DPP – 5

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/80

Video Solution on YouTube:- https://youtu.be/KVm9yZF-AaE

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/17

Q 1. The angular momentum of a flywheel having a moment of inertia of 0.4 kg-m^2 decreases from 30 to 20 kg-m^2/s in a period of 2 second. The average torque acting on the flywheel during this period is:
(a) 10 N-m (b) 2.5 N-m
(c) 5 N-m (d) 1.5 N-m

Q 2. An angular impulse of 20 Nms is applied to a hollow cylinder of mass 2 kg and radius 20 cm. The change in its angular speed is :
(a) 25 rad/s (b) 2.5 rad/s
(c) 250 rad/s (d) 2500 rad/s

Q 3. A solid cylinder of mass 5kg and radius 30cm and free to rotate about its axis receives an angular impulse of 3 kgm^2/s initially, followed by a similar impulse after every 4 second. What is the angular speed of the cylinder 30s after the initial impulse? The cylinder is at rest initially.
(a) 67.67 rad/s (b) 117.35 rad/s
(c) 106.67 rad/s (d) 87.35 rad/s

Q 4. A particle of mass m is rotating in a circular path of radius r. Its angular momentum is J. The centripetal force acting on the particle would be -
(a) $\frac{J^2}{mr}$ (b) $\frac{J^2}{mr^2}$
(c) $\frac{J^2}{mr^3}$ (d) J^2mr

Q 5. A uniform horizontal circular platform of mass 200kg is rotating at 5 rpm about vertical axis passing through its center. A boy of mass 80kg is standing at its edge. if boy moves to center of platform, find out final angular speed
(a) 10 rpm (b) 15 rpm
(c) 5 rpm (d) 9 rpm

Q 6. A uniform circular platform of mass 120kg and radius 10 meter is free to rotate in horizontal plane about its own axis .A person of mass 40kg on the platform is standing at its edge. If the person starts moving on plateform along its circumference with speed 10 m/sec relative to plateform ,find angular velocity of plateform :
(a) 15 rad/sec (b) 1.5 rad/sec
(c) 0.4 rad/sec (d) 2.5 rad/sec

Q 7. Two flywheels A and B are mounted side by side with frictionless bearings on a common shaft. Their moments of inertia are 5 kgm^2 and 20 kgm^2 respectively.

Wheel A is made to rotate at 10 revolutions per second. Wheel B, initially stationary is now coupled to A with the help of a clutch. The rotational speed of the wheels will become:

(a) $2\sqrt{5}$ rps (b) 0.5 rps

(c) 2 rps (d) 5 rps

Q 8. A ballet dancer is rotating on smooth horizontal floor with an angular momentum L. The dancer folds her hands so that her moment of inertia decreases by 25%. The new angular momentum is :

(a) $\frac{3L}{4}$ (b) $\frac{L}{4}$

(c) $\frac{L}{2}$ (d) L

Q 9. A car's wheel has a rotational inertia of 2 kg-m^2. The wheel initially has a counterclockwise angular speed of 6 rad/s, but has a constant counterclockwise torque of 5 N-m applied for 4 s. What is the final angular momentum of the wheel?

(a) 16 kg-m^2/s (b) 24 kg-m^2/s

(c) 32 kg-m^2/s (d) 11 kg-m^2/s

Q 10. A plane's propeller has moment of inertia of 4 kg-m^2. The propeller initially has a clockwise angular speed 9 rad/s, but has a constant anti-clockwise torque of 3 N-m applied until the propeller reaches an anti-clockwise rotation of 12 rad/s. How much time was the torque applied for?

(a) 8 sec (b) 2 sec

(c) 17 sec (d) 28 sec

Q 11. A rigid horizontal smooth rod AB of mass 0.75 Kg and length 40 cm can rotate freely about a fix vertical axis through its midpoint O. Two rings each of mass 1 kg initially at rest at a distance of 10 cm from O on either side of the rod. The rod is set in rotation with an angular velocity of 30 radians per second and when the rings reach the ends of the rod, the angular velocity in rad/sec is:

(a) 5 (b) 10

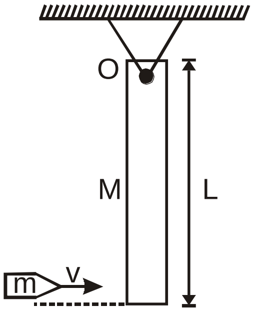
(c) 15 (d) 20

Q 12. A solid disk of radius 0.15 and moment of inertia 1.5 kg m² is mounted on a frictionless axle. You wrap a string around it and then pull on it with a constant force of 65 N. After you have pulled for a little bit, it is turning around at 20 revolutions per second. If you continue to pull on it in the same way, what is its angular speed half a second later?

