DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 8

Topic :- MOTION IN A PLANE

1 **(b)**

Net acceleration in nonuniform circular motion,

$a=\sqrt{a_t^2+a_c^2}=\sqrt{(2)^2+\left(\frac{900}{500}\right)^2}=2.7\ m/s^2$

$a_t=$ tangential acceleration

$a_c=$ centripetal acceleration $=\frac{v^2}{r}$

2 **(d)**

$v_x=\frac{dx}{dt}=2ct$ and $v_y=\frac{dy}{dt}=2bt$

$\therefore v=\sqrt{v_x^2+v_y^2}=2t(c^2+b^2)^{1/2}$

3 **(d)**

Tension at mean position, $mg+\frac{mv^2}{l}=3mg$

$v=\sqrt{2gl}$

And if the body displaces by angle θ with the vertical

Then $v=\sqrt{2gl(1-\cos\theta)}$

Comparing (i) and (ii), $\cos\theta=0 \Rightarrow \theta=90^\circ$

4 **(b)**

$\mathrm{h}=(u\sin\theta)t-\frac{1}{2}\mathrm{g}t^2$

$d=(u\cos\theta)t$ or $t=\frac{d}{u\cos\theta}$

$\mathrm{h}=u\sin\theta\cdot\frac{d}{u\cos\theta}-\frac{1}{2}\mathrm{g}.\frac{d^2}{u^2\cos^2\theta}$

$u=\frac{d}{\cos\theta}\sqrt{\frac{\mathrm{g}}{2(d\tan\theta-\mathrm{h})}}$

5 **(c)**

Resultant acceleration

$=\sqrt{\begin{pmatrix}\text{tangential}\\ \text{acceleration}\end{pmatrix}^2+\begin{pmatrix}\text{centripetal}\\ \text{acceleration}\end{pmatrix}^2}$

$$= \sqrt{a^2 + \left(\frac{v^2}{r}\right)^2} = \sqrt{\frac{v^4}{r^2} + a^2}$$

6 **(d)**

$a_c = k^2rt^4 = \frac{v^2}{r}$ or $v = krt^2$

The tangential acceleration is $a_T = \frac{dv}{dt} = 2krt$

The tangential force on the particle, $F_T = ma_T = 2mkrt$

Power delivered to the particle

$= F_T = ma_T = 2mkrt = F_Tv = (2mkrt)(krt)^2 = 2mk^2r^2t^3$

7 **(c)**

Tension, $T = \frac{mv^2}{r} + mg\cos\theta$

For, $\theta = 30°, T_1 = \frac{mv^2}{r} + mg\cos 30°$

$\theta = 60°, T_2 = \frac{mv^2}{r} + mg\cos 60°$ $\therefore T_1 > T_2$

8 **(c)**

Here, $r = 300$ m, $\mu = 0.3$, $g = 10$ ms^{-2}

$v_{\max} = \sqrt{\mu rg} = \sqrt{0.3 \times 300 \times 10} = 30$ ms^{-1}

$= 30 \times \frac{18}{5}$ km h^{-1} $= 108$ km h^{-1}

9 **(c)**

Let v be the velocity of projection and θ the angle of projection

Kinetic energy at highest point

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

Potential energy at highest point

$= E_k - E_k\cos^2\theta = E_k(1 - \cos^2\theta) = E_k\sin^2\theta$

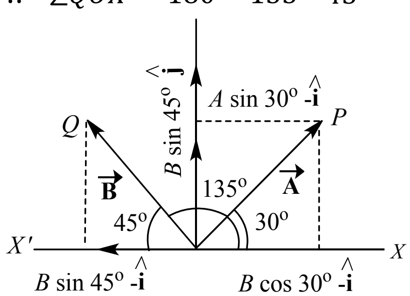
10 **(a)**

Here $\vec{A} - \overrightarrow{OP} = 10$ units along OP

$\vec{B} - (\overrightarrow{OQ}) = 10$ units along OQ

$\therefore$ $\angle XOP = 30°$ and $\angle XOQ = 135°$

$\therefore$ $\angle QOX' = 180° - 135° = 45°$



Resolving $\vec{A}$ and $\vec{B}$ into two rectangular components we have $A\cos 30°$ along OX and $A\sin 30°$ along OY. $B\cos 45°$ along OX' and $B\sin 45°$ along OY'.

