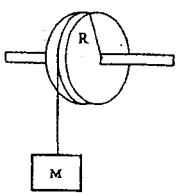
PHYS101.40,41,42 – Chapters 10 & 11 (Instructor: Dr. Al–Shukri) (4 pages)

Q1. A disk has a moment of inertia of 6.0 kg.m^2 and a constant angular acceleration of 2.0 rad/s^2 about its axis of rotation. If it starts from rest, find the work done by the net torque during the first 5.0 s.
a. 300 J b. 30 J c. 60 J
d. 600 J e. 0.0 J

Q2. A 10-kg block is attached to a cord that is wrapped around the rim of a flywheel of radius 0.5 m and hangs vertically (see the **Figure**). If the moment of inertia of the flywheel is 2.0 kg.m^2, find the magnitude of the linear acceleration of the block.
a. 5.4 m/s^2 b. 9.8 m/s^2
c. 0.0 m/s^2 d. 2.0 m/s^2
e. 3.5 m/s^2



Q3. A wheel starting from rest, turns through 8 revolutions in a time interval of 17 s. Assuming constant angular acceleration, the angular speed at the end of this time interval is:
a. 5.9 rad/s b. 8.5 rad/s c. 0.0 rad/s
d. 1.7 rad/s e. 3.5 rad/s

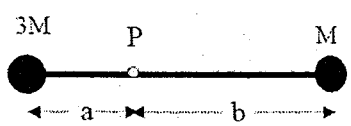
Q4. A disk has a mass of 32 kg and a radius of 25 cm. It rolls without slipping along a level ground at 5.0 m/s. Find the total kinetic energy of the disk.
a. 600 J b. 400 J c. 800 J
d. 200 J e. 100 J

Q5. A 10.0-kg particle is moving in a horizontal circular path of radius 2.00 m with a constant angular speed of 10.0 rad/s. Find the magnitude of its angular momentum (in kg.m^2/s) about a vertical axis passing through the center of the circle.
a. 400 b. 40.0 c. 0
d. 50.0 e. 500

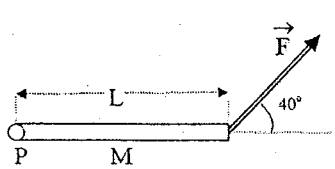
Q6. A 2.0-kg block is located on the x-axis 3.0 m from the origin and is acted upon by a force $\boldsymbol{F} = 8.0\boldsymbol{i}$ N. Find the net torque acting on the block relative to the origin.
a. 0.0 N.m b. -12 k N.m c. -24 k N.m
d. 18 k N.m e. 24 k N.m

Q7. A rotating wheel has an initial angular velocity ω_o. After 3.00 s its angular velocity is 98 rad/s. If it completes 37 revolutions during this 3.00 s interval, find ω_o (assume constant angular acceleration).
a. 57.0 rad/s b. 88.0 rad/s c. 108 rad/s
d. 41.0 rad/s e. 32.0 rad/s

Q8. The rigid body shown in **the Figure** is rotated about an axis perpendicular to the paper and passing through point P. If M = 0.40 kg, a = 30 cm, b = 50 cm, find the work required to increase the angular velocity of the body from rest to 5.0 rad/s. (Neglect the force of friction, mass of the connecting rods and treat the particles as point masses).
a. 2.6 J b. 2.9 J
c. 3.4 J d. 1.2 J
e. 4.3 J



Q9. A uniform rod of mass M = 1.2 kg and length L = 0.80 m is pivoted at point P and rests on a horizontal smooth surface (see the **Figure**). If a force (F = 5.0 N, θ = 40°) is applied as shown, find its angular acceleration about point P.
a. 10 rad/s^2 b. 16 rad/s^2
c. 12 rad/s^2 d. 8.0 rad/s^2
e. 33 rad/s^2



Q10. A student in a class demonstration is sitting on a frictionless rotating chair with his arms by the side of his body. The chair-student system is rotating with an angular speed ω. The student suddenly extends his arms horizontally. The angular velocity of the system:
a. decreases
b. increases
c. remains the same
d. may increase or decrease depending on the mass of the student
e. may increase or decrease depending on the mass of the chair

