Dear student following is a Moderate level [O O ● O O] test paper. Score of 12 Marks in 10 Minutes would be a satisfactory performance. Questions 1-9 (+3, –1). (All Questions have Single Options correct)

Q.1 A ball is projected upwards. Its acceleration at the highest point is :
(A) zero
(B) directed upwards
(C) directed downwards
(D) such as cannot be predicted.

Q.2 The projectile has the maximum value of the time of flight when the angle of projection is
(A) 90º (B) 60º
(C) 45º (D) 30º

Q.3 A particle is moving alnog a circular path with uniform speed. What is the angle between its instantaneous velocity and acceleration?
(A) 0º (B) 45º
(C) 90º (D) 180º

Q.4 A sphere of mass 0.2 kg is attached to an inextensible string of length 0.5 m whose upper end is fixed to the ceiling. The sphere is made to describe a horizontal circle of radius 0.3 m. The speed of the sphere will be
(A) 1.5 ms^{-1} (B) 2.5 ms^{-1}
(C) 3.2 ms^{-1} (D) 4.7 ms^{-1}

Q.5 A body is projected downwards at an angle of 30º to the horizontal with a velocity of 9.8 ms^{-1} from the top of a tower 29.4 m high. How long will it take before striking the ground ?
(A) 1s (B) 2s (C) 3s (D) 4s

Q.6 A body of mass m tied at the end of a string of length ℓ is projected with velocity $\sqrt{4g\ell}$. At what height will it leave the circular path
(A) $\frac{5}{3}\ell$ (B) $\frac{5}{4}\ell$
(C) $\frac{5}{2}\ell$ (D) $\frac{4}{3}\ell$

Q.7 A ball is projected with a velocity V_0 at an angle θ from a point of projection, then :
(A) Its velocity is normal to the initial velocity of projection at $t = \frac{V_0}{g\sin\alpha}$ for $0 < \theta \le \frac{\pi}{2}$
(B) Its velocity is normal to the initial velocity of projection at $t = \frac{V_0}{g\sin\alpha}$ for $0 < \theta \le \frac{\pi}{4}$
(C) Its velocity is normal to the initial velocity of projection at $t = \frac{V_0}{g\sin\alpha}$ for $\frac{\pi}{4} \le \theta \le \frac{\pi}{2}$
(D) Its velocity is normal to the initial velocity of projection at $t = \frac{V_0}{g\sin\alpha}$ for all values of θ

The following questions consist of two statements one labelled Assertion (A) and the another labelled Reason (R). Select the correct answers to these questions from the codes given below :
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not correct explanation of A
(C) A is true but R is false
(D) A is false but R is true.

Q.8 **Assertion** : The maximum range along the inclined plane, when thrown downwards is greater than that when thrown upwards along the inclined plane.
Reason : The maximum range along the inclined plane is independent of angle of inclination.

Q.9 **Assertion** : A particle is moving on a circular path with angular velocity $\omega = \omega_0 - a\theta$ where θ is the angular displacement then angular displacement (θ) exponentially increases with time.
Reason : Angular velocity increases with time linearly.

PHYSICS IIT JEE (JUNE 4th WEEK CLASS TEST 4) (TWO-D-MOTION) ANSWER KEY

Name : ..... **Roll No. :** .....

	A	B	C	D		A	B	C	D		A	B	C	D
1	○	○	○	○	4	○	○	○	○	7	○	○	○	○
2	○	○	○	○	5	○	○	○	○	8	○	○	○	○
3	○	○	○	○	6	○	○	○	○	9	○	○	○	○

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9
Ans.	C	A	C	A	B	A	C	C	A

SOLUTIONS

Sol.1 (C)

The acceleration is g every where during the motion.

Sol.2 (A)

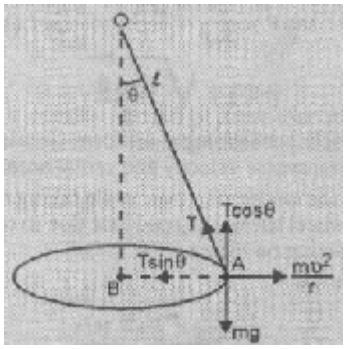
$T = 2u \sin\theta/g$.

T is maximum, when $\sin\theta$ is maximum.

Sol.3 (C)

Acceleration is directed along the radius and velocity is tangential to the path.

