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JEE (Main)

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

2022

COMPUTER BASED TEST (CBT)

Memory Based Questions & Solutions

Date: 29 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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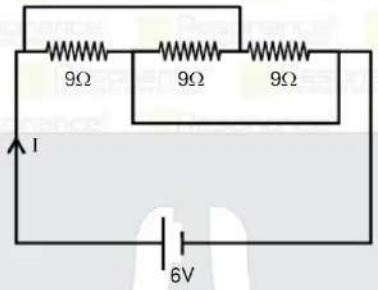
PART : PHYSICS

1. In the given circuit find the value of current I in Ampere :



(1) 1 A (2) 2 A (3) 5 A (4) 4 A

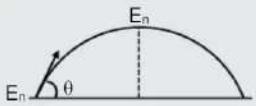
Ans. **(2)**

Sol. $\frac{1}{R_{eq}} = \frac{1}{9} + \frac{1}{9} + \frac{1}{9}$

$R_{eq} = 3\Omega$

$I = \frac{V}{R_{eq}}$; $I = \frac{6}{3} = 2A$

2. A particle is thrown with kinetic energy (E) at angle 60° with horizontal. What will be its kinetic energy at the heights point :



(1) E/4 (2) 3E/4 (3) E/2 (4) Zero

Ans. **(1)**

Sol. $En = \frac{1}{2} m u^2 \cos^2 60° = \frac{E}{4}$

3. Area enclosed by a circular current carrying loop of single winding is 3.14 m^2 and current is 14 A. Find its magnetic moment in A.m^2

(1) 22 (2) 44 (3) 66 (4) 88

Ans. **(2)**

Sol. M = N i A = (1) (14) (3.14)

$= 14 \times \frac{22}{7} = 44$ A. m^2

4. Find the position of centre of mass of two particle system

$M_1 = 1kg$ $(\vec{r}_1 = \hat{i} + 2\hat{j} + \hat{k})$

$M_2 = 3kg$ $(\vec{r}_2 = -3\hat{i} - 2\hat{j} + \hat{k})$

(1) $2\hat{i} - \hat{j} - \hat{k}$ (2) $2\hat{i} + \hat{j} - \hat{k}$ (3) $\hat{i} - 2\hat{j} + \hat{k}$ (4) $-2\hat{i} - \hat{j} + \hat{k}$

Ans. **(4)**

Sol. $\vec{r}_{com} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2}$

$= \frac{1(\hat{i} + 2\hat{j} + \hat{k}) + 3(-3\hat{i} - 2\hat{j} + \hat{k})}{4} = \frac{-8\hat{i} - 4\hat{j} + 4\hat{k}}{4} = \vec{r}_{com} = -2\hat{i} - \hat{j} + \hat{k}$

5. Find the time period of simple oscillation

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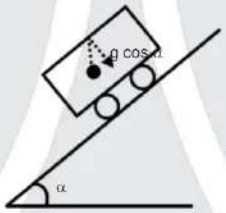


(1) $T = \sqrt{\frac{\ell}{g\cos\alpha}}$ (2) $2\pi\sqrt{\frac{\ell}{g\cos\alpha}}$ (3) $2\pi\sqrt{\frac{\ell}{g\tan\alpha}}$ (4) $2\pi\sqrt{\frac{\ell}{g}}$

Ans. **(2)**

Sol. $T = 2\pi\sqrt{\frac{\ell}{g\cos\alpha}}$

6. Match the column accordingly to the correct use of the electromagnetic waves :

(A) Ultra-violet rays	(P) Detection of bone fracture
(B) Microwaves	(Q) water Purification
(C) X-rays	(R) T.V. remote
(D) Infra-red light	(S) RADAR

	A	B	C	D
(1)	P	S	R	Q
(2)	P	R	Q	S
(3)	Q	S	R	P
(4)	Q	S	P	R

Ans. **(4)**

7. The maximum amplitude modulated wave is 9 volt and the variation in maximum and minimum amplitude is 8 volt, then the modulation index will be :