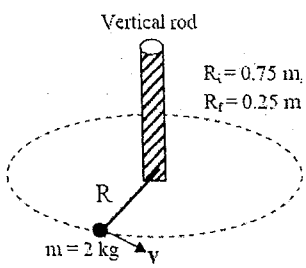
Q11. A solid cylinder of mass M and radius R starts from rest and rolls down an incline plane making an angle of 30° with the horizontal. The linear speed of its center, after it has traveled 5 m down the incline, is: ($I_{cm} = 1/2 \times M \times R^2$)
a. 5.7 m/s b. 3.8 m/s c. 2.5 m/s
d. 4.9 m/s e. 1.3 m/s

Q12. Force F = (2.0$\boldsymbol{i}$ –3.0$\boldsymbol{j}$) N, acts on a mass located at r = (0.50$\boldsymbol{i}$ +2.0$\boldsymbol{j}$) m. Find the resulting torque (in N.m) about the origin.
a. –5.5 $\boldsymbol{k}$ b. +5.5 $\boldsymbol{k}$ c. +2.5 $\boldsymbol{k}$
d. –2.5 $\boldsymbol{k}$ e. 0.0 $\boldsymbol{k}$

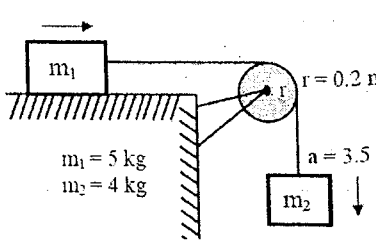
Q13. A disk has a rotational inertia of 6.0 kg.m^2 and a constant angular acceleration of 2.0 rad/s^2. If it starts from rest, the work done by the net torque on it during the first 5.0 seconds is:
a. 300 J b. 0 J c. 60 J
d. 600 J e. 30 J

Q14. If the net external torque acting on an object rotating about fixed axis is zero, which of the following statements is correct?
a. The angular momentum of the object will not change.
b. The angular momentum of the object will change.
c. The angular acceleration of the object is not zero.
d. The rotational kinetic energy of the object will change.
e. The angular velocity of the object will change.

Q15. A 2.0 kg mass is attached to a string and fixed to a vertical rod (see the **Figure**). The mass is initially orbiting with a speed of 5.0 m/s in a circle of radius 0.75 m. The string is then slowly winding around the vertical rod. What is the speed of the mass at the moment the string reaches a length of 0.25 m?
a. 15 m/s b. 3.9 m/s
c. 45 m/s d. 75 m/s
e. 12 m/s



Q16. A mass (m_1 = 5.0 kg) which slides on a frictionless surface is connected by a light cord to a mass (m_2 = 4.0 kg), as shown in the **Figure**. The pulley (radius = 0.20 m) rotates about a frictionless axle. The acceleration of m_2 is 3.5 m/s^2. What is the rotational inertia of the pulley?
a. 0.088 kg.m^2



b. 0.029 kg.m^2
c. 0.044 kg.m^2
d. 0.062 kg.m^2
e. 0.060 kg.m^2

Q17. A solid ball, whose radius R is 10 cm and whose mass M is 8.5 kg, rolls smoothly from rest down a 25 deg inclined plane whose length L is 5.0 m. What is the speed of the center of mass of the ball when it reaches the bottom of the inclined plane?
a. 5.4 m/s b. 1.0 m/s c. 5.1 m/s
d. 4.6 m/s e. 4.2 m/s

Q18. A 2.5 kg block travels around a 0.50 m radius circle with an angular velocity of 12 rad/s. Find the magnitude of the angular momentum of the block about the center of the circle.
a. 7.5 kg.m^2/s
b. 1.5 kg.m^2/s
c. 6.0 kg.m^2/s
d. 9.0 kg.m^2/s
e. 12 kg.m^2/s

