DPP – 7

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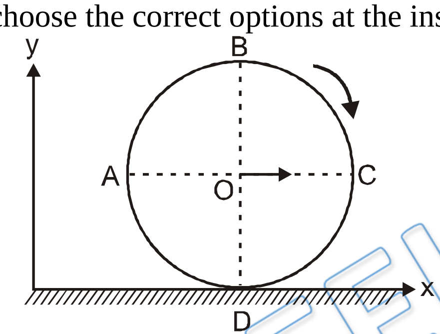
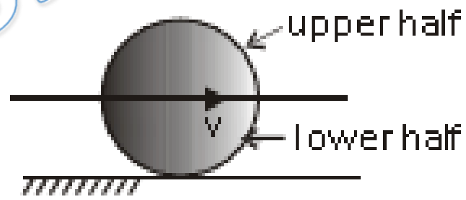
Q 1. A rigid uniform circular disc rolls without slipping on a horizontal surface with uniform speed along the positive x–direction as shown. AC and BD are the two diameters and at the instant shown in diagram AC is horizontal and BD is vertical then choose the correct options at the instant shown. (O : centre of the disc)



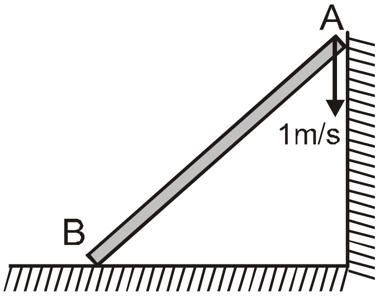
(a) Sector BOC has greater kinetic energy than sector COD
(b) Sector ABC has greater kinetic energy than sector ADC
(c) Sector BOC has same kinetic energy as sector AOB
(d) Sector BOC has same kinetic energy as sector AOD with respect to the centre of mass frame of disc

Q 2. Consider a uniform disc of mass 'm' performing pure rolling with velocity 'v' on a fixed rough surface



(a) Kinetic energy of upper half will be $\frac{3}{8}mv^2$
(b) Kinetic energy of upper half will be less than $\frac{3}{8}mv^2$
(c) Kinetic energy of upper half will be more than $\frac{3}{8}mv^2$
(d) Kinetic energy of upper half will be more than $\frac{3}{4}mv^2$

Q 3. A rod of length 1m is sliding in a corner as shown. At an instant when the rod makes an angle of 60° with the horizontal plane, the velocity of point A on the rod is 1m/s. The angular velocity of the rod at this instant is :

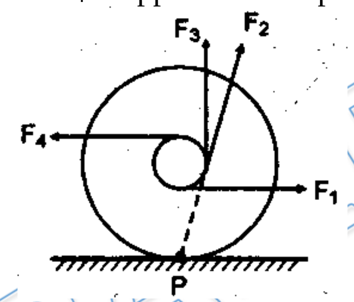


(a) 2 rad/s (b) 1.5 rad/s (c) 0.5 rad/s (d) 0.75 rad/s

Q 4. A rod of length l is given two velocities v_1 and v_2 in opposite directions at its two ends at right angles to the length. The distance of the instantaneous axis of rotation from v_1 is:

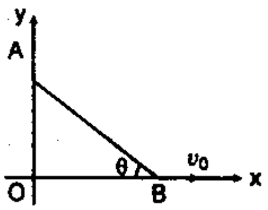
(a) zero (b) $\frac{v_1}{v_1+v_2} l$ (c) $\frac{v_1 l}{v_1+v_2}$ (d) $l/2$

Q 5. A spool of wire rests on a horizontal surface as shown in figure. As the wire is pulled, the spool does not slip at contact point P. On separate trials, each one of the forces F_1, F_2, F_3 and F_4 is applied to the spool. For each one of these forces the spool :



(a) will rotate anticlockwise if F_1 is applied
(b) will not rotate if F_2 is applied
(c) will rotate anticlockwise if F_3 is applied
(d) will rotate clockwise if F_4 is applied

Q 6. The end B of the rod AB which makes angle θ with the floor is being pulled with, a constant velocity v_0 as shown. The length of the rod is l. At the instant when θ = 37°:

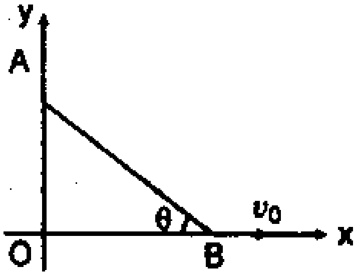


(a) velocity of end A is $\frac{4}{3}$ v_0 downwards
(b) angular velocity of rod is $\frac{5}{3}\frac{v_0}{l}$
(c) angular velocity of rod is constant
(d) velocity of end A is constant

Q 7. A disc is rolling on ground. Velocity of its centre is v. its surface is divided in to two parts. All points in first part have speed less than v , area of this part is A_1 . In second part all points have speed greater than v, area of this part is A_2 . then

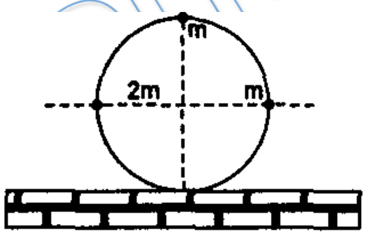
(a) $A_1 > A_2$
(b) $A_1 < A_2$
(c) $A_1 = A_2$
(d) Data is not sufficient to decide the relation

Q 8. The end B of the rod AB which makes angle θ with the floor is being pulled with, a constant velocity v_0 as shown. The length of the rod is l. instantaneous speed of centre of rod at is $\theta = 30^0$ is



(a) $\frac{v_0}{2}$ (b) $\frac{v_0}{4}$
(c) v_0 (d) None of these

Q 9. A ring of mass m and radius R has three particles attached to the ring as shown in the figure. Ring is released on sufficiently rough horizontal surface from position shown. Initial acceleration of centre of ring is