(a) 128.85 rad/s (b) 218.5 rad/s

(c) 18.25 rad/s (d) 72.75 rad/s

Q 13. A rod of mass M and length L is suspended by a frictionless hinge at the point O as shown in figure. A bullet of mass m moving with velocity v in a horizontal direction strikes the end of the rod and gets embedded in it. The angular velocity by the rod just after the collision is –



(a) $\frac{mv}{(3m+M)L}$ (b) $\frac{2mv}{ML}$

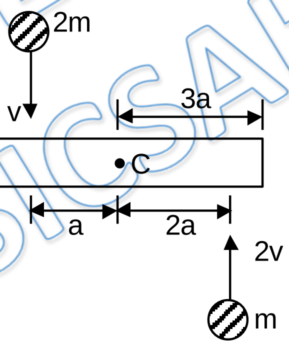
(c) $\frac{2mv}{L}$ (d) $\frac{3mv}{(3m+M)L}$

Q 14. A ring of mass M and radius R is moving in horizontal plane at angular speed ω about self axis. If two equal point masses (mass m) are placed at the ends of any diameter. Find final angular speed of system –

(a) $\frac{M}{2m}\omega$ (b) $\frac{M}{M+2m}\omega$

(c) $\frac{m}{M+2m}\omega$ (d) None of these

Q 15. A uniform bar of length 6a and mass 8m lies on a smooth horizontal table. Two point masses m and 2m moving in the same horizontal plane with speed 2v and v respectively, strike the bar (as shown in the figure) and stick to the bar after collision. Denoting angular velocity (about the center of mass), total energy and center of mass velocity by ω; E and V_c respectively, we have after collision–

