04/04/2025
Morning

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Medical | IIT-JEE | Foundations

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Memory Based Answers & Solutions

for

JEE (Main)-2025 (Online) Phase-2

(Physics, Chemistry and Mathematics)

Time : 3 hrs. M.M. : 300

IMPORTANT INSTRUCTIONS:

(1) The test is of **3 hours** duration.

(2) This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.

(3) This question paper contains **Three Parts**. **Part-A** is Physics, **Part-B** is Chemistry and **Part-C** is **Mathematics**. Each part has only two sections: **Section-A** and **Section-B**.

(4) **Section - A :** Attempt all questions.

(5) **Section - B :** Attempt all questions.

(6) **Section - A (01 – 20)** contains 20 multiple choice questions which have **only one correct answer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

(7) **Section - B (21 – 25) contains** 5 **Numerical value** based questions. The answer to each question should be rounded off to the **nearest integer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1. Find the dimension of $\frac{E}{B}$, where E represents electric field and B represents magnetic field.

   (1) ML^2T^{-1}

   (2) LT^{-1}

   (3) L^2T^{-1}

   (4) LT^{-2}

Answer (2)

Sol. $\frac{E}{B} = C$

$= LT^{-1}$

2. Mean free path for an ideal gas is to be observed 20 μm while average speed of molecules of gas is observed to be 600 m/s. Then frequency of collision is nearly

   (1) 4×10^7

   (2) 1.2×10^7

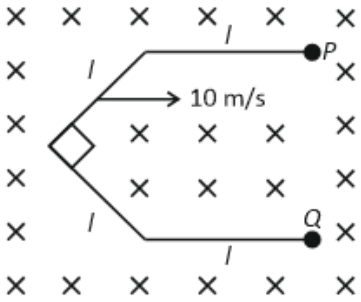
   (3) 3×10^7

   (4) 2×10^{-7}

Answer (3)

Sol. Mean free time $\tau = \frac{\lambda}{v} \Rightarrow f = \frac{v}{\lambda} = \frac{600}{20 \times 10^{-6}} = 3 \times 10^7$

3. 4 rods of equal length are joined as shown in the figure. Combined system is moving with speed 10 m/s in a perpendicular magnetic field of $\frac{1}{\sqrt{2}}$ tesla. Find emf induced between point P and Q (l = 10 cm).



   (1) 1 volt

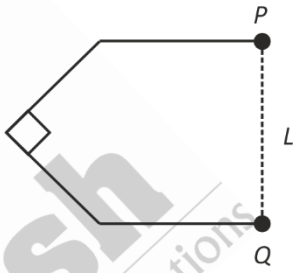
   (2) 0.1 volt

   (3) 2 volts

   (4) $\sqrt{2}$ volt

Answer (1)

Sol.

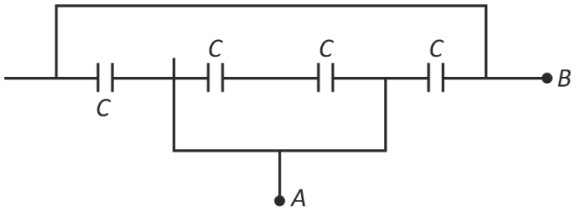


$L = \frac{l}{\sqrt{2}} + \frac{l}{\sqrt{2}} = \sqrt{2}\,l$

$\text{emf} = \frac{1}{\sqrt{2}} \times 10 \times \sqrt{2} \times 0.1$

$= 1$ v

4. Find equivalent capacitance between A and B, where $C = 16$ μF



   (1) 48 μF

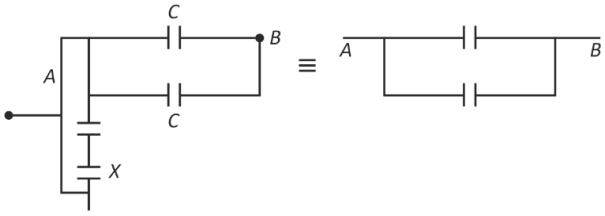
   (2) 8 μF

   (3) 32 μF

   (4) 16 μF

Answer (3)

Sol.



$C_{eq} = 2C = 32\ \mu F$

5. A real object placed in front of a spherical mirror forms an image whose magnification is $-\frac{1}{3}$. If the distance between the image and object is 30 cm. The focal length of the mirror is _____ cm.

(1) –11.25 cm (2) –22.5 cm

(3) – 45 cm (4) –60 cm

Answer (1)

Sol. Magnification is negative implies mirror is conversing.

$$m = -\frac{v}{u} = -\frac{1}{3}$$

Or $v = \frac{u}{3}$

Also, $v - u = 30$ cm

$u = -45$ cm

$v = -15$ cm

$$f = \frac{uv}{u+v} = -11.25 \text{ cm}$$

6. The current in a AC circuit is given as $i = 100\sqrt{2}\sin\left(\frac{100\pi}{t}\right)$A.

Find rms current and frequency is Hertz.

