ICSE Board Class IX Physics Paper – 2 Solution

SECTION I

Answer 1

(a) 1 micro-century = 10^{-6} centuries = $10^{-6} \times 1000$ Y = $10^{-6} \times 365 \times 24 \times 60$ min = 52.6 min

So, 1 micro-century = 52.6 min, which is nearly equal to the length of one lecture period (approximately 50 min)

- (b) On the surface of earth, when lemonade is sucked with a soda straw, the pressure falls within the straw and the outside atmospheric pressure forces the lemonade up the straw. However, on the surface of the moon, there is no atmospheric pressure and hence, lemonade cannot be sucked with a soda straw.
- (c) Graph is useful in physics for finding and confirming the relationship between different variables e.g. stretching of a piece of metal wire and the load applied to it.
- (d) Total distance moved by the ball = Actual length of the path covered = h + h = 2h. Displacement of the ball = Shortest distance between its final and initial positions = 0
- (e) The time period of a simple pendulum is
 - i. directly proportional to the square root of its length (l), i.e. $T \propto \sqrt{I}$.
 - ii. inversely proportional to the square root of acceleration due to gravity (g), i.e.

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

(a) Yes, it will be an accelerated motion because the particle's velocity is changing due to continuous change in the direction of motion.

(b)

- i. A magnet attracts iron nails.
- ii. Squeezing of a toothpaste tube.
- iii. Stretching of a spring.
- iv. Pulling of a luggage trolley.
- (c) If a book is lying on a table, the two forces acting on it are:
 - i. The force exerted by the earth F_{BE} (downwards).
 - ii. The force exerted by the table F_{BT} (upwards). As the book is at rest (in equilibrium), the resultant $F_{BT} + F_{BE} = 0$, i.e. $F_{BT} = -F_{BE}$. These are equal and opposite forces but are acting on the same body. Hence, they are not an action-reaction pair.
- (d) Lake first freezes on the surface because water has the maximum density at 4°C and the densest part sinks to the bottom. So, the water at the bottom of the lake remains at 4°C and that on the top of it is at 0°C where it freezes by losing the heat to the environment.
- (e) A body with large reflectivity is a poor absorber of heat. Poor absorbers of heat are poor emitters.

Answer 3

- (a) When water in pipes freezes at sub-zero temperatures, it expands due to anomalous expansion. In a dripping tap, the expanding water always finds space. Thus, water pipes do not burst.
- (b) The super-consumer of resources is man.
- (c) Both forces will be equal in magnitude but opposite in direction as gravitational force between two bodies is a mutual force.
- (d) No, the virtual image is formed due to reflected divergent rays which can be converged on a screen by a suitable convex lens. In the eye, its convex lens does this job. Hence, the virtual image formed by the mirror serves as a virtual object for the eye lens (convex) and thus, produces a real image on the retina. Hence, the statement is correct.

(e)

- i. In a plane mirror, virtual image is of the same size as the object.
- ii. In a concave mirror, the virtual image is magnified.
- iii. In a convex mirror, the virtual image is always diminished in size.

Answer 4

(a) Periscope is an apparatus based on the principle of reflection at two parallel plane mirrors. It enables us to view the objects at a height/depth which are not visible directly.



(b) Given,
$$\lambda = 0.68$$
 m, T = 0.002 s, v =?
 $v = \frac{\lambda}{L} = \frac{0.68 \text{ m}}{0.68 \text{ m}} = 340 \text{ m/s}$

$$-\frac{1}{T} - \frac{1}{0.002 \text{ s}}$$

- (c) $d = 4 \text{ km} = 4000 \text{ m}, \quad t=12.5 \text{ s}, v=?$ $v = \frac{d}{t} = \frac{4000 \text{ m}}{12.5 \text{ s}} = 320 \text{ m/s}$
- (d) It is easier to start a car engine on a warm day than on a chilly day because battery gives more current on a warm day than on a chilly day. This is because, on a warm day, the internal resistance of battery is less as internal resistance decreases with a rise in the temperature.
- (e) A freely suspended magnet will rest in north-south direction with its north pole pointing towards the geographical north pole of the earth making some angle with the horizontal.

