# UNIT 1
# MEASUREMENTS

**1.1** Define and state the units of mass, length, time and temperature.

**Mass**
- Is a measure of the amount of matter in the body.
- Its unit is kilogram (kg).

**Length**
- Is a measure of the distance between two points.
- Its unit is meter (m).

**Time**
- Is a measure of the duration of an event or the interval between two events.
- Its unit is second (s).

**Temperature**
- Is a measure of how hot or cold a body is.
- Its unit is kelvin (K) or degree Celsius (°C).

**1.2 Describe the methods of measuring length, mass and time.**

**Length**
- Length is measured using a rule or a tape measure.
- Length is measured using a micrometer screw gauge.

**Mass**
- Mass is measured using a balance.

**Time**
- Time is measured using a stopwatch or a clock.

**1.3 Describe the measurement of temperature using a mercury-in-glass thermometer.**

- A mercury-in-glass thermometer consists of a thin-walled glass tube with a bulb at the end containing mercury.
- The bulb is placed in the substance whose temperature is to be measured.
- The mercury expands and rises in the tube.
- The length of the mercury column is read from the scale on the tube.
- The temperature is then read from the scale.

**1.4 Describe the measurement of length using a rule.**

- Place the rule on the object to be measured.
- Align the zero mark of the rule with one end of the object.
- Read the length of the object from the scale on the rule.

**1.5 Describe the measurement of length using a micrometer screw gauge.**

- Place the object between the anvil and the spindle.
- Turn the ratchet until the spindle touches the object.
- Read the main scale reading.
- Read the thimble scale reading.
- Add the main scale reading and the thimble scale reading to get the total reading.

**1.6 Describe the measurement of mass using a balance.**

- Place the object on the balance.
- Add standard masses until the balance is in equilibrium.
- Read the mass from the standard masses.

**1.7 Describe the measurement of time using a stopwatch or a clock.**

- Start the stopwatch when the event begins.
- Stop the stopwatch when the event ends.
- Read the time from the stopwatch or clock.

**1.8 Describe the measurement of the volume of a regular solid.**

- Measure the length, breadth and height of the solid using a rule.
- Multiply the length, breadth and height to get the volume.

**1.9 Describe the measurement of the volume of an irregular solid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the initial volume of water in the measuring cylinder.
- Place the irregular solid in the measuring cylinder.
- Read the final volume of water in the measuring cylinder.
- Subtract the initial volume from the final volume to get the volume of the irregular solid.

**1.10 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.11 Describe the measurement of the volume of a liquid using a burette.**

- Place the burette on a stand.
- Read the volume of the liquid from the burette.

**1.12 Describe the measurement of the volume of a liquid using a pipette.**

- Place the pipette on a stand.
- Read the volume of the liquid from the pipette.

**1.13 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.14 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.15 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.16 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.17 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.18 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.19 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.20 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.21 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.22 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.23 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.24 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.25 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.26 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.27 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.28 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.29 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.30 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.31 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.32 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.33 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.34 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.35 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.36 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.37 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.38 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.39 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.40 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.41 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.42 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.43 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.44 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.45 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.46 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.47 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.48 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.49 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.50 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.51 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.52 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.53 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.54 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.55 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.56 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.57 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.58 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.59 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.60 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.61 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.62 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.63 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.64 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.65 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.66 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.67 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.68 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.69 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.70 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.71 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.72 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.73 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.74 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.75 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.76 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.77 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.78 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.79 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.80 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.81 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.82 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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- Read the volume of the liquid from the measuring cylinder.

**1.83 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.84 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.85 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.86 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.87 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.88 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.89 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.90 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.91 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.92 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.93 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.94 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.95 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.96 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.97 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.98 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.99 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.100 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.101 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.102 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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- Read the volume of the liquid from the measuring cylinder.

**1.103 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.104 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.105 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.106 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.107 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.108 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.109 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.110 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.111 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.112 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.113 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.114 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.115 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.116 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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- Read the volume of the liquid from the measuring cylinder.

