μC, 100 μC
D) 100 μC, 100 μC

Q.51 Equivalent capacitance is greater than individual capacitances in

A) Series combination
C) Both series and parallel combinations
B) Parallel combination
D) None of above

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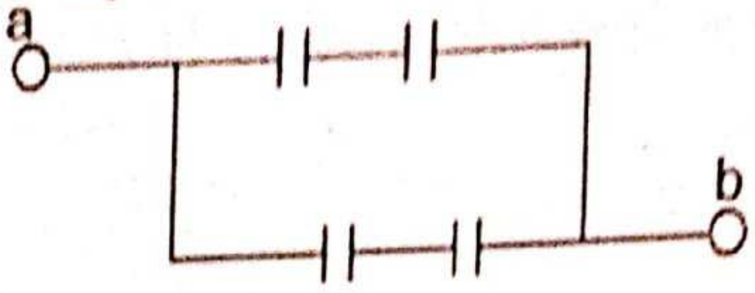
Q.52 The diagram shows four 6-μF capacitors. The capacitance between points a and b is;



A) 6μF
B) 3μF
C) 4μF
D) 9μF

ENERGY STORED IN CAPACITOR

Q.53 The quantity $\frac{1}{2}\varepsilon_o E^2$ has the significance of:

A) Energy/farad
B) Energy/volume
C) Energy/coulomb
D) Energy

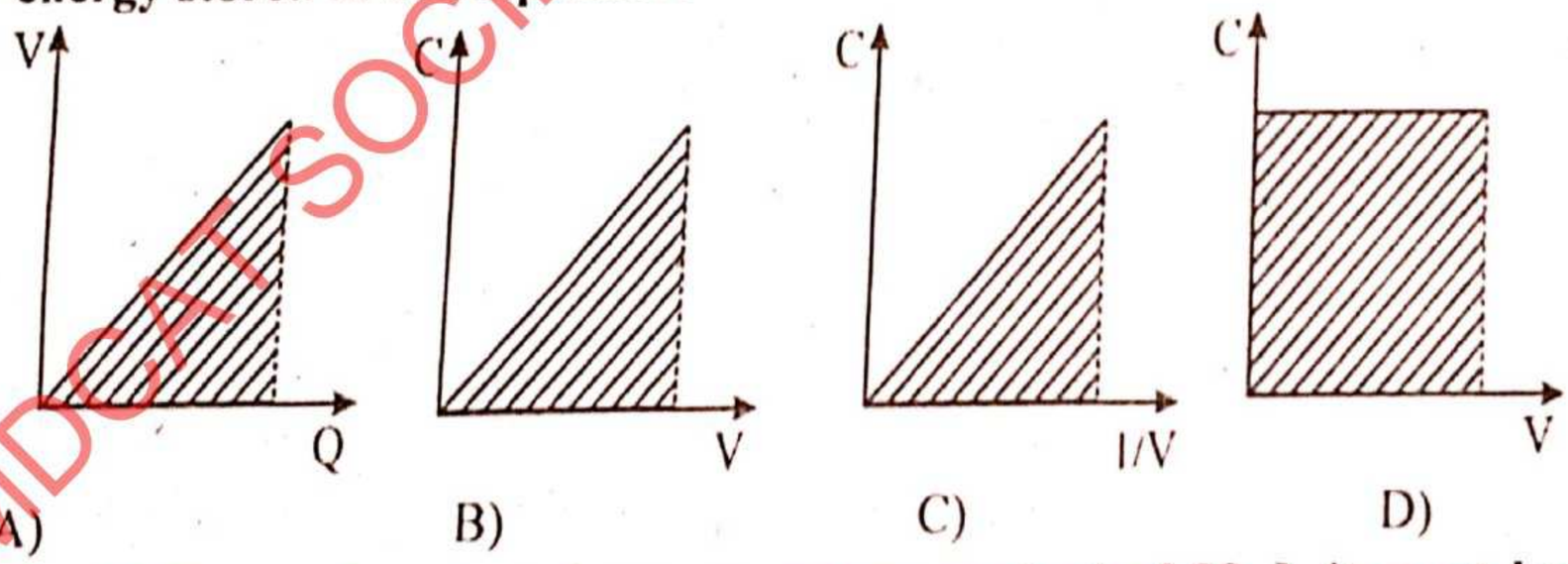
Q.54 The energy stored between the plates of a capacitor in not represented by

A) $U = \frac{CV^2}{2}$
B) $U = 2qV$
C) $U = \frac{q^2}{2C}$
D) $U = \frac{qV}{2}$

Q.55 If the potential difference across the two plates of a parallel plate capacitor is doubled then its energy stored in it will be:

A) 2 times
B) 16 times
C) 4 times
D) Remains same

Q.56 The energy stored in a capacitor of capacitance C, carrying charge Q with potential difference V between its plates, may be obtained by calculating the area under an appropriate graph. Which graph shows the correct relationship between a pair of the quantities C, Q and V, and in addition shows a shaded area which corresponds to the energy stored in the capacitor?



A) B) C) D)

Q.57 If a 10 F capacitor is to have an energy content of 20 J, it must be placed across a potential difference of

A) 4 volts
B) 9 volts
C) 2 volts
D) 1 volt

CHARGING AND DISCHARGING A CAPACITOR

Q.58 A capacitor charging and discharging

A) Rapidly
B) Linearly
C) Exponentially
D) Logarithmically

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Q.59 If RC is small, then capacitor will be charged and discharged

A) slowly
B) with medium speed
C) quickly
D) a and c

Q.60 The unit of RC is

A) Ohm farad
B) Coulomb
C) Second
D) both A and C

ANSWER KEY

1	B	11	A	21	B	31	C	41	B	51	B
2	D	12	D	22	A	32	B	42	A	52	A
3	B	13	C	23	A	33	C	43	A	53	B
4	C	14	C	24	A	34	B	44	B	54	B
5	D	15	C	25	C	35	C	45	B	55	C
6	B	16	A	26	B	36	D	46	A	56	A
7	A	17	C	27	B	37	B	47	C	57	C
8	A	18	B	28	C	38	A	48	A	58	C
9	B	19	C	29	A	39	B	49	A	59	C
10	B	20	B	30	C	40	B	50	C	60	C

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EXPLANATORY NOTES

Q.1 As,

$$F = \frac{F'}{\epsilon_r} = \frac{F'}{K} \quad \therefore \epsilon_r = K$$

$$F = KF$$

Q.2 If $r = 2r$

$$F = \frac{kq^2}{r^2} \Rightarrow F' = \frac{F}{4}$$

Q.3 $F = \frac{kq_1q_2}{r^2}$

$$F = \frac{1}{4\pi\epsilon_o\epsilon_r} \times \frac{q_1q_2}{r^2} \Rightarrow F' = \frac{F}{\epsilon_r}$$

Q.4 $F = \frac{kq_1q_2}{r^2} \Rightarrow F \propto \frac{1}{r^2}$

$$\frac{F_1}{F_2} = \frac{r_2^2}{r_1^2} = \left(\frac{r_2}{r_1}\right)^2 \Rightarrow \frac{4}{F_2} = \left(\frac{1}{4}\right)^2 = \frac{1}{16} \Rightarrow F_2 = 4 \times 16 = 64\,N$$

Q.5 When two balls are connected by a conducting wire the net charge is (2Q–Q) i.e Q and Q is divided equally between two balls.

$F \propto 2Q^2$ _____(i)

$F' \propto \left(\frac{Q}{2}\right)^2$ ---(ii)

Dividing equation (ii) by equation (i)

$$\frac{F'}{F} = \frac{Q^2/4}{2Q^2} = \frac{1}{8}$$

$$\boxed{F' = \frac{1}{8}F}$$

Q.6 As electric charge on electron is

$Q = 1.6 \times 10^{-19}\,C$

If 10^{+19} electrons removed from a neutral plate, then electric charge is + 1.6 C.

Q.7 In second case, charges will be $-2\mu C$ and $+3\mu C$ Since $F \mu Q_1Q_2$ i.e.

$$\frac{F}{F'} = \frac{Q_1Q_2}{Q_1'Q_2'} = \frac{40}{F'} = \frac{3 \times 8}{-2 \times 3} = -4F' = 10\,N\,(\text{Attractive})$$

Q.8 Because +2C charge will become neutral with -2C charge. So F = 0

Q.9 $\varepsilon_r = \frac{\varepsilon}{\varepsilon_o}$

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Q.10 If two electrons are removed from a conductor the charge on it is equal to 2 proton

$$q = 2e^{+} = 2\times1.6\times10^{-19}\ C$$

$$= 3.2\times10^{-19}\ C$$

Q.11 When positive charge is moved against electric field its P.E increases. When negative charge is moved along electric field its P.E increases.

Q.12 Neutron, x-rays and γ-rays are neutral

Q.13 $E = \frac{F}{q} \Rightarrow NC^{-1}$

$$E = \frac{\Delta V}{\Delta r} \Rightarrow Vm^{-1}$$

NC^{-1}, Vm^{-1} both are units of electric field.

Q.14 $F_e = F_g$

$$eE = mg$$

$$E = \frac{mg}{e}$$

Q.15 Electric field between two oppositely charged plates is uniform.

Q.16 $E = \frac{kq}{r^2} \Rightarrow \frac{9\times10^{9}\times2\times10^{-5}}{\left(20\times10^{-2}\right)^2}$

$$E = 4.5\times10^{6}\ N/C$$

Q.17 $E = \frac{F}{q} = \frac{mg}{q} = \frac{1.67\times10^{-27}\times10}{1.6\times10^{-19}} = 10^{-7}\ V\,m^{-1}$

Q.18 Field will be stronger where filed lines are closer to each other

i.e. $E_A > E_B$

Q.19 As

$$E = \frac{\Delta V}{\Delta r}$$

$$E = \frac{300}{0.01} = 30000 = 3\times10^{4}\ V\,m^{-1}$$

Q.20 $E = \frac{\Delta V}{\Delta r} = \frac{4\Delta V}{2\Delta r}$

$$E' = 2E$$

Q.21 According to 3rd application of gauss's law, the electric field between two equal and opposite charged plates is

$$E = \frac{\sigma}{\varepsilon_o}$$

Q.22 Gauss's law is used to determined electric field intensity due to different charge configuration.

Q.23 Gaussian surface is an imaginary surface

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Q.24 $\vec{E} = \frac{\sigma}{2\varepsilon_o} \hat{i}$

Q.25 $V_{med} = \frac{V}{\varepsilon_r}$

$$\varepsilon_r = \frac{V}{V_{med}} = \frac{V}{V/8} = 8$$

Q.26 Because current flows from higher potential to lower potential.

Q.27 $W = QV$

$$V = \frac{W}{Q} = \frac{12}{0.01} = 1200\ V$$

Q.28 $\Delta V = \frac{W}{q} = \frac{16}{4} = 4\ V$

Q.29 As we know,

$$V = \frac{kq}{r} \Rightarrow \frac{V_1}{V_2} = \frac{q_1/r_1}{q_2/r_2}$$

$$V_2 = \frac{q_2}{r_2} \times \frac{r_1}{q_1} \times V_1 \Rightarrow V_2 = \frac{q}{3} \times \frac{1}{q} \times 5 \Rightarrow V_2 = \frac{5}{3} \text{ volt}$$

Q.30 $V = \frac{1}{4\pi\varepsilon_o} \frac{Ze}{r}$

$$V = \frac{9\times10^9 \times 50 \times 1.6\times10^{-19}}{9\times10^{-15}} \Rightarrow V = 8.0\times10^6\ V$$

Q.31 $C_{med} = \varepsilon_r \times C_{vac}$

$$\frac{Q}{V_{med}} = \varepsilon_r \times \frac{Q}{V_{vac}}$$

$$V_{med} = \frac{V_{vac}}{\varepsilon_r} = \frac{100}{10} = 10\ V$$

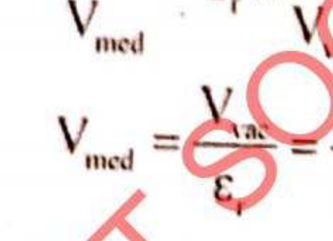
Q.32 In the direction of electric field potential decreases.

Q.33 $V = \frac{1}{4\pi\varepsilon_o} \cdot \frac{Q}{r} \Rightarrow V \propto \frac{1}{r}$

Q.34 Potential energy of the system will be given by $= \frac{(-e)(-e)}{4\pi\varepsilon_o r} = \frac{e^2}{4\pi\varepsilon_o r}$. As r decreases, potential energy increases.

Q.35 $V = \frac{kq}{r} \Rightarrow V \propto \frac{1}{r}$

Q.36 At O, $E \neq 0$, $V = 0$



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Q.37 $K.E = q\Delta V$

where $q_\alpha = 2e$

$K.E = (2e)(10^6\,V) = 2\times10^6\,eV = 2MeV$

Q.38 Both plates has opposite charge having magnitude "Q".

Q.39 $1\,farad = \dfrac{1\ coulomb}{1\,volt}$

Q.40 Energy stored in a capacitor and some loss of energy in the form of heat in resistance.

Q.41 $Q = CV$

$Q = 2\times10^{-6}\times12 \Rightarrow Q = 2.4\times10^{-5}\,C$

Q.42 $Q = CV$

$V = \dfrac{Q}{C} = \dfrac{20\times10^{-6}}{2\times10^{-6}} = 10\,volt$

Q.43 We have $C = \dfrac{\varepsilon_0 A}{d} \Rightarrow A = \dfrac{Cd}{\varepsilon_0} = \dfrac{3\times5\times10^{-3}}{8.85\times10^{-12}} = 1.69\times10^9\,m^2$

Q.44 $C = \dfrac{K\varepsilon_0 A}{d};\ \dfrac{C_1}{C_2} = \dfrac{K_1}{K_2} \Rightarrow \dfrac{C}{C_2} = \dfrac{5}{20} \Rightarrow C_2 = 4C$

Q.45 As, $Q = CV \rightarrow$ also $C = \epsilon_r C$ and $V = V_o$ then $Q = \epsilon_r CV_o$

Q.46 $C_{med} = \dfrac{A\varepsilon_o k}{d} \Rightarrow C_{med} \propto k$

Q.47 $C = \dfrac{A\varepsilon_o\varepsilon_r}{d}$

Q.48 As, $C_{med} = \varepsilon_r \times C_{vac}$

$C = 100\times10$

$C = 1000F$

Q.49 $C_{eq} = C_1 + C_2 + C_3 = 8\mu F$

Q.50 $Q = C_{eq}V = \dfrac{C_1C_2}{C_1 + C_2}V$

$Q = \dfrac{2}{3}\times10^{-6}\times300 = 200\mu C$

Q.51 For parallel $C_{eq} = C_1 + C_2 + C_3 + ...C_n$

Q.52 $C_{eq} = \dfrac{6}{2} + \dfrac{6}{2} = 6\,\mu F$

Q.53 Energy density $= \dfrac{energy}{volume} = \dfrac{1}{2}\varepsilon_o E^2$

Q.54 As we know,

$U_m = \dfrac{1}{2}CV^2 = \dfrac{Q^2}{2C} = \dfrac{qV}{2}$ but $U_m \neq 2qV$

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Q.55 $E = \frac{1}{2}CV^2 \Rightarrow E \propto V^2$

$V' = 2V \Rightarrow E' = 4E$

Q.56 Area of Q-V graph = Area of triangle = $\frac{1}{2}$(Base)(Height) = $\frac{1}{2}$(Q)(V) = Energy stored

Q.57 As we know,

$E = \frac{1}{2}CV^2$

$V = \sqrt{\frac{2E}{C}}$

$V = \sqrt{\frac{2 \times 20}{10}} \Rightarrow V = \sqrt{4} = 2$ volt

Q.58 A capacitor charging and discharging exponentially.

Q.59 RC = time constant

If RC is small then time constant will also small then capacitor will be charged and discharged quickly.

Q.60 RC = Time constant = T

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7 CURRENT ELECTRICITY

TOPIC » PRACTICE EXERCISE

TOPIC-WISE MCQ's

OHM'S LAW

Q.1 How many electrons per second constitute a current of one micro ampere?

A) One electron
B) 10^6 electrons
C) 10^{-6} electrons
D) 6.25×10^{12} electrons

Q.2 A steady current is flowing in a conductor of non-uniform cross-section. The charge passing through any cross-section per unit time is

A) Directly proportional to the area of cross-section
B) Inversely proportional to the area of cross-section
C) Proportional to square of the area of cross-section
D) Independent of the area of cross-section

Q.3 In the case of gases, the charge carries are

A) Positive and negative ions
B) electrons and holes
C) negative ions and electrons
D) positive ions and electron

Q.4 What is meant by 5 A?

A) A charge of 5 C flows through a point in 1 second
B) 5 V electricity flows across 1Ω of resistance
C) 5V electricity is causing 1 C of charge to flow
D) A charge of 5 C flows through a point in 5 seconds.

Q.5 Slope of the graph between "V" On X-axis and "I" on the Y-axis is

A) Resistance
B) Emf
C) Conductance
D) Capacitance

Q.6 When we double the voltage in a simple electric circuits we double the

A) Current
B) Resistance
C) Power
D) Both (A) and (C)

Q.7 An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 4/3 and 2/3, then the ratio of the currents passing through the wire will be

A) 3
B) 1/3
C) 8/9
D) 2

Q.8 Graph between V and I for non-ohmic devices

A) Straight line
B) Usually not straight line
C) Always not straight line
D) Sometime straight line

Q.9 The current in a resistor is 8.0 mA. What charge flows through the resistor in 0.020 s?

A) 0.16 mC
B) 1.6 mC
C) 4.0 mC
D) 0.40 mC

Q.10 Which of the following statements is not true?

A) Conductance is the reciprocal of resistance and is measured in siemens
B) Ohm's law is not applicable at very low and very high temperatures
C) Ohm's law is applicable to semiconductors
D) Ohm's law is not applicable to electron tubes, discharge tubes

Q.11 Ohm's law establishes a relation between

A) Current and voltage
B) Charge and voltage
C) Resistance and voltage
D) Current and resistance

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Q.12 For an ohmic conductor, doubling the voltage without changing the resistance will cause the current to

A) Decrease by a factor of 4
B) Remain unchanged
C) Decrease by a factor of 2
D) Increase by a factor of 2

Q.13 Which equation is used to define resistance?

A) Energy = (current)^2 × resistance × time
B) Potential difference = current × resistance
C) Power = (current)^2 × resistance
D) Resistivity = resistance × area ÷ length

Q.14 The charge of an electron is 1.6×10^{-19} (c) How many electrons strike the screen of a cathode ray tube each second when the beam current is 16 mA

A) 10^{19}
B) 10^{17}
C) 10^{-19}
D) 10^{-17}

ELECTRICAL RESISTANCE AND RESISTIVITY

Q.15 The following four wires are made of the same material and are at the same temperature. Which one of them has highest electrical resistance

A) length = 100 cm, diameter = 1 mm
B) length = 50 cm, diameter = 0.5 mm
C) length = 200 cm, diameter = 2 mm
D) length = 300 cm, diameter = 3 mm

Q.16 The resistance of a wire of uniform diameter d and length l is R. The resistance of another wire of the same material but diameter 2d and length $4l$ will be

A) 2R
B) R
C) $\frac{R}{2}$
D) $\frac{R}{2}$

Q.17 When the length and area of cross-section both are doubled, then its resistance

A) Will become half
B) Will be doubled
C) Will remain the same
D) Will become four times

Q.18 The example for non-ohmic resistance is

A) Copper wire
B) Carbon resistance
C) Diode
D) Tungston wire

Q.19 The resistance of a conductor is 5 ohm at 50 °C and 6 ohm at 100 °C. Its resistance at 0 °C is

A) 1 ohm
B) 2 ohm
C) 3 ohm
D) 4 ohm

Q.20 A wire 100cm long and 2.0 mm diameter has a resistance of 0.7 ohm, the electrical resistivity of the material is

A) 4.4×10^{-6} ohm×m
B) 2.2×10^{-6} ohm×m
C) 1.1×10^{-6} ohm×m
D) 0.22×10^{-6} ohm×m

Q.21 Which of the following have the same temperature coefficient of resistivity?

A) iron and silver
B) iron and platinum
C) platinum and silver
D) silver and gold

Q.22 When a wire is stretched double of is length, then its resistance will be

A) 16 R
B) 2 R
C) 4 R
D) 8 R

Q.23 A wire of resistance R is cut into two equal parts, its resistance becomes R/2, what happens to resistivity:

A) Double
B) Half
C) Same
D) One fourth

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Q.24 A wire of resistance R is stretched four times its length uniformly. Its new resistance will be

A) 16 R
C) 4 R
B) $\frac{R}{4}$
D) $\frac{R}{16}$

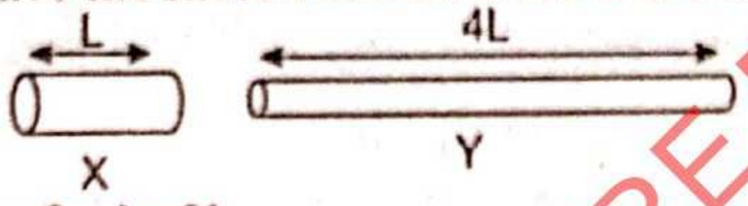
Q.25 The resistance of a wire is 1 Ω. Which of the following is new resistance if length of wire is doubled?

A) 2 Ω
C) 4 Ω
B) $\frac{1}{2}\Omega$
D) $\frac{1}{4}\Omega$

Q.26 When Cu and Ge are cooled to – 150 °C Then resistance of Cu ___ and that of Ge _____

A) Increases, increases
C) Decreases, decreases
B) Increases, decreases
D) Decreases, increases

Q.27 Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.



What is the ratio $\frac{\text{resistance of wire Y}}{\text{resistance of wire X}}$?

A) 4
C) 16
B) 8
D) 64

E.M.F AND INTERNAL RESISTANCE OF SUPPLY

Q.28 If r = 0 , R= ∞, (V = ε–Ir) then

A) V>ε
C) V= ε
B) V<ε
D) V = 0

Q.29 An 8Ω resistance connected to a battery with internal resistance draws 1.6 A and if a 30Ω resistance is connected to the same battery if draws 0.5 (A) What is the current drawn by a 6Ω resistance from this battery?

A) 2A
C) 2.5 A
B) 2.2 A
D) None of these

Q.30 Internal resistance of ideal current source is

A) Infinite
C) Very low
B) Zero
D) Very high

Q.31 Internal resistance is the resistance offered by _____

A) Source of e.m.f
C) Resistor
B) Conductor
D) Capacitor

Q.32 An electric current source is actually source of

A) Current
C) Energy
B) Charge
D) Power

Q.33 A new flashlight cell of emf 1.5 volts gives a current of 15 A, when connected directly to an ammeter of resistance 0.04 Ω . The internal resistance of cell is

A) 0.04 Ω
C) 0.10 Ω
B) 0.06 Ω
D) 10 Ω

Q.34 The terminal potential difference of a cell when short-circuited is (E = E.M.F. of the cell)

A) E
C) E / 2
B) Zero
D) E / 3

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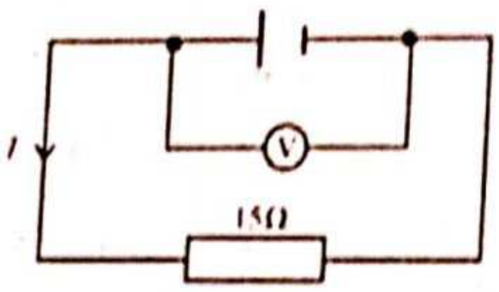
Q.35 **By a cell a current of 0.9 A flows through 2 *ohm* resistor and 0.3 A through 7 *ohm* resistor. The internal resistance of the cell is**

A) 0.5Ω
C) 1.0Ω
B) 1.2Ω
D) 2.0Ω

Q.36 **The emf of the cell in the following circuit is 9.0 V. The reading on the high resistance voltmeter 7.5 V?**



What is the current I?

