



JEE (Main)

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

2022

COMPUTER BASED TEST (CBT) Memory Based Questions & Solutions

Date: 28 June, 2022 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: PHYSICS

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PART : PHYSICS

1. A rod is in rest against a smooth vertical wall and a rough horizontal surface. Find the ratio of total reaction by wall & surface :



$$(1) \frac{3}{\sqrt{109}}$$

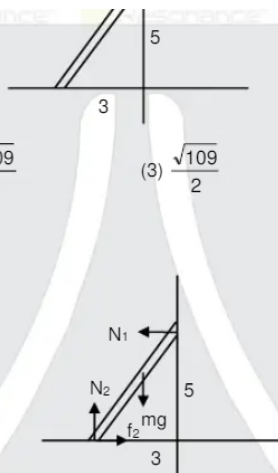
$$(2) \frac{\sqrt{109}}{3}$$

$$(3) \frac{\sqrt{109}}{2}$$

$$(4) \frac{2}{\sqrt{109}}$$

Ans. (1)

Sol.



$$N_1 = f_2, N_2 = mg$$

$$N_1 \times 5 = mg \times \frac{3}{2} \Rightarrow N_1 = \frac{3}{10} mg$$

$$R_1 = N_1 = \frac{3}{10} mg, R_2 = \sqrt{N_2^2 + f_2^2} = \frac{\sqrt{109}}{10} mg$$

$$\frac{R_1}{R_2} = \frac{3}{\sqrt{109}}$$

2. The resistance of a wire is 2Ω at 10°C and 3Ω at 30° find the temperature coefficient of resistivity.

$$(1) 0.022$$

$$(2) 0.025$$

$$(3) 0.033$$

$$(4) 0.05$$

Ans. (3)

Sol. $R = R_0 (1 + \alpha \Delta T)$

$$2 = R_0(1 + 10\alpha)$$

$$3 = R_0(1 + 30\alpha)$$

$$1 = 30\alpha$$

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3. An electromagnetic wave moving along x-axis with speed C. Frequency of wave 10^6 Hz and amplitude

of electric field $E_0 = 60 \text{ N/C} \hat{j}$. Which of the following option is correct :

$$(1) -\frac{60}{C} \hat{k} \sin\left(2 \times 10^6 \pi \left(t - \frac{x}{C}\right)\right)$$

$$(2) \frac{60}{C} \hat{k} \sin\left(2 \times 10^6 \pi \left(t - \frac{x}{C}\right)\right)$$

$$(3) -60C \hat{k} \sin\left(2 \times 10^6 \pi \left(t - \frac{x}{C}\right)\right)$$

$$(4) 60C \hat{k} \sin\left(2 \times 10^6 \pi \left(t - \frac{x}{C}\right)\right)$$

Ans. (2)

Sol. $|B_0| = E_0/C$

$$\hat{E} = -(\hat{V} \times \hat{B})$$

$$\hat{E} = -\hat{V} \times \hat{B}$$

4. Angular acceleration of a body is given by $\alpha = 6t^2 + 2t$

If $\omega(t=0) = 10 \text{ rad/s}$, $\theta(t=0) = 4 \text{ rad}$

Find $\theta(t) =$

$$(1) 4 + 10t + \frac{t^4}{2} + \frac{t^3}{3}$$

$$(2) 14 + 10t + \frac{t^4}{2} + \frac{t^3}{3}$$

$$(3) 16 + 10t + \frac{t^4}{2} + \frac{t^3}{3}$$

$$(4) 4 - 10t - \frac{t^4}{2} + \frac{t^3}{3}$$

Ans. (1)

do

Sol. $\frac{d\omega}{dt} = 6t^2 + 2t$

$$\int_{10}^{\omega} d\omega = \int_0^t (6t^2 + 2t) dt$$

$$\omega - 10 = 2t^3 + t^2$$

$$\omega = 10 + 2t^3 + t^2$$

$$\frac{d\theta}{dt} = 10 + 2t^3 + t^2$$

$$\int_4^{\theta} d\theta = \int_0^t (10 + 2t^3 + t^2) dt$$

$$\theta = 4 + 10t + \frac{t^4}{2} + \frac{t^3}{3}$$

5. A particle travels first one third of distance with speed 11 m/s, next one third with 22 m/s and last one third with speed 33 m/s. Find the average speed.

