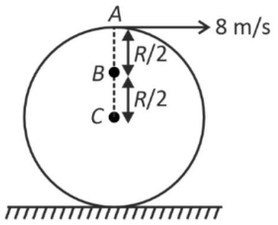
PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1. A disc is performing pure rolling if speed of top point is 8 m/s. Find speed of point *B*.



(1) 2 m/s (2) 4 m/s

(3) 6 m/s (4) 8 m/s

Answer (3)

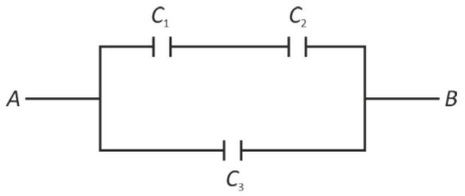
Sol. $2\omega_R = 8$

$V_C = \omega R = 4$ m/s

$V_B = V_C + = \omega\, R/2$

$= 4 + 2 = 6$ m/s

2. The equivalent capacitance between *A* and *B* is



(1) $\frac{C_1C_2 + C_2C_3 + C_1C_2}{C_2 + C_3}$ (2) $\frac{C_1C_2 + C_1C_3 + C_2C_3}{C_1 + C_2}$

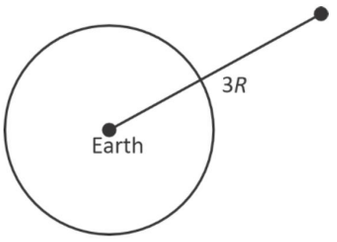
(3) $\frac{2C_1C_2 + C_2C_3}{C_2 + C_3}$ (4) $\frac{2C_2C_3 + C_1C_2}{C_1 + C_3}$

Answer (2)

Sol. $C_{eq} = \frac{C_1C_2}{C_1 + C_2} + C_3$

$= \frac{C_1C_2 + C_1C_3 + C_2C_3}{C_1 + C_2}$

3. A particle of mass *m* is at a distance 3*R* from the centre of Earth. Find minimum kinetic energy of particle to leave Earths field (*R* : Radius of Earth)



(1) $\frac{mgR}{3}$

(2) $3mgR$

(3) $\frac{2}{3}mgR$

(4) $\frac{mgR}{2}$

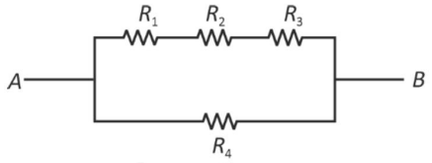
Answer (1)

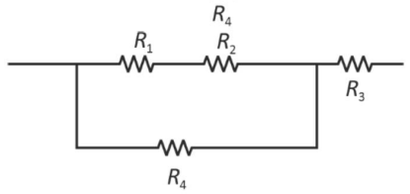
Sol. $k_i + u_i = 0$

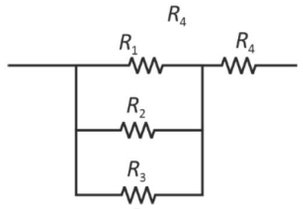
$k_i = +\frac{GMm}{3R}$

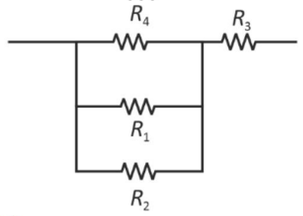
$= \frac{mgR}{3}$

4. If resistor $R_1 = R_2 = R_3 = 5\ \Omega$ and $R_4 = 10\ \Omega$ which circuit diagram is having equivalent (Across A and B) resistance = $6\ \Omega$

(1) 

(2) 

(3) 

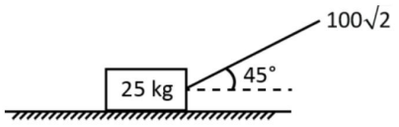
(4) 

Answer (1)

Sol. $R_1 + R_2 + R_3 = 15\ \Omega$

$$\text{Request} = \frac{15.10}{25} = 6\Omega$$

5. If the displacement of the block is 5 m, the work done by force applied is (coefficient of friction between block and surface is $\frac{1}{4}$)



(1) $500\sqrt{2}$ J (2) 250 J

(3) 100 J (4) 500 J

Answer (4)

Sol. $W = F \cdot S$

$= 100 \times 5$

$= 500$ J

6. The dimensional formula of the ratio of electrical dipole moment to the magnetic moment is $M^PL^QT^RA^S$. Then P, Q, R and S are

(1) 0, –1, 1, 0 (2) 0, 1, –1, 0

(3) 0, 1, 0, –1 (4) 0, 1, 0, 1

Answer (1)

Sol. $\left[\frac{P}{M}\right] = \left[\frac{B}{E}\right] = \left[\frac{1}{C}\right] = M^0L^{-1}T^1A^0$

7. Two polarises P_1 & P_2 are aligned in such a way that intensity is zero. P_3 polarises is inserted b/w P_1 and P_3 such that final transmitted ray will have the maximum intensity. Find angle between P_1 and P_3.