A) 0.1 A
C) 0.5 A
B) 0.6 A
D) 2.0 A

Q.37 **If the current in electric bulb decreases by 0.5%, then the power in the bulb decreases by approximately**

A) 1%
C) 0.5%
B) 2%
D) 0.25%

ELECTRIC POWER (UNIT OF ELECTRIC POWER)

Q.38 **1 horse power = _____**

A) 746 kW
C) 746 W
B) 746mW
D) 746MW

Q.39 **If R_1 and R_2 are respectively the filament resistances of a 200-watt bulb and 100-watt bulb designed to operate on the same voltage, then**

A) R_1 is two times R_2
C) R_2 is four times R_1
B) R_2 is two times R_1
D) R_1 is four times R_2

Q.40 **Two electric bulbs, one of 200 volt 40 watt and the other 200 volt 100 watt are connected in a house wiring circuit**

A) They have equal currents through them

B) The resistance of the filament in 40-watt bulb is more than the resistance in 100-watt bulb

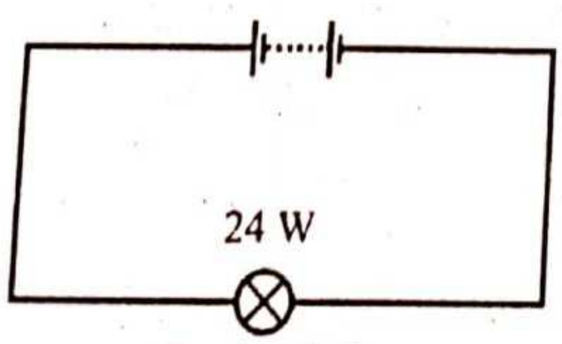
C) The resistance of the filaments in both the bulbs is same

D) The resistance of the filament in 100-watt bulb is more than the resistance in 40-watt bulb

Q.41 **A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be**

A) halved
C) four times
B) one-fourth
D) doubled

Q.42 **A battery is used to light a 24 W electric lamp. The battery provides a charge of 120 C in 60 s.**



What is the potential difference across the bulb?

A) 5 V
C) 12 V
B) 24 V
D) 120 V

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Q.43 A 100 W, 200V bulb is connected to a 160 V supply. The actual power consumption would be
A) 64 W
B) 72 W
C) 100 W
D) 90 W

Q.44 Electrical energy is converted to heat at the rate of _____
A) IRt
B) I^2R
C) I^2Rt
D) VIt

Q.45 A 40 W lamp turns half the electrical energy to give light. How much light energy does it give out in 10 s?
A) 200 J
B) 400 J
C) 800 J
D) 40 J

Q.46 A 40 W lamp turns half the electrical energy to give light. How much light energy does it give out in 10 s?
A) 200 J
B) 400 J
C) 800 J
D) 40 J

Q.47 An electrical bulb marked 100 W, 200 V would mean the resistance is
A) 200-ohm
B) 400 ohm
C) 50 ohm
D) 50 ohm

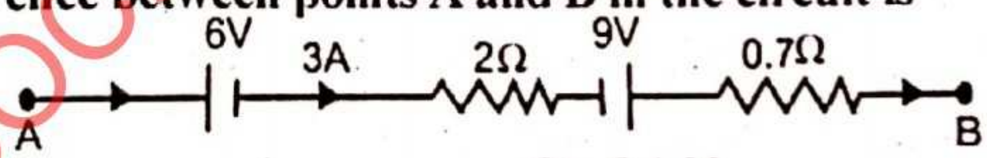
Q.48 You are given four bulbs of 25 W, 40 W, 50 W and 60 W. Which bulb has the lowest resistance?
A) 25 W
B) 50 W
C) 60 W
D) 40 W

Q.49 Two bulbs having the ratings 40 W, 220 V and 20 W, 110 V. The ratio of their resistance is
A) 1: 2
B) 2 :1
C) 1 :1
D) 1 : 4

Q.50 A total charge of 100 C flows through a 12 W light bulb in a time of 50s. What is the potential difference across the bulb during this time?
A) 0.12 V
B) 2.0 V
C) 6.0 V
D) 24 V

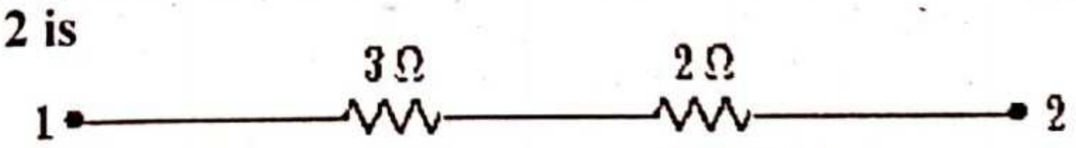
KIRCHHOFF'S RULE (KIRCHHOFF'S CURRENT LAW AND VOLTAGE LAW)

Q.51 The potential difference between points A and B in the circuit is



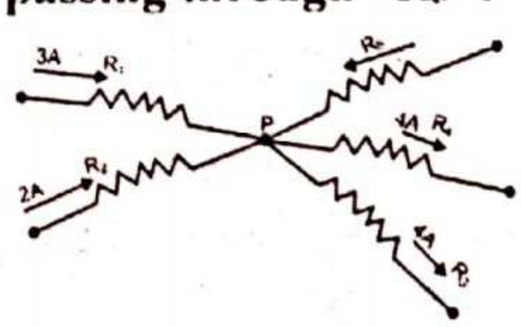
A) 3 V
B) 15 V
C) -5.1 V
D) +5.1 V

Q.52 In the diagram, the current in the 3-Ω resistor is 4 A. The potential difference between points 1 and 2 is



A) 20 V
B) 12 V
C) 0.8 V
D) 1.25 V

Q.53 Consider the circuit diagram in which a mesh is shown carrying currents in each resistor. What is the current passing through "R_5"?



A) 10^a
B) 6 A
C) 3 A
D) 2 A

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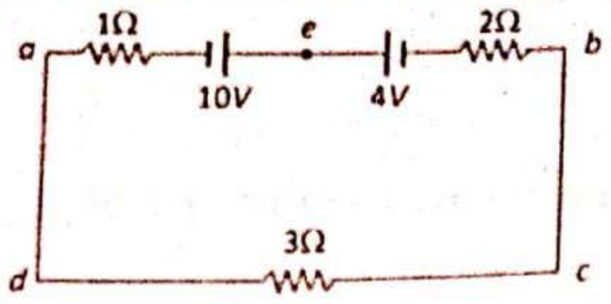
Q.54 The magnitude and direction of the current in the circuit shown will be



A) $\frac{7}{3}A$ from a to b through e

B) $\frac{7}{3}A$ from b to a through e

C) $1A$ from b to a through e

D) $1A$ from a to b through e

Q.55 Kirchhoff's two laws for electrical circuits are manifestations of the conservation

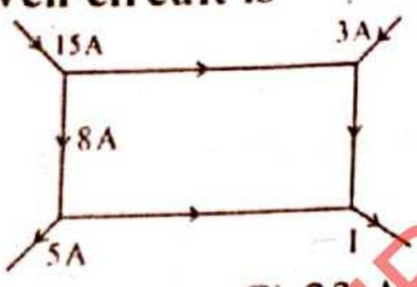
A) Charge only

B) Energy only

C) Both energy and momentum

D) Both charge and energy

Q.56 The value of current I in the given circuit is



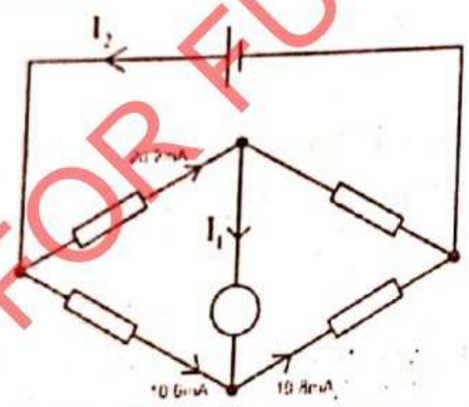
A) 3 A

B) 13 A

C) 23 A

D) –3 A

Q.57 The diagram represents a circuit.



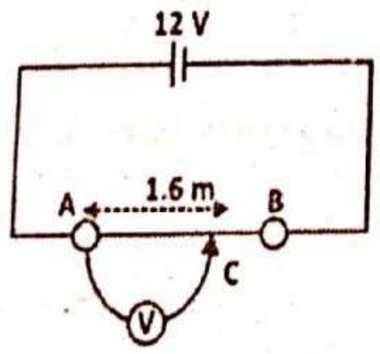
Some currents have been shown on the diagram.

What are the currents I_1 and I_2 ?

	I_1	I_2
A)	0.2 mA	10.8 mA
B)	0.2 mA	30.8 mA
C)	–0.2 mA	20.0 mA
D)	–0.2 mA	30.8 mA

POTENTIOMETER

Q.58 A 10Ω resistance wire AB of length 2 m is connected in a circuit as shown below.



What is the reading on the voltmeter when the jockey is at point C?

A) 1.6V

B) 2.4V

C) 9.6V

D) 12V

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Q.59 In case of potentiometer the ratio of e.m.f's is equal to the ratio of balanced

A) Mass
C) Time
B) Length
D) Current

Q.60 A device which can measure the potential without drawing any current is called

A) Wheat stone bridge
C) Potentiometer
B) Galvanometer
D) Voltmeter

ANSWER KEY

1	D	11	A	21	B	31	A	41	D	51	D
2	A	12	D	22	C	32	C	42	C	52	A
3	D	13	B	23	C	33	B	43	A	53	C
4	A	14	B	24	A	34	B	44	C	54	D
5	C	15	B	25	A	35	A	45	A	55	D
6	A	16	B	26	D	36	C	46	A	56	B
7	B	17	C	27	C	37	A	47	B	57	B
8	C	18	C	28	C	38	C	48	C	58	C
9	A	19	D	29	A	39	B	49	B	59	B
10	C	20	B	30	B	40	B	50	C	60	C

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EXPLANATORY NOTES

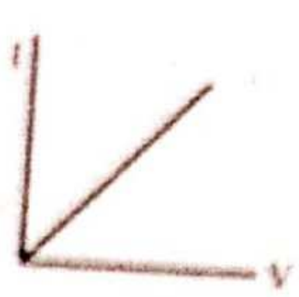
Q.1 $\frac{n}{t} = \frac{I}{e} \Rightarrow$ Number of free electrons per second $= \frac{10^{-3}}{1.6\times10^{-19}} = 6.25\times10^{15}$ electrons / sec

Q.2 $Q/t \propto A$

Q.3 In case of gases, charge carriers are positive ions and electrons.

Q.4 5 A of current means that 5 C of charge is passing through a point in 1 s.

Q.5



$\because$ slope $= \frac{\Delta Y}{\Delta X}$, slope $= \frac{1}{V} = G$

Q.6 According to Ohm's law $I \propto V$
If voltage is doubled then current will also be doubled, so power will be four times as $P \propto V^2$ also $P \propto I^2$

Q.7 $\frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{\ell_2}{\ell_1}\times\left(\frac{r_1}{r_2}\right)^2 = \frac{3}{4}\left(\frac{2}{3}\right)^2 = \frac{1}{3}$

Q.8 For non-ohmic devices, graph is not straight line.

Q.9 $Q = It = 8\times10^{-3}\times0.020 = 0.16\,mC$

Q.10 Ohm's law is applicable to conductors only.

Q.11 $I \propto V \Rightarrow I = \frac{V}{R}$

Q.12 $I = \frac{V}{R} \Rightarrow I \propto V$ $(\because R = \text{constant})$

Q.13 $V = IR$

Q.14 $I = \frac{Q}{t} = \frac{ne}{t} \Rightarrow 16\times10^{-3} = \frac{n\times1.6\times10^{-19}}{1} \Rightarrow n = 10^{17}$

Q.15 $R = \rho\frac{\ell}{A} \propto \frac{\ell}{d^2}$. For highest resistance $\frac{\ell}{d^2}$ should be maximum, which is correct for option.

Q.16 $R = \frac{4\rho L}{\pi d^2} \Rightarrow R' = \frac{4\rho(4L)}{\pi 4d^2} = \frac{4\rho L}{\pi d^2} \Rightarrow R' = R$

Q.17 $R_1 \propto \frac{l}{A} \Rightarrow R_2 \propto \frac{2l}{2A}$ i.e. $R_2 \propto \frac{l}{A}$ $\quad \therefore R_1 = R_2$

Q.18 Because *V-i* graph of diode is non-linear.

Q.19 $R_t - R_o \propto R_o$

Q.20 $\rho = \frac{RA}{L} = \frac{R\pi r^2}{L} \Rightarrow \rho = \frac{R\pi d^2}{4L} = \frac{0.7\times3.14\times4\times10^{-6}}{4\times1} = 2.2\times10^{-6}\,\Omega m$

Q.21 Iron and platinum (information from text book).

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Q.22 $R' = \frac{\rho L'}{A'} = \frac{\rho(2L)}{A/2} = \frac{4 \times \rho L}{A} \Rightarrow R' = 4R$

Q.23 Resistivity does not depend upon dimension (L, W) of wire. It only depends upon nature & temperature of wire.

Q.24 $R = \frac{\rho L}{A}$

$L' = 4L$

$A' = \frac{A}{4} \Rightarrow \boxed{R' = 16R}$

Q.25 $R = \frac{\rho L}{A} \Rightarrow \boxed{R \propto L}$

Q.26 Temperature coefficient of resistance $= \alpha^{+ve\ for\ Cu}_{-ve\ for\ Ge}$

$\Rightarrow \alpha = +ve$ for $Cu \Rightarrow T \uparrow \Rightarrow R \uparrow$ or $T \downarrow \Rightarrow R \downarrow$

& $\alpha = -ve$ for $Ge \Rightarrow T \uparrow \Rightarrow R \downarrow$ or $T \downarrow \Rightarrow R \uparrow$

So resistance of Cu decreases & that of Ge increases by cooling or decreasing temperature.

Q.27 $R = \frac{\rho L}{A} \Rightarrow R \propto \frac{L}{A}$

Q.28 $v_t = \varepsilon - Ir$

Q.29 $v = \varepsilon - I_1 r \Rightarrow I_1 R_1 = \varepsilon - I_1 r$

$(1.6)(8) = \varepsilon - 1.6r \Rightarrow \boxed{12.8 = \varepsilon - 1.6r} \rightarrow (i)$

$(15 - 12.8) = (\varepsilon - 1.6r) - (\varepsilon - 0.5r)$

$2.2 = -1.1r \Rightarrow \boxed{r = 2}$

$\varepsilon = 16V$

$I_2 R_2 = \varepsilon - I_2 r \Rightarrow \boxed{15 = \varepsilon - 0.5r} \rightarrow (ii)$

$\varepsilon = I(R + r) \Rightarrow 16 = I(6 + 2) \Rightarrow \boxed{I = 2A}$

Q.30 Internal resistance of ideal current source is zero.

Q.31 Internal resistance is the resistance offered by source of e.m.f.

Q.32 Source of emf provides energy.

Q.33 $V_t = \varepsilon - ir \Rightarrow IR = \varepsilon - Ir$

$(15)(0.04) = 1.5 - (15)(r)$

$0.6 = 1.5 - 15r \Rightarrow 15r = \frac{0.9}{15} = 0.06\Omega$

Q.34 $V_t = IR = (I)(0) = 0$

Q.35 $0.9\,(2 + r) = 0.3\,(7 + r) \Rightarrow 6 + 3r = 7 + r \Rightarrow r = 0.5\ \Omega$

Q.36 $V = IR$

$I = \frac{V}{R} = \frac{7.5}{15} = \frac{1}{2} = 0.5\ A$

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Q.37 $P = I^2R = 2(1\%) = 2(0.5) = 1\%$

Q.38 1hp = 746 Watt

Q.39 $P \propto \frac{1}{R} \Rightarrow \frac{P_1}{P_2} = \frac{R_2}{R_1} \Rightarrow \frac{200}{100} = \frac{R_2}{R_1} \Rightarrow R_2 = 2R_1$

Q.40 $P = \frac{V^2}{R}$

$\Rightarrow R_1 = \frac{V_1^2}{P_1} = \frac{(200)^2}{40} = 1000\Omega$ and $R_2 = \frac{V_2^2}{P_2} = \frac{(200)^2}{100} = 400\Omega$

So, $R_1 > R_2$

Q.41 $H = I^2Rt \Rightarrow H' = (2I)^2\left(\frac{R}{2}\right)t \Rightarrow H' = 2H$

Q.42 $P = VI = V\frac{Q}{t}$

$V = \frac{Pt}{Q} = \frac{24 \times 60}{120} = 12V$

Q.43 $R = \frac{V^2}{P} = \frac{(200)^2}{100} = 400\ \Omega \Rightarrow P = \frac{V^2}{R} = \frac{(160)^2}{400} = 64$ Watt

Q.44 $H = I^2Rt$

Q.45 $E = P \times t = (20)(10) = 200J$

Q.46 $E = P \times t \Rightarrow 40 \times 10 \Rightarrow 400$ J

but it consume half energy into light, so E= 200 J

Q.47 $P = \frac{V^2}{R}$

$R = \frac{V^2}{P} = \frac{200^2}{100} = 400\Omega$

Q.48 The resistance of high power devices is smaller than the low power ones. The resistance of 60 watt bulb is smaller than 40 watt bulb and so on $P = \frac{V^2}{R}$ For a given voltage, $P \propto \frac{1}{R}$. So, 60 W bulb has the lowest resistance.

Q.49 $P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$

$\frac{R_1}{R_2} = \frac{V_1^2}{V_2^2} \times \frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^2 \times \frac{P_2}{P_1}$

$= \left(\frac{22\cancel{0}}{11\cancel{0}}\right)^2 \times \frac{2\cancel{0}}{4\cancel{0}} = 2:1$

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Q.50 $V = \frac{W}{q} = \frac{P \times t}{q} = \frac{12 \times 50}{100} = 6\,V$

Q.51 $V_A - \varepsilon_1 - IR_1 + \varepsilon_2 - IR_2 - V_B = 0$

$V_A - 6 - 6 + 9 - 2.1 - V_B = 0$

$V_A - V_B - 14.1 + 9 = 0$

$V_A - V_B = 5.1A$

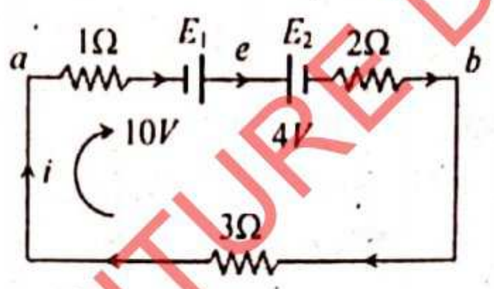
$V_1 - 12 - 8 - V_2 = 0 \Rightarrow V_1 - V_2 = 20V$

Q.52 $(3A) + (2A) + (-4A) + (-4A) + I = 0$

Q.53 $5A - 8A + I = 0 \Rightarrow -3A + I = 0 \Rightarrow I = 3A$

Q.54 Since $E_1(10\,V) > E_2(4V)$

So current in the circuit will be clockwise.



Applying Kirchoff's voltage law

$-1 \times i + 10 - 4 - 2 \times i - 3i = 0 \Rightarrow i = 1A$(a to b via e)

$\therefore$ Current $= \frac{V}{R} = \frac{10-4}{6} = 1.0$ ampere

Q.55 Kirchhoff's first law relates law of conservation of charge

Kirchhoff's second law relates law of conservation of Energy

Q.56 Current flowing towards the point = Current flowing away from the point

$7\,A + 3\,A + 3\,A = I$

$I = 13\,A$

Q.57 According 1st Kirchoff's law

$I_1 + 10.6\,mA = 10.8mA$

$\boxed{I_1 = +0.2\,A}$

$I_2 = 20.2\,mA + 10.6\,mA \Rightarrow \boxed{I_2 = 30.8\,mA}$

Q.58 Voltage across wire AB = 12V voltage across wire AC

$= \frac{\text{length of wire between AC}}{\text{length of wire between AB}} \times \text{voltage across AB} = \frac{1.6}{2.0} \times 12V = 9.6\,V$

Q.59 $\frac{\varepsilon_1}{\varepsilon_2} = \frac{\ell_1}{\ell_2}$

Q.60 Object of potentiometer.

