



# JEE (Main)

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

# 2022

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

Date: 29 July, 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. Some statement regarding nucleus are given

- |                                 |                                   |
|---------------------------------|-----------------------------------|
| (A) Volume is independent of A  | (B) Volume is depend on $A^{1/3}$ |
| (C) Volume is depends on A      | (D) Density depends on A          |
| (E) Density is independent on A |                                   |

Here A is atomic mass number, then choose correct option

- (1) A & B      (2) B & C      (3) A & D      (4) C & E

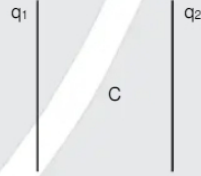
Ans. (4)

Sol.  $r = r_0 A^{1/3}$

$$r^3 \propto A$$

$$\rho = M/V = \frac{A m_p}{A \times \frac{4}{3} \pi r_0^3} = \frac{m_p}{\frac{4}{3} \pi r_0^3}$$

2. Parallel plate capacitor of capacitance C is shown in figure. If charge  $q_1$  and  $q_2$  are given to plates of capacitor. Then potential difference between the plates of capacitor is : ( $q_1 > q_2$ )



- (1)  $\frac{q_1 - q_2}{2C}$       (2)  $\frac{q_1 + q_2}{2C}$       (3)  $\frac{q_1 + 2q_2}{2C}$       (4)  $\frac{q_1 - 2q_2}{2C}$

Ans. (1)

Sol.

$$V = \frac{q}{C} = \frac{q_1 - q_2}{2C}$$

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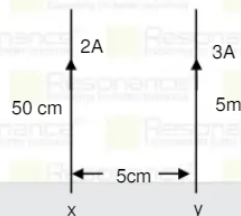
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3. Direction of current and length of two parallel wire are shown in figure. Then force on wire y due to wire

x is



- (1)  $1.2 \times 10^{-5}$  N, attraction      (2)  $1.2 \times 10^{-5}$  N, repulsion  
(3)  $1.2 \times 10^{-8}$  N, attraction      (4)  $1.2 \times 10^{-8}$  N, repulsion

Ans. (1)

Sol.  $F = I_1 l B_2$

$$= 2(0.5) \left[ \frac{\mu_0 (I_2)}{2\pi d} \right]$$

$$= 2(0.5) \left[ \frac{2 \times 10^{-7} \times 3}{5 \times 10^{-2}} \right]$$

$$= \frac{6}{5} \times 10^{-5} \text{ N}$$

$$= 1.2 \times 10^{-5} \text{ N, attraction}$$

4. Juggler throws  $n$  balls per second in upward direction from ground. If second ball is thrown when first ball reaches at maximum height, then maximum height attained by each ball is :

- (1)  $\frac{g}{2n^2}$  (2)  $\frac{g}{2n}$  (3)  $\frac{2n^2}{g}$  (4)  $\frac{g}{2n}$

Ans. (1)

Sol. Time taken by each ball to reach maximum height

$$\frac{u}{g} = \frac{1}{n}$$

Maximum height of each ball

$$H = \frac{u^2}{2g} = \frac{g^2}{2n^2 \times g} = \frac{g}{2n^2}$$

$\frac{n}{\text{ball per/sec}}$

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5.  $\alpha$ -particle & proton are accelerated by same potential difference. Find ratio of linear momentum :

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

Ans. (1)

Sol. Momentum of acceleration charged particle.

$$p = \sqrt{2meV}$$

$$p_p = \sqrt{2meV}$$

$$p_\alpha = \sqrt{2 \times (4m)(2e)V}$$

$$\frac{p_\alpha}{p_p} = \frac{\sqrt{8}}{1} = 2\sqrt{2} : 1$$

6. Two identical conducting charge sphere A & B are placed at a certain distance exerting a force of  $F$  on each other. Another identical sphere C is touched to A then to B and are placed between A & B. Find force on C.