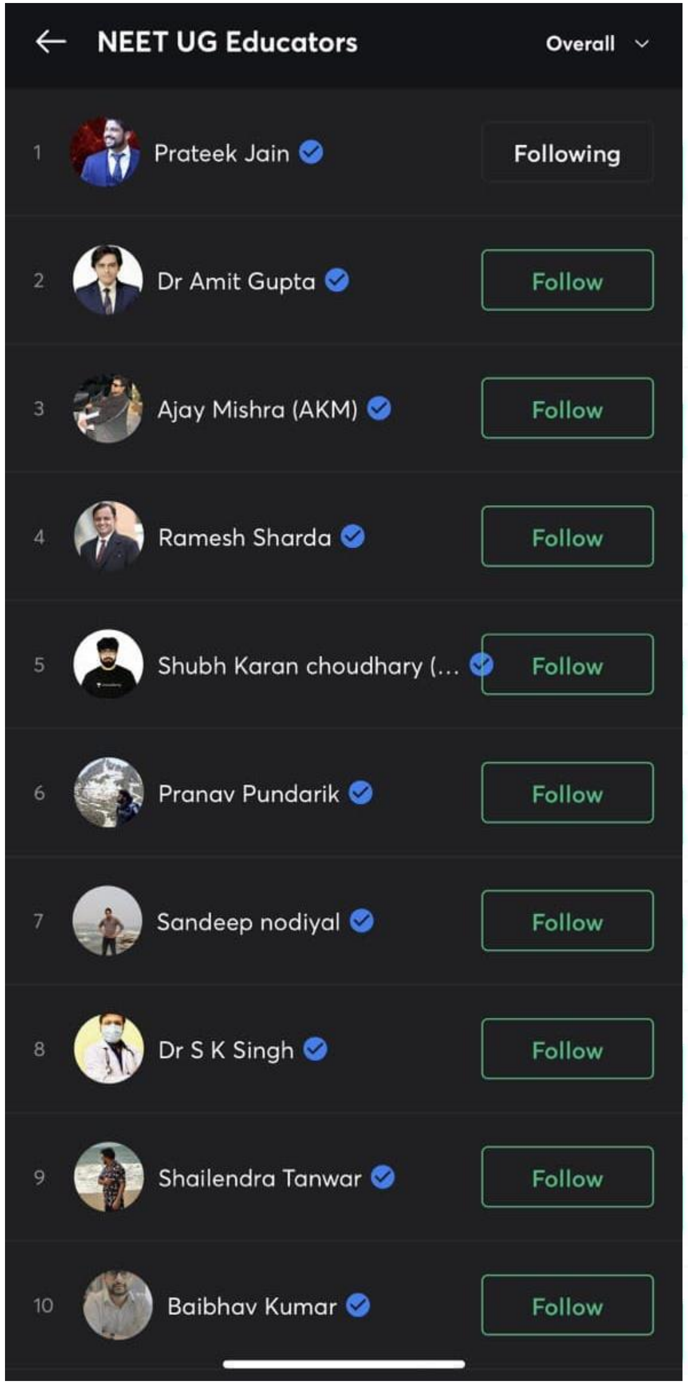


(a) $V_c = 0$ (b) $E = \frac{3mv^2}{5}$

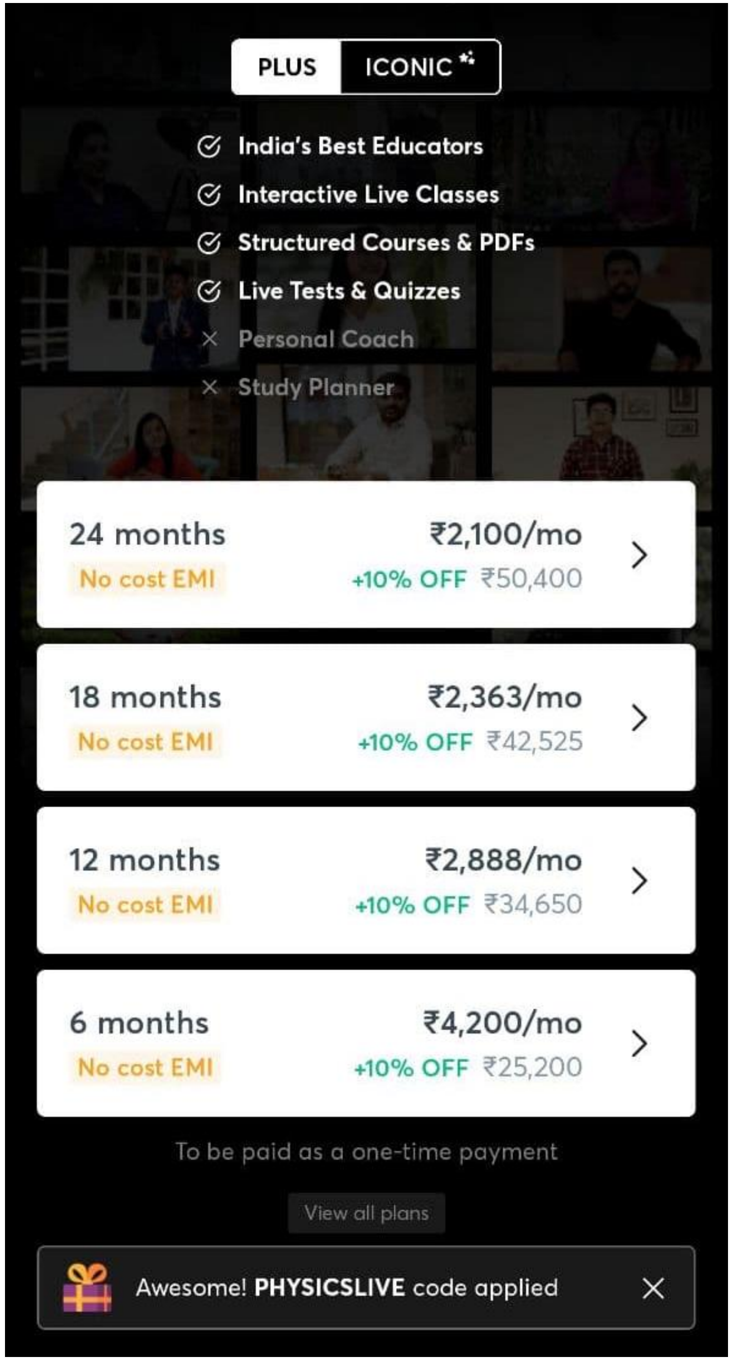
(c) $\omega = \frac{v}{5a}$ (d) All of these

