# ICSE Board <br> Class IX Physics <br> Paper-3 Solution 

## SECTION I

## Answer 1

(a) Diameter of the Earth's orbit around the sun:
i. In A.U. unit $=2$ A.U
ii. In SI unit $=1.496 \times 10^{11} \mathrm{~m} \times 2=2.99 \times 10^{11} \mathrm{~m}$
(b) The ratio of time periods of the pendulums with masses 75 g and 125 g will be 1 because the time period of a simple pendulum is independent of its mass.
(c) Brass, iron are two substances which expand on heating.
(d) For the first 2seconds :
$u=0$
We know, $\mathrm{s}=\mathrm{ut}+\frac{1}{2} \mathrm{at}^{2}$
$\mathrm{x}=0 \times 2+\frac{1}{2} \times \mathrm{a} \times 2^{2}$
$=2 \mathrm{a}$
$\mathrm{a}=\frac{\mathrm{X}}{2}$
From first equation of motion,
$\mathrm{v}=\mathrm{u}+\mathrm{at}$
$v=0+\frac{x}{2} \times 2$
$\mathrm{v}=\mathrm{x}$------(i)
For the next 2 seconds :
$\mathrm{u}=\mathrm{x} \quad$ (Fromeqn (i))
Again, $s=u t+\frac{1}{2}$ at $^{2}$
$y=x \times 2+\frac{1}{2} \times \frac{x}{2} \times 2^{2}$
$y=3 x$
$\frac{x}{y}=\frac{1}{3}$
(e) The source of tension in a string on an atomic scale is the inter-atomic restoring force between the molecules.

## Answer 2

(a) Let $V_{B}$ be the volume of the wooden block and $\rho_{B}$ be its density,

Weight of the block $=V_{B} \rho_{B} g$
Volume of block immersed in brine solution $=\frac{3}{5} V_{B}$
Upthrust $=$ Weight of brine solution displaced by the block $=\frac{3}{5} \mathrm{~V}_{\mathrm{B}} \times 1.15 \times \mathrm{g}$
Since the block floats in the solution,
Weight of the block = Upthrust
$V_{B} \rho_{B} g=\frac{3}{5} V_{B} \times 1.15 \times g$
$\rho_{B}=\frac{3}{5} \times 1.15=0.69 \mathrm{~g} / \mathrm{cm}^{3}$
(b) The value of universal gravitational constant is SI unit $=6.67 \times 10^{-11} \mathrm{Nm}^{2} \mathrm{~kg}^{-2}$.
(c) An athlete run some distance before taking a jump so as to increase his speed and thus, his inertia of motion which helps him to jump a longer distance.
(d) The gap will decrease because the metal rod will expand on heating.
(e) Birds puff up their feathers in winter to trap a large amount of air. Air being a bad conductor, does not allow their body heat to flow out. Thus, birds feel warm.

## Answer 3

(a) The ozone molecules in the stratosphere absorb most of the biologically damaging ultraviolet radiations from the sun. It also plays a key role in the temperature structure of the earth.
(b) Let the required temperature be x ,
$\frac{F-32}{9}=\frac{K-273}{5}$
$\frac{x-32}{9}=\frac{x-273}{5}$
$5 \mathrm{x}-160=9 \mathrm{x}-2457$
$4 \mathrm{x}=2297$
$\mathrm{x}=574.25$
$\therefore 574.25^{\circ} \mathrm{F}=574.25 \mathrm{~K}$
(c) The resources which can be utilized continuously over a very long period of time are called renewable sources. For example: Air, water etc.
(d) Multiple images are seen due to successive reflections of light from the front surface and the back reflecting surface of the thick mirror
(e) The ray diagram is as given below:


## Answer 4

(a) The velocity of sound is independent of pressure but it increases with an increase in the temperature.
(b) No. of crests = 15-5 = 10

Distance between crests $=0.4 \mathrm{~m}$
Wavelength $=0.4 / 10=0.04 \mathrm{~m}$
(c) It does not necessarily indicate that the ball is positively charged. The ball could also be neutral since the rod could repel the electrons to the opposite side of the neutral ball and the closest side of the ball to the rod would then be negative. The neutral ball would then be attracted to the negatively charged rod.
(d) Yes, there will be an exchange of mass between the wool and the polythene because electrons are transferred from the wool to the polythene and electrons carry very small but finite mass.
(e)
i. For a current of 70 A for 20 s we will use a lead acid accumulator.
ii. For a current of 2 mA occasionally we will use a dry cell.

