Date: 22/11/2026

Question Paper Code

63

Aakash
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# Answers & Solutions

Time : 120 Minute

*for*

Max. Marks : 216

## Indian Association of Physics Teachers
## National Standard Examination in
## PHYSICS (NSEP) 2026

### INSTRUCTIONS TO CANDIDATES

(1) There are 60 questions in this paper. Attempt all the 60 Questions.

(2) Question paper has two parts. In **Part A-1** (Q. No. 1 to 48) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q. No. 12 (a) (●) (c) (d)

In **Part A-2** (Q. No. 49 to 60) each question has four alternatives, out of which **any number of alternative (s)** (1, 2, 3 or 4) may be correct. You have to choose ALL correct alternative(s) and fill the appropriate bubble(s), as shown.

Q. No. 52 (a) (●) (c) (●)

(3) For **Part A-1**, each correct answer carries **3 marks** whereas 1 mark will be deducted for each wrong answer. In **Part A-2**, you get **6 marks** if all the correct alternatives are marked. No negative marks in this part.

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## A - 1 (Attempt All Sixty Questions)

**ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION**

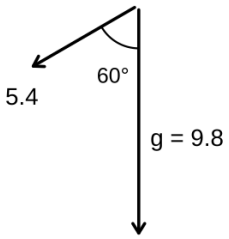
1. A spherical bob of mass 0.20 kg and diameter 2.0 cm, having uniform density, is attached to the end of a string of length 100 cm. This pendulum so formed is suspended from the ceiling of an elevator. The elevator is moving upward with an acceleration of 5.4 $ms^{-2}$ along an incline which makes an angle of 60 degree with vertical. The pendulum is made to oscillate about its mean position. Assuming that there is no aerial friction, the time period of oscillation of the pendulum is (given that acceleration due to gravity is 9.8 $ms^{-2}$)

(a) 1.28 s (b) 1.26 s

(c) 1.59 s (d) 1.79 s

**Answer (d)**

**Sol.**



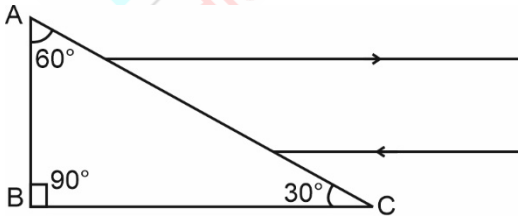

$g_{eff} = 13.34$

$T = 2 \times 3.14 \times \sqrt{\frac{1.01}{13.34}}$

$T = 1.72$ sec

Closest option is (d)

2. When light is incident on an interface between two media at an angle greater than $\theta_c \equiv \sin^{-1}\frac{1}{\mu}$ (where $\mu$ is the relative refractive index of the two media), it is totally reflected – a phenomenon known as total internal reflection. If the angle of incidence is smaller than $\theta_c$ light is partly reflected and partly refracted. A ray of light incident, parallel to the base, on a 30° - 90° - 60° prism, as shown, suffers two total internal reflections before emerging parallel but reversed in direction.




The condition on the critical angle for this to be possible is:

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(a) $\tan\theta_c < \frac{\sqrt{3}}{1+\sqrt{3}}$

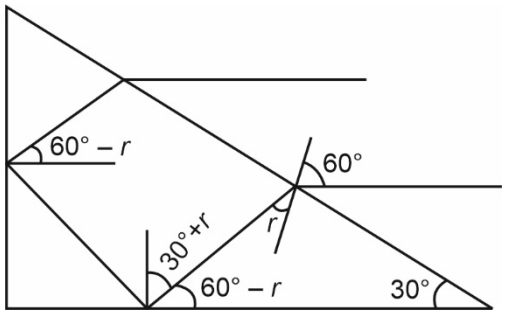
(b) $\tan\theta_c > \frac{\sqrt{3}}{1+\sqrt{3}}$

(c) $\sin\theta_c = \frac{\sqrt{3}}{1+\sqrt{3}}$

(d) $\sin\theta_c > \frac{\sqrt{3}}{1+\sqrt{3}}$

**Answer (a)**

**Sol.**




$$\sin 60° = \frac{\sin r}{\sin\theta_C}$$

$$30° + r > \theta_C$$

$$\sin r > \sin\theta_C \frac{\sqrt{3}}{2} - \cos\theta_C \frac{1}{2}$$

Also, $60° - r > \theta_C$

$$\sin r < \frac{\sqrt{3}}{2}\cos\theta_C - \frac{1}{2}\sin\theta_C$$

$$\frac{\sqrt{3}}{2}\sin\theta_C > \sin\theta_C \frac{\sqrt{3}}{2} - \cos\theta_C \frac{1}{2}$$

$$\frac{\sqrt{3}}{2}\sin\theta_C < \frac{\sqrt{3}}{2}\cos\theta_C - \frac{1}{2}\sin\theta_C$$

$$\sqrt{3} + 1(\tan\theta_C) < \sqrt{3}$$

3. A moving coil galvanometer has a coil with 175 turns and area 1 cm$^2$. It uses a torsion band of torsion constant $10^{-6}$ Nm/rad. The coil is placed in a magnetic field B parallel to its plane. The coil deflects by 1° for a current of 1 mA. The value of the magnetic field B (in Tesla) is approximately

(a) $10^{-2}$

(b) $10^{-3}$

(c) $10^{-1}$

(d) $10^{-4}$

**Answer (b)**

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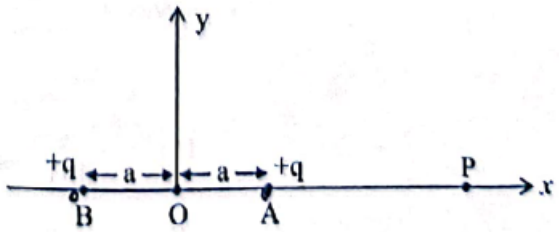
**Sol.** $BiNA\sin\alpha = k\theta$

$$B = \frac{10^{-6} \times \frac{\pi}{180}}{10^{-3} \times 175 \times 10^{-4}}$$

$$B = 99.73 \times 10^{-5}$$

$$B \approx 10^{-3}$$

4. The figure shows an arrangement of charges [–2q at O (0, 0), +q at A (a, 0) and +q at B (–a, 0)]. The electric field E at point P (r, 0) can be expressed as (for r >> a) $\vec{E} = \frac{1}{4\pi\in_0}\frac{\alpha Q}{r^n}\hat{r}$ (where $Q = qa^2$)




Choose the correct option.

(a) $\alpha = 3, n = 3$ (b) $\alpha = 3, n = 4$

(c) $\alpha = 6, n = 3$ (d) $\alpha = 6, n = 4$

**Answer (d)**

**Sol.** $$\vec{E} = \left[\frac{kq}{(r-a)^2} - \frac{k\cdot 2q}{r^2} + \frac{kq}{(r+a)^2}\right]\hat{r}$$

$$\vec{E} = kq\left[\frac{1}{(r-a)^2} + \frac{1}{(r+a)^2} - \frac{2}{r^2}\right]\hat{r}$$

$$\vec{E} = kq\left[\frac{2\left(r^2+a^2\right)}{\left(r^2-a^2\right)^2} - \frac{2}{r^2}\right]\hat{r}$$

$$\vec{E} = 2kq\left[\frac{r^2+a^2}{\left(r^2-a^2\right)^2} - \frac{1}{r^2}\right]\hat{r}$$

$$\vec{E} = 2kq\left[\frac{r^2\left(r^2+a^2\right) - \left(r^2-a^2\right)^2}{r^2\left(r^2-a^2\right)^2}\right]\hat{r}$$

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$$\vec{E} = 2kq\left[\frac{r^4 + r^2a^2 - r^4 - a^4 + 2r^2a^2}{r^2\left(r^2 - a^2\right)^2}\right]\hat{r}$$

$$\vec{E} = 2kq\left[\frac{3r^2a^2 - a^4}{r^2\left(r^2 - a^2\right)^2}\right]\hat{r}$$

$$\vec{E} = 2kqa^2\left[\frac{3r^2 - a^2}{r^2\left(r^2 - a^2\right)^2}\right]\hat{r}$$

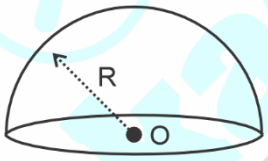
as $r >> a$ so

$$\vec{E} = 2kqa^2\left[\frac{3r^2}{r^2\left(r^2\right)^2}\right]\hat{r}$$

$$\vec{E} = \frac{6kqa^2}{r^4}\hat{r}$$

or $\vec{E} = \frac{6qa^2}{4\pi\varepsilon_0 r^4}$ so $\alpha = 6$ and $n = 4$

5. Charge Q coulomb is uniformly distributed throughout the volume of a solid hemisphere of radius R meter. The potential at the centre 'O' of the hemisphere in volts is




(a) $\frac{1}{4\pi\varepsilon_0}\frac{3Q}{2R}$

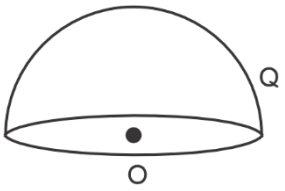
(b) $\frac{1}{4\pi\varepsilon_0}\frac{3Q}{4R}$

(c) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{4R}$

(d) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{8R}$

**Answer (a)**

**Sol.**




Due to symmetry,

$$V_0 = \frac{3K}{2}\frac{Q}{R} = \frac{3Q}{8\pi\varepsilon_0 R} = \frac{3Q}{4\pi\varepsilon_0 2R}$$

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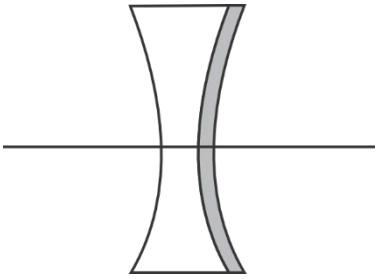
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6. The rear surface of an equi-concave lens of radius of curvature R and refractive index $\mu$ has been silvered; the lens behaves as a mirror. The focal length and the nature of the resulting mirror are



(a) $\frac{R}{2(2\mu-3)}$ converging

(b) $\frac{R}{2(2\mu-1)}$ converging

(c) $\frac{R}{2(2\mu+1)}$ diverging

(d) $\frac{R}{2(2\mu-1)}$ diverging

**Answer (d)**

**Sol.** $\frac{1}{F}=-\frac{1}{f_m}+\frac{2}{f_L}$

$=-\frac{2}{R}+2\left(-\frac{2(\mu-1)}{R}\right)$

$=-\frac{2}{R}-\frac{4(\mu-1)}{R}$

$\Rightarrow \frac{1}{F}=-\frac{2(2\mu-1)}{R}$

$F=-\frac{R}{2(2\mu-1)}$

$\because 2\mu>1 \Rightarrow F=-ve$

$\Rightarrow$ divergens

7. In Millikan's oil drop experiment, a charged drop falls vertically down with a terminal velocity $\nu$. If an electric field E is applied vertically upward, it moves with terminal velocity $2\nu$ in the upward direction. If the electric field reduces to $\frac{E}{2}$ then the terminal velocity of the drop becomes

