

08/04/2023

Morning



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Memory Based Answers & Solutions

Time : 3 hrs.

for

M.M. : 300

JEE (Main)-2023 (Online) Phase-2

(Physics, Chemistry and Mathematics)

IMPORTANT INSTRUCTIONS:

- (1) The test is of **3 hours** duration.
- (2) The Test Booklet consists of 90 questions. The maximum marks are 300.
- (3) There are **three** parts in the question paper consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each part (subject) has two sections.
 - (i) **Section-A:** This section 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.
 - (ii) **Section-B:** This section contains 10 questions. In Section-B, attempt any **five questions out of 10**. The answer to each of the questions is a numerical value. Each question carries **4 marks** for correct answer and **-1 mark** for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

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. For an electron and a proton ($m_p = 1847 m_e$) with same de-Broglie wavelength, the ratio of linear momentum is equal to

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

Answer (3)

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

As $p_1 = p_2 \Rightarrow \lambda_1 = \lambda_2$

2. If the weight of an object on earth's surface is 400 N, then weight of the same object at a depth

$\frac{R}{2}$ from surface would be (R is radius of earth)

- (1) 100 N (2) 300 N
(3) 200 N (4) 250 N

Answer (3)

Sol. $W' = W \left(1 - \frac{R/2}{R}\right)$
 $= 400 \left(1 - \frac{1}{2}\right) = 200 \text{ N}$

3. If two particles A and B are projected with speed of 40 m/s and 60 m/s at an angle of 30° and 60° with the horizontal respectively. The ratio of the range of A to B will be

- (1) $\sqrt{2} : 3$ (2) $\sqrt{3} : 2$
(3) 4 : 9 (4) 2 : 1

Answer (3)

Sol. $\frac{u_1^2 \sin 2\theta_1}{g} = \frac{u_2^2 \sin 2\theta_2}{g}$
 $= \frac{u_1^2}{u_2^2} \times \frac{\sin 2\theta_1}{\sin 2\theta_2}$
 $= \frac{4}{9} \times \frac{\frac{\sqrt{3}}{2}}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{4}{9}$

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

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

Answer (2)

Sol. $A_{\text{net}} = \sqrt{A^2 + \frac{A^2}{4}}$
 $= \frac{\sqrt{5}A}{2}$

5. An air bubble having volume 1 cm^3 at depth 40 m inside water comes to surface. What will be the volume of the bubble at the surface?

- (1) 5 cm^3 (2) 2 cm^3
(3) 4 cm^3 (4) 3 cm^3

Answer (1)

Sol. Initial pressure = $P_0 + \rho gh$
 $= 10^5 + 1000 \times 10 \times 40$
 $= 5 \times 10^5$

Final pressure = 10^5

$PV = \text{constant}$

$\Rightarrow 5 \times 10^5 \times V_i = 10^5 \times V_f$

$\Rightarrow V_f = 5 \text{ cm}^3$

6. The height of antenna is 98 m. The radius of earth is 6400 km. The area upto which it will transmit signal, is

- (1) 3642 km^2 (2) 3942 km^2
(3) 11200 km^2 (4) 22400 km^2

Answer (2)

Sol. $r = \sqrt{2Rh}$

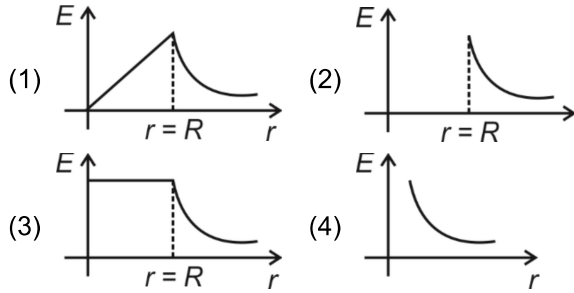
Area = $\pi r^2 = 2\pi Rh$

$= 2 \times \frac{22}{7} \times 6400 \times 10^3 \times 98$

$= 3942.4 \times 10^6 \text{ m}^2$

$= 3942.4 \text{ km}^2$

7. The graph showing the variation of electric field (E) with the distance (r) from the centre of a conducting spherical shell is



Answer (2)

Sol. $E_{\text{inside shell}} = 0$

$$E_{\text{outside shell}} = \frac{KQ}{r^2}$$

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

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

Answer (2)