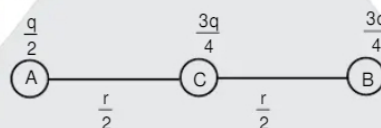
- (1)  $\frac{F}{4}$  (2)  $\frac{3F}{4}$  (3)  $\frac{3F}{16}$  (4)  $\frac{F}{8}$

Ans. (2)

Sol. Initially  $F = \frac{kq^2}{r^2}$   $q$ - charge on A & B.

When A & C are touched. Charge on each becomes  $\frac{q}{2}$

Now when B & C are touched each becomes  $\frac{3q}{4}$



$$F_C = F_{AC} - F_{BC} = \frac{k \frac{q}{2} \frac{3q}{4}}{\left(\frac{r}{2}\right)^2} - \frac{k \left(\frac{3q}{4}\right)^2}{\left(\frac{r}{2}\right)^2}$$

$$= \frac{ka^2}{3} \left( \frac{3}{9} - \frac{9}{3} \right) = \frac{ka^2}{3} \left( -\frac{6}{3} \right) = -\frac{2ka^2}{3}$$

$$-r^2(2-4) - r^2(-4)$$

$$(F_c) = \frac{3F}{4}$$

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7. Linear momentum of a moving particle is increased by 20%. Find percentage increase in kinetic energy of particle

- (1) 36% (2) 40% (3) 44% (4) 54%

Ans. (3)

Sol. Initially  $K_i = \frac{p^2}{2m}$

Momentum is increase by 20%

$$p_f = p + 0.20 p = 1.20 p$$

$$K_f = \frac{(1.20p)^2}{2m} = \frac{1.44p^2}{2m}$$

$$\frac{\Delta KE}{K_i} = \frac{\frac{1.44p^2}{2m} - \frac{p^2}{2m}}{\frac{p^2}{2m}} = 0.44$$

$$\frac{\Delta KE}{K_i} \times 100 = 44\%$$

8. At a place on earth surface vertical component of earth magnetic field is  $6 \times 10^{-5}$  T and angle of dip is  $37^\circ$  find net earth is magnetic field at this place.

- (1)  $10^{-4}$  T (2)  $8 \times 10^{-5}$  T (3)  $10 \times 10^{-4}$  T (4)  $10^{-6}$  T

Ans. (1)

Sol.  $\tan \lambda = \frac{B_v}{B_H}$

$$\tan 37^\circ = \frac{6 \times 10^{-5}}{B_H} = B_H = 8 \times 10^{-5} \text{ T}$$

$$B_{\text{Net}} = \sqrt{B_H^2 + B_v^2} = 10 \times 10^{-5} = 10^{-4} \text{ T}$$

9. A light ray incident on a slab at angle  $45^\circ$ , it is deviation is  $15^\circ$ . Find refractive index of slab

- (1) 1.414 (2) 1.732 (3) 1.523 (4) 1.642

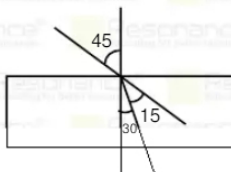
Ans. (1)

Sol.  $i = 45^\circ$

$$\Delta = 15^\circ$$

$$\therefore r = 30^\circ$$

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin 45^\circ}{\sin 30^\circ} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}} = \sqrt{2} = 1.414$$



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10. A capacitance of  $500 \mu\text{F}$  is connected to DC value  $100 \text{ V}$ . If it is connected to an inductor  $50 \text{ mH}$ . Find maximum current in the circuit if two are joined :

- (1)  $10 \text{ A}$  (2)  $15 \text{ A}$  (3)  $20 \text{ A}$  (4)  $30 \text{ A}$

Ans. (1)

Sol.  $q = 500 \times 10^{-6} \times 100 = 5 \times 10^{-2} \text{ C}$

If connected to LC

$$\frac{q^2}{2C} = \frac{1}{2} Li^2$$

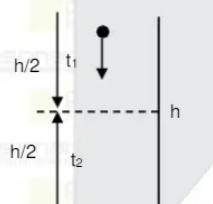
$$i = \frac{q}{\sqrt{LC}} = \frac{5 \times 10^{-2}}{\sqrt{50 \times 10^{-3} \times 500 \times 10^{-6}}} = \frac{5 \times 10^{-2}}{5 \times 10^{-3}} = 10 \text{ A}$$