Answer Key

Q.1 c	Q.2 c	Q.3 c	Q.4 c	Q.5 d
Q.6 c	Q.7 c	Q.8 d	Q.9 c	Q.10 d
Q.11 b	Q.12 a	Q.13 d	Q.14 b	Q.15 d



PHYSICSLIVE



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

Written Solution

DPP- 5 Rotation: Conservation of Angular Momentum, Angular Impulse

By Physicsaholics Team

Solution: 1

$I = 0.4\ kg\text{-}m^2$

$L_i = 30\ kg\text{-}m^2/s$

$L_f = 20\ kg\text{-}m^2/s$

$H = \int \tau \cdot dt = L_f - L_i$

$\tau \times 2 = 20 - 30$

$\tau = -5\ N\text{-}m$

$\boxed{\tau = 5\ N\text{-}m}$ Ans

Ans. c

Solution: 2

$$H = \Delta L$$

$$20 = I(\Delta\omega)$$

$$\Delta\omega = \frac{20}{I}$$

$$I = mr^2 = 2 \times (0.2)^2 = 0.08$$

$$\Delta\omega = \frac{20}{0.08} = \frac{2000}{8} = 250$$

$$\boxed{\Delta\omega = 250 \text{ rad/s}}$$ Ans.

Ans. c

Solution: 3

$$I = \frac{5 \times (0.3)^2}{2} = \frac{0.45}{2} = 0.225 \text{ kg-m}^2$$

$H = 3 \text{ kg m}^2/\text{s}$

first impulse at $t = 0$

then after;

$\Delta t = 4$ sec

$T = 30$ sec

$$n = \frac{T}{\Delta t} = \frac{30}{4} = 7.5$$

$n = 7$

at; $t = 0, 4, 8, 12, 16, 20, 24, 28$ sec

$N = 7 + 1$

$\boxed{N = 8}$ (no. of Impuls)

so; $H_N = 8 \times 3 = 24 \text{ kg m}^2/\text{s}$

$H_N = \Delta L = I(\Delta \omega)$

$$\Delta \omega = \frac{24}{0.225}$$

$\Delta \omega = 106.67$

$\because \omega_i = 0$

so; $\boxed{\omega_f = 106.67 \text{ rad/s}}$ Ans

Ans. c

Solution: 4

$J = mvr$

$v = \frac{J}{mr}$

$F_c = \frac{mv^2}{r} = \frac{m}{r}\left(\frac{J}{mr}\right)^2$

$$F_c = \frac{J^2}{mr^3}$$ Ans

Ans. c

Solution: 5

$m_p = 200\ kg$

$m_b = 80\ kg$

$\omega = 2 \times \frac{2\pi}{60} = \frac{\pi}{15}\ rad/s$

$L_i = L_f$

$I_1 \omega_1 = I_2 \omega_2$

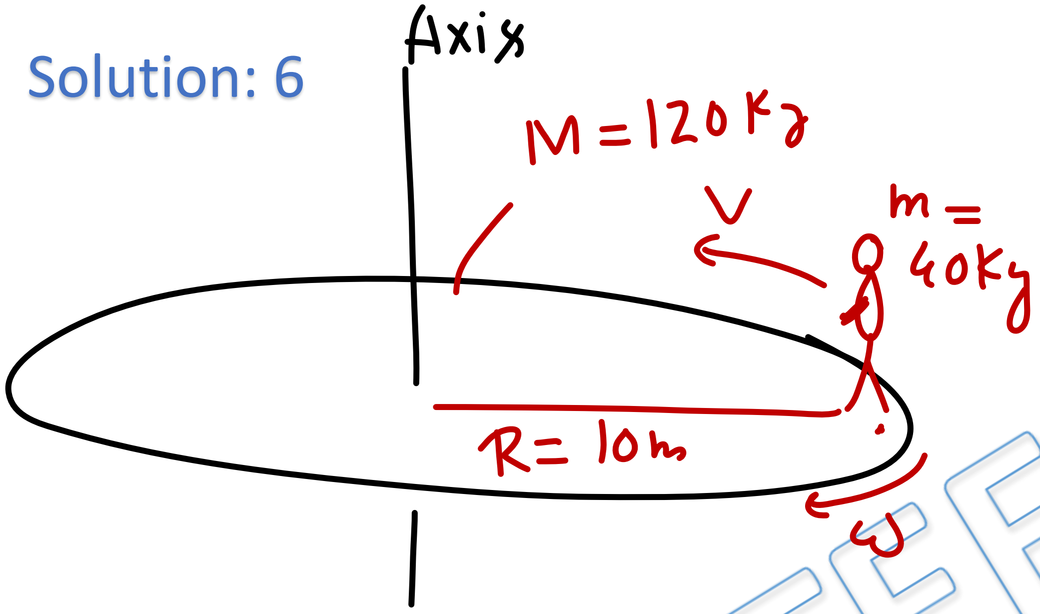
$\left(\frac{200 \times r^2}{2} + 80 \times r^2\right) 5 = \left(\frac{200 \times r^2}{2} + 80 \times 0\right) \times \omega_2$