- (1) 16 m/s (2) 18 m/s (3) 20 m/s (4) 22 m/s

Ans. (2)

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Sol. $V_{av} = \frac{x}{\frac{x}{3 \times 11} + \frac{x}{3 \times 22} + \frac{x}{3 \times 33}} = \frac{3}{\frac{1}{11} + \frac{1}{22} + \frac{1}{33}}$

$$= \frac{3}{\frac{6+3+2}{66}} = \frac{3 \times 66}{11} = 18 \text{ m/s.}$$

6. Two identical bodies are at separation d and force between them is F . If $m/3$ is removed from one body and added to other body, find the new force.



- (1) $6/9 F$ (2) $7/9 F$ (3) $8/9 F$ (4) $9/8 F$

Ans. (3)

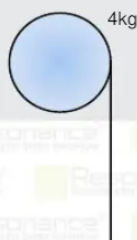
Sol. $F = \frac{Gmm}{d^2}$

$$F' = \frac{G \frac{2m}{3} \times \frac{4m}{3}}{d^2} = \frac{8 Gmm}{9 d^2}$$

$$\frac{F'}{F} = \frac{8}{9}$$

$$F' = \frac{8}{9} F$$

7. Find the tension in the string if there is no slipping between disc and string, radius of disc is 10 cm :



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(1) 8 N (2) 10 N (3) 12 N (4) 20 N

Ans. (2)

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Sol. $T_r = \frac{4r^2}{2} \alpha$

$$\alpha = \frac{T}{2r} = \frac{T}{2 \times 0.1} = 5T$$

$$2g - T = 2a = 2 \times 0.1 \times \alpha$$

$$20 - T = 0.2 \times 5T = T$$

$$20 = 2T$$

$$T = 10 \text{ N.}$$

8. C_1 is charged to 30 V then connected to C_2 . Find final charge on C_2 .



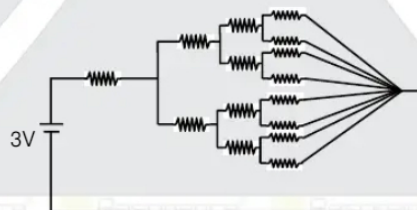
- (1) 100 μC (2) 200 μC (3) 300 μC (4) 400 μC

Ans. (1)

Sol. $V = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2} = \frac{5 \times 30 + 0}{5 + 10} = 10$

$$Q_2 = C_2 V = 10 \times 10 = 100 \mu\text{C}$$

9. If current through the battery is A/5 then A is : ($R = 1\Omega$)



- (1) 8 (2) 10 (3) 12 (4) 14

Ans. (1)

Sol. $R_{eq} = \frac{15}{8}$

$$i = \frac{3}{\frac{15}{8}} = \frac{8}{5} \text{ A}$$

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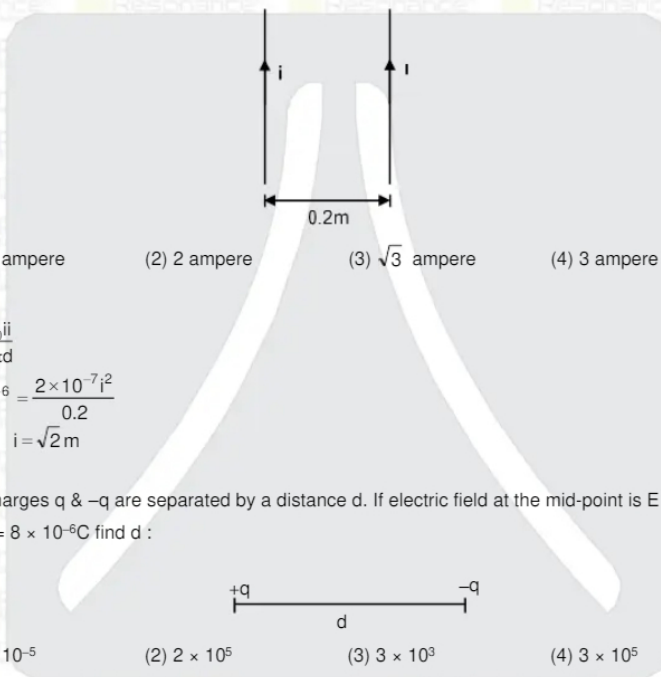
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10. Water is falling from height 40 m at rate of 9×10^4 kg/hr. If 50% of potential energy is convert in electrical energy by turbine. Then how many bulb of 100 W can be light up.
 (1) 20 (2) 50 (3) 75 (4) 80

Ans. (2)

Sol. $\frac{40 \times 9 \times 10^4 \text{ kg}}{3600 \text{ sec}} \times g \times \frac{50}{100} = 100 \text{ N}$
 $N = 50$

11. If force per unit length between 2 parallel wires is $F/\ell = 2 \times 10^{-6}$ N/m. Find current i in each wire.



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

Ans. (1)