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{2}$

(3) $\frac{\pi}{3}$ (4) $\frac{\pi}{8}$

Answer (1)

Sol. $I = I_0 \cos^2\theta_1, \cos^2\theta_2$

$\theta_1 + \theta_2 = 90°$

I is max when $\theta_1 = \theta_2 = 45° = \frac{\pi}{4}$

8. A medium has relative permittivity $\frac{1}{0.085}$ and relative permeability is $\frac{10}{\pi}$. Find ratio of speed of light in vacuum to the medium.

(1) 6.12 (2) 3.14

(3) 2.28 (4) 1.27

Answer (1)

Sol. $\frac{c}{v} = \mu$

$\mu = \sqrt{\varepsilon_r \mu_r}$

$= \sqrt{\frac{1}{0.085} \times \frac{10}{\pi}}$

$= \sqrt{37.46}$

$= 6.12$

9. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Plank's constant and linear momentum have same dimensions.

Reason (R) : Bohr's angular momentum is integral multiple of $\frac{h}{2\pi}$.

In the light of the above statements, choose the correct answer from the options given below :

(1) (A) is false but (R) is true

(2) (A) is true but (R) is false

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

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

Answer (1)

Sol. $L=\frac{nh}{2\pi}$

10. Match the column.

	Column-I		**Column-II**
a.	Adiabatic process	(i)	$W\alpha\Delta T$
b.	Isochoric process	(ii)	$W=0$
c.	Isobaric process	(iii)	$\Delta U+W=0$
d.	Isothermal process	(iv)	$\Delta U=0$

(1) a(ii), b(iii), c(i), d(iv) (2) a(i), b(ii), c(iii), d(iv)

(3) a(iii), b(ii), c(i), d(iv) (4) a(iii), b(ii), c(iv), d(ii)

Answer (3)

Sol. Conceptual

11. n identical bulbs each takes power p when connected with main supply. If n bulbs are connected in series with main supply, then power will be

(1) np (2) $\frac{p}{n^2}$

(3) $\frac{p}{n}$ (4) n^2p

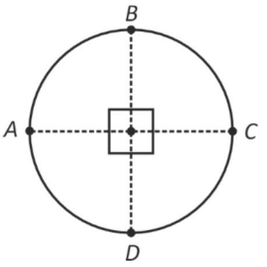
Answer (3)

Sol. $p=\frac{v^2}{R}$

$p'=\frac{v^2}{nR}$

$p'=\frac{p}{n}$

12. Four points on a uniformly charged ring are labelled as A, B, C, and D such that $AB = BC = CD = DA$. If the electric field due to the segment BC at the centre has a magnitude E, then the magnitude of electric field due to the segment ABC is



(1) $\sqrt{2}E$ (2) E

(3) 0 (4) $\frac{E}{\sqrt{2}}$

Answer (1)

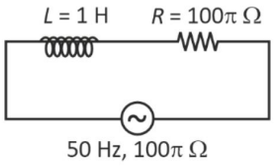
Sol. $E_Q=\frac{2k\lambda}{R}\sin\frac{\theta}{2}$

$E_{BC}=\frac{2k\lambda}{R}\sin\frac{\pi}{4}=E$

$E_{ABC}=\frac{2k\lambda}{R}\sin\frac{\pi}{2}$

$\Rightarrow E_{ABC}=\sqrt{2}E$

13. An ac source of 100π volt is connected to the given circuit. Find maximum value of the current in the circuit.



(1) $\frac{1}{\sqrt{2}}$ A (2) 1 A

(3) $\sqrt{3}$ A (4) 0.5 A

Answer (2)

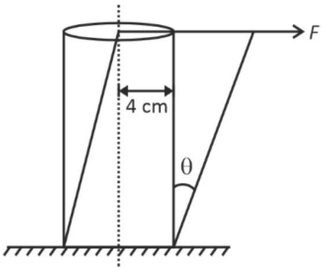
Sol. $Z = (100\pi)\sqrt{2}$

$$I_{rms} = \frac{100\pi}{100\pi\sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$I_{max} = I_{rms}\sqrt{2}$$

$$= 1 \text{ A}$$

14. A force $F = 10^5$ N is applied on the cylinder as shown. If the shear modulus of the cylinder is 10^{10} N/m^2 find θ



