DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 7

Topic :- MOTION IN A PLANE

1 **(c)**

$a_T = \frac{dv}{dt} = \frac{d}{dt}(2t) = 2m/s^2$

$a_c = \frac{V^2}{r} = \frac{(2 \times 3)^2}{30 \times 10^{-2}} = 120\ m/s^2$

2 **(d)**

Let $\vec{\mathbf{u}}_1$ and $\vec{\mathbf{u}}_2$ be the initial velocities of the two particles and θ_1 and θ_2 be their angles of projection with the horizontal

The velocities of the two particles after time t are,

$\vec{\mathbf{v}}_1 = (u_1 \cos\theta_1)\hat{\mathbf{i}} + (u_1 \sin\theta_1 - gt)\hat{\mathbf{j}}$ and

$\vec{\mathbf{v}}_1 = (u_1 \cos\theta_1)\hat{\mathbf{i}} + (u_2 \sin\theta_2 - gt)\hat{\mathbf{j}}$

Their relative velocity is $\vec{\mathbf{v}}_{12} = \vec{\mathbf{v}}_1 - \vec{\mathbf{v}}_2$

$= (u_1 \cos\theta_1 - u_2 \cos\theta_1)\hat{\mathbf{i}} + (u_1 \sin\theta_1 - u_2 \sin\theta_2)\hat{\mathbf{j}}$

Which is a constant. So the path followed by one, as seen by the other is a straight line, making a constant angle with the horizontal

3 **(c)**

Centripetal force is provided by friction, so

$\frac{mv^2}{r} < f_L\ ie, \frac{mv^2}{r} < \mu mg$

$i.e, \quad v < \sqrt{\mu gr}$ so that, $v_{\max} = \sqrt{\mu gr}$

Here, $\mu = 0.4, r = 30\text{m}$ and $g = 10\text{ms}^{-2}$

$\therefore \quad v_{\max} = \sqrt{0.4 \times 30 \times 10} = 11\text{m/s}$

4 **(c)**

$P + Q = 16$ (i)

$P^2 + Q^2 + 2PQ\cos\theta = 64$ (ii)

$\tan 90° = \frac{Q\sin\theta}{P + Q\cos\theta}$

$\infty = \frac{Q\sin\theta}{P + Q\cos\theta}$

$\Rightarrow \quad P + Q\cos\theta = 0 \quad \text{or} \quad Q\cos\theta = -P$

From Eq. (ii)

$P^2 + Q^2 + 2P(-P) = 64$ or $Q^2 - P^2 = 64$

or $(Q - P)(Q + P) = 64$

or $Q - P = \frac{64}{16} = 4$ (iii)

Adding Eq. (i) and (iii), we get

$2Q = 20$ or $Q = 10$ units

From (i), $P + 10 = 16$ or $P = 6$ units

5 **(c)**

Let A and B be the two forces. As per question

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

or $A^2 + B^2 = 25$ (i)

and $A^2 + B^2 + 2AB\cos 120° = 13$

or $25 + 2AB \times (-1/2) = 13$

or $AB = 25 - 13 = 12$

or $2AB = 24$ (ii)

Solving (i) and (ii), we get

$A = 3\text{N}$

and $B = 4\text{ N}$

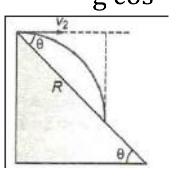
6 **(a)**

Range of the projectile on an inclined plane (down the plane) is,

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

Here, $u = v_0, \alpha = 0$ and $\beta = \theta$

$$\therefore R = \frac{2v_0^2 \sin\theta}{g\cos^2\theta}$$



Now $x = R\cos\theta = \frac{2v_0^2 \tan\theta}{g}$

and $y = -R\sin\theta = -\frac{2v_0^2 \tan^2\theta}{g}$

7 **(c)**

The result follows from the definition of cross product.