(a) $\nu$

(b) $2\nu$

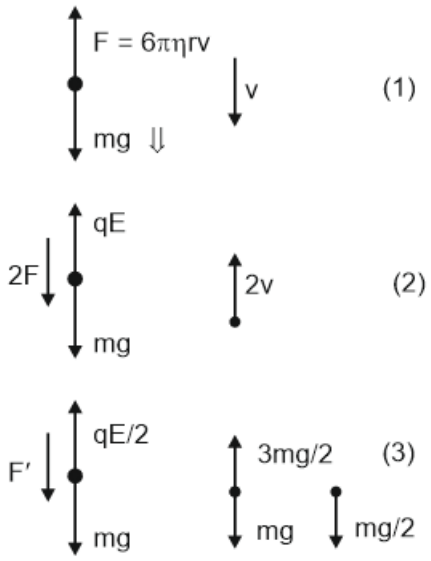
(c) $\frac{3}{2}\nu$

(d) $\frac{\nu}{2}$

**Answer (d)**

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**Sol.**




From (1) & (2)

F = mg

qE = 2F + mg

qE = 2 mg + mg

qE = 3mg

From (3)

$F' = \frac{F}{2}$

$\rightarrow \frac{v}{2}$

8. Seven equal positive charges of magnitude q each are placed at the seven corners of a cube of side $\ell$. The force experienced by a charge Q placed at the centre of the cube is (given = $K = \frac{1}{4\pi \in_0}$)

(a) Zero

(b) $\frac{2KQq}{3\ell^2}$

(c) $\frac{4KQq}{3\ell^2}$

(d) $\frac{7KQq}{3\ell^2}$

**Answer (c)**

**Sol.** Due to symmetry, forces due to 6 of 7q will cancel each other and net force would be due to single q.

$\therefore F_{net} = \frac{KqQ}{r^2}$

$\Rightarrow F_{net} = \frac{4KqQ}{3\ell^2}$

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9. The magnetic moment ($p_m$) and the moment of inertia ($I$) of a magnetic needle are $p_m = 8.7 \times 10^{-2}$ A.m$^2$ and I = 11.5 × 10$^{-6}$ kg.m$^2$ respectively. The magnetic needle performs 10 complete oscillations in 6.70 s when suspended in a uniform horizontal magnetic field **B**. The magnitude of the magnetic field is

(a) 2.10 mT (b) 11.6 mT

(c) 11.6 T (d) 1.5 T

**Answer (b)**

**Sol.** $\tau = mB\sin\theta$

$$T = 2\pi\sqrt{\frac{I}{MB}}$$

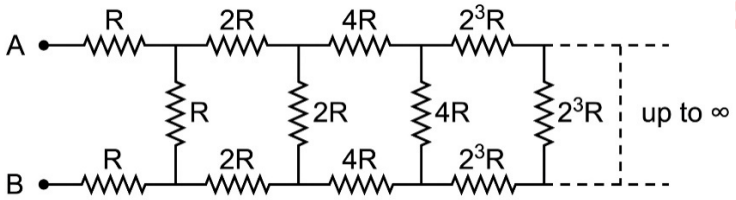
$$\frac{T^2}{4\pi^2} = \frac{I}{MB}$$

$$B = \frac{4\pi^2 I}{MT^2}$$

$$B = \frac{4\pi^2 \times 11.5 \times 10^{-6}}{8.7 \times 10^{-2} \times (0.67)^2}$$

$$= \frac{454}{39.05} \times 10^{-3} = 11.62\text{mT}$$

10. The resistance between the points A and B in the infinite circuit shown, in terms of R, is

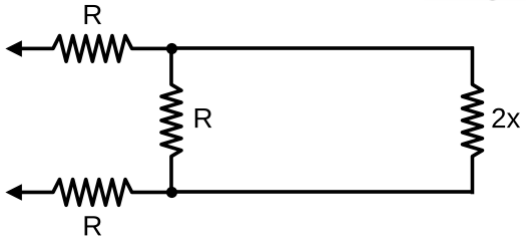



(a) $\frac{5+\sqrt{41}}{4}$R (b) $\frac{-5+\sqrt{41}}{4}$R

(c) $\frac{5+\sqrt{41}}{2}$R (d) $\left(\sqrt{3}+1\right)$R

**Answer (a)**

**Sol.**




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$$\frac{2xR}{2x+R}+2R=x$$

$$2x^2-5Rx-2R^2=0$$

$$x=\frac{5R+\sqrt{41}R}{4}$$

$$R\left(\frac{5+\sqrt{41}}{4}\right)$$

11. Work function of metal A is equal to the ionisation energy of the hydrogen atom in the first excited state. Work function of metal B is equal to the ionisation energy of singly-ionised helium atom in the second orbit. Photons of the same energy E are incident on the two metals A and B. Maximum kinetic energy of photoelectrons emitted from metal A is twice that of the photoelectrons emitted from metal B. The value of the photon energy E is

(a) 20.8 eV (b) 32.2 eV

(c) 24.6 eV (d) 23.8 eV

**Answer (d)**

**Sol.** $\Phi_A=\frac{13.6}{4}=3.4$

$$\Phi_B=\frac{13.6\times4}{4}=13.6$$

$$E=\Phi_A+k\cdot E_A$$

$$E=3.4+k\cdot E_A$$

$$E=13.6+k\cdot E_B$$

$$(E-3.4)=2(E-13.6)$$

$$E=23.8$$

12. During an excavation in the ancient volcanic caves, an archaeologist discovered a sample of a rare mineral trapped inside a sealed rock chamber. Laboratory analysis of the sample showed that the mineral originally contained a radioactive isotope X, which decays into a stable element Y. The radioactive isotope has a half-life T = $10^4$ year. Due to contamination from underground water, 20 % of the stable element got washed away before the sample was analysed. At the time of the analysis, the ratio of remaining (undecayed) radioactive isotope X to stable element Y in the sample is found to be 1: 5.6. Assuming that no radioactive material X was lost from the sample, the archaeologist claimed that the actual age of the rock is

(a) 1 × $10^4$ year (b) $\sqrt{3}\times10^4$ year

(c) 3 × $10^4$ year (d) $2\sqrt{3}\times10^4$ year

**Answer (c)**

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**Sol.**

| | X | → | Y |
|---|---|---|---|
| at t = 0 | $N_0$ | | 0 |
| t | $N$ | | $N_0 - N$ |

Given 20% washed away

$N_Y = 0.8(N_0 - N)$

$$\frac{N}{0.8(N_0 - N)} = \frac{1}{5.6}$$

$$N = \frac{N_0}{8}$$

$$N = \frac{N_0}{2^3}$$

$t = 3T_{1/2}$

$t = 3 \times 10^4$ year

13. Two identical particles of mass m each are moving in circular orbits under a central potential given by $V(r) = \frac{K}{r^n}$, where $K$ is a constant. If the radii of their orbits are $r_1$ and $r_2$ while the time periods are $T_1$ and $T_2$ respectively, the correct mathematical relation is

(a) $T_1^2 r_1^{-(n+2)} = T_2^2 r_2^{-(n+2)}$

(b) $T_1^2 r_1^{-3} = T_2^2 r_2^{-3}$

(c) $T_1^2 r_1^{-(2n-1)} = T_2^2 r_2^{-(2n-1)}$

(d) $T_1^2 r_1^{-(n+1)} = T_2^2 r_2^{-(n+1)}$

**Answer (a)**

**Sol.** $V(r) = \frac{K}{r^n}$

$$U = \frac{mK}{r^n}$$

$$F = -\frac{dU}{dr} \propto \frac{1}{r^{n+1}}$$

$$\& \; F = \frac{mv^2}{r}$$

$$\therefore v^2 \propto \frac{1}{r^n}$$

$$\& \; v \propto \frac{1}{r^{n/2}}$$

$$\& \; T \propto r^{n/2+1}$$

$$\text{or } T \propto r^{\frac{n+2}{2}}$$

$$\text{or } T^2 \propto r^{n+2}$$

$$\text{or } T^2 r^{-(n+2)} = \text{const.}$$

$$\therefore \; T_1^2 r_1^{-(n+2)} = T_2^2 r_2^{-(n+2)}$$

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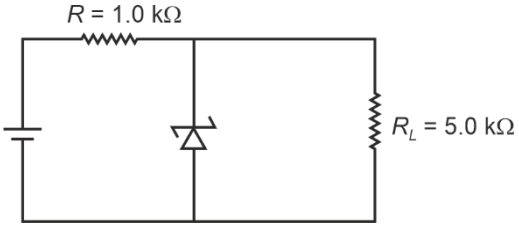
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14. The figure represents a voltage regulator circuit using a zener diode. The breakdown voltage of the zener diode is 5.5 V and the load resistance is 5 kilo ohm. The series resistance R is 1 kilo ohm. If the battery voltage varies from 8 V to 14 V then what is the minimum and maximum value of current through the zener diode?




(a) 2.5 mA, 8.5 mA
(b) 1.4 mA, 7.4 mA
(c) 1.1 mA, 1.1 mA
(d) 0.5 mA, 1.5 mA

**Answer (b)**

**Sol.** $V_Z = 5.5\ \text{V}$

$R_L = 5\ \text{k}\Omega$

$R = 1\ \text{k}\Omega$

$\therefore$ For the given circuit, the Zener diode will allow current beyond 5.5 volt.

$\therefore$ At 8 V battery, the current through the Zener diode will be minimum, and at 14 V it will be maximum.

At 8 V, $i_L = \dfrac{5.5}{5\ \text{k}\Omega} = 1.1\ \text{mA}$

& $i_R = 2.5\ \text{mA}$

$\therefore i_{Z\text{min}} = 1.4\ \text{mA}$

At 14 V, $i_L = 1.1\ \text{mA}$

& $i_R = 8.5\ \text{mA}$

$\therefore\ i_{Z\text{max}} = 7.4\ \text{mA}$

15. Two coherent electromagnetic plane waves, of exactly equal amplitude, propagating with a very small angle of divergence $\psi$, fall almost normally on a distant screen to produce interference fringes with a separation (fringe width) $\bar{x} = 1.0$ mm between neighbouring maxima. The wavelength of light is $\lambda$ = 6000 Å. The angle of divergence $\psi$

(a) is estimated to be $\psi$ = 6.0 milliradians
(b) is estimated to be $\psi$ = 0.6 milliradians
(c) is estimated to be $\psi$ = 1.2 milliradians
(d) cannot be estimated from this data

**Answer (b)**

**Sol.** fringe width $= \dfrac{\lambda D}{d} = \bar{x}$

$\dfrac{\lambda}{d/D} = \bar{x}$

$\dfrac{\lambda}{\psi} = \bar{x}$

$\psi = \dfrac{\lambda}{\bar{x}} = \dfrac{6000 \times 10^{-10}}{1 \times 10^{-3}}$

$\Rightarrow\ \psi$ = 6.0 milliradians

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16. In a line-of-sight radio communication, there is a distance of about 50 km between transmitting and receiving antennas. If the height of the receiving antenna is 70 m, then the minimum height of the transmitting antenna should be (Radius of the Earth = 6400 km)

(a) 20 m (b) 51 m

(c) 32 m (d) 40 m

**Answer (c)**

**Sol.** $d = \sqrt{2R_e h_t} + \sqrt{2R_e h_R}$

$50000 = \sqrt{2\times 6400\times 10^3 h_t} + \sqrt{2\times 6400\times 10^3 \times 70}$

