PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 78

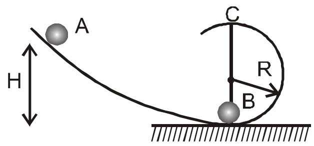
Total Marks : 24

Max. Time : 24 min.

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

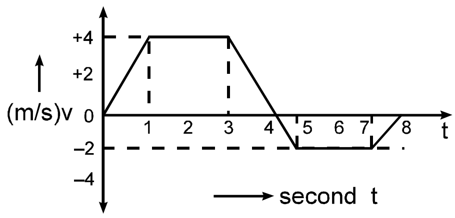
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. Ball A of mass m after sliding from an inclined plane, strikes elastically another ball B of same mass at rest. Find the minimum height H so that ball B just completes the circular motion.



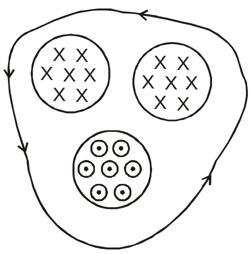
(A) H = 3R (B) H = 2R (C) H = $\frac{5R}{2}$ (D) H = 4R

2. The velocity time graph of a linear motion is shown in the figure. The distance from the starting point after 8 seconds will be:



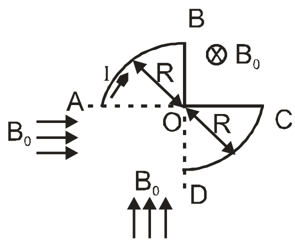
(A) 18 m (B) 6 m (C) 8 m (D) none of these

3. Figure shows three regions of magnetic field, each of area A, and in each region magnitude of magnetic field decreases at a constant rate α. If $\vec{E}$ is induced electric field then value of line integral $\oint \vec{E} \cdot d\vec{r}$ along the given loop is equal to



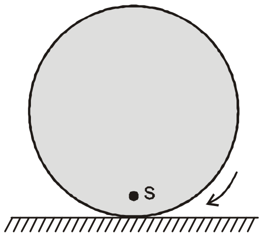
(A) αA (B) $-\alpha A$ (C) $3\alpha A$ (D) $-3\alpha A$

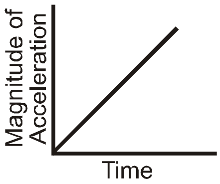
4. Wire bent as ABOCD as shown, carries current I entering at A and leaving at D. Three uniform magnetic fields each B_0 exist in the region as shown. The force on the wire is

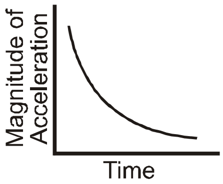


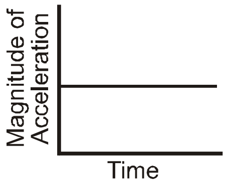
(A) $\sqrt{3}\,IRB_0$ (B) $\sqrt{5}\,IRB_0$ (C) $\sqrt{8}\,IRB_0$ (D) $\sqrt{6}\,IRB_0$

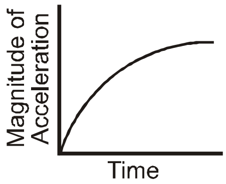
5. As shown in figure, S is a point on a uniform disc rolling with uniform angular velocity on a fixed rough horizontal surface. The only forces acting on the disc are its weight and contact forces exerted by horizontal surface. Which graph best represents the magnitude of the acceleration of point S as a function of time



(A) 

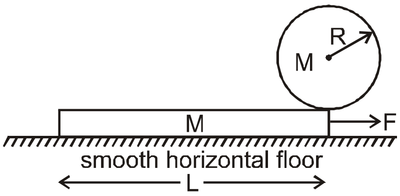
(B) 

(C) 

(D) 

COMPREHENSION

A uniform disc of mass M and radius R initially stands vertically on the right end of a horizontal plank of mass M and length L, as shown.The plank rests on smooth horizontal floor and friction between disc and plank is sufficiently high such that disc rolls on plank without slipping. The plank is pulled to right with a constant horizontal force of magnitude F.