(1) 100 A, 100 Hz (2) 50 A, 100 Hz

(3) 200 A, 50 Hz (4) 100A, 50 Hz

Answer (4)

Sol. 1 rms $= \frac{i_0}{\sqrt{z}} = \frac{100\sqrt{z}}{\sqrt{z}} = 100$

$\omega t = 100\ \pi\ t \Rightarrow \omega = 2\pi f = 100\ \pi$

$f = 50$ Hz

7. An electric dipole with charges 2 μC and a separation 20 cm is placed close to an infinitely charge non-conducting sheet with surface charge density 100 C/m^2. Find the torque acting on the dipole if the dipole makes an angle 30° with the normal to the sheet.

(1) $\frac{12}{\varepsilon_0}\times10^{-5}$ N-m (2) $\frac{2}{\varepsilon_0}\times10^{-5}$ N-m

(3) $\frac{4}{\varepsilon_0}\times10^{-5}$ N-m (4) $\frac{1}{\varepsilon_0}\times10^{-5}$ N-m

Answer (4)

Sol. $\tau = pE\sin\theta$

$p = qd$

$$E = \frac{\sigma}{2\varepsilon_0}$$

$\tau = qdE\sin\theta$

$$= \frac{(2\times10^{-6}\text{ C})(0.2\text{ m})\times100}{2\varepsilon_0}\text{ C/m}^2\sin30° = \frac{2}{\varepsilon_0}\times10^{-5}\text{ N-m}$$

8. **Assertion (A):** The minimum kinetic energy required to take a body of mass m from surface of earth to infinity is mgR.

Reason (R): Potential energy at surface of earth is zero.

(1) (A) and (R) both are correct and (R) is correct explanation of (A)

(2) (A) and (R) both are correct and (R) is not correct explanation of (A)

(3) (A) is correct but (R) is incorrect

(4) (A) is incorrect but (R) is correct

Answer (3)

Sol. Conceptual.

9. Longitudinal sound waves travel in three different gases namely helium, methane and carbon dioxide. Mean temperature of three gases are equal then ratio of speeds of wave in three gases respectively is

(1) $\sqrt{5}:\sqrt{7}:\frac{1}{\sqrt{11}}$ (2) $\sqrt{3}:\sqrt{5}:\frac{1}{\sqrt{11}}$

(3) $\sqrt{5}:1:\sqrt{\frac{21}{55}}$ (4) $\frac{1}{\sqrt{3}}:\frac{1}{\sqrt{5}}:\frac{1}{2}$

Answer (3)

Sol. $v=\sqrt{\frac{\gamma RT}{M_0}}$

Ratio $\equiv \sqrt{\frac{\gamma_1}{M_1}}:\sqrt{\frac{\gamma_2}{M_2}}:\sqrt{\frac{\gamma_3}{M_3}}$

$=\sqrt{\frac{5}{3\times4}}:\sqrt{\frac{4}{3\times16}}:\sqrt{\frac{7}{5\times44}}\equiv\sqrt{\frac{5}{3}}:\sqrt{\frac{1}{3}}:\sqrt{\frac{7}{55}}$

10. Ratio of radii of 5th orbit of He^+ and Li^{2+} atom will be

(1) $\frac{5}{3}$ (2) $\frac{25}{3}$

(3) $\frac{3}{2}$ (4) $\frac{2}{3}$

Answer (3)

Sol. $r=\frac{\eta^2}{Z}a_0$ $\qquad \frac{r_{He^+}}{r_{Li^{2+}}}=\frac{\eta^2}{Z_{He^+}}\frac{Z_{Li^{2+}}}{\eta^2}=\frac{3}{2}$

11. **Assertion :** In photoelectric effect, if intensity of monochromatic light is increased then stopping potential increases.

Reason : Increased intensity results in increment of photocurrent.

(1) A is correct, R is correct and R is explanation of A

(2) A is correct, R is correct and R is not explanation of A

(3) A is incorrect and R is correct

(4) A is correct and R is incorrect

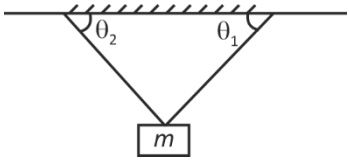
Answer (3)

Sol. (1) Frequency changes the stopping potential not intensity.

(2) Higher in tensity means higher number of electrons.