**1.117 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.118 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.119 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.120 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.121 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.122 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.123 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.124 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.125 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.126 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.127 Describe the measurement of the volume of a liquid using a measuring flask.**

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**1.128 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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**1.129 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.130 Describe the measurement of the volume of a liquid using a measuring cylinder.**

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- Read the volume of the liquid from the measuring cylinder.

**1.131 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.132 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.133 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.134 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.135 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.136 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.137 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.138 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.139 Describe the measurement of the volume of a liquid using a measuring flask.**

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- Read the volume of the liquid from the measuring flask.

**1.140 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.141 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.142 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.143 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.144 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.145 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.146 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.147 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.148 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.149 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.150 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.151 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.152 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.153 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.154 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.155 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.156 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.157 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.158 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.159 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.160 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.161 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.162 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.163 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.164 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.165 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.166 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
- Read the volume of the liquid from the measuring cylinder.

**1.167 Describe the measurement of the volume of a liquid using a measuring flask.**

- Place the measuring flask on a flat surface.
- Read the volume of the liquid from the measuring flask.

**1.168 Describe the measurement of the volume of a liquid using a measuring cylinder.**

- Place the measuring cylinder on a flat surface.
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**1.221 Describe the measurement of the volume of a liquid using a

# EXERCISE

**Select the correct answer of the following questions.**

**1) Which of the following quantities has not been expressed in proper unit?**

a. $\frac{Newton}{meter}$ = newton meter$^{-1}$ b. Force = kg ms $^{-2}$

c. Energy = kg ms $^{-2}$ d. Pressure = Newton ms $^{-2}$

**2) Which of the following correctly represent the $L_1$ unit pressure?**

a. Newton meter$^{-1}$ b. Newton/ meter$^{-1}$ c. Newton d. Newton $^{-1}$

**3) Which of the following may be used as a valid formula to calculate speed of accident? v = speed, g = acceleration due to gravity, y = wave length, ρ = density, h=depth**

a. $\sqrt{\frac{2\rho h}{g}}$ b. $\sqrt{\rho h}$ c. $\sqrt{\rho g}$ d. none

**4) What is the SI unit of coulomb is in the following equation? where F = force, where F = force, r = radius.**

a. kg m/s$^2$ b. kg ms c. kg / m$^2$s d. kg m/s$^2$

**5) Which of the following is a smallest value?**

a. 1 mm a 1 μm b. 1 cm a 1 km c. 1 μm a 1 fm d. a nm a 1m

**6)** $\frac{\left(\frac{1}{2}\right)^{-1}}{\left(\frac{1}{2}\right)^{-2}} =$

a. $10^{-10}$ b. p c. $10^{-7}$ d. $10^{-4}$





**7) In a vernier match, 100 operations are counted one by one. How many significant figures will be there in the final result?**

a. 3 b. 1 c. 2 d. 0

**8) The equation relating pressure and density is p = ρgh. How can both sides of this equation be written in terms of base units?**

a. [mm⁻¹] = [kgm⁻³] [ms⁻²] [m] b. [mm⁻¹] = [kgm⁻³] [ms⁻²]

c. [kgm⁻¹] = [kgm⁻³] [ms⁻²] [m] d. [kgm⁻¹] = [kgm⁻³] [ms⁻²]

**9) A series of measurements of the acceleration of free fall g is shown in the table which set of results is precise but not accurate?**

| | g/ms$^{-2}$ | | | | |
|---|---|---|---|---|---|
| a | **9.81** | **9.79** | **9.84** | **9.82** | **9.79** |
| b | **9.82** | **10.12** | **9.89** | **9.94** | **9.82** |
| c | **9.82** | **9.21** | **8.99** | **8.76** | **8.51** |
| d | **9.82** | **9.86** | **9.8** | **9.81** | **9.87** |

