



# JEE (Main)

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

# 2022

## COMPUTER BASED TEST (CBT) Memory Based Questions & Solutions

Date: 25 July, 2022 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300

**SUBJECT: PHYSICS**

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### PART : PHYSICS

1. Speed of a block of mass 0.5kg varies with position  $x$  according to  $V(x) = 3x^2 + 4$  work done on the block

from  $x = 0$  to  $x = 2$  will be :

(1) 15

(2) 30

(3) 60

(4) 90

Ans. (3)

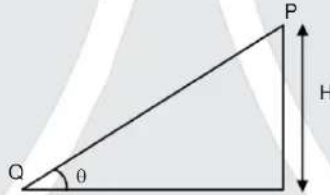
Sol.  $V_{x=0} = 4$

$V_{x=2} = 16$

$$W_{\text{all}} = \Delta KE = KE_F - KE_{\text{ini}} = \frac{1}{2} m (V_F^2 - V_{\text{ini}}^2)$$

$$W_{\text{all}} = \frac{1}{2} \times \frac{1}{2} ((16)^2 - (4)^2) = 60 \text{ J}$$

2. A solid cylinder and solid sphere are released from point P as shown in diagram. Find ratio of velocities at Q. (Assume pure rolling)



(1)  $\sqrt{\frac{15}{12}}$

(2)  $\sqrt{\frac{7}{5}}$

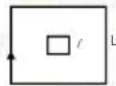
(3)  $\sqrt{\frac{14}{15}}$

(4)  $\sqrt{\frac{3}{5}}$

Ans. (3)

Sol.  $\frac{V_{\text{cy}}}{V_{\text{solid}}} = \frac{1 + \frac{2}{5}}{1 + \frac{1}{2}} = \sqrt{\frac{7 \times 2}{5 \times 3}} = \sqrt{\frac{14}{15}}$

- 3 Two square loops are placed in the same plane. The mutual inductance between them will be approximately proportional to ( $\ell \ll L$ )



(1)  $\frac{\ell}{L}$

(2)  $\frac{\ell^2}{L}$

(3)  $\frac{L^2}{\ell}$

(4)  $\frac{L}{\ell}$

Ans. (2)

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4. If a light of wavelength  $\lambda = 800 \text{ nm}$  is incident on a metal surface the maximum kinetic energy of emitted electrons is  $T$ . If light of wavelength  $\lambda = 500 \text{ nm}$  is incident on the same metal, the maximum kinetic energy of emitted electrons is  $2T$ . Find the work function of the metal.

(1) 0.62 eV

(2) 1.24 eV

(3) 7.78 eV

(4) 0.82 eV

Ans. (1)

Sol.  $KE_{\text{max}} = \frac{hc}{\lambda} - \psi$

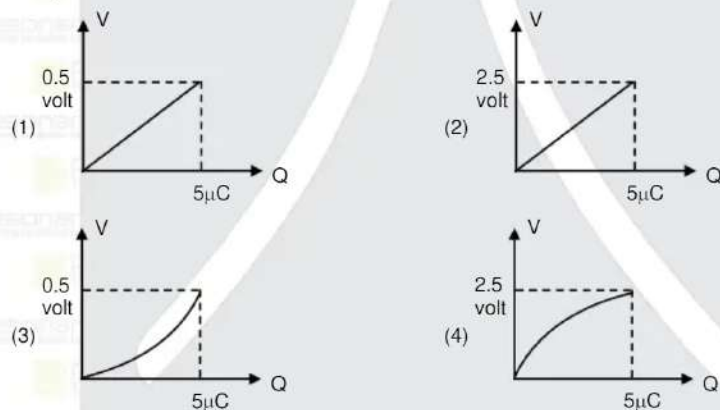
$$T = \frac{hc}{800 \text{ nm}} - \psi$$

$$2T = \frac{hc}{500 \text{ nm}} - \psi$$

$$\dots \dots \dots hc \quad 1240 \dots \dots$$

Solving  $\psi = \frac{2000 \text{ nm}}{2000} = 0.62 \text{ eV}$

5. Charge of a capacitor of capacitance  $C = 2 \mu\text{F}$  is increased from 0 to  $5 \mu\text{C}$ . The graph of potential  $V$  and charge  $Q$  will be :



Ans. (2)

Sol.  $Q = CV$

$$V = \frac{Q}{C}, \text{ At } Q = 0, V = 0,$$

$$\text{At } Q = 5 \mu\text{C}, V = \frac{5 \mu\text{C}}{2 \mu\text{F}} = 2.5 \text{ volt}$$

Since  $C = \text{constant}$ , so  $V \propto Q$ , so the graph will be a straight line.