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8 ELECTROMAGNETISM

TOPIC PRACTICE EXERCISE

TOPIC-WISE MCQ's

MAGNETIC FIELD

Q.1 The magnetic field due to the electric current in a conducting straight wire is:
A) Towards the centre of the conducting wire
B) Circular around the conducting wire
C) In the direction of the electric current
D) In the direction opposite to the electric current

Q.2 Two parallel wires carrying currents in the opposite directions
A) Repel each other
B) Have no effect upon each other
C) Attract each other
D) They cancel out their individual magnetic fields

Q.3 The direction of the magnetic lines of force depends upon:
A) Nature of the material of the conducting wire
B) Area of the conducting wire
C) Amount of the current
D) Direction of the current

Q.4 The direction at a point on the magnetic lines of force can be taken along:
A) Normal at that point
B) The tangent at that point
C) Axis of the magnetic line of force at that point
D) Can't be taken

Q.5 The direction of the magnetic lines of force can be found by using:
A) Right hand rule
B) Henry's law
C) Left hand rule
D) Faraday's law

Q.6 A uniform magnetic field is represented by a set of lines of force which are
A) Parallel
B) Divergent
C) Convergent
D) None of these

Q.7 When a current carrying conductor is placed in a magnetic field. It moves from a region of
A) Stronger to weak field
B) Strong to weak if current is large
C) Weak to strong field
D) Weak to strong if current is large

Q.8 A long straight current carrying conductor has current direction from bottom to top when held vertically. What will be the direction of magnetic field lines when observed from below the conductor?
A) Clockwise
B) Vertically upward
C) Anticlockwise
D) Vertically downward

Q.9 Magnetic lines of force
A) Always intersect
B) Are always in closed shape
C) Tend to crowd far away from the poles of a magnet
D) Do not pass through vacuum

Q.10 A magnetic needle is kept in a non-uniform magnetic field. It experiences
A) Neither a force on a torque
B) A torque but not a force
C) A force but not a torque
D) A force and a torque

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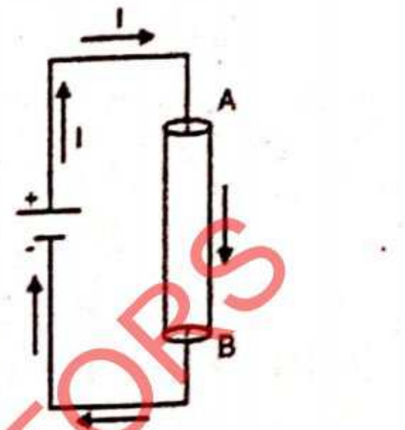
Topic-B

Q.11 **Which of the following quantity is not affected by a magnetic field?**

A) Stationary charge
B) Moving charge
C) Change in magnetic flux
D) Current flowing in a conductor

Q.12 **A straight current carrying conductor is shown in the figure. A person observes it from below at paint "B". What must be direction of magnetic field observed?**

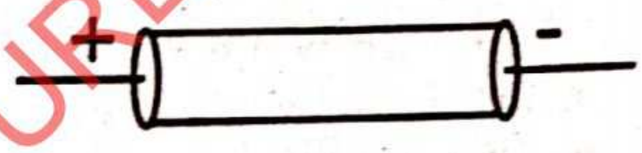


A) Clock-wise
B) Anti-clock wise
C) Out of paper
D) Into the paper

Q.13 **Magnetic field has its application in _____**

A) Motors
B) Generators
C) Current detector
D) All

Q.14 **A conductor is shown in the figure connected with the terminals of a source as shown. What is true about this?**



A) $\vec{B}$ is present inside conductor
B) $\vec{B}$ is present outside conductor
C) $\vec{B}$ and $\vec{E}$ both are present inside conductor
D) $\vec{B}$ is outside while $\vec{E}$ is inside conductor

MAGNETIC FLUX AND MAGNETIC FLUX DENSITY

Q.15 **Direction of magnetic flux is**

A) Normal to the surface
B) Parallel to the surface
C) At any angle
D) No direction

Q.16 **If 0.5 T magnetic field is perpendicular to the 0.5 m^2 area then the magnetic flux would be**

A) 0.25 Wb
B) 6.25 Wb
C) 1.25 Wb
D) Zero

Q.17 **20 Wb magnetic flux passes through the 5m^2 area of certain sheet, the magnetic flux density would be**

A) 2 Wb m^{-2}
B) 4 Wb m^{-2}
C) 6Wb m^{-2}
D) 8Wb m^{-2}

Q.18 **The Relationship between tesla(T) and smaller unit gauss(G) of magnetic induction is given by**

A) $1T = 10^3\ G$
B) $1T = 10^{-2}\ G$
C) $1T = 10^{-4}\ G$
D) $1T = 10^4\ G$

Q.19 **Weber ampere per metre is equal to**

A) Joule
B) Watt
C) Newton
D) Henry

Q.20 **Gauss is the unit of**

A) B
B) H
C) M
D) I

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Q.21 The unit of magnetic flux density is

A) Wbm^{-2} C) $NA^{-1}m^{-1}$

B) Tesla D) All of these

Q.22 The magnetic induction B is also called the

A) Flux C) Flux density

B) Density D) Tesla

Q.23 Magnetic flux and flux density are related by _____

A) Magnetic flux = flux density / area C) Flux density = magnetic flux area

B) Magnetic flux = flux density × area D) Flux density = magnetic flux × area

FORCE ACTING ON CHARGE PARTICLE IN UNIFORM MAGNETIC FIELD

Q.24 The force acting on a charge q moving with a velocity $\vec{v}$ in a magnetic field of induction $\vec{B}$ is given by:

A) $q/(\vec{v} \times \vec{B})$ C) $q(\vec{v} \times \vec{B})$

B) $(\vec{v} \times \vec{B})/q$ D) $q(\vec{v} \cdot \vec{B})$

Q.25 A 2 MeV proton is moving perpendicular to a uniform magnetic field of 2.5 T. The force on the proton is:

A) 2.5×10^{-10} N C) 2.5×10^{-11} N

B) 8×10^{-11} N D) 8×10^{-12} N

Q.26 An electron of mass m is accelerated through a potential difference of V and then it enters a magnetic field of induction B normal to the lines. Then the radius of the circular path is

A) $\sqrt{\frac{2eV}{m}}$ C) $\sqrt{\frac{2Vm}{eB}}$

B) $\sqrt{\frac{2Vm}{eB^2}}$ D) $\sqrt{\frac{2Vm}{e^2B}}$

Q.27 The magnitude of the force on a moving charge is maximum when angle between the velocity of the charge and the magnetic field is,

A) 0° C) 90°

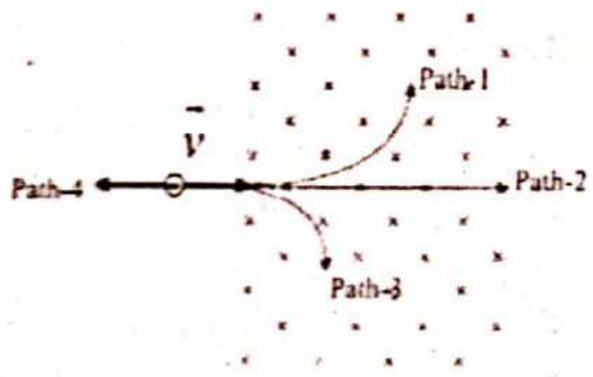
B) 180° D) 45°

Q.28 If a charge particle enters a uniform magnetic field, there is a change in its

A) Kinetic energy C) Direction of velocity

B) Magnitude of velocity D) All of these

Q.29 The fig shows a uniform magnetic field $\vec{B}$ directed into the plane of paper. A particle with negative charge moves in the plane, which of four paths 1, 2, 3 or 4 does the particle follow



A) Path 1

B) Path 2

C) Path 3

D) Path 4

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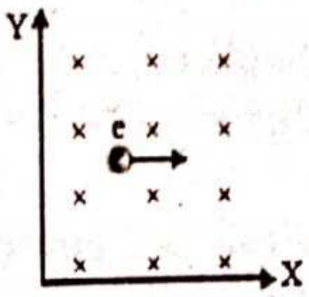
Topic-8

Q.30 **Which of the following Statements is false?**
A) A stationary charge produces a constant electric field
B) A moving charge with uniform speed produces a constant magnetic field.
C) An accelerated charge produces combination of varying electric and magnetic field
D) A conductor carrying steady current has no electric field in it

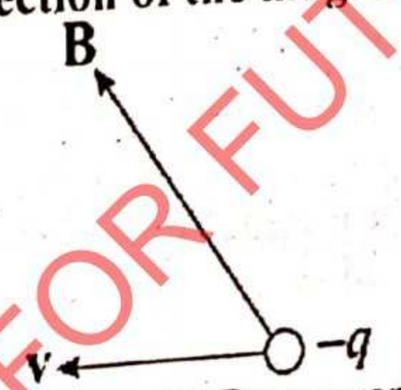
Q.31 **In the given figure the electron enters into the magnetic field. It deflects in.....direction**



A) +ve X direction
B) + ve Y direction
C) –ve X direction
D) – ve Y direction

Q.32 **In the formula F = q (v× B)**
A) F must be perpendicular to v but not necessarily to B
B) F must be perpendicular to both v and B
C) v must be perpendicular to B but not necessarily to F
D) All three vectors must be mutually perpendicular

Q.33 **In the figure below, what is the direction of the magnetic force F_B?**

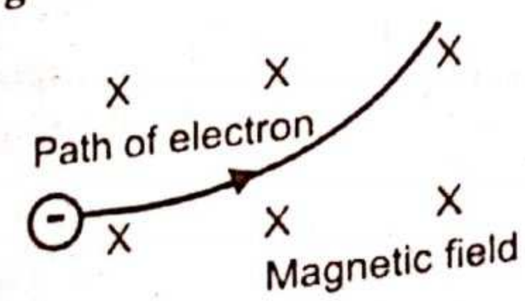


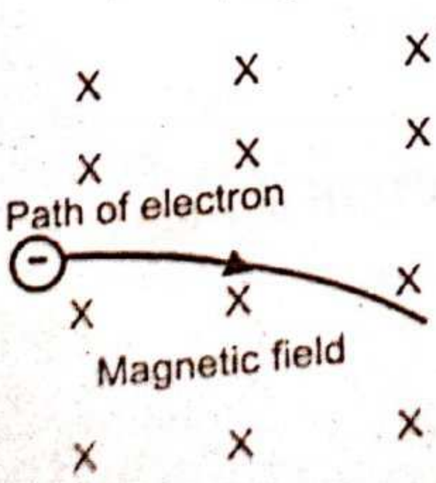
A) To the right
B) Upward, in the plane of the page
C) Downward, in the plane of the page
D) Out of the plane of the page

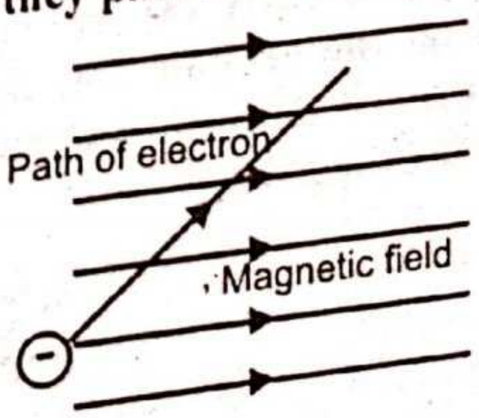
Q.34 **Which of the following cannot be deflected by a magnetic field?**
A) Alpha rays
B) Beta rays
C) Gamma rays
D) Cosmic rays

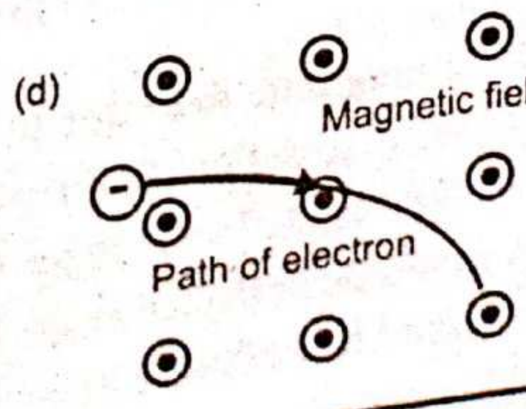
Q.35 **A proton is moving northward in a magnetic field directed vertically upward. The electron will be deflected.**
A) Eastward
B) Westward
C) Vertically upward
D) Remain undeflected

Q.36 **The following diagrams shows an electron passing through a magnetic field. Which diagram shows the possible path of the electrons as they pass through the field?**

(a)


(b)


(c)


(d)


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Q.37 **Work done by magnetic force on a moving charge particle is**

A) Positive
B) Negative
C) Zero
D) Infinite

Q.38 **A proton and an electron both moving with the same velocity v enter into a region of magnetic field directed perpendicular to the velocity of the particles. They will now move in circular orbits such that**

A) Their time periods will be same
B) The time period for electron will be higher
C) The time period for proton will be higher
D) Their orbital raddi will be same

Q.39 **A positively charged particle moving due east enters a region of uniform magnetic field directed vertically upwards. The particle will**

A) Continue to move due east
B) Move in a circular orbit with its speed unchanged
C) Move in a circular orbit with its speed increases
D) Get deflected vertically upwards

Q.40 **A strong magnetic field is applied to a stationary electron, then**

A) Electron move in the direction of field
B) Electron move opposite to field
C) Electron start spinning
D) Electron remain stationary

Q.41 **The magnitude of force on a moving charge is zero then angle between the velocity of the charge carrier and magnetic field is**

A) 0^o
B) 90^o
C) 45^o
D) 120^o

Q.42 **An electron enters in a uniform magnetic field making an angle 60° with field. The shape of its trajectory in magnetic field is**

A) Circle
B) Parabola
C) Straight line
D) Helix

Q.43 **The radius of curvature of the path of the charged particle in a uniform magnetic field is directly proportional to**

A) The energy of the particle
B) The momentum of the particle
C) The intensity of the field
D) The charge on the particle

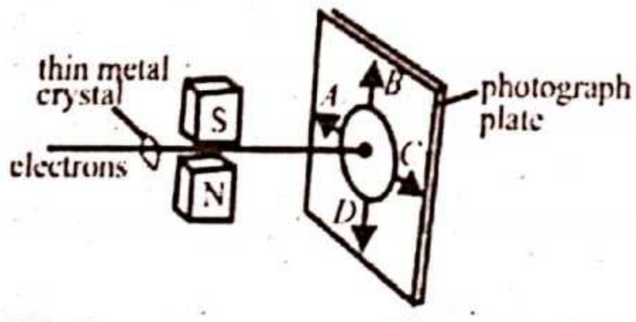
Q.44 **Which of the following in motion cannot be deflected by magnetic field?**

A) Electron
B) Neutron
C) Proton
D) Sodium ion

Q.45 **When a charged particle is projected perpendicularly in a magnetic field its trajectory is**

A) Hyperbola
B) Helix
C) Parabola
D) Circular

Q.46 **G.P Thomson's early experiments on the diffraction of the electrons by crystals were criticized on the ground that the beams affecting the photographic plate might be X-rays. He proved that this was not so by placing bar magnets on each side of the beam as shown in the diagram.**



How would the magnetic field due to magnetic affect the diffraction rings?

A) The rings would be deflected in the direction A
B) The rings would be deflected in the direction C
C) The rings would be deflected in the direction B
D) The rings would be deflected in the direction D

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Q.47 **When a charged particle moves through a magnetic field, it suffers a change in**
A) Direction
B) Speed
C) Energy
D) No change

Q.48 **Magnetic field is caused by**
A) Stationary charge
B) A moving positive charge only
C) A moving negative charge only
D) Moving positive and negative charges both

Q.49 **A charged particle moves through a magnetic field in a direction perpendicular to it. Which of the following remain unchanged for the particle?**
A) Velocity
B) Acceleration
C) Speed
D) Direction

Q.50 **An α-particle, a deuteron and a proton are moving with same momentum in a uniform magnetic field. The ratio of their speeds will be**
A) 1:2:4
B) 4:2:1
C) 1:1:1
D) 2:2:4

Q.51 **The radius of curvature of the path of a charged particle moving in a static uniform magnetic field is**
A) Directly proportional to the magnitude of the charge on the particle
B) Directly proportional to the magnitude of the linear momentum of the particle
C) Directly proportional to the kinetic energy of the particle
D) Inversely proportional to the magnitude of the magnetic field

Q.52 **A proton (mass m and charge +e) and an α – particle (mass 4m and charge +2e) are projected with the same kinetic energy at right angles to the uniform magnetic field. Which one of the following statements will be true?**
A) The α – particle and the proton will be bent in a circular path with the same radius
B) The α – particle will be bent in a circular path with a small radius that for the proton
C) α – particle and the proton will go through the field in a straight line
D) The radius of the path of the α – particle will be greater than that of the proton

Q.53 **One proton beam enters a magnetic field of 10^{-4}T normally, Specific charge = 10^{11}C/kg. velocity = 10^{7}m/s. What is the radius of the circle described by it?**
A) 0.1 m
B) 1 m
C) 10 m
D) None of these

Q.54 **A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to the magnetic field B. The time taken by the particle to complete one revolution is**
A) $\frac{2\pi q^2 B}{m}$
B) $\frac{2\pi m}{qB}$
C) $\frac{2\pi M}{qB}$
D) $\frac{2\pi qB}{m}$

Q.55 **An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to**
A) $\sqrt{\frac{B}{v}}$
B) $\frac{B}{v}$
C) $\sqrt{\frac{v}{B}}$
D) $\frac{v}{B}$

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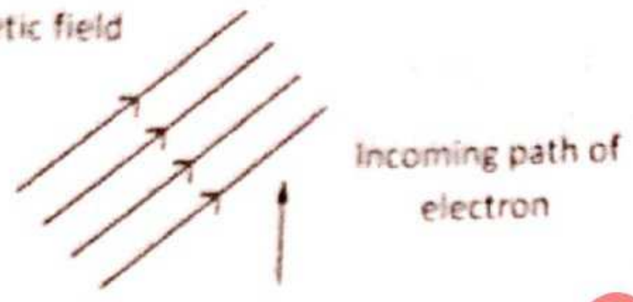
Q.56 A proton and an electron, with the same momenta, enter a magnetic field in a direction at right angles to the lines of force. If the radii of their circular paths are r_p and r_e respectively then the value of $r_p : r_e$ will be

A) 1:1
B) 1:2
C) 2:1
D) 4:1

Q.57 The diagram shows an electron as it enters magnetic field. The path of the electron and the magnetic field are in the plane of the paper.
In which direction is the electron initially deflected?



A) into the plane of the paper
B) out of the plane of the paper
C) to the left of its incoming path
D) to the right of its incoming path

Q.58 The cyclotron frequency of an electron projected with velocity v perpendicular to a magnetic field B is given by

A) $f = \frac{eB}{2\pi m}$
B) $f = \frac{mB}{2\pi e}$
C) $f = \frac{2\pi e}{Bm}$
D) $f = 2\pi \frac{e}{m} B$

Q.59 The momentum of a fast moving charged particle can be determined by from the radius of its trajectory in a

A) Uniform magnetic field
B) Strong magnetic field
C) Non-uniform magnetic field
D) Weak magnetic field

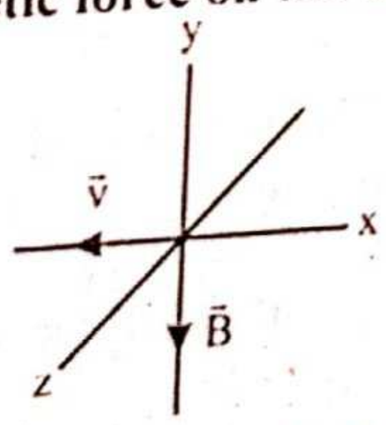
Q.60 When charge particle enter into a magnetic field then K.E

A) Remain same
B) Increases
C) Decreases
D) None of these

Q.61 An electron is moving northward in a magnetic field directed vertically downward. The electron will be deflected.

A) Eastward
B) Westward
C) Vertically upward
D) Remain undeflected

Q.62 An electron moves in the negative x direction, through a uniform magnetic field in the negative y direction. The magnetic force on the electron is



A) In the negative z direction
B) In the positive z direction
C) In the negative y direction
D) In the positive y direction

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Topic-8

Q.63 The magnitude of force experienced by a stationary charged particle in a uniform magnetic field is

A) Of $\vec{v} \times \vec{B}$

B) Minimum

C) Zero

D) Maximum

Q.64 When an electron moving with a uniform speed in a vacuum enters a magnetic field in a direction perpendicular to the field, the subsequent path of the electron is _____

A) A straight line parallel to the field

B) A parabola in a plane perpendicular to the field

C) A circle in a plane perpendicular to the field

D) A straight line along its initial direction

Q.65 Two charged particles M and N are projected with same velocity in a uniform magnetic field. Then M and N are:

A) A proton and α-particle respectively

B) A deuteron and an electron respectively

C) An electron and a proton respectively

D) A protium and a proton respectively

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ANSWER KEY

1	B	11	A	21	D	31	D	41	A	51	B	61	A
2	A	12	B	22	C	32	B	42	D	52	A	62	A
3	D	13	D	23	B	33	D	43	B	53	B	63	C
4	B	14	D	24	C	34	C	44	B	54	B	64	C
5	A	15	D	25	D	35	A	45	D	55	D	65	A
6	A	16	A	26	B	36	B	46	A	56	A		
7	A	17	B	27	C	37	C	47	A	57	B		
8	A	18	D	28	C	38	C	48	D	58	A		
9	B	19	C	29	C	39	B	49	C	59	A		
10	D	20	A	30	D	40	D	50	A	60	A		

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EXPLANATORY NOTES

Q.1 Magnetic field is circular in case of a straight wire.

Q.2 Two parallel wires having current in opposite direction always repel each other because magnetic field between the wires become stronger.

Q.3 Direction of magnetic field depends upon direction of current according to right hand rule.

Q.4 Direction of magnetic field is along the tangent on a curve.

Q.5 Right hand rule indicates the direction of magnetic lines of force

Q.6 Parallel lines of forces produce uniform field.

Q.7 Current carrying conductor will move from stronger to weaker magnetic field.

Q.8 According to right hand rule the direction of magnetic field line will be clock-wise.

Q.9 Because magnetic monopoles do not exist in nature.

Q.10 Magnetic force produces force and torque on magnetic needle due to position of magnetic needle.

Q.11 $F_m = qvB \Rightarrow v = 0$, $F_m = 0$ for stationary charge.

Q.12 According to right hand rule the direction of magnetic field line will be anti-clock-wise.

Q.13 Motors, generators and current detectors all are applications of magnetic field.

Q.14 Magnetic field is always produced around the electric field.

Q.15 Magnetic flux is a scalar quantity.

Q.16 $\phi = B.A = 0.5 \times 0.5 = 0.25 Wb$

Q.17 $B = \frac{\phi}{A} = \frac{20}{5} = 4\ \text{Wb m}^{-2}$

Q.18 $1T = 10^4 G$

Q.19 $\frac{\text{weber} \times \text{ampere}}{\text{meter}} = \frac{NmA^{-1}.A}{m} = N$

Q.20 Gauss is the unit of magnetic field.

Q.21 Basic from unit conversion.

Q.22 Book information.

Q.23 $\phi = B.A$

Q.24 Formula form book.

Q.25 $K.E = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2\,K.E}{m}}$; $F = qvB$

Q.26 $\frac{e}{m} = \frac{2V}{B^2 r^2} \Rightarrow r = \sqrt{\frac{2mV}{eB^2}}$

Q.27 $F = qvB\sin\theta$, $F_{max} = qvB$ $\because \sin 90° = 1$

Q.28 Magnetic force is just a deflecting force.

Q.29 According to right hand rule the electron will be deflected downward when magnetic field is into the plane.

Q.30 When an electron charge will move through a conductor it will carry its electric field.

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Q.31 According to right hand rule the electron will be deflected downward when magnetic field is into the plane.

Q.32 By using the concept of cross product the resultant i.e force will be perpendicular to both $\vec{v}$ and $\vec{B}$.

Q.33 By using right hand rule the magnetic force will be out of the plane of the page.

Q.34 $F=qvB\sin\theta$, $F=0$ $\because q=0$

Q.35 $\vec{F}_m = -e\vec{v}\times\vec{B} = -e\left(\vec{v}\hat{j}\right)\times B\left(-\hat{k}\right) = evB\hat{i}$ i.e. direction of force is eastward

Q.36 Application of right hand palm rule or Fleming's left hand rule.

Q.37 Magnetic force is perpendicular to velocity of the charge particle so no work is done.

Q.38 We know that time period $T = \frac{2\pi m}{qB}$ i.e.$T \propto m$ (Since q and B are same)

Mass of proton > Mass of electron

$\therefore$ Time period of proton > Time period of electron.

Q.39 According to $\vec{F} = q\left(\vec{v}\times\vec{B}\right)$

In perpendicular magnetic field, the path of a charged particle is a circle, and the magnetic field does not cause any change in speed and energy.

Q.40 $F=qvB\sin\theta$, $F=0$ $\because v=0$

Q.41 $F = qvB\sin\theta \Rightarrow F = 0$ when $\theta = 0°$

Q.42 If angle equal to 90°, then trajectory will be circle and $90° > \theta > 0°$ trajectory will be helix.

Q.43 $r = \frac{p}{qB} \rightarrow r \propto p$

Q.44 Only charge particle can deflect in a magnetic field.

Q.45 When $\theta = 90°$ path is circular

Q.46 According to right hand rule ring will deflect towards "A".

Q.47 Magnetic field is deflecting field which only change the direction.

Q.48 Moving charge (may +ve or –ve) produce magnetic field

Q.49 Magnetic field does no work so, K.E of charge remain same, so speed also remain same.

Q.50 $P = mv$; $v \propto \frac{1}{m}$ $\because P = \text{constant}$

Charge on proton, duetron and α – particles is +e, +e and +2e respectively.

