

1. The necessary and sufficient condition for a rigid body to be in equilibrium is the sum of:(UEE:2003)
 - A. All torques acting on it is zero.
 - B. All forces acting on it should be zero.
 - C. All forces should be equal in magnitude, but opposite in direction to the sum of all torques acting on it.
 - D. All forces and the sum of all torques should be zero
 2. The angular momentum of a particle is:(UEE:2003)
 - A. Independent of the specific origin of coordinates.
 - B. Zero when its position and momentum vectors are parallel.
 - C. Zero when its position and momentum vectors are perpendicular.
 - D. Not zero for non zero position and momentum vectors.
 3. A disk rolls without slipping along a horizontal surface. The center of the disk has a translational speed v . The uppermost point on the disk has a translational speed (UEE: 2003).
 - A. Zero.
 - B. v .
 - C. $2v$.
 - D. 2π
 4. Two discs of moments of inertia I_1 and I_2 about their respective axes (which are normal to the disc and passing through the center), and rotating with angular speeds ω_1 and ω_2 are brought into contact face-to-face with their axes of rotation coincident take $\omega_1 \neq \omega_2$. What is the angular speed of the two-disc system after contact? (UEE:2003)
 - A. $\frac{I_1\omega_1 + 2I_2\omega_2}{I_1 + I_2}$.
 - B. $\frac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$.
 - C. $\frac{I_1\omega_1 + 2I_2\omega_2}{I_1 - 2I_2}$.
 - D. $\frac{I_1\omega_1 + I_2\omega_2}{I_1 - I_2}$.
 5. A wheel starts from rest and rotates with constant angular acceleration to reach an angular speed of 12 rad/s in 3 s . What is the magnitude of the angular acceleration of the wheel in rad/s^2 and the angle in radians through which it rotates in this time interval respectively? (UEE: 2004).
 - A. 4, 18.
 - B. 3, 18.
 - C. 18, 5.
 - D. 18, 4.
 6. The radius of the wheel shown below is 0.75 m . What is its moment of inertia? (UEE:2005)
 - A. 2.25 kgm^2 .
 - B. 3.38 kgm^2 .
 - C. 6.75 kgm^2 .
 - D. 9.00 kgm^2 .
- The diagram shows a square with four circles at its corners, each labeled '3kg'. The circles are connected by lines forming the square. A horizontal line and a vertical line intersect at the center of the square, representing the axes of rotation. The circles are positioned at the top, bottom, left, and right vertices of the square.
7. A 1.5 kg particle moves in the xy -plane with velocity $\mathbf{v} = (4.4\hat{i} - 3.6\hat{j}) \text{ m/s}$. What is the angular momentum when its position vector is $\mathbf{r} = (1.5\hat{i} + 2.2\hat{j}) \text{ m}$? (UEE: 2005).
 - A. $-22\hat{k} \text{ kgm}^2/\text{s}$.
 - B. $14.6\hat{k} \text{ kgm}^2/\text{s}$.
 - C. $-14.6\hat{k} \text{ kgm}^2/\text{s}$.
 - D. $22\hat{k} \text{ kgm}^2/\text{s}$.
 8. If two particles have equal momenta, then which one of the following statements is TRUE about their kinetic energies?(UEE:2005)
 - A. Their kinetic energies are always equal.
 - B. Their kinetic energies are never equal.
 - C. Their kinetic energies are equal when their masses are the same.
 - D. Their kinetic energies are equal when the speed of one of the particles is half the speed of the other particle and their masses are the same.

9. A uniform ball of radius r and mass m starts from rest and rolls down a frictionless incline of height h . When the ball reaches the ground, how fast is it going? (UEE:2005)

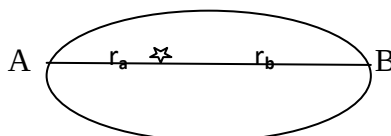
A. $\sqrt{\frac{10}{7}gh}$. B. $\sqrt{\frac{9}{10}gh}$. C. $\sqrt{\frac{10}{9}gh}$. D. $\sqrt{\frac{7}{10}gh}$.