**10) A mass m has acceleration a. If moves through a distance s in time t. The power used in accelerating the mass is equal to the product of force and velocity. The percentage uncertainties are 2.1% in m, 1% in a, 1.5% in s, 0.5 in t.**

a. 2.1 % b. 2.6 % c. 3.1% d. 4.1 %

**11) Which one is a pair of SI base units?**

a. ampere, joule b. coulomb, second

c. kilogram, Kelvin d. meter, Newton

**12) What is the value** $\frac{\left(\frac{1}{2}\right)^{-1}}{\left(\frac{1}{2}\right)^{-2}}$ **?**

a. $10^{-7}$ b. $10^{-4}$ c. $10^{-10}$ d. $10^{-12}$





**13) A student measured the diameter of wire using a screw gauge with least count 0.001 cm. The correct measurement is**

a. 3.3 cm b. 3.30 cm c. 3.300 cm d. 3.3000 cm

**14) The dimensions of frequency f are**

a. $[T^{-1}]$ b. $[LT^{-1}]$ c. $[T^{-2}]$ d. $[MT^{-1}]$

**15) Which one is the least sub multiple?**

a. pico b. femto c. Atto d. nano

**16) One femto is equal to**

a. $10^{-12}$ b. $10^{-15}$ c. $10^{-18}$ d. $10^{-9}$

**17) The scientific notation of a number 0.0023 is expressed as**

a. $2.3 \times 10^{-3}$ b. $0.023 \times 10^{-1}$ c. $2.3 \times 10^{-4}$ d. $0.23 \times 10^{-2}$

**Answers**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (c) | **2.** | (d) | **3.** | (a) | **4.** | (a) | **5.** | (d) |
| **6.** | (b) | **7.** | (a) | **8.** | (c) | **9.** | (c) | **10.** | (b) |
| **11.** | (d) | **12.** | (d) | **13.** | (c) | **14.** | (a) | **15.** | (c) |
| **16.** | (b) | **17.** | (a) | | | | | | |

**Write the short answer of the following:**

**Q.1 Define the number π and show that 2π radian is equal to 360°.**

**Answer**

The number π, denoted by the Greek letter π, pronounced 'pie', is one of the most common constants in all of mathematics.





It is the circumference of any circle, divided by its diameter. Mathematicians like to teach values because no matter how many digits are included in the number never ends. For most practical uses, you can assume π is 3.142. It is the ratio of circumference of a circle to the diameter of the same circle.

**Mathematically**

$$\pi = \frac{\text{Circumference of a circle}}{\text{Diameter of the circle}}$$

$$= 22/7$$

Since 1 Radian = 57.3°

2 π Radian = 57.3° × 2 × 3.14

2 π Radian = 360°

**Q.2 Define the terms error, uncertainty, precision and accuracy in measurement?**

**Answer**

**Errors and Uncertainties**

All physical measurements are uncertain and imprecise to some limit. There are three sources of errors.

**Sources of errors**

**(i)** Negligence or inexperience of a person

**(ii)** Faulty apparatus

**(iii)** Inappropriate method or technique

The uncertainty is usually described as an error in measurement.

**Type of Errors**

There are two major types of errors.

(1) Random error (2) Systematic error

**Precision**

Precision indicates how close the measured values are to each other. The precision of a measurement depends upon the least count of measuring





instrument. The smaller the unit, the more precise the measurement. The precision of a measurement describes the units you used to measure something. For example, you might describe your height as "about 6 feet". That wouldn't be very precise. If, however, you said that you were 74 inches tall that would be more precise.

A precise measurement is the per which has less absolute uncertainty. The precision of a measurement is determined by the instrument or device being used.

**Accuracy**

Accuracy means how close is measured value (result) to the correct (true) value. The accuracy of a measurement is the difference between our measurement and the accepted correct present. The bigger the difference, the less accurate your measurement. An accurate measurement is one which has less fractional or percentage error. The accuracy of measurement depends on the fractional or percentage uncertainty in that measurement.

**Example**

When the object is measured as 35.3 cm by using a meter rod having smallest division in millimeter. It's the difference of two reading of the initial and position. The uncertainty in the single reading as discussed before is taken as 0.05 cm which is now double and called absolute uncertainty equal to 0.1 cm (i.e 0.05 x 2 cm=0.1). Absolute uncertainty, in effect, is equal to the least count of the measuring instrument. This is called precision.