$m_\alpha : m_{duet} : m_{proton} = 4:2:1$; $v_\alpha : v_{duet} : v_{proton} = 1:2:4$

Q.51 $r = \frac{p}{qB} \rightarrow r \propto p$

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Q.52 $r = \frac{\sqrt{2mK}}{qB}$ i.e. $r \propto \frac{\sqrt{m}}{q}$ Here kinetic energy K and B are same.

$$\therefore \quad \frac{r_p}{r_\alpha} = \sqrt{\frac{m_p}{m_\alpha}} \cdot \frac{q_\alpha}{q_p} = \sqrt{\frac{m_p}{4m_p}} \cdot \frac{2q_p}{q_p} = 1 \Rightarrow r_p = r_\alpha$$

Q.53 $r = \frac{mv}{qB} = \frac{10^7}{10^{11} \times 10^{-4}} = 1m \left(\because q/m = 10^{11} C/kg\right)$

Q.54 $F_c = F_m \Rightarrow \frac{mv^2}{r} = qvB \Rightarrow 1 = \frac{m\omega}{qB}$; $\frac{qB}{m} = \omega \Rightarrow \frac{qB}{m} = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi m}{qB}$

Q.55 $F_c = F_m \Rightarrow \frac{mv^2}{r} = qvB \Rightarrow \frac{mv}{qB} = r \Rightarrow \frac{v}{B} \propto r$

Q.56 $F_c = F_m \Rightarrow \frac{mv}{r} = qvB \Rightarrow \frac{mv}{r} = qB \Rightarrow \frac{mv}{qB} = r$

$mv =$ same ; $q =$ same ; $B =$ same $\Rightarrow r_p = r_e$

Q.57 Electron will be deflected out of plane of paper due to magnetic force by right hand rule.

Q.58 $F_c = F_m \Rightarrow \frac{mv^2}{r} = qvB \Rightarrow \frac{mv}{r} = qB$; $\frac{mr\omega}{r} = qB \Rightarrow m\frac{2\pi}{T} = qB \Rightarrow f = \frac{qB}{2\pi m}$

Q.59 Momentum of fast moving charge particle can be determined from radius of trajectory in uniform magnetic field.

Q.60 Magnetic field force can just deflect electron but K.E remains same.

Q.61 By right hand rule electron will move towards eastward.

Q.62 By using the concept of cross product the direction of force on electron will be in negative z direction.

Q.63 $F = qvB\sin\theta$, $F = 0$ $\because$ $v = 0$ So, electron remain stationary

Q.64 Magnetic force will act as centripetal force which changes its path into circular shape.

Q.65 Both particle have same nature of charge but of different magnitudes

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9 ELECTROMAGNETIC INDUCTION

TOPIC

PRACTICE EXERCISE

TOPIC-WISE MCQ's

ELECTROMAGNETIC INDUCTION

Q.1 **Which of the following will not generate emf?**

A) Holding a magnet stationary inside a coil
B) Rotating a coil in a magnetic field
C) Rotating a coil around a stationary coil
D) Moving a bar magnet across a flat piece of metal

Q.2 **Which one of the following does not affect the magnitude of the induced emf in electromagnetic induction?**

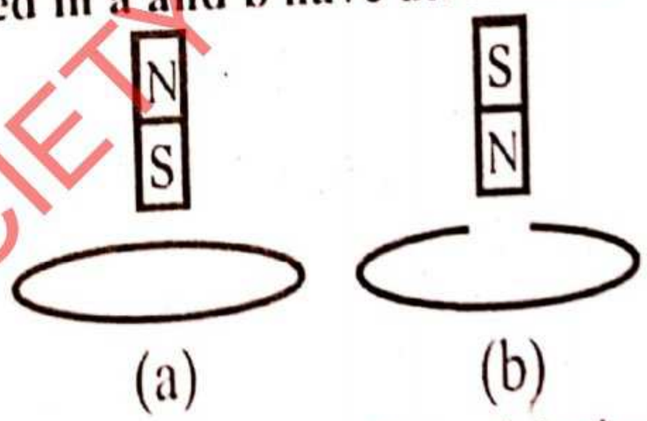
A) The strength of the magnetic field linking to the coil
B) The resistance of the coil cutting the magnetic field
C) The speed with which the coil cuts the magnetic field
D) The number of turns in the coil

Q.3 **Relative motion between a _____ and a conducting coil produces current in the coil**

A) Magnet
B) Iron bar
C) Insulator
D) All of these

FARADAY'S LAW (APPLICATION IN SEISMOMETER), MOTIONAL EMF AND LENZ'S LAW

Q.4 **In a closed ring (A) and in an open ring (B) magnets are falling along the axis of the ring. The current generated in a and b have directions**

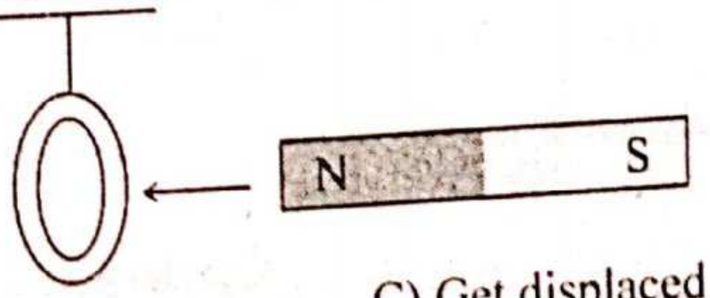


A) Clockwise, Zero
B) Anticlockwise, zero
C) Anticlockwise, clockwise
D) Zero, zero

Q.5 **The direction of induced current in a coil or circuit is such that it opposes every cause of its production. This law is given by**

A) Faraday
B) Kirchhoff
C) Lenz
D) Ampere

Q.6 **A metallic circular ring is suspended by a string and is kept in a vertical plane. When a magnet is approached towards the ring then it will**



A) Remain stationary
B) Get displaced away from the magnet
C) Get displaced towards the magnet
D) Nothing can be said

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Q.7 In the equation $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$ the negative sign indicates that

A) The self-induced current opposes its cause
B) The accordance of equation with the Lenz's Law
C) The induced e.m.f opposes the change which produces it.
D) All of the above

Q.8 The e.m.f. induced in a coil is ..... the rate of change in flux linkages.

A) Directly proportional to
B) Inversely proportional to
C) Independent of
D) None of the above

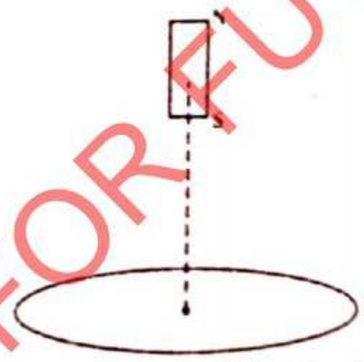
Q.9 A coil having 500 square loops each of side 10 cm is placed normal to a magnetic induction which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is

A) 5
B) 0.1
C) 1
D) 0.5

Q.10 In a circuit with a coil of resistance 2 ohms, the magnetic flux changes from 2.0 Wb to 10.0 Wb in 0.2 second. The charge that flows in the coil during this time is

A) 5.0 coulomb
B) 4.0 coulomb
C) 1.0 coulomb
D) 0.8 coulomb

Q.11 A magnet falls with its S-pole along the axis of ring. The current generated is .... And acceleration is



A) Clockwise, > g
B) Clockwise, < g
C) Anticlockwise, > g
D) Anticlockwise, < g

Q.12 The direction of induced current in a coil or circuit is such that it opposes the very cause of its production. This law is given by

A) Faraday
B) Kirchhoff
C) Lenz
D) Ampere

Q.13 The maximum value of induced emf in a coil rotating in magnetic field does not depend on

A) The resistance of coil
B) The number of turns in the coil
C) The area of the coil
D) Rotational frequency of the coil

Q.14 Lenz's law is a manifestation of the conservation of

A) Current
B) Voltage
C) Energy
D) All of these

Q.15 The inertial seismometers are working on base of _____

A) 1st law of motion
B) 2nd law of motion
C) 3rd law of motion
D) Law of conservation of charge

Q.16 The Seismometer which work on the base of faraday's law, convert vibrational energy to _____

A) Draw the graph
B) Voltage
C) Mechanical energy
D) Both A and B

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MUTUAL INDUCTION (MUTUALLY INDUCED EMF), SELF INDUCTION

Q.17 When the number of turns per unit length in a solenoid is doubled then its coefficient of self-induction will become

A) Half
B) Double
C) Four times
D) Unchanged

Q.18 If the number of turns in a coil is N then the value of self-inductance of the coil will become

A) N times
B) N^2 times
C) N^{-2} times
D) N^n times

Q.19 The value of mutual inductance can be increased by

A) Decreasing N
B) Increasing N
C) Winding the coil on wooden frame
D) Winding the coil on china clay

Q.20 Unit of inductance is

A) 1 Henry
B) VsA^{-1}
C) Ω s
D) All of these

Q.21 In the equation $\varepsilon_l = -L\frac{\Delta I}{\Delta t}$ the negative sign indicates that

A) The self-induced current opposes its cause
B) The self-induced e.m.f opposes the change which produces it.
C) The accordance of equation with the Lenz's Law
D) All of the above

Q.22 The mutual inductance of a pair of coils is 2H, If the current in one of the coils changes from 10A to zero in 0.1s, the emf induced in the other coil is

A) 2V
B) 0.2 V
C) 20V
D) 200 V

Q.23 An emf of 5 V is induced in an inductance when the current in it changes at a steady rate for 3 A to 2 A in 1 milli seconds. The value of the inductance is

A) 5 mH
B) 5000H
C) 5 H
D) Zero

Q.24 The areas of cross-section of two solenoids A and B of equal length are equal are equal but the number of turns in the solenoid A is double than that of B. If the coefficient of self-induction of B is 6 mH, then the coefficient of self-induction of A will be

A) 12 mH
B) 3 mH
C) 24 mH
D) 1.5 mH

ALTERNATING CURRENT GENERATOR

Q.25 When a coil of cross-sectional area A and number of turns N is rotated in a uniform magnetic field B with angular velocity ω, then the maximum emf induced in the coil will be

A) BNA
B) $\frac{Ba\omega}{N}$
C) $BNA\omega$
D) Zero

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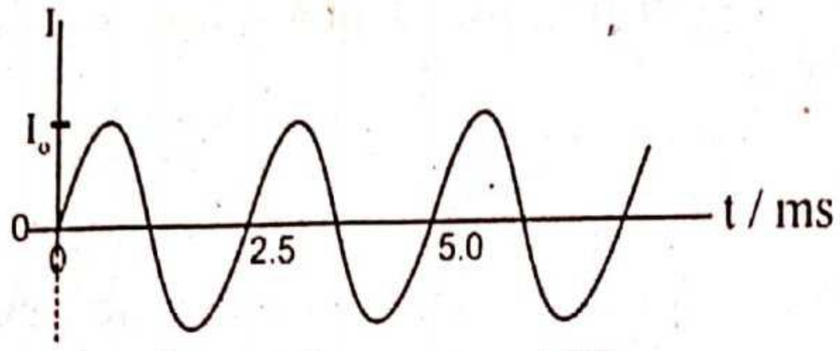
Q.26 The graph shows how an alternating current I of peak value I_o varies with time t.



Which expression gives the alternating current I ?

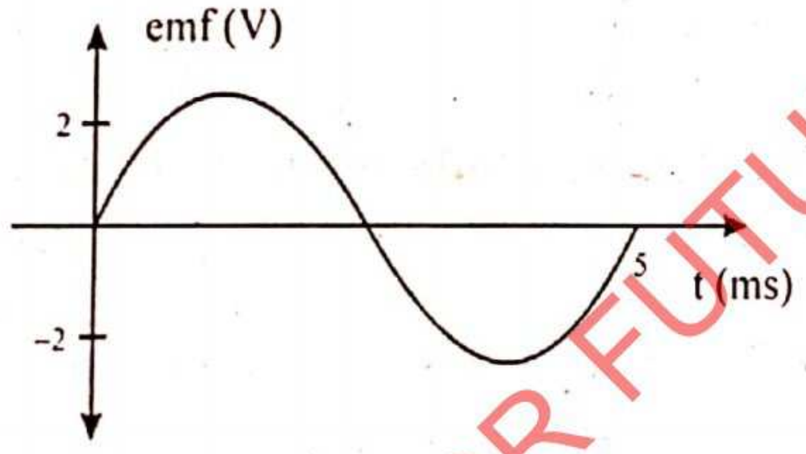
A) $I = I_o \sin(5\pi t)$

C) $I = I_o \sin\left(\frac{\pi t}{0.0025}\right)$

B) $I = I_o \sin\left(\frac{2\pi t}{2.5}\right)$

D) $I = I_o \sin(800\pi t)$

Q.27 The diagram shows how the e.m.f. of a simple generator varies with time. What is the frequency and the maximum value of the e.m.f?



	Frequency / Hz	Maximum e.m.f. / V
A)	200	2.0
B)	400	2.0
C)	200	4.0
D)	400	4.0

Q.28 An electric generator is a device that transforms _____ energy into electrical energy

A) Sound
C) Heat
B) Mechanical
D) Magnetic

Q.29 The output of an a.c. generator has a

A) Sinusoidal shape
C) Triangular shape
B) Square shape
D) Straight line shape

Q.30 The principle of an electric generator is based on

A) Faraday's law
C) Ampere's law
B) Coulomb's law
D) Lenz's law

Q.31 The armature of a generator consists of a flat square coil of side 4 cm and 200 turns. The coil rotates in a magnetic field of 0.75T. The angular speed so that a maximum emf of 1.6V is generated is _____

A) $\frac{20}{3} rads^{-1}$
C) $\frac{20}{3} rpm$
B) $\frac{20}{3} rotations/s$
D) None

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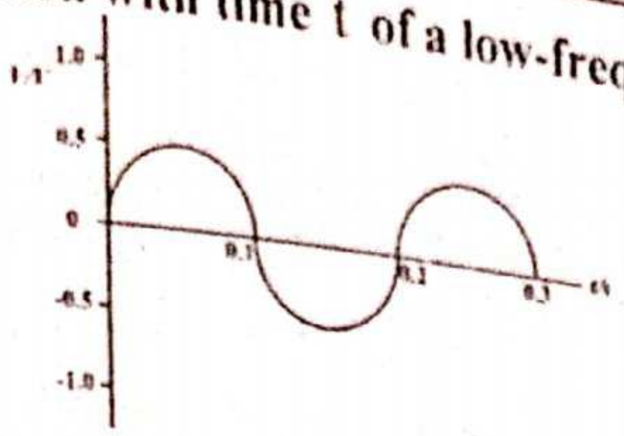
Q.32 The graph shows the variation with time t of a low-frequency alternating voltage V.



Which expression is a representation of this voltage?

A) $0.5\sin(0.4\pi t)$
B) $0.5\sin(10\pi t)$
C) $1.0\sin(0.2\pi t)$
D) $1.0\sin(10\pi t)$

TRANSFORMER

Q.33 Which quantity is increased in step-down transformer?
A) Current
B) Voltage
C) Power
D) Frequency

Q.34 Which of the remain constant in a transformer?
A) Current
B) Power
C) Potential
D) Frequency

Q.35 The voltage in the primary and the secondary coils of a step-up transformer are 200 V and 4 kV respectively. If the current in the primary is 1 ampere then the current in the secondary coil will be
A) 50 mA
B) 5A
C) 500 mA
D) 5 mA

Q.36 The turn ratio of a transformer is 2:3. If the current through primary is 3A, then current through load resistance is
A) 1A
B) 2A
C) 4.5 A
D) 1.5 A

Q.37 A transformer is used to
A) Convert alternating current to direct current
B) Convert direct current to alternating current
C) Convert mechanical energy to electrical energy
D) Change the level of alternating voltage

Q.38 A transformer is used to light a 100 W and 110 V lamp from 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately.
A) 10%
B) 50 %
C) 30%
D) 90 %

Q.39 If the current in the primary coil and number of turns in it are I_p and N_p respectively and the number of turns and current in the secondary are N_s and I_s respectively then the value the of $N_s : N_p$
A) $I_s : I_p$
B) $I_p : I_s$
C) $I_s^2 : I_p^2$
D) $I_p^2 : I_s^2$

Q.40 The ratio of emf across primary coil to the emf across secondary coil is
A) $\frac{N_s}{N_p}$
B) $\frac{I_s^2}{I_p^2}$
C) $\frac{I_s}{I_p}$
D) None of these

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Topic-9

Q.41 In step up transformer, voltage in the secondary increases and power in secondary

A) Remain same
B) Decreases because voltage increases
C) Increases because current decreases
D) May increases if voltage remain same

Q.42 In a transformer heat is produced due to eddy current in

A) Primary coil
B) Iron core
C) Secondary coil
D) All of these

Q.43 _____ is the energy expended to magnetize and demagnetize the core material in each cycle of the A.C.

A) Power loss
B) Hysteresis loss
C) Heat loss
D) All of the above

Q.44 Laminated core in a transformer is used to reduce

A) Eddy current losses
B) Iron losses
C) Hysteresis losses
D) Heat losses due to resistance

Q.45 The loss of power in transformer is due to

A) Eddy current
B) Resistance of coils
C) Magnetic hysteresis
D) All

Q.46 A step-down transformer, transforms 220 volt to 11 volt. If the current in primary and secondary coil are 5A and 90 A respectively, efficiency of transformer is

A) 70%
B) 40%
C) 20%
D) 90%

Q.47 If turns in primary = 50, secondary = 200, primary voltage = 120V, primary current 3A, then output power will be about

A) 360 W
B) 300 W
C) 460 W
D) Zero

Q.48 To improve efficiency of transformer the flux coupling between primary & secondary coils should be

A) Small
B) May be small or may be maximum
C) Maximum
D) Zero

Q.49 Primary and secondary coils of a transformer have 50 and 200 turns respectively. When primary is connected to 9-volt battery secondary voltage is

A) 90
B) 36
C) 18
D) Zero

Q.50 The ratio of secondary to the primary turns in a transformer is 3 : 2. If the power output be *P*, then the input power neglecting all loses must be equal to

A) 5 P
B) P
C) 1.5 P
D) $\frac{2}{5}$P

Q.51 The efficiency of transformer is very high because

A) There is no moving part in a transformer
B) It produces very low voltage
C) It produces very high voltage
D) None of the above

Q.52 A step-down transformer is used on a 1000 *V* line to deliver 20 *A* at 120 *V* at the secondary coil. If the efficiency of the transformer is 80% the current drawn from the line is.

A) 3 A
B) 0.3 A
C) 30 A
D) 2.4 A

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Q.53 A step-up transformer

A) Increases power-level
B) Increases voltage-level
C) Decreases current-level
D) Both B and C

Q.54 The number of turns in the primary and secondary coil of a step up transformer are 200 and 500 respectively. If the power in the input is 100 Watt and current 1A then the output power and current will respectively

A) 100 W, 2 A
B) 400 W, 4 A
C) 200 W, 0.2 A
D) 100 W, 0.4 A

Q.55 In the step up transformer, when the alternating voltage increase then the alternating current will

A) Increase
B) Decrease
C) Not change
D) Not depend on core

ANSWER KEY

1	A	12	C	23	A	34	B	45	D
2	B	13	A	24	C	35	A	46	D
3	A	14	C	25	C	36	C	47	A
4	A	15	A	26	D	37	D	48	C
5	C	16	B	27	A	38	D	49	D
6	B	17	C	28	B	39	B	50	B
7	D	18	B	29	A	40	C	51	A
8	A	19	B	30	A	41	A	52	A
9	A	20	D	31	A	42	B	53	D
10	B	21	D	32	D	43	B	54	D
11	B	22	D	33	A	44	A	55	B

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EXPLANATORY NOTES

Q.1 Holding a magnet inside solenoid will not change magnetic flux. Hence no emf is generated.

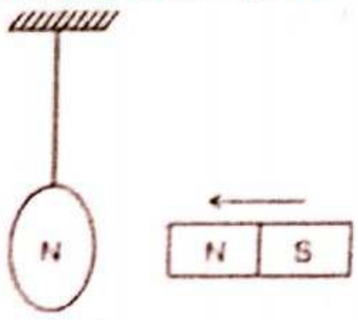
Q.2 Resistance of coil has no effect on emf.

Q.3 Induce current will produce when there is relative motion between magnet and coil.

Q.4 (i) A magnet falls with S-pole along the axis of ring. So according to Lenz's law S-pole form along the face of magnet. As shown in Fig. the current clock wise.
(ii) The ring is open. So, no current induced in the ring i.e $I = 0$

Q.5 It is the statement of Lenz's law.

Q.6 According to Lenz's law, the current induced in the ring oppose the cause that produce it



Q.7 All options are correct by using Lenz's law.

Q.8 $\varepsilon = -N\frac{\Delta\phi}{\Delta t} \Rightarrow \varepsilon \propto \frac{\Delta\phi}{\Delta t}$

Q.9 $\varepsilon = N\left(\frac{\Delta B}{\Delta t}\right).A\cos\theta = 500\times1\times\left(10\times10^{-2}\right)^2\cos0^\circ = 5\ V$

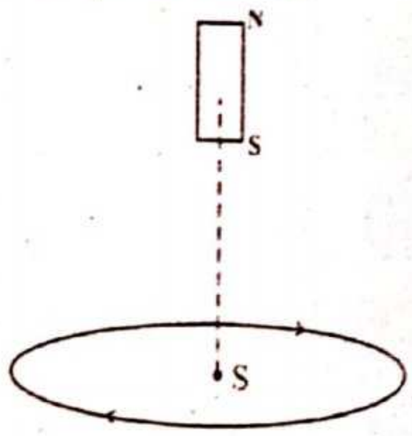
Q.10 $\varepsilon = \frac{\Delta\phi}{\Delta t} \Rightarrow IR = \frac{\Delta\phi}{\Delta t} \Rightarrow \frac{Q}{\Delta t} = \frac{\Delta\phi}{R\Delta t}$

$\Rightarrow Q = \frac{\Delta\phi}{R} = \frac{10-2}{2} = 4C$

Q.11

(i) A magnet falls with S-pole along the axis of ring. So according to lenz's law S-pole form along the face of magnet. As shown in Fig. the current clock wise.

(ii) Due to repulsion between magnet and ring, the acceleration of magnet is less than "g".



Q.12 It is the statement of Lenz's law. This law proposed by Russian physicist Heinrich Lenz in 1834.

Q.13 As, $\varepsilon = -N\frac{\Delta\phi}{\Delta t} = -N\frac{\Delta\left(\vec{B}.\vec{A}\right)}{\Delta t}$

From the relation the induced emf does not depend upon resistance of coil.

Q.14 Lenz's law is a manifestation of the conservation of energy.

Q.15 Inertial seismometer work on the principle of Newton's law of inertia (1^{st} law).

Q.16 It convert mechanical energy into voltage.

Q.17 As

$L = \mu_o n^2 A\ell \Rightarrow L \propto n^2$

$\Rightarrow \frac{L_1}{L_2} = \left(\frac{n_1}{n_2}\right)^2 \Rightarrow \frac{L}{L_2} = \left(\frac{n}{2n}\right)^2 = \frac{n^2}{4n^2} \Rightarrow L_2 = 4L$

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Q.18 $L = \mu_o n^2 AL \Rightarrow L \propto n^2 \left(n = \frac{N}{\ell} \right)$

Q.19 $N\phi = LI$

According to above relation L varies directly with N

Q.20 $L = \frac{\varepsilon}{\Delta I / \Delta t}$

Q.21 -ve sign indicate opposition and for the accordance of equation with the Lenz's law.

Q.22 $M = -\frac{\varepsilon_s}{\frac{\Delta I_p}{\Delta t}}$

Q.23 $\varepsilon = -L\frac{\Delta I}{\Delta t}$

Q.24 $L = \frac{\mu_0 N^2 A}{l}$

μ_0, A and l are constants.

$L \propto N^2$

$L_B = 2 \times 2 \times L_A = 4 \times 6mH = 24mH$

Q.25 As, $\varepsilon = N\omega AB \sin 0$

For maximum induced emf $0 = 90°$

$\varepsilon = N\omega AB$

Q.26 $I = I_o \sin \omega t = I_o \sin(2\pi f t)$

From the graph, the period T is 2.5 ms.

