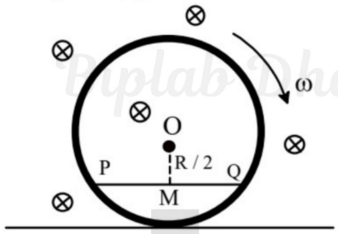
Advanced Test on: Duration: **40 min.**

Multi options correct type

1) A conducting ring of radius R has a conducting rod PQ rigidly attached inside it. The ring rolls without slipping on a rough floor. In the space an uniform magnetic field B exists perpendicular to the surface of ring. Choose the correct option (s).



(A) $V_P - V_Q = B\omega R^2$

(B) $V_P - V_M = \frac{3}{8}B\omega R^2$

(C) Considering PQ as x axis with P as origin, $\frac{d\varepsilon}{dx}$ is positive at Q, ε is the emf induced.

(D) Considering PQ as x axis with P as origin, $\frac{d\varepsilon}{dx} = -B\omega R\left(\sqrt{3}-1\right)$ at $x = \frac{R}{2}$; ε is the emf induced.

2) A uniform conducting ring of mass $m = 2kg$, radius $r = 2m$ and resistance $8\ \Omega$ is kept on a smooth, horizontal surface. A time varying magnetic field $\vec{B} = \left(\hat{i} + t^2\hat{j}\right)$ Tesla is present in the region, where t is time in seconds and takes vertical as y-axis. (Take $\pi^2 = 10$). Then

(A) Time when the ring starts toppling is 1 sec.

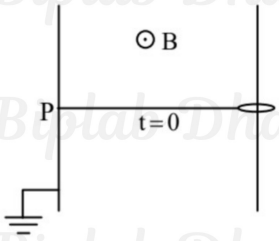
(B) Time when the ring starts toppling is 3/4 sec .

(C) Heat generated through the ring till the instant when the ring starts toppling is 40/3 Joule.

(D) Heat generated through the ring till the instant when the ring starts toppling is 80/3 Joule.

Comprehension type:

A conducting string of length 'ℓ' has fixed end at $x = 0$ and free end at $x = \ell$. It has fundamental frequency of vibration f_0. Now consider it is vibrating in its third overtone with maximum amplitude 'a'.



3) At this given instant (t = 0) the potential difference between the ends of the string is
(A) zero (B) $2Baf_0\ell$ (C) $4\ Baf_o\ell$ (D) $7\ Baf_o\ell$

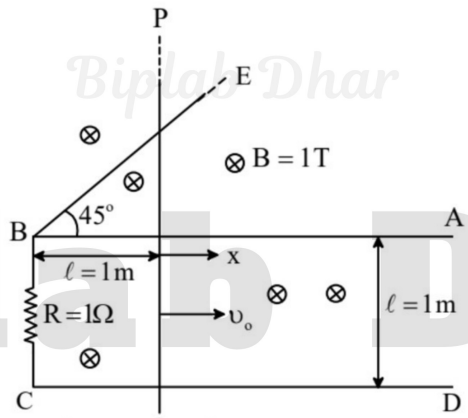
4) At this instant (t = 0) the potential different between any two adjacent nodes is
(A) $Baf_o\ell$ (B) $2Baf_o\ell$ (C) $4\ Baf_o\ell$ (D) $8\ Baf_0\ell$

5) At this instant (t = 0) the potential different between any two adjacent antinodes
(A) zero (B) $2Baf_0\ell$ (C) $4\ Baf_o\ell$ (D) $6\ Baf_o\ell$

Comprehension Type:

A rod PQ of mass 1 kg can slide freely on two parallel rails AB and CD. B and C ends are connected with a fixed resistor R = 1 ohm. Seperation of the rails is ℓ=1m . There is another long rod BE on the same plane as that of the rails. Resistance per unit length of this rod BE is $\frac{5}{4\sqrt{2}}\ \Omega/m$. The rod PQ also slides on rod BE.

The sliding rod PQ and rails do not have any resistance. The system is placed in a uniform magnetic field B = 1 T. Initially the rod PQ is given a horizontal velocity V_0 = 1 m/s as shown. Answer the following question



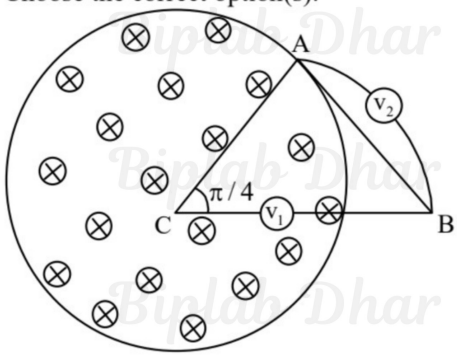
(neglect any rotational e.ect)

6) After what displacement the velocity of the rod will become zero?
(A) 0.5 m (B) 1 m (C) $\left(\sqrt{3}-1\right)$m (D) $\sqrt{3}$ m

7) What is the heat loss in resistor 'R'
(A) $\frac{4}{15}$J (B) $\frac{9}{13}$J (C) $\frac{31}{120}$J (D) $\frac{7}{160}$J

Matrix Match:

8) Magnetic field decreasing in a cylindrical region at a constant rate $\frac{96}{\pi R^2}$ T / sec. Radius of the cylinder is R and its centre is C. An 'L' shaped rod CAB is placed as shown in figure. Resistance of the rods AC and AB are 'r' each. Two voltmeters are corrected as shown in figure. Voltmeter v_1 has resistance 10 r and v_2 is ideal voltmeter. Choose the correct option(s).



Column – I		Column – II	
(A)	Reading of V_1	(P)	1 volt
(B)	Reading of V_2	(Q)	10 volts
(C)	$\int_C^A \bar{E}.\bar{dl}$ along the line CA	(R)	0 volts
(D)	$\int_B^C \bar{E}.\bar{dl}$ along the line BC	(S)	4 volts
		(T)	None of the above