Sol. $\rho = \frac{m}{\pi r^2 h}$

$$\frac{\Delta \rho}{\rho} = \pm \left(\frac{\Delta m}{m} + \frac{2\Delta r}{r} + \frac{\Delta h}{h} \right)$$

$$= 0.04$$

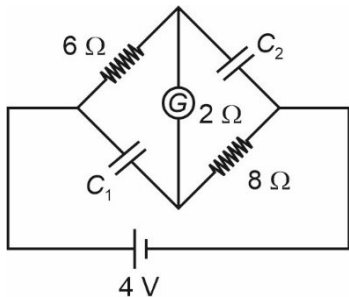
9. An atom of atomic mass 242, having binding energy per nucleon 8.4 MeV, breaks into two atoms of atomic mass 121 each (with binding energy per nucleon 7.1 MeV). Find the absolute Q-value of the reaction

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

Answer (2)

Sol. $Q\text{-value} = 242 [8.4 - 7.1] \text{ MeV}$
 $= 314.6 \text{ MeV}$

10. What is the ratio of potential difference across C_1 and C_2 at steady state for the given circuit?



- (1) 4 : 5 (2) 2 : 5
 (3) 1 : 4 (4) 3 : 1

Answer (1)

Sol. At steady state $R_{\text{eq}} = 6 + 2 + 8 = 16 \Omega$

$$i_{\text{battery}} = \frac{4}{16} = \frac{1}{4} \text{ A}$$

$$\Delta V_{C_1} = \frac{1}{4} \times 8 = 2 \text{ V}$$

$$\Delta V_{C_2} = \frac{1}{4} \times 10 = \frac{5}{2} \text{ V}$$

11. If velocity of charged particle has the component both in and perpendicular to the direction of magnetic field then the path traced by the charged particle will be

- (1) Circular (2) Straight line
 (3) Cycloid (4) Helical

Answer (4)

Sol. Velocity perpendicular to \vec{B} will cause circular motion which parallel to \vec{B} will cause pitch so helical motion is the correct answer.

12. The dimension of $\frac{1}{\mu_0 \epsilon_0}$ is

- (1) MLT^{-1} (2) M^0LT^{-2}
 (3) ML^2T^{-1} (4) $M^0L^2T^{-2}$

Answer (4)

Sol. $\frac{1}{\mu_0 \epsilon_0} = (LT^{-1})$

$$\frac{1}{\mu_0 \epsilon_0} = (L^2T^{-2})$$

13. In an LC oscillating circuit with $L = 75$ mH and $C = 30 \mu\text{F}$. The maximum charge of capacitor is $2.7 \times 10^{-4}\text{C}$. Maximum current through the circuit will be

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

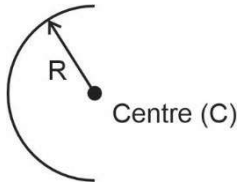
Answer (1)

Sol. $\frac{1}{2} \times 75 \times 10^{-3} \times I^2 = \frac{1}{2} \times \frac{2.7 \times 2.7 \times 10^{-9}}{3 \times 10^{-6}}$

$$I^2 = \frac{27 \times 9}{75} \times 10^{-2} = \frac{81}{25} \times 10^{-2}$$

$$\Rightarrow I = \frac{0.9}{5} \text{ Amp} = 0.18 \text{ Amp}$$

14. The moment of inertia of a semi-circular ring of mass M and radius R about an axis passing through centre and perpendicular to the plane of ring is



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

Answer (1)

Sol. Distance of mass from centre is same so,
 $I = \int dmR^2 = R^2 \int dm = MR^2$

15. **Statement (1):** If total energy of a satellite revolving around earth in circular path is E , then potential energy of satellite is $2E$

Statement (2): Kinetic energy is also twice of total energy

- (1) (1) & (2), both are true
 (2) (1) is true, but (2) is false
 (3) Both (1) & (2) are false
 (4) (1) is false, but (2) is true

Answer (2)

Sol. Total energy = $-\frac{Gm_1m_2}{2r}$

$$P \cdot E = -\frac{Gm_1m_2}{r}$$

$$K \cdot E = \frac{Gm_1m_2}{2r}$$

16. Consider the following Assertion (A) and Reason (R):

(A): When heat is supplied to a system, temperature increase.

(R): Positive work done by the system increases volume of thermodynamic system.

- (1) Assertion is true, reason is false
 (2) Assertion is false, reason is true
 (3) Both are true and reason is correct explanation of assertion
 (4) Both are true and reason is incorrect explanation of assertion

Answer (2)

Sol. When heat is supplied, if work done exceeds increase in internal energy, then $\Delta T < 0$.

Also, if volume increases \rightarrow work done is positive

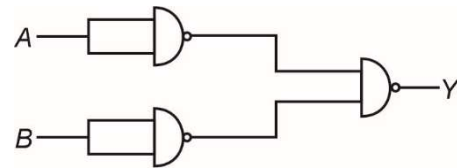
17. Two different lenses are used in telescope because

- (1) Magnification is increased
 (2) Focal length is increased
 (3) More light is captured
 (4) Spherical aberration is increased

Answer (1)

Sol. Theoretical.

