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Unleashing Potential

JEE MAIN 2023

APRIL ATTEMPT

PAPER-1 (B.Tech / B.E.)

QUESTIONS & SOLUTIONS

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SHIFT - 1

08 APRIL, 2023

9:00 AM to 12:00 Noon

Duration : 3 Hours | Maximum Marks : 300

SUBJECT - PHYSICS

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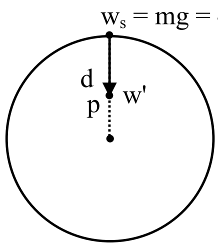
PHYSICS

1. The weight of an object at the surface of earth is 400 N. Find the weight of the object at depth R/2.

(1) 200 N (2) 250 N (3) 300 N (4) 350 N

Ans. **(1)**

Sol.



$$g_p = g\left(1-\frac{d}{R}\right)$$

$$g_p = g\left(1-\frac{R/2}{R}\right)$$

$$g_p = \frac{g}{2}$$

$$w' = mg_p = \frac{mg}{2} = \frac{400}{2} = 200\text{ N}$$

2. For an electron and a proton (m_p = 1847 m_e) with same de-Broglie wavelength, ratio of linear momentum will be :

(1) 2 : 1 (2) 1 : 1 (3) $2:\sqrt{1847}$ (4) $\sqrt{1847}:1$

Ans. **(2)**

Sol. $\lambda = \frac{h}{p}$

$$p = \frac{h}{\lambda}$$

3. Two forces of magnitude A and $\frac{A}{2}$ act perpendicular to each other. The magnitude of the resultant force is:

(1) $\frac{A}{2}$ (2) $\frac{\sqrt{5}}{2}A$ (3) $\frac{3A}{2}$ (4) $\frac{5A}{2}$

Ans. **(2)**

4. Find ratio of range of two projectiles if projection speeds and projection angles are (V_1 = 40 m/s, θ_1 = 30°) and (V_2 = 60 m/s and θ_2 = 60°) respectively.

(1) $\frac{4}{3}$ (2) $\frac{3}{5}$ (3) $\frac{4}{9}$ (4) $\frac{4}{5}$

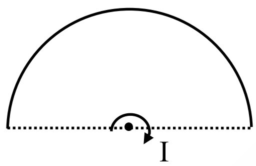
Ans. (3)

Sol.

5. The moment of Inertia of a half ring having mass M and radius about an axis passing through centre of ring and perpendicular to its plane is given by $\frac{MR^2}{x}$. Find the value of 'x'.

Ans. 1

Sol.



$I = MR^2 = \frac{MR^2}{x}$

x = 1

6. The height of a transmitting antenna is 98 m. Find the range upto which signals can be received if the receiving antenna is at the ground level. Radius of Earth is 6400 km.

Ans. $\mathbf{11200\sqrt{10}}$ **m**

Sol. Range $= \sqrt{2Rh} = \sqrt{2 \times 6400 \times 10^3 \times 98} = 7 \times 2 \times 8 \times 100\sqrt{10} = 11200\sqrt{10}$

7. Unit of $\frac{1}{\mu_0 \varepsilon_0}$?

(1) $\frac{L}{T}$ (2) L^2T^{-2} (3) LT^{-2} (4) $L^{-1}T^{-1}$

Ans. (2)

Sol. $C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

$\Rightarrow \quad C^2 = \frac{1}{\mu_0 \varepsilon_0} \qquad [C^2] = (LT^{-1})^2$

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8. A satellite of mass 'm' is revolving around the planet.

Statement I: Total energy of satellite is E and its potential energy is $\frac{E}{2}$.

Statement II: Total energy of satellite is E and its kinetic energy is 2E.