(1) 0.4 (2) 8/9 (3) 0.8 (4) 0.9

Ans. **(3)**

Sol. $(A_{eq})_{max} = A_c + A_m = 9$

$(A_{eq})_{min} = A_c - A_m = 9 - 8 = 1$

Solving $A_c = S$, $A_m = 4$

$$\mu = \frac{Am}{Ac} = \frac{4}{5} = 0.8$$

8. In P-n junction diode, the barrier potential is 0.6 volt, and the width of depletion layer is 6μm. The electric field inside the depletion layer will be : (in $\frac{\text{volt}}{\text{meter}}$)

(1) 10^4 (2) 10^5 (3) 10^6 (4) 10^7

Ans. **(2)**

Sol. $E = \frac{V}{d} = \frac{0.6\text{volt}}{6\times10^{-6}} = 10^5 \text{v/m}$

9. Statement-1 : Plane water cannot remove the spots of Greece on cloths.

Statement-2 : The Contact angle between water and greece cloths is obtuse.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True.

Ans. **(1)**

10. In an experiment the angles are required to be measured using an instrument. 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is half-a-degree (0.5°), then the least count of the instrument is:

(1) half minute (2) one degree (3) half degree (4) one minute

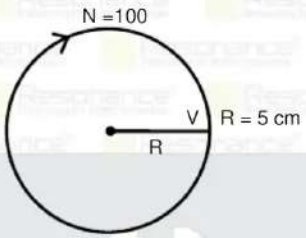
Ans. **(4)**

Sol. 29 division of main scale coincides with 30 divisions of vernier scale Hence one division of vernier scale

$= \frac{30-29}{30}$ of main scale

$= \frac{1}{30} \times 0.5^\circ = \frac{1}{30} \times 0.5 \times 60 \text{ min} = 1 \text{ min.}$

11. Find the value of current, if magnetic field at the centre of circular loop of radius 5 cm & total number of terns 100 is 37.68×10^{-4} T :



(1) 2A (2) 3A (3) 5A (4) 6A

Ans. **(2)**

Sol. $N \times \frac{\mu_0 I}{2R} = (B)$

37.68×10^{-4}

$I = \frac{B \times 2R}{\left(\frac{\mu_0}{4\pi}\right)(4\pi) \times 100} = \frac{37. \times 10^{-4} \times 10\text{cm}}{10^{-7} \times (4\pi) \times 100}$

$I = \frac{3 \times 10^{-5}}{10^{-5}} = 3\text{A}$

12. A steel wire is stretched so that its length gets doubled and its cross sectional area becomes half, the percentage change in its young's modulus will be :

(1) 50% (2) 100% (3) 200% (4) zero

Ans. **(4)**

13. **Statement-1 :** $T = k\sqrt{\frac{\rho R^3}{S^{2/3}}}$ (T is time, ρ is density, R is radius & S is surface Tension)

Statement-2 : The above formula is wrong because it is dimensionally incorrect

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(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

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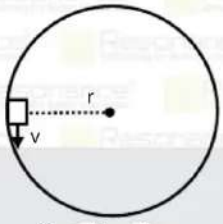
(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True.

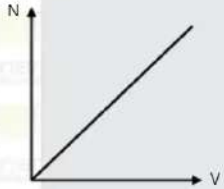
Ans. **(1)**

14. A block in moving in horizontal circular motion with the support of vertical wall. All the surfaces are smooth then the correct variation of normal force v/s velocity is :

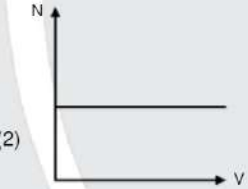


Smooth surface

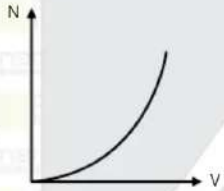
(1)