**Q.3 Explain several repetitive phenomena occurring naturally which could serve reasonable time standard.**

**Answer**

There are many natural processes, which could be used as time standard in nature some of them are:

**a)** Rotation of moon around the earth.





**b)** Rotation of earth about its own axis, and around the sun.

**c)** Crystal lattice vibration.

**d)** Radioactive decay of radioactive elements.

**e)** Pulse rate of human beings.

**f)** Change of season.

**Q.4 Why do we find it useful to have two units for the amount of substance i.e. kilogram and mole?**

**Answer**

The amount of substance is measured in kilogram when macroscopic properties of a substance are not required i.e. number of particles, atoms, molecules ions etc. The term kilogram is used only at macroscopic level.

The mole is concerned to the microscopic properties of a substance i.e. when we are concerned with number of particles, we use mole as the unit of amount of substance because one mole of substance contains equal number of particles i.e. NA =6.02 x $10^{23}$





**Q.5 Show that the famous Einstein equation E = mc² is dimensionally consistent. Answer**

L=L = $T^{-1}$

Since the unit of energy is joule and

1J = kg m/s²

= (kg.M) $\frac{L}{T^2}$ ——————(1)

K=L3 = mc²

= kgm/s²

= (m.M) $\frac{L^2}{T^2}$ ——————(2)

From Equation (1) & (2) it is clear that E = mc² is dimensionally consistent.





**Q.6 Deduce the dimension of gravitational constant**

**Answer**

As: $F = \frac{GMm}{r^2}$

$G = \frac{Fr^2}{Mm}$

$G = MF \cdot M^{-1}$ ——————(1)

The dimension of Force is [MLT⁻²]

The dimension of M is [L]

The dimension of m & r is [M]

So equation (1) becomes

$G = [ML^{-1} \times L^1 \times M^{-1} \times M^{-1}]$

$G = [L^3 \cdot M^{-1} T^{-2}]$

**Q.7 Find the dimension of E.**

**Answer**

As E = 1/2 mv²

The dimension of mass is [M]

The dimension of velocity of $[L^2]$

So, equation (1) becomes

= 1/2 [M x $[L^2]$ $[T^{-2}]$]

= 1/2 $[ML^2T^{-2}]$

Which is the required dimension.





$T \propto \sqrt{\frac{L}{g}}$ ——————(1)

It is clear from Equation (1) that time period of pendulum is directly proportional to the square root of length of pendulum and inversely proportional to the square root of acceleration due to gravity i.e.,

$T \propto \sqrt{l}$

$T \propto \frac{1}{\sqrt{g}}$

- Since length of pendulum is temperature dependent, that is summer and winter it changes.
- Similarly, acceleration due to gravity varies with altitude, also its value at poles and at equator is different. That's why period of a pendulum cannot be used as time standard.

**Q.9 Are radian & steradians the basic units of system international? Justify your answer**

**Answer**

Radian & steradians both are not considered as basic units of system international. These are supplementary units. Plane angle is measured in radians & solid angle is measured in steradians. Although both plane & solid angles are pure quantities (dimensionless), Yet these are measured in radian & steradian. That's why they are called supplementary units.

**Q.10 What does the word 'micro' signify in the word microwave oven?**

**Answer**





The prefix micro represented by symbol 'μ (mew) in the word microwave oven' signifies that electromagnetic waves produced in microwave oven have wave lengths of the order of $10^{-6}$ m.

i.e. $10^{-6}$ m = 1 μm.

The thermal radiations whose wave lengths are of the order of $10^{-6}$ m is called microwaves.

**Q.11 Density of oil is 1.2 kg/m³. Change it into g/cm³.**

**Answer:**

$\rho = 1.2\ kg/m^3$

$= \frac{1.2 \times 1000\ g}{(100\ cm)^3}$ $\quad 1kg = 1000\ g$

$= \frac{1.2 \times 10^3\ g}{(10^2\ cm)^3}$

$= 1.2 \times 10^{-3}\ g/cm^3$

**Q.12 An old saying is that A chain is only as strong as its weakest link, what ambiguous statement can you make regarding measurement.**

**Answer**

As analogous statement in measurement is 'A result of experimental data is only as much accurate as possible if it has least fractional uncertainty in the data.