(1) Statement I & II both are correct

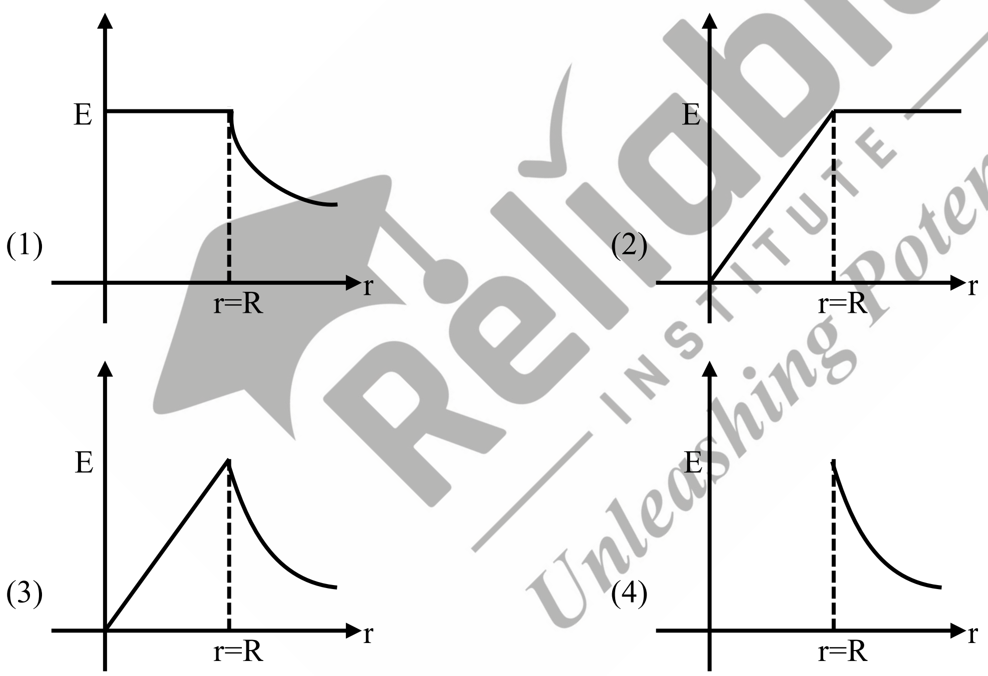
(2) Statement I & II both are wrong

(3) Statement I is right statement II is wrong.

(4) Statement I is wrong statement II is right.

Ans. (2)

9. Which of the following graph is correct for variation of electric field inside uniformly charged solid sphere.



Ans. (3)

10. If a particle of mass 500 gm is moving with velocity $\vec{v} = (2t\hat{i} + 3t^2\hat{j})$ m/s, where t is time in sec. The value of force at t = 1 sec is $(\hat{i} + x\hat{j})$N. These value of 'x' is :

Ans. 3

Sol. $\vec{a} = \frac{d\vec{v}}{dt} = 2\hat{i} + 6\hat{j}$

$\vec{F} = m\vec{a} = 0.5(2\hat{i} + 6\hat{j}) = \hat{i} + 3\hat{j} \quad \Rightarrow \quad x = 3$

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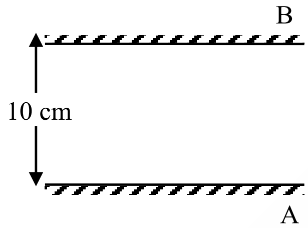
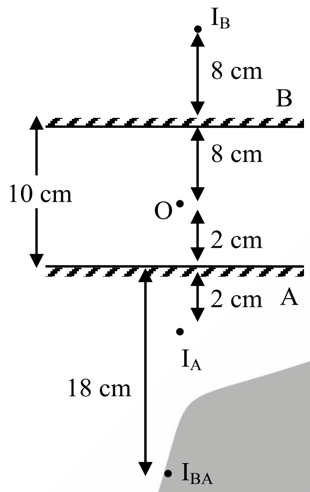
11. An object is between two plane mirrors 2 cm from mirror A. The distance between mirrors is 10 cm. Find the distance of second nearest image from mirror A.



Ans. **18 cm**

Sol.



