

28/01/2025

Morning



Aakash

Medical | IIT-JEE | Foundations

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot-13, Sector-18, Udyog Vihar,
Gurugram, Haryana-122018

Memory Based Answers & Solutions

Time : 3 hrs.

for

M.M. : 300

JEE (Main)-2025 (Online) Phase-1

(Physics, Chemistry and Mathematics)

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.

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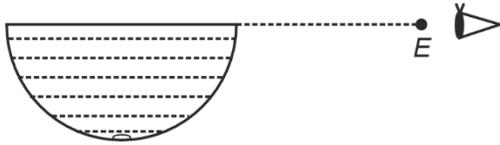
JEE (Advanced) 2024

AIR	Name	Classroom
25	Rishi Shekher Shukla	2 Year Classroom
67	Krishna Sai Shishir	2 Year Classroom
78	Abhishek Jain	2 Year Classroom
93	Hardik Aggarwal	2 Year Classroom
95	Ujjwal Singh	2 Year Classroom
98	Rachit Aggarwal	2 Year Classroom

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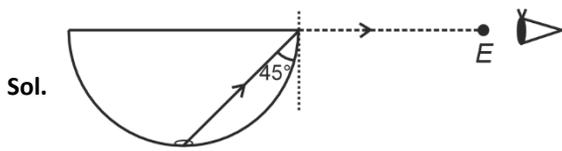
AIR	Name	Classroom	State
1	Sarvvi Jais	2 Year Classroom	Karnataka
15	M Sai Divya Tuja Reddy	2 Year Classroom	Telangana
19	Rishi Shekher Shukla	2 Year Classroom	Telangana

5. A coin is placed at the bottom of a hemispherical container filled with a liquid of refractive index μ . Find the least refractive index if the coin is visible to an observer at E .



- (1) $\sqrt{3}$ (2) $\sqrt{2}$
 (3) $\frac{\sqrt{3}}{2}$ (4) $3\sqrt{2}$

Answer (2)



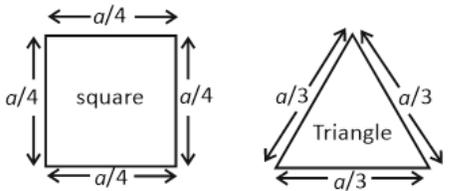
Sol.

$$\theta_c = 45^\circ$$

$$\sin 45^\circ = \frac{1}{\mu}$$

$$\mu = \frac{1}{\sin 45^\circ} = \sqrt{2}$$

6. In the given figure, the square and the triangle have same resistance per unit length. Find the ratio of their resistances about adjacent corners.



- (1) $\frac{32}{27}$ (2) $\frac{27}{32}$
 (3) $\frac{8}{9}$ (4) $\frac{9}{8}$

Answer (2)

- Sol. Let the resistance per unit length be λ , then

For square,

$$R_{\text{Square}} = \frac{\left(\frac{3\lambda a}{4}\right)\left(\frac{\lambda a}{4}\right)}{\frac{3\lambda a}{4} + \frac{\lambda a}{4}} = \frac{3\lambda a}{16}$$

For triangle,

$$R_{\text{Triangle}} = \frac{\left(\frac{2\lambda a}{3}\right)\left(\frac{\lambda a}{3}\right)}{\frac{2\lambda a}{3} + \frac{\lambda a}{3}} = \frac{2\lambda a}{9}$$

$$\frac{R_{\text{Square}}}{R_{\text{Triangle}}} = \frac{3\lambda a}{16} \times \frac{a}{2\lambda a} = \frac{27}{32}$$

7. **Assertion :** Work done by central force is independent of path.

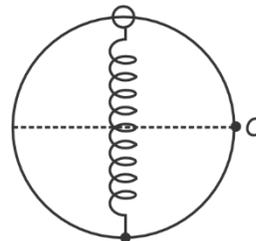
Reason : Potential energy is associated with every force.

- (1) Both Assertion and Reason are correct
 (2) Assertion is correct, Reason is incorrect
 (3) Assertion is incorrect, Reason is correct
 (4) Both Assertion and Reason are incorrect

Answer (4)

- Sol. Not all central force/s are conservative so work done by central force might depend on path.

8. There is smooth ring of radius R in vertical plane. A spring of natural length R & elastic constant K is vertical along a diameter. The free end is connected to bead of mass m & when slightly disturbed it reaches point C with speed v where v is



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JEE (Main) 2024

Karnataka Topper AIR 1 Sarvi Jain 2 Year Classroom	Telangana Topper AIR 15 M Sai Divya Teja Reddy 2 Year Classroom	Telangana Topper AIR 19 Rishi Shekher Shukla 2 Year Classroom
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(1) $\sqrt{\frac{KR^2(\sqrt{2}-1)+2mgR}{m}}$