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6. In series LCR circuit, to increase the resonant frequency :

- (1) The angular frequency of the source should be increased
- (2) One more capacitor is connected in series with  $C$
- (3) One more resistance is connected in series
- (4) One more inductor is connected in series

Ans. (2)

Sol.  $\omega_r = \frac{1}{\sqrt{LC}}$ , to increase  $\omega_r$ , the capacitance is to be decreased.

7. If there is a rod of length  $\ell$  and radius  $r$  is pulled by an external force  $F$ , then elongation of rod is 5 cm. If length and radius of rod is 4 times of initial length and radius and now if it is again pulled by an external force  $4F$ , then elongation of the rod is (Young's modulus of rod is  $Y$ ) :

- (1) 5 cm
- (2) 7 cm
- (3) 10 cm
- (4) 12 cm

Ans. (1)

Sol.  $Y = \frac{F}{\pi R^2} \frac{x}{\Delta x}$

$$\Delta x = \frac{Fx}{\pi R^2 Y}$$

$$\Delta x \propto \frac{Fx}{R^2} \propto \frac{(4F)(4\ell)}{(4R)^2} \propto \frac{F\ell}{R^2}$$

Remain same 5 cm.

8. Pick the wrong answer in the context with rainbow.
- (1) Rainbow is combined effect of dispersion, refraction and reflection of sunlight.
  - (2) When the light rays undergo two internal reflections in a water drop, a secondary rainbow is formed.
  - (3) The order of colours is reversed in the secondary rainbow.
  - (4) An observer can see a rainbow when his front is towards the sun.

Ans. (4)

Sol. To see the rainbow the sun should be on his backside

9. A car is moving with velocity 150 km/hr stops at 27 m on applying breaks. If speed is  $\frac{1}{3}$ rd then how much distance will it travel before coming to rest :

- (1) 12 (2) 8 (3) 6 (4) 3

Ans. (4)

Sol.  $v_i = 0$ ,  $u = 150$ ,  $s = 27$  m

$$0^2 = 150^2 - 2a \times 27$$

$$v_f = 0$$
,  $u = 50$ ,  $s = ?$

$$0^2 = 50^2 - 2as ; [s = 3\text{m}]$$

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10. A capacitance is connected to 230 volt, 600 Hz of conducting current in capacitor is 6.90  $\mu\text{A}$ . Then the value of capacitor is :

- (1) 7.93 pF (2) 5.63 pF (3) 4.33 pF (4) 2.23 pF

Ans. (1)

Sol.  $X_c = \frac{1}{C\omega}$

$$X_c = \frac{V_{ms}}{I_m} = \frac{230}{6.9 \times 10^{-10}} = \frac{2.3}{6.9} \times 10^8 = \frac{1}{3} \times 10^8$$

$$\frac{1}{C\omega} = \frac{1}{3} \times 10^8$$

$$C = \frac{1}{\frac{1}{3} \times 10^8} = \frac{1}{\frac{1}{3} \times 10^8 \times 2\pi \times 600}$$

$$= \frac{1}{400\pi \times 10^8}$$

$$= \frac{1}{4\pi} \times 10^{-10} = \frac{100}{4\pi} \times 10^{-12} = \frac{25}{\pi} \text{ PF} = 7.93 \text{ PF}$$

11. Dimensions of coefficient of viscosity  $\eta$  in terms of momentum (P) Area (A), time (T)

- (1)  $[\eta] = [\text{PA}^{-1} \text{T}^0]$  (2)  $[\eta] = [\text{PA}^{-1} \text{T}^1]$  (3)  $[\eta] = [\text{PA}^{-1} \text{T}^{-1}]$  (4)  $[\eta] = [\text{P}^{-1} \text{A}^{-1} \text{T}^0]$