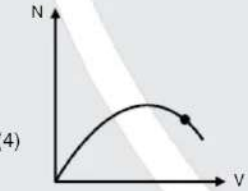
(2)



(3)



(4)



Ans. **(3)**

15. Value of acceleration due to gravity at height h from surface & at depth αh from surface of extra is same. Find α (h << Re)

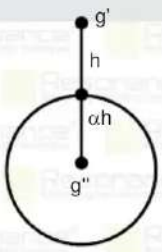
(1) 1 (2) 2 (3) 3 (4) 4

Ans. **(2)**

Sol. $g' = g\left(1-\frac{2h}{R}\right)$

$g' = g\left(1-\frac{\alpha h}{R}\right)$

$1h = \alpha h \quad \Rightarrow \alpha = 2$



16. Pitch of a screw gauge is 0.5 mm and there are 50 divisions on its circular scale. It has a zero error of –0.03 mm when a solid cylinder is tightly fitted between its saws, the main scale reading is 2.5 mm and the 45th mark of circular scale co-inside with the reference line. The diameter of the cylinder will be

(1) 2.98 mm (2) 2.92 mm (3) 2.95 mm (4) 2.91 mm

Ans. **(1)**

Sol. $\text{Least count} = \frac{\text{ptich}}{\text{number of divisions on circular scale}} = \frac{0.5\text{mm}}{50} = 0.01 \text{ mm}$

measured diameter = (main scale reading) + (circular scale reading) (least count)

= 2.5 mm + (45) (0.01mm) = 2.95 mm

Actual diameter = measured diameter – zero error

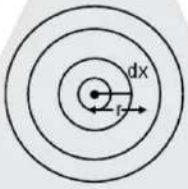
= (2.95 mm) – (–0.03 mm) = 2.98 mm

17. Volume charge density in a sphere having radius R varies as

$\rho = \rho_0\left(\frac{3}{4} - \frac{r}{R}\right)$, $r \le R$

= 0, $r > R$

Find electric field at a distance R from centre (inside sphere)



(1) $\frac{\rho_0}{\epsilon_0}\left(\frac{r}{2} - \frac{r^2}{4R}\right)$ (2) $\frac{\rho_0}{\epsilon_0}\left(\frac{r}{4} - \frac{r^2}{4R}\right)$ (3) $\frac{\rho_0}{2\epsilon_0}\left(\frac{r}{4} - \frac{r^2}{4R}\right)$ (4) $\frac{\rho_0}{\epsilon_0}\left(\frac{r}{4} - \frac{r^3}{4R}\right)$

Ans. **(2)**

Sol. $dq = \rho \times 4\pi r^2.dr = \rho_0\left(\frac{3}{4} - \frac{r}{R}\right) \times 4\pi r^2.dr$

$q = 4\pi\rho_0 \int_0^2 \left(\frac{3}{4}r^2 - \frac{r^3}{R}\right)dr = 4\pi\rho_0\left[\frac{r^3}{4} - \frac{r^4}{4R}\right]$

$\int \vec{e} \cdot d\vec{s} = \frac{q}{\epsilon_0}$

$E \times 4\pi r^2 = \frac{4\pi\rho_0}{\epsilon_0}\left(\frac{r^3}{4} - \frac{r^4}{4R}\right)$

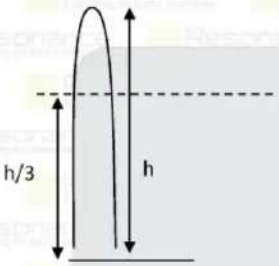
$E = \frac{\rho_0}{\epsilon_0}\left(\frac{r}{4} - \frac{r^2}{4R}\right)$

18. A ball is thrown up with a certain velocity so that it reaches a height 'h'. Find the ratio of the two different times of the ball reaching h/3 in both the directions.

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

Ans. **(3)**

Sol.



