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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)**

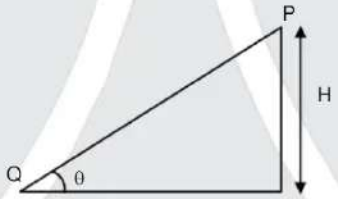
Sol. $V_{x=0} = 4$

$V_{x=2} = 16$

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

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

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

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)**

4. If a light of wavelength λ = 800 nm is in incident on a metal surface the maximum kinetic energy of emitted electrons is T. If light of wavelength λ = 500 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. $$KE_{max} = \frac{hc}{\lambda} - \psi$$

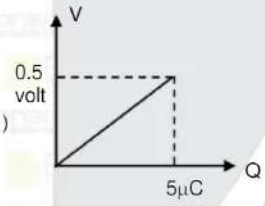
$$T = \frac{hc}{800nm} - \psi$$

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

$$\frac{hc}{} \quad \frac{1240}{}$$

Solving $\psi = \frac{}{2000\,nm} = \frac{}{2000} = 0.62ev$

5. Charge of a capacitor of capacitance C = 2μF is increased from O to 5 μC, The graph of potential V and charge Q will be :

(1)


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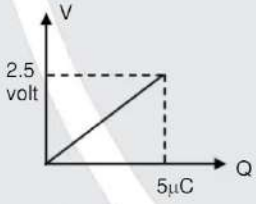
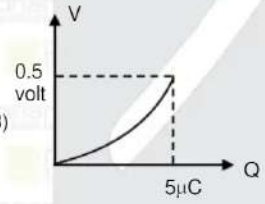
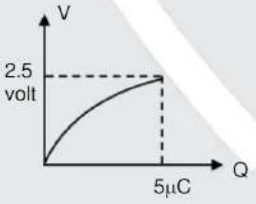


(3)


(4)


Ans. (2)

Sol. Q = CV

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

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

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

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 ω_r, the capacitance is to be decreased.

7. If there is a rod of length ℓ 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 shops at 27 m on applying breaks. If speed is $\frac{1}{3}$ rd then how much distance will it travel before coming it rest :
(1) 12 (2) 8 (3) 6 (4) 3

Ans. **(4)**

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

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

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

$0^2 = 50^2 - 2as$; $[s = 3m]$

10. A capacitance is connected to 230 volt, 600 Hz of conducting current in capacitor is 6.90 μA. 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. $X_c = \frac{1}{c\omega}$

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

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

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

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

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

11. Dimensions of coefficient of viscosity η in terms of momentum (P) Area (A), time (T)
(1) $[\eta] = [PA^{-1} T^0]$ (2) $[\eta] = [PA^{-1} T^1]$ (3) $[\eta] = [PA^{-1} T^{-1}]$ (4) $[\eta] = [P^{-1}A^{-1}T^0]$

Ans. **(1)**

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

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

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

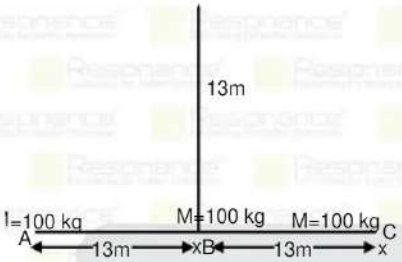
$[a = 1] = (c = 0)$

$-1 = 1 + 2b$

$[b = -1]$

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

12.

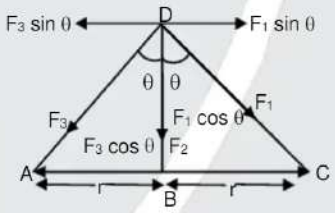


In figure there are four identical masses of mass 100kg placed respectively at A, B, C and D. Then gravitation force on mass which is placed at D-due remaining three masses :

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

Ans. **(1)**

Sol.



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

Let $F = F_0$

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

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

13. Charge density in free space is 2 c/cm^3 electric field lines passing through a surface per unit volume will be:

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

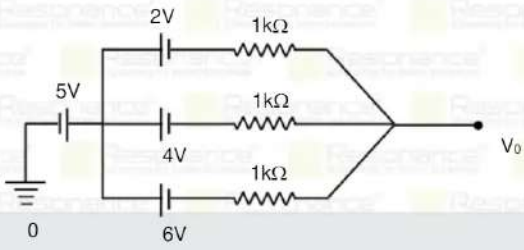
Ans. **(4)**

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

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

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

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



(1) 0 V (2) 1 V (3) 3 V (4) 4V

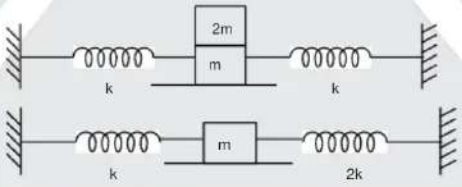
Ans. **(2)**

Sol. $$I = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2} + \frac{E_3}{r_3} \ldots\ldots \frac{E_n}{r_n}}{\frac{1}{r_1} + \frac{1}{r_2} + \ldots \frac{1}{r_n}}$$

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

$V_0 = 1V$

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) $\sqrt{2}$

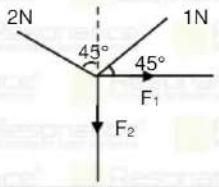
Ans. **(3)**

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

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

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

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. $1\cos45° + F_1 = 2\sin45°$

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

$1\sin45° + 2\cos45° = F_2$

$$\frac{1}{\sqrt{2}} + \frac{2}{\sqrt{2}} = F_2 = 0 \; .F_2 = \frac{3}{\sqrt{2}}$$

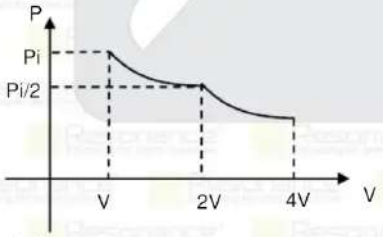
$$\frac{F_1}{F_2} = \frac{1}{3}$$

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 2×10^7 N/m^2, then final pressure will be ($\gamma = 1.5$)

(1) 1.5×10^6 N/m (2) 3.5×10^6 N/m (3) 2.5×10^6 N/m (4) 4.5×10^6 N/m

Ans. (2)

Sol.



$$\left(\frac{Pi}{2}\right)(2v)^r = P_f(4v)^r$$

$$P_f = \frac{Pi}{2^{r+1}} = \frac{2\times10^7}{2^{5/2}} = \frac{10^7}{2\sqrt{2}} = 3.5 \times 10^6 \text{ N/m}$$

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 ℓ and diameter d connected in parallel is equal to resistance of wire length 2ℓ and diameter d'. Material of all wire is same then find d'.

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

Ans. **(2)**

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

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