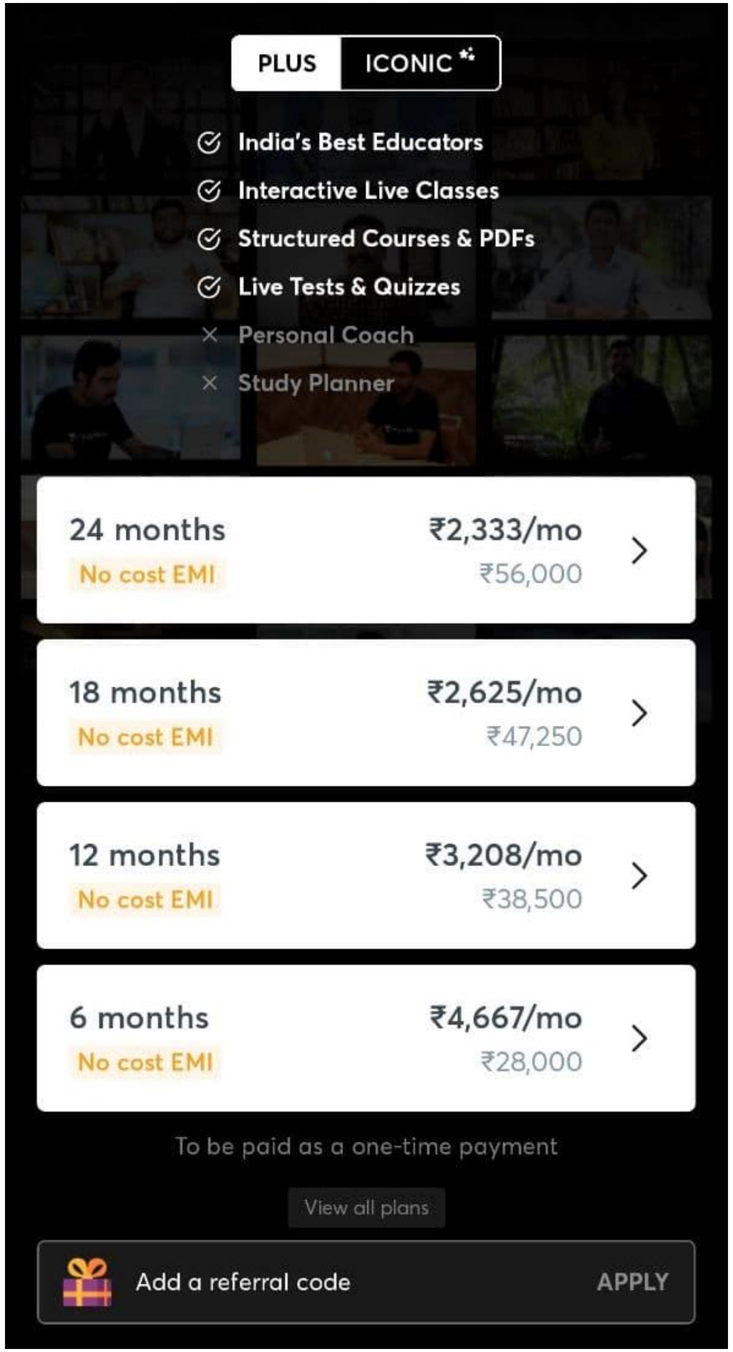


(a) g/3 (b) g/4 (c) g/6 (d) g/12

Q 10. A sphere of radius R is moving on ground. Ratio of velocity of its centre and its angular velocity is greater than R. if d is distance of axis of instantaneous rotation from centre of sphere, then
(a) d > R (b) d < R
(c) d = R (d) None of these

Answer Key

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



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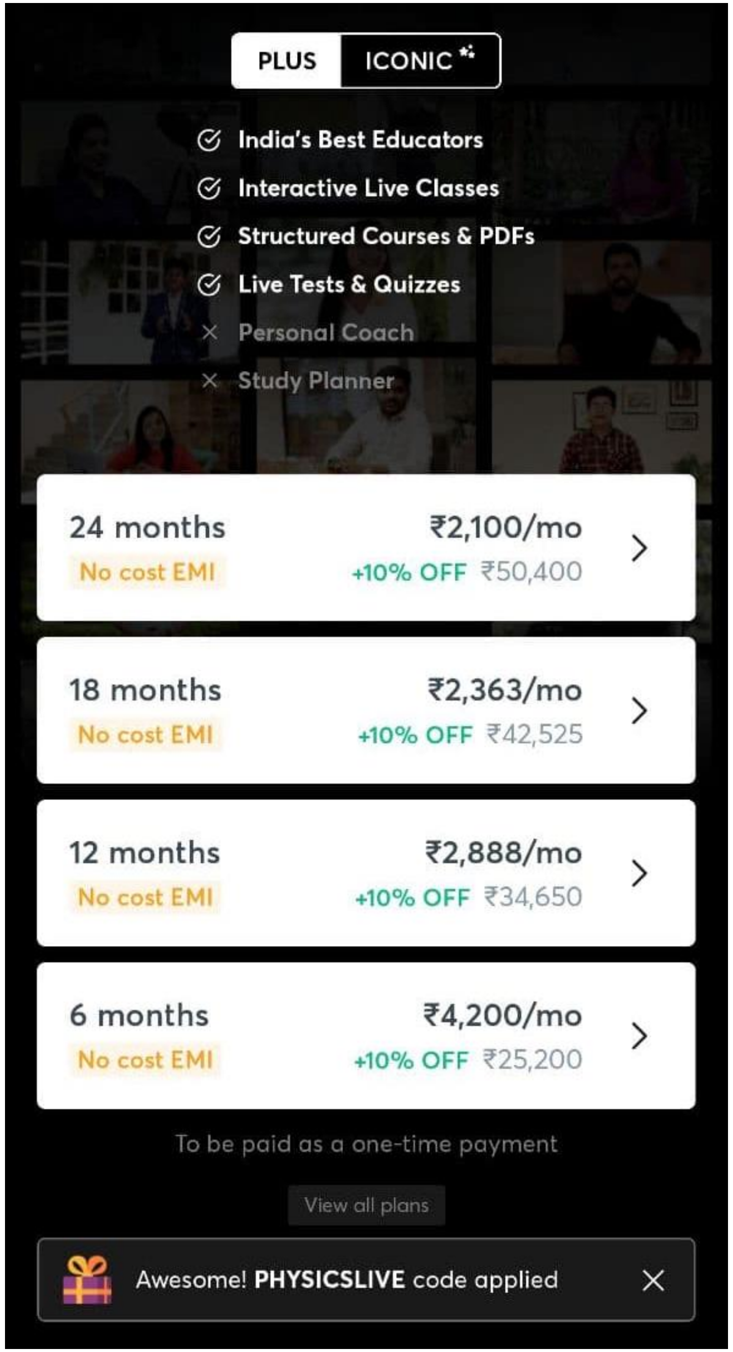


