Practice Test 3

Name: _____ Date: _____

1. If a wheel turns with constant angular speed then:
   A) each point on its rim moves with constant velocity
   B) each point on its rim moves with constant acceleration
   C) the wheel turns through equal angles in equal times
   D) the angle through which the wheel turns in each second increases as time goes on
   E) the angle through which the wheel turns in each second decreases as time goes on

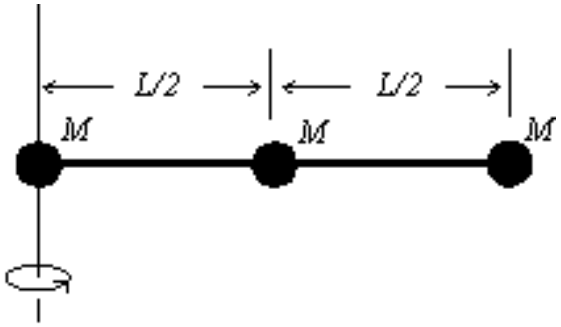
2. If a wheel is turning at 3.0 rad/s, the time it takes to complete one revolution is about:
   A) 0.33 s
   B) 0.67 s
   C) 1.0 s
   D) 1.3 s
   E) 2.1 s

3. A flywheel, is initially roatating at 20 rad/s and has a constant angular acceleration. After 9.0 s it has rotated through 450 rad. Its angular acceleration is:
   A) 3.3 rad/s
   B) 4.4 rad/s
   C) 5.6 rad/s
   D) 6.7 rad/s
   E) 11 rad/s

4. If the angular velocity vector of a spinning body points out of the page then, when viewed from above the page, the body is spinning:
   A) clockwise about an axis that is perpendicular to the page
   B) counterclockwise about an axis that is perpendicular to the page
   C) about an axis that is parallel to the page
   D) about an axis that is changing orientation
   E) about an axis that is getting longer

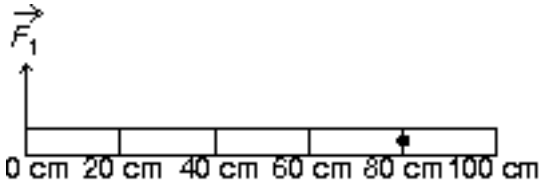
5. For a wheel spinning on an axis through its center, the ratio of the tangential acceleration of a point on the rim to the tangential acceleration of a point halfway between the center and the rim is:
   A) 1
   B) 2
   C) 1/2
   D) 4
   E) 1/4

6. Three identical balls, with masses of M, $2M$, and $3M$ are fastened to a massless rod of length L as shown. The rotational inertia about the left end of the rod is:



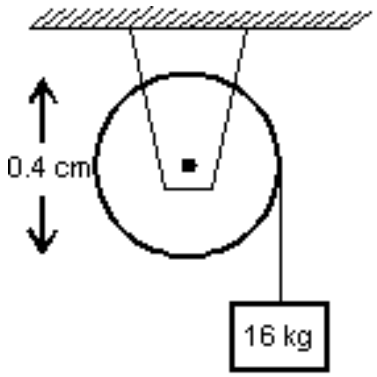
   A) $ML^2/2$
   B) ML^2
   C) $3ML^2/2$
   D) $6ML^2$
   E) $3ML^{2/4}$

7. A meter stick on a horizontal frictionless table top is pivoted at the 80-cm mark. A horizontal force $\not{c}_1$ is applied perpendicularly to the end of the stick at 0 cm, as shown. A second horizontal force $\not{c}_2$ (not shown) is applied at the 100-cm end of the stick. If the stick does not rotate:



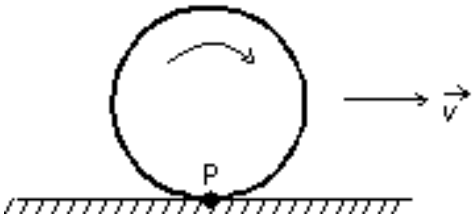
   A) $|\not{c}_2| > |\not{c}_1|$ for all orientations of $\not{c}_2$
   B) $|\not{c}_2| < |\not{c}_1|$ for all orientations of $\not{c}_2$
   C) $|\not{c}_2| = |\not{c}_1|$ for all orientations of $\not{c}_2$
   D) $|\not{c}_2| > |\not{c}_1|$ for some orientations of $\not{c}_2$ and $|\not{c}_2| < |\not{c}_1|$ for others
   E) $|\not{c}_2| > |\not{c}_1|$ for some orientations of $\not{c}_2$ and $|\not{c}_2| = |\not{c}_1|$ for others

8. A 16 kg block is attached to a cord that is wrapped around the rim of a flywheel of diameter 0.40 m and hangs vertically, as shown. The rotational inertia of the flywheel is 0.50 kg · m^2. When the block is released and the cord unwinds, the acceleration of the block is:



A) 0.15 *g*
B) 0.56 *g*
C) 0.84 *g*
D) *g*
E) 1.3 *g*

9. A wheel rolls without slipping along a horizontal road as shown. The velocity of the center of the wheel is represented by →. Point P is painted on the rim of the wheel. The instantaneous velocity of point P is:



A) →
B) ←
C) ↑
D) «
E) zero

10. Two wheels roll side-by-side without sliding, at the same speed. The radius of wheel 2 is twice the radius of wheel 1. The angular velocity of wheel 2 is:
A) twice the angular velocity of wheel 1
B) the same as the angular velocity of wheel 1
C) half the angular velocity of wheel 1
D) more than twice the angular velocity of wheel 1
E) less than half the angular velocity of wheel 1

11. When the speed of a rear-drive car is increasing on a horizontal road the direction of the frictional force on the tires is:
    A) forward for all tires
    B) backward for all tires
    C) forward for the front tires and backward for the rear tires
    D) backward for the front tires and forward for the rear tires
    E) zero

12. A solid wheel with mass *M,* radius *R*, and rotational inertia $MR^2/2$, rolls without sliding on a horizontial surface. A horizontal force *F* is applied to the axle and the center of mass has an acceleration *a*. The magnitudes of the applied force *F* and the frictional force *f* of the surface, respectively, are:
    A) $F = Ma, f = 0$
    B) $F = Ma, f = Ma/2$
    C) $F = 2Ma, f = Ma$
    D) $F = 2Ma, f = Ma/2$
    E) $F = 3Ma/2, f = Ma/2$

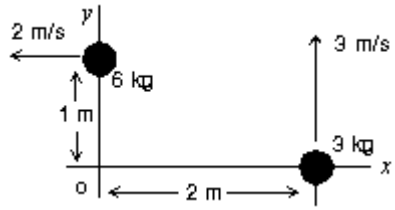
13. A hoop rolls with constant velocity and without sliding along level ground. Its ratation kinetic energy is:
    A) half its translational kinetic energy
    B) the same as its translational kinetic energy
    C) twice its translational kinetic energy
    D) four times its translational kinetic energy
    E) one-third its translational kinetic energy

14. A hoop, a uniform disk, and a uniform sphere, all with the same mass and outer radius, start with the same speed and roll without sliding up identical inclines. Rank the objects according to how high they go, least to greatest.
    A) hoop, disk, sphere
    B) disk, hoop, sphere
    C) sphere, hoop, disk
    D) sphere, disk, hoop'
    E) hoop, sphere, disk

15. When we apply the energy conversation principle to a cylinder rolling down an incline without sliding, we exclude the work done by friction because:
    A) there is no friction present
    B) the angular velocity of the center of mass about the point of contact is zero
    C) the coefficient of kinetic friction is zero
    D) the linear velocity of the point of contact (relative to the inclined surface) is zero
    E) the coefficient of static and kinetic friction are equal

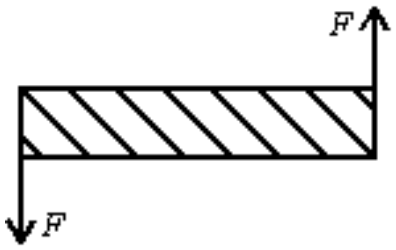
16. The angular momentum vector of Earth, due to its daily rotation, is directed:
    A) tangent to the equator toward the east
    B) tangent to the equator toward the west
    C) north
    D) south
    E) toward the sun

17. Two objects are moving in the *x*,,*y* plane as shown. The magnitude of their total angular momentum (about the origin O) is:



    A) zero
    B) 6 kg · m^2/s
    C) 12 kg · m^2/s
    D) 30 kg ·m^2/s
    E) 78 kg · m^2/s

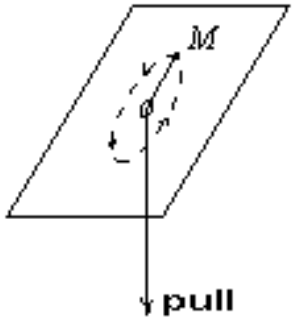
18. A rod rests on frictionless ice. Forces that are equal in magnitude and opposite in direction are simultaneously applied to its ends as shown. The quantity that vanishes is its:



A) angular momentum
B) angular acceleration
C) total linear momentum
D) kinetic energy
E) rotational inertia

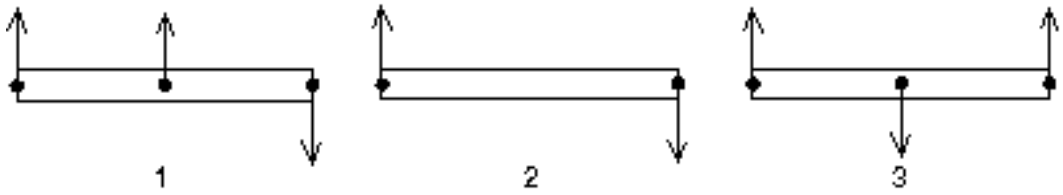
19. An ice skater with rotational inertia I_0 is spinning with angular speed ω_0. She pulls her arms in, thereby increasing her angular speed to $4\omega_0$. Her rotational inertia is then:
A) I_0
B) $I_0/2$
C) $2\ I_0$
D) $I_0/4$
E) $4\ I_0$