11. A ball is dropped from height  $h$ . First  $h/2$  takes  $t_1$  and next  $h/2$  takes  $t_2$  time, find relation between  $t_1$  and  $t_2$  :

- (1)  $(\sqrt{2} + 1)t_1 = t_2$  (2)  $(\sqrt{2} - 1)t_1 = t_2$  (3)  $(\sqrt{2} - 1)t_2 = t_1$  (4)  $(\sqrt{2})t_2 = t_1$

Ans. (2)

Sol.



$$\frac{h}{2} = \frac{1}{2} gt_1^2$$

$$h = \frac{1}{2} g(t_1 + t_2)^2$$

$$2 \frac{1}{2} gt_1^2 = \frac{1}{2} g(t_1 + t_2)^2$$

$$\sqrt{2} t_1 = t_1 + t_2$$

$$(\sqrt{2} - 1)t_1 = t_2$$

12. Wire of length  $1 \text{ m}$  is cut into two parts  $x$  and  $y$  now  $x$  is stretched to double its length. After stretching resistance of  $x$  is twice of  $y$ . Find ratio of length of  $x$  and  $y$  ?

- (1)  $4 : 1$  (2)  $1 : 2$  (3)  $1 : 3$  (4)  $2 : 1$

Ans. (2)

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Sol. Now length of  $x$  is doubled its are becomes half.

$$R_x^1 = \int \frac{2\ell}{A_1} = 4 \int \frac{\ell}{A}$$

$$\text{Given } R_x^1 = 2R_y$$

$$4 \int \frac{\ell}{A} = 2 \int \frac{(1-\ell)}{A}$$

$$\ell = 1$$



$$\frac{1-l}{2}$$

$$\frac{x}{y} = \frac{1}{2}$$



13. Given system is in equilibrium find normal force between 5 kg block and inclined plane.

(1) 20 N

(2) 30 N

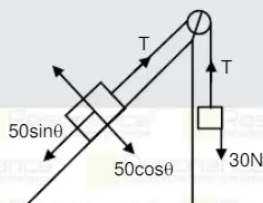
(3) 40 N

(4) 50 N

Ans. (3)

Sol.  $T = 30 \text{ N}$

$$T = 50 \sin \theta$$



$$30 = 50 \sin \theta \Rightarrow \sin \theta = \frac{3}{5}$$

$$\theta = 37^\circ$$

$$N = 50 \cos 37^\circ = 40 \text{ N}$$

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14. A zener diode of zener voltage 8 volt is connected as shown in figure. Find value of minimum resistance

R :

(1) 220  $\Omega$

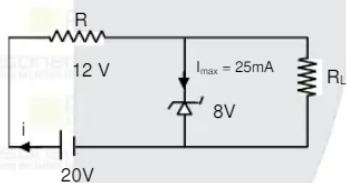
(2) 380  $\Omega$

(3) 480  $\Omega$

(4) 520  $\Omega$

Ans. (3)

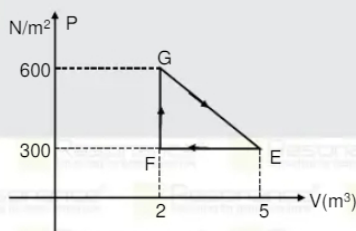
Sol.



$$i = \frac{V}{R_{\min}}$$

$$i = \frac{20 \text{ V} - 12 \text{ V}}{R} = 25 \text{ mA}$$

15. Find work done in cyclic process EFG.



- (1) 150 J      (2) 250 J      (3) 350 J      (4) 450 J

Ans. (4)

Sol.  $\Delta Q = \text{area enclosed in the cycle}$

$$= \frac{1}{2} \times 3 \times 300 = 450 \text{ J}$$

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16. Match the column of physical Quantity and unit of measurement :