10. A hoop of mass M and radius R is at rest at the top of an incline plane of height h . The hoop rolls down the plane without slipping. When the hoop reaches bottom, its angular momentum about the center of mass is : (UEE: 2006).

A. Mgh . B. $MR\sqrt{2gh}$ C. $MR\sqrt{gh}/2$ D. $MR\sqrt{gh}$

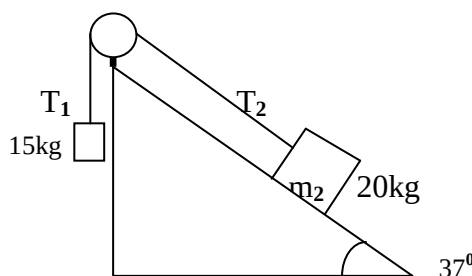
11. A planet of mass m is circling a star in an elliptical orbit as shown below. If its velocity at a point A is 60,000 m/s, and $r_b = 8r_a$ what is its velocity at point B? (UEE: 2006).

- A. 7,500 m/s.
B. 8,571 m/s.
C. 60,000 m/s
D. 488,000 m/s.



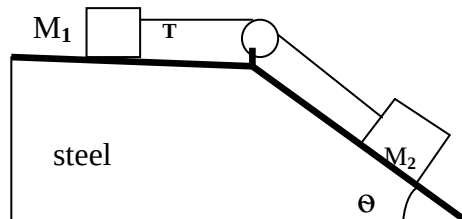
12. As shown in Figure below, two blocks are connected by a string of negligible mass passing over a pulley of radius $r = 0.2$ m and moment of inertia I . The block on the frictionless incline is moving with a constant acceleration $a = 2$ m/s² up along the incline. What is the moment of inertia of the pulley? (UEE: 2006).

- A. 0.8 kg m^2 .
B. 1.25 kg m^2 .
C. 4 kg m^2 .
D. 40 kg m^2 .



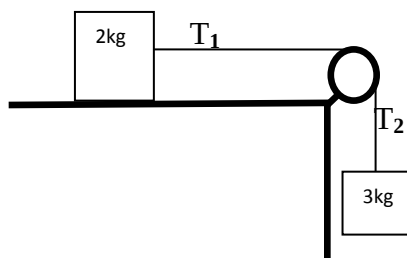
13. An aluminum block of mass $m_1 = 3$ kg and a copper block of mass $m_2 = 5$ kg are connected by a light string over a frictionless pulley. They sit on a steel surface as shown in figure below, where $\Theta = 53^\circ$. The coefficient of kinetic friction between the steel surface and each block is 0.3. If the blocks are released from rest what is the tension T in the string? (UEE: 2006).

- A. 29.40 N.
B. 17.25 N.
C. 12.25 N.
D. 8.60 N.



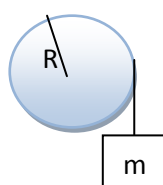
14. Two blocks are connected by a string of negligible mass passing over a pulley of radius $r = 0.2$ m and moment of inertia I as shown in figure below. The block on the horizontal frictionless surface is moving with a constant acceleration $a = 2$ m/s². If the pulley axis is frictionless, the string is inextensible and does not slip on the pulley, what should be the inertia of the pulley? (UEE: 2007).

- A. 0.40 kg m^2 .
- B. 0.80 kg m^2 .
- C. 4.00 kg m^2 .
- D. 8.00 kg m^2 .



15. An object with a mass of $m = 3.0 \text{ kg}$ is attached to the free end of a light string wrapped around a pulley of radius $R = 0.50 \text{ m}$ and moment of inertia $I = 0.75 \text{ kg m}^2$. The pulley is free to rotate in a vertical plane about a fixed frictionless axis passing through its center as shown in figure below. The suspended object is released from rest at 3.60 m above the floor. What is the angular momentum of the pulley at the time when the object strikes the floor? (UEE: 2007).

- A. $4.5 \text{ kg m}^2/\text{s}$.
- B. $9.0 \text{ kg m}^2/\text{s}$.
- C. $12.3 \text{ kg m}^2/\text{s}$.
- D. $18 \text{ kg m}^2/\text{s}$.

