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

for

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

(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.
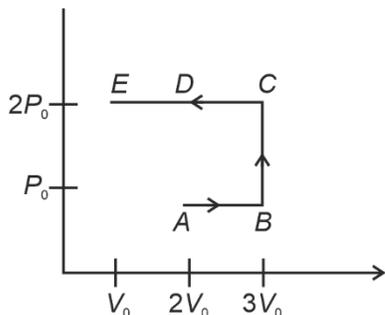
PHYSICS

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 total work done from *A* to *E*.

(1) $-3\, P_0V_0$

(2) $3\, P_0V_0$

(3) $3\, P_0V_0$

(4) $5\, P_0V_0$

Answer (1)

Sol. Work done = Area under curve

$$= -4\, P_0V_0 + P_0V_0$$

$$= -3\, P_0V_0$$

2. **Statement 1:** Graph of frequency *f* of X ray and atomic number Z of heavy nucleus is straight line, in X ray emission.

   Statement 2: Graph of square root of frequency $\sqrt{f}$ of X ray and atomic number Z of heavy nucleus is straight line, in X ray emission.

   (1) Statement 1 is correct and statement 2 is correct

   (2) Statement 1 is incorrect and statement 2 is correct

   (3) Statement 1 is correct and statement 2 is incorrect

   (4) Statement 1 is incorrect and statement 2 is incorrect

Answer (2)

Sol. Mosley law $\sqrt{f} = a(z - b)$

3. Two ideal diodes are connected in circuit as shown. Find current through battery.
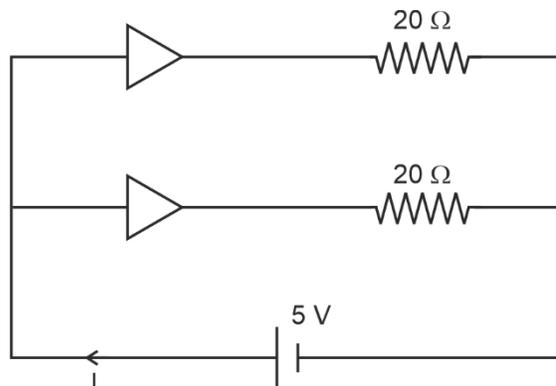
(1) 0.3 A

(2) 1 A

(3) 0.5 A

(4) 0.25 A

Answer (3)

Sol. Both diode are in forward bias.

$$I = \frac{5}{20} + \frac{5}{20}$$

$I = 0.5$ A

4. In a series LCR circuit, inductance $L = 100$ mH and capacitance $C = 1$nF. The angular frequency of the source when current has maximum amplitude in the circuit is

(1) $\dfrac{10^4}{2\pi}\, \text{rad}/\text{s}$

(2) $\dfrac{10^5}{2\pi}\, \text{rad}/\text{s}$

(3) $10^5\, \text{rad}/\text{s}$

(4) $10^6\, \text{rad}/\text{s}$

Answer (3)

Sol. The current is maximum at resonance,

$$\Rightarrow \quad w = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\left(100 \times 10^{-3}\text{H}\right)\left(1 \times 10^{-9}\text{F}\right)}}$$

$$= 10^5\, \text{rad}/\text{s}$$

5. Two charges +7 C and –4 C are located at (–7, 0, 0) and (7, 0, 0), find electrostatic potential energy of the system. $\left(k = \dfrac{1}{4\pi \in_0} = 9 \times 10^9 \text{ SI units} \right)$

   (1) -6×10^9 J
   (2) -18×10^9 J
   (3) 18×10^9 J
   (4) 6×10^9 J

Answer (2)

Sol. $E = \dfrac{Kq_1 q_2}{r}$

$$= \dfrac{-9 \times 10^9 \times 7 \times 4}{14}$$

$$= -18 \times 10^9 \text{ J}$$

6. A satellite is nine times closer to earth compared to moon. Time period of moon is 27 days then period of satellite is

   (1) 3 days
   (2) 9 days
   (3) 1 day
   (4) $3\sqrt{3}$ days

Answer (3)

Sol. $\dfrac{T_m^2}{T_s^2} = \dfrac{r_m^2}{\left(\dfrac{r_m}{9} \right)^3} = 9^3$

$$\Rightarrow T_s = \dfrac{T_m}{9^{3/2}} = 1 \text{ day}$$

7. A concave mirror of focal length f dipped into a fluid of refractive index μ. The new focal length mirror is

   (1) μf
   (2) f
   (3) $\dfrac{f}{\mu - 1}$
   (4) $\dfrac{f}{\mu}$

Answer (2)

Sol. Focal length of spherical mirror does not depends on medium in which it placed.