$\therefore$ Frequency, $f = \frac{1}{2.5 \times 10^{-3}} = 400\,Hz$

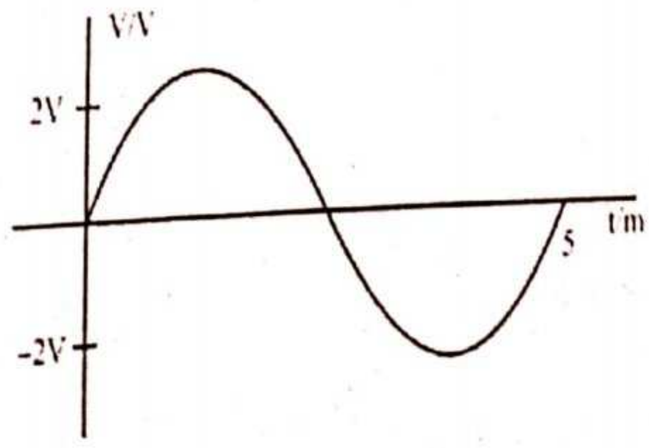
$\therefore$ $I = I_o \sin(2\pi(400)t) = I_o \sin(800\pi t)$

Q.27 From graph

$V_o = 2\,V$

$T = 5\,ms$

$= 5 \times 10^{-3}\,sec$



As

$f = \frac{1}{T} = \frac{1}{5 \times 10^{-3}}$

$= \frac{10^3}{5} = \frac{1000}{5}$

$= 200\,Hz$

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Topic-9

Q.28 Generator is a device that converts mechanical energy into electrical energy.

Q.29 Output of A.C generator is a sine wave.

Q.30 Electric generator work on the principal of Faraday's law

Q.31 $\varepsilon = N\omega AB$

$$\varepsilon_{max} = N\omega AB \Rightarrow \omega = \frac{\varepsilon}{NAB} = \frac{1.6}{(200)\left(\frac{4\times4}{100\times100}\right)(0.75)} = \frac{20}{3} rad/s$$

Q.32 $V = V_0 \sin(\frac{2\pi}{T}t)$

Q.33 Transformer is a device which is use to increase or decrease the alternating voltage.

$$P = VI \Rightarrow P = \text{same} \Rightarrow V \propto \frac{1}{I}$$

Q.34 As, $\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$

From relation current and voltage changes. Only for ideal transformer power remain same otherwise power also changes. But frequency in transformer does not change.

Q.35 As, $\frac{V_S}{V_P} = \frac{I_P}{I_S}$

$$\frac{4\times10^3}{200} = \frac{1}{I_S}$$

$$I_S = \frac{200}{4\times10^3} = 50\times10^{-3}\,A = 50\,mA$$

Q.36 As, $\frac{N_S}{N_P} = \frac{I_P}{I_S}$

$$\frac{2}{3} = \frac{3}{I_S} \Rightarrow I_S = \frac{9}{2} = 4.5\,A$$

Q.37 Because transformer only works with alternating voltage and it is used increase or decrease the alternating voltages.

Q.38 $\text{efficiency} = \frac{P_{output}}{P_{input}} \times 100$

$$= \frac{100}{V_P I_P} \times 100 = \frac{100}{220\times0.5} \times 100$$

$$= \frac{100}{110} \times 100 = 90\%$$

Q.39 As, $\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$

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Q.40 As. $\frac{V_s}{V_p} = \frac{I_p}{I_s} \Rightarrow \frac{V_p}{V_s} = \frac{I_s}{I_p}$

Q.41 In an ideal transformer power remain same.

Q.42 The magnetic flux changes through solid conductor (core material), induce current (i.e eddy current) are setup in closed path in the body of conductor. It results in power dissipation and heating of core material.

Q.43 Hysteresis loss

Q.44 The insulation between lamination sheets should be perfect so as to stop the flow of eddy currents.

Q.45 (i) The eddy current results in power dissipation and heating of the core material.

(ii) Hysteresis loss (magnetic hysteresis) is the energy spent to magnetize and demagnetize the core material

(iii) The power also loss in transformer due to resistance of coil.

Q.46 $\eta = \frac{P_{output}}{P_{input}} \times 100\% = \frac{V_s I_s}{V_p I_p} = \frac{11(90)}{220(5)} = \frac{990}{1100} = 0.9$

$\%\eta = 0.9 \times 100\% = 90\%$

Q.47 $P_o = P_i = I_i V_i = 120 \times 3 = 360$ W

Q.48 Flux coupling between primary and secondary coils must be maximum.

Q.49 Voltage by a battery is D.C but transformer operates on A.C

Q.50 Transformer is a device use to step up or down alternating current and voltage keeping power constant ideally.

Q.51 A machine having moving parts reduce its efficiency due to frictional losses but in transformer there is no moving parts.

Q.52 $\eta = \frac{P_o}{P_i} = \frac{I_s V_s}{I_p V_p} = 0.8$

$I_p = \frac{I_s V_s}{V_p (0.8)} = \frac{(20)(120)}{(1000)(0.8)} = 3A$

Q.53 Step-up transformer increase voltage level hence current level decreases.

Q.54 Power input = power output for an ideal transformer

For current $\frac{I_s}{I_p} = \frac{N_p}{N_s}$

Q.55 For transformer $I \alpha \frac{1}{V}$

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10 TOPIC ELECTRONICS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

RECTIFICATION

Q.1 The device which coverts A.C into D.C is called

A) Oscillator
B) Rectifier
C) Transducer
D) Diode

Q.2 The types of rectifications are

A) 3
B) 5
C) 4
D) 2

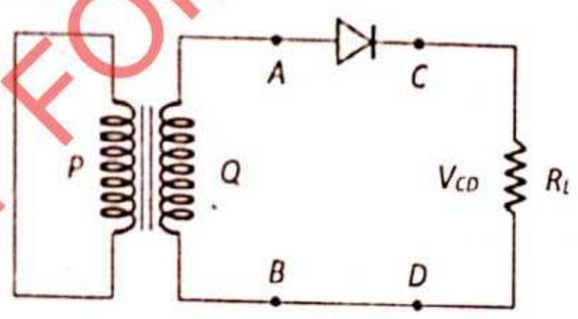
Q.3 Rectification is possible by

A) Transistor
B) Amplifier
C) Diode
D) Capacitor

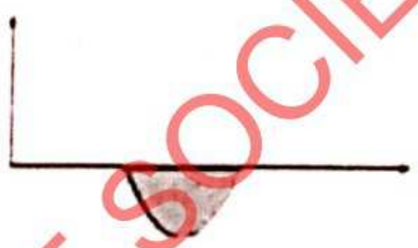
Q.4 The semiconductor diode can be used as a rectifier because _____

A) It has low resistance to the current flow when forward biased & high resistance when reverse biased
B) It has high resistance to the current flow when reverse biased
C) It has low resistance to the current flow when forward biased
D) Its conductivity increases with rise of temperature

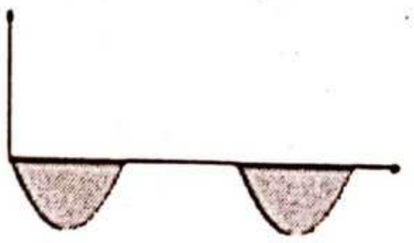
Q.5 In the half-wave rectifier circuit shown. Which one of the following wave forms is true for diode, the output across C and D?



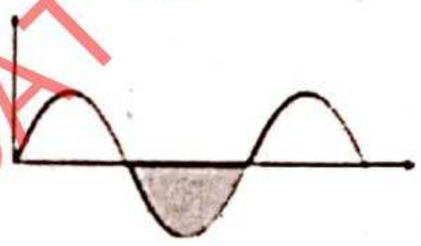
A)



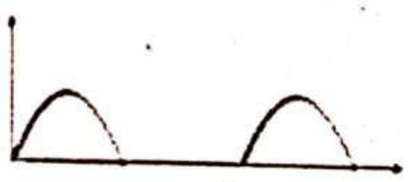
B)



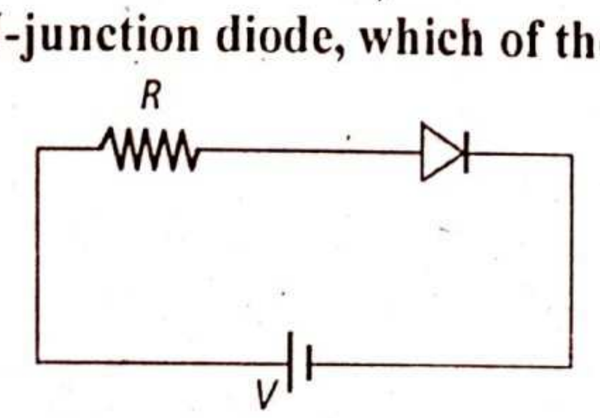
C)



D)



Q.6 For the given circuit of PN-junction diode, which of the following statement is correct



A) In forward biasing the voltage across R is 2V
B) In forward biasing the voltage across R is V
C) In reverse biasing the voltage across R is V
D) In reverse biasing the voltage across R is 2V

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Q.7 **The simplest type of rectification known as half wave rectification is obtained by**

A) Using a transistor
B) Suppressing the harmonics in A.C voltage
C) Suppressing half wave of A.C supply by using diode
D) Using a Coolidge tube

Q.8 **Output of half wave rectifier is suitable only**

A) To operate radio
B) For running a D.C motor
C) Charging batteries
D) All of these

Q.9 **During the interval $0 \rightarrow \frac{T}{2}$ the forward biased diode offers**

A) Very small resistance
B) Very small current flow through it
C) Very high resistance
D) Zero resistance

Q.10 **In a half wave rectifier, the frequency of the input is N, the frequency and form of the output will be**

A) N/2 and Pulsating
B) N and Pulsating
C) 2 N and steady
D) N and continuous

Q.11 **The most common device used as filter is**

A) Capacitor
B) Resistor
C) Transformer
D) Transistor

Q.12 **The method by which only one half of A.C cycle is converted into direct current is called**

A) Half wave amplification
B) Half wave rectification.
C) Full wave rectification
D) Full wave amplification

Q.13 **If time period of input T in the full wave bridge rectifier circuit, then time period of the pulsating output of the circuit will be**

A) T
B) 2T
C) T/2
D) T/4

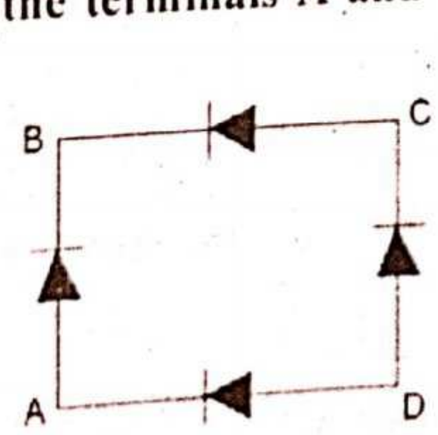
Q.14 **In a bridge rectifier how many diode conduct during each half cycle of input A.C**

A) 2
B) 3
C) 1
D) All

Q.15 **If a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be**

A) 50 Hz
B) 100 Hz
C) 70.7 Hz
D) 25 Hz

Q.16 **In figure the input is across the terminals A and C and the output is across B and D. Then the output is**



A) Half wave rectified
B) Zero
C) Full wave rectified
D) Same as input

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Topic-10

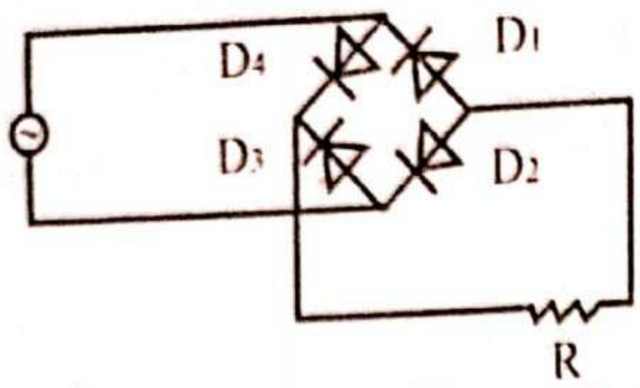
Q.17 To reduce ripples in the output of bridge rectifier we should use

A) Diodes having low forward resistance
B) Diodes having high forward resistance
C) Low frequency A.C
D) A filter circuit

Q.18 In full wave rectification, the output D.C. voltage across the load is obtained for

A) The positive half cycle of input A.C
B) The negative half cycle of input A.C
C) The complete cycle of input A.C
D) All of the above

Q.19 In the following figure

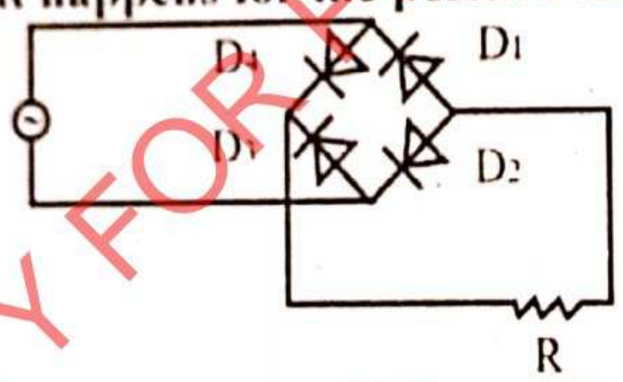


A) D_1 and D_3 conducts simultaneously
B) D_1 and D_2 conducts simultaneously
C) D_1 and D_2 conducts alternatively
D) Both A and C

Q.20 Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as:

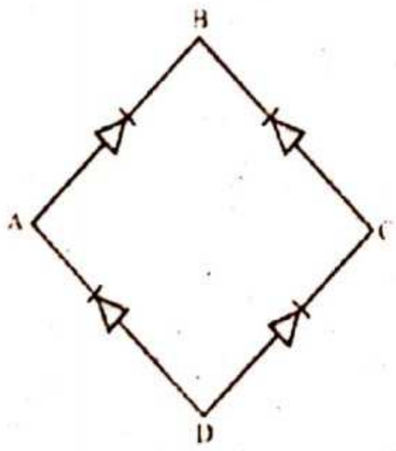
A) Wheat stone circuit
B) Bridge circuit
C) Ripple circuit
D) Filter circuit

Q.21 In the following figure what happens for the positive half cycle of the input



A) D_1 and D_3 conducts
B) D_1 and D_2 conducts
C) D_4 and D_2 conducts
D) D_4 and D_3 conducts

Q.22 In the diagram, diodes are arranged for the full wave rectification where input alternating voltage must be applied



A) across A and B
B) Across A and C
C) Across B and D
D) Across B and C

Q.23 In full wave rectification, the output D.C. voltage across the load is obtained for_____

A) The positive half cycle of input A.C
B) The negative half cycle of input A.C
C) The complete cycle of input A.C
D) All of the above

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Q.24 In full wave rectification by bridge the number of diodes required are

A) 3
B) 2
C) 5
D) 4

Q.25 In the process of rectification, the current received across the load resistance is

A) A.C
B) Pulsating D.C
C) Uni- directional
D) Both B and C

ANSWER KEY

1	B	6	B	11	A	16	C	21	C
2	D	7	C	12	B	17	D	22	B
3	C	8	C	13	C	18	C	23	C
4	A	9	A	14	A	19	D	24	D
5	D	10	B	15	B	20	D	25	B

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EXPLANATORY NOTES

Q.1 Definition of rectifier.

Q.2 Two types of rectification

1) Half wave rectification 2) Full wave rectification

Q.3 Diode is used as rectifier.

Q.4 Its reverse biased resistance is very high in order of M Ω and forward biased resistance is very low in order of few ohms.

Q.5 Half wave rectifier, rectifies only the half cycle of input ac signal and it blocks the other half

Q.6 In forward biasing, resistance of PN junction diode is zero, so whole voltage appears across the resistance.

Q.7 PN junction has low resistance in one direction of potential difference +V, so a large current flows (forward biasing). It has a high resistance in the opposite potential difference direction V, so a very small current flows (Reverse biasing)

Q.8 Output voltage of half wave rectifier is pulsating, when it made smooth by filter, voltage level is decrease this low voltage suitable for charging batteries.

Q.9 Forward biased diodes has low resistance.

Q.10 In half wave rectifier

- Input frequency = output frequency
- Output wave is pulsating

Q.11 Filters made output smooth.

Q.12 In half wave rectification only one half of AC is converted into DC.

Q.13 As in the full wave rectification

$$f_{out} = 2 f_{in} \Rightarrow T_o = \frac{T}{2}$$

Q.14 In a bridge rectifier two diodes in forward biased and conduct in each half cycle of input A.C

Q.15 In full wave rectifier, frequency of output wave is double of input wave.

Q.16 It is the diagram of full wave bridge rectifier circuit.

Q.17 We use capacitor as filter circuit.

Q.18 Direction of current flow through the load resistance R is the same in both halves cycles of input wave.

Q.19 Full wave rectifier circuit opposite diodes work simultaneously

Q.20 Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as filter circuit.

Q.21 During the positive half-cycle, the diodes D_2 and D_4 are forward biased and diodes D_1 and D_3 are reversed biased.

Q.22 In full wave bridge rectification circuit, input must be applied at the terminals where opposite ends of two diodes are joined

Q.23 In full wave rectification both halves of AC are converted into DC.

Q.24 There are 4 diodes require in full wave bridge rectification.

Q.25 Output across load resistor in case of rectification is always pulsating DC.

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11 TOPIC DAWN OF MODERN PHYSICS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

PHOTON

Q.1 The momentum of a photon is 2×10^{-16} gm-cm/sec. Its energy is

A) 0.61×10^{-26} erg
B) 6×10^{-6} erg
C) 2.0×10^{-26} erg
D) 6×10^{-8} erg

Q.2 If we express the energy of a photon in KeV and the wavelength in angstroms, then energy of a photon can be calculated from the relation

A) $E = 12.4\,h\nu$
B) $E = 12.4/\lambda$
C) $E = 12.4\,h/\lambda$
D) $E = h\nu$

Q.3 Ratio of momentum of photons having wavelength 4000 angstrom and 8000 angstroms is

A) 2 : 1
B) 20 : 1
C) 1 : 2
D) 1 : 20

Q.4 A radio station emits 10 kW power of 90.8 MHz. Find the number of photon emitted per second

A) 1.6×10^{28}
B) 1.6×10^{30}
C) 1.6×10^{29}
D) 1.6×10^{32}

Q.5 The energy of a photon is 3×10^{-19} J. Its momentum is

A) 10^{-27} kg ms^{-1}
B) 10^{-11} kg ms^{-1}
C) 9×10^{-11} kg ms^{-1}
D) 3×10^{-7} kg ms^{-1}

Q.6 The mass of a photon at rest is

A) 1 a.m.u.
B) 1.67×10^{-35} kg
C) 9×10^{-31} kg
D) zero

Q.7 The momentum of a photon is p. The frequency associated with it is given by

A) pc/h
B) ph/c
C) hc/p
D) h/pc

Q.8 Photon A has twice the energy of photon B. What is the ratio of the momentum of A to that of B?

A) 2 : 1
B) 1 : 1
C) 1 : 2
D) none of these

Q.9 The value and units of the Plank's constant 'h' can be expressed as:

A) 6.63×10^{-34} Js^{-1}
B) 6.63×10^{-43} Js
C) 6.63×10^{-34} Js
D) 3.63×10^{-34} Js

Q.10 Let n_r and n_b be respectively the number of photons emitted by a red bulb and a blue bulb of equal power in a given time. Then

A) $n_r = n_b$
B) $n_r < n_b$
C) $n_r > n_b$
D) The information is insufficient to get a relation between n_r and n_b

Q.11 λ is proportional to

A) $\frac{1}{E}$ for both photons and particles
B) $\frac{1}{E}$ for photons and $\frac{1}{\sqrt{E}}$ for particles
C) $\frac{1}{\sqrt{E}}$ for both photons and particles
D) $\frac{1}{\sqrt{E}}$ for photons and $\frac{1}{E}$ for particles

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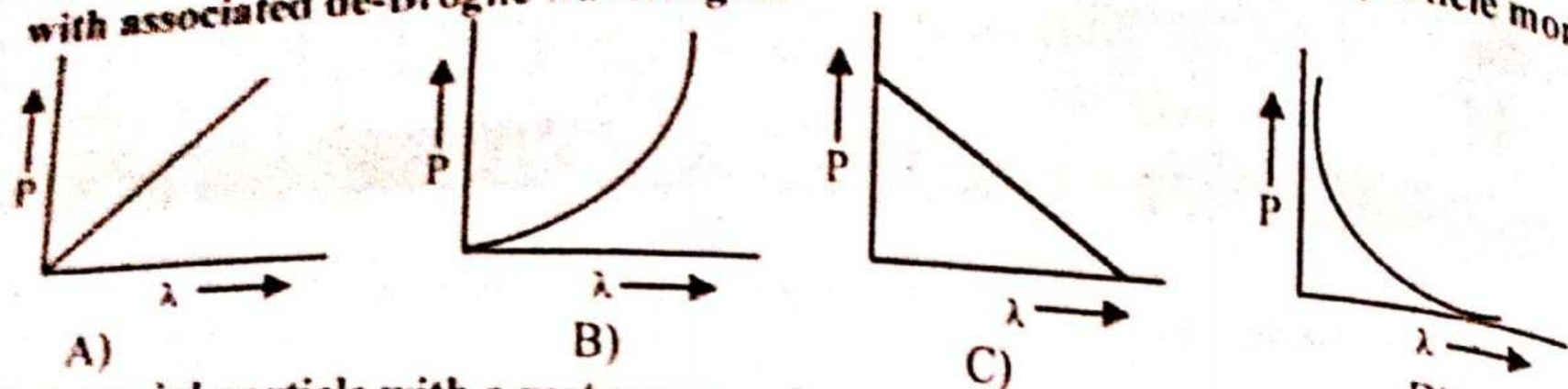
Q.12 Which of the following graphs correctly represents the variation of particle momentum with associated de-Broglie wavelength?