12. A bubble of volume 1 cm^3 is at 40 m depth, when it reaches to the surface find its new volume? (Assume process to be isothermal) :

(1) 5 cm^3 (2) 6 cm^3 (3) 7 cm^3 (4) 8 cm^3

Ans. **(1)**

Sol. $P_1V_1 = P_2V_2$

$(10^5 + 4 \times 10^5)V_1 = 10^5\ V_2$

$5V_1 = V_2$

$5\ cm^3 = V_2$

13. Find energy density in rod ?

Young's modulus (Y) = 7×10^{10} N/m^2 and strain = 0.04 %

(1) 500 J/m^3 (2) 5200 J/m^3 (3) 5600 J/m^3 (4) 6000 J/m^3

Ans. **(3)**

Sol. Energy density = $\frac{1}{2}\times$stress $\times$strain $\left(\frac{\sigma}{\varepsilon}=Y\right)$

$$= \frac{1}{2}\times\sigma\times\varepsilon \quad \left(\frac{\sigma}{\varepsilon}=Y\right)$$

$$= \frac{1}{2}Y\varepsilon^2$$

$$= \frac{1}{2}\times 7\times 10^{10}\times\left(\frac{0.04}{100}\right)^2 = \frac{1}{2}\times 7\times 10^{10}\times(4\times 10^{-4})^2$$

$$= \frac{1}{2}\times 7\times 10^{10}\times 16\times 10^{-8}$$

$$= 8\times 7\times 100$$

$$= 5600\ \text{J/m}^3$$

14. If momentum of particle increases by 50%. Then percentage increase in kinetic energy is :

(1) 75% (2) 50% (3) 125% (4) 100%

Ans. **(3)**

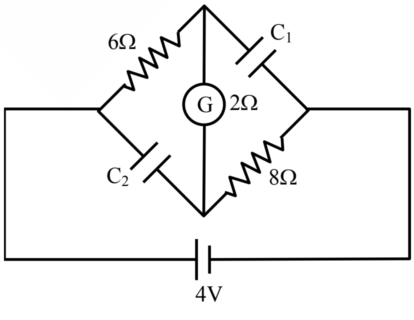
Sol. $P = \sqrt{2mE}$

$1.5P = \sqrt{2mE'}$

$E' = 2.25\ E$

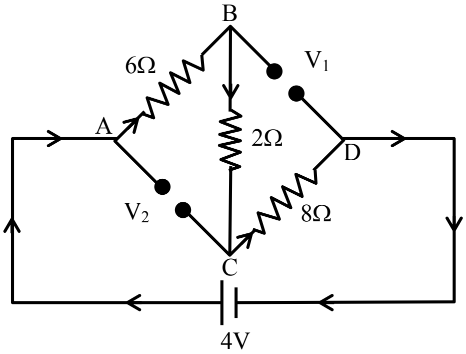
% change in K.E. = $\left(\frac{E'-E}{E}\right)\times 100 = 125\%$

15. Find the ratio of potential drop across the capacitor C_1 and C_2 at steady state for the circuit shown below.



Ans. $\frac{5}{4}$

Sol.



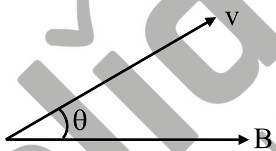
Current flowing in circuit = i = $\frac{4\,\text{volts}}{16\Omega} = \frac{1}{4}$ Amp.

$\Rightarrow V_1 = i\,(2 + 8) = 2.5$ volts.

$\Rightarrow V_2 = i\,(6 + 2) = 2$ volts

$\Rightarrow \frac{V_1}{V_2} = \frac{5}{4}$

16. If a particle is moving with velocity v at an angle θ to magnetic field as shown. Determine path taken by it ?



(1) Along B

(2) Perpendicular to B

(3) Helical path

(4) Circular motion.

Ans. **(3)**

Sol. (iii) Basic Theory

17. Statement I : If the heat is supplied to gas its temperature increases.

Statement II : If work is done by gas its volume increases.

(1) Statement I is true and Statement II is false.