12. A block of mass *m* kg is connected to two strings as shown.

If $T_1=\sqrt{3}T_2$, then choose correct option



(1) $\theta_1=60°, \theta_2=30°, T_1=\frac{mg}{2}$

(2) $\theta_1=60°, \theta_2=30°, T_2=\frac{mg}{2}$

(3) $\theta_1=30°, \theta_2=60°, T_1=\frac{3mg}{4}$

(4) $\theta_1=30°, \theta_2=60°, T_2=\frac{3mg}{4}$

Answer (2)

Sol. $T_2\cos\theta_2=T_2\cos\theta_1$

$T_2\cos\theta_2=\sqrt{3}T_2\cos\theta_1$

$\cos\theta_2=\sqrt{3}\cos\theta_1$

$\theta_1=60°, \theta_2=30°$

$T_1\sin\theta_1+T_2\sin\theta_2=mg$

$\sqrt{3}T_2\cdot\frac{\sqrt{3}}{2}+T_2\cdot\frac{1}{2}=mg$

$2T_2=mg$

$T_2=\frac{mg}{2}$

$T_1=\frac{\sqrt{3}}{2}mg$

13. A Closed organ pipe having fundamental frequency f_0. Now $\frac{1}{5}$ of volume its filled with water then % change in the fundamental frequency.

(1) +10%

(2) +25%

(3) –20%

(4) –10%

Answer (2)

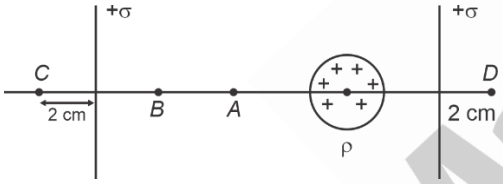
Sol. $f_0 = \frac{v}{4L}$

$$f_0' = \frac{v}{4\left(\frac{4L}{5}\right)} = \frac{5}{4}\left(\frac{v}{4L}\right) = \frac{5}{4}f_0$$

$= 1.25\, f_0$

$\Rightarrow$ +25%

14. In arrangement shown, has two non-conducting plane sheets with charge density σ, and a non-conducting sphere with volume charge density ρ.



Choose the correct relation between the magnitude of electric fields at *A*, *B*, *C* and *D*. Point *A* is at the middle of two sheets.

(1) $E_A = E_B$, $E_C \neq E_D$

(2) $E_A > E_B$, $E_C \neq E_D$

(3) $E_A > E_B$, $E_C = E_D$

(4) $E_A \neq E_B$, $E_C = E_D$

Answer (2)

Sol. $\Rightarrow |E_A| = \left|+\frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0} - \frac{1}{4\pi\varepsilon_0}\frac{Q}{r_A^2}\right| = \frac{Q}{4\pi\varepsilon_0 r_A^2}$

$\Rightarrow |E_B| = \left|+\frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0} - \frac{1}{4\pi\varepsilon_0}\frac{Q}{r_B^2}\right| = \frac{Q}{4\pi\varepsilon_0 r_B^2}$

$\Rightarrow |E_A| > |E_B|$ since $r_A < r_B$

$\Rightarrow |E_C| = \left|-\frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0} - \frac{1}{4\pi\varepsilon_0}\frac{Q}{r_C^2}\right| = \frac{\sigma}{\varepsilon_0} + \frac{Q}{4\pi\varepsilon_0 r_C^2}$

$\Rightarrow |E_D| = \left|\frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} + \frac{Q}{4\pi\varepsilon_0 r_D^2}\right| = \frac{\sigma}{\varepsilon_0} + \frac{Q}{4\pi\varepsilon_0 r_D^2}$

$\Rightarrow |E_C| \neq |E_D|$ as $r_C \neq r_D$

15. Two simple pendulums with amplitudes θ_1 and θ_2 have length of strings as l_1 and l_2 respectively. Choose the correct options if the maximum angular accelerations are same.

(1) $\theta_1 l_1 = \theta_2 l_2$

(2) $\theta_1 l_2 = \theta_2 l_1$

(3) $\theta_1 l_1^2 = \theta_2 l_2^2$

(4) $\theta_1 l_2^2 = \theta_2 l_1^2$

Answer (2)

Sol. $\theta = \theta_0 \sin\left(\sqrt{\frac{g}{l}}t + \phi\right)$

or $\alpha = -\frac{g}{l}\theta$

$$\alpha_{max} = \frac{g}{l}\theta_0$$

$$(\alpha_{max})_1 = (\alpha_{max})_2$$

$$\frac{\theta_1}{l_1} = \frac{\theta_2}{l_2}$$

16. In YDSE setup, distance between slits d = 0.2 mm. If d is changed to 0.4 mm, then % change in fringe width

(1) 25%

(2) 50%

(3) 100%

(4) 75%

Answer (2)

Sol. $B=\frac{XD}{d}$ $\quad B'=\frac{\lambda D}{2d}=\frac{B}{2}$

$100\times\frac{DB}{B}=50\%$

17. Regarding the rotational motion of rigid bodies, following two statements are given where symbols is are having usual meaning.