A) B) C) D)

Q.13 A material particle with a rest mass m_o is moving with speed of light c. The associated de-Broglie wavelength is given by

A) $\frac{h}{m_o c}$

B) 0

C) $\frac{m_o c}{h}$

D) ∞

Q.14 A photon is considered to have:

A) Energy

B) Momentum

C) Wavelength and frequency

D) All of these

THE WAVE NATURE OF PARTICLE

Q.15 The De-Broglie of wavelength of particle of mass moving with the kinetic energy

A) $\sqrt{\frac{h}{2mE}}$

B) $\frac{h}{\sqrt{2mE}}$

C) $\frac{h}{2mE}$

D) $\frac{\sqrt{h}}{2mE}$

Q.16 If electron and proton have same De-Broglie wavelength, which have greater speed

A) Electron

B) Both have same

C) Proton

D) Electron and Proton can't have wavelength

Q.17 The wavelength of a moving particle is inversely proportional to

A) mass

B) energy

C) velocity

D) momentum

Q.18 According to De-Broglie, an electron can be regarded as:

A) particle only

B) are negligible

C) particle and wave both

D) none of these

Q.19 Davisson determine the wavelength of scattered electron from the relation:

A) $\lambda = \frac{h}{2mVe}$

B) $\lambda = \frac{h}{2\sqrt{2mVe}}$

C) $\lambda = \frac{2h}{\sqrt{mVe}}$

D) $\lambda = \frac{h}{\sqrt{2mVe}}$

Q.20 If an electron is accelerated through a potential difference of 54 volts, its de-Broglie wavelength will be:

A) 1.66×10^{-8}m

B) 1.66×10^{-9}m

C) 1.66×10^{-10}m

D) 1.66×10^{-12}m

Q.21 In Davisson and Germer experiment, target crystal is made up of

A) Copper

B) Aluminium

C) Nickle

D) Silver

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Q.22 A body of mass 200 g moves at the speed of 5 m/hr. So de-Broglie wavelength related to it is of the order ($h=6.26 \times 10^{-34}$ Js)

A) 10^{-10}m
B) 10^{-30} m
C) 10^{-20} m
D) 10^{-40} m

Q.23 In Davisson-Germer experiment, the diffracted electron beam from crystal shows

A) Particle property
B) Wave property
C) Light property
D) Quantum property

Q.24 The electron, accelerated by a potential difference V has de-Broglie wavelength λ. If the electron is accelerated by a p.d 4V, its de-Broglie wavelength will be

A) 2λ
B) 4λ
C) $\frac{\lambda}{2}$
D) $\frac{\lambda}{4}$

Q.25 A proton and an α – particle are accelerated through the same potential difference. The ratio of their de-Broglie wavelengths $(\lambda_p / \lambda_\alpha)$ is

A) 1
B) 2
C) $2\sqrt{2}$
D) $1\sqrt{2}$

Q.26 The ratio of momenta of an electron and an α-particle which are accelerated from rest by a potential difference of 100 V is

A) 1
B) $\sqrt{\frac{2m_e}{m_\alpha}}$
C) $\sqrt{\frac{m_e}{m_\alpha}}$
D) $\sqrt{\frac{m_e}{2m_\alpha}}$

Q.27 What is the de Broglie wavelength of a proton whose linear momentum has a magnitude of 3.3×10^{-23} kg m/s?

A) 0.0002 nm
B) 0.02 nm
C) 0.002 nm
D) 0.2 nm

Q.28 The velocity of a particle of mass m of de-Broglie wavelength λ is _____

A) $\frac{2h}{m\lambda}$
B) $2\,m\lambda c^2$
C) $\frac{m\lambda c^2}{h}$
D) $h/m\lambda$

Q.29 Wave nature of light appears in

A) Pair production
B) Photoelectric effect
C) Compton effect
D) Interference

Q.30 If E_1, E_2 and E_3 are the respective kinetic energies of an electron, an alpha particle and a proton, each having the same de-Broglie wavelength, then

A) $E_1 > E_3 > E_2$
B) $E_2 > E_3 > E_1$
C) $E_1 > E_2 > E_3$
D) $E_1 = E_2 = E_3$

Q.31 If the K.E of a free electron doubles then its de-Broglie wavelength changes by a factor

A) $\frac{1}{2}$
B) $\frac{1}{\sqrt{2}}$
C) 2
D) $\sqrt{2}$

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Topic - 11

Q.32 The magnitude of de-Broglie wavelength (λ) of electrons (e), proton (p), neutron (n), and α particles all have the same energy 1 MeV, in increasing order will follow the sequence.

A) $\lambda_e, \lambda_p, \lambda_n, \lambda_\alpha$

B) $\lambda_\alpha, \lambda_n, \lambda_p, \lambda_e$

C) $\lambda_e, \lambda_p, \lambda_n, \lambda_\beta$

D) $\lambda_\alpha, \lambda_p, \lambda_n, \lambda_e$

Q.33 The wavelength of matter waves is independent of:

A) Mass

B) Momentum

C) Velocity

D) Charge

Q.34 Of the following moving with same momentum, the one which has largest wavelength is:

A) An electron

B) A proton

C) An α-particle

D) All have same de-Broglie wavelength

Q.35 A particle of mass M at rest decays into two masses m_1 and m_2 with non-zero velocities. The ratio of de-Broglie wave lengths of the particles $\frac{\lambda_1}{\lambda_2}$ is

A) $\sqrt{\frac{m_2}{m_1}}$

B) $\frac{\sqrt{m_1}}{\sqrt{m_2}}$

C) $\frac{m_1}{m_2}$

D) 1 : 1

Q.36 The Davisson and Garmer experiment indicate

A) Interference

B) Polarization

C) Electron diffraction

D) Refraction

THE WAVE PARTICLE DUALITY

Q.37 Interference and diffraction of light confirm its

A) Particle nature of light

B) Wave nature of light

C) Dual nature of light

D) Electromagnetic nature of light

Q.38 Light behaves as a stream of

A) Protons

B) Electrons

C) Photons

D) Positrons

Q.39 The principle regarding the dual nature of light was first discovered by

A) Campton

B) de-Broglie

C) J.J. Thomson

D) Heisenberg

ELECTRON MICROSCOPE

Q.40 The wavelength of electrons is _____ times shorter than those of visible light used in optical microscope

A) 10

B) 100

C) 1000

D) 10000

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Q.41 **The specimen being observed by electron microscope must be very thin to minimize _____ of electrons**

A) Interference
B) Polarization
C) Scattering
D) All of these

Q.42 **In electron microscope, image is formed on _____ by magnetic lens.**

A) Eye
B) Photographic film
C) Fluorescent screen
D) Eye-piece

Q.43 **Electron microscope makes practical use of the:**

A) Particle nature of electrons
B) Wave nature of electrons
C) Dual nature of electrons
D) None of these

Q.44 **An electron microscope employs which one of the following principles?**

A) Electron has wave nature
B) Electrons can be focused by an electric field
C) Electrons can be focused by a magnetic field
D) All of the above

Q.45 **The resolving power of electron microscope is _____ times greater than an optical microscope.**

A) 100
B) 1000
C) 10,000
D) 100,000

Q.46 **A three-dimensional image of remarkable quality can be achieved by modern versions called**

A) Scanning electron microscope
B) Scanning electron telescope
C) Scanning proton microscope
D) Scanning electron spectrometer

Q.47 **The resolution of 50 KV electron microscope is**

A) 0.2 to 0.5 μm
B) 0.5 μm to 1 nm
C) 0.5 to 1 *nm*
D) 0.2 nm

UNCERTAINTY PRINCIPLE

Q.48 **When photon of momentum $\frac{h}{\lambda}$ scattered due to hitting with electron, then _____ of the electron change.**

A) Energy
B) Momentum
C) Acceleration
D) Both A and B

Q.49 **The form of uncertainty principle which relates the energy of a particle and the time at which it had the energy is given by:**

A) $\Delta E.h \approx \Delta t$
B) $\Delta E.\ \Delta t \approx 2h$
C) $\Delta E.\Delta P \approx h$
D) $\Delta E.\ \Delta t \approx h$

Q.50 **Uncertainty in position of electron will be minimum for light of _____**

A) Larger
B) Smaller
C) Intermediate
D) Infinite

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Topic - 11

Q.51 The uncertainty principle significant to:

A) Small system only
B) Sub-atomic particles only
C) Large system only
D) Both sub-atomic and large system

Q.52 The uncertainty principle is applicable only when:

A) Momentum is measured only
B) Both position and momentum are measured
C) Position is measured only
D) None of these

Q.53 Value of h

A) 1.05×10^{34} J
B) 1.05×10^{-34} Ns
C) 1.05×10^{-34} Js
D) All

Q.54 The uncertainty principle confirms that an electron

A) Can exist inside a nucleus.
B) Cannot exist inside a nucleus
C) Can exist in a nucleus only as a wave
D) Can exist outside a nucleus as a wave

Q.55 If light of wave length λ is used to locate a micro particle moving along x-axis, the uncertainty in its position measurement is

A) $\Delta x \approx \lambda$
B) $\Delta x \approx \frac{\lambda}{h}$
C) $\Delta x \approx \frac{1}{\lambda}$
D) $\Delta x \approx \frac{1}{h\lambda}$

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ANSWER KEY

1	D	11	B	21	C	31	B	41	C	51	B
2	B	12	D	22	B	32	B	42	C	52	B
3	A	13	B	23	B	33	D	43	B	53	C
4	C	14	D	24	C	34	D	44	D	54	B
5	A	15	B	25	C	35	A	45	B	55	A
6	D	16	A	26	D	36	C	46	A		
7	A	17	D	27	B	37	B	47	C		
8	A	18	C	28	D	38	C	48	D		
9	C	19	D	29	D	39	B	49	D		
10	C	20	C	30	A	40	C	50	B		

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EXPLANATORY NOTES

Q1 $E = mc^2 = pc = (2\times10^{-28})(3\times10^{8}) = 6\times10^{-20}$ erg

Q2 $E = hf = \frac{hc}{\lambda} \Rightarrow E = \frac{12400}{\lambda}\,eV = \frac{12.4}{\lambda}\,KeV = \frac{12.4}{\lambda}$

Q3 $P = \frac{h}{\lambda} \Rightarrow \frac{P_1}{P_2} = \frac{\lambda_2}{\lambda_1} = \frac{4000\,\text{Å}}{2000\,\text{Å}} = 2:1$

Q4 $E = nhf \Rightarrow \frac{E}{t} = \frac{n}{t}hf \Rightarrow \frac{n}{t} = \frac{P}{hf} = 1.6\times10^{20}$

Q5 $E = Pc \Rightarrow P = \frac{E}{c} = \frac{3\times10^{-19}}{3\times10^{8}} = 10^{-27}\,kg\,ms^{-1}$

Q6 The rest mass of photon is zero.

Q7 De-Broglie wavelength $= \lambda = \frac{h}{P} \Rightarrow \frac{c}{f} = \frac{h}{P} \Rightarrow f = \frac{Pc}{h}$.

Q8 $E = Pc \Rightarrow P \propto E$, $\frac{P_A}{P_B} = \frac{E_A}{E_B} = \frac{2E_B}{E_B} = \frac{2}{1}$

Q9 Plank's constant $= h = 6.63\times10^{-34}$ Js

Q10 $En = nhf \Rightarrow n = \frac{E}{hf} = \frac{E\lambda}{hc} \Rightarrow n \propto \lambda$

Q11 For photon $\Rightarrow E = hf = \frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda}$

For particle $\Rightarrow \lambda = \frac{h}{\sqrt{2mE}} \Rightarrow \lambda \propto \frac{1}{\sqrt{E}}$

Q12 $P = \frac{h}{\lambda} \Rightarrow P \propto \frac{1}{\lambda}$

Q13 $m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} = \infty$ $\lambda = \frac{h}{mv} \Rightarrow \boxed{\lambda = 0}$

Q14 Wavelength, frequency, momentum and energy all are associated with photon.

Q15 $\lambda = \frac{h}{P} \Rightarrow \lambda = \frac{h}{\sqrt{2mE}}$

Q16 $\lambda = \frac{h}{P} \Rightarrow \lambda = \frac{h}{mv} \Rightarrow v = \frac{h}{m\lambda} \Rightarrow v \propto \frac{1}{m}$

Q17 $\lambda = \frac{h}{P} \Rightarrow \lambda \propto \frac{1}{P}$

Q18 According to de-Broglie relation electron regarded as both wave and particle i.e $\lambda = \frac{h}{P}$

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Q.19 $\lambda = \frac{h}{P}$, $P = \sqrt{2meV}$

So, $\lambda = \frac{h}{\sqrt{2meV}}$

Q.20 $\lambda = \frac{h}{\sqrt{2meV}} = \frac{6.63\times10^{-34}}{\sqrt{2\left(9.1\times10^{-31}\right)\left(1.6\times10^{-19}\right)(54)}} = 1.66\times10^{-10}m$

Q.21 Davisson and Germer showed that electrons are diffracted from nickel crystal in exactly same manner as X-rays.

Q.22 $m = 200\,g = 0.2\,kg,\ v = 5\frac{m}{hr} = \frac{5}{3600}\frac{m}{s}$

$p = \frac{h}{\lambda} = mv$

$\therefore \lambda = \frac{h}{mv} = \frac{6.626\times10^{-34}\times3600}{0.2\times5}$

$= 23.85\times10^{-31}$

$= 2.385\times10^{-30} = 10^{-30}m$

Q.23 Diffracted electron beam from crystal shows wave nature.

Q.24 $\lambda = \frac{h}{\sqrt{2meV}} \Rightarrow \lambda = \frac{1}{\sqrt{V}}$

Q.25 $\lambda = \frac{h}{\sqrt{2mqV}} \propto \frac{1}{\sqrt{mq}} \Rightarrow \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{m_\alpha q_\alpha}{m_p q_p}} = \sqrt{\frac{4m_p\times2e}{mp\times e}} = \sqrt{8} = 2\sqrt{2}$

Q.26 $\lambda = \frac{h}{\sqrt{2meV}}$

$P = \sqrt{2meV}$

$\frac{p_e}{p_\alpha} = \sqrt{\frac{2m_e eV}{2m_\alpha(2e)V}} \Rightarrow \frac{p_e}{p_\alpha} = \sqrt{\frac{m_e}{2m_\alpha}}$

Q.27 $\lambda = \frac{h}{P} \Rightarrow \lambda = \frac{6.63\times10^{-34}}{3.3\times10^{-23}} = 2\times10^{-11}m = 0.02\times10^{-9}m = 0.02nm$

Q.28 $\lambda = \frac{h}{P} = \frac{h}{mv} \Rightarrow v = \frac{h}{m\lambda}$

Q.29 Interference shows wave nature of light.

Q.30 $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow E = \frac{h^2}{2m\lambda^2} \Rightarrow E \propto \frac{1}{m}$

Q.31 $\lambda = \frac{h}{\sqrt{2mk.E}} \Rightarrow \lambda = \frac{1}{\sqrt{K.E}}$

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Q.32 $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow \lambda \propto \frac{1}{\sqrt{m}}$

Q.33 Wavelength of matter wave is independent of charge.

Q.34 $\lambda = \frac{h}{p}$, all have same de-Broglie wavelength.

Q.35 $\lambda = \frac{h}{\sqrt{2meV}} \Rightarrow \lambda = \frac{1}{\sqrt{m}} \Rightarrow \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2}{m_1}}$

Q.36 Davission and Germer shows diffraction of electron through metal crystal.

Q.37 Wave nature of light confirmed by interference and diffraction.

Q.38 Light behaves as a stream of photons when it interacts with matter.

Q.39 De-Broglie discovered dual nature of light.

Q.40 Wavelength of electron 1000 times shorter than visible light.

Q.41 The specimen being observed by electron microscope must be very thin to minimize scattering of electrons

Q.42 In electron microscope, image is formed on fluorescent screen by magnetic lens.

Q.43 Electron microscope makes particle use of wave nature of electrons.

Q.44 In electron microscope electrons can be focused by electric and magnetic field or shows electrons have wave nature.

Q.45 The resolving power of electron microscope is 1000 times greater than an optical microscope.

Q.46 A three-dimensional image of remarkable quality can be achieved by modern versions called scanning electron microscope.

Q.47 The resolution of 0.5 to 1nm is possible with a 50 kV microscope.

Q.48 When photon scattered due to hitting with electron then both momentum and energy of electron change.

Q.49 $\Delta E . \Delta t \approx h$ more accurately we determined the energy of particle, the more uncertain we will be of the time during which it has that energy.

Q.50 Uncertainty in position of electron will be minimum for light of smaller wavelength i.e $\Delta x = \lambda$

Q.51 The uncertainty principle significant to sub-atomic particles only.

Q.52 Uncertainty principle is applicable only when both position and momentum are measured.

Q.53 $h = \frac{h}{2\pi} = 1.05 \times 10^{-34} Js$.

Q.54 The uncertainty principle confirms that an electron cannot exist inside a nucleus.

Q.55 If light of wave length λ is used to locate a micro particle moving along x-axis, the uncertainty in its position measurement is $\Delta x \approx \lambda$

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12 TOPIC ATOMIC SPECTRA

PRACTICE EXERCISE

TOPIC-WISE MCQ's

ATOMIC SPECTRA/ LINE SPECTRUM, BOHR'S ATOMIC MODEL

Q.1 Lyman series of H-atoms lie in the _____ region of EM spectrum

A) visible
B) infrared
C) ultraviolet
D) red

Q.2 The ionization energy of H-atom is

A) 10.2 eV
B) 13.6 eV
C) 2 eV
D) 15 eV

Q.3 The prominent lines of the Balmer series lie in

A) visible
B) infrared
C) ultraviolet
D) red

Q.4 In Bohr's model of H-atom the Angular momentum is

A) h
B) $n\frac{h}{2\pi}$
C) $2\pi r$
D) none of these

Q.5 When electron jumps from n^{th} to the p^{th} orbit in an hydrogen atom then the wavelength of the emitted radiation is given by

A) $\frac{1}{\lambda}=R_H\left[\frac{1}{p^2}-\frac{1}{n^2}\right]$
B) $\frac{1}{\lambda}=\frac{1}{R_H}\left[\frac{1}{p^2}-\frac{1}{n^2}\right]$
C) $\frac{1}{\lambda}=R_H\left[\frac{1}{n^2}-\frac{1}{p^2}\right]$
D) $\frac{1}{\lambda}=\frac{1}{R_H}\left[\frac{1}{4^2}-\frac{1}{n^2}\right]$

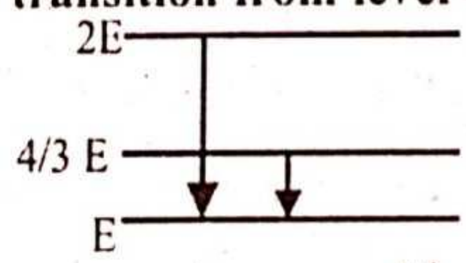
Q.6 An expression for electrostatic force between the electron and the nucleus of hydrogen atom is given by:

A) $F_e=K\frac{e^2}{r_n^2}$
B) $F_e=\frac{K^2e^2}{r_n^2}$
C) $F_e=\frac{Ke^2}{r_n^2}$
D) $F_e=\frac{ke}{r_n^2}$

Q.7 In the state $n=\infty$ of hydrogen atom, total energy of electron is:

A) 5.2 eV
B) 9.8 eV
C) zero
D) 10.5 eV

Q.8 The following fig indicates the energy levels of a certain atom. When the system moves from 2 E level to E a photon of wavelength λ is emitted. The wavelength of photon produced during its transition from level 4E/3 to level E is.



A) $\frac{\lambda}{3}$
B) $\frac{3\lambda}{4}$
C) $\frac{4\lambda}{3}$
D) 3λ

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Q.9 The hydrogen atoms are excited to the stationary state designated by the principal quantum number n = 4. The number of maximum spectral lines are observing

A) 2
B) 3
C) 4
D) 6

Q.10 The ratio of the energies of the hydrogen atom in the first and the second excited states is

A) 1 : 4
B) 4 : 1
C) 4 : 9
D) 9 : 4

Q.11 With increasing quantum number the energy difference between adjacent levels in atoms

A) decreases
B) increases
C) decreases for low Z and increase for high Z atoms
D) remains constant

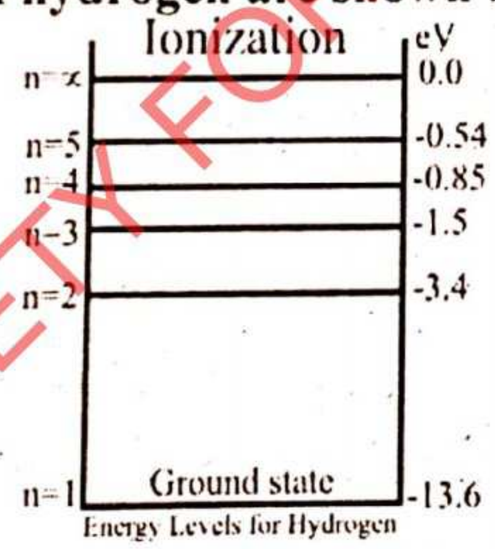
Q.12 Photon of highest frequency will be absorbed when transition takes place from _____.

A) 1^{st} to 5^{th} orbit
B) 2^{nd} to 5^{th} orbit
C) 3^{rd} to 5^{th} orbit
D) 4^{th} to 5^{th} orbit

Q.13 In Bohr model of hydrogen atom, let PE represent potential energy and TE the total energy. In going to a higher level:

A) PE decreases, TE increases
B) PE increases, TE decreases
C) PE decreases, TE decreases
D) PE increases, TE increases

Q.14 Some of the energy levels of hydrogen are shown below (not to scale).



Energy Levels for Hydrogen

Which transition will result in the emission of the photon with the greatest energy?

A) n = 5 to n = 5
B) n = 5 to n = 2
C) n = 5 to n = 3
D) n = 2 to n = 1

Q.15 If the electron in a hydrogen atom jumps from the third orbit to second orbit the emitted radiation has wavelength

A) 5/36 R
B) 36/5 R
C) 6/5 R
D) 5 R/6

Q.16 An electron of hydrogen is present in the 3.4 eV energy state. Find the angular momentum of the electron.

A) $\frac{2h}{\pi}$
B) $\frac{h}{\pi}$
C) $\frac{3h}{2\pi}$
D) $\frac{4h}{\pi}$

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Topic - 12

Q.17 In terms of the Bohr radius a_0 the radius of the second Bohr orbit of a hydrogen atom is given by

A) $4a_0$
B) $\sqrt{2}a_0$
C) $8a_0$
D) $2a_0$

Q.18 The ratio of the K.E & the P.E of electron in hydrogen atom will be.

A) 1 : 2
B) 1 : – 2
C) 2 : 1
D) – 2 : 1

Q.19 The experimental value of Rydberg constant is

A) $1.097 \times 10^{-8}\ m^{-1}$
B) $1.097 \times 10^{7}\ m^{-1}$
C) $1.097 \times 10^{8}\ m^{-1}$
D) $1.097 \times 10^{-7}\ m^{-1}$

Q.20 Number of the emission spectra are

A) One
B) Two
C) Three
D) Four

Q.21 A Balmer line is emitted when the electron in a hydrogen atom jumps from

A) A higher orbit to the first orbit
B) A higher orbit to the second orbit
C) The first orbit to a higher orbit
D) The second orbit to a higher orbit

Q.22 The velocity of a particle of mass m of de-Broglie wavelength λ is _____

A) $\frac{2h}{m\lambda}$
B) $2m\lambda c^2$
C) $\frac{m\lambda c^2}{h}$
D) $h/m\lambda$

Q.23 Which of the following statement is true of hydrogen atom?

A) Angular momentum $\propto \frac{1}{n}$
B) Linear momentum $\propto \frac{1}{n}$
C) Radius $\propto \frac{1}{n}$
D) Energy $\propto \frac{1}{n}$

PRODUCTION OF X-RAYS AND CHARACTERISTICS X-RAYS, BRAKING X-RAYS, PROPERTIES AND USES OF X-RAYS

Q.24 In the X-rays production, let λ_c be the cut off wavelength, λ_α be the wavelength of K-alpha line and λ_β be wavelength of K-beta line, then

A) $\lambda_\beta > \lambda_\alpha > \lambda_c$
B) $\lambda_\alpha > \lambda_\beta > \lambda_c$
C) $\lambda_\alpha > \lambda_c > \lambda_\beta$
D) $\lambda_\beta > \lambda_c > \lambda_\alpha$

Q.25 X-rays are produced by applying potential difference of 40 KV. Find minimum wavelength produced

A) 3.3×10^{-10} m
B) 3.3×10^{-12} m
C) 0.3×10^{-10} m
D) 3.3×10^{-6} m

Q.26 The ratio of speed of γ-rays and X-rays is:

A) 1
B) <1
C) >1
D) None of these

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Q.27 Maximum speed of electrons in X-rays tube which is producing X-rays photons of frequency f is

A) $\frac{hf}{m}$

B) $\frac{2hf}{m}$

C) $\sqrt{\frac{2hf}{m}}$

D) $\sqrt{\frac{hf}{m}}$

Q.28 Who discovered X-rays?

