Dear student following is a Moderate level [○○●○○] test paper. Score of 15 Marks in 10 Minutes would be a satisfactory performance. Questions 1-8 (+3, –1). (All Questions have Single Options correct)

Q.1 A flywheel rotates at a constant speed of 3000 rpm. The angle described by the shaft in radian in one second is:
(A) 2π (B) 30π
(C) 100π (D) 3000π

Q.2 The angular acceleration of particle moving along a circular path with uniform speed is :
(A) uniform but non zero (B) Zero
(C) Variable (D) Such as cannot be predicted from the given information

Q.3 A stone of mass m is tied to a string of length ℓ and rotated in a circle with a constant speed υ. If the string is released the stone files.
(A) Radially outward (B) Radially inward
(C) Tangentially outward
(D) With an acceleration $\frac{m\upsilon^2}{\ell}$

Q.4 A body of mass 1 kg is projected with velocity 40 m/s at an angle of projection 30^0 with horizontal. The magnitude of change in momentum from t = 0 to t = 2 sec is:
(A) 20 N-s (B) $10\sqrt{3}$ N-s
(C) $2\times1\times40\times\frac{\sqrt{3}}{2}$ N-s (D) 10 N-s

Q.5 A car is moving in a circular path of radius 10 m with velocity of 20 m/s such that in each second its velocity increase by 10 m/s. The net acceleration of car (nearly) will be :
(A) 40 m/s^2 (B) 50 m/s^2
(C) 60 m/s^2 (D) 30 m/s^2

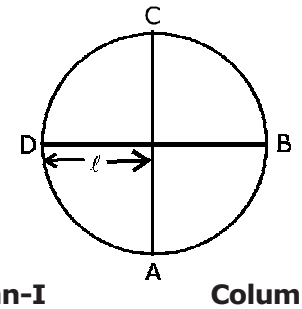
Q.6 The speed of a projectile when it is at its greatest height is $\sqrt{\frac{2}{5}}$ times its speed at half the maximum height. The angle of projection is
(A) 30^0 (B) 60^0 (C) 45^0 (D) $\tan^{-1}(3/4)$

Q.7 A hollow vertical cylinder of radius R and height h has smooth internal surface. A small particle is placed in contact with the inner side of the upper rim at a point P. It is given a horizontal speed υ_0 tangential to rim. It leaves the lower rim at point Q, vertically below P. The number of revolutions made by the particle will.

(A) $\frac{h}{2\pi R}$ (B) $\frac{\upsilon_0}{\sqrt{2gh}}$

(C) $\frac{2\pi R}{h}$ (D) $\frac{\upsilon_0}{2\pi R}\left(\sqrt{\frac{2h}{g}}\right)$

Q.8 Tension at any point on vertical loop.



Column-I Position	**Column-II Tension**
(a) A	(p) $\frac{mu^2}{\ell}$ – mg
(b) B	(q) $\frac{mu^2}{\ell}$ + mg
(c) C	(r) $\frac{mu^2}{\ell}$ – 2mg
(d) D	(s) $\frac{mu^2}{\ell}$ – 5mg

(A) a-q, b-r, c-s, d-r
(B) a-r, b-r, c-s, d-q
(C) a-s, b-r, c-q, d-r
(D) a-p, b-r, c-s, d-r

PHYSICS IIT JEE (JUNE 5th WEEK CLASS TEST 1) (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	○	○	○	○					

ANSWER KEY

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

SOLUTIONS

Sol.1 (C)

$\theta = 3000 \times 2\pi / 60 = 100\pi$.

Sol.2 (B)

The angular velocity of the particle is constant and hence $\alpha = 0$.

Sol.3 (C)

Stone flies in the direction of instantaneous velocity due to inertia.

Sol.4 (A)

Velocity at

$t = 2$ sec.