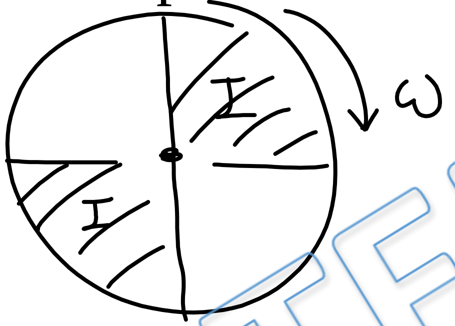
Written Solution

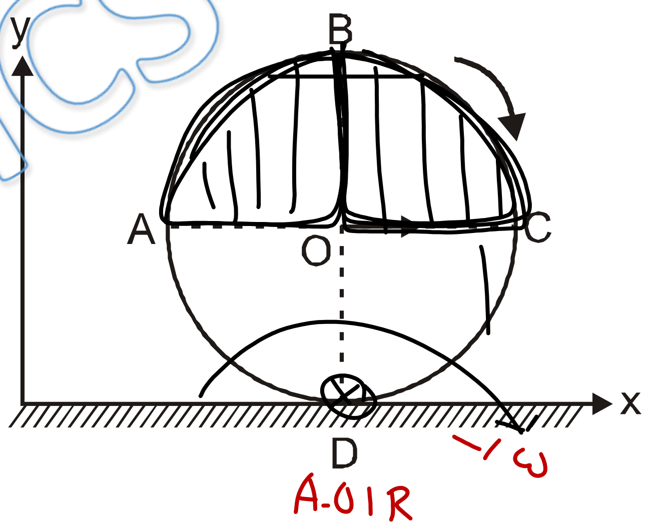
JEE Main & Advanced, NSEP, INPhO, IPhO
Physics DPP

DPP-7 Instantaneous Axis of rotation

By Physicsaholics Team

Q1) A rigid uniform circular disc rolls without slipping on a horizontal surface with uniform speed along the positive x–direction as shown. AC and BD are the two diameters and at the instant shown in diagram AC is horizontal and BD is vertical then choose the correct options at the instant shown. (O : centre of the disc)





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(c) Sector BOC has same kinetic energy as sector AOB

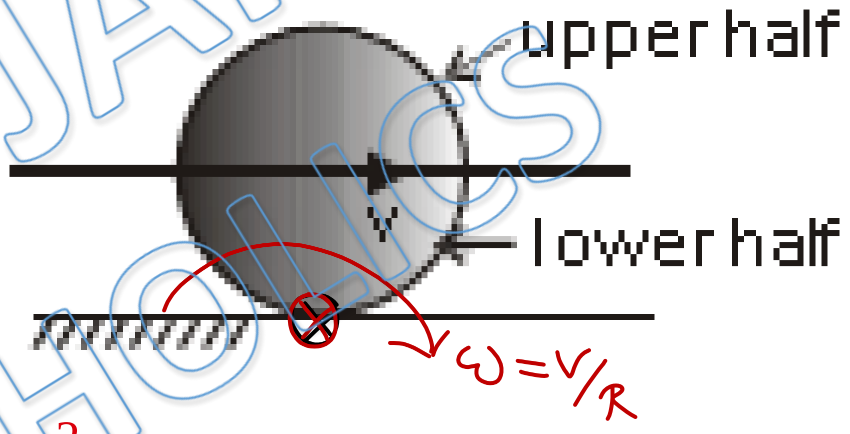
(d) Sector BOC has same kinetic energy as sector AOD with respect to the centre of mass frame of disc

