DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 10

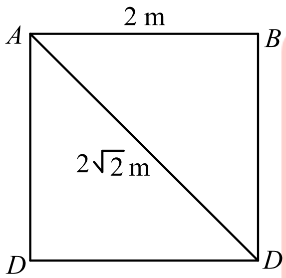
Topic :- MOTION IN A PLANE

1 **(d)**

Displacement is distance from initial to final position In 40s cyclist completes =1 round

$\therefore$ In 3 min(180 s) cyclist will complete = $4\frac{1}{2}$ round Displacement for 4 round is zero.

Displacement for $\frac{l}{2}$ round = length of diagonal = $2\sqrt{2}$m.



2 **(d)**

$B_x = 10 - 6 = 4$ and $B_y = 9 - 6 = 3$

so, $B = (B_x^2 + B_y^2)^{1/2} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9}$

$= \sqrt{25} = 5$

3 **(a)**

$(2\hat{i} - 3\hat{j} + \hat{k}).(3\hat{i} + 3\hat{j}) = 6(\hat{i}.\hat{i}) - 6(\hat{j}.\hat{j}) = 0$

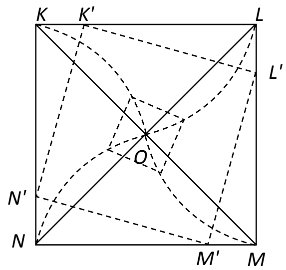
4 **(c)**

$\omega = \frac{d\theta}{dt} = \frac{d}{dt}(2t^3 + 0.5) = 6t^2$

At $t = 2\ s, \omega = 6 \times (2)^2 = 24\ rad/s$

5 **(a)**

It is obvious from considerations of symmetry that at any moment of time all of time all of the persons will be at the corners of square whose side gradually decreases (see fig.) and so they will finally meet at the centre of the square O



The speed of each person along the line joining his initial position and O will be $v\cos 45 = v/\sqrt{2}$

As each person has displacement $d\cos 45 = d/\sqrt{2}$ to reach the centre, the four persons will meet at the centre of the square O after time

$$\therefore t = \frac{d/\sqrt{2}}{v/\sqrt{2}} = \frac{d}{v}$$

6 **(a)**

From $\mathrm{h} = \frac{1}{2}\mathrm{g}t^2$

We have $t_{OB} = \sqrt{\frac{2\mathrm{h}_{OA}}{\mathrm{g}}}$

$$= \sqrt{\frac{2 \times 1960}{9.8}} = 20\mathrm{s}$$

Horizontal distance $AB = vt_{\mathrm{OB}}$

$$= \left(600 \times \frac{5}{18}\right)(20)$$

$$= 3333.33\ \mathrm{m} = 3.33\ \mathrm{km}$$

7 **(a)**

Here, $r = 92$ m, $v = 26\ \mathrm{ms}^{-1}, \mu = ?$

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

$$\mu = \frac{v^2}{r\mathrm{g}} = \frac{26 \times 26}{92 \times 9.8} = 0.75$$

8 **(c)**

$$\frac{u_x}{u_y} = \cot 30° = \sqrt{3} \therefore u_x = 80\sqrt{3}\ \mathrm{ms}^{-1}$$

$$T = \frac{2u_y}{\mathrm{g}} = \frac{2 \times 80}{10} = 16\ \mathrm{s}$$

At $t = \frac{T}{4} = 4\ s, v_x = 80\sqrt{3}\ \mathrm{ms}^{-1}$

$v_y = 80 - 10 \times 4 = 40\ \mathrm{ms}^{-1}$

$$\therefore 0\ v = \sqrt{(80\sqrt{3})^2 + (40)^2} = 140\ \mathrm{ms}^{-1}$$

9 **(b)**

Due to air resistance, it's horizontal velocity will decrease so it will fall behind the aeroplane

