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JEE MAIN (APRIL) 2023 (08-04-2023-FN)

*Memory Based Question Paper*  
**PHYSICS**



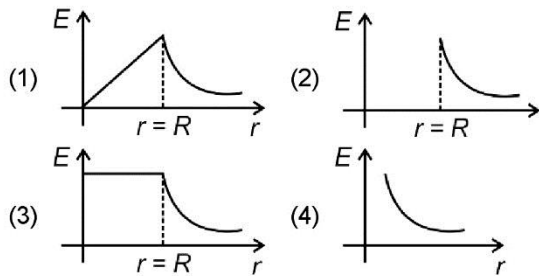
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7. The graph showing the variation of electric field ( $E$ ) with the distance ( $r$ ) from the centre of a conducting spherical shell is



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

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

$$= 0.04$$

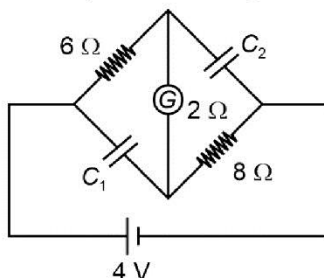
9. An atom of atomic mass 242, having binding energy per nucleon 8.4 MeV, breaks into two atoms of atomic mass 121 each (with binding energy per nucleon 7.1 MeV). Find the absolute Q-value of the reaction

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

**Answer (2)**

**Sol.** Q-value =  $242 [8.4 - 7.1]$  MeV  
= 314.6 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)  $M^0L^2T^{-2}$   
(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  $C = 30$   $\mu$ F. The maximum charge of capacitor is  $2.7 \times 10^{-4}$ C. Maximum current through the circuit will be

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

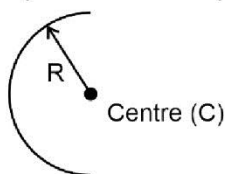
**Answer (1)**

**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 =  $-\frac{Gm_1m_2}{2r}$

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

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

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  $\Delta T < 0$ .

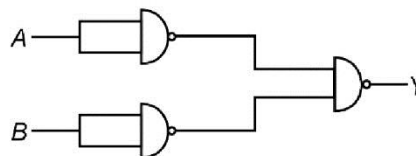
Also, if volume increases  $\rightarrow$  work done is positive

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 =  $10^3 \text{ kg/m}^3$ )

- (1)  $16.76 \text{ kg/m}^3$                       (2)  $15.32 \text{ kg/m}^3$   
 (3)  $6.33 \text{ kg/m}^3$                       (4)  $45.94 \text{ kg/m}^3$

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

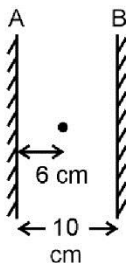
$$= 400 \left[ \frac{310 - 0}{310 - 10} \right]$$

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

**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 2<sup>nd</sup> and 3<sup>rd</sup> image formed left of mirror A.



**Answer (12.00)**

**Sol.**

	A	B
	6	10
	4	16
2 <sup>nd</sup>	14	10
	16	24
3 <sup>rd</sup>	26	10
	24	16

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

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

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

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

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  $90^\circ$  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.