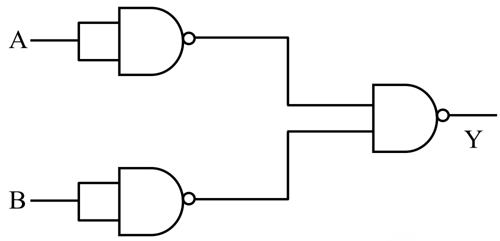
(2) Statement I is false and Statement II is true.

(3) Both Statement I and Statement II are true.

(4) Both Statement I and Statement II are False.

Ans. **(2)**

18. This figure represents which of the following logic gate :



(1) AND (2) OR (3) NAND (4) NOR

Ans. **(2)**

Sol. $\overline{\overline{A}.\overline{B}} = A + B$

19. If mass, radius of cross-section and height of a cylinder are (0.4 ± 0.01) g, (6 ± 0.03) m & (8 ± 0.04) m. The maximum percentage of error in the measurement of density of cylinder is ?

(1) 1% (2) 4% (3) 8 % (4) 7 %

Ans. **(2)**

Sol. $d = \frac{m}{V} = \frac{m}{\pi R^2 H}$

$$\%\frac{\Delta d}{d} = \%\frac{\Delta m}{m} + 2\%\frac{\Delta R}{R} + \%\frac{\Delta H}{H}$$

$$= \frac{0.01}{0.4}\times 100 + 2\times\frac{0.03}{6}\times 100 + \frac{0.04}{8}\times 100$$

$$= \frac{5}{2} + 1 + \frac{1}{2}$$

$= 4\ \%$

20. An atom of atomic mass 242, having binding energy per nucleon 8.4 MeV, breaks into two atoms of atomic mass 121 each (with binding energy per nucleon 7.1 MeV) Find the absolute Q value of reaction?

(1) 150 MeV (2) 314.6 MeV (3) 208.4 MeV (4) 290.8 MeV

Ans. **(2)**

Sol. $Q_{value} = |BE_P - BE_R|$

$= |121 \times 7.1 \times 2 - 242 \times 8.4|$

$= 242\ (8.4 - 7.1)$

$= 242 \times 1.3$

$= 314.6$ MeV

21. Find drift velocity.

Given I = 2A, n = 2×10^{28} m^{-3}, Area = 0.25 mm^2.

(1) 5×10^{-3} m/s (2) 2.5×10^{-3} m/s (3) 2×10^{-3} m/s (4) 7×10^{-3} m/s

Ans. **(2)**

Sol. $i = neA\, v_d$

$$\Rightarrow \quad v_d = \frac{i}{neA} = \frac{2}{2\times10^{28}\times1.6\times10^{-19}\times\frac{1}{4}\times10^{-6}}$$

$$= 2.5 \times 10^{-3} \text{ m/s}$$

22. In an LC oscillating circuit, L = 75 mH and C = 30 μF, the maximum charge of capacitor is 2.7×10^{-4} C. Maximum current through the circuit will be :

(1) 0.18 Amp. (2) 0.24 Amp. (3) 0.72 Amp. (4) 0.92 Amp.

Ans. **(1)**

Sol. $\frac{1}{2}Li^2 = \frac{q^2}{2C}$

$$\Rightarrow \quad 75\times10^{-3}\times i^2 = \frac{(2.7\times10^{-4})^2}{30\times10^{-6}} \quad \Rightarrow \quad i = 0.18 \text{ A}$$

23. In an open pipe find second harmonic frequency. (Given length of tube = 40 cm, velocity of sound in air = 360 m/s)

Ans. 900 Hz

Sol. $f = \frac{n}{2\ell}v$

$$n = 2 \Rightarrow = \frac{2\times100}{2\times40}\times360 = 900\text{Hz}$$

24. A train is moving with velocity 10 m/s towards platform blows a horn 400 hz. Passenger sitting inside train listen the horn at how much frequency:

(1) 412 hz (2) 400 hz (3) 388 hz (4) 80 hz

Ans. **(2)**

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SATYAM CHAKRAVORTY

(Classroom) ··→

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