Physicsaholics

DPP – 3 (Circular Motion)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/39

Video Solution on YouTube:- https://youtu.be/DZt1IUrR71E

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/42

Q 1. The magnitude of the centripetal force acting on a body of mass m executing uniform motion in a circle of radius r with speed v is:

(a) mvr (b) mv^2r

(c) $\frac{mv^2}{r}$ (d) $\frac{m}{v^2r}$

Q 2. A stone of mass m is tied to a string of length l and rotated in a circle with a constant speed v. If the string is released, the stone flies:

(a) Radially outward (b) Radially inward

(c)Tangentially outward (d)With an acceleration $\frac{mv^2}{l}$

Q 3. A stone tied at the end of a string 80 cm long is whirled in a horizontal circle with a constant speed. If the stone makes 25 revolutions in 14 s, what is the magnitude of acceleration of the stone?

(a) 90 m/s^2 (b) 100 m/s^2

(c) 110 m/s^2 (d) 120 m/s^2

Q 4. A stone of mass 0.5 kg is attached to a string of length 2m and is whirled in a horizontal circle. If the string can withstand a tension of 9N the maximum velocity with which the stone can be whirled is:

(a) 6 m/s (b) 8 m/s

(c) 4 m/s (d) 12 m/s

Q 5. A stone of mass 0 .25 kg tied to the end of a string is whirled round in a circle of radius 1.5 m with a speed of 40 rev/min in a horizontal plane What is the tension in the string?

(a) 6.1 N (b) 4.2 N

(c) 8.5 N (d) 6.7 N

Q 6. A mass of 2 kg is whirled in a horizontal circle by means of a string at an initial speed of 5 revolutions per minute. Keeping the radius constant, the tension in the string is doubled. The new speed is nearly:

(a) 14 rpm (b) 10 rpm

(c) 2.25 rpm (d) 7 rpm

Q 7. A string breaks if its tension exceeds 10 newtons. A stone of mass 250 gm tied to this string of length 10 cm is rotated in a horizontal circle. The maximum angular velocity of rotation can be:

(a) 20 rad/s (b) 400 rad/s

(c) 80 rad/s (d) 200 rad/s

Q 8. A ball of mass 0.1 Kg. is whirled in a horizontal circle of radius 1 m. by means of a string at an initial speed of 20 R.P.M. Keeping the radius constant, the tension in the string is reduced to one quarter of its initial value. The new speed is:
(a) 5 r.p.m. (b) 10 r.p.m.
(c) 20 r.p.m. (d) 40 r.p.m.

Q 9. If the radius of curvature of the path of two particles of mass 2kg and 4kg are in the ratio 1:2, then in order to have constant centripetal force, their velocity, should be in the ratio of
(a) 1 : 1 (b) 1 : 2
(c) 2 : 1 (d) 1 : 4

Q 10. In an atom for the electron to revolve around the nucleus, the necessary centripetal force is obtained from the following force exerted by the nucleus on the electron:
(a) Nuclear force
(b) Normal reaction force
(c) Magnetic force
(d) Electrostatic force

Q 11. Two bodies of equal masses revolve in circular orbits of radii R_1 and R_2 with the same period. Their centripetal forces are in the ratio:
(a) $\left(\frac{R_1}{R_2}\right)^2$ (b) $\left(\frac{R_2}{R_1}\right)^2$ (c) $\frac{R_1}{R_2}$ (d) $\sqrt{R_1 R_2}$

Q 12. Centrifugal force is pseudo force because:
(a) its magnitude is equal to centripetal force
(b) origin cannot be imaginary
(c) its direction is outward along radius
(d) it is not provided by any real force but it arises due to accelerated frame of reference

Answer Key

Q.1 c	**Q.2 c**	**Q.3 b**	**Q.4 a**	**Q.5 d**
Q.6 d	**Q.7 a**	**Q.8 b**	**Q.9 a**	**Q.10 d**
Q.11 c	**Q.12 d**			