$\left(\sqrt{20h_t} + \sqrt{1400}\right)800 = 50000$

$\Rightarrow h_t \simeq 31.45\,\text{m}$

Nearest answer is 32

So, option (c)

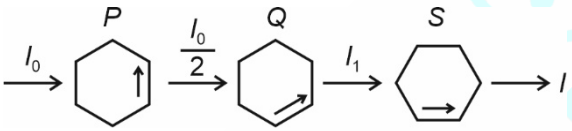
17. In an arrangement, three polarisers P, Q and S have been set up in sequence such that transmission axis of S is crossed with respect to that of P. The transmission axis of Q is inclined at 60° to the transmission axis of S. When a beam of unpolarised light of intensity $I_0$ is incident on P, the intensity of light transmitted by the three polarisers in succession is I. The ratio I : $I_0$ is equal to

(a) 1 : 16 (b) 3 : 16

(c) 3 : 32 (d) 10 : 18

**Answer (c)**

**Sol.**




$\theta_1 = 30°$ $\theta_2 = 60°$ as *P* & *S* are at 90°

$I_1 = \frac{I_0}{2}\cos^2 30°$

& $I = I_1 \cos^2 60°$

$\Rightarrow I = \frac{I_0}{2}\cos^2 60° \times \cos^2 30°$

$= \frac{I_0}{2}\times\frac{3}{16}$

So, $\frac{I}{I_0} = \frac{3}{32}$

Option (c)

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18. A solid sphere of mass m and radius R rolls without slipping on a horizontal surface. It collides with a light spring of stiffness constant K with kinetic energy E. If the surface under the spring is smooth (frictionless), then the maximum compression of the spring is

(a) $\sqrt{\frac{2E}{K}}$ (b) $\sqrt{\frac{10E}{7K}}$

(c) $\sqrt{\frac{E}{K}}$ (d) $\sqrt{\frac{7E}{10K}}$

**Answer (b)**

**Sol.** As the surface below is smooth so only translational it will convert in *PE*.

$$E = \frac{1}{2}mv^2 + \frac{1}{2}\cdot\frac{2}{5}mR^2\cdot\frac{v^2}{R^2}$$

$$\Rightarrow E = \frac{1}{2}mv^2\left(1+\frac{2}{5}\right) = \frac{1}{2}mv^2\times\frac{7}{5}$$

$$\Rightarrow KE_T = \frac{5E}{7}$$

Now, $\frac{1}{2}kx^2 = \frac{5E}{7}$

$$\Rightarrow x = \sqrt{\frac{10E}{7k}}$$

19. When a mass of 9.0 kg is suspended vertically from the free end of the wire of a sonometer, it resonates with a given tuning fork forming standing waves with five antinodes between the two bridges. When the 9.0 kg mass is replaced by another unknown mass M, the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. The mass M is

(a) 5.4 kg (b) 15 kg

(c) 25 kg (d) 35 kg

**Answer (c)**

**Sol.** For 5 Antinodes the string is in $5^{th}$ harmonic

So, $f = \frac{5}{2l}\sqrt{\frac{T_1}{\mu}}$ ...(I)

$T_1 = 9g$

Now for another mass *M*.

We have $f = \frac{3}{2l}\sqrt{\frac{Mg}{\mu}}$ ...(II)

So, from (I) and (II)

$$\frac{5}{2l}\sqrt{\frac{9g}{\mu}} = \frac{3}{2l}\sqrt{\frac{Mg}{\mu}}$$

$$\Rightarrow \frac{25\times 9g}{\mu} = \frac{9\times Mg}{\mu}$$

$$\Rightarrow M = 25 \text{ kg}$$

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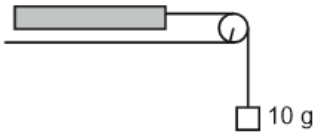
20. A thin rectangular metal plate of surface area 0.1 $m^2$ is placed on a large horizontal table. There are a few drops of a liquid between the metal plate and the table forming a thin liquid layer of 0.3 mm thickness. The plate is pulled horizontally with the help of a string passing over a massless and frictionless fixed pulley. When a mass of 10 g is attached to the vertically hanging free end of the string, the plate is observed to move gently towards the pulley with a constant speed of 8.5 $cms^{-1}$. The coefficient of viscosity of the liquid is approximately

(a) 3.5 Pascal-s (b) 0.035 Pascal-s

(c) 0.0035 Pascal-s (d) 0.0025 Pascal-s

**Answer (c)**

**Sol.**




$$\left(\frac{10}{1000}\right)g = \eta \cdot A\frac{dv}{dz}$$

$$\Rightarrow \frac{1}{10} = \eta \cdot \frac{1}{10} \times \frac{8.5 \times 10000}{100 \times 3}$$

$$\Rightarrow \eta = \frac{3}{850} \approx 3.53 \times 10^{-3} \text{ Pa-s}$$

$$\Rightarrow \eta \approx 0.0035 \text{ Pa-sec}$$

21. In an experiment for determination of the focal length of a thin convex lens, the object distance is measured as 15 cm with 1% error and the image distance is measured as 30 cm with 2% error. From the given data, the focal length of the lens is estimated with n% error. The value of n is

(a) 1.33 (b) 3

(c) 0 (d) 2

**Answer (a)**

**Sol.** $\frac{1}{15} + \frac{1}{30} = \frac{1}{f}$

$$f = 10\,cm$$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\frac{df}{f^2} = \frac{du}{u^2} + \frac{dv}{v^2}$$

$$\frac{df}{f} = 10\left[\frac{du}{u}\cdot\frac{1}{u} + \frac{dv}{v}\cdot\frac{1}{v}\right]$$

$$\frac{df}{f} \times 100 = 10\left[\frac{du}{u} \times 100 \cdot \frac{1}{u} + \frac{dv}{v} \times 100 \cdot \frac{1}{v}\right]$$

$$= 10\left[\frac{1\%}{15} + \frac{2\%}{30}\right]$$

$$= \frac{4}{3}\%$$

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22. The Earth is revolving around the Sun in a circular orbit with a period of revolution equal to 1 year. Suppose that during its motion around the Sun, the mass of the Sun doubles suddenly, the time period of revolution of the Earth will then become

(a) $\frac{1}{\sqrt{2}}$ year (b) $\frac{2\sqrt{2}}{3\sqrt{3}}$ year

(c) $\frac{2}{3\sqrt{3}}$ year (d) $\frac{1}{2\sqrt{2}}$ year

**Answer (c)**

**Sol.** $v_0 = \sqrt{\frac{GM}{R}}$

$T = \frac{2\pi R^{3/2}}{\sqrt{GM}} = 1$ year

After the mass of the sun becomes double:

$E = \frac{1}{2}mv_0^2 - \frac{G\cdot 2M\cdot m}{R} = -\frac{G\cdot 2M\cdot m}{2a}$

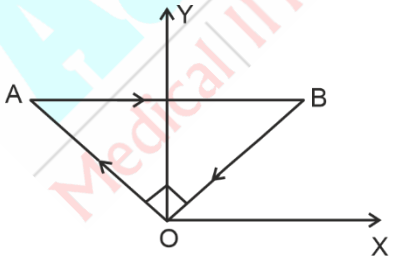
$\frac{1}{2}m\left(\frac{GM}{R}\right) - \frac{G\cdot 2M\cdot m}{R} = -\frac{GMm}{a}$

$a = \frac{2R}{3}$

$T' = \frac{2\pi\left(\frac{2R}{3}\right)^{3/2}}{\sqrt{G\cdot 2M}}$

$T' = \frac{2\pi R^{3/2}}{\sqrt{GM}}\cdot\frac{2}{3\sqrt{3}} = \frac{2}{3\sqrt{3}}$ year

23. Three metallic wires form an isosceles right-angled triangle AOB with wire AB parallel to x-axis and the vertex O at the origin. The length of the wire OA = length OB = $2\sqrt{2}$ m. A current of 10 A flows in the loop along OABO. A magnetic field $\vec{B} = 2.5(\hat{i} - \hat{k})$ T exists in the region $y \geq 1$. The force acting on the triangle due to this field is



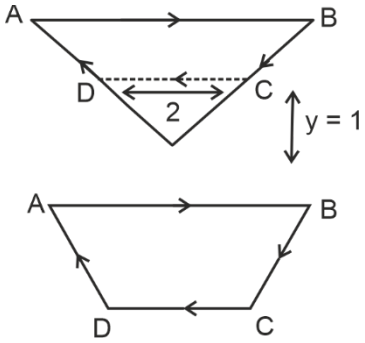

(a) $50\hat{j}$N (b) $50(\hat{i} + \hat{k})$N

(c) $50(\hat{j} + \hat{i})$N (d) Zero

**Answer (a)**

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**Sol.**







$\underline{F}_{net}$ on loop is zero

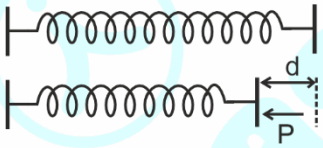
$\left|\vec{F}_{CD}\right| = F$ on wire DABC

$\vec{F}_{CD} = 10\times(-2\hat{i})\times 2.5\left(\hat{i}-\hat{k}\right)$

$= -50\hat{j}$

$F$ on DABC $= 50\hat{J}$

24. A spring is in a compressed state under the action of a constant force P. Compression of the spring is d. Suppose direction of the force is reversed suddenly with its magnitude changed to 2P; the maximum extension of the spring will now be




(a) 2d (b) 3d

(c) 4d (d) 5d

**Answer (d)**

**Sol.** $P = Kd \Rightarrow K = \dfrac{P}{d}$

$W_{ext} + W_{spring} = \Delta K = 0$

$2P\left[x_m + d\right] - \dfrac{1}{2}K\left(x_m^2 - (-d)^2\right) = 0$

$2P\left(x_m + d\right) = \dfrac{1}{2}K\left(x_m + d\right)\left(x_m - d\right)$

$\Rightarrow \quad 2Kd = \dfrac{1}{2}K\left(x_m - d\right)$

$\Rightarrow \quad 4d = x_m - d$

$\therefore \quad x_m = 5d$

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25. In a process, one mole of a monoatomic gas is heated from initial temperature 27°C, in such a way that its molar heat capacity is constant equal to 2R. During the process, volume of the gas is doubled. The final temperature of the gas becomes

(a) 108°C (b) 927°C

(c) 527°C (d) 2127°C

**Answer (b)**

**Sol.** $n = 1$

$T_1$ = 300 K

$$C = C_v + \frac{R}{1-x}$$

$$\Rightarrow 2R = \frac{3R}{2} + \frac{R}{1-x}$$

$$x = -1$$

$$\Rightarrow PV^{-1} = \text{constant}$$

$$\therefore TV^{-2} = \text{constant}$$

$$\therefore \frac{T_2}{T_1} = \left(\frac{V_2}{V_1}\right)^2$$

$$\Rightarrow \frac{T_2}{300} = 2^2$$

$$\therefore T_2 = 1200 \text{ K}$$

or $T_2$ = 927 °C

26. When placed in a liquid of density $d_1$, a solid sphere sinks displacing a volume V of the liquid. When placed in a second liquid of density $d_2$, the same sphere floats with half of its volume appearing over the surface of the liquid. When placed in a third liquid of density $d_3$, the same sphere floats with $\frac{1}{4}$th of its volume over the surface of the liquid. The buoyant force exerted by the liquid of density $d_3$ on the sphere is

