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JEE (Main)

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

2023

COMPUTER BASED TEST (CBT)

Memory Based Questions & Solutions

Date: 31 January, 2023 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: PHYSICS

Resonance Eduventures Ltd.
Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222
To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in | CIN : U80302RJ2007PLC024029
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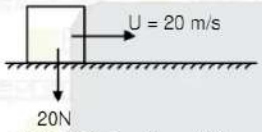
PART : PHYSICS

1. A block of mass 2 kg is given a horizontal velocity of 20 m/s on rough horizontal surface of friction co-efficient μ, if block stops after 5 sec.. then value of μ will be :

(1) 0.6 (2) 0.4 (3) 0.8 (4) 0.2

Ans. (2)

Sol.



Friction force = $\mu N = \mu(20)$

(a) retardation = $\frac{20\mu}{2} = 10\mu$

$a = -10\mu$

$V_{final} = 0$

$U_{initial} = 20$ m/s

time taken to stop = 5 sec.

$v = u + at$

$0 = 20 + (-10\mu)(5)$

$\Rightarrow \quad 50\mu = 20$

$\mu = \frac{20}{50} = \frac{2}{5} = 0.4$

2. A body is placed at the earth surface whose weight is W at the earth surface. What will be it's weight at $9R_e$ from earth's surface. Where R_e is the radius of earth.

(1) $\frac{W}{50}$ (2) $\frac{W}{100}$ (3) $\frac{W}{25}$ (4) $\frac{W}{90}$

Ans. **(2)**

Sol.

$W = \frac{Gm_e}{R_e^2} \times m$

$W' = \frac{Gm_e}{(9R_e + R_e)^2} \times m = \frac{Gm_e}{(10R_e)^2} \times m$

$W' = \frac{Gm_e}{100R_e} \times m \Rightarrow \quad W' = \frac{1}{100} \times W$

3. Find speed of sound wave in a steel rod of Young's modulus 32×10^{11} N/m^2 and density 8×10^3 kg/m^3.

(1) 2×10^4 m/s (2) 2×10^2 m/s (3) 10^4 m/s (4) 10^2 m/s

Ans. **(1)**

Sol. $V = \sqrt{\frac{Y}{\rho}}$ Y = Young's modulus

ρ = density

V = velocity of wave

$V = \sqrt{\frac{32 \times 10^{11}}{8 \times 10^3}} = \sqrt{\frac{32 \times 10^{11} \times 10^{-3}}{8}} = \sqrt{4 \times 10^8} = 2 \times 10^4$ m/s

$V = 2 \times 10^4$ m/s

4. A group of positive charge are placed in a system. Comment about the net electric field strength and net potential by the system at a general point :

(1) E_{net} can be zero and V_{net} also can be zero.

(2) E_{net} can not be zero and V_{net} also can not be zero

(3) E_{net} can be zero and V_{net} can not be zero.

(4) E_{net} can not be zero and V_{net} can be zero.

Ans. **(3)**

5. Two different conducting metal plates who have work function ϕ_1 = 4.8 eV and ϕ_2 = 2.2 eV. A source of

light whose wavelength is λ = 350 nm, is falling on the plates, comment which metal plate will emit electrons

(1) First plate (2) Second plate (3) Both plate (4) Neither plate

Ans. **(2)**

Sol. For photo-emission

$h\nu > \phi$

$E \text{ of photon} = \frac{12400}{350 \times 10^{-9}} = \frac{12400}{3500\,\text{Å}} = \frac{124}{35} = 3.54 \text{ eV}$

for ϕ_1, $h\nu < \phi_1$ 3.54 eV < 4.8 eV

for ϕ_2, $h\nu > \phi_2$ 3.54 eV > 2.2 eV

So, second plate will be able to emit electron.