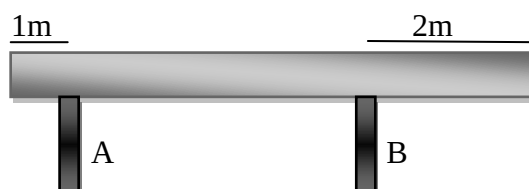


16. Determine the torque due to a force $\vec{F} = 2\hat{i} - 3\hat{j} + 4\hat{k} \text{ N}$ acting at a point $\vec{r} = 3\hat{i} + 2\hat{j} + 3\hat{k}$ about the origin? (UEE: 2008).

- A. $6\hat{i} - 6\hat{j} + 12\hat{k}$.
- B. $-6\hat{i} + 6\hat{j} + 12\hat{k}$.
- C. $17\hat{i} + 6\hat{j} - 13\hat{k}$.
- D. $-17\hat{i} + 6\hat{j} + 13\hat{k}$.

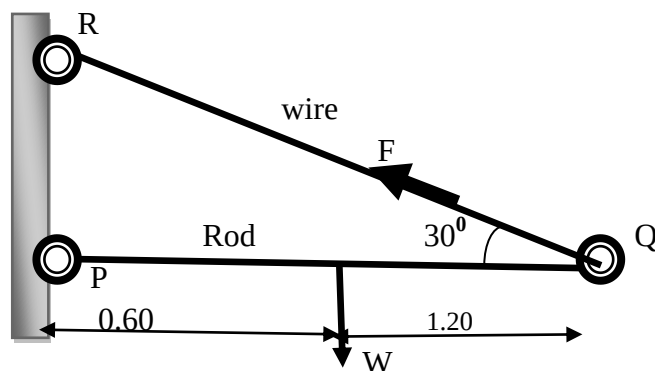
17. A uniform, 6 m long, and 600-N beam, rests on two supports, as shown. The force exerted on the beam by the right support B is closest to: (UEE: 2008).

- A. 75 N .
- B. 240 N .
- C. 400 N .
- D. 320 N .



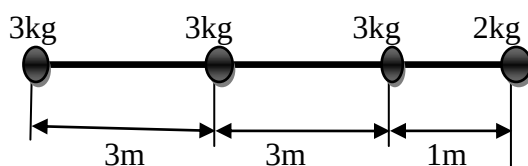
18. A rod PQ is attached at P to a vertical wall, as shown in the Figure below. The length of the rod is 1.80 m . The weight W of the rod acts at 0.60 m from P. The rod is kept horizontal and in equilibrium by a wire attached to Q and to the wall at R. The wire provides a force F on the rod of 50 N at 30° to the horizontal. By taking moments about P, determine the weight W of the rod. (UEE:2008)

- A. 130.0 N.
- B. 150.0 N.
- C. 75.0 N.
- D. 50.0 N.



19. Find the distance of the center of mass of the system shown in the diagram from point A. The rod is massless.(UEE:2008)

- A. 3.73 m.
- B. 2.09 m.
- C. 2.45 m
- D. 5.86 m



20. The rotational analogue of mass is: (UEE:2008)

- A. Moment of inertia.
- B. Torque.
- C. Angular momentum.
- D. Angular acceleration.

21. A fly wheel is rotating with an angular velocity of 2 rad/sec and acted by an acceleration of $1/\pi\text{ rad/s}^2$. How long will it take to complete three revolutions? (UEE:2008)

- A. $0.5\pi\text{ s}$.
- B. $\pi\text{ s}$.
- C. $2\pi\text{ s}$.
- D. $4\pi\text{ s}^2$.

22. A disk of radius R with uniform distribution of mass M , rotates about axis perpendicular to its plane at the rim with angular speed w . the moment of inertia of the disk about the axis through the center is $\frac{1}{2}MR^2$. What is the kinetic energy of the disk?(UEE:2009)

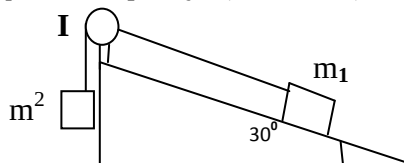
- A. $\frac{1}{4}MR^2w^2$.
- B. $\frac{1}{3}MR^2w^2$.
- C. $\frac{1}{2}MR^2w^2$.
- D. $\frac{3}{4}MR^2w^2$.

