DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 2

Topic :- MOTION IN A PLANE

1 **(c)**

$R = 4H\cot\theta$

When $R = H$ then $\cot\theta = 1/4 \Rightarrow \theta = \tan^{-1}(4)$

2 **(c)**

For looping the loop, the velocity at the lowest point of loop should be

$v = \sqrt{5gr} = \sqrt{5gD/2} = \sqrt{2gh}$ or $h = 5\,D/4$

3 **(a)**

$$\vec{P} = \frac{\vec{F}\,.\,\vec{S}}{t}$$

$$= \frac{(2\hat{i} + 2\hat{j})\,.\,(2\hat{i} + 2\hat{k})}{16}\,Js^{-1} = \frac{4}{16}Js^{-1} = 0.25Js^{-1}$$

4 **(a)**

Work done by centripetal force in uniform circular motion is always equal to zero

5 **(c)**

$$h_1 = \frac{v^2\sin^2\alpha}{2g},\ h_2 = \frac{v^2\cos^2\alpha}{2g},\ \frac{h_1}{h_2} = \tan^2\alpha$$

6 **(b)**

Since, acceleration is constant

$$\therefore\ \vec{\mathbf{s}} = \vec{\mathbf{u}} + \frac{1}{2}\vec{\mathbf{a}}t^2$$

$$= (2\hat{i} - 4\hat{\mathbf{j}})t + \frac{1}{2}(3\hat{\mathbf{i}} + 5\hat{\mathbf{j}})t^2$$

$$= (2\hat{\mathbf{i}} - 4\hat{j})2 + \frac{1}{2}(3\hat{\mathbf{i}} + 5\hat{\mathbf{j}})2^2$$

$$= 10\hat{\mathbf{i}} + 2\hat{\mathbf{j}}$$

$$|\vec{\mathbf{s}}| = \sqrt{10^2 + 2^2} = \sqrt{104} = 10.2\text{m}$$

7 **(d)**

Here $W = T(\cos\theta + \sin\theta) < T$

so $P + Q = T(\cos\theta + \sin\theta) < T$

Where as (a), (b) and (c) are correct and (d) is wrong.

8 **(c)**

Given that, radius of circle, $r = 30\text{cm} = 0.3\text{m}$

linear speed $v = 2t$

Now, radial acceleration $a_R = \frac{v^2}{r} = \frac{(2t)^2}{0.3}$

at $t = 3s$

$a_R = \frac{(2 \times 3)^2}{0.3}$

$\frac{36}{0.3} = 120\text{ms}^{-2}$

or $a_R = 120\text{ms}^{-2}$

and tangential acceleration $a_T = \frac{dv}{dt} = \frac{d}{dt}(2t) = 2\text{ms}^{-2}$

9 **(c)**

$\mathbf{L} = m(\mathbf{r} \times \mathbf{v})$

$\mathbf{L} = m\left[v_0\cos\theta\, t\hat{\mathbf{i}} + \left(v_0\sin\theta\, t - \frac{1}{2}gt^2\right)\hat{\mathbf{j}}\right]$

$\times \left[v_0\cos\theta\, \hat{\mathbf{i}} + (v_0\sin\theta - gt)\hat{\mathbf{j}}\right]$

$= mv_0\cos\theta\, t\left[-\frac{1}{2}gt\right]\hat{\mathbf{k}}$

$= -\frac{1}{2}mgv_0t^2\cos\theta\, \hat{\mathbf{k}}$

10 **(b)**

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

At max. height $v = 0$ and for upward direction $a = -g$

$\therefore u^2 = 2gs \Rightarrow s = \frac{u^2}{2g}$; $\because s_e = s_p$

$\left(\frac{u_e}{u_p}\right)^2 = \left(\frac{g_e}{g_p}\right) \Rightarrow \left(\frac{5}{3}\right)^2 = \frac{9.8}{g_p} \Rightarrow g_p = 3.5\ m/s^2$

11 **(c)**

From $\frac{mv^2}{r} = F = \mu\, mg$

$\therefore v = \sqrt{\mu rg} = \sqrt{0.75 \times 60 \times 10} = \sqrt{450} = 21\text{ms}^{-1}$