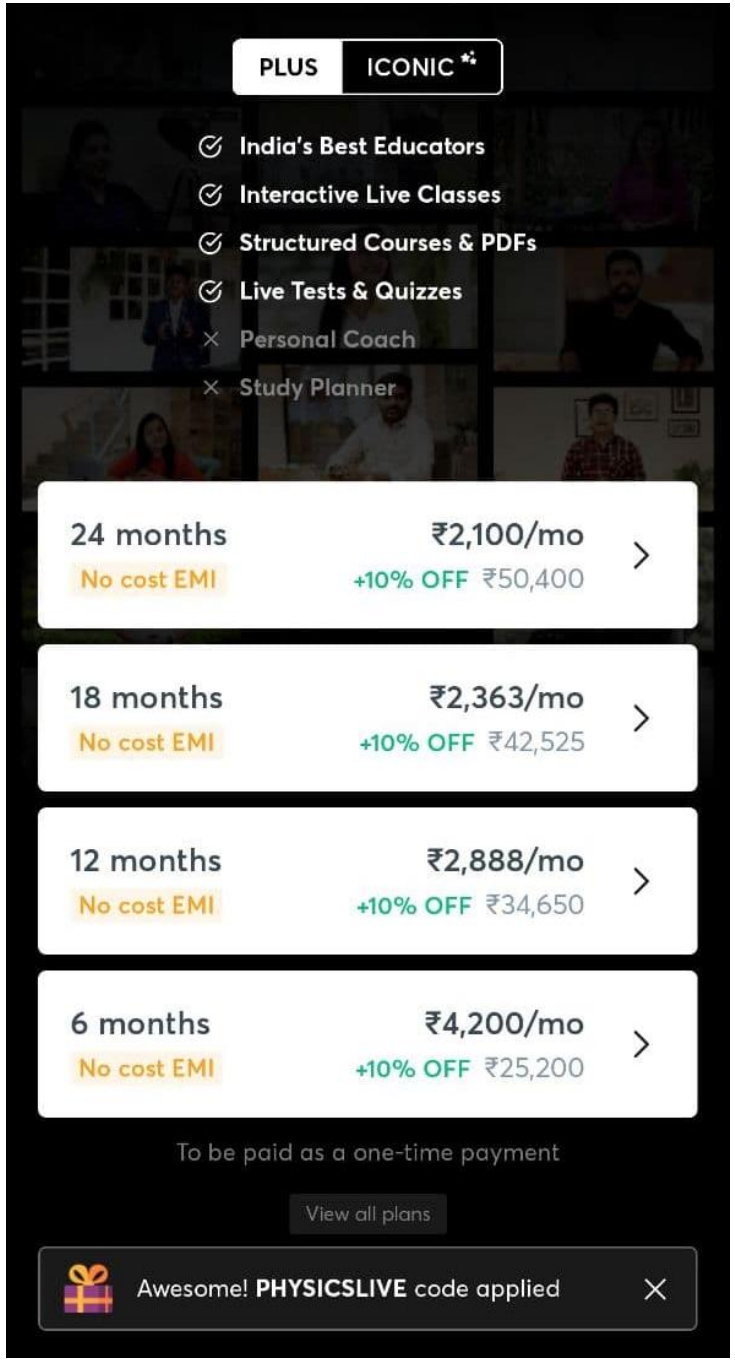
Plus leaderboard

Based on educator activity in last 30 days

1	Prateek Jain	11.4M mins
2	Ajay Mishra (Akm)	6.3M mins
3	Shubh Karan Choudhary (Skc)	5.9M mins
4	Dr Amit Gupta	5.5M mins
5	Ramesh Sharda	4.9M mins
6	Sandeep Nodiyal	4.8M mins
7	Shailendra Tanwar	3.6M mins
8	Vishal Vivek	2.7M mins
9	Garima Goel	2.7M mins
10	Saurabh Sharma	2.6M mins
11	Dr S K Singh	2.6M mins
12	Nishant Varshney	

PHYSICSLIVE

Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS and learn from India's Top Faculties.



Written Solution

DPP-3 Centripetal and Centrifugal Force

By Physicsaholics Team

Solution: 1

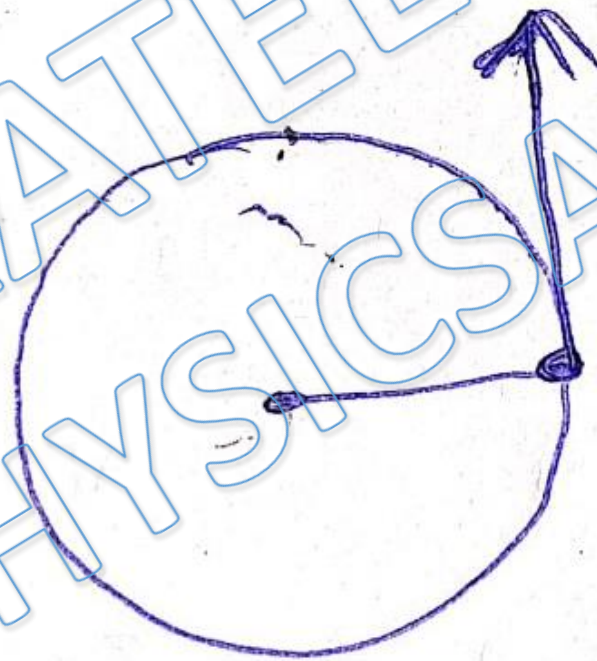
Centripetal force:

$$F_c = ma_c = \frac{mv^2}{r}$$

Ans. c

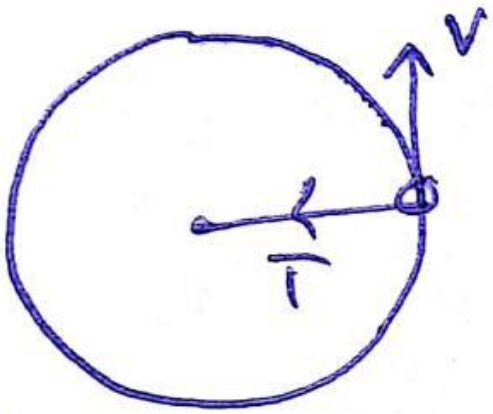
Solution: 2

Stone flies in the direction of instantaneous velocity as there is no force on stone after breaking string.



Ans. c

Solution: 3



25 rev in 14 sec.

$\Rightarrow$ 14 sec $\rightarrow$ 25 rev.

1 sec $= \frac{25}{14}$ rev

$r = 80\ cm.$

$\omega = 2\pi \times \frac{25}{14}$ rad/sec

$T = m\omega^2 r$

$a = \omega^2 r = \left(2\pi \times \frac{25}{14}\right)^2 \times 80 \times 10^{-2}$

$a = 100.6\ m/s^2$

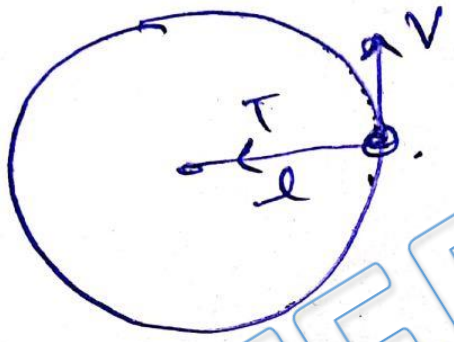
$\boxed{a \simeq 100\ m/s^2}$

Ans. b

Solution: 4

$m = 0.5\ kg$

$l = 2\ m.$



for max velocity
Tension in String
is $T = 9\ N$

$$T = \frac{mv^2}{l}$$

$$9 = \frac{(0.5)\,v^2}{2}$$

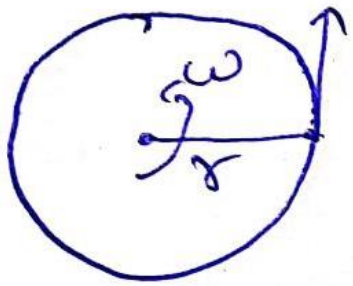
$$v^2 = 9 \times 4$$

$$v = 3 \times 2$$

$$\boxed{v = 6\ m/s}$$

Ans. a

Solution: 5



40 rev/min

$\Rightarrow 40 \frac{\text{rev}}{60 \text{ sec}}$

$= \frac{2}{3} \text{ rev/sec}$

$\omega = 2\pi \times \frac{2}{3} = \frac{4\pi}{3} \text{ rad/sec}$

Tension; $F = m\omega^2 r = 0.2 \times \left(\frac{4\pi}{3}\right)^2 \times 1.5$

$= \frac{1}{4} \times \frac{16 \times \pi^2}{9} \times \frac{3}{2}$

$= \frac{4}{6} \times 10$

$F = \frac{20}{3} N$

$\boxed{F \simeq 6.67 N}$

Ans. d

Solution: 6

Tension in string

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

$\omega = (2\pi)n$ (n - no. of rev. per min)

$$T = m(2\pi n)^2 r$$

$$T \propto n^2 r$$

$$\frac{T_1}{T_2} = \frac{n_1^2}{n_2^2} \cdot \frac{r_1}{r_2}$$

$r_1 = r_2$ & $T_2 = 2T_1$

$$\frac{T_1}{2T_1} = \frac{n_1^2}{n_2^2} \times 1$$

$$n_2 = \sqrt{2}\, n_1$$

$$n_2 = \sqrt{2} \times 5$$

$n_2 \simeq 7$ rev/min

Ans. d

Solution: 7

$$F_c = m\omega^2 r$$

$$T_{max} = 10\,N.$$

for ω_{max} :$\Rightarrow$ $F_c = T_{max}$

$$\therefore 10 = \left(\frac{250}{1000}\right)\omega^2 (10\times10^{-2})$$

$$\omega^2 = \frac{10\times1000}{250\times10\times10^{-2}} = \frac{10\times1000}{25}$$