6. In the LCR circuit L, C and R are connected in series with source whose emf is equal to v = 2500sin100t volt. If inductive reactance, capacitive reactance and resistance are 100Ω, 40Ω and 80Ω. Then find the value of current amplitude :

(1) 50 A (2) 100 A (3) 25 A (4) 5 A

Ans. **(3)**

Sol. $V_0 = I_0 Z$

$I_0 = \frac{V_0}{Z} \quad \left[Z = \sqrt{R^2 + (X_L - X_C)^2}\right]$

$I_0 = \frac{2500}{\sqrt{(80)^2 + (100-40)^2}} = \frac{2500}{\sqrt{80^2 + 60^2}} = \frac{2500}{100} = 25\,A$

7. A wire forms a circular loop of radius R carrying current I having N number of turns produces magnetic field B_1 at the centre. If same wire forms another circular loops carrying same current and having n number of turns produce magnetic field B_2 at the centre. Then the ratio of B_1/B_2 :

(1) N/n (2) $(N/n)^2$ (3) n/N (4) $(n/N)^2$

Ans. **(2)**

Sol. $B_1 = \frac{\mu_0 i \times N}{2R}$

$B_2 = \frac{\mu_0 i \times n}{2R'}$

But $(2\pi R)N = (2\pi R')n$

So, R'/R = N/n

$\frac{B_1}{B_2} = \left(\frac{N}{n}\right)^2$

8. Match the following :

(a) Torque	(p) $[ML^2T^{-1}]$
(b) Stress	(q) $[ML^{-1}T^{-2}]$
(c) Angular momentum	(r) $[ML^1T^{-3}A^{-1}]$
(d) Electric Potential gradient	(s) $[ML^2T^{-2}]$

(1) a-s, b-q, c-p, d-r (2) a-p, b-s, c-q, d-r (3) a-r, b-p, c-q, d-s (4) a-q, b-r, c-p, d-s

Ans. **(1)**

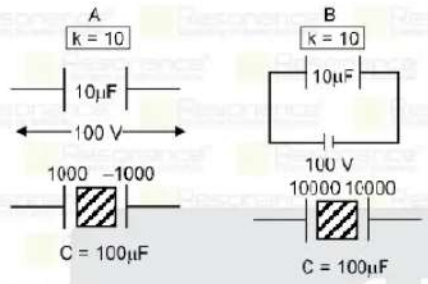
9. Two capacitor A & B of capacity 10μF are charged by a battery of potential difference 100 V. Now battery of capacitor A is removed and battery of capacitor B remains connected and a dielectric k = 10 is inserted in both capacitor. Now capacitor B is removed from battery and both A & B are connected to each other with same polarity, then voltage across them will be :

(1) 10 V (2) 50 V (3) 11 V (4) 55 V

(1) 40 V (2) 50 V (3) 44 V (4) 55 V

Ans. **(4)**

Sol.



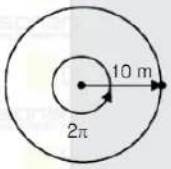
$$V = \frac{1000 + 10000}{100 + 100} = \frac{11000}{200} = 55\ V$$

10. A particle is rotating in circular path of radius 10 m completes one cycle in 4 second then find displacement after 3 second :

(1) 10 m (2) 4.71 m (3) 14 m (4) 3.57m

Ans. **(3)**

Sol.



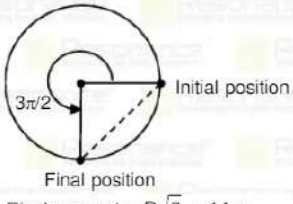
Completing 2π angle in 4 second

ω (Angular velocity) $= \frac{2\pi}{4} = \frac{\pi}{2}$

$\omega = \frac{\pi}{2}$ rad/sec.

Angular displacement = $\omega(t)$

Angular displacement in 3 sec. $= \left(\frac{\pi}{2}\right)(3) = \frac{3\pi}{2}$ rad.



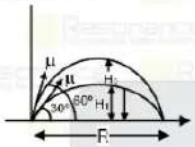
Displacement = $R\sqrt{2}$ = 14m

11. Two particles are projected with same speed 40 m/s at different angles have same range. If one of the angle is 30° and maximum height of particle are H_1 and H_2 respectively in both cases then $H_1 + H_2$ will be :

(1) 20 m (2) 40 m (3) 60m (4) 80 m

Ans. (4)

Sol.



$$H_1 = \frac{u^2 \sin^2(30)}{2g}, \qquad H_2 = \frac{u^2 \sin^2 60^\circ}{2g}$$

$$H_1 = \frac{u^2}{8g}, \qquad H_1 = \frac{3u^2}{8g}$$

$$\therefore H_1 + H_2 = \frac{4u^2}{8g} = 80 \text{ m}$$

12. If radius of second orbit for hydrogen atom is R then the radius of third orbit in hydrogen atom :

(1) 2.25 R (2) 13.6R (3) 3.25R (4) 6.25R

Ans. (1)