A) Roentgen
B) Marie curie
C) Rutherford
D) All

Q.29 Consider a photon of continous X-rays coming from a Coolidge tube. Its energy comes from

A) KE of the striking electron
B) KE of free electron of the target
C) KE of the ions of the target
D) An atomic transition in the target

Q.30 For harder X-rays

A) Wavelength is higher
B) Intensity is higher
C) Frequency is higher
D) All of these

Q.31 X-rays are absorbed maximum by?

A) Lead
B) Copper
C) Paper
D) Steel

Q.32 Water is circulated in Coolidge tube to

A) Cool the target
B) Cool both cathode and target
C) Cool the cathode
D) None of these

Q.33 If the incident electrons in Coolidge tube are accelerated through a potential of V volt, then the maximum frequency of continuous X-rays will be

A) V

B) $\frac{eV}{h}$

C) hV

D) $\frac{h}{eV}$

Q.34 If anode potential of X-rays tube increase, then

A) Bremsstrahlung radiation wavelength increases
B) Characteristic wavelength increases
C) Bremsstrahlung radiation wavelength decreases
D) Characteristic wavelength decreases

Q.35 Electrons of mass m and charge e are accelerated through a potential difference V and strike the target. The maximum speed of these electrons is

A) $\frac{eV}{m}$

B) $\frac{eV^2}{m}$

C) $\sqrt{\frac{eV}{m}}$

D) $\sqrt{\frac{2eV}{m}}$

Q.36 X-rays cannot produce

A) Compton effect
B) Photoelectron
C) Electron-positron pair
D) All of the above

Q.37 X-ray region is situated between

A) Visible and short radio wave regions
B) Ultraviolet and visible regions
C) γ-rays and ultraviolet regions
D) Short and long radio wave regions

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Topic - 12

Q.38 When electrons lose their all K.E in striking electrons producing X-rays then

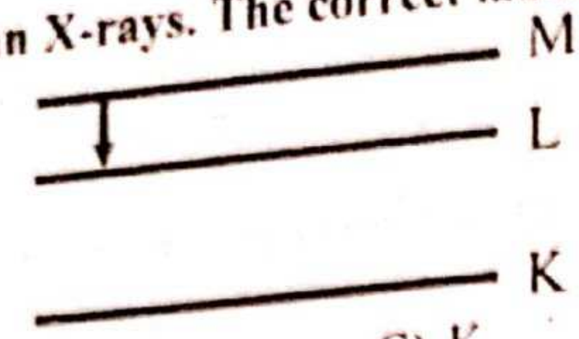
A) K.E = eV

B) $K.E = \frac{h\lambda_{min}}{c}$

C) $K.E = \frac{hc}{\lambda_{min}}$

D) $K.E = \frac{h}{\lambda_{min}}$

Q.39 Transition gives rise to an X-rays. The correct label for this



A) L_α

B) L_β

C) K_α

D) K_β

Q.40 High energy photon emitted due to transition of inner shell electrons in heavy atom are called

A) K-photons

B) Heavy photons

C) Continuous X-Rays

D) Characteristics X-Rays

Q.41 Characteristic X-rays are produced by energy changes in

A) The nucleus

B) Electron far from the nucleus

C) Electrons close to the nucleus

D) Electrons and protons

Q.42 An X-ray photon produced due to transition of electron from M-shell to K-shell is called:

A) K_α

B) K_γ

C) K_β

D) none of these

Q.43 Which of the following X-rays has greater intensity?

A) K_α

B) K_β

C) K_γ

D) All have same

Q.44 Kinetic energy of electrons by applying potential difference V_1 across the X-ray tube is KE_1 while V_2 potential difference produces kinetic energy equal to KE_2. What will be the value of $KE_1 : KE_2$ if ratio of potential difference $V_1:V_2 = 2:3$?

A) 3:2

B) 4:9

C) 9:4

D) 2:3

Q.45 The wavelength range of X-rays is

A) 1 mm to 700 nm

B) 400 nm to 1 nm

C) 1 nm to 0.001 nm

D) 0.1 m to 1 mm

Q.46 X-ray crystallography uses which characteristic of light?

A) Polarization

B) Interference

C) Diffraction

D) Coherency

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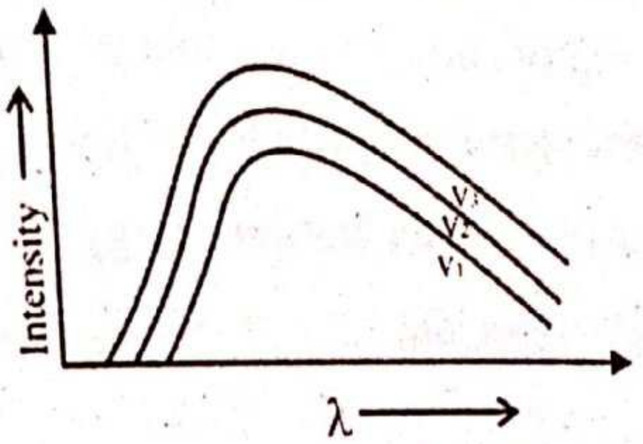
Q.47 X- ray intensity distribution versus wavelength graphs at three different voltages V_1, V_2, V_3 are shown in fig. Which voltage is maximum.



A) V_1
B) V_3
C) V_2
D) $V_1 = V_2 = V_3$

Q.48 Density difference is measured in CAT scanner. We can detect density difference upto _____% with it.

A) 10%
B) 20%
C) 0.1%
D) 1%

Q.49 Energy order of characteristics x-rays

A) $K_\gamma > K_\beta > K_\alpha$
B) $K_\gamma = K_\beta = K_\alpha$
C) $K_\gamma < K_\beta < K_\alpha$
D) $K_\gamma > K_\beta < K_\alpha$

Q.50 The frequency of K_α line of characteristic X-ray is proportional to (Z=atomic No)

A) Z
B) $Z^{1/2}$
C) Z^2
D) $Z^{3/2}$

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ANSWER KEY

1	C	11	A	21	B	31	A	41	C
2	B	12	A	22	D	32	C	42	C
3	A	13	D	23	B	33	B	43	A
4	B	14	D	24	B	34	C	44	D
5	A	15	B	25	C	35	D	45	C
6	A	16	B	26	A	36	C	46	C
7	C	17	A	27	C	37	C	47	B
8	D	18	B	28	A	38	C	48	D
9	D	19	B	29	A	39	A	49	A
10	D	20	C	30	C	40	D	50	C

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EXPLANATORY NOTES

Q.1 Lyman series lies in UV region, having max energy difference w.r.t other transitions.

Q.2 $E_o = -13.6eV$ which is the energy of ground level of electron in hydrogen atom.

So, $E_o = +13.6eV$ must be the ionization energy.

Q.3 Balmer series lies in visible spectrum.

Q.4 Angular momentum $= mvr = n\dfrac{h}{2\pi}$

Q.5 According to Rydberg.

$$\frac{1}{\lambda} = R_H\left(\frac{1}{p^2} - \frac{1}{n^2}\right)$$

Q.6 For Hydrogen atom

$Q_1 = e^+$ $\qquad$ $Q_2 = e^-$

Now, $F = \dfrac{kQ_1Q_2}{r^2} = \dfrac{-Ke^2}{r^2}$

Q.7 $n = \infty$

As, $E_n - \dfrac{E_o}{n^2} = 0$

Q.8 $E' = \dfrac{4E}{3} - E$

$E' = \dfrac{E}{3}$

$\dfrac{hc}{\lambda'} = \dfrac{hc}{3\lambda} \Rightarrow \lambda' = 3\lambda$

Q.9 No of spectral lines $= \dfrac{n(n-1)}{2}$

Here $n = 4$, $\quad$ so $\dfrac{4(4-1)}{2} = 6$

Q.10 $E_n = \dfrac{-E_o}{n^2}$

$E_n \propto \dfrac{1}{n^2}$

$\dfrac{E_1}{E_2} = \left(\dfrac{n_2}{n_1}\right)^2 = \left(\dfrac{3}{2}\right)^2 = \dfrac{9}{4}$

Q.11 $E_n \propto \dfrac{1}{n^2}$

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Q.12 If energy gap is maximum, then energy and frequency required will also be maximum.

Q.13 $P.E = \dfrac{-Ke^2}{r_n}$, $T.E = \dfrac{-Ke^2}{2r_n}$

From above relation it is clear that P.E and T.E both will increase while moving at higher level.

Q.14 $\Delta E = E_2 - E_1 = -3.4 - (-13.6) = 10.2eV$ this is maximum energy difference between atomic levels

Q.15 $\dfrac{1}{\lambda} = R_H\left[\dfrac{1}{2^2} - \dfrac{1}{3^2}\right]$

Q.16 –3.4 eV energy indicate that electron is in 2nd orbit so n=2 $\Rightarrow mvr = \dfrac{nh}{2\pi} = \dfrac{2h}{2\pi}$

Q.17 $r_n = n^2 r_1 \Rightarrow n = 2$

Q.18 $\dfrac{K.E}{P.E} = \dfrac{ke^2 / 2r_n}{-ke^2 / r_n}$

Q.19 $R_H = 1.097 \times 10^7\ m^{-1}$

Q.20 There are three types of atomic spectra

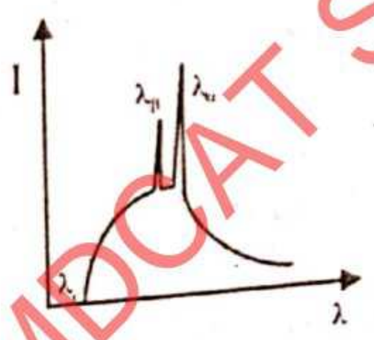
Q.21 For the Balmer series transition take place from any of higher orbit to the 2nd orbit

Q.22 De-Broglie relation

Q.23 $mv_n r_n = \dfrac{nh}{2\pi} \Rightarrow p_n = \dfrac{nh}{2\pi r_n}$

$$p_n = \frac{nh}{2\pi n^2 r_1} \Rightarrow p_n \propto \frac{1}{n}$$

Q.24



From the diagram it is clear that

$\lambda_c < \lambda_\beta < \lambda_\alpha$ or $\lambda_\alpha > \lambda_\beta > \lambda_c$

Q.25 $\lambda_{min} = \dfrac{1240\,nm}{V} = \dfrac{1240 \times 10^{-9}}{40 \times 1000}\,m$

$$= \frac{1.24}{4} \times 10^{-10}\,m \Rightarrow 0.31 \times 10^{-10}\,m$$

Q.26 Both have $3 \times 10^8\ ms^{-1}$ speed.

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Q.27 $\frac{1}{2}mv^2 = hf$

$$v = \sqrt{\frac{2hf}{m}}$$

Q.28 X-rays discovered by Dr. Roentgen

Q.29 K.E = V q

Q.30 For harder x-rays penetration power, energy and frequency is high.

Q.31 Lead is absorber for the X-rays

Q.32 Water is used to cool the target and anode.

Q.33 $hf_{max} = eV$

Q.34 $hf_{max} = eV \Rightarrow \lambda_{min} = \frac{hc}{eV}$

Q.35 $\frac{1}{2}mv^2 = eV$

Q.36 For pair production γ-rays are required

Q.37 Microwave $\rightarrow I.R \rightarrow$ Visible $\rightarrow$ U.V $\rightarrow X-$ rays $\rightarrow \gamma-$ rays

Q.38 $hf_{max} = K.E \Rightarrow \lambda_{min} = \frac{hc}{K.E}$

Q.39 When electron moves from 3rd to 2nd shell then corresponding photon is L_α

Q.40 Definition of characteristics X-rays

Q.41 Inner shell transition is required for characteristics x-rays

Q.42 When electron moves from 3rd to 1st shell then corresponding photon is K_β

Q.43 Intensity order for x-rays $K_\alpha > K_\beta > K_\gamma$

Q.44 $\frac{K.E_1}{K.E_2} = \frac{qV_1}{qV_2}$

Q.45 X-ray lies beyond the UV region of the electromagnetic spectrum. Its wavelength range is from 1 nm to 0.001 nm. Beyond X-rays lies Gamma rays

Q.46 X-ray crystallography is used to identify the molecular and atomic structure of the crystal. The crystal diffracts the incident X-ray beam. By measuring the intensities and angle of these

Q.47 $\lambda_{min} \propto \frac{1}{V} \Rightarrow V_3 > V_2 > V_1$

Q.48 Using CAT scanner, density difference of 1% can be detected

Q.49 Energy order for x-rays $K_\alpha < K_\beta < K_\gamma$

Q.50 $\sqrt{f} \propto Z$ Mosely's Law

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13 TOPIC NUCLEAR PHYSICS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

THE ATOM TO INCLUDE PROTONS, NEUTRONS AND ELECTRONS. (ATOMIC NUCLEUS)

Q.1 What are the number of neutrons, protons and electrons in a neutral atom of $^{235}_{92}U$?

	Number of neutrons	Number of protons	Number of electrons
A)	92	143	143
B)	92	235	235
C)	143	92	92
D)	235	92	92

Q.2 Which two nuclei contain the same number of neutrons?

A) $^{12}_{6}C$ and $^{14}_{6}C$

B) $^{16}_{7}N$ and $^{15}_{8}O$

C) $^{23}_{11}Na$ and $^{24}_{12}Mg$

D) $^{32}_{14}Si$ and $^{32}_{15}P$

Q.3 Nucleus of an atom whose atomic mass is 24 consists of

A) 11 electrons, 11 protons and 13 neutrons C) 11 protons and 13 neutrons

B) 11 electrons, 13 protons and 11 neutrons D) 11 protons and 13 electrons

Q.4 As compared ^{12}C atom, ^{14}C atom has

A) Two extra protons and two extra electrons

B) Two extra protons but no extra electrons

C) Two extra neutrons and no extra electrons

D) Two extra neutrons and two extra electrons

Q.5 The difference between U^{235} and U^{238} atom is that

A) U^{238} contains 3 more protons

B) U^{238} contains 3 more protons and 3 more electrons.

C) U^{238} contains 3 more neutrons and 3 more electrons.

D) U^{238} contains 3 more neutrons

Q.6 The composition of an α-particle can be expressed as

A) 1P + 1N C) 1P + 2N

B) 2P + 1N D) 2P + 2N

Q.7 What is the ratio of the nuclear densities of two nuclei having mass numbers in the ratio 1:4?

A) 1:1 C) 1:2

B) 1:4 D) 1:3

Q.8 Diameter of nucleus is approximately_____

A) $10^{-12}m$ C) $10^{-10}m$

B) $10^{-11}m$ D) $10^{-14}m$

SPONTANEOUS AND RANDOM NUCLEAR DECAY/ THE LAW OF RADIOACTIVE DECAY

Q.9 During a negative β-decay

A) An atomic electron is ejected

B) A neutron in the nucleus decays emitting an electron

C) An electron which already present with in the nucleaus is ejected

D) A part of binding energy of nuclei is converted into electron

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Topic-13

Q.10 The most penetrating radiations out of the following is that of

A) γ-rays
B) β-rays
C) α-particles
D) X-rays

Q.11 In a given reaction $\overset{A}{\underset{Z}{X}} \longrightarrow \overset{A}{\underset{Z+1}{Y}} \longrightarrow \overset{A-4}{\underset{Z-1}{B}} \longrightarrow \overset{A-4}{\underset{Z-1}{B}}$

Radioactive radiations are emitted in the sequence

A) γ,β,γ
B) γ, α, β
C) β, α, γ
D) α, γ, β

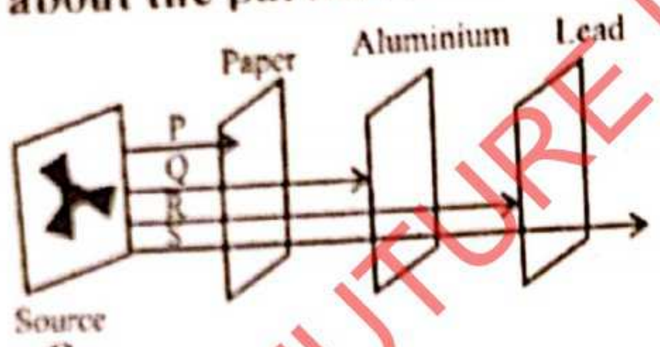
Q.12 When boron ${}^{10}_{5}B$ **is bombarded by neutrons, α-particles are emitted. The resulting nucleus has the mass number**

A) 11
B) 7
C) 6
D) 15

Q.13 In which radioactive disintegration neutron dissociates into proton and electron?

A) α–emission
B) γ–emission
C) β–emission
D) None of these

Q.14 Which of the arrangement about the particle is in accordance with the diagram?



	P	Q	R	S
A)	α	β	γ	n
B)	α	β	n	γ
C)	α	β	n	γ
D)	γ	n	β	α

Q.15 When a radioactive nucleus emits a beta particle, the proton neutron ratio:

A) Decreases
B) Remains the same
C) Increases
D) None of the above

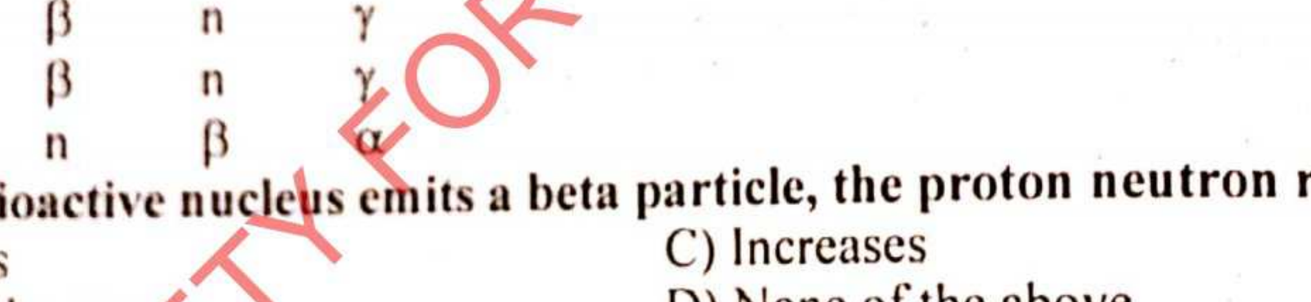
Q.16 Beta particles have penetration of about:

A) 100 times more than that of the gamma ray
B) 100 times less than that of an alpha particle
C) 100 times more than that of an alpha particle
D) 10 times more than that of an alpha particle

Q.17 ${}_{92}U^{238}$ **nucleus emits two α-particles and two β-particles and transforms into a thorium nucleus. Which of the following is the mass number and atomic number of the thorium nucleus so produced?**

A) 230, 90
B) 234, 90
C) 230, 88
D) 234, 88

Q.18 Specify the parent, daughter nuclei and emitted particle in given reaction



	Parent nucleus	Daughter nucleus	Emitted particle
A)	Thorium	Uraniumγ	neutron
B)	Thorium	Uranium	Alpha
C)	Uranium	Thorium	neutron
D)	Uranium	Thorium	Alpha

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Q.19 Which statement concerning α-particles, is correct?

A) An α-particle has charge +4e
B) An α-particle is a helium atom
C) When α particle travel through air, they cause ionization
D) When α-particle travel through a sheet of gold foil, they make the gold radioactive

Q.20 The following represents a sequence of radioactive decays involving two α-particles and one β-particles. $^{217}_{85}\text{At} \xrightarrow{\alpha} \text{V} \xrightarrow{\alpha} \text{W} \xrightarrow{\beta} \text{X}$

What is the nuclide X?

A) $^{213}_{85}\text{At}$
B) $^{215}_{77}\text{Ir}$
C) $^{209}_{82}\text{Pb}$
D) $^{217}_{81}\text{Tl}$

Q.21 The decay of a nucleus of neptunium is accompanied by the emission of a β-particle and γ-radiation. What effect (if any) does this decay have on the proton number and the nucleon number of the nucleus?

	proton number	nucleon number
A)	increases	decreases
B)	decreases	increases
C)	unchanged	decreases
D)	increases	unchanged

Q.22 Radon-220 is radioactive and decays to Polonium-216 with the emission of an α-particle. The equation for the radioactive decay is shown. $^{220}_{86}\text{Rn} \rightarrow ^{216}_{84}\text{Po} + ^{4}_{2}\text{He}$ **How many neutrons are in the radon and polonium nuclei?**

	Rn	Po
A)	86	84
B)	134	132
C)	220	212
D)	220	216

Q.23 Rodon $^{222}_{86}\text{Rn}$ **decays by α-and β-emission to bismuth** $^{214}_{83}\text{Bi}$ **For the decay of each nucleus of radon. How many α–and β– particles are emitted?**

	α–particles	β–particles
A)	1	1
B)	2	1
C)	1	2
D)	2	2

Q.24 A radioactive nucleus undergoes a series of decay according to the scheme $A \xrightarrow{\alpha} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$**. If the mass number and atomic number of A are 180 and 72 respectively, then what are these number for A4.**

A) 172 and 69
B) 174 and 70
C) 176 and 69
D) 176 and 70

Q.25 Neutron decay in the free space is given as follows

$$_0n^1 \rightarrow _1H^1 + _{-1}e^0 + [\ ]$$

Then the parenthesis represents an

A) Photon
B) Graviton
C) Neutrino
D) Antineutrino

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Q.26 The value of A in the following reaction is

$${}_4Be^9 + {}_2He^4 = {}_6C^A + {}_0n^1$$

A) 14
B) 12
C) 10
D) 16

Q.27 In a radioactive series, $^{238}_{92}U$ changes to $^{206}_{82}Pb$ through n_1 α-decay processes and n_2 β-decay processes.

A) $n_1 = 8, n_2 = 8$
B) $n_1 = 6, n_2 = 6$
C) $n_1 = 8, n_2 = 6$
D) $n_1 = 6, n_2 = 8$

HALF-LIFE AND RATE OF DECAY

Q.28 Let T be the mean life of a radioactive sample. 75% of the active nuclei present in the sample initially will decay in time.

A) $2T$
B) $\frac{1}{2}(\ln 2)T$
C) $4T$
D) $2(\ln 2)T$

Q.29 In a sample of radioactive material, what fraction of the inertial number of active nuclei will remain undisintegrated after half of a half-life of the sample?

