DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 6

Topic :- MOTION IN A PLANE

1 **(c)**

$V \cos\beta = v\cos\theta$

or $V = v\cos\theta\sec\beta$

2 **(b)**

Given $(KE)_{\text{highest}} = \frac{1}{2}(\text{KE})$

$\frac{1}{2}mv^2\cos^2\theta = \frac{1}{2}\cdot\frac{1}{2}mv^2$

$\cos^2\theta = \frac{1}{2} \Rightarrow \cos\theta = \sqrt{\frac{1}{2}}$

$\Rightarrow \theta = 45°$

3 **(a)**

The horizontal range $R_x = \frac{u^2\sin 2\theta}{g}$

When projected at angle of 15°

$R_{x1} = \frac{u^2}{g}\sin(2\times 15) = \frac{u^2}{2g} = 1.5\text{km}$

When projected at angle of 45°

$R_{x1} = \frac{u^2}{g}\sin(2\times 45°)\frac{u^2}{g}$

$= \frac{2u^2}{2g} = 2\times 1.5 = 3.0\text{ km}$

5 **(d)**

In complete revolution total displacement is zero so average velocity is zero

6 **(b)**

For banking $\tan\theta = \frac{V^2}{Rg}$

$\tan 45 = \frac{V^2}{90\times 10} = 1$

$V = 30\ m/s$

7 **(a)**

$\vec{A} = A\hat{A}$ or $\hat{A} = \frac{\vec{A}}{A}$

$\therefore$ required unit vector is $\frac{\hat{i}+\hat{j}}{|\hat{i}+\hat{j}|} = \frac{\hat{i}+\hat{j}}{\sqrt{2}}$

8 **(a)**

$v = \sqrt{rg}$

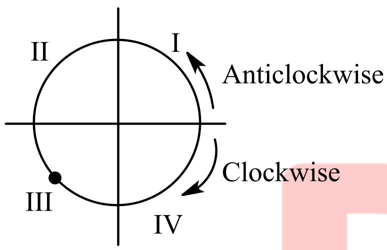
$2r = \frac{2v^2}{g} = \frac{2 \times 9.8 \times 9.8}{9.8} = 19.6$ m

9 **(c)**

When the force acting on a body is directed towards a fixed point, then it changes only the direction of motion of the body without changing its speed. So, the particle will describe a circular motion

10 **(b)**

The figure shows a circular path of moving particle. At any instant velocity of particle.



v = $-3\hat{\mathbf{i}}$ - $4\hat{\mathbf{j}} = (-3, -4)$ (in coordinate from).

The coordinates of velocity show that particle is in 3rd quadrant at that instant. While moving clockwise particle will enter into 4th quadrant and these into 3rd and while moving anticlockwise particle will enter into 2nd quadrant and then into 3rd quadrant.

$\therefore$ 4th and 2nd quadrants.

11 **(a)**

Retarding force $F = ma = \mu R = \mu\, mg$

$a = \mu g$

Now, from equation of motion, $v^2 = u^2 - 2as$

$\therefore\ 0 = u^2 - 2as$

$\therefore\ s = \frac{u^2}{2a} = \frac{u^2}{2\mu g} = \frac{v_0^2}{2\mu g}$

12 **(a)**

$a = \omega^2 R = \left(\frac{2\pi}{0.2\pi}\right)^2 (5 \times 10^{-2}) = 5\ m/s^2$

13 **(c)**

$v = 36\frac{km}{h} = 10\frac{m}{s}\ \therefore F = \frac{mv^2}{r} = \frac{500 \times 100}{50} = 1000\ N$

14 **(a)**

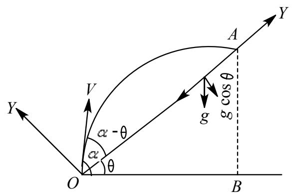
$\tan\theta = \frac{h}{b} = \frac{v^2}{rg}$,