(a) $Vd_3g$ (b) $\frac{1}{2}Vd_1g$

(c) $\frac{1}{2}Vd_2g$ (d) $\frac{1}{4}Vd_3g$

**Answer (c)**

**Sol.** For liquid 1: Sphere sinks

∴ Volume of sphere = $V$

**For 2:**

$$V_{in,2} = \frac{V}{2}$$

$$\therefore mg = F_{B2} = \frac{Vd_2g}{2}$$

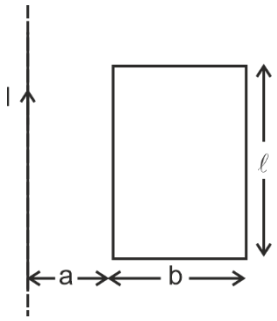
**For 3:**

∵ the sphere is in equilibrium.

$$F_{B3} = mg = \frac{Vd_2g}{2} = \frac{3V}{4}d_3g$$

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27. A flat rectangular $\ell \times b$ loop and a long straight wire lie in the same plane (see figure). Current in the wire varies according to $I = I_0 \sin\omega t$. The amplitude of emf induced in the loop is




(Given b =2a)

(a) $\left[\frac{\mu_0 \omega I_0 \ell}{2\pi} \ln 3\right]$

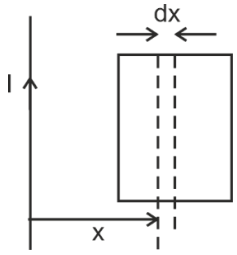
(b) $\left[\frac{\mu_0 \omega I_0 \ell}{2\pi} \ln 2\right]$

(c) $\left[\frac{3\mu_0 \omega I_0 \ell}{2\pi}\right]$

(d) $\left[\frac{\mu_0 \omega I_0 \ell}{\pi}\right]$

**Answer (a)**

**Sol.** For flux $\phi$




$$d\phi = \frac{\mu_0 I}{2\pi x} \times \ell dx$$

$$\int_0^{\phi} d\phi = \frac{\mu_0 I \ell}{2\pi} \int_a^{a+b} \frac{dx}{x}$$

$$\phi = \frac{\mu_0 I \ell}{2\pi} ln\left(\frac{a+b}{a}\right)$$

or $\phi = \frac{\mu_0 I_0 \ell}{2\pi} \ln\left(\frac{a+b}{a}\right) \cdot \sin\omega t$

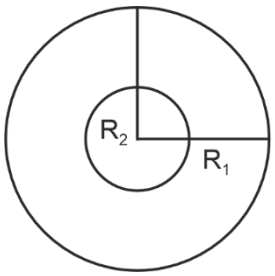
so, $Emf = -\frac{d\phi}{dt} = -\frac{\mu_0 I_0 \omega \ell}{2\pi} ln\left(\frac{a+b}{a}\right) cos\,\omega t$

so, Emf amplitude $= \frac{\mu_0 I_0 \omega \ell}{2\pi} \ln\left(\frac{a+b}{a}\right)$

$= \frac{\mu_0 I_0 \omega \ell}{2\pi} \ln 3$

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28. There are two concentric and coplanar coils of radii $R_1$ and $R_2$ ($R_1 >> R_2$), and number of turns $N_1$ and $N_2$ respectively. The current in the second (smaller) coil is changing at a constant rate $\frac{dI_2}{dt} = k$. The magnitude of induced emf in the first (larger) coil will be




(a) $\frac{\mu_0 \pi N_1 N_2}{2}\sqrt{R_1 R_2}k$

(b) $\mu_0 \pi N_1^2 N_2 \frac{R_2^2}{2R_1}k$

(c) $\mu_0 \pi N_1 N_2 \frac{R_1^2}{2R_2}k$

(d) $\mu_0 \pi N_1 N_2 \frac{R_2^2}{2R_1}k$

**Answer (d)**

**Sol.** For mutual inductance, let the current in the outer loop be $I$, so

$$\phi = \frac{\mu_0 I N_1}{2R_1} \times \pi R_2^2 N_2$$

So, $M = \frac{\mu_0 \pi R_2^2 N_1 N_2}{2R_1}$

So, if the current in inner loop is $I_2$, so flux $\phi$ in the outer loop is

$$\phi = MI_2$$

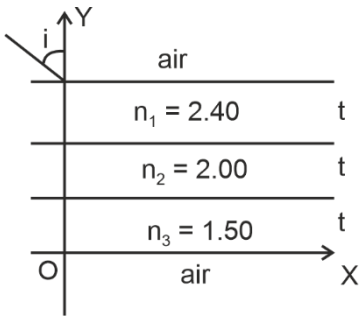
$$\phi = \frac{\mu_0 \pi R_2^2}{2R_1} N_1 N_2 I_2$$

So, $Emf = \frac{\mu_0 \pi N_1 N_2 R_2^2}{2R_1}\frac{dI_2}{dt}$

$$= \frac{\mu_0 \pi N_1 N_2 R_2^2}{2R_1}k$$

29. A beam of light in air is incident at an angle of incidence $i$ = 75° on a large block made of three parallel layers of different transparent materials stacked on top of each other, as shown. The thickness of each layer is t = 10.0 cm. Refractive indices of the three successive layers with respect to air are $n_1$ = 2.40, $n_2$ = 2.00 and $n_3$ = 1.50 respectively. The beam of light emerges from the third medium on the X axis at a distance $\xi$ from O. The value of $\xi$ is

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(a) 30.3 cm (b) 23.4 cm

(c) 18.3 cm (d) 9.02 cm

**Answer (c)**

**Sol.** Let angle of refraction in $n_1$ is $\theta_1$, in $n_2$ is $\theta_2$ and in $n_3$ is $\theta_3$ so

Using Snell's law

$\sin 75^\circ = 2.4\sin\theta_1 = 2\sin\theta_2 = 1.5\sin\theta_3$

$\Rightarrow \theta_1 \simeq 23.7^\circ,\ \theta_2 \simeq 28.88^\circ$ and $\theta_3 \simeq 40.01^\circ$

So, distance *OE* = Summation of shift in all the 3 medium

So, $OE = \left(10\tan\theta_1 + 10\tan\theta_2 + 10\tan\theta_3\right)$ cm

= 10 × 1.83 cm

*OE* = 18.3 cm approx.

30. A uniform rod AB of weight W is symmetrically suspended with the help of two identical un-stretchable light strings (1) and (2) of equal length from a rigid horizontal support. The rod is horizontal. The tension in the string (1), immediately after the string (2) is burnt, would be

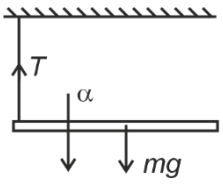



(a) W (b) $\frac{3W}{4}$

(c) $\frac{W}{2}$ (d) $\frac{W}{4}$

**Answer (d)**

**Sol.**




Just after 2 is burnt

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$$mg - T = m\alpha\frac{l}{2} \quad \ldots(1)$$

and $\quad mg\frac{l}{2} = \frac{ml^2}{3}\alpha$

$$\Rightarrow \quad \alpha = \frac{3g}{2l} \quad \ldots(2)$$

$$mg - T = m \times \frac{3g}{2l} \times \frac{l}{2}$$

$$\Rightarrow T = \frac{mg}{4} = \frac{W}{4}$$

31. Speed of sound is measured in a confined gas and found to be 0.632 times the RMS velocity ($V_{rms}$) of the gas molecules as determined from the temperature. The degree of freedom f and molar heat capacity $C_y$ at constant volume of the ga are

(a) f = 10, $C_V$ = 5R (b) f = 6, $C_V$ = 3R

(c) $f = 5,\ C_V = \frac{5}{2}R$ (d) $f = 3,\ C_V = \frac{3}{2}R$

**Answer (a)**

**Sol.** $V_{(Sound)} = \sqrt{\frac{\lambda P}{P}} = \sqrt{\frac{\lambda RT}{M}}$

And $V_{rms}^2 = \frac{3RT}{M}$

So $V_{(sound)} = 0.632\ V_{rms}$

$$\Rightarrow \quad \frac{\lambda RT}{M} = (0.632)^2 \cdot \frac{3RT}{M}$$

$$\Rightarrow \quad \lambda = (0.632)^2 \times 3 \approx 1.2$$

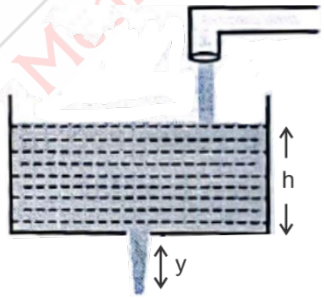
So $\frac{f+2}{f} = 1.2$

$\Rightarrow$ f + 2 = 1.2f

$\Rightarrow$ 2 = 0.2f

$\Rightarrow$ f = 10 so $C_V$ = 5R

32. In a wide container, water is always filled up to a height h. There is a nozzle (hole) of radius $r_0$ at its bottom. For some distance below the nozzle, water falls in a laminar stream. Radius r of stream as a function of y below the nozzle is expressed as [ignore the viscosity of water]




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(a) $r = \dfrac{r_0}{\left(1+\dfrac{y}{h}\right)^{\frac{1}{2}}}$

(b) $r = \dfrac{r_0}{\left(1+\dfrac{y}{h}\right)^{\frac{1}{4}}}$

(c) $r = r_0\left(1+\dfrac{y}{h}\right)^{\frac{1}{2}}$

(d) $r = \dfrac{r_0}{\left(1+\dfrac{h}{y}\right)^{\frac{1}{4}}}$

**Answer (b)**

**Sol.** $\pi r_0^2 v_0 = \pi r_0^2 v_1$

$v_0 = \sqrt{2gh}$ and $v_y^2 = v_0^2 + 2gy$

So $r_0^2\sqrt{2gh} = r^2\sqrt{2g(h+y)}$

$\Rightarrow \quad r_0^2 = r^2\sqrt{\dfrac{h+y}{h}}$

$\Rightarrow \quad r_0^2 = r^2\sqrt{1+\dfrac{y}{h}}$

$\Rightarrow \quad r = \dfrac{r_0}{\left(1+\dfrac{y}{h}\right)^{\frac{1}{4}}}$

33. A point object of mass m starts moving from rest along *x* axis from the origin, under the action of a force which delivers a constant power P. The position *x* of the object at time is

(a) $x = \left(\dfrac{8Pt^3}{9m}\right)^{\frac{1}{2}}$

(b) $x = \left(\dfrac{9Pt^3}{8m}\right)^{\frac{1}{2}}$

(c) $x = \left(\dfrac{8Pt^4}{27m}\right)^{\frac{1}{3}}$

(d) $x = \dfrac{2}{3}\left(\dfrac{Pt^3}{m}\right)^{\frac{1}{2}}$

**Answer (a)**

**Sol.** $F \cdot V = P$ (constant)

$\Rightarrow \quad \dfrac{dv}{dt}\cdot v = P$

$\Rightarrow \quad \int v\,dv = \int \dfrac{P}{m}\cdot dt$

$\Rightarrow \quad \dfrac{v^2}{2} = \dfrac{P}{m}\cdot t$

$\Rightarrow \quad v = \sqrt{\dfrac{2P}{m}}\cdot t$

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$$\int dx = \int \sqrt{\frac{2P}{M}} \cdot (t)^{\frac{1}{2}} \cdot dt$$

$$x = \frac{2\sqrt{\frac{2P}{m}} \cdot (t)^{\frac{3}{2}}}{3}$$

$$x = \frac{3}{2}\left(\frac{2P}{m} \cdot t^3\right)^{\frac{1}{2}} = \left(\frac{8P}{9m} t^3\right)^{\frac{1}{2}}$$