## SECTION II

## Answer 5

(a) No. of divisions on the vernier scale, $n=40$

Value of one main scale division, $x=1 \mathrm{~mm}$
Least count, $\mathrm{LC}=\frac{\mathrm{x}}{\mathrm{n}}=\frac{1}{40}=0.025 \mathrm{~mm}$
Main scale reading, MSR $=75 \mathrm{~mm}$
Since 12th vernier scale division coincides with the main scale division, $p=12$
Vernier reading $=\mathrm{p} \times \mathrm{LC}=12 \times 0.025=0.3 \mathrm{~mm}$
Total reading $=$ MSR + Vernier reading

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=75+0.3=75.3 \mathrm{~mm}
$$

Corrected reading $=75.3 \mathrm{~mm}-0.125 \mathrm{~mm}=75.175 \mathrm{~mm}$
(b) The graph between the effective length and (time period) ${ }^{2}$ of a simple pendulum is shown in the figure given below:


The value of acceleration due to gravity can be calculated by using the following relation:
$\mathrm{g}=\frac{4 \pi^{2}}{\text { (Slope of } \mathrm{T}^{2} \text { vs l graph) }}$
(c) Mass of block $=1.35 \mathrm{~kg}$

Volume of the block $=1.5 \times 10^{-3} \mathrm{~m}^{3}$
Density $=\frac{\text { mass }}{\text { volume }}=1.35 / 1.5 \times 10^{-3}=0.9 \times 10^{3}=0.9 \times 10^{3} \mathrm{~kg} / \mathrm{m}^{3}$
Yes, it will float on water because it has density less than that of water ( $1000 \mathrm{~kg} / \mathrm{m}^{3}$ ).

## Answer 6

(a)
i. Distance covered $=360 \mathrm{~m}=0.36 \mathrm{~km}$.
ii. Displacement $=0 \mathrm{~m}$; because the athlete has returned to his initial position.
iii. Average speed $=$ Total distance $/$ time $=\frac{0.36}{1 / 60}=21.6 \mathrm{~km} / \mathrm{hr}$.
iv. Average velocity $=$ Total displacement $/$ time $=\frac{0}{1 / 60}=0 \mathrm{~km} / \mathrm{hr}$.
(b)
i. Velocity-time graph is shown in the figure below.

ii. For time interval of 5-7 s,

Change in velocity $=7-10=-3 \mathrm{~m} / \mathrm{s}$
Time $=7-5=2 \mathrm{~s}$
Rate in change of velocity $=-3 / 2=-1.5 \mathrm{~m} / \mathrm{s}^{2}$
For time interval 7-10 s,
Change in velocity $=10-7=3 \mathrm{~m} / \mathrm{s}$
Time = 10-7 = 3 s
Rate of change in velocity $=3 / 3=1 \mathrm{~m} / \mathrm{s}^{2}$
For time interval of 10-15 s,
Change in velocity $=0-10=-10 \mathrm{~m} / \mathrm{s}$
Time $=15-10=5 \mathrm{~s}$
Rate of change of velocity $=-10 / 5=-2 \mathrm{~m} / \mathrm{s}^{2}$
(c)


The distance $s$ travelled by the object in time $t$ is given by $s=$ area of the trapezium OABC
$=\frac{1}{2}(O A+B C) \times O C$
But $\mathrm{OA}=\mathrm{u}, \mathrm{BC}=\mathrm{V}$ and $\mathrm{OC}=\mathrm{t}$
$\mathrm{s}=\frac{1}{2}(\mathrm{v}+\mathrm{u}) \mathrm{t}$
(1)

From velocity -timerelation $v=u+a t$,
Wehave,
$\mathrm{t}=\frac{\mathrm{v}-\mathrm{u}}{\mathrm{a}}$
Substiting the value of time ' t ' from equation
(2)into(1) weget
$\mathrm{s}=\frac{1}{2}(\mathrm{v}+\mathrm{u})\left[\frac{\mathrm{v}-\mathrm{u}}{\mathrm{a}}\right]=\frac{\mathrm{v}^{2}-\mathrm{u}^{2}}{2 \mathrm{a}}$
$\therefore 2$ as $=v^{2}-\mathrm{u}^{2}$