8 **(d)**

Maximum height attained is given by

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

Given, $u = 20\text{ms}^{-1}$

$$h_{max} = \frac{(20)^2}{2 \times 10} = 20\text{m}$$

For the second body also $h_{max} = 20\text{m}$

$\therefore$ Sum of maximum height = 20m+20m=40m

9 **(a)**

$$\frac{a_R}{a_r} = \frac{\omega_{R\times R}^2}{\omega_r^2 \times r} = \frac{T_r^2}{T_R^2} \times \frac{R}{r} = \frac{R}{r} [As\, T_r = T_R]$$

10 **(b)**

$v = r\omega = 20 \times 10 cm/s$=$2m/s$

11 **(d)**

Tension at the top of the circle

$T = m\omega^2 r$ - mg

$T = 0.4 \times 4\pi^2 n^2 \times 2 - 0.4 \times 9.8$

$= 115.86$ N

12 **(c)**

$x = 20 \times 5 = 100$m

$y = \frac{1}{2} \times 10 \times 5 \times 5 = 125$m

$r = \sqrt{100^2 + 125^2} = 160$m

13 **(a)**

Initial angular velocity $\omega_0 = 0$. Final angular velocity $\omega = \frac{v}{r} = \frac{80}{(20/\pi)} = 4\pi$ rad s^{-1}

angle described, $\theta = 4\pi$ rad

$\therefore$ Angular acceleration, $\alpha = \frac{\omega^2 - \omega_0^2}{2\theta}$

$= \frac{(4\pi)^2 - 0}{2 \times 4\pi} = 2\pi$ rad s^{-2}

Linear acceleration, $a = \alpha r$

$= 2\pi \times \frac{20}{\pi} = 40$ ms^{-2}

14 **(b)**

Maximum height $H = \frac{v^2 \cos^2\beta}{2g}$

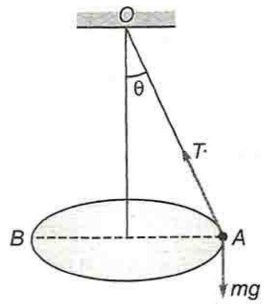
or $v\cos\beta = \sqrt{2gH}$

$t = \frac{v\cos\beta}{g} = \frac{\sqrt{2gH}}{g}$

$t = \sqrt{\frac{2H}{g}}$

15 **(d)**

In figure, $\sin 30° = \frac{AB}{OA}$



or $OA = \frac{AB}{\sin 30°} = \frac{4}{1/2} = 8\text{m}$

$\frac{T}{AO} = \frac{F}{AB} = \frac{mg}{OB}$

$F = \frac{AO}{AB} \times F = \frac{AO}{AB}\frac{mv^2}{r} = \frac{8}{4} \times 10 \times \frac{5^2}{4} \approx 125\text{ N}$

16 **(b)**

If any two vectors are parallel or equal, then the scalar triple product is zero.

17 **(c)**

The body crosses the top most position of a vertical circle with critical velocity, so the velocity at the lowest point of vertical circle $u = \sqrt{5gr}$

Velocity of the body when string is horizontal is

$v^2 = u^2 - 2gr = 5gr - 2gr = 3gr$

$\therefore$ Centripetal acceleration $= \frac{v^2}{r} = \frac{3gr}{r} = 3\text{g}$

18 **(a)**

To avoid slipping friction force

$F = \frac{mv^2}{r}$

$F = \frac{2000 \times 10 \times 10}{20} = 10^4\text{ N}$

19 **(a)**

Let $\vec{A} + \vec{B} = \vec{R}$. Given $A_x = 7$ and $A_y = 6$

Also $R_x = 11$ and $R_y = 9$. Therefore,

$B_x = R_x - A_x = 11 - 7 = 4$

and $B_y = R_y - A_y = 9 - 6 = 3$

Hence, $B = \sqrt{B_x^2 + B_y^2} = \sqrt{4^2 + 3^2} = 5$

20 **(c)**

Instantaneous velocity of rising mass after t sec will be

$v_t = \sqrt{v_x^2 + v_y^2}$

Where $v_x = v\cos\theta$ = Horizontal component of velocity

$v_y = v\sin\theta - gt$ = Vertical component of velocity

$v_t = \sqrt{(v\cos\theta)^2 + (v\sin\theta - gt)^2}$

$v_t = \sqrt{v^2 + g^2t^2 - 2v\sin\theta\ gt}$

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