**Q.13 Differentiate between the light year and year?**

**Answer**

- **Light year:** It is the distance travelled by light in one year between any two points in space is called light year.





1 light year = 9.45 x 10¹⁵ m

- **Year:** The time period in which earth completes one revolution around the sun is called a year. 1 year = 3.1536 x $10^7$ sec

# Numerical Problems

**1. Express the following quantities by using prefixes:**

**(a) $4.0 \times 10^{-3}$ m** **(b) $15.0 \times 10^{-3}$ s** **(c) $7.5 \times 10^{-7}$ g**

**Solution**

**(a)** $4.0 \times 10^{-3}$ m

$= 4.0 \times 10^{-3}$ m

$= 0.4 \times 10^{-1}$ m $10^{-3}$ = milli

$= 1.4$ mm

**(b)** $15.0 \times 10^{-3}$ s

$= 15.0 \times 10 \times 10^{-3} \times 10^{-6}$ s

$= 150 \times 10^{-6}$ s $10^{-6}$ = nano

$= 150$ ns

**(c)** $7.5 \times 10^{-7}$ g

$= 7.5 \times 10^{-6} \times 10^{-6}$ g

$= 0.75 \times 10^{-6}$ g $10^{-6}$ = micro = μ

$= 0.75$ μg

**2. The length and width of a rectangular plate are (15.6 ± 0.1) cm and (10.80 ± 0.01) cm respectively. Calculate area of the plate and uncertainty in it.**





**Data:** Length of the plate l = (15.6 ± 0.1) cm, width of the plate w (10.80 ± 0.01) cm,

area of the plate with uncertainty = ?

Solution

- **%age uncertainty in length**
  - $= \frac{0.1}{15.6} \times 100$
  - $= 0.64\%$
- **%age uncertainty in width**
  - $= \frac{0.01}{10.80} \times 100$
  - $= 0.093\%$

Since in multiplication uncertainty is added so total uncertainty (%age)

$= (0.64 + 0.093)$ %

$= 0.732\%$

- **As area of rectangular plate, A = l x w**

A = 15.6 x 10.80 $cm^2$ with %age

Uncertainty 0.732%

A = 168.4 $cm^2$ with %age uncertainty of 0.732%

OR = (168.4 ± 1.22) $cm^2$

**3. The length of a pendulum is (100 ± 0.1) cm. If acceleration of a free fall is (9.8 ± 0.1) $ms^{-2}$, calculate the percentage uncertainty in time period of the pendulum.**

**Solution**





%age uncertainty in length

$= 0.1/100 \times 100$

$= 0.1\%$

%age uncertainty in acceleration due to gravity

$= 0.1/9.8 \times 100$

$= 1.02\%$

Total %age uncertainty

$= 0.1\% + 1.02\%$

$= 1.12\%$

%age uncertainty in time period of the pendulum

$= 1/2\ (1.12\%)$ $T = const\ \boxed{L^{\frac{1}{2}}}$

$= 0.6\%$

**Note.**

For power factor multiply the percentage uncertainty by that power. Since the power of $\frac{1}{2} = \frac{1}{2}$, that is why total %age uncertainty is multiplied by $\frac{1}{2}$.

**4. Theory suggests that drag force depends upon the viscosity of the medium, average radius of the object and velocity of the object moving through the fluid. Derive a formula for dragging force of fluid by using dimensional analysis.**

**Answer**

The dragging force depends on the following factors.





(a) Viscosity of the medium 'η'

(b) Radius of the object 'r'

(c) Velocity of the object 'v'

So the relation for the dragging force 'F' will be of the form

$F = Const\ \eta^a r^b v^c$ ..... (1)

Write the dimensions of Equation (1) on both sides we get

$[MLT^{-2}] = Const\ [ML^{-1}T^{-1}][L^b][LT^{-1}]^c$

$[MLT^{-2}] = Const\ [M]^{a+1}[L]^{-a+b+c}[T]^{-a-c}$ ..... (2)

Comparing the dimension of both sides we get

$[M]^1 = [M]^{a+1}$ ..... (3)

$[L]^1 = [L]^{-a+b+c}$ ..... (4)

