DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 5

Topic :- MOTION IN A PLANE

1 **(d)**

Momentum, speed and kinetic energy change continuously in a vertical circular motion. The physical quantity which remains constant is the total energy.

2 **(d)**

Maximum tension $= m\omega^2 r = m \times 4\pi^2 \times n^2 \times r$

By substituting the values we get $T_{\max} = 87.64\ N$

3 **(d)**

$v \cos \beta = u \cos \alpha$

$v = \dfrac{u \cos \alpha}{\cos \beta}$

4 **(d)**

$\alpha = \dfrac{\omega_2 - \omega_1}{t} = \dfrac{2\pi v_2 - 2\pi v_1}{t}$

$= \dfrac{2\pi\left(\frac{1200}{60} - \frac{600}{60}\right)}{10} = 2\pi$ rads^{-2}

5 **(b)**

$t = \sqrt{\dfrac{2h}{g}}, x = v\sqrt{\dfrac{2h}{g}}$ or $v = x\sqrt{\dfrac{g}{2h}}$

6 **(d)**

Here, $r = 50$ m

As $\tan\theta = \frac{v^2}{rg}$, therefore, when speed v is doubled; r must be made 4 times, if θ remains the same

∴ New radius of curvature,

$r' = 4r = 4 \times 50\ \text{m} = 200\ \text{m}$

7 **(a)**

Using the equation for projectile motion,

$y = x\tan\theta - \frac{gx^2}{2u^2}(1 + \tan^2\theta)$, we have

$40 = 30\tan\theta - \dfrac{g(30)^2}{2u}(1 + \tan^2\theta)$

or $900\tan^2\theta - 6u^2\tan\theta + (900 + 8u^2) = 0$

For real value of θ

$(6u^2)^2 \geq 4 \times 900(900 + 8u^2)$

or $(u^4 - 800u^2) \geq 90000$

or $(u^2 - 400)^2 \geq 200000$

or $u^2 \geq 900$ or $u \geq 30\text{ms}^{-1}$

8 **(c)**

Frequency of wheel, $v = \frac{300}{60} = 5$ rps. Angle described by wheel in one rotation $= 2\pi$ rad.

Therefore, angle described by wheel in 1 s $= 2\pi \times 5$ rad $= 10\pi$ rad

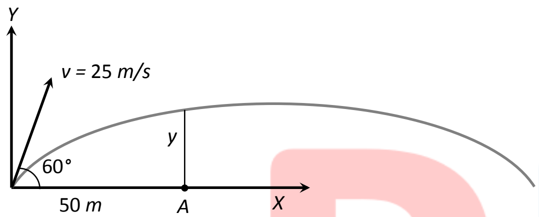
9 **(a)**

Horizontal component of velocity

$v_x = 25 \cos 60° = 12.5\ m/s$

Vertical component of velocity

$v_y = 25 \sin 60° = 12.5\sqrt{3}\ m/s$



Tim to over 50 m distance $t = \frac{50}{12.5} = 4\ sec$

The vertical height y is given by

$y = v_y t - \frac{1}{2}gt^2 = 12.5\sqrt{3} \times 4 - \frac{1}{2} \times 9.8 \times 16 = 8.2\ m$

10 **(c)**

For water not to spill out of the bucket,

$v_{\min} = \sqrt{5gR}$ (at the lowest point)

$= \sqrt{5 \times 10 \times 0.5 = 5\ \text{ms}^{-1}}$

11 **(b)**

Here, $m = 5$ kg,$r = 2$m,$v = 6$ ms^{-1}

The tension is maximum at the lowest point

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

$= 5 \times 9.8 + \frac{5 \times 6 \times 6}{2}$

$= 139$N

12 **(a)**

As the body just completes the circular path, hence critical speed at the highest point.

$v_H = \sqrt{gR}$

which is totally horizontal.

As the string breaks at the highest point, hence form here onwards the body will follow parabolic path. Time taken by the body to reach the ground

$t=\sqrt{\frac{2h}{g}}=\sqrt{\frac{2\times 2R}{g}}$

Hence, horizontal distance covered by the body

$=v_H\times t$

$=\sqrt{gR}\times\sqrt{\frac{4R}{g}}=2R$

13 **(d)**

$v=\sqrt{\mu rg}=\sqrt{0.25\times 40\times 10}=10\ m/s$

14 **(c)**

$\alpha=\frac{\omega}{t}$ and $\omega=\frac{\theta}{t}$

$\therefore\ \alpha=\frac{\theta}{t^2}$

But $\alpha=$ constant

So, $\frac{\theta_1}{\theta_1+\theta_2}=\frac{(2)^2}{(2+2)^2}$

or $\frac{\theta_1}{\theta_1+\theta_2}=\frac{1}{4}$

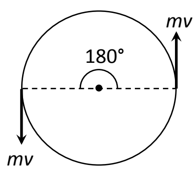
or $\frac{\theta_1+\theta_2}{\theta_1}=\frac{4}{1}$

or $1+\frac{\theta_2}{\theta_1}=\frac{4}{1}$

$\therefore\ \frac{\theta_2}{\theta_1}=3$

15 **(d)**

As momentum is vector quantity



$\therefore$ change in momentum

$\Delta P=2mv\sin(\theta/2)$

$=2mv\sin(90)=2mv$

But kinetic energy remains always constant so change in kinetic energy is zero

16 **(a)**

The shape of free surface of water is parabolic, because of difference in centrifugal force ($F=mr\omega^2$, which is proportional to r)

17 **(d)**

$\vec{A}=\hat{i}+\hat{j}+\hat{k};A=\sqrt{1^2+1^2+1^2}=\sqrt{3}$

$\cos\theta=\frac{\vec{A}.\hat{i}}{\sqrt{3}}=\frac{1}{\sqrt{3}}=\frac{\sqrt{3}}{3}$

$=\frac{1.732}{3}=0.5773=\cos 54°44'$

$\theta=54°44'$

18 **(d)**

For body to move on circular path. Frictional force provides the necessary centripetal force,

ie, frictional force = centripetal force

or $\mu mg = \frac{mv_0^2}{r} = mr\omega^2$

or $\mu g = r\omega^2$

$\therefore$ $0.5 \times 9.8 = 10\ \omega^2$

or $\omega = 0.7$ rad s^{-1}

19 **(d)**

Horizontal range, $R = \frac{u^2 \sin^2 45°}{2g} = \frac{u^2}{g}$

Maximum height, $H = \frac{u^2 \sin^2 45°}{g} = \frac{u^2}{4g}$

$\therefore$ $\frac{R}{H} = \frac{4}{1}$

20 **(a)**

Because the reaction on inner wheel decreases and becomes zero. So it leaves the ground first

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