1. Momentum can disappear in a collision between two objects, but the total kinetic energy of the two objects before and after must always be the same.
(a) True
(b) False

Moment can never disappear, but kinetic energy can be converted to potential energy or heat (molecular kinetic energy)

2. The Earth is at this instant accelerating in towards the Sun.
(a) True
(b) False

with a value v^2/r

3. If a solid cylinder and a hollow cylinder are released together and allowed to roll down the same inclined plane, the solid cylinder will reach the bottom first.
(a) True
(b) False

The solid cylinder has a smaller moment of inertia (average radius less than maximum radius) hence more of the energy is available for translation

4. The force with which the earth attracts the moon is larger than the force with which the moon attracts the earth.
(a) True
(b) False

All forces are in reality equal and opposite attractions or repulsions between two object.

5. Astronauts in an orbiting space satellite are said to be "weightless" because the earth exerts no forces on them.
(a) True
(b) False

The earth exerts a force on both the astronauts and the satellite, and they both fall toward it. The are "weightless" because the floor doesn't push back.

6. Dropping an object near the earth causes the object and the earth to acquire equal and opposite momenta.
(a) True
(b) False

$$m_{object} V_{object} = M_{earth} v_{earth}$$

7. If objects of two different masses have equal momenta, their kinetic energies must also be equal.
(a) True
(b) False

$$\left.\begin{array}{l} p = mv \\ KE = \frac{1}{2} m v^2 \end{array}\right\} \quad KE = \frac{p^2}{2m}$$

for a big mass, KE for a given v is small.

8. It is possible for an object to undergo a collision in which the *change* in its momentum is larger than its original momentum.
(a) True
(b) False

Particle with $p = mv$ bounces off a massive wall,

$$\Delta p = mv - (-mv) = 2mv$$

9. It is possible for an object to undergo a collision in which it imparts a large amount of its momentum to another object with only a negligible loss in its own kinetic energy.
(a) True
(b) False

Combine 7 and 8. Particle bounces off a massive wall, and its vector momentum changes by twice its initial value, but its scalar speed (and thus KE) change by a negligible amount.

10. If two separately moving freight cars collide and couple together so that they move off at the same speed, the total kinetic energy is the same before and after, but the total momentum is decreased after the collision.
(a) True
(b) False

Total momentum is unchanged.
Kinetic energy is converted to Potential Energy that holds them together

11. When a stationary stick of dynamite explodes momentum is not conserved, because there is net momentum after the explosion but not before.
(a) True
(b) False

add up the vector components of the momentum of all the fragments and they sum to zero.

12. A rotating tire increases its angular speed from 1 rad/s to 9 rad/s in 3 seconds. Through what angle does the tire rotate during those three seconds?

(a) 3 radians
(b) 6 radians
(c) 9 radians
(d) 12 radians
(e) 15 radians

$$\theta = \omega_{avg} t = \left(\frac{1+9}{2}\ \frac{rad}{s}\right)(3\,s) = 15\ rad/s$$

13. An object near the earth falls with an acceleration of approximately 10 m/s^2. The moon is 60 earth radii from the earth. The moon falls toward the earth with an acceleration of approximately

(a) 0.003 m/s^2
(b) 0.05 m/s^2
(c) 0.17 m/s^2
(d) 3.0 m/s^2
(e) 10. m/s^2

$$a = \frac{F}{m} = G\frac{mM}{r^2}/m \quad ; \quad r = 60R$$

$$g = \frac{GM}{R^2}$$

$$a = \frac{Gm}{(60R)^2}$$

$$a = \frac{g}{60^2} = 0.003\ m/s^2$$

14. A ball is whirled in a circle on the end of a string. If the string were suddenly to break, the ball would fly off

(a) outwardly from the center of the circle
(b) inwardly toward the center of the circle
(c) straight ahead along the tangent to the circle

15. A rifle with a mass of 3 kg fires a bullet of mass 0.005 kg with a muzzle velocity of 300 m/s. The recoil speed of the rifle is
(a) 0.5 m/s
(b) 1.8 m/s
(c) 5 m/s
(d) 10 m/s