$[T]^{-2} = [T]^{-a-c}$ ..... (5)

Equating the powers on both sides we get

$\boxed{a = 1}$ ..... (A)

$-a+b+c = 1$ ..... (B)

$-a-c = 2$

$a+c = 2$ ..... (C)

Put Equation (A) in (C) we get

$1+c = 2$

$\boxed{c = 1}$ ..... (D)

Equation (D) => $-1 +b +1 = 1$

$\boxed{b = 1}$

Substituting the values of a, b & c in equation (1)





$F = Const\ \eta^{-1} r^1 v^1$

$\boxed{F = Const\ \eta r v}$

**5. (a) Suppose that the displacement of an object is related to time according to the expression x = Bt², what are the dimensions of 'B'.**

**(b) A displacement is related to time as x = A sin (2ωt), where 'A' and 'T' are constants. Find the dimension of 'A'.**

**Solution:**

(a) Given that

$x = Bt^2$

$B = x/t^2$ ..... (1)

As dimension of 'x' is [L] and 'T' is [T], so Equation becomes

$[B] = \left[\frac{L}{T^2}\right]$

$B = [LT^{-2}]$

(b) Given that

$X = A \sin (2\omega t)$

$A = X/\sin 0$ ..... $2\omega t = 0$

$A = [L]/1$

$\boxed{A = [L]}$

**6. Carry out the following conversions.**





**(a) Calculate the density 1.33 x $10^{-3}$ $gcm^{-3}$ into $kgm^{-3}$**

**(b)Calculate a speed 20ms$^{-1}$ into kmh$^{-1}$**

**Solution**

a. $^{\bullet}$= 1.33 x $10^{-3}$ $gcm^{-3}$

$^{\bullet}$= 1.33 x $10^{-3}$ x $10^{-3}$ kg x $(10^{-2})^{-3}$ $m^{-3}$

$^{\bullet}$= 1.33 x $10^{-3+3+6}$ $kgm^{-3}$

$\boxed{= 1.33 \times 10^{6}\ kgm^{-3}}$

b. v = 20 $ms^{-1}$

$v = \frac{20 \times 3600}{1000}$ km/h

v =72 $kmh^{-1}$

**7. If there are No. = 6.02 x $10^{23}$ atoms in 4.0 g of helium what is the mass of helium atom.**

**Solution**

**Mass of helium atom**

$= \frac{\text{mass of He}}{\text{No.}}$

Putting values, we get

$= \frac{4.0\ g}{6.02 \times 10^{23}}$

$\boxed{\text{Mass of the He atom} = 6.6 \times 10^{-24}\ g}$

**8. Compute the following to correct significant digits.**

**(a)** 3.85 m x 3.9 m





$= 15.015\ m^2$

$= 15\ m^2$

**(b)** 1023 kg + 8.5489 kg

$= 1031.5489$ g

$= 1032$ kg

**(c)** $\pi 22/7$

$= 3.14285$

**(d)** $= \frac{1.67 \times 10^{-27}\ kg}{9.109 \times 10^{-31}\ kg}$

$\boxed{= 0.83 \times 10^{3}}$

**9. A rectangular metallic piece is (x.ro ± 0.01) cm we and (7.20 ± 0.01) cm long.**

**(a) Find the area of the rectangular metallic piece and uncertainty in area.**

Length 'l'= (7.20 ± 0.01) cm

Width 'w' = (3.70 ±0.01) cm

%age uncertainty in length

'l'= 0.01 / 7.20 x 100

= 0.139% ~

%age uncertainty in width

'w' = 0.01 / 3.70 x 100

'w' = 0.27%

Total %age uncertainty in area





= 0.4%

Area = 26.64 $cm^2$ with %age uncertainty 0.4%

A = (26.64 ± 0.1) $cm^2$

**10. Calculate the answer up to appropriate numbers of significant**

**(a)** 168.99 x 9

= 1520.91

= 1521

**(b)** 23.5 + 234

=257.59

=257.6

**(c)** $\frac{984.25}{80}$

= 12.303

= 12.3

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## Objective Type Questions & Answers