10 **(d)**

$v\cos\theta = 10\cos 60° = 5\ \text{ms}^{-1}$

11 **(c)**

$v = \sqrt{\mu rg} = \sqrt{0.25 \times 80 \times 9.8} = 14\ \text{ms}^{-1}$

12 **(b)**

$\text{Tan } 45° = \frac{2\sin60°}{a + 2\cos60°} = \frac{\sqrt{3}}{a+1}$

$1 = \frac{\sqrt{3}}{a+1}$

or $a + 1 = \sqrt{3}$

$a = \sqrt{3} - 1$

13 **(a)**

$|\overrightarrow{\Delta v}| = 2v\sin(\theta/2) = 2v\sin\left(\frac{90}{2}\right) = 2v\sin 45 = v\sqrt{2}$

14 **(b)**

$T_{\text{top}} = \frac{mv^2}{r} - mg$ ...(i)

$T_{\text{bottom}} = \frac{mv^2}{r} + mg$ ...(ii)

$$\frac{T_{\text{top}}}{T_{\text{bottom}}} = \frac{\frac{v^2}{r} - g}{\frac{v^2}{r} + g} = \frac{\frac{40 \times 40}{4} - 10}{\frac{40 \times 40}{4} + 10}$$

$$= \frac{400 - 10}{400 + 10} = \frac{390}{410} = \frac{39}{41}$$

15 **(b)**

Let $\hat{A} + \hat{B} = \hat{R}$ then using parallelogram law of vectors we have

$1 = (1^2 + 1^2 + 2.1.1\cos\theta)^{1/2}$

or $1 = 2(1 + \cos\theta)$

or $\frac{1}{2} - 1 = \cos\theta$

or $\cos\theta = -\frac{1}{2} = \cos120°$

or $\theta = 120°$

$\therefore |\hat{A} - \hat{B}| = |\hat{A} + (-\hat{B})|$.

Now the angle between $\hat{A}$ and $-\hat{B}$ is 60°

The resultant of $|\hat{A} + (-\hat{B})|$

$(1^2 + 1^2 + 2 \times 1 \times 1 \times \cos60°)^{1/2}$

$= \sqrt{3}$

16 **(d)**

We know that if two stones have same horizontal range, then this implies that both are projected at θ and $90° - \theta$.

Given, $\theta = \frac{\pi}{3} = 60°$

$\therefore 90° - \theta = 90° - 60° = 30°$

For first stone,

Maximum height $= 102 = \frac{u^2 \sin^2 60°}{2g}$

For second stone,

Maximum height, $h = \frac{u^2 \sin^2 30°}{2g}$

$\therefore \frac{h}{102} = \frac{\sin^2 30°}{\sin^2 60°} = \frac{(1/2)^2}{(\sqrt{3}/2)^2}$

or $h = 102 \times \frac{1/4}{3/4} = 34$ m

17 **(b)**

$\vec{L} = \vec{r} \times m\vec{v} = H\, mv\cos\theta = \frac{v\sin^2\theta}{2g} mv\cos\theta = \frac{mv^3}{4\sqrt{2}g}$

18 **(a)**

As $S = t^3 + 5$

$\frac{ds}{dt} = 3t^2 = v$

$\therefore a_t = \frac{dv}{dt} = 6t$

at $t = 2\, sec$

$|\vec{a}| = \sqrt{a_c^2 + a_t^2}$

$= \sqrt{\left(\frac{v^2}{R}\right)^2 + a_t^2} = \sqrt{\left(\frac{4t^4}{R}\right)^2 + \left(\frac{dv}{dt}\right)^2}$

$= \sqrt{(7.2)^2 + 144}$

$|\vec{a}| = 14 m/s^2$

19 **(c)**

$\frac{v^2}{g} = 100$ or $v^2 = 100$ g

$h_{max.} = \frac{v^2}{2g} = \frac{100g}{2g} = 50m$

20 **(b)**

In going from C to A, potential energy lost = potential energy gained in going from A to B
For looping the loop, minimum velocity required at B is $\sqrt{gR}$. This must be the velocity of push down initially from C

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