PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 77

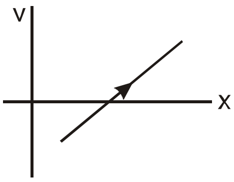
Total Marks : 26

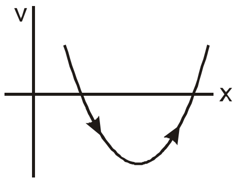
Max. Time : 26 min.

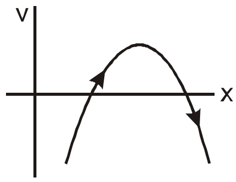
Topics : Kinematics, Electromagnet Induction, Magnetic Effect of Current and Magnetic Force on Charge/ current, Center of Mass, Rotation

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks, 3 min.)**	**[12, 12]**
Multiple choice objective ('–1' negative marking) Q.4 to Q.5	**(4 marks, 4 min.)**	**[4, 4]**
Comprehension ('–1' negative marking) Q.6 to Q.8	**(3 marks, 3 min.)**	**[9, 9]**

1. For a particle moving along x-axis, which of the velocity versus position graphs given in options below is/are possible : (position is represented by x-coordinate of the particle)

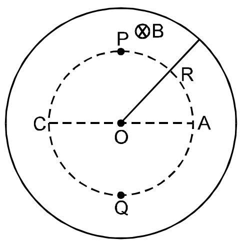
(A) 

(B) 

(C) 

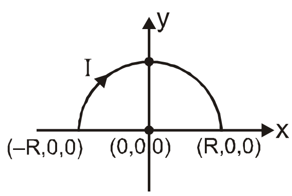
(D) None of these

2. A uniform magnetic field B increasing with time exists in a cylindrical region of centre O and radius R. The direction of magnetic field is inwards the paper as shown. The work done by external agent in taking a unit positive charge slowly from A to C via paths APC, AOC and AQC be W_{APC}, W_{AOC} and W_{AQC} respectively. Then-



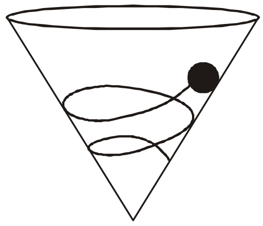
(A) $W_{APC} = W_{AOC} = W_{AQC}$
(B) $W_{APC} > W_{AOC} > W_{AQC}$
(C) $W_{APC} < W_{AOC} < W_{AQC}$
(D) $W_{APC} = W_{AQC} < W_{AOC}$

3. A semi–circular current carrying wire having radius R is placed in x–y plane with its centre at origin O. There is a position x dependent non–uniform magnetic field $\vec{B} = \frac{B_0 x}{2R}\hat{k}$ (here B_0 is positive constant) existing in the region. The force due to magnetic field acting on the semi–circular wire will be along :



(A) negative x-axis
(B) positive x-axis
(C) negative y-axis
(D) positive y-axis

4. A ball is rolling without slipping in a spiral path down the inner surface of a hollow fixed cone whose axis is vertical. The work done by the inner surface of the cone on the ball is

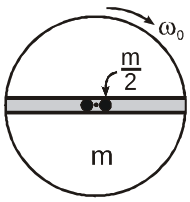


(A) positive (B) zero (C) negative (D) Impossible to determine

5. Two blocks of mass m and 2m are fixed to the ends of a spring. The spring is initially compressed & then the system is released in air (neglecting the air resistance). After time t
(A) the momentum of the system will be zero
(B) the momentum of the system will be 3 m g t
(C) the momentum of the system will be m g t
(D) the momentum of the system will not depend on the value of spring constant.

COMPREHENSION

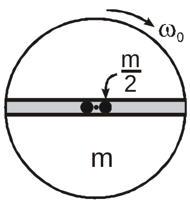
A disc of mass 'm' and radius R is free to rotate in horizontal plane about a vertical smooth fixed axis passing through its centre. There is a smooth groove along the diameter of the disc and two small balls of mass $\frac{m}{2}$ each are placed in it on either side of the centre of the disc as shown in fig. The disc is given initial angular velocity ω_0 and released.