$$\omega^2 = 400$$

$$\boxed{\omega = 20 \text{ rad/sec}}$$

Ans. a

Solution: 8

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

$$\omega^2 \propto T$$

$$\omega \propto \sqrt{T}$$

if $T_1 = T$

then; $T_2 = \frac{T}{4}$

$$\frac{\omega_1}{\omega_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\therefore \frac{\omega_1}{\omega_2} = \sqrt{\frac{T}{T/4}} = \sqrt{\frac{4}{1}} = 2$$

$$\omega_2 = \frac{\omega_1}{2}$$

$$2\pi n_2 = \frac{2\pi n_1}{2}$$

$$n_2 = \frac{n_1}{2}$$

$$n_2 = \frac{20}{2}$$

$$\boxed{n_2 = 10 \text{ rpm}}$$

Ans. b

Solution: 9

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

$m_1 = 2\,kg$

$m_2 = 4\,kg$.

$\frac{r_1}{r_2} = \frac{1}{2}$

for F_c = constant

$$\frac{m_1 v_1^2}{r_1} = \frac{m_2 v_2^2}{r_2}$$

$$\frac{v_1^2}{v_2^2} = \frac{r_1}{r_2} \cdot \frac{m_2}{m_1}$$

$$\frac{v_1^2}{v_2^2} = \frac{1}{2} \times \frac{4\,kg}{2\,kg}$$

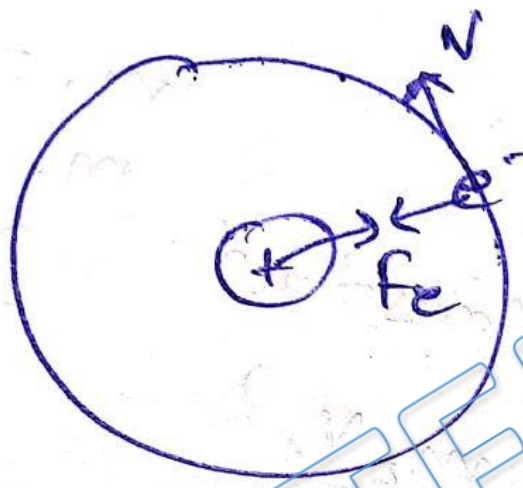
$$\frac{v_1^2}{v_2^2} = \frac{1}{2} \times \frac{2}{1}$$

$$\frac{v_1^2}{v_2^2} = \frac{1}{1}$$

$$\boxed{\frac{v_1}{v_2} = \frac{1}{1}}$$

Ans. a

Solution: 10



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

So; Electrostatic force provides
necessary centripetal force
for circular motion of electron.

Ans. d

Solution: 11

$$F_c = \frac{m\omega^2}{r}$$

$$\text{Time period} = \frac{2\pi r}{v} = \frac{2\pi r}{r\omega} = \frac{2\pi}{\omega}$$

$$T = \frac{2\pi}{\omega} \Rightarrow \omega = \frac{2\pi}{T}$$

$$F_c = \frac{m}{r}\left(\frac{2\pi}{T}\right)^2$$

$$F_c \propto \frac{1}{rT^2} \quad (\because m = \text{same})$$

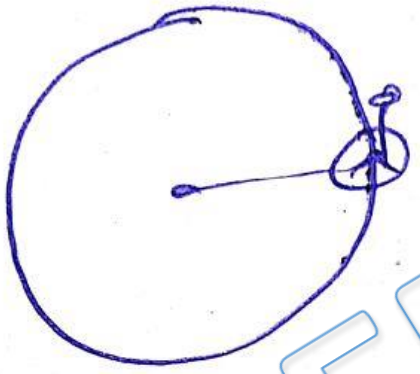
$$\frac{F_1}{F_2} = \frac{r_1 T_1^2}{r_2 T_2^2} \quad (\because T_1 = T_2)$$

$$\frac{F_1}{F_2} = \frac{r_1}{r_2} = \frac{R_1}{R_2}$$

$$\boxed{\frac{F_1}{F_2} = \frac{R_1}{R_2}}$$

Ans. c

Solution: 12



It arises when we observe the circular motion in the frame of the revolving body, means from the accelerating frame of reference.

Ans. d

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/39

Video Solution on YouTube:- https://youtu.be/DZt1IUrR71E

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/42

SUBSCRIBE

@Physicsaholics

@Physicsaholics_prateek

@NEET_Physics
@IITJEE_Physics

physicsaholics.com

Unacademy

CLICK

Chalo Niklo