8. In an electromagnetic wave of frequency 20 MHz, value of electric field is 9.3 V/m, then magnitude of magnetic field at that instant is

   (1) 3.1×10^8
   (2) 27.9×10^8
   (3) 3.1×10^{-8}
   (4) 18.6×10^{-6}

Answer (3)

Sol. $E = CB$

$$\Rightarrow B = \dfrac{9.3}{3 \times 10^8} = 3.1 \times 10^{-8} \text{ } T$$

9. Match the correct dimensions

(a)	Magnetic field	(i)	ML^2
(b)	Permittivity of free space	(ii)	$M^{-1}L^{-3}T^4A^2$
(c)	Moment of inertia	(iii)	$MT^{-2}A^{-1}$
(d)	Velocity	(iv)	LT^{-1}

   (1) (a) → (iii), (b) → (ii), (c) → (i), (d) → (iii)
   (2) (a) → (iii), (b) → (iv), (c) → (iv), (d) → (iv)
   (3) (a) → (iii), (b) → (ii), (c) → (i), (d) → (iv)
   (4) (a) → (i), (b) → (ii), (c) → (iii), (d) → (iv)

Answer (3)

Sol. $qvB = F$

$$B = \dfrac{MLT^{-2}}{A}$$

$$MT^{-2}A^{-1}$$

$$\dfrac{q}{\varepsilon_0} = EA$$

$$\dfrac{1}{\varepsilon_0} = \dfrac{MLT^{-2}}{AT} \dfrac{L^2}{AT}$$

$$\varepsilon_0 = \dfrac{A^2T^2}{ML^3T^{-2}}$$

10. The temperature of a body of mass m and specific heat capacity s is raised slowly from T_1 to T_2. The change is entropy of the system is

   (1) $ms \ln\left(\dfrac{T_2}{T_1}\right)$

   (2) ms

   (3) $ms \ln\left(\dfrac{T_1}{T_2}\right)$

   (4) Zero

Answer (1)

Sol. $d(\text{Entrophy})_{sys} = \dfrac{dQ}{T}$

$$(\Delta \text{Entropy})_{sys} = \int_{T_1}^{T_2} \dfrac{dQ}{T}$$

$$= ms \int_{T_1}^{T_2} \dfrac{dT}{T}$$

$$= ms \ln \dfrac{T_2}{T_1}$$

11. A moving coil galvanometer with coil resistance $G = 30\ \Omega$, shows full scale deflection when the current through it is 20 mA. The galvanometer is converted to an ammeter of range 3 A by using a shunt resistance S, then resistance S is

   (1) $0.2\ \Omega$

   (2) $2\ \Omega$

   (3) $0.8\ \Omega$

   (4) $1.2\ \Omega$

Answer (1)

Sol. $i_g G = IS$

$$S = \dfrac{i_g G}{I}$$

$$= \dfrac{\left(20 \times 10^{-3}\,\text{A}\right)(30\ \Omega)}{(3\,\text{A})}$$

$$= \dfrac{1}{5}\ \Omega$$

12. Torque on a uniform disk of mass 2 kg, radius 1 m is given as $\tau(t) = 5t^2 - 8t$. If the disk was initially at rest, find power by torque at $t = 1$s.

   (1) 5 W

   (2) 3 W

   (3) 7 W

   (4) 9 W

Answer (3)

Sol. $\rho = \vec{\tau} \cdot \vec{\omega}$

$\tau = I\alpha$

$I = \dfrac{MR^2}{2} = 1$

$\alpha = 5t^2 - 8t$

$\omega = \dfrac{5}{3}t^3 - 4t^2$

At $t = 1$, $\omega = \dfrac{5}{3} - 4 = -\dfrac{7}{3}$

$t(3) = 5 - 8 = -3$

$\rho = \vec{\tau} \cdot \vec{\omega} = 7$ W

13. During charging of capacitor of 2.5 μF in DC circuit, the displacement current is found to be 0.25 mA then find rate of change of voltage V w.r.t. time $\dfrac{dV}{dt}$.