Sol. $\frac{F}{\ell} = \frac{\mu_0 i I}{2\pi d}$
 $2 \times 10^{-6} = \frac{2 \times 10^{-7} i^2}{0.2}$
 $i^2 = 2 ; i = \sqrt{2} \text{ m}$

12. Two charges q & $-q$ are separated by a distance d . If electric field at the mid-point is $E = 6.4 \times 10^{-6}$ V/m and $q = 8 \times 10^{-6}$ C find d :

- (1) 3×10^{-5} (2) 2×10^5 (3) 3×10^3 (4) 3×10^5

Ans. (4)

Sol. $E = \frac{2Kq}{d^2} = \frac{8Kq}{d^2}$
 $6.4 \times 10^{-6} = \frac{8 \times 9 \times 10^9 \times 8 \times 10^{-6}}{d^2}$
 $d^2 = \frac{9 \times 64 \times 10^9}{6.4} = 9 \times 10^{10}$
 $d = 3 \times 10^5$

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13. Ratio of wavelengths of two photon is $\lambda_1/\lambda_2 = 3$ and energy of these photons are K_1 & K_2 respectively, then :

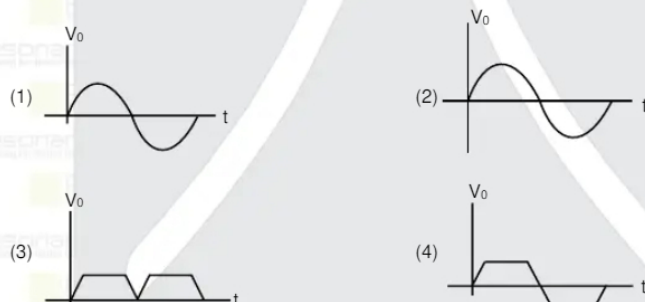
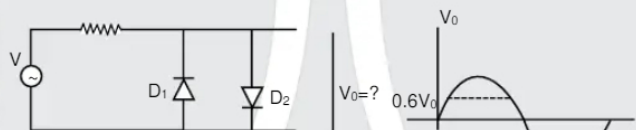
- (1) $K_1 = 3 K_2$ (2) $3 K_1 = K_2$ (3) $K_1 = K_2$ (4) $K_1 = \sqrt{3} K_2$

Ans. (2)

Sol. $K = \frac{hc}{\lambda}$
 $K \propto \frac{1}{\lambda}$
 $K \propto \frac{1}{\lambda_1}$

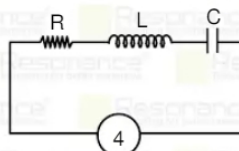
$$\frac{V_1}{K_1} = \frac{V_2}{K_2} = 3$$

14. Given cut-off voltage = 0.6 V of diode



Ans. (4)

15. In L - C - R AC circuit $V_L = V_C = 2V_R$ and $R = 5 \Omega$, if $L = \frac{1}{K\pi}$ then find K.



220 Volt, 50 Hz

- (1) 10 (2) 20 (3) 30 (4) 40

Ans. (1)

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Sol. $V_S = \sqrt{V_R^2 + (V_L - V_C)^2}$

$$V_L = V_C = 2V_R$$

$$\therefore V_S = V_R = 220 \text{ volt} = I_{\text{rms}} R$$

$$I_{\text{rms}} = \frac{220}{5} = 44 \text{ A}$$

$$V_L = I_{\text{rms}} X_L = 2V_R$$

$$44 X_L = 2 \times 220$$

$$X_L = \frac{440}{44} = 10 \Omega$$

$$L\omega = 10 ; L = \frac{10}{100\pi} = \frac{1}{10\pi} \therefore K = 10$$

16. Measured values of quantity x are 1.19 mm, 1.20 mm, 1.21 mm and 1.22 mm. Then find % error in x.

- (1) 3.3 (2) 2.3 (3) 4.2 (4) 1.25

Ans. (1)

Sol. Average value of x = $\frac{1.19 \text{ mm} + 1.20 \text{ mm} + 1.21 \text{ mm} + 1.22 \text{ mm}}{4} = 1.205$

$$\text{Total error in x} = 0.040$$

$$\% \text{ error in x} = \left(\frac{0.040}{1.205} \times 100 \right) = 3.3\%$$

17. Band width transmission will be if amplitude modulated signal is given as

$$E = 10(1 + \cos 10^{-4} t) \sin (10^6 t) \text{ is :}$$

- (1) $2 \times 10^6 \text{ Hz}$ (2) $2 \times 10^4 \text{ Hz}$ (3) $2 \times 10^7 \text{ Hz}$ (4) $2 \times 10^9 \text{ Hz}$