18. The truth table of the given circuit is



(1)

A	B	Y
1	0	1
0	0	0
1	1	1
0	1	1

(2)

A	B	Y
1	0	1
0	0	0
1	1	0
0	1	1

(3)

A	B	Y
1	0	1
0	0	1
1	1	1
0	1	1

(4)

A	B	Y
1	0	0
0	0	0
1	1	0
0	1	0

Answer (1)

Sol.

A	B	\bar{A}	\bar{B}	Y
1	0	0	1	1
0	0	1	1	0
1	1	0	0	1
0	1	1	0	1

19. In a lake of depth 40 m a bubble is at bottom. Assuming temperature and density of lake water to be uniform find density of air in bubble. (Assume temperature $T = 12^\circ\text{C}$ and density water = 10^3 kg/m^3)

- (1) 16.76 kg/m^3 (2) 15.32 kg/m^3
 (3) 6.33 kg/m^3 (4) 45.94 kg/m^3

Answer (3)

Sol. $PV = \frac{m}{M}RT$

$$\Rightarrow PM = \rho RT$$

$$\Rightarrow \rho = \frac{5 \times 10^5 \times 30 \times 10^{-3}}{8.314 \times 285}$$

$$= 6.33 \text{ kg/m}^3$$

20. A train is moving with a speed of 10 m/s towards a platform and blows a horn with frequency 400 Hz. Find the frequency heard by a passenger standing on the platform. Take speed of sound = 310 m/s.
- (1) 405 Hz (2) 425 Hz
 (3) 380 Hz (4) 413 Hz

Answer (4)

Sol. $f' = f \left[\frac{v - v_0}{v - v_s} \right]$

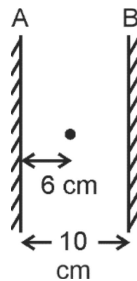
$$= 400 \left[\frac{310 - 0}{310 - 10} \right]$$

$$= \frac{4}{3}(310) \text{ Hz} \simeq 413 \text{ Hz}$$

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g., 06.25, 07.00, -00.33, -00.30, 30.27, -27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

21. In the given diagram, find the distance (in cm) between 2nd and 3rd image formed left of mirror A.



Answer (12.00)

Sol.

	A		B
	6	10	4
2 nd	14	10	16
3 rd	26	10	24

Distance = 26 - 14
 = 12 cm

22. In a long solenoid the magnetic field intensity inside the solenoid is equal to $1.6 \times 10^{-3} \text{ T}$. If number of turns per unit length on the solenoid is equal to $\frac{8}{\pi}$ per cm then current flowing in the solenoid is equal to _____ Amperes.

Answer (5)

Sol. $B = \mu_0 n I$

$$I = \frac{1.6 \times 10^{-3} \times 10^7 \times \pi}{800 \times 4 \pi}$$

$$= \frac{160}{32} = 5 \text{ Amperes}$$

23. A particle of mass 500 grams is moving with velocity $\vec{v} = 2t\hat{i} + 3t^2\hat{j}$ m/s. Then the force on the particle at $t = 1$ s is $\hat{i} + x\hat{j}$ N. Find x.

Answer (3)

Sol. $\vec{a} = 2\hat{i} + 6t\hat{j}$

$$\Rightarrow \vec{F} = m\vec{a} = \hat{i} + 3t\hat{j}$$

$$= \hat{i} + 3\hat{j} \text{ N at } t = 1.$$

24. Momentum of a particle is increased by 50% by keeping its mass constant. Percentage increase in kinetic energy of particle is

Answer (125)

Sol. K.E. = $\frac{p^2}{2m}$

$$\text{K.E.}_i = \frac{p_i^2}{2m}$$

$$\text{K.E.}_f = \frac{p_f^2}{2m} = \frac{2.25p_i^2}{2m}$$

$$= 2.25 \text{ K.E.}_i$$

25. An electric dipole with dipole moment $5 \mu\text{Cm}$ is placed in a region with uniform electric field 600 N/C at angle 90° with the direction of field. The torque experienced by the dipole (in milli Newton-meters) is equal to _____.

Answer (3)

Sol. $\tau = |\vec{p} \times \vec{E}| = 5 \times 10^{-6} \times 600 \text{ Nm} = 3 \times 10^{-3} \text{ Nm}$

26.

Answer ()

- Sol.**
 27.
 28.
 29.
 30.