(1) $\frac{\pi}{160}$ (2) $\frac{1}{160\pi}$

(3) $\frac{1}{16\pi}$ (4) $\frac{\pi}{16}$

Answer (2)

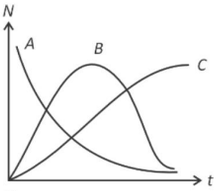
Sol. $C_1 = \frac{F}{A\theta}$

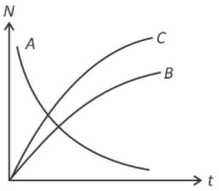
$$\theta = \frac{F}{AC_1}$$

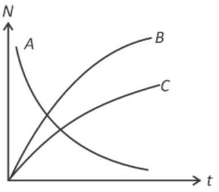
$$= \frac{10^5}{\pi \times 16 \times 10^{-4} \times 10^{10}}$$

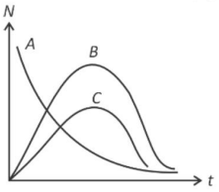
$$\theta = \frac{1}{160\pi}$$

15. In a successive nuclear decay, a sample of radioactive nuclei A decays into an unstable nuclei B which further disintegrates into a stable nuclei C. Which of the following graphs correctly represents the concentration of the nuclei as a function of time? (Assume concentration of B and C to be zero initially)

(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. At $t = \infty$

$N_A = 0, N_B = 0, N_C \neq 0$ (Entire sample contains C)

16. For n-type semi-conductor choose the correct option having correct statements

(i) $n_e \cdot n_n = n_i^2$

(ii) $n_e n_n \neq n_i^2$

(iii) Pentavalent impurity

(iv) Electrons are majority carriers

(v) Additional are not generated

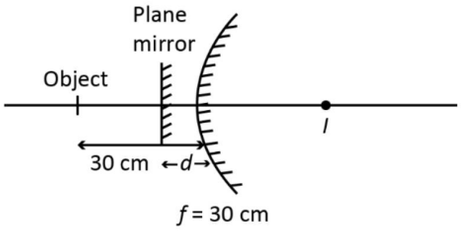
(1) (ii), (iii), (iv) (2) (i), (iii), (iv), (v)

(3) (i), (v) only (4) (i), (iii), (iv)

Answer (2)

Sol. Conceptual

17. A convex mirror with $f = 30$ cm is given an object is placed in front of this mirror at distance 30 cm from mirror. Find the position of plane mirror (with small aperture) with respect to convex mirror, such that images of the both mirrors coincide.



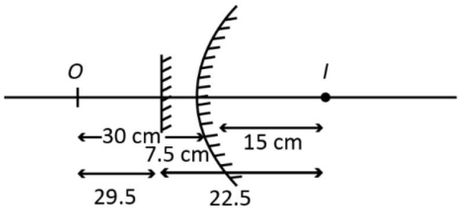
(1) 22.5 cm (2) 7.5 cm

(3) 20 cm (4) 30 cm

Answer (2)

Sol. $\frac{1}{v}=\frac{1}{f}-\frac{1}{4}=\frac{1}{30}-\frac{1}{-30}$

$v=15$ cm



18. Two adiabatic containers A and B have volume in the ratio 1 : 2. The pressure and temperature for gas in A is 8 kPa and 1000 K, and the corresponding values for B is 7 kPa and 500 K. If the containers are connected by a thin pipe and gases are allowed to mix thoroughly, the final temperature of the mixture is 600 K. The final pressure in the vessel is

(1) 7.6 kPa (2) 7.8 kPa

(3) 7.4 kPa (4) 7.2 kPa

Answer (4)

Sol. $\frac{P_1V_1}{T_1}+\frac{P_2V_2}{T_2}=\frac{P}{T}(V_1+V_2)$ ... conserving moles.

$$\left(\frac{8\text{ kPa}}{1000\text{ K}}\right)(V)+\left(\frac{7\text{ kPa}}{500\text{ K}}\right)(2V)=\frac{P(3V)}{600\text{ K}}$$

$P = 7.2$ kPa

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. In a YDSE setup, the slits are separated by 1.5 mm and the distance between slits and screen is 2 m. On using light of wavelength 400 nm, it is observed that 20 maxima's of double slit experiment lie inside the control maxima of single slit diffraction. The width of each slits is ____ μm.

Answer (150)

Sol. $20\frac{\lambda D}{d}=2\frac{\lambda D}{a}$

or $a=\frac{d}{10}$

$a=\frac{1.5\text{ mm}}{10}=150\ \mu\text{m}$

22.

23.

24.

25.