Q2) Consider a uniform disc of mass ‘m’ performing pure rolling with velocity ‘v’ on a fixed rough surface

$$\text{Total KE} = \frac{1}{2}\left(\frac{3}{2}mR^2\right)\omega^2$$

$$= \frac{3}{4}mv^2$$

KE of upper > KE of lower



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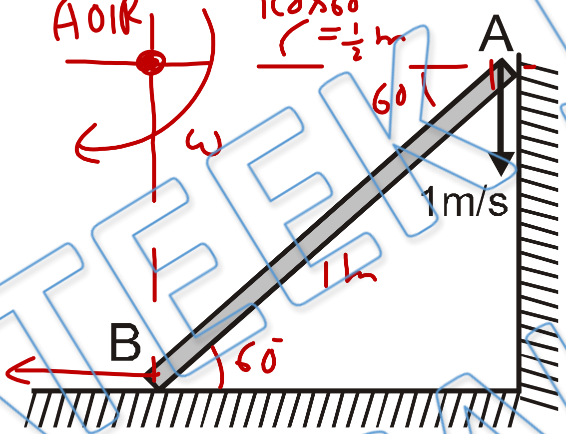

(a) 2 rad/s (b) 1.5 rad/s (c) 0.5 rad/s (d) 0.75 rad/s

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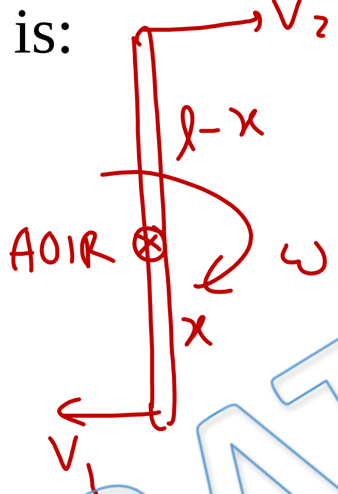


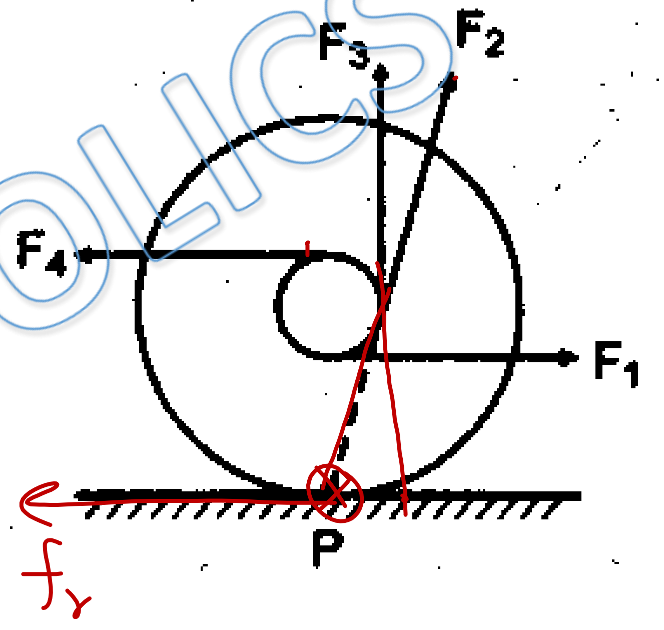
$$\omega x = V_1$$
$$\omega(l-x) = V_2$$
$$\frac{V_1}{x}(l-x) = V_2$$
$$V_1 l - V_1 x = V_2 x$$

(a) zero (b) $\frac{v_2}{v_1+v_2} l$ (c) $\frac{v_1 l}{v_1+v_2}$ (d) $l/2$

$$x = \frac{V_1 l}{V_1+V_2}$$

Q5) A spool of wire rests on a horizontal surface as shown in figure. As the wire is pulled, the spool does not slip at contact point P. On separate trials, each one of the forces F_1, F_2, F_3 and F_4 is applied to the spool. For each one of these forces the spool :