Sol. $r_n = \frac{n^2 r_0}{Z}$ Z = 1 for hydrogen

for n = 2

$R = 2^2 r_0$

$r_0 = \frac{R}{4}$

for n = 3

$r_3 = 3^2 \times \frac{R}{4}$

$r_3 = \frac{9}{4} R$

$r_3 = 2.25\ R$

13. If a resistor load of resistance RΩ carries a current I for 10 sec produces heat energy H joules. If we increase the load resistance by 4 times for the same time in same line then :

(1) Heat loss decreased by 4 times (2) Heat loss increased by 16 times

(3) Heat loss increased by 4 times (4) Heat loss decreased by 16 times

Ans. (3)

Sol. $H = i^2 Rt$

$H = i^2 \times R \times 10$

After increasing resistance by 4 times

$H' = i^2 \times 4R \times 10$

$H/H' = 1/4 \Rightarrow H' = 4H$

14. Energy of ground sate for H-atom is –13.6eV then the energy of second excited state of Li^{2+}

(1) –1.51 eV (2) –3.4 eV (3) –13.6 eV (4) –30.6 eV

Ans. **(3)**

Sol. $E = -13.6 \times z^2/n^2$ eV [n = 3 ; z = 3]

$E_D = -13.6 \times (3)^2/(3)^2$

$E_D = -13.6$ eV

15. Match the list

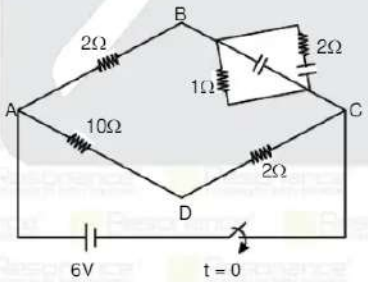
(1) Microwave	(A) physiotherapy
(2) UV ray	(B) Cancer treatment
(3) infrared	(C) Leser eye surgery
(4) X-ray	(D) Aircraft navigation

(1) 1 – D ; 2 – C ; 3 – A ; 4 – B (2) 1 – C ; 2 – A ; 3 – D ; 4 - B

(3) 1 – A ; 2 – B ; 3 – D ; 4 – C (4) 1 – D ; 2 – B ; 3 – C ; 4 – A

Ans. **(1)**

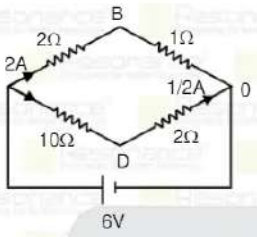
16. Calculate $V_B - V_D$ long time after switch is turned on :



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

Ans. **(2)**

Sol. After a long time



KVL :

$V_B - 2 \times 1 + 2 \times \frac{1}{2} = V_D$

$\Rightarrow V_B - V_D = 1V$

17. **Assertion (A) :** Transistor in general, all three regions are equally dropped

Reason (R) : Base is thinnest and collector is thickest

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) true but (R) is NOT the correct explanation of (A)

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

Ans. **(4)**

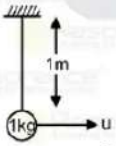
Sol. Assertion (A) is false but Reason (R) is true.

18. A ball of mass 1 kg is hanging from 1 m long inextensible string which can withstand maximum tension of 400 N. Find the maximum speed u given to the ball will be :

(1) $\sqrt{390}\,m/s$ (2) $\sqrt{410}\,m/s$ (3) 20 m/s (4) 22 m/s

Ans. (1)

Sol.



$$T = mg + \frac{mu^2}{R}$$

$$400 = 1\left[10 + \frac{u^2}{1}\right]$$

$$\sqrt{390}\,m/s = u$$

19. In an adiabatic process ratio of initial pressure to final pressure is $\frac{81}{16}$ and ratio of final volume to initial volume is $\frac{27}{8}$. Then the ratio of specific heat at constant pressure to specific heat at constant volume will be :

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

Ans. (2)