S1 : Torgue τ is given as $\vec{\tau}=\frac{d\vec{L}}{dt}$ and angular momentum about inertial point is given as $\vec{L}=\sum(\vec{r}_i\times\vec{p}_i)$.

S2 : Torque τ is given as $\vec{\tau}=I\vec{r}$ and angular momentum about inertial point is given as $\vec{L}=I\vec{\omega}$.

(1) S1 is correct and S2 is incorrect

(2) S1 is incorrect and S2 is correct

(3) Both are incorrect

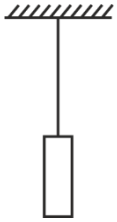
(4) Both are correct

Answer (1)

Sol. $\vec{L}=I_{ang}\vec{\omega}+\vec{r}\times M\vec{v}_{CM}$

Results in S2 is specific cases derived from results in S1.

18. A small mirror of mass m is suspended to a fix point with an ideal string of length l. A photon of energy E incident normally on the mirror. Find maximum angular deviation (θ) of the mirror.

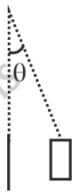


(1) $\frac{3E}{mc\sqrt{gl}}$ (2) $\frac{E}{2mc\sqrt{gl}}$

(3) $\frac{E}{mc\sqrt{2gl}}$ (4) $\frac{2E}{mc\sqrt{gl}}$

Answer (4)

Sol.



Moment imparted to the mirror = $\frac{2E}{c}$

$\Delta KE = -\Delta PE$

$\frac{\left(\frac{2E}{c}\right)^2}{2m}=mg(l-l\cos\theta)$

$\frac{2E^2}{mc^2}=mgl\cdot 2\sin^2\left(\frac{\theta}{2}\right)$

$\frac{2E^2}{mc^2}=mgl\cdot\frac{\theta^2}{2}$

$\theta=\frac{2E}{mc\sqrt{gl}}$

19. $\vec{L}$ and $\vec{p}$ are angular momentum about origin and linear momentum of a particle. If position vector of particle is given as $\vec{r} = a(\sin\omega t\hat{i} + \cos\omega t\hat{j})$ then direction of force is

(1) Opposite to $\vec{L}\times\vec{r}$

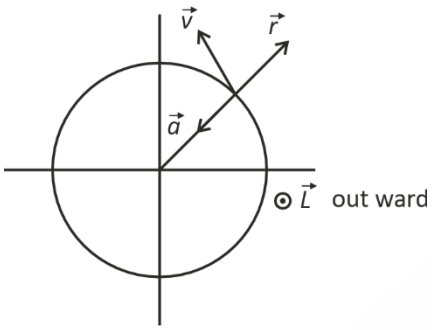
(2) Opposite to $\vec{p}\times\vec{r}$

(3) Opposite to $\vec{L}\cdot\vec{r}$

(4) Opposite to $\vec{p}\times\vec{L}$

Answer (4)

Sol.



20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. A ring and a solid sphere released from rest from same height on enough rough inclined surface. Ratio of their speed when they reach at bottom is $\sqrt{\frac{7}{x}}$ m/s, then x is

Answer (10)

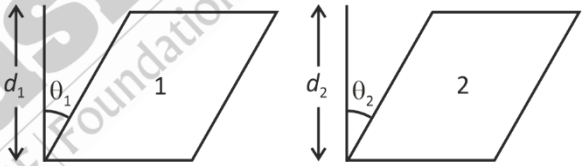
Sol. $mgh = \frac{1}{2}2mR^2\frac{(v_r^2)}{R^2} = \frac{1}{2}\cdot\frac{7}{5}mR^2\frac{(v_s^2)}{R^2}$

$$\Rightarrow \frac{2(v_r^2)}{R^2} = \frac{7}{5}\frac{(v_s^2)}{R^2}$$

$$\Rightarrow \left(\frac{v_r}{v_s}\right)^2 = \frac{7}{10}$$

$$\Rightarrow \frac{v_r}{v_s} = \sqrt{\frac{7}{10}}$$

22. The figure shows two boxes with identical square cross-sections and heights h_1 and h_2 ($h_1 = 2h_2$) are made of different materials. An equal force is applied on the square cross-sections such that the deformations θ_1 and θ_2 are realized ($\theta_1 = 2\theta_2$). If shear modulus of box 1 is 4×10^9 N/m^2 and that of box 2 is $x\times10^9$ N/m^2, then x is _____.



Answer (8)

Sol. $G = \frac{F}{A\theta}$

$\Rightarrow G\theta = \frac{F}{A}$

Since $F_1 = F_2$ and $A_1 = A_2$

$G_1\theta_1 = G_2\theta_2$

$(4\times10^9\text{N/m}^2)\theta_1 = (x\times10^9\text{N/m}^2)\theta_2$

$x = 8$

23.

24.

25.