$\tau_P = I_P \alpha$



(a) will rotate anticlockwise if F_1 is applied
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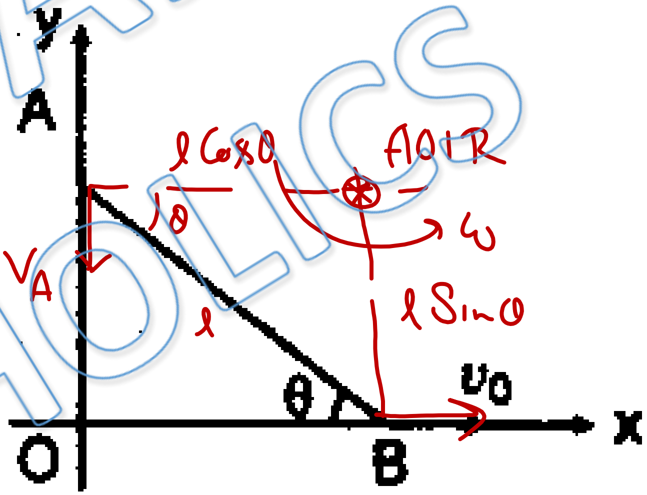
Q6) The end B of the rod AB which makes angle θ with the floor is being pulled with, a constant velocity v_0 as shown. The length of the rod is l. At the instant when θ = 37° :



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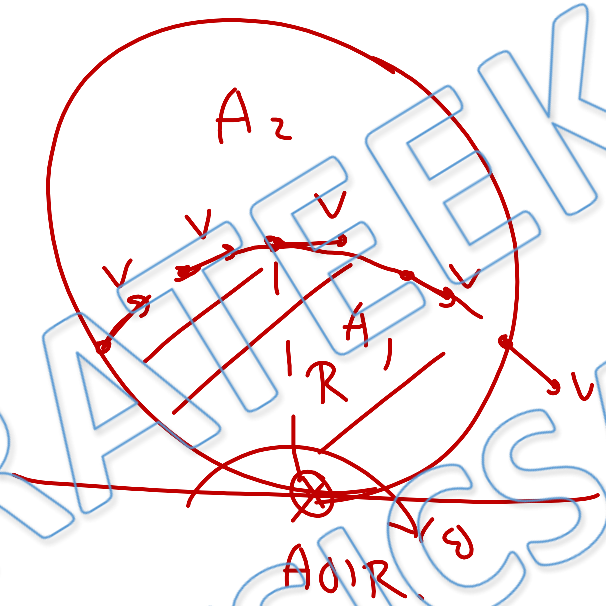


(a) $A_1 > A_2$

(b) $A_1 < A_2$

(c) $A_1 = A_2$

(d) Data is not sufficient to decide the relation

Q8) The end B of the rod AB which makes angle θ with the floor is being pulled with, a constant velocity v_0 as shown. The length of the rod is l. instantaneous speed of centre of rod at is $\theta = 30^0$ is