Ans. (1)

Ans. Band width = $2f_c$

- $= 2 \times 10^{-9} \text{ Hz}$
18. A time dependent magnetic field is present in coil. If number of turns becomes half and radius is doubled. Then electrical power dissipated becomes –
 (1) Double (2) Half (3) quadruple (4) Same
- Ans. (3)
- Sol. Resistance of coil remains same if number of turn becomes half and radius is doubled.

$$E = \frac{Nd\phi}{dt}$$

$$= - \frac{NAdB}{dt}$$

$$P = \frac{e^2}{R}$$

$$P \propto e^2 \propto N^2 A^2 \propto N^2 r^4$$

$$(1/2)^2 (2)^4 = 2^2$$

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19. Drop of radius $1 \mu\text{m}$ is falling with terminal velocity in air (bouncy force due to air is negligible), density of drop is 10^3 kg/m^3 , coefficient of viscosity is $1.8 \times 10^{-5} \text{ N sm}^{-2}$ then find terminal velocity.
 (1) $123.4 \times 10^{-6} \text{ m/s}$ (2) $62.4 \times 10^{-6} \text{ m/s}$ (3) $93.4 \times 10^{-6} \text{ m/s}$ (4) $73.4 \times 10^{-6} \text{ m/s}$

Ans. (1)

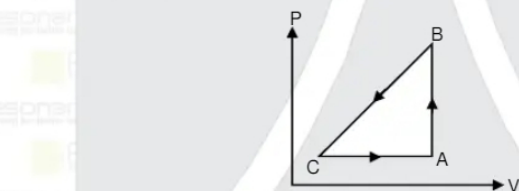
Sol. $\frac{4}{3} \pi r^3 \rho g = 6 \pi \eta r v$

$$\frac{4}{3} \times \frac{r^2 \rho g}{6 \eta} = v$$

$$\frac{4}{3} \times \frac{10^{-12} \times 10^3 \times 10}{1.8 \times 10^{-5} \times 6}$$

$$v = 123.4 \times 10^{-6} \text{ m/s}$$

20. Initial internal energy of gas at A is 1560 J. Energy lost from C to A is 60 J. Work done by gas from B to C is 30 J and energy given to gas from B to C is zero. Energy given to gas from A to B is 40 J. Then work done from C to A is :



- (1) -50 J (2) -30 J (3) -60 J (4) 60 J

Ans. (1)

Sol. For cycle process

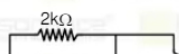
$$\text{Total heat} = W_{\text{total}} + \Delta U$$

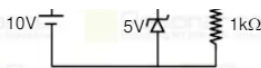
$$-60 + 40 + 0 = W_{CA} + W_{AB} + W_{BC}$$

$$-20 = W_{CA} + 0 + 30$$

$$W_{CA} = -50.$$

21. Determine current $2k\Omega$ resistance





For the circuit above current through Zener diode.

- (1) 1.125 mA (2) 2.25 mA (3) 4 mA (4) 4.5 mA

Ans. (1)

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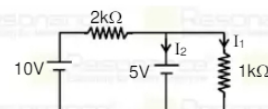
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Sol.



$$-10 + 2000I + 5 = 0$$

$$I = \frac{5}{2000} \text{ Amp} = 2.5 \text{ mA}$$

22. Two particles are moving with uniform acceleration a_1 & a_2 from rest. Their acceleration and velocity are related as $V_2 = \frac{n^2}{m} V_1$, $a_2 = \frac{1}{mn} a_1$. Which of the following relations are correct.

(1) $t_2 = \frac{n^2}{m} t_1$, $s_2 = \frac{n^2}{m^3} s_1$

(2) $t_2 = n^3 t_1$, $s_2 = \frac{n^5}{m^2} s_1$

(3) $t_2 = n^3 t_1$, $s_2 = \frac{n^5}{m} s_1$

(4) $t_2 = n^2 t_1$, $s_2 = \frac{m^2}{n^3} s_1$

Ans. (3)

Sol. $\frac{V_1}{V_2} = \frac{a_1 t_1}{a_2 t_2}$

$$\frac{m}{n^2} = mn \frac{t_1}{t_2}$$

$$t_2 = n^3 t_1$$

$$\frac{V_1^2}{V_2^2} = \frac{2a_1 s_1}{2a_2 s_2}$$

$$\frac{m^2}{n^4} = mn \frac{s_1}{s_2}$$

$$s_2 = \frac{n^5}{m} s_1$$

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