Resultant component force along X-axis.
$(A\cos 30° - B\sin 45)\hat{i}$
$= (10 \times \sqrt{3}/2 - 10 \times 1/\sqrt{2})\hat{i} = 1.59\hat{i}$
Resultant component force along Y-axis
$= (A\sin 30° + B\sin 45°)\hat{j}$
$= (10 \times 1/2 + 10 \times 1/\sqrt{2})\hat{j} = 12.07\hat{j}$

11 **(a)**

The angle of banking, $\tan\theta = \frac{v^2}{rg}$

$\Rightarrow \tan 12^o = \frac{(150)^2}{r \times 10} \Rightarrow r = 10.6 \times 10^3 m = 10.6\ km$

12 **(c)**

$\vec{A} + \vec{B} = \vec{C}$ (given)
So, it is given that $\vec{C}$ is the resultant of $\vec{A}$ and $\vec{B}$
$\therefore \quad C^2 = A^2 + B^2 + 2AB\cos\theta$
$3^2 = 3 + 3 + 2 \times 3 \times \cos\theta$
$3 = 6\cos\theta$ or $\cos\theta = \frac{1}{2} \quad \Rightarrow \theta\ 60°$

13 **(a)**

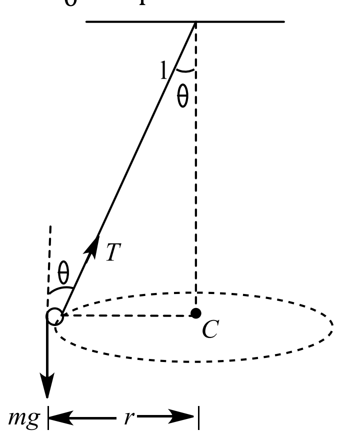
At the highest point, velocity is horizontal

14 **(a)**

$\vec{A} \cdot \vec{B} = 0 \Rightarrow \vec{A} \perp \vec{B}$
Now, $\vec{A} \times \vec{B} = \vec{1}$ or $AB\sin\theta = 1$
$AB\sin 90° = 1$ or $AB = 1 \Rightarrow A = 1$ and $B = 1$
So, $\vec{A}$ and $\vec{B}$ are perpendicular unit vectors.

15 **(d)**

$T\cos\theta$ component will cancel mg.



$T\sin\theta$ Component will provide necessary centripetal force the ball towards center C.
$\therefore T\sin\theta = mr\omega^2 = m(l\sin\theta)\omega^2$
or $T = ml\omega^2 \Rightarrow \omega = \sqrt{\frac{T}{ml}}$ rad/s

or $\omega_{max} = \sqrt{\frac{T_{max}}{ml}} = \sqrt{\frac{324}{0.5 \times 0.5}} = 36 \text{ rad/s}$

16 **(c)**

Here, $v_{max} = ?, r = 18$ m, $g = 10$ ms^{-2}

$\mu = 0.2$

$\frac{mv_{max}^2}{r} = F = \mu R = \mu mg$

$v_{max} = \sqrt{\mu rg} = \sqrt{0.2 \times 18 \times 10} = 6$ ms^{-1}

$= 6 \times \frac{18}{5}$ km h^{-1} = 21.6 km h^{-1}

17 **(b)**

$v = \sqrt{5gR}$

When $R' = \frac{R}{4}$

$v' = \sqrt{5gR'} = \sqrt{5gR/4} = \frac{1}{2}\sqrt{5gR} = \frac{1}{2}v$

18 **(b)**

Given, $R = H$

$\frac{u^2 \sin 2\alpha}{g} = \frac{u^2 \sin^2 \alpha}{2g}$

or $2\sin\alpha \cos\alpha = \frac{\sin^2\alpha}{2}$

or $\frac{\sin\alpha}{\cos\alpha} = 4$ or $\tan\alpha = 4$

$\therefore \ a = \tan^{-1}(4)$

19 **(b)**

$T \sin\theta = mr\omega^2 = m(l \sin\theta)\omega^2$

or $T = ml\omega^2 = ml\left(2\pi \times \frac{2}{\pi}\right)^2 = 16ml$

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