1. Momentum may be expressed in:
   A) kg/m  B) gram·s  C) N·s  D) kg/(m·s)  E) N/s

2. A 1.0 kg-ball moving at 2.0 m/s perpendicular to a wall rebounds from the wall at 1.5 m/s. The change in the momentum of the ball is:
   A) zero  B) 0.5 N·s away from wall  C) 0.5 N·s toward wall

3. A 6.0-kg block is released from rest 80 m above the ground. When it has fallen 60 m its kinetic energy is approximately:
   A) 4800 J  B) 3500 J  C) 1200 J  D) 120 J  E) 60 J

4. No kinetic energy is possessed by:
   A) a shooting star  B) a rotating propeller on a moving airplane  C) a pendulum at the bottom of its swing
   D) an elevator standing at the fifth floor  E) a cyclone

5. A mass moves in a circle of radius 1 m with a angular speed of 1 rad/s, what is its linear velocity?
   A) 10 m/s  B) 0 m/s  C) \(2\pi\) m/s  D) 1 m/s  E) \(2\pi\)R m/s

6. If the total momentum of a system is changing:
   A) particles of the system must be exerting forces on each other  B) the system must be under the influence of gravity
   C) the center of mass must have constant velocity  D) a net external force must be acting on the system
   E) none of the above

7. A 2-kg block is thrown upward from a point 20 m above Earth's surface. At what height above Earth's surface will the gravitational potential energy of the Earth-block system have increased by 500 J?
   A) 5 m  B) 25 m  C) 46 m  D) 70 m  E) 270 m

8. The center of mass of a uniform disk of radius \(R\) is located:
   A) on the rim  B) a distance \(R/2\) from the center  C) a distance \(R/3\) from the center
   D) a distance \(2R/3\) from the center

9. A projectile is shot with a vertical component of velocity which is 4 and a horizontal component of velocity which is 3. What is the Net velocity of the projectile?
   A) 3  B) 4  C) 0  D) 7  E) 5

10. A large cannon is fired from ground level over level ground at an angle of 30° above the horizontal. The muzzle speed is 980 m/s. Neglecting air resistance, the projectile will travel what horizontal distance before striking the ground?
    A) 85 km  B) 8.5 km  C) 43 km  D) 170 km

11. A net torque applied to a rigid object always tends to produce:
    A) linear acceleration  D) rotational inertia
    B) rotational equilibrium  E) none of these
    C) angular acceleration
12. Two projectiles are shot with the same velocity but one at an angle of 40 degrees and the other at the angle of 50 degrees. Both projectiles will
   A) have different ranges
   B) have different height
   C) have the same range
   D) have the same travel time
   E) None of these answers are correct

13. A radian is about:
   A) 25°  B) 57°  C) 67°  D) 90°

14. One revolution is the same as:
   A) 1 rad    B) 57 rad    C) π/2 rad    D) π rad    E) 2π rad

15. Let $F_1$ be the magnitude of the gravitational force exerted on the Sun by Earth and $F_2$ be the magnitude of the force exerted on Earth by the Sun. Then:
   A) $F_1$ is much greater than $F_2$
   B) $F_1$ is slightly greater than $F_2$
   C) $F_1$ is equal to $F_2$
   D) $F_1$ is slightly less than $F_2$
   E) $F_1$ is much less than $F_2$

16. A planet travels in an elliptical orbit about a star as shown. At what pair of points is the speed of the planet the same?

   A) W and S    B) P and T    C) P and R    D) Q and U    E) V and R

17. A sphere and a cylinder of equal mass and radius are simultaneously released from rest on the same inclined plane sliding down the incline. Then:
   A) the sphere reaches the bottom first because it has the greater inertia
   B) the cylinder reaches the bottom first because it picks up more rotational energy
   C) the sphere reaches the bottom first because it picks up more rotational energy
   D) they reach the bottom together
   E) none of the above is true

18. Possible units of angular momentum are:
   A) kg·m/s    B) kg·m²/s²    C) kg·m/s²    D) kg·m²/s    E) none of these

19. 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

20. An object at the surface of Earth (at a distance $R$ from the center of Earth) weighs 90 N. Its weight at a distance $3R$ from the center of Earth is:
   A) 10 N    B) 30 N    C) 90 N    D) 270 N    E) 810 N
For the questions below you have to show detail solution and work to get full or partial credit. Do the work on a separate sheet provided to you. Make sure you PRINT your name on every sheet and staple if necessary. Each question is worth 5 points. These are practice problems.

21. A rifle of mass $M$ is initially at rest but free to recoil. It fires a bullet of mass $m$ and velocity $v$ (relative to the ground). After firing, find the velocity of the rifle (relative to the ground): The answer is in symbolic form (an equation in terms of $m$, $M$ and $v$).

22. For a block of mass $m$ to slide without friction up the rise of height $h$ shown, find the minimum initial speed it must have: The answer is in symbolic form (an equation in terms of $g$ and $h$ and constants, arithmetic operator).

23. To measure the mass of a planet with the same radius as Earth, an astronaut drops an object from rest (relative to the planet) from an altitude of one radius above the surface. When the object hits its speed is 4 times what it would be if the same experiment were carried out for Earth. In units of Earth masses, show that the mass of the planet is $16$: You have to show the mathematical work.

24. Tony an eight grade student is watching a soccer game. He hears the commentator say "the team has momentum", and a little while later he hears the same commentator say "her momentum carried her out of bounds". Tony is confused as to the difference in the meaning and ask his science teacher to explain to him what the difference in the two meanings. Formulate a short (5-10 lines) answer that tony would understand.

25. What causes the trill in an amusement part ride? Use a simple ride to illustrate your point. Use and explain the relevant concept, and do the math to prove your point.

26. The human body is composed mostly of water. Why does the Moon overhead cause appreciably less tidal effect in the fluid compartment of your body than a 1-kg melon held over your head?
Answer Key

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

21. \(-\frac{mv}{M}\)

22. \(\sqrt{2gh}\)

23. 16