A) 1/4
B) $\frac{1}{2\sqrt{2}}$
C) $\frac{1}{\sqrt{2}}$
D) $\sqrt{2}-1$

Q.30 In a radioactive substance at $t = 0$, the number of atoms is 8×10^4. Its half-life period is 3 years. The number of atoms 1×10^4 will remain after interval

A) 9 years
B) 6 years
C) 8 years
D) 24 years

Q.31 If the decay or disintegration constant of a radioactive substance is λ, then its half-life and mean life are respectively

A) $\frac{1}{\lambda}$ and $\frac{\log_e 2}{\lambda}$
B) $\lambda \log_e 2$ and $\frac{1}{\lambda}$
C) $\frac{\log_e 2}{\lambda}$ and $\frac{1}{\lambda}$
D) $\frac{\lambda}{\log_e 2}$ and $\frac{1}{\lambda}$

Q.32 Three-fourths of the radioactive nuclei present in a radioactive sample decay in $\frac{3}{4}s$. The half-life of the sample is:

A) $\frac{3}{4}s$
B) $1\,s$
C) $\frac{3}{8}s$
D) $\frac{1}{2}s$

Q.33 The decay constant of radium is 4.28×10^{-4} per year. Its half-life will be

A) 1240 years
B) 2000 years
C) 1620 years
D) 63 years

Q.34 The decay constant λ of a radioactive sample

A) Decrease as the age of atoms increase
B) Is independent of the age
C) Increase as the age of atoms increase
D) Depends on the nature of activity

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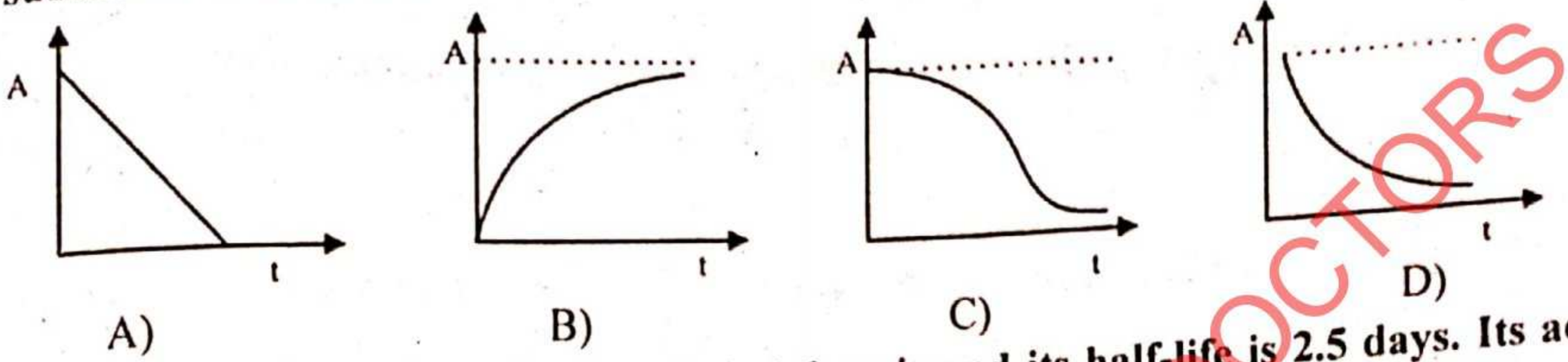
Q.35 A radioactive decay rate of radioactive elements is found to be 10^3 disintegrations per sec at a certain time. If the half-life of the element is 1 second, the decay rate after one second is _____ and after 3 second is_____

A) 500, 125
B) 10^3, 10^3
C) 125, 500
D) 100, 10

Q.36 Which of the following graph represents the variation of activity A of a radioactive substance with time t?



A) B) C) D)

Q.37 The activity of a radioactive sample is 1.6 curie and its half-life is 2.5 days. Its activity after 10 days will be

A) 0.8 curie
B) 0.4 curie
C) 0.1 curie
D) 0.16 curie

Q.38 If the radioactive decay constant of radium is 1.07×10^{-4} per year, then its half-life period is approximately equal to

A) 8,900 years
B) 7,000 years
C) 6,476 years
D) 2,520 years

Q.39 A radioactive element emits 200 particles per second. After three hours 25 particles per second are emitted. The half-life period of element will be

A) 50 minutes
B) 60 minutes
C) 70 minutes
D) 80 minutes

Q.40 A radioactive substance has a half-life of 60 minutes. After 3 hours, the fraction of atom that have decayed would be

A) 12.5%
B) 87.5%
C) 8.5%
D) 25.1%

Q.41 Half–life of radium is 1600 years. Which of the following is the fraction of a sample of radium that would remain undecayed after 6400 years?

A) $\frac{1}{2}$
B) $\frac{1}{8}$
C) $\frac{1}{4}$
D) $\frac{1}{16}$

Q.42 The half-life of Bi^{210} is 5 days. If we start with 50000 atoms of this isotope, then which of the following will be the number of atoms left over after ten days?

A) 5000
B) 20000
C) 12500
D) 25000

Q.43 Which of the following is the percentage of the original quantity of a radioactive material left after five half–lives approximately?

A) 3%
B) 10%
C) 5%
D) 20%

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Q.44 Half-life of radioactive element depends upon

A) Amount of element present
B) Pressure
C) Temperature
D) None

Q.45 Relation for half-life of any radioactive element is

A) $T_{½} = \lambda \ln 2$
B) $T_{½} = \frac{\ln 2}{\lambda}$
C) $\lambda = T_{½} ln2$
D) $T_{½} = \frac{\lambda}{\ln 2}$

Q.46 The half-life period of radium is 1600 years. Its average life time will be

A) 3200 years
B) 4800 years
C) 2319 years
D) 4217 years

Q.47 The decay constant of a radioactive element is 0.01 per second. Its half-life period is

A) 0.693 sec
B) 69.3 sec
C) 6.93 sec
D) 693 sec

BIOLOGICAL EFFECT OF RADIATION

Q.48 What is the absorbed dose D of a sample of 2 kg which is given an amount of 100 J of radioactive energy?

A) 200 Gy
B) 102 Gy
C) 50 Gy
D) 98 Gy

Q.49 Relative Biological Effectiveness (RBE) usually refers to the damages caused by

A) Low temperature
B) High temperature
C) Radiation
D) Pollution

Q.50 One Joule of energy absorbed per kg of body is

A) Rem
B) Becqueral
C) Gray
D) Rontgen

Q.51 1 rad=

A) 0.01 Gy
B) 0.09 Gy
C) 1.01 Gy
D) 0.001 Gy

Q.52 One curie is equal to

A) 3.70×10^{10} Bq
B) 3.70×10^{10} Henry
C) 3.7×10^{16} Bq
D) 3.7×10^{25} Bq

Q.53 1 Sv =

A) 1 Gy x RBE
B) 1 Gy/RBE
C) 2 Gy x RBE
D) RBE/1 Gy

Q.54 Doses of _____ will cause radiation burns to the skin

A) 2Sv
B) 4Sv
C) 3Sv
D) 5Sv

Q.55 A man of 100 kg absorbs energy 1000J from radiations. The absorbed dose in Gy is

A) 100
B) 10
C) 0.1
D) 0.01

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Q.56 Absorb dose is defined as

A) D= E/m
B) D=Em
C) D=m/ E
D) D=1/mE

Q.57 An old unit, the rem is equal to

A) 0.1 Sv
B) 1Sv
C) 0.01 Sv
D) 100 Sv

Q.58 The effect of radiation on a body absorbing it relates to a quantity called

A) radiated dose
B) ionized dose
C) absorbed dose
D) integrated dose

Q.59 The back ground radiation to which we are expose on the average per year is:

A) 2 rem
B) 2mSv
C) 2Sv
D) 3Sv

BIOLOGICAL AND MEDICAL USES OF RADIATION

Q.60 Which one of the following can be preferred for the treatment of skin?

A) β-particles
B) γ-radiations
C) x-rays
D) α-rays

Q.61 In radiotherapy X-rays are used to:

A) Detect bone fractures
B) Treat cancer by controlled exposure
C) Detect heart diseases
D) Detect fault in radio receiving circuits

Q.62 Radioactive iodine can be used to check person's _____ is working properly

A) Cancer
B) Skin cancer
C) Lungs
D) Thyroid gland

Q.63 For skin cancer which of following can be used:

A) Iodine 131
B) Phosphorous 32
C) Carbon 14
D) Carbon 12

Q.64 Phosphorus is used as tracer in

A) Industries
B) Agriculture
C) Electrical machinery
D) All of these

Q.65 Radio isotope cobalt which emit high energy γ-rays is used for the treatment of

A) Temperature
B) Bones
C) Liver
D) Cancer

Q.66 Cobalt-60 is used for treatment of

A) Cancer
B) Lungs
C) Kidneys
D) Thyroid

Q.67 Cancerous tissue in a thyroid gland can be detected by the intake of

A) Radio iodine
B) Radio sodium
C) Radio carbon
D) Radio phosphors

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Q.68 Circulation of blood can be studied by:

A) Sodium – 24
B) Strontium 90
C) Carbon 14
D) Iodine 131

Q.69 Which one of the following is the most useful tracer?

A) Strontium – 90
B) Iodine – 131
C) Carbon – 14
D) Cobalt – 60

Q.70 The γ – rays radiographs are used in:

A) Agriculture industry
B) Support Industry
C) Medical industry
D) All of above

ANSWER KEY

1	C	11	C	21	D	31	C	41	D	51	A	61	B
2	C	12	B	22	B	32	C	42	C	52	A	62	D
3	C	13	C	23	B	33	C	43	A	53	A	63	B
4	C	14	A	24	A	34	B	44	D	54	C	64	B
5	D	15	C	25	D	35	A	45	B	55	B	65	C
6	D	16	C	26	B	36	D	46	C	56	A	66	A
7	A	17	A	27	C	37	C	47	B	57	C	67	A
8	D	18	D	28	D	38	C	48	C	58	C	68	A
9	B	19	C	29	C	39	B	49	C	59	B	69	C
10	A	20	C	30	A	40	B	50	C	60	B	70	C

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EXPLANATORY NOTES

Q.1 $^{235}_{92}U$ Number of protons = Number of electrons = Z = 92

Number of neutrons = N = A–Z = 143

Q.2 Number of neutrons in $Na^{23}_{11} = 23 - 11 = 12$

Number of neutrons in $Mg^{24}_{12} = 24 - 12 = 12$

Q.3 Nucleus of an atom whose atomic mass is 24 consist of

$A = P+N$

$24=11+13$

So, number of protons = 11

Number of neutrons = 13

Q.4 For $_6C^{12}$, p = 6, e = 6, n = 6 For $_6C^{14}$, p = 6, e = 6, n = 8

Q.5 U-238 contains 3 more neutrons than U-235.

Q.6 α-particle contains 2 protons and 2 neutrons.

Q.7 As the nuclear density is independent of mass number, so the ratio of nuclear densities of the two given nuclei is 1:1.

Q.8 $d = 10^{-14}$ m

Q.9 'β' particle is emitted when neutron breaks.

Q.10 γ-rays are more penetrating than that of α, β and other electromagnetic radiations.

Q.11 $^{A}_{Z}X \xrightarrow{-1\beta} {}^{A}_{Z+1}Y \xrightarrow{+\alpha} {}^{A-4}_{Z-1}B \xrightarrow{\gamma} {}^{A-4}_{Z-1}B$

- When β is emitted then charge will increase.
- When α is emitted then mass will reduce by 4 and charge will reduce by 2.

Q.12 $^{10}_{5}B + {}^{1}_{0}n \rightarrow {}^{7}_{3}X + {}^{4}_{2}He$ Resultant nucleus has mass number "7".

Q.13 In β-emission $^{1}_{0}n \rightarrow {}^{0}_{-1}\beta + {}^{1}_{1}H$

Q.14 Order of penetration power is $\alpha < \beta < \gamma < n$

Q.15 β-particle emits when a neutron break and proton is produced as follow.

$$^{1}_{0}n \rightarrow {}^{1}_{+1}p + {}^{0}_{-1}\beta + \bar{\nu} \quad \left(\frac{p+1}{n-1} > \frac{p}{n}\right)$$

So, number of protons increase and number of neutrons decrease and proton-neutron ratio increases

Q.16 Range of β-particle is 100 times more than α-particles.

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Q.17 $^{238}_{92}U \rightarrow ^{230}_{90}Th + 2^{4}_{2}He + 2^{0}_{-1}\beta$

Q.18 Here parent nucleus is "$_{92}U$" uranium, thorium is $\beta-$particle and emitted radiation is He (Alpha).
So, correct option is "D".

Q.19 Alpha particles are helium nuclei $\left(^{4}_{2}He\right)$ they cause ionization when they pass through air.

Q.20 $^{217}_{85}At \xrightarrow{\alpha} ^{213}_{83}V \xrightarrow{\alpha} ^{209}_{81}W \xrightarrow{\beta} ^{209}_{82}X$

Q.21 By the emission of a $\beta-$particle and $\gamma-$radiation from nucleus of neptunium then, "proton number" increases by "1" but "nucleon number" remains same.

Q.22 Number of neutrons in radon = 220-86=134
Number of neutrons in polonium = 216-84=132

Q.23 $^{222}_{86}Rn \xrightarrow{\alpha} ^{218}_{84}X \xrightarrow{\alpha} ^{214}_{82}Y \xrightarrow{\beta} ^{214}_{83}Bi$

No of α-particles = 2

No of β-particles = 1

Q.24 $_{72}A^{180} \xrightarrow{\alpha} {}_{70}A_1^{176} \xrightarrow{\beta} {}_{71}A_2^{176} \longrightarrow {}_{69}A_3^{172} \xrightarrow{\gamma} {}_{69}A_4^{172}$

Q.25 The reaction for neutron decay is

$^{1}_{0}n \longrightarrow ^{1}_{1}H + ^{0}_{-1}e + \bar{\nu}$

Here $\bar{\nu}$ = anti – neutrino

Q.26 According to law of conservation of mass
$9+4=A+1 \Rightarrow 13=A+1 \Rightarrow A=12$

Q.27 No. of $\alpha-particle = n_1 = \frac{\Delta A}{4} = \frac{238-206}{4} = \frac{32}{4} = 8$

No. of $\beta^{-}-particle = n_2 = 2N_a - \Delta Z = 2(8)-(92-82) = 16-10 = 6$

Q.28 When 75% decays, 25% is left un-decayed. This requires a time $t = 2T_{1/2}$, where

$T_{1/2}$ = half life $= \frac{\ln 2}{\lambda}$. Also $T = \frac{1}{\lambda}$.

$\therefore t = 2\left(\frac{\ln 2}{\lambda}\right) = 2(\ln 2)T$

Q.29 As $n = \frac{t}{T_{1/2}} = \frac{\frac{1}{2}T_{1/2}}{T_{1/2}} = \frac{1}{2}$

Fractional un-decay $= \frac{1}{2^n} = \frac{1}{2^{1/2}} = \frac{1}{\sqrt{2}}$

Q.30 $8\times10^4 \xrightarrow{1T_{1/2}} 4\times10^4 \xrightarrow{2T_{1/2}} 2\times10^4 \xrightarrow{3T_{1/2}} 1\times10^4$, So n = 3

Now $n = \frac{t}{T_{1/2}} \Rightarrow t = n\times T_{1/2} = 3\times3 = 9$ years

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Q.31 Relation for half-life is $T_{1/2} = \frac{0.693}{\lambda} = \frac{\ell n(2)}{\lambda} = \frac{\log_e(2)}{\lambda}$

Relation for mean life is $T = \frac{1}{\lambda}$

Q.32 $\frac{4}{3}N_o = \frac{3}{2^2}N_o \Rightarrow n = 2$, As $n = \frac{t}{T_{1/2}}$

$T_{1/2} = \frac{t}{n} = \frac{3/4}{2} = \frac{3}{8}\text{sec}$

Q.33 As $T_{1/2} = \frac{0.693}{\lambda} = \frac{0.693}{4.28\times10^{-4}} \approx 1620\,\text{year}$

Q.34 "λ" is decay constant that remain constant and does not depend upon age.

Q.35 After 1 sec, 1 half-life will pass so, remaining activity $= \frac{10^3}{2^1} = 500$

- After 3 sec, 3 half-lives will pass so, Remaining activity $= \frac{10^3}{2^3} = \frac{1000}{8} = 125$

Q.36 It is a decay curve which is "D".

Q.37 Number of half lives $n = \frac{10}{2.5} = 4 \Rightarrow \frac{A}{A_o} = \frac{N}{N_o} = \left(\frac{1}{2}\right)^n \Rightarrow A = 1.6\times\left(\frac{1}{2}\right)^4 = 0.1\,\text{curie}$

Q.38 Half – life $\left(T_{1/2}\right) = \frac{0.693}{\lambda} = \frac{0.693}{1.07\times10^{-4}} = 6476\,\text{years}$

Q.39 $R = \frac{dN}{dt} \propto N \Rightarrow \frac{R_2}{R_1} = \frac{N_2}{N_1}$ But $\frac{N_2}{N_1} = \left(\frac{1}{2}\right)^{t/T_{1/2}} \Rightarrow \frac{25}{200} = \frac{1}{8} = \left(\frac{1}{2}\right)^3 \Rightarrow \frac{t}{t_{1/2}} = 3$

$\therefore t_{1/2} = \frac{t}{3} = \frac{3}{3} = 1\,\text{hour} = 60\,\text{minutes}$

Q.40 $N = N_o\left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$. Hence fraction of atoms decayed $= 1 - \frac{N}{N_o} = 1 - \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}} = 1 - \left(\frac{1}{2}\right)^{\frac{3\times60}{60}} = \frac{7}{8}$

In percentage it is $\frac{7}{8}\times100 = 87.5\%$

Q.41 $N_R = N_o\left(\frac{1}{2}\right)^n$ Given information $n = \frac{6400}{1600} = 4$, Remaining amount $= \frac{1}{2^n} = \frac{1}{16}$

Q.42 10 days has 2 half-lives , So, remaining amount $= N_o\left[\frac{1}{2}\right]^n$

Remaining amount $= \frac{50000}{2^2} = \frac{50000}{4} = 12500$

Q.43 After 5 half-lives remaining amount $= \frac{1}{2^5} = \frac{1}{32}$

Percentage of remaining amount $= \frac{1}{32}\times100 \approx 3\%$

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Q.44 Half-life is a natural process that does not depend upon amount of element present, pressure and temperature.

Q.45 $T_{1/2} = \frac{\ell n 2}{\lambda}$

Q.46 Average life $= \frac{1}{\lambda} = \frac{T_{1/2}}{0.693} = \frac{1600}{0.693} = 2308 \approx 2319$ years

Behavior of λ with time depends on the nature of the activity

Q.47 As $T_{\frac{1}{2}} = \frac{0.693}{\lambda} = \frac{0.693}{0.01} = 69.3 \sec$

Q.48 As $D = \frac{E}{m} = \frac{100}{2} = 50 Gy$

Q.49 Relative Biological Effectiveness (RBE) is a comparison the dose of the radiation being studied with the dose of standard radiation producing the same effect.

Q.50 The S.I unit of absorbed dose is gray (Gy) defined as one joule per kg.

Q.51 The old unit of absorbed dose is rad. which is related with gray (Gy) as 1 rad = 0.01 Gy

Q.52 The strength of radiation source is indicated by its activity measured in becquerel (Bq). One becquerel is one disintegration per second. A larger unit is curie (Ci) which is equal to 3.7×10^{10} Bq.

Q.53 The S.I unit of equivalent dose is sievert (Sv).
i.e 1Sv = 1 Gy × RBE

Q.54 Doses of 3Sv will cause radiation burns to the skin

Q.55 As $D = \frac{E}{m} = \frac{1000}{100} = 10 Gy$

Q.56 Absorb dose is defined as the energy E absorbed from ionization radiation per unit mass m of the absorbing body is $D = \frac{E}{m}$

Q.57 The old unit of equivalent dose is rem, which is related with sievert (Sv) as 1 rem = 0.01 Sv

Q.58 The effect of radiation on a body absorbing it relates to a quantity called absorbed dose

Q.59 The back ground radiation to which we are expose on the average is 2 mSv per year.

Q.60 γ-radiations can be preferred for the treatment of skin

Q.61 In radiotherapy X-rays are used to treat cancer by controlled exposure.

Q.62 Radioactive iodine can be used to check person's thyroid gland is working properly.

Q.63 For skin cancer phosphorus-32 or strontium-90 may be used.

Q.64 Phosphorus is used as tracer in agriculture.

Q.65 Radiotherapy with γ-rays from cobalt-60 is often used in the treatment of cancer of liver.

Q.66 Radiotherapy with γ-rays from cobalt-60 is often used in the treatment of cancer.

Q.67 Radio-iodine is absorbed mostly by the thyroid gland.

Q.68 Study the circulation of blood using radioactive isotope sodium-24.

Q.69 Carbon-14 is the most useful tracer.

Q.70 The γ-rays radiographs are used in medical diagnosis such as internal imaging of brain.

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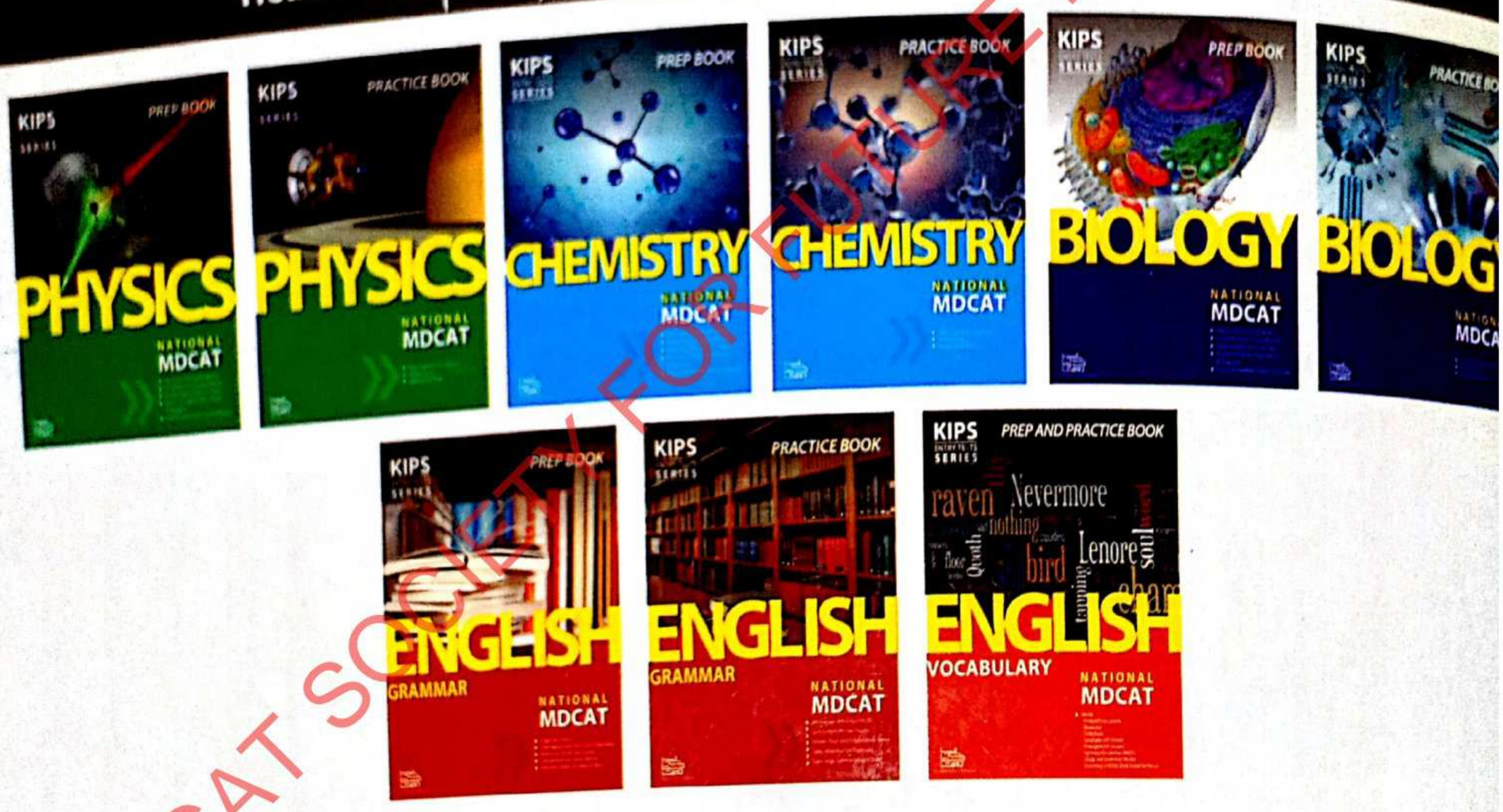

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