$V = \sqrt{2gh}$

$$\frac{h}{3} = \sqrt{2gh}t - \frac{1}{2}gt^2$$

$$gt^2 - 2\sqrt{2gh}t + \frac{2h}{3} = 0$$

$$t = \frac{2\sqrt{2gh} \pm \sqrt{8gh - 4g \times \frac{2h}{3}}}{2g} = \frac{2\sqrt{2gh} \pm \sqrt{\frac{16gh}{3}}}{2g} = \frac{2\sqrt{2gh} \pm 4\sqrt{\frac{gh}{3}}}{2g}$$

$$\frac{t_1}{t_2} = \frac{2\sqrt{2gh} - 4\sqrt{\frac{gh}{3}}}{2\sqrt{2gh} + 4\sqrt{\frac{gh}{3}}} = \frac{2\sqrt{2} - \frac{4}{\sqrt{3}}}{2\sqrt{2} + \frac{4}{\sqrt{3}}} = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$$

19. An ideal gas whose adiabatic exponent $\gamma = 7/5$ is undergone through an adiabatic process. If the ratio of final density to the initial density $\rho_f/\rho_i = 32/1$ then find the ratio of final to initial temperature (T_f/T_i) :

(1) 4 (2) 1/4 (3) 8 (4) 1/8

Ans. **(1)**

Sol. $PV^\gamma = \text{Constant} \Rightarrow \left(\frac{nRT}{V}\right)(v)^\gamma = \text{constant}$

$$T \propto \frac{1}{V^{\gamma-1}} \Rightarrow T \propto \rho^{\gamma-1}$$

$$\frac{T_f}{T_i} = \left(\frac{\rho_f}{\rho_i}\right)^{\gamma-1} = (32)^{\frac{7}{5}-1} = (2^5)^{\frac{2}{5}} = 4$$

20. 1 mole of monoatomic is mixed with 3 moles of diatomic molecules. If C_v mixture is $\frac{\alpha^2 R}{4}$, then find α.

(1) 1 (2) 3 (3) 6 (4) 9

Ans. **(2)**

$$1 \times \frac{R}{2}3 + 3 \times \frac{R}{2}5$$

Sol. $\frac{n_1v_1 + n_2v_2}{n_1 + n_2} = \frac{2 \quad 2}{1+3}$

$= \frac{9R}{4} = \frac{\alpha^2}{4}.R$

$[\alpha^2 = 9] \Rightarrow \alpha = 3$

21. Intensity of two sources are 4I & 9I, find out the difference in intensity at two points where phase difference is 0 & π.

(1) 12I (2) 24 I (3) 36 I (4) 48 I

Ans. **(2)**

Sol. $I_0 = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = 25I$

$I_\pi = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2 = I$

$I_0 - I_\pi = 24I$

22. Statement-1 : In electrostatic condition of conductors, the potential at the surface and potential at the inner part of metal is same

Statement -2 : Equipotential surface is perpendicular to the electric field

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True.

Ans. **(2)**

23. A particle is moving in a straight line, such that the relation between position and time is moving in a straight (x) and time is $t = \sqrt{x} + 4$ .its speed at t = 4 will be:

(1) zero (2) 2 m/sec. (3) 1 m/sec. (4) 3 m/sec.

Ans. **(1)**

Sol. $x = (t-4)^2$

$v = \frac{dx}{dt} = 2(t-4)$

$v = 2(4-4) = 0$

at t = 4

24. In ground to ground projectile, for a speed of projection u, the maximum range is $R_{max.}$ with the same speed of projection u, at which angle from the horizontal, should we throw the ball to achieve a range of $\frac{R_{max}}{2}$

(1) 15° (2) 30° (3) 45° (4) 60°

Ans. **(1)**

Sol. $R_{max} = \frac{4^2}{2}$

$R_2 = \frac{4^2 \sin 2Q}{2} = \frac{\frac{4^2}{2}}{2} \Rightarrow \sin 2Q = \frac{1}{2} = \sin 30°$

$Q = 15°$ and $Q = 75°$ is also possible, so both 15° and 75° are the correct answer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