- |                 |                        |
|-----------------|------------------------|
| (a) Power       | (i) N-m/kg             |
| (b) Stress      | (ii) N-m               |
| (c) Torque      | (iii) N/m <sup>2</sup> |
| (d) Latent heat | (iv) N-m/s             |

(1) (a) – (i) ; (b) – (iv) ; (c) – (ii) ; (d) – (i)

(2) (a) – (iv) ; (b) – (iii) ; (c) – (ii) ; (d) – (i)

(3) (a) – (iii) ; (b) – (iv) ; (c) – (ii) ; (d) – (i)

(4) (a) – (i) ; (b) – (iv) ; (c) – (iii) ; (d) – (ii)

Ans. (2)

17. A ball of mass 0.3 gram dropped in a liquid of density 1.3 gram/cc attain terminal velocity after some time. If density of ball is 8 gram/cc, find viscous force on the ball :

- (1)  $3.5 \times 10^{-3} \text{ N}$       (2)  $2.5 \times 10^{-3} \text{ N}$       (3)  $2.5 \times 10^{-6} \text{ N}$       (4)  $5.5 \times 10^{-3} \text{ N}$

Ans. (2)

Sol.  $mg - F_b - F_v = 0$

$$F_v = mg - F_b$$

$$F_v = \frac{4}{3} \pi r^3 \rho_b g - \frac{4}{3} \pi r^3 \rho_f g$$

$$= \rho_b \frac{4}{3} \pi r^3 g \left( 1 - \frac{\rho_f}{\rho_b} \right)$$

$$= mg \left( 1 - \frac{\rho_f}{\rho_b} \right)$$

$$= 0.3 \times 10^{-3} \times 10 \left( 1 - \frac{1.3}{8} \right)$$

$$= 2.5 \times 10^{-3} \text{ N}$$

18. A beam of intensity  $2I$  is passes through two polarizer which is parallel to each other. If second polarizer is rotate by  $30^\circ$ , then find intensity coming out from second polarizer

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

Ans. (3)

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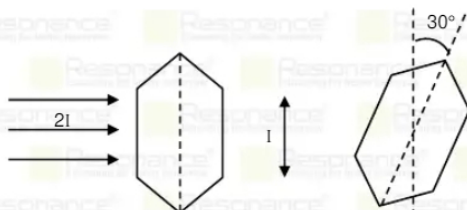
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Sol.



Intensity through second polarizer

$$= I \cos^2 \theta$$

$$= I \cos^2 30^\circ = \frac{3I}{4}$$

19. A pendulum have time period 10 second. When it is placed in water, time period becomes  $5\sqrt{x}$  second, then find value of x. (Relative density of bob = 5)

(1) 7 (2) 5 (3) 8 (4) 3

Ans. (2)

Sol. 
$$\frac{T_f}{T} = \sqrt{\frac{g}{g(1 - \frac{\rho_f}{\rho_b})}} = \sqrt{\frac{1}{1 - \frac{1}{5}}} = \frac{\sqrt{5}}{2}$$

$$T_f = 5\sqrt{5}$$

$$x = 5$$

20. A body of mass m is shifted from surface to a height 3R. Find the gain in potential energy of body in the field of earth of mass M and radius R

(1)  $\frac{3}{4} \frac{GMm}{R}$  (2)  $\frac{2}{3} \frac{GMm}{R}$  (3)  $\frac{1}{3} \frac{GMm}{R}$  (4)  $\frac{1}{2} \frac{GMm}{R}$

Ans. (1)

Sol. 
$$u_i = m \left[ -\frac{GM}{R} \right]$$

$$u_f = m \left[ -\frac{GM}{4R} \right]$$

$$\Delta U = u_f - u_i$$

$$\Delta U = \frac{GMm}{R} - \frac{GMm}{4R}$$

$$\Delta U = \frac{3}{4} \frac{GMm}{R}$$

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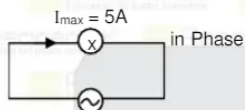


21. In an A.C. circuit having source of peak voltage 100V. If an element x is connected, Peak current is 5A with no phase difference between voltage and current. If an element y is connected peak current is 5A with current lagging the voltage by  $90^\circ$ . If the x & y are connected in series, find the r.m.s. current.