Ans. (1)

Sol.  $[\eta] = [\text{P}]^a [\text{A}]^b [\text{T}]^c$

$$[\text{ML}^{-1} \text{T}^{-1}] = [\text{MLT}^{-1}]^a [\text{L}^2]^b [\text{T}]^c$$

$$\begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix} = \begin{bmatrix} a \\ a+2b \\ -a+c \end{bmatrix}$$

$$[a = 1] = [c = 0]$$

$$-1 = 1 + 2b$$



$$[b] = -1$$

$$[\eta] = [PA^{-1} T^0]$$

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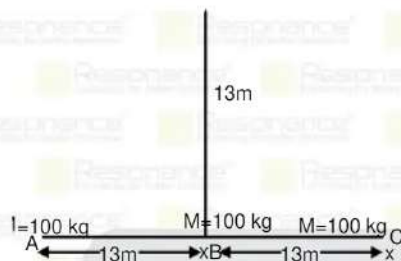
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12.

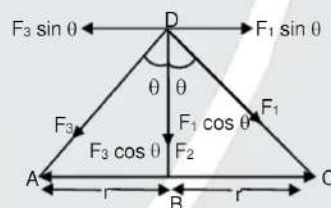


In figure there are four identical masses of mass 100kg placed respectively at A, B, C and D. Then gravitation force on mass which is placed at D-due remaining three masses :

- (1) 100 G      (2) 60 G      (3) 64 G      (4) 70 G

Ans. (1)

Sol.



$$DC = DA = r\sqrt{2} = 13\sqrt{2} \text{ m}$$

Let  $F = F_0$

$$\vec{F}_1 = \frac{F_0}{2} ; \vec{F}_3 = \frac{F_0}{2} ; |\vec{F}_D| = \frac{2F_0}{2} \cos \theta + F_0$$

$$|\vec{F}_D| = F_0(\cos \theta + 1) = \frac{G(100)^2}{13^2} \left( \frac{13}{13\sqrt{2}} + 1 \right) = |\vec{F}_D| = \frac{G(100)^2}{13^2} \left( \frac{1+\sqrt{2}}{\sqrt{2}} \right) = 100 \text{ G}$$

13. Charge density in free space is  $2 \text{ C/cm}^3$  electric field lines passing through a surface per unit volume will be:

- (1)  $62\pi \times 10^{15} / \text{m}^3$       (2)  $22\pi \times 10^{15} / \text{m}^3$       (3)  $32\pi \times 10^{15} / \text{m}^3$       (4)  $72\pi \times 10^{15} / \text{m}^3$

Ans. (4)

Sol.  $\frac{\phi}{V} = \frac{\rho}{\epsilon_0}$

$$= 2 \times 10^6 \times 4\pi \times 9 \times 10^9$$

$$= 72\pi \times 10^{15}$$

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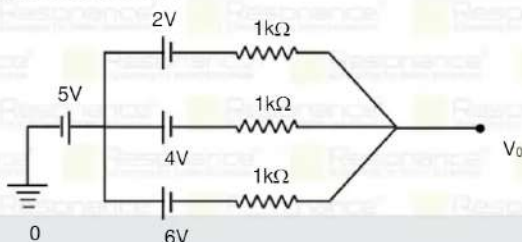
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14. Find the value of  $V_0$  in the circuit shown :



(1) 0 V

(2) 1 V

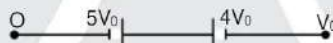
(3) 3 V

(4) 4 V

Ans. (2)

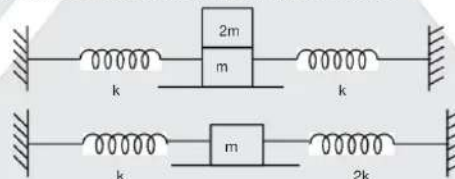
Sol. 
$$I = \frac{E_1 + E_2 + E_3 + \dots + E_n}{\frac{1}{r_1} + \frac{1}{r_2} + \dots + \frac{1}{r_n}}$$

$$E_{eq} = \frac{\frac{2}{1} + \frac{4}{1} + \frac{6}{1}}{\frac{1}{1} + \frac{1}{1} + \frac{1}{1}} = \frac{12}{3} V = 4V$$



$$V_0 = 1V$$

15. Find the ratio of time period of oscillations in two diagrams shown



(1)  $\frac{1}{\sqrt{2}}$

(2)  $\frac{\sqrt{3}}{2}$

(3)  $\frac{3}{\sqrt{2}}$

(4)  $\sqrt{2}$

Ans. (3)