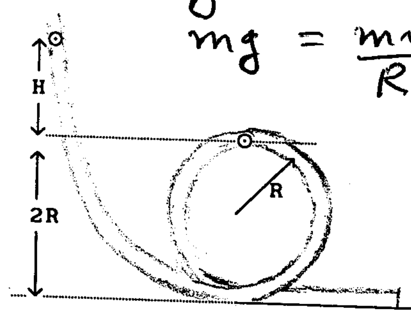
$$mv = MV$$

$$V = \frac{mv}{M} = \frac{(0.005\,kg)(300\,\frac{m}{s})}{3\,kg} = 0.5\ m/s$$

$mgH = \frac{1}{2}mv^2$ (Energy)

$mg = \frac{mv^2}{R}$ (Force)

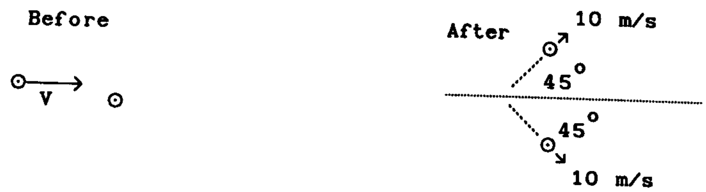
16. In the Rollercoaster shown, what is the minimum height H above the top of the loop-the-loop of radius R must the cars start so that they do no lose contact with the rails at the top of the loop?



(a) R/4
(b) R/3
(c) R/2
(d) R
(e) 2R

$\cancel{m}gH = \frac{1}{2}(\cancel{m}gR)$

17. A cueball of initial speed V strikes a stationary eightball and glances off a 45° knocking the eight ball off also at 45°. Both balls travel at a speed of 10 m/s after the collision. What was the initial speed V of the cueball?

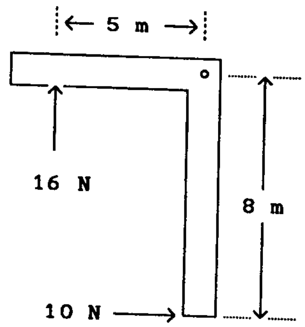


$\cancel{m}v = 2\cancel{m}(10\,m/s)\cos 45^\circ$

$v = 2(10)\frac{1}{\sqrt{2}} = 14.14\,m/s$

(a) V = 5 m/s
(b) V = 10 m/s
(c) V = 14 m/s
(d) V = 20 m/s
(e) V = 45 m/s

18. The L-shaped object shown is initially stationary. When forces of 10 N and 16 N are applied at distances of 5m and 8 m from the fixed pivot shown, the object will



$\tau = (8m)(10N) - (5m)(16N) = 80 - 80 = 0$

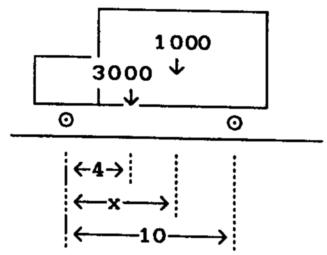
(a) remain stationary in static equilibrium
(b) begin to rotate counterclockwise
(c) begin to rotate clockwise

19. A skater is spinning with her arms outstretched. When she brings her arms in close to her body,

(a) her angular momentum increases and her angular velocity decreases.
(b) her moment of inertia increases and her angular momentum decreases.
(c) her moment of inertia decreases and her angular velocity increases.

$L = I\omega = I\omega$

20. A truck with a wheelbase of 10 m and a weight 3000 N has its center of gravity 4 m behind the front wheels. How far x behind the front wheels should a cargo weighing 1000 N be placed so that each of the axles supports half the total weight of the truck and its cargo?



(a) x = 5 m
(b) x = 6 m
(c) x = 7 m
(d) x = 8 m
(e) x = 9 m

$$0 = \tau = (3000)(4) + (1000)X - \left(\frac{3000+1000}{2}\right)10$$

$$12 + X - 20 = 0$$

$$X = 8$$