34. A black body, maintained at absolute temperature T, is emitting radiations of wavelength $\lambda$ with maximum (peak) intensity. The emitted photons are capable of exciting the electron in a Bohr-model hydrogen atom from ground state ($E_g$ = – 13.60 eV) to the third excited state. Using Wien's constant b = $2.90 \times 10^{-3}$ mK, the estimated value of temperature T is nearly

(a) $2.98 \times 10^3$ K (b) $2.98 \times 10^4$ K

(c) $2.83 \times 10^4$ K (d) $2.68 \times 10^4$ K

**Answer (b)**

**Sol.** Excitation is from ground state to 4th state.

$$\text{So } \Delta E = 13.6\left(1 - \frac{1}{16}\right)\text{eV} = \frac{15 \times 13.6}{16}\text{eV}$$

$$\Rightarrow \quad \frac{15 \times 13.6}{16} = \frac{hc}{\lambda}$$

$$\Rightarrow \quad \lambda = \frac{1240 \times 16}{15 \times 13.6}\text{ nm} = 97.25\text{ nm}$$

Now from Wien's displacement law

$\lambda T = b$

$$\Rightarrow \quad T = \frac{2.9 \times 10^{-3}}{97.25 \times 10^{-9}} \approx 29820\text{ K}$$

$$\Rightarrow \quad T \approx 2.98 \times 10^4\text{ K}$$

35. In order to form standing waves in a medium, the following two waves are superposed

$y_1 = A \sin \pi(5x + 100t + 0.8)$

$y_2 = A \sin \pi(5x - 100t)$

the variables *x* and y are in meter and t in second. The correct statement is that the

(a) Positions of first two displacement nodes (for $x > 0$) are $x = 2$ cm and $x = 22$ cm respectively

(b) Velocity amplitude is maximum at both the positions (for $x > 0$) $x = 12$ cm and $x = 22$ cm

(c) Pressure variation is maximum at both the positions (for $x > 0$) $x = 22$ cm and $x = 32$ cm

(d) Positions of first two displacement antinodes (for $x > 0$) are $x = 2$ cm and $x = 22$ cm respectively

**Answer (d)**

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**Sol.** $y = y_1 + y_2$

$y = 2A\sin[5\pi x + 04\pi]\cos(100\pi t + 0.4\pi)$

For nodes

$5\pi x + 0.4\pi = n\pi$

$x = 12, 32$

For antinodes

$5\pi x + 0.4\pi = \frac{(2n-1)\pi}{2}$

$x = 2, 22$

36. The density $\rho$ of a solid sphere, of mass M and radius R, varies radially according to $\rho = \rho_0\left(\frac{r}{2R}\right)$, where $\rho_0$ is a constant. The moment of inertia of this sphere about a diameter is $I = \alpha MR^2$ with a equal to

(a) $\frac{28}{125}$ (b) $\frac{28}{75}$

(c) $\frac{7}{25}$ (d) $\frac{7}{50}$

**Answer (b)**

**Sol.** $I = \frac{2}{3}\int_0^R dm r^2$

$I = \frac{2}{3}\int_0^R \rho_0\left(1-\frac{r}{2R}\right)4\pi r^2 dr\, r^2$

$I = \frac{2}{3}\cdot 4\pi\rho_0\frac{7R^5}{60}$

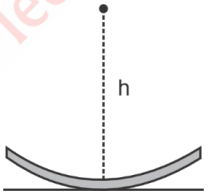
$m = \int_0^R \rho_0\left(1-\frac{r}{2R}\right)4\pi r^2 dr$

$m = \frac{\rho_0 4\pi\cdot 5R^3}{24}$

$\rho_0 4\pi = \frac{24}{5}\frac{m}{R^3}$

$I = \frac{28}{75}mR^2$

37. A concave mirror of radius of curvature R = 1.00 m is placed on the floor as shown. A small, light-weight ball falls from a height h = 1.20 m vertically along the principle axis towards the mirror. If the ball loses 16% of its energy after each collision with the mirror, the distance between the ball and its image formed by the mirror, when the ball reaches its maximum height after the 2nd collision, is nearly




(a) 0.75 m (b) 0.66 m

(c) 0.55 m (d) 0.37 m

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**Answer (b)**

**Sol.** After 2 collisions

$mgH' = 0.84 \times 0.84 \times mgH$

$H' = 0.84 \times 0.84 \times 1.2$

$H' = 0.84672$

$H' = 84.67$ cm

$\frac{1}{v} + \frac{1}{(-84.67)} = -\frac{1}{50}$

$v = -122.06$ cm

$\Rightarrow |v| - |u|$

$\Rightarrow 37.39$ cm

$\approx 0.37$ metre

38. The magnetic field vector in a plane electromagnetic wave is given by $\vec{B} = 2 \times 10^{-7} \sin(kx + \omega t)\hat{j}T$. It is given that speed of wave is c = 3.00 × $10^8$ $ms^{-1}$ and $\omega$ = 1.50 ×$10^{11}$ $s^{-1}$

(a) The wavelength of the wave is 2 mm

(b) The frequency of the wave is nearly 2.39 GHz

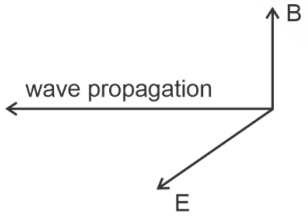
(c) The electric field of the wave is $\vec{E} = 60\sin(kx - \omega t)\hat{k}\ Vm^{-1}$

(d) The electric field of the wave is $\vec{E} = 60\sin(\omega t + kx)\hat{k}\ Vm^{-1}$

**Answer (d)**

**Sol.** $k = \frac{\omega}{v} = 500$

$\frac{\omega}{2\pi} = f$




$f = 23.9$ GHz

$E_0 = B_0 c$

$E_0 = 2 \times 10^{-7} \times 3 \times 10^8$

$E_0 = 60$

$\vec{E} = 60\sin(\omega t + kx)\hat{k}$

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39. An astronomical telescope is used to view an object of size 4 cm kept at a distance of 20 m. The focal lengths of the objective and the eyepiece are 80 cm and 5 cm respectively. The final image is 25 cm from the eyepiece (with the eye close to the eyepiece).

**Statement 1:** The size of the final image is 1.0 cm.

**Statement 2:** The angular magnification is numerically 20

(a) Both statements 1 and 2 are wrong

(b) Statement 1 is correct but statement 2 is wrong

(c) Statement 1 is wrong but statement 2 is correct

(d) Both statements 1 and 2 are correct

**Answer (d)**

**Sol.** $u_e = -2000$

$$\frac{1}{v_e} - \frac{1}{(-2000)} = +\frac{1}{80}$$

$$v_e = \frac{250}{3}$$

$$|m_e| = \frac{250}{3 \times 2000} = \frac{1}{24}$$

For eyepiece

$$-\frac{1}{25} - \frac{1}{-x} = \frac{1}{5}$$

$$|x| = \frac{25}{6}$$

$$|m_o| = \frac{25}{\frac{25}{6}} = 6$$

$$\frac{h_I}{h_o} = |m_e| \cdot |m_o|$$

$$\frac{h_I}{4} = \frac{1}{24} \times 6$$

$$= 1 \text{ cm}$$

$$\theta = \frac{\frac{1}{25}}{\frac{4}{2000}}$$

$$\theta = 20$$

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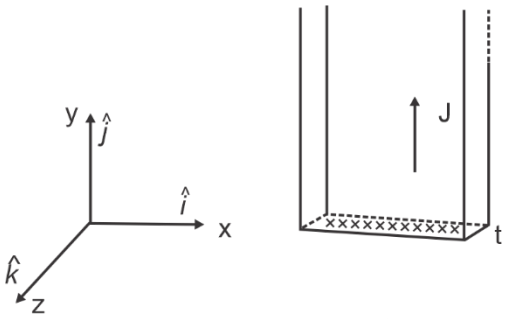
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40. A thin metal plate of infinite length extending in positive y direction carries a current of current density J all along its length as shown. The very small thickness of the plate is t. The breadth (much larger than thickness) of the plate lies exactly along the *x* axis. The magnetic field produced at a small distance 'a' above and very close to the surface of the plate is

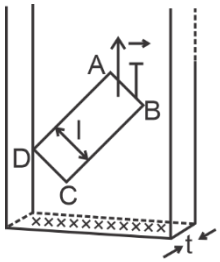



(a) $-\frac{\mu_0 Jt}{2}\hat{i}$ (b) $+\frac{\mu_0 Jt}{2}\hat{i}$

(c) $+\frac{\mu_0 Jt}{2a}\hat{k}$ (d) $+\frac{\mu_0 Jt}{a}\hat{i}$

**Answer (b)**

**Sol.** Taking amperian loop as shown (ABCD) using amperes law




$$\oint \vec{B}\cdot d\vec{l} = \int_A^B \vec{B}\cdot d\vec{l} + \int_B^C \vec{B}\cdot d\vec{l} + \int_C^D \vec{B}\cdot d\vec{l} + \int_D^A \vec{B}\cdot d\vec{l}$$

We can say $\int_B^C \vec{B}\cdot d\vec{l} = \int_D^A \vec{B}\cdot d\vec{l} = 0$

So $2Bl = \mu_0 i_{enc} = \mu_0 J \times t \times l$

$$B = \frac{\mu_0 Jt}{2}$$

Direction must be along x axis.