20. A block with mass *M,* on the end of a string, moves in a circle on a horizontal frictionless table as shown. As the string is slowly pulled through a small hole in the table:



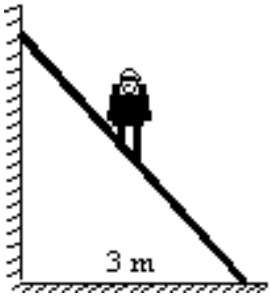
A) the angular momentum of *M* remains constant
B) the angular momentum of *M* decreases
C) the kinetic energy of *M* remains constant
D) the kinetic energy of *M* decreases
E) none of the above

21. Three identical uniform rods are each acted on by two or more forces, all perpendicular to the rods. Which of the rods could be in static equilibrium if an additional force is applied at the center of mass of the rod?



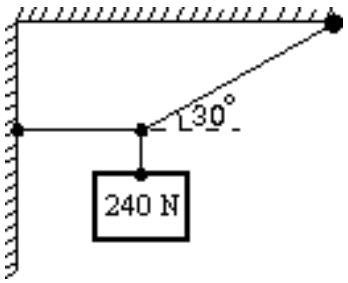
A) Only 1
B) Only 2
C) Only 3
D) Only 1 and 2
E) All three

22. An 800-N man stands halfway up a 5.0 m ladder of negligible weight. The base of the ladder is 3.0 m from the wall as shown. Assuming that the wall-ladder contact is frictionless, the wall pushes against the ladder with a force of:



A) 150 N
B) 300 N
C) 400 N
D) 600 N
E) 800 N

23. A 240-N weight is hung from two ropes as shown. The tension in the horizontal rope has magnitude:



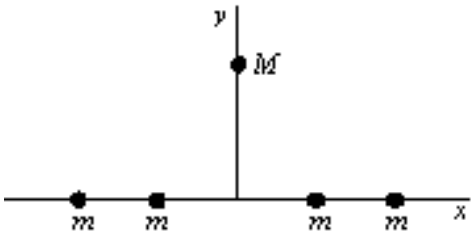
A) 0
B) 656 N
C) 480 N
D) 416 N
E) 176 N

24. Young's modulus is a proportionality constant that relates the force per unit area applied perpendicularly at the surface of an object to:
A) the shear
B) the fractional change in volume
C) the fractional change in length
D) the pressure
E) the spring constant

25. The bulk modulus is a proportionality constant that relates the pressure acting on an object to:
A) the shear
B) the fractional change in volume
C) the fractional change in length
D) Young's modulus
E) the spring constant

26. In the formula $F = Gm_1m_2/r^2$, the quantity G:
A) depends on the local value of g
B) is used only when the Earth is one of the two masses
C) is greatest at the surface of the Earth
D) is a universal constant of nature
E) is related to the Sun in the same way that g is related to the Earth

27. Four particles, each with mass *m,* are arranged symmetrically about the origin on the *x* axis. A fifth particle, with mass *M*, is on the *y* axis. The direction of the gravitational force on *M* is:



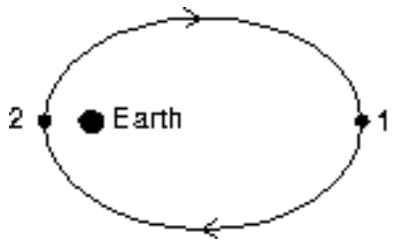
A) ↑
B) ↓
C) ←
D) →
E) none of these directions

28. The mass of a hypothetical planet is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600 N on Earth, what would he weigh on this planet?
A) 24 N
B) 48 N
C) 96 N
D) 192 N
E) 600 N

29. An object at the surface of Earth (at a distance *R* from the center of Earth) weighs 90 N. Its weight at a distance 3*R* from the center of Earth is:
A) 10 N
B) 30 N
C) 90 N
D) 270 N
E) 810 N

30. A projectile is fired straight upward from Earth's surface with a speed that is half the escape speed. If *R* is the radius of Earth, the highest altitude reached, measured from the surface, is:
A) *R*/4
B) *R*/3
C) *R*/2
D) *R*
E) 2*R*

31. A small satellite is in elliptical orbit around Earth as shown. If L denotes the magnitude of its angular momentum and K denotes kinetic energy:



A) $L_2 > L_1$ and $K_2 > K_1$
B) $L_2 > L_1$ and $K_2 = K_1$
C) $L_2 = L_1$ and $K_2 = K_1$
D) $L_2 < L_1$ and $K_2 = K_1$
E) $L_2 = L_1$ and $K_2 > K_1$

Answer Key

1. C
2. E
3. D
4. B
5. B
6. E
7. A
8. B
9. E
10. C
11. D
12. E
13. B
14. A
15. D
16. C
17. B
18. C
19. D
20. A
21. C
22. B
23. D
24. C
25. B
26. D
27. B
28. C
29. A
30. B
31. E