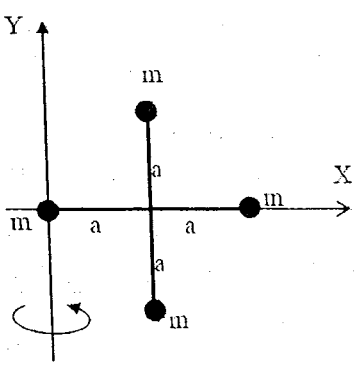
Q19. The **Figure** shows an object of mass m=100 g and velocity= V_o is fired onto one end of a uniform thin rod (L= 0.4 m, M= 1.0 kg) initially at rest. The rod can rotate freely about an axis through its center (O). The object sticks to the rod after collision. The angular velocity of the system (rod + object) is 10 rad/s immediately after the collision. Calculate V_o.
a. 8.7 m/s
b. 4.0 m/s
c. 1.8 m/s
d. 2.2 m/s
e. 9.5 m/s

Q20. The angular speed in rad/s of the minute hand of a watch is:
a. π/1800 b. π/60 c. π /3600
d. 2 π e. 60

Q21. A wheel of radius 0.10 m has a 2.5 m cord wrapped around its outside edge. Starting from rest, the wheel is given a constant angular acceleration of 2.0 rad/s^2. The cord will unwind in:
a. 5.0 s b. 2.0 s c. 8.0 s
d. 0.82 s e. 130 s

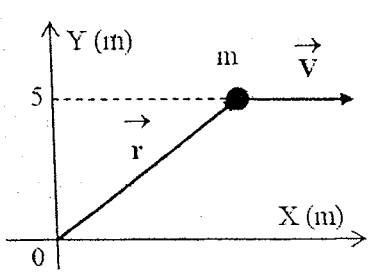
Q22. A disk starts from rest and rotates around a fixed axis, subject to a constant net torque. The work done by the torque from t = 0 to t = 3.0 s is W_1 and the work done from t = 0 s to t = 6 s is W_2. The value of W_1/W_2 is:
a. 1/4 b. 2 c. 1/2
d. 1 e. 4

Q23. Four identical particles, each with mass m, are arranged in the x, y plane as shown in the **Figure**. They are connected by massless rods to form a rigid body. If m = 2.0 kg and a = 1.0 m, the rotational inertia of this array about the y-axis is:



a. 12 kg.m^2 b. 4.0 kg.m^2 c. 9.6 kg.m^2
d. 4.8 kg.m^2 e. 16 kg.m^2

Q24. A 2-kg particle moves in the xy plane with constant speed of 3.0 m/s in the +x-direction along the line y = 5 m (see the **Figure**). What is its angular momentum (in kg.m^2/s) relative to the origin? (i, j, k are the unit vectors in x, y, z axes)

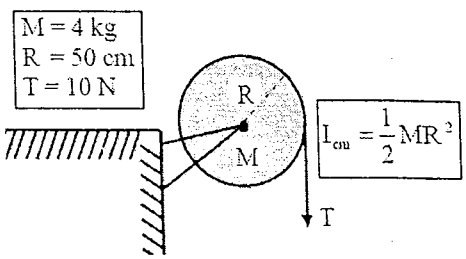


a. -30 k b. +30 k
c. -15 j d. +15 j
e. -30 i

Q25. A solid sphere rolls without slipping along the floor. The ratio of its translational kinetic energy to its rotational kinetic energy (about an axis through its center of mass) is:
a. 5/2 b. 7/5 c. 2/5
d. 1/2 e. 1/3

Q26. A man, with his arms at his sides, is spinning on a light frictionless turntable. When he extends his arms:
a. his angular momentum remains the same
b. his angular velocity remains the same
c. his rotational inertia decreases
d. his rotational kinetic energy increases
e. his angular velocity increases

Q27. A uniform disk of radius 50 cm and mass 4 kg is mounted o a frictionless axle, as shown in the **Figure**. A light cord is wrappe around the rim of the disk and a steady downward pull of 10 N is exerted on the cord. Find the tangential acceleration of a point on the rim of the disk.



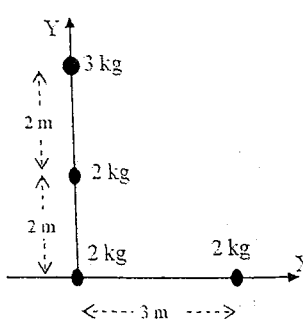
a. 5.0 m/s^2
b. 4.0 m/s^2
c. 3.0 m/s^2
d. 2.0 m/s^2
e. 1.0 m/s^2

Q28. At t=0, the motor of a turntable (radius = 10 cm) rotating at 33.33 rev/ min i turned off. It slows down uniformly and stops at t=2 min. What the magnitude of the angular acceleration of the turntable?
a. 0.029 rad/s^2 b. 0.123 rad/s^2 c. 0
d. 0.107 rad/s^2 e. 0.003 rad/s^2

Q29. The angular position of a point on the rim of a rotating wh is given by $\theta = 4.0t - 3.0t^2 + t^3$, where θ is in radians and t is in seconds. What is the average angular acceleration for the time interval that begins at t = 0 s and ends at t = 1.0 s?