41. A uniform rod of mass M and length L is hinged freely on a horizontal peg at a variable distance $\xi$ from one of its ends, so as to execute SHM with small angular amplitude in a vertical plane about the horizontal axis with time period T. If the minimum value of its time period $T_{min}$ = 1.0 second, the approximate value of L is

(a) 24.8 (b) 43.0 cm

(c) 56.8 cm (d) 99.2 cm

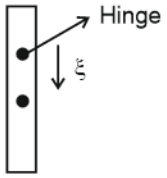
**Answer (b)**

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**Sol.** $\tau = -mg\,\xi\sin\theta = \left(\frac{ml^2}{12} + m\xi^2\right)\alpha$

$$\Rightarrow \quad \frac{d^2\theta}{dt^2} = -\left(\frac{g\xi}{\frac{l^2}{12} + \xi^2}\right)\theta$$

$$\Rightarrow \quad T = 2\pi\sqrt{\frac{\frac{l^2}{12} + \xi^2}{g\xi}}$$




Or $\quad T = 2\pi\sqrt{\frac{\frac{l^2}{12\xi} + \xi}{g}}$

For $T_{min}$, $\frac{l^2}{12\xi} + \xi$ must be minimum

Using AM ≥ GM

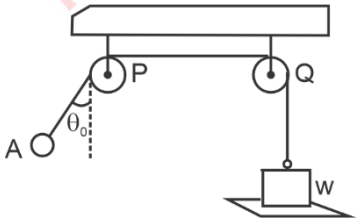
$$\frac{\frac{l^2}{12\xi} + \xi}{2} \geq \sqrt{\frac{l^2}{12}}$$

Or $\quad \frac{l^2}{12\xi} + \xi \geq \frac{l}{\sqrt{3}}$

So $\quad T_{min} = 1 = 2\pi\sqrt{\frac{l}{g\sqrt{3}}}$

$l \simeq 0.438$ m or 43.8 cm

42. P and Q are two smooth weightless pulleys attached to the ceiling as shown. An un-stretchable, light string passes over both the pulleys. A weight W = 40 kg, resting on the floor, is tied to one end of the string. A ball of mass 20 kg is attached, at the other end A. The string PA is deflected by angle $\theta_0$ when the ball A is released from rest. The ball at the end A is capable of just lifting up the weight W for the value of $\theta_0$




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(a) $= 30°$ (b) $= 45°$

(c) $\leq 53°$ (d) $\geq 60°$

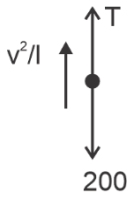
**Answer (d)**

**Sol.** If the angle of deflection is $\theta_0$ the velocity of the ball at lowest point

$v = \sqrt{2gl(1-\cos\theta_0)}$

To lift w, T = 400 N

So $T - 200 = 20\frac{v^2}{l}$




$400 - 200 = 20(2g(1-\cos\theta_0))$

$\cos\theta_0 = \frac{1}{2}$

$\theta_0 = 60°$

43. The position vector $\vec{r}$ of a particle of mass m moving in XY plane is given as a function of time by $\vec{r} = R(\omega t - \sin\omega t)\hat{i} + R(1-\cos\omega t)\hat{j}$ where R and $\omega$ are positive constants. The particle is momentarily at rest when

(a) $t = \frac{n\pi}{\omega}$ where n = 1, 3, 5… (b) y component of $\vec{r}$ is $= 2R\,\hat{j}$

(c) the acceleration $\vec{a} = \omega^2 R\,\hat{j}$ (d) the acceleration $\vec{a} = -\omega^2 R\,\hat{j}$

**Answer (c)**

**Sol.** $\vec{v} = \frac{d\vec{r}}{dt} = R(\omega - \omega\cos\omega t)\hat{i} + R\omega\sin\omega t\,\hat{j}$

And $\vec{a} = \frac{d\vec{v}}{dt} = R\omega^2\sin\omega t\,\hat{i} + R\omega^2\cos\omega t\,\hat{j}$

For $\vec{v} = 0$, $\sin\omega t = 0$

$\Rightarrow \omega t = \pi, 2\pi\ldots$

$\Rightarrow t = \frac{\pi}{\omega}, \frac{2\pi}{\omega}$

And $\cos\omega t = 1$

$\Rightarrow \omega t = 2n\pi$

$\Rightarrow t = \frac{2n\pi}{\omega} \Rightarrow \frac{2\pi}{\omega}, \frac{4\pi}{\omega}\ldots$

Option (a) incorrect

$r_y = R(1-\cos\omega t) = 0$

Option (b) incorrect

$\vec{a} = +R\omega^2\,\hat{j}$

Option (c) correct

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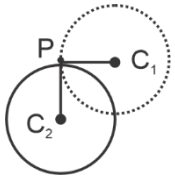
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44. A thin circular disk of mass m and radius R can rotate freely in a vertical plane about a pivot P on its rim (as in the figure). It is released when its centre is at $C_1$ at the level of the pivot in a vertical plane. The speed of the lowest point of the disk when the centre is vertically below the pivot P at $C_2$ is




(a) $\sqrt{\frac{4gR}{3}}$ (b) $\sqrt{4gR}$

(c) $\sqrt{2gR}$ (d) $\sqrt{\frac{16gR}{3}}$

**Answer (d)**

**Sol.** Using conservation of energy

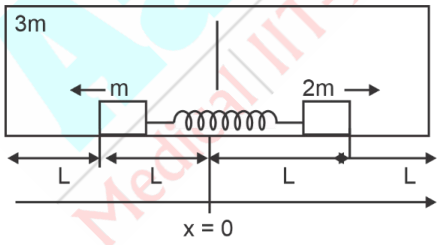
$$mgR = \frac{1}{2}\frac{3}{2}mR^2\omega^2$$

$$\omega R = \sqrt{\frac{4gR}{3}}$$

So velocity of lowest point is

$$v_1 = 2\omega R = \sqrt{\frac{16gR}{3}}$$

45. Two rectangular blocks of masses m and 2m are held against a massless compressed spring within a box of mass 3m and length 4L. The box as well as the two blocks are free to move on a horizontal frictionless surface along the x-axis. Just when the blocks leave contact with the spring, each block is at a distance L from the wall of the box in front of it and the centre of the box is at origin x = 0 (see figure). When released, each block moves its own way, collides with the front wall and immediately sticks to it. The position of the centre of the box in the process shifts to




(a) $x = -\frac{L}{2}$ (b) $x = +\frac{L}{3}$

(c) $x = +\frac{L}{6}$ (d) $x = -\frac{L}{6}$

**Answer (d)**

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**Sol.** Center of mass will not shift

So initially

$$\frac{3m(0)+2m(L)-m(L)}{6m}=+\frac{L}{6}$$

Now as the block of 2m, m sticks to the respective ends of the wall.

Let 3m shifts right by x. Then

$$3m(x) + 2m(2L + x) + m(-2L + x) = 6m\cdot\frac{L}{6}$$

$\Rightarrow$ $3mx + 4mL + 2mx - 2mL + mx = mL$

$\Rightarrow$ $6mx = -mL$

$\Rightarrow$ $x=-\frac{L}{6}$

46. A charge q is uniformly distributed over the surface of a thin circular disk of radius R. The disk rotates about its own axis with an angular velocity $\omega$ rad/s, maintaining its axis normal to a uniform magnetic field B. The magnitude of the torque acting on the charged disk is??

(a) Zero

(b) $\frac{q\omega R^4B}{4}$

(c) $\frac{q\omega R^2B}{4}$

(d) $\frac{q\omega R^2B}{2}$

**Answer (c)**

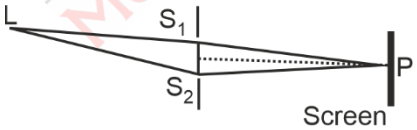
**Sol.** We know $\frac{\mu}{L}=\frac{q}{2m}$

$$\Rightarrow\mu=\frac{q}{2m}\cdot\frac{mR^2}{2}\cdot\omega=\frac{q\omega R^2}{4}$$

Now $\vec{\tau}=\vec{\mu}\times\vec{B}$

$$\Rightarrow|\vec{\tau}|=\frac{q\omega R^2}{4}\cdot B$$

47. A line source L (perpendicular to the plane of the paper) emitting light of wavelength 5625 Å is placed 1.00 m away directly in front of the slit $S_1$ in an opaque wall (see figure). A second slit $S_2$ in the same wall is parallel to sit $S_1$ and at distance d from it; both the slits are parallel to each other and to the line source L. Intensity of light is measured at the position P, equidistant from each of the slits $S_1$ and $S_2$ on the screen, for three different conditions. When $S_2$ is covered it is $I_1$, when $S_1$ is covered it is $I_2$. When both slits are open it is I. If $I = I_1 + I_2$, the distance d between the two slits is




(a) 0.75 mm

(b) 0.53 mm

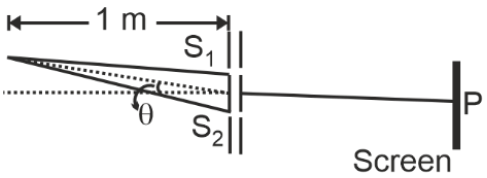
(c) 1.06 mm

(d) 1.50 mm

**Answer (b)**

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**Sol.**




Let the amplitude received from $S_1$ alone is $A_1$. So $I_1 \propto A_1^2$

And $I_2 \propto A_2^2$

$A^2 = A_1^2 + A_2^2 + 2A_1A_2\cos\phi$

Since $A^2 = A_1^2 + A_2^2$ so $\cos\phi = 0$

$d\sin\theta = (\text{odd})\frac{\lambda}{4}$

$\Rightarrow d \cdot \frac{d}{2D} = (\text{odd})\frac{\lambda}{4}$

$\Rightarrow d = \sqrt{\frac{\lambda D}{2}}\,(\text{odd})$

$d = 0.53$ mm

48. ${}_1H^3$ and ${}^2He^3$ have almost same atomic mass. ${}_1H^3$ contains one proton, one electron and 2 neutrons while ${}_2He^3$ has two protons, two electrons and one neutron. Knowing that the mass of a neutron is slightly greater than that of the proton, the estimation of the nuclear binding energy in the two cases reveals that

(a) the binding energy of the nucleus of ${}_1H^3$ is equal to that of ${}_2He^3$ nucleus

(b) the binding energy of the nucleus of ${}_1H^3$ is less than that of ${}_2He^3$ nucleus

(c) the binding energy of the nucleus of ${}_1H^3$ is greater than that of ${}_2He^3$ nucleus

(d) the data is insufficient to predict any information about the binding energy

**Answer (c)**

**Sol.** Binding energy is = (Mass defect) × $c^2$

$BE = (\text{Mass of separate constituent} - \text{Mass of atom})c^2$

Since both have almost same mass.

So, one made of heavier constituent have large BE.

Clearly ${}_1H^3$ will have greater BE.

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## A – 2

**ANY NUMBER OF OPTIONS (4, 3, 2 or 1) MAY BE CORRECT**

**MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED AND NO INCORRECT**

49. Charge Q is distributed in non-uniform but spherically symmetric manner with charge density $\rho(r)$ such that

$\rho(r) = \rho_0\left(1-\frac{r}{R}\right)$ for $r \le R$

$\rho(r) = 0$ for $r \ge R$

The correct statement(s) is/are

(a) The value of the constant $\rho_0$ is $\frac{3Q}{2\pi R^3}$

(b) The electric field produced by the given charge has maximum value at $r = \frac{2R}{3}$

(c) The maximum electric field produced by this charge distribution is $E = \frac{1}{3\pi\varepsilon_0}\frac{Q}{R^2}$

(d) The maximum electric field produced is $E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R^2}$ at $r = R$

**Answer (b, c)**

**Sol.** $Q = \int_0^R \rho 4\pi r^2 dr$

$Q = \int_0^R \rho_0\left(1-\frac{r}{R}\right)4\pi r^2 dr$

$Q = \frac{\rho_0 \pi R^3}{3}$

$E \cdot 4\pi r^2 = \int_0^r \rho_0\left(1-\frac{r}{R}\right)4\pi r^2 dr$

$E = \rho_0\left(\frac{r}{3}-\frac{r^2}{4R}\right)$

$\frac{dE}{dr} = 0$

$r = \frac{2R}{3}$

$E_{max} = \frac{Q}{3\pi R^2}$

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50. A proton of mass $m$ is released from rest at $x_0 = \frac{\alpha}{\beta}$ and starts moving along x axis under the influence of a conservative force F(x). Its potential energy function is $U(x) = \frac{\alpha}{x^2} - \frac{\beta}{x}$, where $\alpha$ and $\beta$ are positive constants. Rigorous calculations predict that