Sol.  $T_1 = 2\pi\sqrt{\frac{3m}{2k}}$

$$T_2 = 2\pi\sqrt{\frac{m}{3k}}$$

$$\frac{T_1}{T_2} = \sqrt{\frac{9}{2}} = \frac{3}{\sqrt{2}}$$

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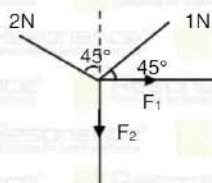
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16. Find the ratio  $\frac{F_1}{F_2}$  for equilibrium of body which is acted upon by following forces



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

Ans. (1)

Sol.  $1 \cos 45^\circ + F_1 = 2 \sin 45^\circ$

$$F_1 = \frac{2}{\sqrt{2}} - \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$1 \sin 45^\circ + 2 \cos 45^\circ = F_2$$

$$\frac{1}{\sqrt{2}} + \frac{2}{\sqrt{2}} = F_2 \Rightarrow F_2 = \frac{3}{\sqrt{2}}$$

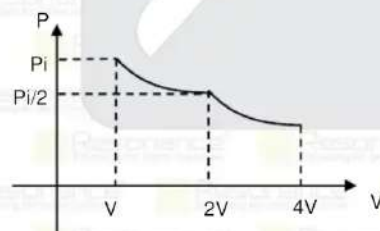
$$\frac{F_1}{F_2} = \frac{1}{3}$$

17. In an isothermal process volume of an ideal gas is doubled and then in an adiabatic process volume of gas again doubled. If initial pressure is  $2 \times 10^7 \text{ N/m}^2$ , then final pressure will be ( $\gamma = 1.5$ )

- (1)  $1.5 \times 10^6 \text{ N/m}^2$       (2)  $3.5 \times 10^6 \text{ N/m}^2$       (3)  $2.5 \times 10^6 \text{ N/m}^2$       (4)  $4.5 \times 10^6 \text{ N/m}^2$

Ans. (2)

Sol.



$$\left(\frac{P_i}{2}\right)(2V)^r = P_f(4V)^r$$

$$P_f = \frac{P_i}{2^{r+1}} = \frac{2 \times 10^7}{2^{5/2}} = \frac{10^7}{2\sqrt{2}} = 3.5 \times 10^6 \text{ N/m}^2$$

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18. Two particles are moving in a uniform magnetic field in circular orbits such that  $\frac{m_1}{m_2} = \frac{9}{4}$  and  $\frac{r_1}{r_2} = \frac{6}{5}$ . If two particles have same K.E. Then find the ratio of their charges

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

Ans. (4)

Sol.  $r = \frac{\sqrt{2mk}}{qB}$

$$\frac{r_1}{r_2} = \sqrt{\frac{m_1}{m_2} \times \frac{q_2}{q_1}}$$

$$\frac{6}{5} = \frac{3}{2} \times \frac{q_2}{q_1}$$

$$\frac{q_1}{q_2} = \frac{3 \times 5}{12} = \frac{5}{4}$$

19. Which of the following having same dimension
- (1) Conductivity and current density      (2) Electric potential and energy
- (3) Pressure and Young's modulus      (4) Resistivity and Resistance

Ans. (3)

20. Equivalent resistance of eight resistance wire of length  $\ell$  and diameter  $d$  connected in parallel is equal to resistance of wire length  $2\ell$  and diameter  $d'$ . Material of all wire is same then find  $d'$ .

- (1)  $2d$       (2)  $4d$       (3)  $6d$       (4)  $8d$

Ans. (2)

Sol.  $\frac{\rho \ell}{8\pi \frac{d^2}{4}} = \frac{\rho(2\ell)}{\pi \frac{d'^2}{4}}$

$$d'^2 = 16d^2 ; \quad d' = 4d$$

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