(1)  $3/2$  (2)  $1/2$  (3)  $5/2$  (4)  $7/2$

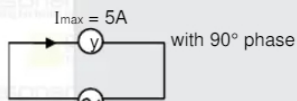
Ans. (3)

Sol.



$$V_{\max} = 100V$$

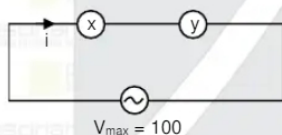
$$R = \frac{V}{I} = \frac{100}{5} = 20\Omega$$



$$V_{\max} = 100V$$

$$X = \frac{V}{I} = \frac{100}{5} = 20\Omega$$

when X and Y are connected in series with source



$$V_{\max} = 100$$

$$i_{\max} = \frac{V_{\max}}{Z} = \frac{100}{\sqrt{x^2 + y^2}} = \frac{100}{\sqrt{20^2 + 20^2}}$$

$$i_{\max} = \frac{5}{\sqrt{2}}$$

$$i_{\text{rms}} = \frac{5}{2}$$

22. Two element A and B have decay constant  $16\lambda$  and  $25\lambda$  their initial amount is equal. After time  $1/a\lambda$  the ratio of number of nuclei of A and B is e. Then the value of a is :

(1) 7 (2) 9 (3) 11 (4) 12

Ans. (2)

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Sol.  $N_0 \xrightarrow{16\lambda} N_1 = N_0 e^{-16\lambda t}$

$$t = 0 \quad t = t$$

$$N_0 \xrightarrow{25\lambda} N_2 = N_0 e^{-25\lambda t}$$

$$t = 0 \quad t = t$$

Given  $\frac{N_1}{N_2} = e$

$$N_0 e^{-16\lambda t}$$

$$N_0 e^{-25\lambda t} = e$$

$$\Rightarrow e^{9\lambda t} = e$$

$$\Rightarrow 9\lambda t = 1$$

$$\Rightarrow t = \frac{1}{9\lambda}$$

Ans. a = 9

23. One force  $F = 2\hat{i} - 5\hat{j} - 6\hat{k}$  is acting on a body at the point  $(1, 1, 0)$ . Find torque acting on the body about point  $(-1, 0, 1)$ .

$$(1) \vec{\tau} = (-11\hat{i} + 10\hat{j} - 12\hat{k})$$

$$(2) \vec{\tau} = (-11\hat{i} - 10\hat{j} - 12\hat{k})$$

$$(3) \vec{\tau} = (-11\hat{i} + 5\hat{j} - 12\hat{k})$$

$$(4) \vec{\tau} = (-11\hat{i} + 10\hat{j} - 2\hat{k})$$

Ans. (1)

Sol.  $F = 2\hat{i} - 5\hat{j} - 6\hat{k}$  at point  $(1, 1, 0)$

$r_0(-1, 0, 1)$

$$\vec{r} = (1\hat{i} + \hat{j} + 0\hat{k}) - (-\hat{i} + 0\hat{j} + \hat{k})$$

$$\vec{r} = (2\hat{i} + \hat{j} - \hat{k})$$

$$\vec{\tau} = \vec{r} \times \vec{F} = (2\hat{i} + \hat{j} - \hat{k}) \times (2\hat{i} - 5\hat{j} - 6\hat{k})$$

$$\vec{\tau} = (-10\hat{k} + 12\hat{j} - 2\hat{k} - 6\hat{i} - 2\hat{j} - 5\hat{i})$$

$$\vec{\tau} = (-11\hat{i} + 10\hat{j} - 12\hat{k})$$

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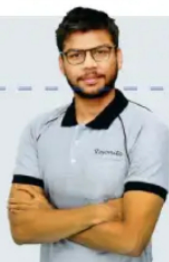
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