$\omega = \frac{V_0}{l/2} = \frac{2V_0}{l}$

(a) $\frac{v_0}{2}$

(b) $\frac{v_0}{4}$

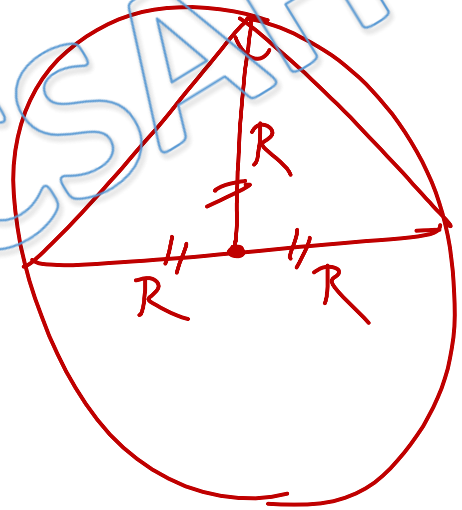
(c) v_0

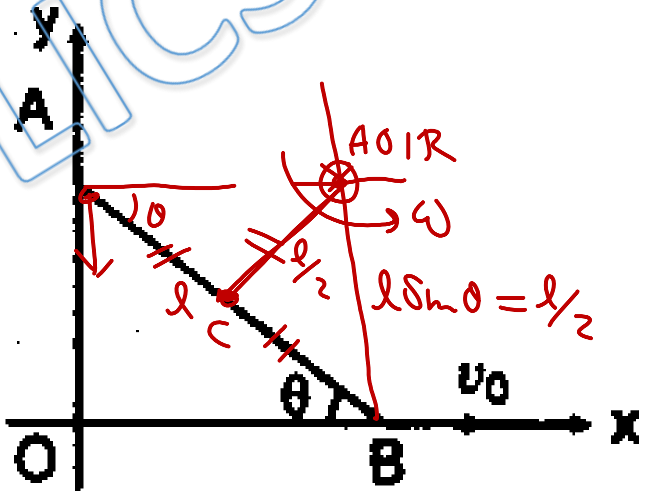
(d) None of these

$V_c = \omega\, l/2$

$= \frac{2V_0}{l} \times \frac{l}{2}$

$= V_0$





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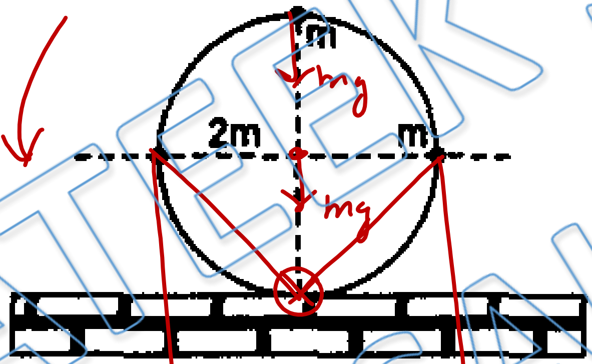

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Q10) A sphere of radius R is moving on ground. Ratio of velocity of its centre and its angular velocity is greater than R. if d is distance of axis of instantaneous rotation from centre of sphere then

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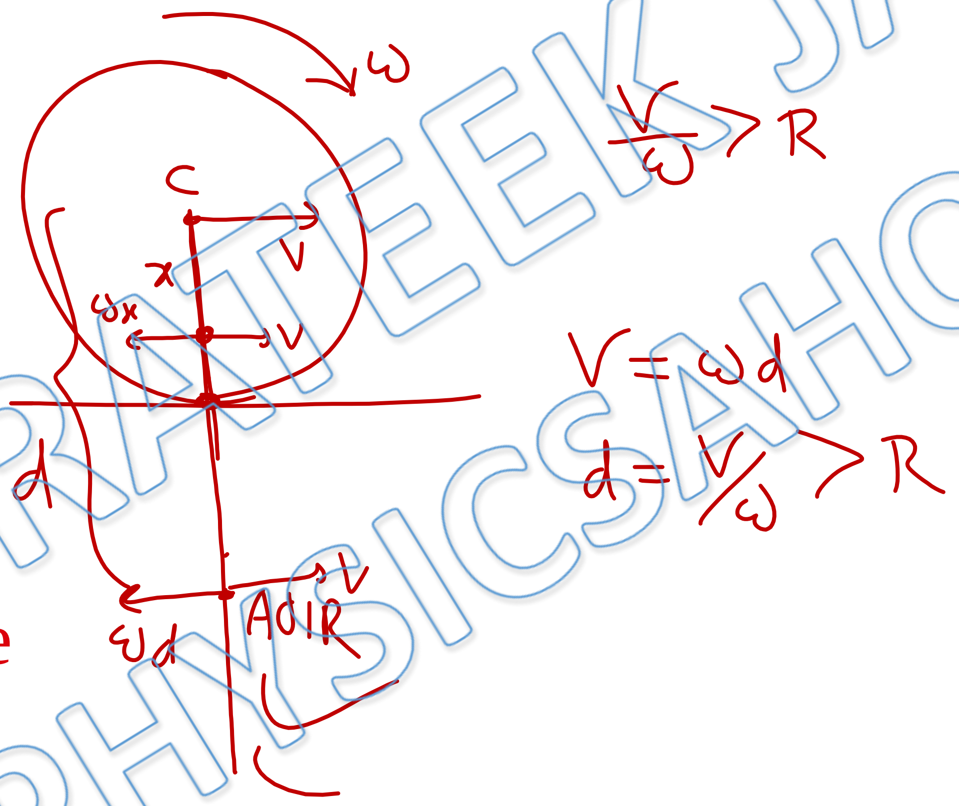

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