6. The magnitude of acceleration of plank

(A) $\frac{F}{8M}$ (B) $\frac{F}{4M}$ (C) $\frac{3F}{2M}$ (D) $\frac{3F}{4M}$

7. The magnitude of angular acceleration of the disc

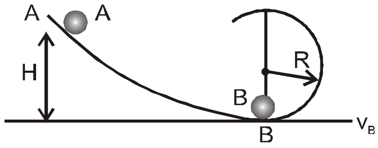
(A) $\frac{F}{4mR}$ (B) $\frac{F}{8mR}$ (C) $\frac{F}{2mR}$ (D) $\frac{3F}{2mR}$

8. The distance travelled by centre of disc from its initial position till the left end of plank comes vertically below the centre of disc is

(A) $\frac{L}{2}$ (B) $\frac{L}{4}$ (C) $\frac{L}{8}$ (D) L

Answers Key

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

1. 

For the just completing the circular motion, minimum velocity at bottom in

$v_B = \sqrt{5gR}$

Energy conservation b/w point A and B

$MgH + 0 = 0 + \frac{1}{2} m v_B^2$

$MgH = \frac{1}{2} m (5gR)$

$H = \frac{5R}{2}$

3. $\int \vec{E} \cdot d\vec{r} = -\frac{d\phi}{dt}$

and take the sign of flux according to right hand curl rule get.

$\int \vec{E} \cdot d\vec{r} = -(-(-\alpha A) - (-\alpha A) + (-\alpha A)) = -\alpha A$

4. $\vec{F} = \vec{F} = I\vec{\ell} \times \vec{B}$

$\vec{\ell} = \overrightarrow{AD} = R(\hat{i} - \hat{j})$

$\vec{B} = B_0 (\hat{i} + \hat{j} - \hat{k})$

$\therefore \vec{F} = IRB_0 (\hat{i} - \hat{j}) \times (\hat{i} + \hat{j} - \hat{k}) = IRB_0$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 0 \\ 1 & 1 & -1 \end{vmatrix} = IRB_0 (\hat{i} + \hat{j} + 2\hat{k})$$

$F = IRB_0 \sqrt{6}$

Aliter :

$\vec{B} = B_0 (\hat{i} + \hat{j} - \hat{k})$

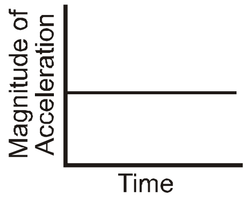
$\vec{\ell} = R(\hat{i} - \hat{j})$

$\vec{B}\ \vec{\ell} = 0$

$\Rightarrow$ Angle = 90°

$\Rightarrow F = BI\ell = \sqrt{3} B_0 I \sqrt{2} R = \sqrt{6} B_0 IR$

5. Since angular velocity is constant, acceleration of centre of mass of disc is zero. Hence the magnitude of acceleration of point S is $\omega^2 x$ where ω is angular speed of disc and x is the distance of S from centre. Therefore the graph is



Sol. 14 to 16

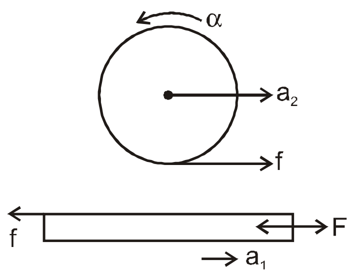
The free body diagram of plank and disc is

Applying Newton's second law

$F - f = Ma_1$ .... (1)

$f = Ma_2$ .... (2)

$FR = \frac{1}{2}MR^2\alpha$ .... (3)



from equation 2 and 3

$a_2 = \frac{R\alpha}{2}$

From constraint $a_1 = a_2 + R\alpha$

$\therefore a_1 = 3a_2$ .... (4)

Solving we get $a_1 = \frac{3F}{4M}$ and $\alpha = \frac{F}{2MR}$

If sphere moves by x the plank moves by L + x.

The from equation (4)

$L + x = 3x$ or $x = \frac{L}{2}$