   (1) 1 V/s

   (2) 10 V/s

   (3) 100 V/s

   (4) 0.1 V/s

Answer (3)

Sol. $V = \dfrac{q}{C}$

$\dfrac{dV}{dt} = \dfrac{i}{C} = \dfrac{0.25 \times 10^{-3}}{2.5 \times 10^{-6}}$

$\dfrac{1000}{10}$

14. In a photoelectric experiment, the stopping potential of 2 V, the work function of metal is 2.14 eV. Find the wavelength of incident light (given hc = 1242 eV-nm)

   (1) 200 nm

   (2) 300 nm

   (3) 600 nm

   (4) 400 nm

Answer (2)

Sol. E = 2 + 2.14 = 4.14 eV

$E = \dfrac{hc}{\lambda}$

$\therefore \quad \lambda = \dfrac{1242}{4.14} = 300$ nm

15. The equation of wave travelling in a medium is given by $y(x, t) = 4.0 \sin(20 \times 10^{-3}x + 600t)$mm. The velocity of wave is $n \times 10^4$ m/s. Find n.

   (1) 7

   (2) 5

   (3) 4

   (4) 3

Answer (4)

Sol. Velocity of wave $= \dfrac{\text{Coefficient of } t}{\text{Coefficient of } x}$

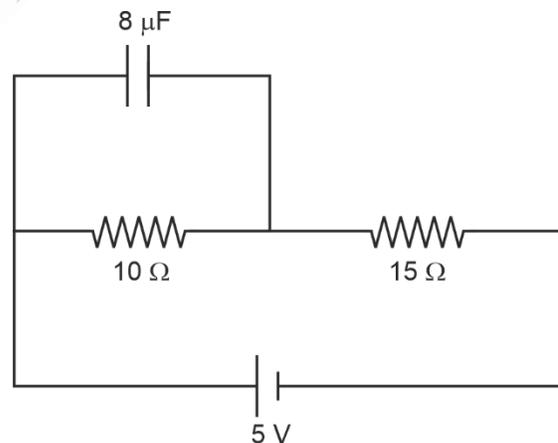$= \dfrac{600}{20 \times 10^{-3}}$

$= 3 \times 10^4$ m/s

$n = 3$

16.

17.

18.

19.

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. Find charge on the capacitor (in μF) at steady state.

Answer (16)

Sol. $i = \dfrac{5}{25} = \dfrac{1}{5}$ A

$V = 10 \times \dfrac{1}{5} = 2$ V

$Q = CV = 8 \times 2 \ \mu F$

$= 16 \ \mu F$

22. A particle of mass m is projected at angle 60° with horizontal. If initial kinetic energy is KE_0 and kinetic energy at maximum height is $\dfrac{KE_0}{x}$, find value of x.

Answer (4)

Sol. $KE_0 = \dfrac{1}{2} mV^2$

$KE = \dfrac{1}{2} m(V \cos 60°)^2$

$= \dfrac{1}{2} m \dfrac{V^2}{4}$

$x = 4$

23. The energy in a system varies with position and time as $E(x, t) = x^3 e^{-\beta t}$, where $\beta = 0.3 \ sec^{-1}$. Given that the percentage error in $x = 1.2\%$ and that the % error in $t = 1.6\%$, find the maximum % error in E at $t = 5$ sec.

Answer (6)

Sol. $E = x^3 e^{-\beta t}$

$\ln E = 3\ln x - \beta t$

$\dfrac{1}{E} dE = \dfrac{3}{x} dx - \beta \, dt$

$\left(\dfrac{dE}{E} \times 100\right) = 3\left(\dfrac{dx}{x} \times 100\right) + 100\beta \, dt$

% error in $E = 3(1.2\%) + (100)(0.3)\left(\dfrac{1.6}{100} \times 5\right)\%$

% error in $E = 6\%$

24. For a prism, the minimum deviation is equal to the angle of prism. If the refractive index is $\sqrt{3}$, find the minimum deviation (in degrees)

Answer (60)

Sol. $\mu = \dfrac{\sin\left(\dfrac{A+\delta}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$

$\mu = 2\cos\left(\dfrac{A}{2}\right)$

$\dfrac{A}{2} = 30°$

$A = 60°$

$\therefore \ \delta = 60°$

25. A satellite of mass m is moving in circular orbit at a heigh R from surface of Earth (mass M, radius R). If the angular momentum of the satellite is $m\sqrt{NGMR}$, find N.

Answer (2)

Sol. $L = mvr$

$= m\sqrt{\dfrac{GM}{2R}} \ 2R$

$= m\sqrt{2GMR}$