$v=\sqrt{\frac{h^r h}{b}}=\sqrt{\frac{1.5\times 50\times 10}{10}}=8.5\ \mathrm{ms}^{-1}$

15 **(b)**

$v_x=v\cos(\alpha-\theta)\,;v_y=v\sin(\alpha-\theta)$

$a_x=-g\sin\theta\,;a_y=-g\cos\theta$



If T is the time of flight, then

$0=v\sin(\alpha-\theta).T-\frac{1}{2}g\cos\theta\,.T^2$

or $T=\frac{2v\sin(\alpha-\theta)}{g\cos\theta}$

$OB=v\cos\alpha\times T$

Now, $\cos\theta=\frac{OB}{OA}$ or $OA=\frac{OB}{\cos\theta}$

or $OA=\frac{v\sin\alpha T}{\cos\theta}$

or $OA=v\cos\alpha\times\frac{2v\sin(\alpha-\theta)}{g\cos\theta}\times\frac{1}{\cos\theta}$

or $OA=\frac{v^2}{g\cos^2\theta}[\sin(2\alpha-\theta)\cos\alpha]$

or $OA=\frac{v^2}{g\cos^2\theta}[\sin(2\alpha-\theta)+\sin(-\theta)]$

or $OA=\frac{v^2}{g\cos^2\theta}[\sin(2\alpha-\theta)-\sin\theta]$

Clearly, the range $R(=OA)$ will be maximum when $\sin(2\alpha-\theta)$ is maximum, *ie*,1.

This would mean

$2\alpha-\theta=\frac{\pi}{2}$ or $\alpha\frac{\theta}{2}+\frac{\pi}{4}$

Maximum range up the inclined plane,

$R_{\max}=\frac{v^2}{g\cos^2\theta}(1-\sin\theta)=\frac{v^2(1-\sin\theta)}{g(1-\sin^2\theta)}$

$=\frac{v^2(1-\sin\theta)}{g(1-\sin\theta)(1+1-\sin\theta)}=\frac{v^2}{g(1+\sin\theta)}$

16 **(b)**

$R_{\max}=\frac{u^2}{g}=16\times 10^3$

$\Rightarrow u=400m/s$

17 **(c)**

Because horizontal velocity is same for coin and the observer. So relative horizontal displacement will be zero

18 **(c)**

As, $\vec{A}\cdot\vec{B}=0$ so $\vec{A}$ is perpendicular to $\vec{B}$. Also $\vec{A}.\vec{C}=0$ means $\vec{A}$ is perpendicular to $\vec{C}$. Since

$\vec{B} \times \vec{C}$ is perpendicular to $\vec{B}$ and $\vec{C}$, so $\vec{A}$ parallel to $\vec{B} \times \vec{C}$.

19 **(b)**

Given, $y = 12x - \frac{3}{4}x^2$

$u_x = 3$ ms^{-1}

$v_y = \frac{dy}{dt} = 12\frac{dx}{dt} - \frac{3}{2}x\frac{dx}{dt}$

At $x = 0, v_y = u_y = 12\frac{dx}{dt} = 12u_x = 12 \times 3 = 36$ ms^{-1}

$a_y = \frac{d}{dt}\left(\frac{dy}{dt}\right) = 12\frac{d^2x}{dt^2} - \frac{3}{2}\left(\frac{dx}{dt} + x\frac{d^2x}{dt^2}\right)$

But $\frac{d^2x}{dt^2} = a_x = 0$, hence

$a_y = -\frac{3}{2}\ \frac{dx}{dt} = -\frac{3}{2}u_x = -\frac{3}{2} \times 3 - \frac{9}{2}$ ms^{-2}

Range $R = \frac{2u_xu_y}{a_y} = \frac{2 \times 3 \times 12}{9/2} = 16$m

20 **(c)**

They have same ω

Centripetal acceleration $= \omega^2 r$

$\frac{a_1}{a_2} = \frac{\omega^2 r_1}{\omega^2 r_2} = \frac{r_1}{r_2}$

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