DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

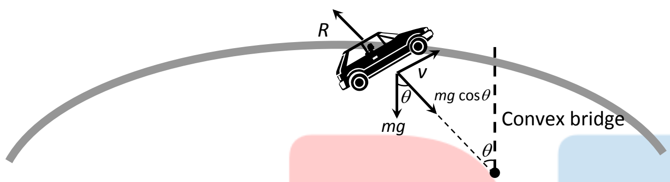
Solutions

SUBJECT : PHYSICS
DPP NO. : 9

Topic :- MOTION IN A PLANE

1 **(a)**

$R = mg\cos\theta - \frac{mv^2}{r}$



When θ decreases $\cos\theta$ increases *i.e.*, R increases

2 **(a)**

Area of parallelogram $= |A \times B|$

$AB\sin\theta = \frac{1}{2}AB$

$\therefore \sin\theta = \frac{1}{2}, \theta = 30°$

3 **(a)**

$\vec{L} = \vec{r} \times \vec{p} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 4 & 0 \\ 2 & 3 & 1 \end{vmatrix}$

$= \hat{i}[4 - 0] + \hat{j}[0 - 0] + \hat{k}[0 - 8] = 4\hat{i} - 8\hat{k}$

4 **(a)**

In this problem it is assumed that particle although moving in a vertical loop but its speed remain constant

Tension at lowest point $T_{max} = \frac{mv^2}{r} + mg$

Tension at highest point $T_{min} = \frac{mv^2}{r} - mg$

$\frac{T_{max}}{T_{min}} = \frac{\frac{mv^2}{r} + mg}{\frac{mv^2}{r} - mg} = \frac{5}{3}$

By solving we get, $v = \sqrt{4gr} = \sqrt{4 \times 9.8 \times 2.5} = \sqrt{98}\ m/s$

5 **(b)**

$F^2 = F_1^2 + F_2^2 + 2F_1F_2\cos 90°$

or $F^2 = F_1^2 + F_2^2 \Rightarrow F = \sqrt{F_1^2 + F_2^2}$

6 **(c)**

For uniform circular motion $a_t = 0$

$a_r = \frac{v^2}{r} \neq 0$

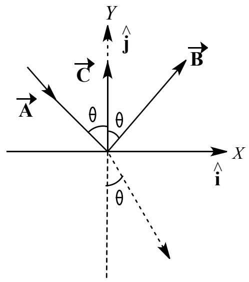
7 **(c)**

$F = m\omega^2 R \therefore F \propto R$ (m and ω are constant)

If radius of the path is halved, then force will also become half

8 **(d)**

Let $\vec{A}$,$\vec{B}$ and $\vec{C}$ be as shown in figure. Let θ be the angle of incidence, which is also equal to the angle of reflection. Resolving these vectors in rectangular components, we have



$\vec{A} = \sin\theta\hat{i} - \cos\theta\hat{j}$

$\vec{B} = \sin\theta\hat{i} + \cos\theta\hat{j}$

$\vec{B} - \vec{A} = 2\cos\theta\,\hat{j}$

or $\vec{B} = \vec{A} + 2\cos\theta\,\hat{j}$

Now $\vec{A}.\vec{C} = 2\cos\theta\hat{j}$ or $\vec{B} = \vec{A}\cos\theta\,\hat{j}$

$\therefore \vec{B} = \vec{A} - 2(\vec{A}.\vec{C})\hat{j}$ or $\vec{B} = \vec{A} - 2(\vec{A}.\vec{C})\vec{C}$ (as $\hat{j} = \vec{C}$)

9 **(c)**

When a stone tied at the end of string is rotated in a circle, the velocity of the stone at an instant acts tangentially outwards the circle. When the string is released, the stone files off tangentially outwards *ie*, in the direction of velocity

10 **(c)**

In projectile motion given angular projection, the horizontal component velocity remains unchanged. Hence

$v\cos\alpha = u\cos\theta$ or $v = u\cos\theta\sec\alpha$

11 **(d)**

$s = 0 \times 1 + \frac{1}{2} \times 9.8 \times 1 \times 1 = 4.9$ m

12 **(d)**

Minimum speed at the highest point of vertical circular path $v = \sqrt{gR}$

13 **(c)**

When θ = 180°, the particle will be at diametrically opposite point, where its velocity is opposite to the initial directions of motion. The change in momentum $= mv - (-mv) = 2$ mv (maximum). When θ = 360°, the particle is at the initial position with momentum m.

Change in momentum mv - $mv = 0$ (minimum)

14 **(d)**

$R = 4H\cot\theta$, if $\theta = 45°$ then $R = 4H \Rightarrow \frac{R}{H} = \frac{4}{1}$

16 **(b)**

Maximum tension in the thread is given by

$T_{\max} = mg + \frac{mv^2}{r}$

or $T_{\max} = mg + mrw^2$ $\quad (\because v = r\omega)$

or $\omega^2 = \frac{T_{\max} - mg}{mr}$

Given, $T_{\max} = 37$ N, m = 500g = 0.5 kg, $g = \text{mg}^{-2}$,

$r = 4\text{m}$

$\therefore \quad \omega^2 = \frac{37 - 0.5 \times 10}{0.5 \times 4} = \frac{37 - 5}{2}$

or $\omega^2 = 16$

or ω = 4 rad s^{-1}

17 **(a)**

$mg = 1 \times 10 = 10N, \frac{mv^2}{r} = \frac{1 \times (4)^2}{1} = 16$

Tension at the top of circle $= \frac{mv^2}{r} - mg = 6N$

Tension at the bottom of circle $= \frac{mv^2}{r} + mg = 26N$

18 **(b)**

Let v be the velocity acquired by the body at B which will be moving making an angle 45° with the horizontal direction. As the body just crosses the well so $\frac{v^2}{\text{g}} = 40$

or $v^2 = 40\text{g} = 40 \times 10 = 400$

or $v = 20 \text{ ms}^{-1}$

Taking motion of the body from A to B along the inclined plane we have

$u = v_0, a = -\text{g} \sin 45° = -\frac{10}{\sqrt{2}} \text{ms}^{-2}$

$s = 20\text{m}, v = 20\text{ms}^{-1}$

As $v^2 = u^2 + 2as$

$\therefore 400 = v_0^2 + 2\left(-\frac{10}{\sqrt{2}}\right) \times 20\sqrt{2}$

or $v_0^2 = 400 + 400 = 800$ or $v = 20\sqrt{2}\text{ms}^{-1}$

19 **(a)**

Centripetal force

$\frac{mv^2}{R} = ma$

or $\quad a = \frac{v^2}{R}$

$\therefore \quad \frac{a_1}{a_2} = \frac{v_1^2}{v_2^2}$

Here, $v_1 = v, \ \ v_2 = 2v, \ a_1 = a$

$\therefore \quad \frac{a}{a_2} = \frac{v^2}{(2v)^2} = \frac{1}{4}$

or $\ a_2 = 4a$

20 **(c)**

$L = I\omega$. In U.C.M. $\omega =$ constant $\therefore L =$ constant.

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	A	A	A	A	B	C	C	D	C	C
Q.	11	12	13	14	15	16	17	18	19	20
A.	D	D	C	D	A	B	A	B	A	C