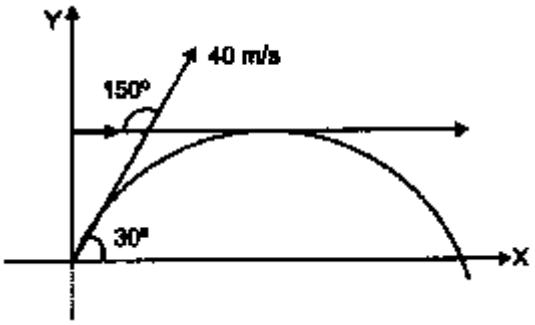
$$V = \sqrt{u^2 + g^2t^2 - 2ugt\sin\theta}$$

$$= \sqrt{1600 + 100 \times 4 - 2 \times 40 \times 10 \times 2 \times \frac{1}{2}}$$

$$= \sqrt{2000 - 800}$$

$$= \sqrt{1200}$$

$$= 20\sqrt{3} \text{ m/s}$$



Resultant momentum

$$P = \sqrt{p_1^2 + p_2^2 + 2p_1p_2\cos\theta}$$

$$= \sqrt{(40)^2 + \left(20\sqrt{3}\right)^2 + 2 \times 40 \times 20\sqrt{3}\cos 150^0}$$

$$= 20\text{N-second}$$

Sol.5 (A)

$$a_C = \frac{V^2}{R} = \frac{400}{10} = 40 \text{ m/s}^2$$

$$\Rightarrow \quad a_T = 10 \text{ m/s}^2$$

$$a_{Net} = \sqrt{a_C^2 + a_T^2 + 2a_Ca_T\cos 90^0}$$

$$= \sqrt{1600 + 100}$$

$$= \sqrt{1700}$$

$$\Rightarrow \quad 10\sqrt{17} \simeq 40 \text{ m/s}^2$$

Sol.6 (B)

Let θ be the angle of projection and u its initial speed. Then maximum height will be:

$$H = \frac{u^2\sin^2\theta}{2g} \Rightarrow gH = \frac{u^2\sin^2\theta}{2}$$

Now $\upsilon_H = u\cos\theta$

or $\upsilon_H^2 = u^2\cos^2\theta$ ...(1)

$$\upsilon_{H/2}^2 = u^2 - 2g\frac{H}{2} = u^2 - gH$$

$$= u^2 - \frac{u^2\sin^2\theta}{2} \quad \text{... (2)}$$

Now it is given that

$$\upsilon_H = \sqrt{\frac{2}{5}}\upsilon_{H/2}$$

or $\upsilon_H^2 = \frac{2}{5}\upsilon_{H/2}^2$

Substituting the values from (1) and (2) we get

$$(u^2\cos^2\theta) = \frac{2}{5}\left[u^2 - \frac{u^2\sin^2\theta}{2}\right]$$

or $5\cos^2\theta = 2\left[1 - \frac{\sin^2\theta}{2}\right]$

or $5(1 - \sin^2\theta) = 2 - \sin^2\theta$

or $\sin^2\theta = \frac{3}{4}$

or $\sin\theta = \frac{\sqrt{3}}{2}$

or $\theta = 60^0$

Sol.7 (D)

$$h = \frac{1}{2}gt^2$$

$$\therefore \quad t = \sqrt{\frac{2h}{g}}$$

Let n be number of revolution made Then

$n(2\pi R) = \upsilon_0 t$

or $n = \frac{\upsilon_0}{2\pi R}.t$

or $n = \frac{\upsilon_0}{2\pi R}\sqrt{\frac{2h}{g}}$

Sol.8 (A)

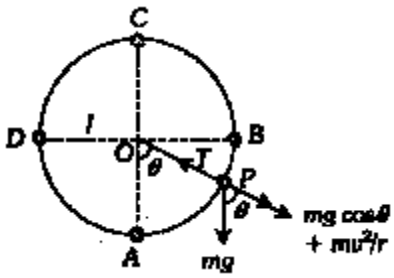
Tension at general point P, According to Newton's second law of motion.

Net force towards centre = centripetal force

$$T - mg\cos\theta = \frac{m\upsilon^2}{\ell}$$

or $T = mg\cos\theta + \frac{m\upsilon^2}{\ell}$

$$T = \frac{m}{\ell}[u^2 - g\ell\,(2 - 3\cos\theta)]$$



[As $\upsilon = \sqrt{u^2 - 2g\ell(1-\cos\theta)}$]

It is clear from the table that : $T_A > T_B > T_C$

and $T_B = T_D$

$T_A - T_B = 3mg$, $T_A - T_C = 6mg$

and $T_B - T_C = 3mg$,