23. A pulley is rotating at a frequency of 20 rev/min . A motor speeds up the wheel so that 30 s later the frequency of motion is 60 rev/min . How far will points on the pool 0.30 m from its center has travelled during that period? (UEE:2009)

- A. 125.7 m .
- B. 0.13 m .
- C. 37.68 m .
- D. 4.2 m .

24. A block of mass $m_1 = 10\text{kg}$ placed on a frictionless incline plane connected to mass $m_2 = 15\text{kg}$ using a string of negligible mass passing over a pulley of moment of inertia $I = 0.25\text{kgm}^2$ and radius $R = 10\text{ cm}$ as shown in the diagram. What is the torque on the pulley? (UEE:2009)

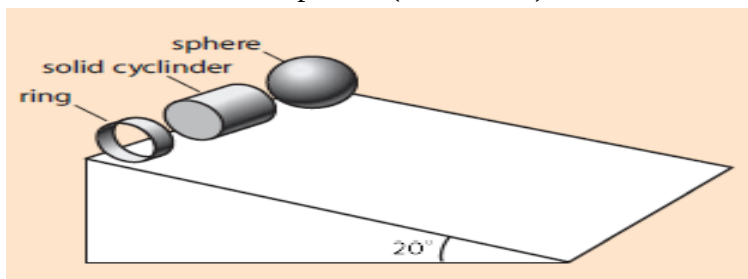
- A. 2.5 N m .
- B. 4 N m .
- C. 5 N m .
- D. 12 N m .



25. A thin rod when rotated about an axis at the end of the rod has a moment of inertia $\frac{1}{3}ML^2$.

The rod has a mass of 1.5 kg and length 1 m . If the rod initially at rest gains a rotational kinetic energy of 1000J , at what speed does it rotate? (UEE:2010)

- A. $10\sqrt{5}$ rad/s. B. $20\sqrt{10}$ rad/s. C. 10 rad/s. D. 18.8 rad/s
26. A ring, a solid cylinder and solid sphere, all having the same mass and the same radius, are held at the top of an inclined plane as shown figure below. If the objects roll without slipping and the plane is 0.3, which one of the following shows the order in which they will get to the bottom of the inclined plane? (UEE:2010)



- A. All will reach the bottom at the same time. C. Ring, solid cylinder, sphere.
B. Sphere, solid cylinder, ring. D. Solid cylinder, sphere, ring.
27. If in a given rotational system of a body the angular momentum is increased with the time, which one of the following statements is **NOT** correct? (UEE:2010)
- A. The radius of rotation may increase. C. There is a torque exerted on the system.
B. The moment of inertia may increase. D. There is no torque exerted on the system.
28. Five beads of equal mass are fixed on a rigid light rod that is free to rotate about a frictionless vertical bearing. The arrangement is such that, four of them are placed at 0.25 m and the fifth one is at 0.5 m from the axis of rotation. The rotational kinetic energy is 144J when the beads were rotating with angular speed of 48 rad/s. What is the mass of each bead? (UEE: 2011).
- A. 0.25 kg. B. 0.5 kg. C. 0.75 kg. D. 1 kg.
29. A thin circular ring of mass M and radius r and moment of inertia Mr^2 is rotating about its axis with a constant angular velocity ω . Two objects each of mass m , are attached gently to the opposite ends of a diameter of the ring. What would be the angular velocity of the wheel? (UEE: 2011).
- A. $\frac{\omega M}{(M+m)}$. B. $\frac{\omega(M+2m)}{(M+2m)}$. C. $\frac{\omega M}{(M+2m)}$. D. $\frac{\omega(M+2m)}{M}$.
30. In a playing room a turn table of radius 2m has moment of inertia 250 kgm^2 and it is rotating about a frictionless vertical axel. When a boy of mass 50 kg stands near the rim, the system rotates with angular speed 3 rad/s. The boy walks towards the center and stands at 1m from the axel. What is the final angular speed of the system? (UEE: 2011).
- A. 3 rad/s. B. 2.5 rad/s. C. 5.4 rad/s. D. 4.5 rad/s.

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