SECTION II

Answer 5

- (a) Ratchet is attached to the screw by a spring. Its function is to save the stud from the excess pressure exerted by the flat end of the screw when the flat end of the screw is brought in contact with the stud i.e. further rotation given to the ratchet does not press the flat end against the stud.
 - i. Pitch = $\frac{0.5 \text{ mm}}{1}$ = 0.5 mm = 0.05 cm ii. Least count of the screw gauge = $\frac{0.05 \text{ cm}}{100}$ = 0.0005 cm Diameter of the wire = 9 × 0.05 cm + 67 × 0.0005 cm = (0.45 cm + 0.0335 cm) = 0.4835 cm iii. Correct diameter = Observed diameter - correction = 0.48535 cm - (7 × 0.0005 cm) = 0.4800 cm
- (b) When the girl sits on the swing, the centre of gravity of the swing is lowered i.e. the effective length of the swing increases and hence, the time period increases. As frequency of oscillation is inversely proportional to the time period, the frequency of oscillation decreases.
- (c) Volume of a body is the space occupied by it.

Given: r =14 m, m=500 kg, ρ =? We know that, $\rho = \frac{Mass(m)}{Volume(V)} = \frac{500 \text{ kg}}{\frac{4}{3} \times \frac{22}{7} \times (1.4\text{m})^3} = \frac{500 \text{ kg}}{11.498 \text{ m}^3} = 43.48 \text{ kg/m}^3$

(a)

- i. Acceleration of car A = $\frac{(35 0) \text{ m/s}}{10 \text{ s}} = 3.5 \text{ m/s}^2$
- ii. Acceleration of car B between 2 s 5 s = $\frac{(25 0) \text{ m/s}}{3 \text{ s}} = 8.33 \text{ m/s}^2$
- iii. After 3 s velocity of both cars is 10 m/s and at 7s velocity of each car is 25 m/s.
- iv. Distance travelled by car A = Area of $\triangle OPQ$

$$= \frac{1}{2} \times PQ \times OQ = \frac{1}{2} \times 35 \text{ m/s} \times 10 \text{ s}$$
$$= 175 \text{ m}$$

Distance travelled by car B = Area of trapezium RTLQ

$$=\frac{1}{2} \times (8+5) \text{ s} \times 25 \text{ m} / \text{s} = 162.5 \text{ m}$$

Car A is ahead by 175 - 162.5 = 12.5 m

(b) Let a body be moving with initial velocity 'u'. After time 't', its velocity becomes 'v' and during this journey, uniform acceleration is 'a.'

We know that, $a = \frac{v - u}{t}$ v = u + at

i. Given : u = 0, t = 4s, g = 9.8 m/s²
h = ut +
$$\frac{1}{2}$$
 gt²
= 0 × 4s + $\frac{1}{2}$ (9.8 m/s²)×(4s)² = 78.4 m
ii. v = u +gt
= 0 + (9.8 m/s²) × 4 s = 39.2 m/s
iii. u = 39.2 m/s, v = 0, s = 0.8 m
v² = u² + 2as
0 = (39.2)² + 2a × 0.8
a = $-\frac{39.2 \times 39.2}{1.6}$ m / s²
a = -960.4 m/s²

(a) When a ball is allowed to roll on the floor, it ultimately stops because of the frictional force exerted on it by the ground. Thus, the state of uniform motion of the ball changes due to external force (friction). On the Earth, every change in uniform motion of a body can be related with some external force acting on it; However, in free space, where no external force acts, state of motion described by the Newton's first law can be obtained and experienced.

(b) Given $V_a = 330 \text{ m/s}$

t= 3 s Distance travelled by sound in air

$$d_a = V_a \times t$$

= 330 × 3 =990 m

 \div Time taken by sound to travel 990 m in water

$$=\frac{d_W}{V_W}=\frac{990 \text{ m}}{1650 \text{ m/s}}=0.6 \text{ s}$$

(c) Coefficient of linear expansion of a material is defined as the fractional change in length per unit change in its temperature when a rod of that material is heated (or cooled).

Coefficient of linear expansions (α) =

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Change in length (l_2 - l_1)
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\overline{\text{Original length } (l_1) \times \text{change in temperature}(t_2 - t_1)}
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Its SI unit is K⁻¹.

Thermal expansion of a solid depends on the following factors:

- i. Nature of the material.
- ii. Initial dimension of the solid.
- iii. Rise in temperature of the solid.