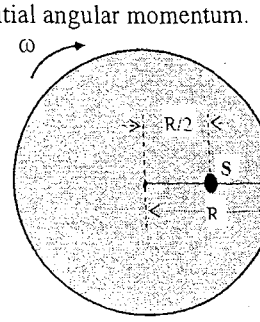
a. -3.0 rad/s^2 b. +3.0 rad/s^2 c. +2.5 rad/s^2
d. -2.5 rad/s^2 e. +1.4 rad/s^2

Q30. The four particles in the **Figure** are connected by rigid rods of negligible mass. Find the rotational inertia of the four particles about the y-axis.



a. 18 kg.m^2 b. 20 kg.m^2
c. 38 kg.m^2 d. 12 kg.m^2
e. 45 kg.m^2

Q31. A star of radius R is spinning with an angular velocity w. If it shrinks till its radius becomes R/2, find the rat the final angular momentum to its initial angular momentum.
a. 1 b. 2 c. 4
d. 1/2 e. 1/4



Q32. Mohammed (M) and Salim (S) (have the same mass) are riding on a merry-go-round rotating at a constant rate. Salim is half way in from the edge, as shown in the **Figure**. The angular

momenta of Salim and Mohammed about the axis of rotation are L_s and L_m respectively. Which of the following relations is correct? (M and S have the same mass)

a. $L_m = 4\,L_s$ b. $L_m = L_s$
c. $L_m = L_s/4$ d. $L_m = 2\,L_s$
e. $L_m = L_s/2$

Q33 A particle located at the position vector r=(1.2 i+ 1.2 j) m has a force F=(150 i) N acting on it. The torque (in N.m) of the force about the origin is:

a. -180 k b. 180 k c. 180 i
d. 180 (i+j) e. -180 j

Q34 A wheel, initially at rest, has a constant angular acceleration. The wheel completes 71 revolutions in 9.0 s. Its angular acceleration in rad/s^2 is:

a. 11 b. 1.7 c. 50
d. 10 e. 15

Q35 The rotational inertia of a solid object rotating about an axis DOES NOT DEPEND UPON ITS:

a. angular speed
b. mass
c. distribution of mass
d. geometry (the shape of the object)
e. axis of rotation

Q36 A disk has a rotational inertia of 6.0 kg×m^2 and a constant angular acceleration of 2.0 rad/s^2. If it starts from rest the work done during the first 5.0 s by the net torque acting on it is:

a. 300 J b. 30 J c. 120 J
d. 0 J e. 600 J

Q37 A uniform wheel of radius 0.5 m rolls without slipping on a horizontal surface. Starting from rest, the wheel moves with constant angular acceleration 6.0 rad/s^2. The distance traveled by the center of mass of the wheel from t = 0 to t = 3 s is:

a. 13.5 m b. 27 m c. zero m
d. 18 m e. none of other answers

Q38. A 2.0 kg stone is tied to a 0.50 m string and swung around a circle at a constant angular velocity of 12 rad/s. The net torque on the stone about the center of the circle is:

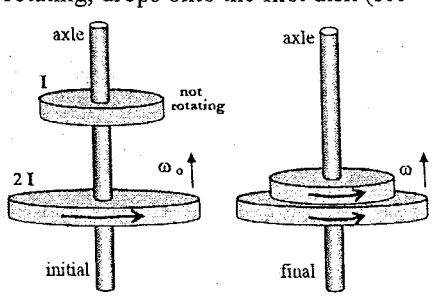
a. 0 N×m b. 6.0 N×m c. 12 N×m
d. 72 N×m e. 140 N×m