(2) $\sqrt{\frac{2KR^2(\sqrt{2}-1)+2mgR}{m}}$

(3) $\sqrt{\frac{2KR^2(\sqrt{2}-1)+mgR}{m}}$

(4) $\sqrt{\frac{KR^2(\sqrt{2}-1)+mgR}{m}}$

Answer (2)

Sol. Loss in PE = gain in KE

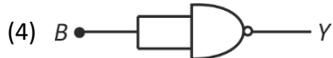
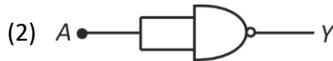
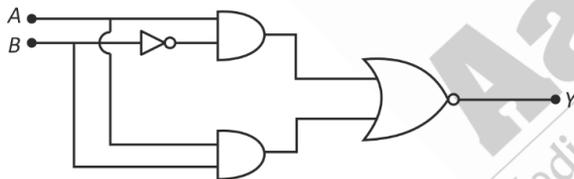
$$\frac{1}{2}K(R^2) - \frac{1}{2}K(\sqrt{2}-1)^2 R^2 + mgR = \frac{1}{2}mv^2$$

$$\frac{1}{2}KR^2 \{1 - 2 + 1 + 2\sqrt{2}\} + mgR = \frac{1}{2}mv^2$$

$$KR^2(\sqrt{2}-1) + mgR = \frac{1}{2}mv^2$$

$$\sqrt{\frac{2KR^2(\sqrt{2}-1)+2mgR}{m}} = v$$

9. The equivalent logic gate for the circuit shown below is



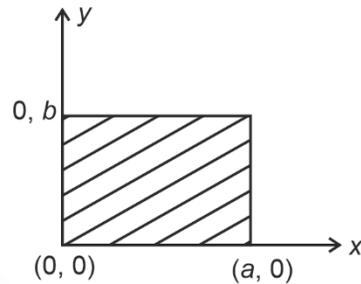
Answer (2)

Sol. $Y = \overline{AB} + AB$

$$Y = \overline{A(\overline{B+B})}$$

$$Y = \overline{A}$$

10. Surface mass density varies as $\sigma = \frac{\sigma_0 x}{ab}$ for the given plane sheet. Find the position of centre of mass for the distribution given



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

(2) $\frac{2a}{3}, \frac{b}{2}$

(3) $\frac{a}{3}, \frac{b}{2}$

(4) $\frac{a}{2}, \frac{b}{2}$

Answer (2)

Sol. As there is no variation of mass density in y direction. So

$$y_{cm} = \frac{b}{2}$$

Now for x direction

$$dm = \left(\frac{\sigma_0 x}{ab}\right) b dx$$

$$x_{cm} = \frac{\int_0^a x dm}{\int_0^a dm} = \frac{\frac{\sigma_0}{a} \int_0^a x^2 dx}{\frac{\sigma_0}{a} \int_0^a x dx}$$

$$\Rightarrow x_{cm} = \frac{a^3 \times 2}{3 \times a^2} = \frac{2}{3} a$$

$$\text{So } r_{cm} = \frac{2}{3} a, \frac{b}{2}$$

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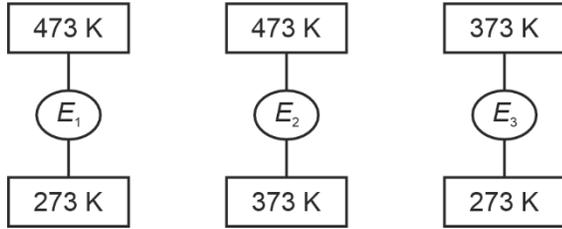
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JEE (Main) 2024

- Karnataka Topper: Sarvi Jais (100 Percentile Rank)
- Telangana Topper: M Sai Divya Tuja Reddy (100 Percentile Rank)
- Telangana Topper: Rishi Shekher Shukla (100 Percentile Rank)

11. η_1 , η_2 and η_3 are the efficiencies of the three Carnot engines E_1 , E_2 and E_3 operating between temperatures shown in the figure. Choose the correct option relating the efficiencies.



- (1) $\eta_2 + \eta_3 > \eta_1$ (2) $\eta_2 + \eta_3 = \eta_1$
 (3) $\eta_2 + \eta_3 < \eta_1$ (4) $\eta_1 + \eta_2 = \eta_3$

Answer (1)

Sol. $\eta_1 = 1 - \frac{273}{473} = \frac{200}{473}$

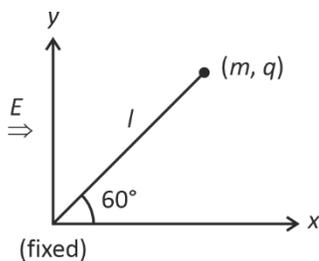
$\eta_2 = 1 - \frac{373}{473} = \frac{100}{473}$

$\eta_3 = 1 - \frac{273}{373} = \frac{100}{373}$

$\eta_1 - \eta_2 = \frac{100}{473} < \eta_3$

i.e., $\eta_2 + \eta_3 > \eta_1$

12. A simple pendulum of length l and bob of mass m is placed on smooth horizontal surface as shown. When electric field of strength E is switched on, the bob passes the x -axis with speed v then



(1) $v = \sqrt{\frac{2qEl}{m}}$

(2) $v = \sqrt{\frac{qEl}{m}}$

(3) $v = \sqrt{\frac{qEl}{2m}}$

(4) $v = 2\sqrt{\frac{qEl}{m}}$

Answer (2)

Sol. $W = \Delta K$

$qE(l - l \cos 60^\circ) = \frac{1}{2}mv^2$

$\frac{qEl}{m} = v^2$

13. **Statement-I** : Velocity of sound in solids is more compared to that in gases.