$\frac{360}{2} \times 5 = \frac{200}{2} \times \omega_2$

$\boxed{\omega_2 = 9\ rpm}$

Ans. d

Solution: 6



$V + \omega R = 10 \quad \text{---} (1)$

by Conservation of Angular Momentum –

$$\frac{MR^2}{2}\omega = mRV$$

$$V = \frac{120 \times 10 \times \omega}{2 \times 40} = 15\omega$$

$$15\omega + 10\omega = 10$$

$$\omega = \frac{10}{25} = .4 \text{ rad/Sec}$$

Ans. c

Solution: 7

$L_i = L_f$

$(5 \times 10) = (5+20) \times \omega$

$5 \times 10 = 25\,\omega$

$\boxed{\omega = 2 \text{ rps}}$ Ans

Ans. c

Solution: 8

$\because \tau_{ext} = 0$

$\Rightarrow$ Angular momentum is conserved

so; $L_i = L_f$

if $L_i = L$

then $\boxed{L_f = L}$ Ans.

Ans. d

Solution: 9

$I = 2\,kg\text{-}m^2$

$\omega = 6\,rad/s$ (counter clockwise)

$\tau = 5\,N\text{-}m$ (counter clockwise)

angular impulse $H = \int \tau\,dt \Rightarrow \tau\Delta t = \Delta L$

$\tau\Delta t = L_f - L_i$

$5 \times 4 = L_f - I\omega$

$L_f = 20 + I\omega$

$L_f = 20 + 2 \times 6$

$\boxed{L_f = 32\ kg\text{-}m^2/s}$ Ans

Ans. c

Solution: 10

$I = 4\ kg\text{-}m^2$

$\omega_i = 9\ rad/s$

$\tau = -3\ N\text{-}m$

$\omega_f = -12\ rad/s$

$H = \tau \Delta t = L_f - L_i = I(\omega_f - \omega_i)$

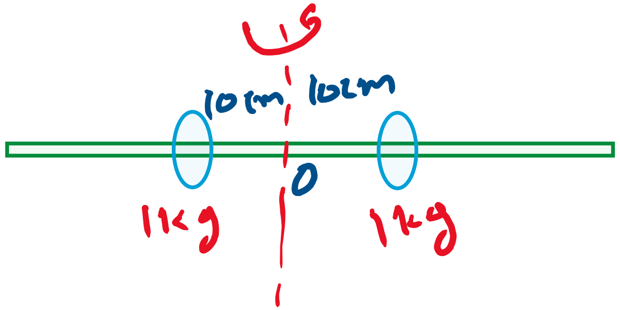
$\Rightarrow -3 \times \Delta t = 4(-12-9)$

$\Delta t = \frac{4(-21)}{-3}$

$\boxed{\Delta t = 28\ sec}$ Ans

Ans. d

Solution: 11



$\omega_i = 30$ rad/s

here, $\tau_{ext} = 0$

$\Rightarrow L_i = L_f$

$$\left[2\left(1\times(0.1)^2\right) + \frac{0.75\times(0.4)^2}{12}\right]\times 30 = \left[2\left(1\times(0.2)^2\right) + \frac{0.75\times(0.4)^2}{12}\right]\omega$$

$$0.03 \times 30 = 0.09\,\omega$$

$\boxed{\omega = 10 \text{ rad/s}}$ Ans.

