DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH | **Solutions** | **SUBJECT : PHYSICS**
DATE : | | **DPP NO. : 1**

Topic :- MOTION IN A PLANE

1 **(d)**

Given, $x = 0.20$ m, $y = 0.20$ m, $u = 1.8$ms^{-1}

Let the ball strike the nth step of stairs,

Vertical distance travelled

$$= ny = n \times 0.20 = \frac{1}{2} g t^2$$

Horizontal distance travelled, $nx = ut$

or $t = \frac{nx}{u}$

$$\therefore ny = \frac{1}{2} g \times \frac{n^2 x^2}{u^2}$$

or $n = \frac{2u^2}{g} \frac{y}{x^2} = \frac{2 \times (1.8)^2 \times 0.20}{9.8 \times (0.20)^2}$

$= 3.3 = 4$

2 **(d)**

Work done in circular motion is always zero

4 **(a)**

The cord is most likely to break at the orientation, when mass is at B as tension in the string at this point is maximum

5 **(a)**

$$\frac{T_{\max}}{T_{\min}} = \frac{\frac{mv^2}{L} + mg}{\frac{mv^2}{L} - mg} = 2 \quad ...(i)$$

Simplifying Eq. (i), we get,

$$v_H = \sqrt{3gL} = \sqrt{\frac{3 \times 10 \times 10}{3}} = 10 \text{ ms}^{-1}$$

6 **(a)**

Here, $\vec{v}_1$=30km h^{-1} due north $= \overrightarrow{OA}$

$\vec{v}_2 = 40$kmh^{-1} due east $= \overrightarrow{OB}$

Change in velocity in 20 s

$\Delta\vec{v} = \overrightarrow{v_2} - \overrightarrow{v_1} = \overrightarrow{v_2} + \overrightarrow{(-v_1)}$

$= \overrightarrow{OB} + \overrightarrow{OC} = \overrightarrow{OD}$

$|\Delta\vec{v}| = \sqrt{v_2^2 + v_1^2} = \sqrt{40^2 + 30^2}$

$= 50$ kmh^{-1}

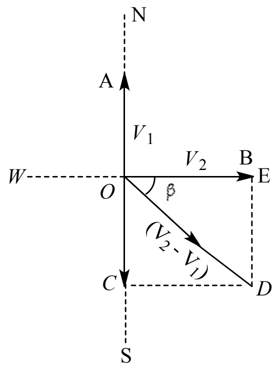
Acceleration , $\vec{a} = \frac{|\Delta \vec{v}|}{\Delta t}$

$= \frac{50}{20} = 2.5$ kmh^{-2}

Tan $\beta = \frac{v_1}{v_2} = \frac{30}{40}$

$= 0.75 = \tan 37°$

$\therefore\ \beta = 37°$ north of east



7 **(b)**

Maximum horizontal range = 80 m

$\because\ \theta = 45°$ m

$\therefore\ \frac{u^2}{g} = 80$ m

Maximum height, $h = \frac{u^2 \sin^2\theta}{2g}$

$= \frac{80}{2}(\sin^2 45°) = 20$ m

8 **(c)**

If v is velocity of the bob on reaching the lowest point, then $\frac{1}{2}mv^2 = mgL$

To void breaking, strength of the string

$T_L = \frac{mv^2}{L} + mg = \frac{2mg\,L}{L} + mg = 3\,mg$

10 **(c)**

When a force of constant magnitude acts on velocity of particle perpendicularly, then there is no change in the kinetic energy of particle.

Hence, kinetic energy remains constant.