Sol.4 (A)



In fig.,

$T \sin\theta = \frac{mv^2}{r}$;

$T \cos\theta = mg$;

so $\tan\theta = \frac{v^2}{rg} = \frac{r}{\sqrt{\ell^2 - r^2}}$

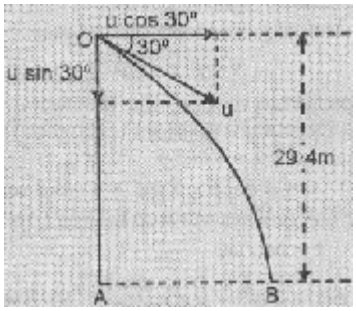
$\therefore \quad v = \left[\frac{r^2 g}{(\ell^2 - r^2)^{1/2}}\right]^{1/2} = \left[\frac{0.9 \times 10}{(0.25 - 0.09)^{1/2}}\right]^{1/2}$

$= 1.5$ m/s.

Sol.5 (B)

Initial velocity downward velocity of object

at O = $u \sin 30^o = 9.8 \times \frac{1}{2} = 4.9$ m/s



Taking vertical downward motion of object from O to B, we have

$u = 4.9$ m/s, $a = 9.8$ m/s^2, $s = 29.4$ m, $t = ?$

As, $s = ut + \frac{1}{2}at^2$

$\therefore \quad 29.4 = 4.9 \times t + \frac{1}{2} \times 9.8t^2$

or $4.9t^2 + 4.9t - 29.4 = 0$

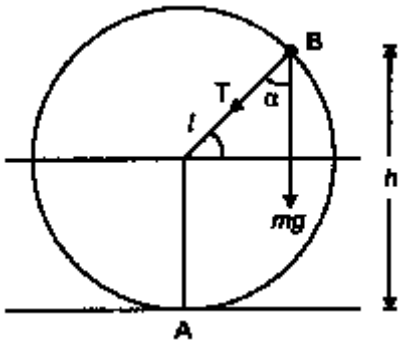
or $t^2 + t - 6 = 0$

or $t^2 + 3t - 2t - 6 = 0$

or $(t + 3)(t - 2) = 0$

i.e. $t = 2$ or -3s

Sol.6 (A)



$\frac{mV_B^2}{\ell} = T + mg\cos\alpha$

On leaving the circle $T = 0$

$V_B^2 = g\ell\cos\alpha \qquad ....(1)$

$\frac{1}{2}mV_A^2 + 0 = \frac{1}{2}mV_B^2 + mg(\ell + \ell\cos\alpha)$

$V_A^2 = V_B^2 + 2g\ell(1 + \cos\alpha)$

$4g\ell = g\ell\cos\alpha + 2g\ell + 2g\ell\cos\alpha$

$2g\ell = 3g\ell\cos\alpha$

$\cos\alpha = \frac{2}{3}$

$\Rightarrow \quad \frac{h - \ell}{\ell} = \frac{2}{3} \qquad \Rightarrow \quad 2\ell = 3h - 3\ell$

$\Rightarrow \quad h = \frac{5}{3}\ell$

Sol.7 (C)

$$\vec{V}_0 = V_0\cos\theta\hat{i} + v_0\sin\theta\hat{j}$$

Velocity at any instant "t" is

$$\vec{V}_0 = V_0\cos\theta\hat{i} + (v_0\sin\theta - gt)\hat{j}$$

For $\vec{V}_0$ and $\vec{V}$ to be perpendicular

$$\vec{V}_0 \cdot \vec{V} = 0$$

$$(v_0\cos\theta\hat{i} + v_0\sin\theta\hat{j}).[v_0\cos\theta\hat{i} + (v_0\sin\theta - gt)\hat{j}] = 0$$

$$v_0^2 - V_0\sin\theta\, gt = 0$$

$$\Rightarrow \quad t = \frac{V_0}{g\sin\theta}$$

Now time of flight for the projectile will be

$$T = \frac{2V_0\sin\theta}{g}$$

and 't' must be less than T

$$\text{i.e., } \frac{V_0}{g\sin\theta} \le \frac{2V_0\sin\theta}{g}$$

$$\Rightarrow \quad \sin^2\theta \ge \frac{1}{2}$$

$$\Rightarrow \quad \sin\theta \ge \frac{1}{\sqrt{2}}$$

This inequality is satisfied for

$$\frac{\pi}{4} \le \theta \le \frac{\pi}{2}$$

Sol.8 (C)

Assertion is correct but Reason is wrong because maximum horizntal range on the inclined plane

$$R = \frac{u^2}{g(1 \pm \sin\alpha)}$$

where α is the angle of inclination.

Sol.9 (C)

Assertion is correct but Reason is wrong.

$$\omega = \omega_0 - a\theta$$

$$\frac{d\theta}{dt} = \omega_0 - a\theta$$

$$\int_0^{\theta} \frac{d\theta}{\omega_0 - a\theta} = \int_{t=0}^{t} dt$$

$$-[\log_e(\omega_0 - a\theta)]_0^{\theta} = [t]_0^t$$

Solving we get θ to change exponentially.