Ans. b

Solution: 12

$I = 1.5 \ kg\text{-}m^2$

$t = 0.5 \ sec$

$\omega_i = 20 \ rps = 20 \times 2\pi = 40\pi \ rad/s$

$\int \tau \cdot dt = \Delta L$

$\tau \times \Delta t = L_f - L_i = I(\omega_f - \omega_i)$

$(65 \times 0.15) \times 0.5 = 1.5(\omega_f - 40\pi)$

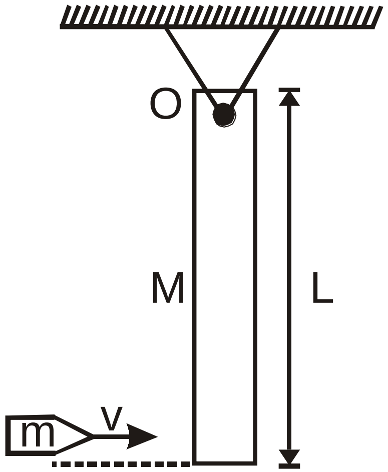
$\frac{65 \times 0.5}{10} = \omega_f - 40\pi$

$3.25 = \omega_f - 125.6$

$\boxed{\omega_f = 128.85 \ rad/s}$ Ans.

Ans. a

Solution: 13



For the (Rod + bullet) system.

$\tau_0 = 0$

$\therefore$ momentum about 'O' will be conserved

$L_i = L_f$

$$(mvL + 0) = \left(\frac{ML^2}{3} + mL^2\right)\omega$$

$$\Rightarrow \omega = \frac{3mvL}{ML^2 + 3mL^2}$$

$$\boxed{\omega = \frac{3mv}{(M+3m)L}}$$ Ans.

Ans. d

Solution: 14

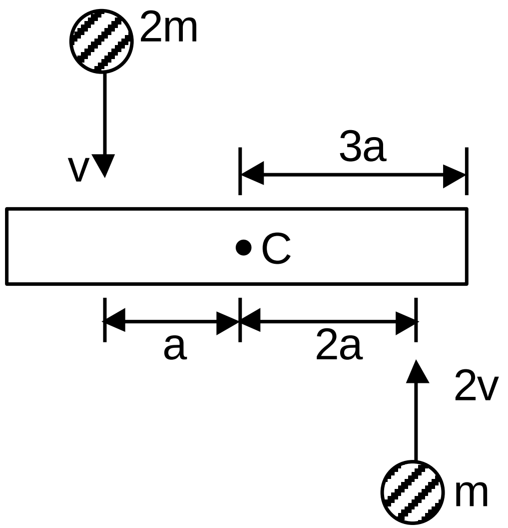
$$L_i = L_f$$

$$(MR^2)\omega = (MR^2 + 2mR^2)\omega'$$

$$\boxed{\omega' = \frac{M\omega}{M+2m}}$$ Ans.

Ans. b

Solution: 15



For ball & rod system

$\tau_{ext} = 0$

$\therefore$ L = conserved.

take L about 'c'

$L_i = L_f$

$(2m \times v \times a) + (m \times 2v \times 2a) = I\omega$

$I = \frac{M\ell^2}{12} + 2ma^2 + m(2a)^2$

$I = \frac{8m(6a)^2}{12} + 6ma^2 = 24ma^2 + 6ma^2$

$I = 30ma^2$

$\Rightarrow 6mva = 30ma^2\,\omega$

$\omega = \frac{v}{5a}$

$\therefore F_{ext} = 0$

$\Rightarrow (v_c)_i = (v_c)_f$

$v_c = \frac{2m(-v) + m(2v) + 8m(0)}{11m}$

$v_c = 0$

$KE = \frac{1}{2}I\omega^2 = \frac{1}{2}(30ma^2)\left(\frac{v}{5a}\right)^2$

$KE = \frac{3mv^2}{5}$ Ans.

Ans. d

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/80

Video Solution on YouTube:- https://youtu.be/KVm9yZF-AaE

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/17

SUBSCRIBE

@Physicsaholics

@Physicsaholics_prateek

@NEET_Physics
@IITJEE_Physics

physicsaholics.com

Unacademy

CLICK

Chalo Niklo