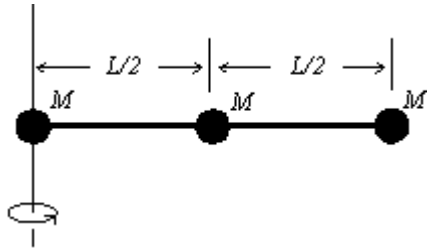
1. A phonograph turntable, initially rotating at 0.75 rev/s, slows down and stops in 30 s. The magnitude of its average angular acceleration in rad/s^2 for this process is:
   A) 1.5
   B) 1.5π
   C) π/40
   D) π/20
   E) 0.75

2. A wheel initially has an angular velocity of –36 rad/s but after 6.0 s its angular velocity is –24 rad/s. If its angular acceleration is constant the value is:
   A) 2.0 rad/s^2
   B) –2.0 rad/s^2
   C) 3.0 rad/s^2
   D) –3.0 rad/s^2
   E) –6.0 rad/s^2

3. A wheel starts from rest and has an angular acceleration of 4.0 rad/s^2. The time it takes to make 10 revolutions is:
   A) 0.50 s
   B) 0.71 s
   C) 2.2 s
   D) 2.8 s
   E) 5.6 s

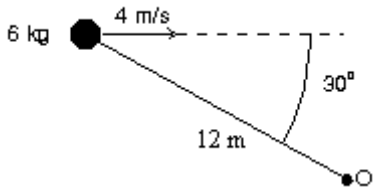
4. Three identical balls, with masses of M, 2M, and 3M are fastened to a massless rod of length L as shown. The rotational inertia about the left end of the rod is:



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

5. A certain wheel has a rotational inertia of 12 kg · m^2. As it turns through 5.0 rev its angular velocity increases from 5.0 rad/s to 6.0 rad/s. If the net torque is constant its value is:
   A) 0.016 N · m
   B) 0.18 N · m
   C) 0.57 N · m
   D) 2.1 N · m
   E) 3.6 N · m

6. A 6.0-kg particle moves to the right at 4.0 m/s as shown. The magnitude of its angular momentum about the point O is:



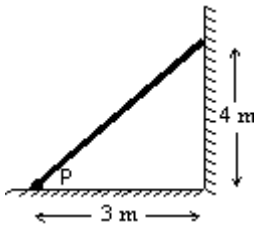
   A) zero
   B) 288 kg · m^2/s
   C) 144 kg · m^2/s
   D) 24 kg · m^2/s
   E) 249 kg · m^2/s

7. A uniform disk has radius *R* and mass *M*. When it is spinning with angular velocity ω about an axis through its center and perpendicular to its face its angular momentum is $I\omega$. When it is spinning with the same angle velocity about a parallel axis a distance *h* away its angular momentum is:
   A) $I\omega$
   B) $(I + Mh^2)\omega$
   C) $(I - Mh^2)\omega$
   D) $(I + MR^2)\omega$
   E) $(I - MR^2)\omega$

8. A man, holding a weight in each hand, stands at the center of a horizontal frictionless rotating turntable. The effect of the weights is to double the rotational inertia of the system. As he is rotating, the man opens his hands and drops the two weights. They fall outside the turntable. Then:
   A) his angular velocity doubles
   B) his angular velocity remains about the same
   C) his angular velocity is halved
   D) the direction of his angular momentum vector changes
   E) his rotational kinetic energy increases

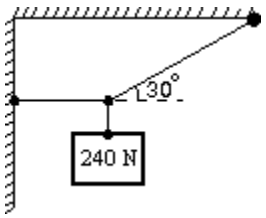
9. When a man on a frictionless rotating stool extends his arms horizontally, his rotational kinetic energy:
   A) must increase
   B) must decrease
   C) must remain the same
   D) may increase or decrease depending on his initial angular velocity
   E) may increase or decrease depending on his angualar acceleration

10. An 80-N uniform plank leans against a frictionless wall as shown. The torque (about point P) applied to the plank by the wall is:



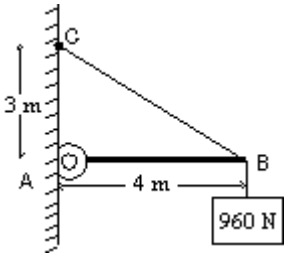
   A) 40 N·m
   B) 60 N·m
   C) 120 N·m
   D) 160 N·m
   E) 240 N·m

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



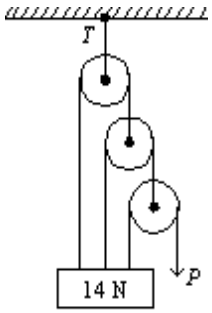
A) 0
B) 656 N
C) 480 N
D) 416 N
E) 176 N

12. A 960-N block is suspended as shown. The beam AB is weightless and is hinged to the wall at A. The tension force of the cable BC has magnitude:



A) 720 N
B) 1200 N
C) 1280 N
D) 1600 N
E) none of these

13. The pull *P* is just sufficient to keep the 14-N block and the weightless pulleys in equilibrium as shown. The tension *T* in the upper cable is:

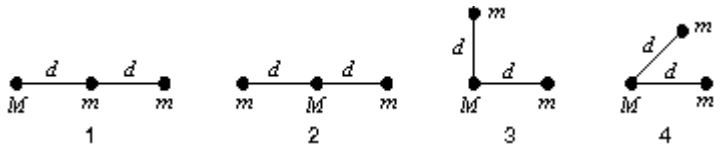


A) 14 N
B) 28 N
C) 16 N
D) 9.33 N
E) 18.7 N

14. A certain wire stretches 0.90 cm when outward forces with magnitude *F* are applied to each end. The same forces are applied to a wire of the same material but with three times the diameter and three times the length. The second wire stretches:
A) 0.10 cm
B) 0.30 cm
C) 0.90 cm
D) 2.7 cm
E) 8.1 cm

15. A cube with edges exactly 2 cm long is made of material with a bulk modulus of 3.5×10^9 N/m^2. When it is subjected to a pressure of 3.0×10^5 Pa its volume is:
A) 7.31 cm^3
B) 7.99931 cm^3
C) 8.00069 cm^3
D) 8.69 cm^3
E) none of these

16. Three particles, two with mass *m* and one mass *M*, might be arranged in any of the four configurations known below. Rank the configurations according to the magnitude of the gravitational force on *M*, least to greatest.



A) 1, 2, 3, 4
B) 2, 1, 3, 4
C) 2, 1, 4, 3
D) 2, 3, 4, 2
E) 2, 3, 2, 4

17. Venus has a mass of about 0.0558 times the mass of Earth and a diameter of about 0.381 times the diameter of Earth. The acceleration of a body falling near the surface of Venus is about:
A) 0.21 m/s^2
B) 1.4 m/s^2
C) 2.8 m/s^2
D) 3.8 m/s^2
E) 25 m/s^2

18. Two particles, each of mass *m*, are a distance *d* apart. To bring a third particle, with mass 2*m*, from far away to a resting point midway between the two particles the work done by an external agent does work given by:
A) $4Gm^2/d$
B) $-4Gm^2/d$
C) $8Gm^2/d^2$
D) $-8Gm^2/d^2$
E) zero

19. The escape velocity at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?
A) 2
B) 4
C) 8
D) 1/2
E) 1/4

20. A spherical shell has inner radius R_1, outer radius R_2, and mass M, distributed uniformly throughout the shell. The magnitude of the gravitational force exerted on the shell by a point mass particle of m a distance d from the center, outside the inner radius, is:
    A) 0
    B) GMm/R_1^2
    C) GMm/d^2
    D) $GMm/\left(R_2^2 - d^2\right)$
    E) $GMm/(R_1 - d)^2$

Answer Key

1. D
2. A
3. E
4. E
5. D
6. C
7. B
8. B
9. B
10. C
11. D
12. D
13. C
14. B
15. B
16. B
17. D
18. D
19. C
20. C