11 **(c)**

Due to constant velocity along horizontal and vertical downward force of gravity stone will hit the ground following parabolic path

12 **(d)**

$\theta = \tan^{-1}\left(\frac{v^2}{rg}\right) = \tan^{-1}\left[\frac{(14\sqrt{3})^2}{20\sqrt{3}\times 9.8}\right] = \tan^{-1}[\sqrt{3}] = 60^o$

13 **(b)**

The two angles of projection are clearly θ and (90° − θ)

$T_1 = \frac{2v\sin\theta}{g}$ and $T_2 = \frac{2v\sin(90° - \theta)}{g}$

$T_1T_2 = \frac{2(v)^2(2\sin\theta\cos\theta)}{g\times g} = \frac{2R}{g}$

14 **(b)**

Computing the given equation with

$y = x\tan\theta - \frac{gx^2}{2v^2\cos^2\theta}$, we get

$\tan\theta = \sqrt{3}$

15 **(d)**

Angle made by the cyclist with vertical is given by

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

$\therefore \theta = \tan^{-1}\left(\frac{10\times 10}{80\times 10}\right)\left(\because v = 36\times\frac{5}{18} = 10\text{ ms}^{-1}\right)$

$= \tan^{-1}\left(\frac{1}{8}\right)$

16 **(b)**

Let x be increase in length of the spring. The particle would move in a circular path of radius $(l + x)$. Centripetal force = force due to the spring

$m(l + x)\omega^2 = kx$

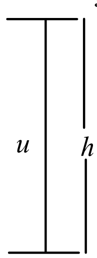
$\therefore x = \frac{m\omega^2 l}{k - m\omega^2}$

17 **(c)**

$h = \frac{u^2}{2g} \Rightarrow u^2 = 2gh$

Maximum horizontal distance

$R_{max} = \frac{u^2}{g}$



$R_{max} = 2h$

18 **(d)**

$\omega = \sqrt{\frac{g}{r}} = \sqrt{\frac{9.8}{0.2}} = 7 rad/s$

19 **(a)**

Minimum tension $T_1 = \frac{mv^2}{r} - mg$

Maximum tension $T_2 = \frac{mv^2}{r} + mg$

Let $\frac{mv^2}{r} = x$

So, $T_1 = x - mg$ ...(i)

$T_2 = x + mg$ ...(ii)

Diving Eq. (i) by Eq. (ii)

$\frac{T_1}{T_2} = \frac{x - mg}{x + mg} \quad \left(\because \text{Given} \frac{T_1}{T_2} = \frac{3}{5}\right)$

$\therefore \frac{3}{5} = \frac{x - mg}{x + mg}$

or $3x + 3mg = 5x - 5mg$

or $x = 4\,mg$

ie, $\frac{mv^2}{r} = 4mg$

$\therefore \quad v^2 = 4\,rg$

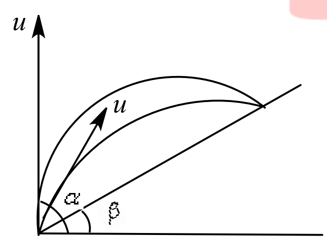
or $v = \sqrt{4rg}$

or $v = \sqrt{4 \times 2.5 \times 9.8}$

$v = \sqrt{98}\ \text{ms}^{-1}$

20 **(d)**

Let α'' be the angle of projection of the second body



$R = \frac{u^2}{g \cos \beta}[\sin(2\alpha - \beta)]$

Range of both the bodies is same. Therefore,

$\sin(2\alpha - \beta) = \sin(2\alpha'' - \beta)$

or $2\alpha'' - \beta = \pi - (2\alpha - \beta)$

$\alpha'' = \frac{\pi}{2} - (\alpha - \beta)$

Now, $T = \frac{2u \sin(\alpha - \beta)}{g \cos \beta}$ and $T'' = \frac{2u \sin(\alpha'' - \beta)}{g \cos \beta}$

$\therefore \frac{T}{T''} = \frac{\sin(\alpha - \beta)}{\sin(\alpha'' - \beta)} = \frac{\sin(\alpha - \beta)}{\sin\left\{\frac{\pi}{2} - (\alpha - \beta) - \beta\right\}}$

$$= \frac{\sin(\alpha - \beta)}{\sin\left(\frac{\pi}{2} - \alpha\right)} = \frac{\sin(\alpha - \beta)}{\cos \alpha}$$

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