## Answer 7

(a) Newton's first law states that a body at rest or in uniform motion continues to be in its state of rest or motion unless an unbalanced force acts upon it.
According to Newton's second law, the rate of change of momentum produced in body is directly proportional to the net external force applied on it, i.e.
$\mathrm{F}=\frac{\mathrm{k}(\mathrm{v}-\mathrm{u})}{\mathrm{t}}$
where k is the constant of proportionality,
F is the net force applied
$v$ is the final velocity
$u$ is the initial velocity
t is the time
If no force acts on a body, $\mathrm{O}=\frac{\mathrm{k}(\mathrm{v}-\mathrm{u})}{\mathrm{t}}$
$\mathrm{v}=\mathrm{u}$
This means that in the absence of an applied force, a body continues in its previous state of rest or motion.
(b)
i. Yes, for example, in uniform circular motion, speed is constant but the direction of motion and hence, the velocity keeps on changing continuously.
ii. No, this is not possible.
iii. Yes, it is possible if the body is moving uniformly on a circular path. In such a motion, speed remains constant but the motion is accelerated due to change in the velocity because of the change in the direction of motion.
(c)
i. As the earth is attracting the ball with a force of 1 N , the ball will also attract the earth with the same force i.e. 1 N . The ball exerts a force of reaction on the earth.
ii. When a body is lying in a free falling lift or when the body is taken at the centre of the earth, its weight becomes zero.

## Answer 8

(a)
i. A pendulum which has a time period of 2 s is called a second's pendulum. Its effective length is 1 m .
ii. The time period increases on the surface of the moon.

It is because $T \propto \frac{1}{\sqrt{g}}$. Thus, as ' $g$ ' on moon decreases, the time period increases.
(b) The graph below depicts how the density of water changes with a change in the temperature from $0^{\circ} \mathrm{C}$ to $10^{\circ} \mathrm{C}$. The water shows anomalous behavior from $0^{\circ} \mathrm{C}$ to $4^{\circ} \mathrm{C}$.

(c) Ice box is made of two metal sheets with space in between filled with glass wool to provide heat insulation. Thus, the heat from outside is prevented from getting in and ice does not melt.

## Answer 9

(a) Angle of incidence $=90^{\circ}-30^{\circ}=60^{\circ}$

Angle of reflection $=$ Angle of incidence $=60^{\circ}$
Total angle turned by the ray of light = angle of reflection + angle of incidence

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=60^{\circ}+60^{\circ}=120^{\circ}
$$

(b)


The image forms at the centre of curvature itself. The image is real, inverted and of the same size as the object.
(c)
i. Distance travelled by a wave in time period $T=$ Wavelength $(\lambda)$ of the wave

So, velocity of the wave, $v=\frac{\text { Distance }}{\text { Time }}=\frac{\lambda}{\mathrm{T}}$
$\mathrm{v}=\frac{\lambda}{\mathrm{T}}=\left(\frac{1}{\mathrm{~T}}\right) \lambda$
But, $\frac{1}{T}=v$ (Frequency)
So, $v=u \lambda$
In other words, velocity of a wave is the product of its wavelength and frequency.
ii. No. of rarefactions $=8-3=5$

Distance between rarefactions $=50 \mathrm{~cm}$
Wavelength $=50 / 5=10 \mathrm{~cm}$

## Answer 10

(a)
i. The sphere $Q$ has negative charge and the sphere $P$ has positive charge because due to repulsion, the electrons move from $P$ to $Q$. These charges are developed due to electrostatic induction.
ii. None of the sphere has any charge because electrons redistribute themselves as soon as $\operatorname{rod} A$ is removed and both the spheres regain their original uncharged condition.
(b) The resistance of a wire depends on the following four factors:
i. The material of the wire - Good conductors of electricity having higher concentration of free electrons such as metals, offer less resistance.
ii. The length of the wire - A longer wire offers more resistance (Resistance is proportional to length).
iii. The area of cross section of the wire - A thicker wire offers less resistance (Resistance is inversely proportional to cross section.)
iv. The temperature of the wire - The resistance of the metallic wire increases with an increase in the temperature.
(c) On heating the magnet, the molecular magnets present in the magnet start vibrating and move out of the magnetic alignment. Hence, the magnet loses its magnetism. Neutral points are the points where the magnetic field of the magnet is equal in magnitude to the earth's horizontal magnetic field, but in the opposite direction. Thus, the resultant (or net) magnetic field at the neutral points is zero.