Sol. We know $\frac{C_P}{C_V} = \gamma$

and for an adiabatic process $P_1V_1^{\gamma} = P_2V_2^{\gamma}$

$$\frac{P_1}{P_2} = \left(\frac{V_2}{V_1}\right)^{\gamma}$$

$$\frac{81}{16} = \left(\frac{27}{8}\right)^{\gamma}$$

$$\left(\frac{3}{2}\right)^4 = \left(\frac{3}{2}\right)^{3\gamma}$$

comparing power index

$4 = 3\gamma$

$\gamma = 4/3$

20. Two discs of same mass, thickness 1 mm and 0.5 mm respectively, have densities in the ratio of 3 : 5. Then the ratio of their moment of inertia about diameter is 5 : x, find x

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

Ans. (3)

Sol. $m_1 = m_2$

$$\pi R_1^2 \times t_1 \times \rho_1 = \pi R_2^2 \times t_2 \times \rho_2$$

$$\frac{R_1^2}{R_2^2} = \frac{25}{30}$$

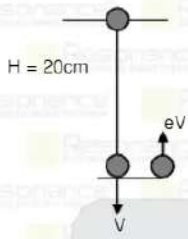
$$\frac{I_1}{I_2} = \frac{\frac{mR_1^2}{4}}{\frac{mR_2^2}{4}} = \frac{R_1^2}{R_2^2} = \frac{25}{30} = \frac{5}{6}$$

21. A ball was dropped from 20 m from ground. Find the height (in m) up to which it rises after the collision. (use e = 0.5, g = 10 m/s²)

(1) 10 m (2) 15 m (3) 5 m (4) 7.5 m

Ans. **(3)**

Sol.



$V = \sqrt{2gH}$ ...(1)

$H_{max} = \frac{e^2v^2}{2g}$ ...(2)

from equation (1) and (2)

$H_{mass} = \frac{e^2(2gH)}{2g}$

$H_{max} = \frac{1}{4} \times 20 = 5m$

22. If 725 J heat is given to diatomic gas which is allowed to expand under constant pressure. If it rotates about own axes but does not oscillate then find change in internal energy.

(1) 415 (2) 515 (3) 645 (4) 725

Ans. **(2)**

Sol. For isobaric process

$\Delta\theta = nC_P\Delta T$

$\Delta\theta = n\frac{7}{2}R\Delta T$

$\Rightarrow nR\Delta T = \frac{2}{7}\Delta\theta$

now change in internal energy

$\Delta U = \frac{5}{2}nR\Delta T$

$\Rightarrow \Delta U = \frac{3}{2} \times \frac{2}{7}\Delta\theta$

$\frac{5}{7}\Delta\theta = \frac{5}{7} \times 725 = 517.857143$ J

23. Given two wave forces

$$y_1 = 10\sin(\omega t + \frac{\pi}{3})$$

$$y_2 = 5(\sin\omega t + \sqrt{3}\cos\omega t)$$

Find resultant amplitude produced by their interference.

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

Ans. **(2)**

Sol. $y_1 = 10\sin\left(\omega t + \frac{\pi}{3}\right)$

$$y_2 = 5\times 2\left(\frac{\sqrt{3}}{2}\cos\omega t + \frac{1}{2}\sin\omega t\right) = 10\sin\left(\omega t + \frac{\pi}{3}\right)$$

$$y_{net} = y_1 + y_2 = 20\sin\left(\omega t + \frac{\pi}{3}\right)$$

24. In AC source the emf of source is equal to E = 260 sin 628 t is connected with an inductor of 5 mH. Find inductive reactance

(1) 3.14Ω (2) 6.28Ω (3) 12.56Ω (4) 1.57Ω

Ans. **(1)**

Sol. $X_L = \omega L = 628 \times 5 \times 10^{-3} = 3140 \times 10{-}3$

$X_L = 3.14\ \Omega$

25. A beaker's bottom most point has been viewed by a microscope which is placed at H height from the bottom most point of the beaker. Now beaker is filled with liquid of $\mu_0 = 5/3$. To see the bottom point by the microscope clearly, microscope need to shift 30 cm above from its' original position. Calculate the depth of water filled in beaker. (Given – refractive index of water 5/3).

(1) 50 cm (2) 75 cm (3) 100 cm (4) 150 cm

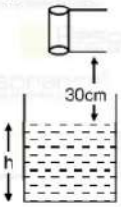
Ans. **(2)**

Sol. $d = h\left(1 - \frac{1}{\mu}\right)$

$$30 = h\left(1 - \frac{3}{5}\right)$$

$$30 = h\times\frac{2}{5}$$

$\therefore$ h = 75 cm

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