(a) the speed of the proton is maximum at $x = 2x_0$

(b) the maximum speed of the proton is $v = \sqrt{\frac{\alpha}{mx_0^2}}$

(c) the force on the proton is zero at $x = 2x_0$

(d) during its motion the proton can move in a region $x_0 \le x \le \infty$

**Answer (a, c, d)**

**Sol.** $U(x_0) = 0$, $E = 0$

$$F = -\frac{dU}{dx}$$

$$F = -\left(-\frac{2\alpha}{x^3} + \frac{\beta}{x^2}\right)$$

$$F = \frac{2\alpha}{x^3} - \frac{\beta}{x^2}$$

If $F = 0$

$$\Rightarrow x = \frac{2\alpha}{\beta} = 2x_0$$

U at $x = 2x_0$, $U = -\frac{\beta^2}{4\alpha}$ is min

$$\frac{mv_{max}^2}{2} - \frac{\beta^2}{4\alpha} = 0$$

$$v_{max} = \sqrt{\frac{\alpha}{2mx_0^2}}$$

For $x \ge x_0$, $K.E \ge 0$

51. A long horizontal thin metal wire under tension is attached at one end to a vibrator, which causes transverse oscillations in the wire when the other end of the wire is fastened rigidly. The vibration produces a travelling wave in the wire, which is described by $y = y_0 \sin\pi(\alpha t - \beta x)$, where $x$ is measured in meter along the wire from the vibrator end. Here $\alpha$ and $\beta$ are known positive constants. The linear density of the wire is $\mu$ kg/m. Then

(a) the tension in the wire is $T = \mu\frac{\alpha^2}{\beta^2}$

(b) the transverse wave propagates in the negative $x$ direction with a speed $v = \frac{\alpha}{\beta}$

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(c) the power supplied by the vibrator is $P = \frac{\mu\pi^2\alpha^3 y_0^2}{2\beta}$

(d) if the vibrator vibrates with double the frequency, delivering double power to the same wire under the same tension, the amplitude of the wave will reduce to half of the original value.

**Answer (a, c)**

**Sol.** $y = y_0 \sin(\pi\alpha t - \pi\beta x)$

$$v = \frac{\omega}{k} = \frac{\pi\alpha}{\pi\beta} = \frac{\alpha}{\beta}$$

$$v = \sqrt{\frac{T}{\mu}}$$

$$\frac{\alpha}{\beta} = \sqrt{\frac{T}{\mu}}$$

$$T = \frac{\mu\alpha^2}{\beta^2}$$

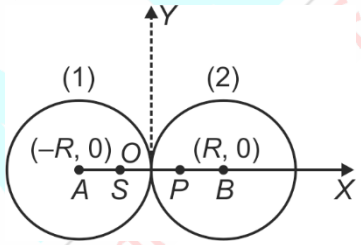
$$P = \frac{\mu A^2\omega^2 v}{2} = \frac{\mu\pi^2\alpha^3 y_0^{\,2}}{2\beta}$$

$$P' = 2P$$

$$\frac{\mu A'^2(2\omega)^2 v}{2} = \frac{2\mu A^2\omega^2 v}{2}$$

$$A' = \frac{A}{\sqrt{2}}$$

52. Two non-conducting solid spheres (1) and (2), with uniformly distributed charge throughout their volumes, are held at positions $A$ and $B$, as shown in the figure. Each sphere has radius $R$. The centers $A$ and $B$ of the spheres (1) and (2) lie on $x$ axis with the point of contact $O$ at the origin. Given that the total charge on sphere (1) is $Q$ and the electric field $E$ at point $P\left(\frac{R}{2}, 0\right)$ is zero. The correct statement(s) is/are




(a) The charge on sphere (2) is $Q_2 = \frac{8Q}{9}$

(b) The ratio of the magnitudes of the electric fields at $O$ and at $B$ is 4 : 9

(c) The electric potential at $B$ is $V_B = \frac{1}{8\pi\epsilon_0}\frac{Q}{R}$ [taking $V = 0$ at infinity]

(d) The electric field at the point $S\left(-\frac{R}{2}, 0\right)$ is in positive $x$-direction

**Answer (a, b, d)**

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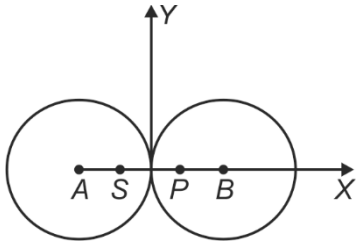
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**Sol.**




Since field at $P\left(\frac{R}{2}, 0\right)$ is zero

So, $\frac{Q_1 4}{4\pi \in_0 9R^2} = \frac{Q_2}{4\pi \in_0 R^3} \cdot \frac{R}{2}$

$\Rightarrow \quad Q_2 = \frac{8Q_1}{9} = \frac{8Q}{9}$

Now $E(0) = \frac{1}{4\pi \in_0 R^2}\left(Q - \frac{8Q}{9}\right) = \frac{Q}{9} \cdot \frac{1}{4\pi \in_0 R^2}$

$E(B) = \frac{Q}{4\pi \in_0 \cdot 4R^2}$

$\frac{E_0}{E_B} = \frac{4}{9}$

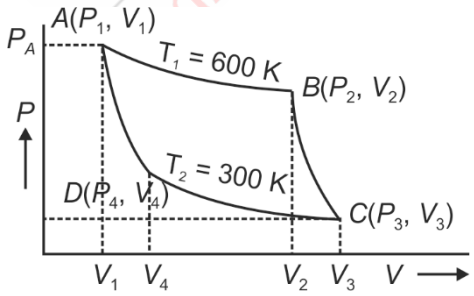
Now $V_B = \frac{Q}{4\pi \in_0 \cdot 2R} + \frac{3}{2} \cdot \frac{8Q}{9 \cdot 4\pi \in_0 R} = \frac{Q}{4\pi \in_0 R}\left(\frac{1}{2} + \frac{4}{3}\right)$

$\Rightarrow \quad V_B = \frac{11Q}{24\pi \in_0 R}$

Now $E(S) = \frac{Q}{4\pi \in_0 R^3} \cdot \frac{R}{2} - \frac{8Q \times 4}{9 \cdot 4\pi \in_0 9R^2} = \frac{Q}{4\pi \in_0 R^2}\left(\frac{1}{2} - \frac{32}{81}\right)$

So, $E(S)$ is along +ve $x$ direction.

53. Two moles of a mixture of a monoatomic gas and a diatomic gas are being used as the working substance in a reversible Carnot cycle as shown in figure. For the mixture of gasses, the value of $\gamma_{\text{mixture}} = \frac{C_P}{C_V} = \frac{3}{2}$. The cycle operates between the source temperature 600 K and the sink temperature 300 K. The highest and lowest pressures during the cycle are 1600 kPa and 100 kPa. The correct statement(s) is/are




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(a) If the minimum volume in the cycle is V, then the maximum volume is 8 V

(b) The working substance consists of one mole of monoatomic and one mole of diatomic gas

(c) Work done per cycle by the engine is 600 R ln 2

(d) The minimum volume of working substance is 6.23 litre

**Answer (a, b, c, d)**

**Sol.** Maximum pressure at *A* & minimum pressure at *C*

| | P | V | T |
|---|---|---|---|
| A | 1600 kPa | V | 600 K |
| B | $P_2$ = 800 kPa | $V_2$ = 2V | 600 K |
| C | 100 kPa | $V_3$ = 8V | 300 K |
| D | 200 kPa | $V_4$ = 4V | 300 K |

$N = 2$ & $\gamma = \frac{3}{2}$

So, $\frac{N_1 C_{p_1} + (2-N_1) C_{p_2}}{N_1 C v_1 + (2-N_1) C v_1} = \frac{3}{2}$

$\Rightarrow \frac{N_1 \frac{5}{2} R + (2-N_1)\frac{7R}{2}}{N_1 \frac{3}{2} R + (2-n_1)\frac{5R}{2}} = \frac{3}{2}$

$\Rightarrow$ $N_1$ = 1 mole

So $N_2$ = 1 mole

Let pressure at point *B* is $P_2$ then, for *BC* $\frac{T^\gamma}{P^{\gamma-1}}$ = constant

$\Rightarrow \frac{(600)^\gamma}{P_2^{\gamma-1}} = \frac{(300)^\gamma}{(100)^{\gamma-1}} \Rightarrow P_2 = 800$ kPa

So $V_2$ = 2V

So $V_3$ (at *C*)

$\frac{P_1 V_1}{T_1} = \frac{P_3 V_3}{T_3}$

$\Rightarrow \frac{1600\ V}{600} = \frac{100 \times V_3}{300} \Rightarrow V_3 = 8V$

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For $(AD)$ $TV^{\gamma-1}$ = constant

$\Rightarrow \quad (600)V^{1/2} = (300)V_4^{\gamma-1}$

$\Rightarrow \quad V_4 = 4\text{V}$

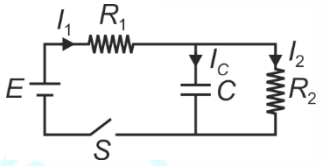
$P_4 = 200$ kPa

Minimum volume $V = \dfrac{2 \times R \times 600}{1600 \times 1000} = 6.23$ liters

$\Delta W\,(\text{per cycle}) = 2R \cdot 600 \ln\left(\dfrac{V_2}{V}\right) - 2 \times R \times 300 \ln\left(\dfrac{V_3}{V_4}\right)$

= 600R ln2

54. In the circuit shown, $E$ is the emf of an ideal battery. Capacitor $C$ is initially uncharged. Switch $S$ is closed at time $t = 0$. The time dependent current through the resistances $R_1$ and $R_2$ are $I_1$ and $I_2$ respectively. At any moment $t$, the charging current through the capacitor is $I_C(t)$. Choose correct option(s)




(a) Current $I_C$ charging the capacitor is given by $I_C = \dfrac{E}{R_1} e^{-\frac{t}{CR}}$ where $\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$

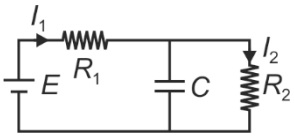
(b) Current $I_C$ charging the capacitor is given by $I_C = \dfrac{E}{R} e^{-\frac{t}{CR}}$ where $R = R_1 + R_2$

(c) Soon after the switch $S$ is closed (at $t = 0$), the currents are $I_1 = \dfrac{E}{R_1}$ and $I_2 = 0$

(d) Long time after the switch $S$ is closed ($t \to \infty$), charge on the capacitor is $q = CE$

**Answer (a, c)**

**Sol.** Given




Current through capacitor $C$ is given by

$I_c = A + Be^{-t/\tau}$

Here, $\tau = \dfrac{R_1 R_2}{(R_1 + R_2)}$

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And at $t = \infty$, $I_C = 0$, So $A = 0$.

And at $t = 0$, $I_C = E/R_1$, So $B = E/R_1$.