(a) Thermal expansion of gases:



Take a round bottom flask which is filled with air and closed with a one holed rubber cork. A narrow capillary tube is passed through the rubber stopper and the flask is supported on a tripod in an inverted position as shown in the figure; so that, the end of the capillary tube is under water. Now, heat the flask gently with a spirit lamp. You will observe bubbles coming out from the capillary tube. This shows that air has expanded on heating and it escapes from the flask. Like air, all other gases also behave in the same way.

(b) Number of divisions between lower fixed point (ice point) and upper fixed point (steam point) on Celsius scale = 100

$$\therefore \frac{8}{15} \text{ of Celsius scale} = \frac{8}{15} \times 100 = 53.33 \text{ }^{\text{O}}\text{C}$$

∴ Temperature of Celsius scale = (100 - 53.33) ^oC = 46.67 ^oC Temperature on Fahrenheit scale = $\frac{9}{5} \times C + 32 = \frac{9}{5} \times 46.67 + 32$ = 116.006 ^oF : 116.01 ^oF

(c)

- i. The infrared rays emitted from the sun have shorter wavelength than the infrared rays radiated from the earth.
- ii. A degree on Celsius scale is 1/100th part of the interval between the ice point and the steam point. A degree on Fahrenheit scale is 1/180th part of the interval between the ice point and the steam point.

- (a) Point object will be seen from different positions of the eye, but the image will be observed only when the reflected rays will enter into the eye. In position E_1 of the eye, both the object and the image will be seen while in position E_2 only the object will be seen.
- (b) Three applications of plane mirrors are:
 - i. Plane mirrors are used in many optical instruments.
 - ii. Plane mirrors are used in periscopes and kaleidoscopes.
 - iii. They are used in dressing rooms for viewing oneself.
- (c)
- i. Differences between sound waves and light waves:

Sound Waves	Light Waves
1. These waves require material medium for	1. These waves do not require material
their propagation.	medium for their propagation.
2. These are caused due to the vibrations of	2. These are caused due to varying electric
the particles of the medium.	and magnetic fields.
3. These waves have low speeds which vary	3. These waves have very high speed of
from medium to medium.	$3 \times 10^8 \mathrm{m/s}.$

ii. Speed of sound in gases < Speed of sound in liquids < Speed of sound in solids.

- (a) When a glass rod is rubbed with silk, the rod gets positively charged due to loss of electrons to the silk.
 - i. The leaves diverge as the positively charged glass rod is brought near the cap of a neutral electroscope. The leaves collapse as the rod is taken away.
 The positively charged glass rod attracts the electrons of the leaves to the cap. Hence, due to deficit of electrons on the leaves, they get positively charged and diverge because of repulsion between like charges. When the rod is removed, the electrons redistribute themselves. The cap and the leaves become neutral again. Therefore, the leaves collapse.
 - ii. On touching the cap with the finger momentarily, the leaves collapse and then diverge again as the rod is moved away. On touching the cap (with the rod kept near the cap), the free electrons at the cap cannot flow to earth as they are bound (by the force of attraction of the positive charge of the rod). But the deficit of electrons in the leaves of electroscope is compensated by the flow of electrons from the earth to the leaves. As the leave system becomes neutral, the leaves collapse. When the rod is removed, the free electrons at the cap spread throughout the cap, stem and leaves. Therefore, the leaves diverge due to the repulsion between the like charges on the leaves.
 - iii. The leaves diverge when the cap is touched with the rod and it remains diverged on removal of the rod. When the positively charged rod is touched to the cap of the neutral electroscope, the sharing of positive charge takes place i.e. electrons from the leaves, stem and cap move to the rod. Hence, the electroscope gets positively charged. The leaves diverge due to repulsion between the like charges on the leaves. On removing the rod, the leaves remain diverged because the electroscope remains positively charged.
- (b)
- i. The potential difference between points A and B is 1.5 V as the voltage in parallel combination of the cells remains the same.
- ii. In series combination, e.m.f. of cells is added i.e. 3 V which is twice the effective voltage in parallel arrangement of two cells.
- iii. The cells in a conventional flash light are connected in series.
- (c) Suspend each of the three bars separately by means of a thread. We will observe that one bar sets itself in a particular direction even after being disturbed and the other two can stay in any direction. The one having a fixed direction will be a permanent magnet. Remove this bar and bring it near the other bars. One of them will be attracted by the magnet bar at both the ends. This is the soft iron bar. The third bar will be of a non-magnetic substance.