1. A bowling ball, moving to the east at a speed of 1.4 m/s, collides head-on with a stationary beach ball of the same diameter but less than one twentieth the mass. After the collision, the beach ball moves with a speed of 1.6 m/s. Which of the following is then true?
A) The bowling ball has a velocity of slightly under 1.4 m/s, to the east.
B) The beach ball has more momentum than the bowling ball.
C) The bowling ball recoils to the west with nearly the same speed as before the collision.
D) The bowling ball and the beach ball have the same momentum after the collision.

2. Shown below are 4 figures that represent the heat flow in a heat engine. The thickness of the arrows represents the amount of heat flow. Which figure best represents a real heat engine?
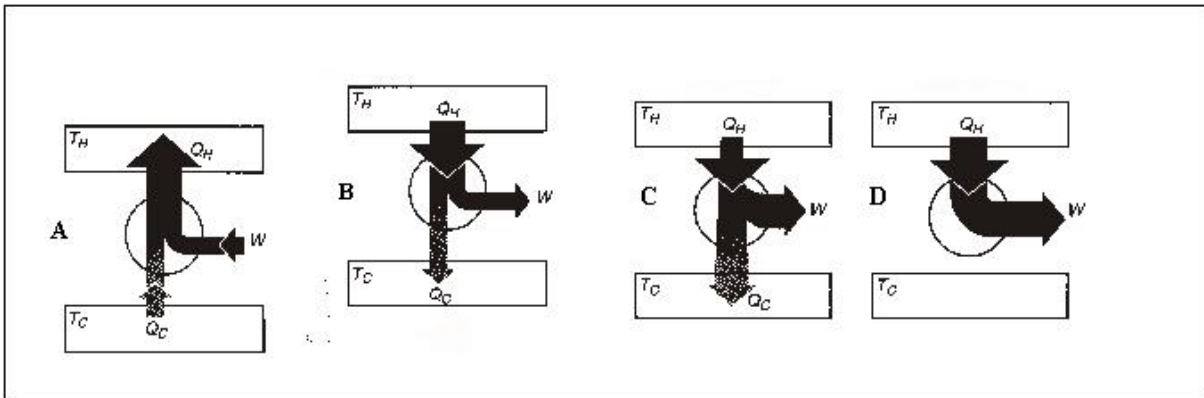
3. A child blows up a balloon with air. This balloon will not float to the ceiling because
A) the balloon and the air it contains weigh more than the air displaced by the balloon.
B) the weight of the balloon is less than the weight of the air displaced by the balloon.
C) the pressure of the air inside the balloon is greater than the atmospheric pressure.
D) the pressure of the air inside the balloon is less than the atmospheric pressure.
E) the temperature of the air inside the balloon is less than the atmospheric temperature.

4. A torque acting on a body tends to produce
A) equilibrium.
B) linear velocity.
C) a new center of gravity.
D) angular rotation.

5. A correct statement of the 2nd Law of Thermodynamics is:
A) the random motion of gas molecules will be decreased if energy is added to a gas.
B) there is no process that can make heat flow from a cold object to a hot object.
C) no heat engine can have an efficiency greater than 30%.
D) heat will not flow spontaneously from a cold object to a hot object.

6. The momentum of a truck is increased by a factor of 4; its weight does not change. Thus,
A) its acceleration is doubled.
B) its speed increased by a factor of 4.
C) its speed doubled.
D) its kinetic energy doubled.

7. The angular momentum of a rotating body is conserved when
A) no net force acts on the body.
B) no net torque acts on the body.
C) when the body has a constant angular acceleration.
D) when a shape of the body does not change.

8. Suppose 150 Joules of work is done *on* a system and that 300 Joules of heat are delivered *to* the system. Which of these is predicted by the first law of thermodynamics?
A) The internal energy U of the system increases by 150 J, since Q = +300 and W = +150.
B) The internal energy U of the system decreases by 150 J, since Q = -300 and W = +150.
C) The internal energy U of the system increases by 450 J, since Q = +300 and W = -150.
D) The internal energy U of the system does not change.

9. If you hold a light tissue in your hands and gently blow across its top, the tissue will rise slightly because
A) the pressure of moving air is less than that of static air.
B) collisions of the moving air with the tissue cause it to rise.
C) blowing across the tissue removes all of the air, and then the air below the tissue pushes the tissue up.
D) according to Archimedes' principle, moving air exerts more buoyant force.

10. One section of a pipe carrying water has a cross-sectional area of 20 cm^2; in this section the water has flow velocity of 1.0 m/s. Another section of this pipe has a constricted cross-sectional area of 5 cm^2. If the flow is steady, what is the water velocity in the cons tricted section?
A) 0.25 m/s
B) 0.50 m/s
C) 1.0 m/s
D) 2.0 m/s
E) 4.0 m/s

11. Hot cider is poured into a metal cup. Shortly thereafter the handle of the cup becomes hot. This is due to the process of
A) conduction.
B) convection.
C) radiation.
D) osmosis.

12. A 20-kg child runs at 4.0 m/s and jumps onto a shopping cart, which also has mass 20 kg.
   Assuming the child rides on the cart after the collision, the speed of the child and shopping cart,
   just after the child jumps on, is
A) zero.
B) 2.0 m/s.
C) 3.0 m/s.
D) 4.0 m/s.

13. One form of the proper metric unit for momentum is
A) Nt·sec.
B) Kg·m.
C) Kg·m/s^2.
D) Joule.

14. When a bicycle pedal is at the top of its motion, you can exert the greatest torque on the crank by
A) pushing straight down on the pedal with your foot.
B) pushing straight forward on the pedal with your foot.
C) hooking your toes under the pedal and pulling upward.

15. A mixture consists of 60 g of ice and 40 g of liquid water, both at 0°C. The amount of heat that must be added to melt all of the ice is about
A) 3200 cal.
B) 4000 cal.
C) 4800 cal.
D) 8000 cal.

16. Heat is added to an ideal gas and the gas expands. In such a process the temperature
A) must always increase.
B) will remain the same if the work done equals the heat added.
C) must always decrease.
D) will remain the same if work done is less than the heat added.
E) will remain the same if the work done exceeds the heat added.

17. Because the rotational inertia is higher, it is hardest in springboard diving to perform a forward somersault in
A) the straight position (no bending at knees or waist).
B) the pike position (bending at the waist but not the knees).
C) the tuck position (bending at both the waist and knees).

18. The amount of heat is often measured in calories. If I add 1 calorie of heat energy to 1 gram of water, the temperature of the water will
A) decrease by 1°C.
B) decrease by 1°F.
C) stay the same since water has a very high specific heat.
D) increase by 1°C.
E) increase by 1°F.

19. Entropy is
A) another term for heat.
B) a quantity that is conserved in any thermal process.
C) something that never decreases in any process.
D) a quantity that increases as the disorder of a system increases.

20. A gas originally occupies a volume of 0.5 m^3 at a pressure of 100 kPa. It is slowly allowed to expand until the volume is 2.5 m^3. Assuming the temperature is kept constant, the final pressure will be:
A) 10 kPa.
B) 20 kPa.
C) 50 kPa.
D) 100 kPa.
E) 500 kPa.

Answer Key

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