Q39. A stone in the form of a uniform circular disk of radius 0.20 m and mass 14 kg can rotate about its axis. Starting from rest, it reaches an angular velocity of 44 rad/s in 10 s under the action of a constant torque. What is the instantaneous power at the end of this time interval?

a. 54 W b. 110 W c. 75 W
d. 3 W e. 0 W

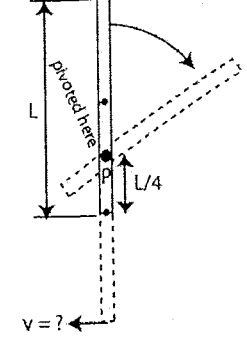
Q40. A disk (rotational inertia = 2×I) rotates with angular velocity W_o about a vertical, frictionless axle. A second disk (rotational inertia = I) and initially not rotating, drops onto the first disk (see the **Figure**). The two disks stick together and rotate with an angular velocity W. Find W.

a. (2/3)×W_o
b. (1/2)×W_o
c. (3/4)×W_o
d. W_o
e. 2×W_o



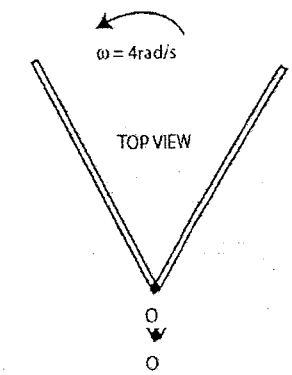
Q41 A uniform rod (M = 2.0 kg, L = 2.0 m) is held vertical about a pivot at point P, a distance L/4 from one end (see the **Figure**). The rotational inertia of the rod about P is 1.17 kg*m**2. If it starts rotating from rest, what is the linear speed of the lowest point of the rod as it passes again through the vertical position (v)?

a. 8.7 m/s b. 4.8 m/s
c. 17 m/s d. 2.4 m/s
e. zero



Q42 Consider two thin rods each of length (L = 1.5 m) and mass 30 g, arranged on a frictionless table as shown in the **Figure**. The system rotates about a vertical axis through point O with constant angular speed of 4.0 rad/s. What is the angular momentum of the system about O?

a. 0.18 kg*m**2/s
b. 0.54 kg*m**2/s
c. 1.5 kg*m**2/s
d. 0.27 kg*m**2/s
e. 0.0

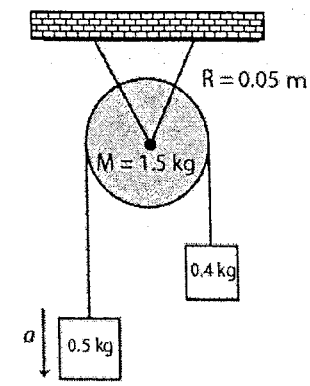


Q43. At t=0, a disk has an angular velocity of 360 rev/min, and constant angular acceleration of -0.50 rad/s^2. How many rotations does the disk make before coming to rest?

a. 226 b. 180 c. 360
d. 90 e. 113

Q44. In the **Figure**, m_1 = 0.50 kg, m_2 = 0.40 kg and the pulley has a disk shape of radius 0.05 m and mass M = 1.5 kg. What is the linear acceleration of the block of mass m2?

a. 0.59 m/s^2 b. 0.42 m/s^2
c. 1.46 m/s^2 d. 0.21 m/s^2
e. 0.0



Q45. A uniform solid sphere of radius 0.10 m rolls smoothly across a horizontal table at a speed 0.50 m/s with total kinetic energy 0.70 J. Find the mass of the sphere.

a. 4.0 kg b. 8.0 kg c. 2.0 kg
d. 1.0 kg e. 5.0 kg

Q46. A 2.0 kg particle is moving such that its position vector (**r**) relative to the origin is **r** =(-2.0×t^2 **i** + 3.0 **j**) m. What is the torque (about the origin) acting on the particle at t=2.0 s?

a. 24 k N.m b. -36 k N.m c. -24 k N.m
d. -48 k N.m e. 0

Q47. A man, with his arms at his sides, is spinning on a light turntable that can rotate freely about a vertical frictionless axis. When he extends his arms:

a. his angular velocity will decrease.
b. his angular momentum will increase.
c. his angular velocity remains the same.
d. his rotational inertia decreases.
e. his rotational kinetic energy remains the same