12 **(d)**

$\omega_1 = 2\pi \times 300$ rad/min

$\omega_2 = 2\pi \times 100$ rad/min

Angular retardation

$\alpha = \frac{\omega_1 - \omega_2}{2}$

$= \frac{2\pi \times 300 - 2\pi \times 100}{2}$

$= 2\pi \times 100\ \text{rad/min}^2$

$= 200\pi\ \text{rad/min}^2$

13 **(c)**

If a particle is projected with velocity u at an angle θ with the horizontal, the velocity of the particle at the highest point is

$v = u\cos\theta = 200\cos 60^\circ = 100$ ms^{-1}

If m is the mass of the particle, then its initial momentum at highest point in the horizontal direction $= mv = m \times 100$. It means at the highest point, initially the particle has no momentum vertically upwards or downwards. Therefore, after explosion, the final momentum of the particles going upwards and downwards must be zero. Hence, the final momentum after explosion is the momentum of the third particle, in the horizontal direction. If the third particle moves with velocity v', then its momentum $= \frac{mv'}{3}$,

According to law of conservation of linear momentum,

We have $\frac{mv'}{3} = m \times 100$ or $v' = 300$ ms^{-1}

14 **(b)**

Reaction on inner wheel $R_1 = \frac{1}{2}M\left[g - \frac{v^2 h}{ra}\right]$

Reaction on outer wheel $R_2 = M\left[g + \frac{v^2 h}{ra}\right]$

where, $r =$ radius of circular path, $2a =$ distance between two wheels and $\mathrm{h} =$ height of centre of gravity of car

15 **(a)**

$\vec{A} = 2\hat{i} + 4\hat{j}, \vec{B} = 5\hat{i} + p\,\hat{j}$

$A = \sqrt{2^2 + 4^2} = \sqrt{20}$

$B = \sqrt{5^2 + p^2}$

$\vec{A} \cdot \vec{B} = 10 - 4p$

If $\vec{A} \parallel \vec{B}$ then

$\vec{A} \cdot \vec{B} = AB\cos 0^\circ = AB$

$10 - 4p = \sqrt{20}\sqrt{25 + p^2}$

Square $100 + 16p^2 - 80p$

$= 20(25 + p^2) = 500 = 20p^2$

or $20p^2 - 16p^2 + 80p + 400 = 0$

or $p^2 + 20p + 100 = 0$

or $(p + 10)^2 = 0$

$\therefore$ $p = -10$

$\therefore$ $\vec{B} = 5\hat{i} + 10\hat{j}$

$B = \sqrt{5^2 + (10)^2} = \sqrt{125} = 5\sqrt{5}$

16 **(c)**

In uniform circular motion only centripetal acceleration works

17 **(b)**

Given, $r = 40$ m and $g = 10\text{m/s}^2$

we have $v = \sqrt{gr}$

$= 10 \times 40 = \sqrt{400}$

$= 20$ m/s

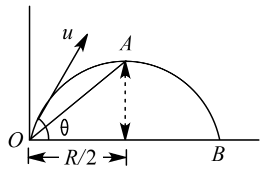
19 **(a)**

$$T = \frac{2u\sin\theta}{g} = 10\text{ Sec} \Rightarrow u\sin\theta = 50\ m/s$$

$$\therefore H = \frac{u^2\sin^2\theta}{2g} = \frac{(u\sin\theta)^2}{2g} = \frac{50\times 50}{2\times 10} = 125\ m$$

20 **(b)**

Refer figure are when projectile is at A, then



$$OC = \frac{R}{2} = \frac{1}{2}\frac{u^2}{g}\sin 2\theta = \frac{1}{2}\times\frac{(20\sqrt{2})^2}{10}\sin 2\times 45°$$

$$= 40\text{ m}$$

$$AC = H = \frac{u^2\sin^2\theta}{2g} = \frac{(20\sqrt{2})^2}{2\times 10}\sin^2 45°$$

$$\therefore \text{ Displacement, } OA = \sqrt{OC^2 + CA^2} = \sqrt{40^2 + 20^2}$$

Time of projectile from O to A

$$= \frac{1}{2}\left(\frac{2u\sin\theta}{g}\right) = \frac{u\sin\theta}{2g} = \frac{(20\sqrt{2})\sin 45°}{10} = 2\text{s}$$

$$\therefore \text{ Average velocity } = \frac{\text{displacement}}{\text{time}}$$

$$= \frac{\sqrt{40^2+20^2}}{2} = 10\sqrt{5}\text{ ms}^{-1}$$

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