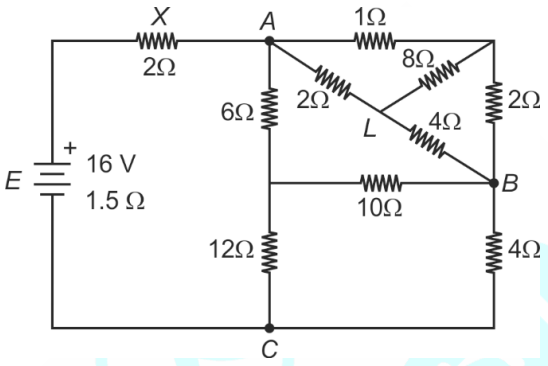
Now $I_C = \frac{E}{R_1} e^{-\frac{t(R_1+R_2)}{R_1R_2C}}$

At $t = 0$, $I_2 = 0$

And at $t = \infty$

$$q = \left(\frac{E}{R_1+R_2}\right) R_2C$$

55. In the given circuit, the emf $E$ of the battery is 16 V and its internal resistance is $r = 1.5\ \Omega$.
The correct option(s) is/are




(a) The potential difference across terminals of battery is 3 V

(b) The power dissipated in the resistance $X$ (= 2 Ω) is 8 W

(c) The power dissipated in 12 Ω resistance is 3 W

(d) The potential difference across junctions $A$ and $B$ is 3 V

**Answer (b, c, d)**

**Sol.** First, we will calculate equivalent resistance between $A$ & C. Clearly there are two balanced Wheatstone bridges.

$$R_{AB} = \frac{3\times6}{9} = 2\Omega$$

$$\& \ R_{AC} = \frac{6\times18}{24} = \frac{18}{4} = \frac{9}{2}\Omega$$

$$\therefore \quad \text{Total resistance} = \frac{9}{2} + 2 + \frac{3}{2}$$

$$\Rightarrow \quad 8\Omega$$

$$i = \frac{16}{8} = 2\text{A}$$

$$\therefore \quad V_t = 16 - \frac{3}{2}\times2 = 13 \text{ volt}$$

$\therefore$ $(a)$ ×

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$P_x = i^2R = 4 \times 2 = 8$ W

(b) ✓

In 12Ω current will be $\frac{6}{24} \times i$

$\Rightarrow$ 0.5 A

$\therefore$ $P_{12} = \frac{1}{4} \times 12 = 3$ W

& $V_{AB}$ = 3V

56. A train, moving in a straight line with an initial speed u $ms^{-1}$ at t = 0, is given a constant acceleration 'a' $ms^{-2}$ to attain a maximum speed $V_m = \frac{7}{3}u$. The driver runs the train at that maximum speed for some duration and then decelerates at a rate of 'a' $ms^{-2}$ to attain the same initial speed u $ms^{-1}$ at t = T. The average speed of the train for the entire journey (from time t = 0 to t = T) is 2u. Choose the correct statement(s)

(a) The train runs at the maximum speed for a duration of $T\sqrt{1-\frac{4u}{aT}}$

(b) The train runs at the maximum speed for a duration of $T\sqrt{1-\frac{2u}{aT}}$

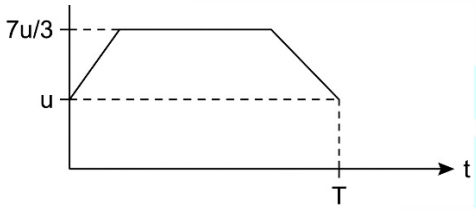
(c) The train runs at the maximum speed for a duration of $\frac{T}{2}$

(d) The acceleration $\frac{16u}{3T}$

**Answer (a,c,d)**

**Sol.** $V_{av} = \frac{\text{total distance}}{\text{total time}}$

Let's draw v–t curve




$V_{av} = 2u = \frac{\text{total area}}{\text{total time}} = \frac{10ut + 7Tu - 14ut}{3T}$

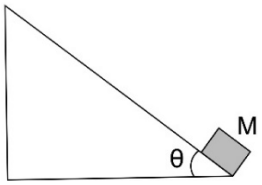
$\therefore$ $t = \frac{T}{4}$

$\therefore$ It travels for $\frac{T}{2}$ time with max speed and $a = \frac{16u}{3T}$

$\therefore$ (a, c, d) Answer

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57. A rectangular block of mass M projected up an inclined plane, set at an angle $\theta$ with the horizontal, comes to a stop at a certain height and slides back down the incline. The down trip takes exactly twice as long as the up trip. The observations reveal that




(a) coefficient of sliding friction between the block and the surface of the incline is 0.6 tan $\theta$

(b) coefficient of sliding friction between the block and the surface of the incline is 0.6 sin $\theta$

(c) about 75% of the original energy of projection has been lost to friction during the entire trip

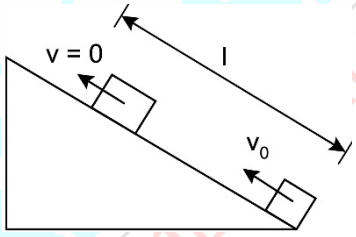
(d) the acceleration of the block during its sliding down is 0.4 g sin $\theta$

**Answer (a, c, d)**

**Sol.** For upward journey $|a_1| = g\sin\theta + \mu g\cos\theta$

$$v_0^2 = 2g(\sin\theta + \mu\cos\theta)l$$

$$t_1 = \frac{v_0}{g(\sin\theta + \mu\cos\theta)}$$




For downward journey

$$l = \frac{1}{2}g(\sin\theta - \mu\cos\theta)t_2^2$$

$$\frac{v_0^2}{g(\sin\theta + \mu\cos\theta)} = g(\sin\theta - \mu\cos\theta)t_2^2$$

$$t_2^2 = 4t_1^2$$

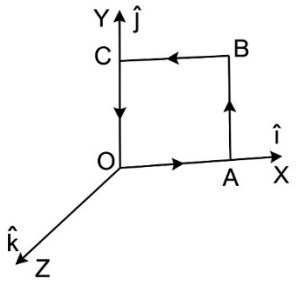
$$\mu = 0.6\tan\theta$$

$$|a_2| = g(\sin\theta - 0.6\tan\theta\cos\theta) = 0.4g\sin\theta$$

$$\frac{K.E.f}{K.E.i} = \frac{v_1^2}{v_0^2} = \frac{\sin\theta - 0.6\tan\theta\cos\theta}{\sin\theta + 0.6\tan\theta\cos\theta} = \frac{1}{4}$$

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58 A wire loop OABC, with corners at O (0, 0), A (L, 0), B (L, L) and C (0, L) lying in XY plane, carries a current I in anti-clock wise direction as shown. The correct statement(s) is/are




(a) The magnetic field produced at the centre of the loop is $\vec{B}_1 = \frac{2\sqrt{2}\mu_0 I}{\pi L}\hat{k}$

(b) The magnetic moment of the current loop is $\mu_0 I L^2 \hat{k}$

(c) If a non-uniform magnetic field $\vec{B}_2 = \left(\frac{B_0 z}{L}\right)\hat{j} + \left(\frac{B_0 y}{L}\right)\hat{k}$ is switched on, the magnetic force on the loop is $B_0 I L \hat{j}$

(d) The magnetic force on the current carrying loop due to the magnetic field $\vec{B}_2$ is zero

**Answer (a, c)**

**Sol.** $B = \frac{4\times\mu_0 I}{4\pi\frac{L}{2}}(2\times\sin 45°)$

$B = \frac{\mu_0 I \cdot 2\sqrt{2}}{\pi L}\hat{k}$

$\vec{M} = IA\hat{k}$

$= L^2 I\hat{k}$

$F_{OA} = 0$

$\vec{F}_{AB} + \vec{F}_{CD} = 0$

$\vec{F}_{BC} = ILB\hat{j}$

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59. A rocket is fired from Earth at 60° to the local vertical with an initial speed $v_0 = \sqrt{gR}$ where R is radius of the Earth and g is the acceleration due to gravity at the surface of the Earth. Choose correct option(s) [Assume the Earth to be a uniform solid sphere. Also ignore the rotation of the Earth]

(a) The maximum distance reached by the rocket from the Earth's centre is 2R

(b) The maximum distance reached by the rocket from the Earth's centre is $\frac{3R}{2}$

(c) The minimum velocity of the rocket during the motion is $\sqrt{\frac{gR}{3}}$

(d) The maximum height attained by the rocket above the Earth's surface is $\frac{R}{3}$

**Answer (b, c)**

**Sol.** $\frac{1}{2}m\frac{GM}{R} - \frac{GMm}{R} = -\frac{GMm}{2a}$

$a = R$

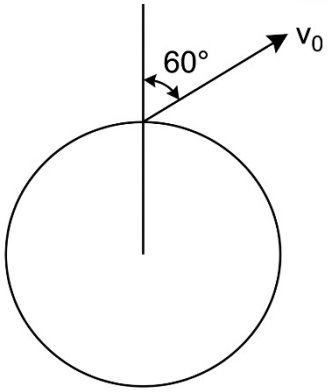
$e = \cos(60°)$

$r_{max} = a(1+e)$

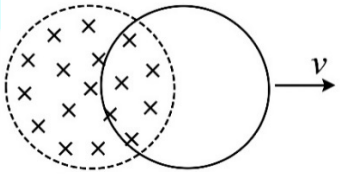
$= \frac{3R}{2}$

$v_{min} = \sqrt{\frac{GM}{a} \cdot \left(\frac{1-e}{1+e}\right)}$

$= \sqrt{\frac{GM}{3R}}$




60. A uniform magnetic field B = 0.5 T exists in a circular region of radius R = 5 m . A wire loop of radius R = 5 m completely encloses the magnetic field at t = 0. The loop is pulled at uniform speed v = 2 $ms^{-1}$ in the plane of the paper as shown.




(a) The emf induced in the loop at time t = 3 s will be 8 V

(b) The maximum emf induced in the loop will be 10 V

(c) The emf induced in the loop will be minimum at time t = 4 s

(d) The emf induced in the loop will be maximum just at start at the time t = 0 s

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2072 Classroom Students Aakashians Qualified in NSO (Level-1) 2025-26

**Answer (a, b, d)**

**Sol.** $v=2$

$l=\sqrt{25-t^2}$

$L_{eft}=2l=\sqrt{100-4t^2}$

$\varepsilon=Bv2l$

$\varepsilon=0.5\times2\times\sqrt{100-4t^2}$

$\varepsilon=\sqrt{100-4t^2}$

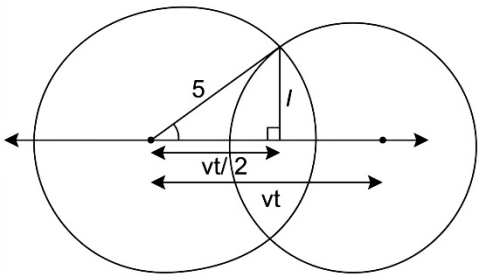
at $t=3$

$\varepsilon=8$

$\varepsilon_{min}=0$

at $t=5$

$\varepsilon_{max}$ at $t=0,\ \varepsilon=10$




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Olympiads Results
777 Classroom Students Aakashians Qualified in IOQM 2025
134 Classroom Students Aakashians Qualified in RMO 2025-26
378 Classroom Students Aakashians Qualified in NSEs 2025-26
26 Classroom Students Aakashians Qualified for OCSCs/IMOTC /APMO 2025-26
2072 Classroom Students Aakashians Qualified in NSO (Level-1) 2025-26