6. The angular speed of the disc when the balls reach the end of the disc is :

(A) $\frac{\omega_0}{2}$ (B) $\frac{\omega_0}{3}$ (C) $\frac{2\omega_0}{3}$ (D) $\frac{\omega_0}{4}$

7. The speed of each ball relative to ground just after they leave the disc is :



(A) $\frac{R\omega_0}{\sqrt{3}}$ (B) $\frac{R\omega_0}{\sqrt{2}}$ (C) $\frac{2R\omega_0}{3}$ (D) none of these

8. The net work done by forces exerted by disc on one of the ball for the duration ball remains on the disc is

(A) $\frac{2mR^2\omega_0^2}{9}$ (B) $\frac{mR^2\omega_0^2}{18}$ (C) $\frac{mR^2\omega_0^2}{6}$ (D) $\frac{mR^2\omega_0^2}{9}$

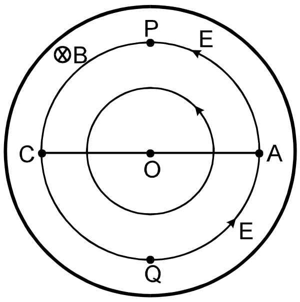
Answers Key

1.	(D)	**2.**	(C)	**3.**	(A)	**4.**	(B)
5.	(B) (D)	**6.**	(B)	**7.**	(C)	**8.**	(D)

Hints & Solutions

1. It is clearly visible from all graphs that as x-increases. Velocity changes sign. Since this is not possible, no graph represents the possible motion.

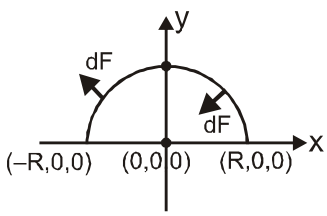
2. Because of increase in magnetic field with time, electric field is induced in the circular region and represented by lines of forces as shown in figure. The signs of minimum work done by external agent in taking unit positive charge from A to C via path APC, AOC and AQC are



$W_{APC} = -\text{ve}$, $W_{AOC} = 0$, $W_{AQC} = +\text{ve}$

$\therefore$ (C) is the correct choice.

3. The direction of forces on the two elements taken symmetrical on two sides of the y–axis are shown. Clearly the net force will be on negative x-axis.



4. For a ball rolling without slipping on a fixed rough surface, no work is done by friction.

5. Δp - Implse = Ft = 3mgt

6. Let the angular speed of disc when the balls reach the end be ω. From conservation of angular momentum

$$\frac{1}{2}mR^2\,\omega_0 = \frac{1}{2}\,mR^2\omega + \frac{m}{2}R^2\;\omega + \frac{m}{2}R^2\;\omega \quad \text{or} \quad \omega$$

$$= \frac{\omega_0}{3}$$

7. The angular speed of the disc just after the balls leave

the disc is $\omega = \dfrac{\omega_0}{3}$

Let the speed of each ball just after they leave the disc be v.

From conservation of energy

$$\frac{1}{2}\left(\frac{1}{2}mR^2\right)\omega_0^{\,2} = \frac{1}{2}\left(\frac{1}{2}mR^2\right)\omega^2 + \frac{1}{2}\left(\frac{m}{2}\right)v^2$$

$$+\frac{1}{2}\left(\frac{m}{2}\right)v^2$$

solving we get

$$v = \frac{2R\omega_0}{3}$$

NOTE : $v = \sqrt{(\omega R)^2 + v_r^2}$

; v_r = radial velocity of the ball

8. Workdone by all forces equal $K_f - K_i = \dfrac{1}{2}\left(\dfrac{m}{2}\right)v^2 =$

$$\frac{mR^2\omega_0^2}{9}$$