**Select the best answer for the following MCQs:**

**1. The branch of physics which is concerned with the ultimate particles of which the matter composed of is called,**
a. Atomic physics b. Nuclear physics c. Plasma physics
d. Particle physics

**2. Computer chips are made of,**
a. germanium b. silicon c. cadmium d. cobalt

**3. Electromagnetic theory was proposed by,**
a. Faraday b. Maxwell c. Yong d. Bohr

**4. Cathode rays were discovered in 1878 by,**
a. Crooks b. Roentgen c. J.J.Thomson d. Newton

**5. The first book of physics was written by,**
a. Maxwell b. Newton c. Faraday d. Aristotle

**6. The velocity of light was determined accurately by,**
a. Newton b Michelson c. Yong d. Fresnel

**7. The concept of an atom which central nucleus was introduced by,**
a. De Broglie b. Bohr field c. Rutherford d. J. J. Thomson

**8. Neutron was discovered by,**
a. Curie b. Fermi c. Lawrence d. Chadwick

**9. Quantum Mechanics was introduced by,**
a. G. P. Thomson b. De Broglie c. Heisenbergs d. Max Plancks

**10. Transistor was invented by,**
a. Edison b. Bardeen c. Thomson d. Faraday

**11. X-rays were discovered by,**
a. Edison b. Bardeen c. Thomson d. J.J. Thomson

**12. Who was the most outstanding theoretical physicist?**
a. Daniel b. Maxwell c. Ampere d. Young





**13. The base units in S.I. system are,**
a. four b. five c. six d. seven

**14. The S.I. unit of solid angle is,**
a. degree b. radian c. steradian d. candela

**15. Light year is unit of,**
a. time b. light c. radiation d. distance

**16. One light year is equal to,**
a. $9.46 \times 10^{-15}$ cm b. $9.46\times10^{-15}$ m c. $9.46\times10^{15}$ km d. $9.46 \times 10^{-15}$ m

**17. S.I unit of force is,**
a. Joule b. Watt c. Newton d. Joule-second

**18. One atto is equal to,**
a. $10^{-10}$ b. $10^{12}$ c. $10^{-15}$ d. $10^{-18}$

**19. One femto is equal to,**
a. $10^{12}$ b. $10^{15}$ c. $10^{-18}$ d. $10^{21}$

**20. The scientific notation of number 0.0023 is expressed as,**
a. $2.3 \times 10^{-3}$ b. $23 \times 10^{-4}$ c. $0.23 \times 10^{-2}$ d. $0.023 \times 10^{-1}$

**21. Significant figures in 0.0010 are,**
a. one b. two c. three d. four

**22. The systematic error may occur due to,**
a. zero error of instrument b. poor calibration of the instrument
c. incorrect marking d. all of these

**23. A precise measurement is the one which has,**
a. max precision b. absolute precision c. $10^{15}$ d. $10^{18}$

**24. The dimensions of pressure are:**
a. MLT b. $ML^1T^{-1}$ c. $ML^1T^{-2}$ d. $ML^2T^2$

**25. The dimensions of angular momentum are,**
a. MLT b. $ML^1T^{-1}$ c. $ML^1T^{-2}$ d. $ML^2T^2$

**26. The dimensions of work are,**
a. MLT b. $ML^1T^{-1}$ c. $ML^1T^2$ d. $ML^2T^2$





**27. The dimensions of power is,**
a. $ML^2T^2$ b. $ML^2T^{-1}$ c. $ML^1T^{-1}$ d. $ML^2T^2$

**28. The dimensions of density are,**
a. $ML^2$ b. $ML^3$ c. $ML^1$ d. $ML^2T^2$

**29. The dimensions of viscosity are,**
a. $ML^1T^2$ b. $ML^1T^2$ c. $ML^2T^2$ d. $ML^2T^1$

**30. The dimensions of gravitational constant are,**
a. $ML^1T^2$ b. $M^1L^3T^2$ c. $ML^2T^2$ d. $ML^2T^1$

**31. The dimensions of moment of inertia are,**
a. $ML^2$ b. $ML^{-2}$ c. ML d. $M^2L^2$

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