Statement-II : Bulk modulus of gas is more than that of solids.

- (1) Statement-I is correct statement-II is correct
 (2) Statement-I is correct statement-II is incorrect
 (3) Statement-I is incorrect statement-II is correct
 (4) Statement-I is incorrect statement-II is incorrect

Answer (2)

Sol. Speed of sound in medium depends on elastic and inertia property of medium.

for gas $v = \sqrt{\frac{B}{\rho}}$

for solids $v = \sqrt{\frac{Y}{\rho}}$

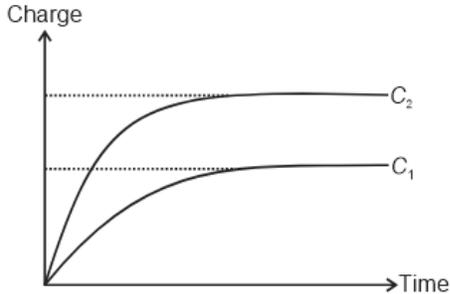
The elastic property of solids happens to be many fold greater than that of elastic property of gases.

Bulk modulus of gas depends on the process,

$B = \frac{-\Delta P}{\Delta V/V}$, which varies between 0 to ∞ therefore in

general statement 2 is incorrect.

14. To capacitor C_1 and C_2 are connected across same battery and store energies U_1 and U_2 respectively at steady state. Choose the correct option by observing the graph of charge vs time shown below.



- (1) $C_1 > C_2$
 $U_1 > U_2$
- (2) $C_1 < C_2$
 $U_1 < U_2$
- (3) $C_1 > C_2$
 $U_1 < U_2$
- (4) $C_1 < C_2$
 $U_1 > U_2$

Answer (2)

Sol. Steady state

$$\frac{C_1}{C_2} = \frac{Q_1}{Q_2} < 1 \quad (\text{Connected across same potential difference})$$

$$\frac{C_1}{C_2} = \frac{U_1}{U_2} < 1$$

15. Energy of photon of wavelength λ is E_0 which is equal to kinetic energy of proton of mass m_p . The ratio of de Broglie wavelengths of proton and photon is

- (1) $\frac{1}{c} \sqrt{\frac{2E_0}{m_p}}$
- (2) $\frac{1}{c} \sqrt{\frac{E_0}{2m_p}}$
- (3) $\frac{2}{c} \sqrt{\frac{E_0}{m_p}}$
- (4) $\frac{1}{2c} \sqrt{\frac{E_0}{m_p}}$

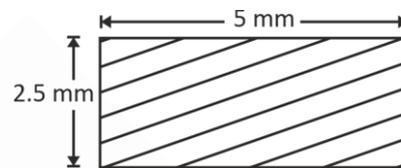
Answer (2)

Sol. $\frac{1}{2} m_p v^2 = E_0 \Rightarrow p = \sqrt{2m_p E_0} \quad \lambda_p = \frac{h}{\sqrt{2m_p E_0}}$

for photon $\frac{hc}{\lambda} = E_0 \Rightarrow \lambda_{ph} = \frac{hc}{E_0}$

$$\Rightarrow \frac{\lambda_p}{\lambda_{ph}} = \frac{h}{\sqrt{2m_p E_0}} \times \frac{E_0}{hc} = \frac{1}{c} \sqrt{\frac{E_0}{2m_p}}$$

16. The lengths of a rectangular sheet is measured from a screw gauge of pitch 0.75 mm and number of division on circular scale = 15. Find maximum possible error in measurement of area.



- (1) 0.225 mm²
- (2) 0.375 mm²
- (3) 0.75 mm²
- (4) 0.30 mm²

Answer (2)

Sol. Lest count of screw gauge

$$= \frac{0.75}{15} = 0.05 \text{ mm}$$

Now, $S = lb$

$$\Rightarrow \frac{\Delta S}{S} = \frac{\Delta l}{l} + \frac{\Delta b}{b}$$

$$\Rightarrow \frac{\Delta S}{S} = \left(\frac{0.05}{5}\right) + \frac{0.05}{2.5} = \frac{1}{100} + \frac{2}{100} = \frac{3}{100}$$

$$\Delta S = \left(\frac{3}{100}\right) \times 5 \times 2.5 = 0.375 \text{ mm}^2$$

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