# Physical Science 101
# Sample Exam #2
## Part I: Multiple Choice (3 Points Each)

1. Two of the major components of Kool-Aid are water and sugar. Water molecules have less mass than sugar molecules. If a child's drink of Kool-Aid is at 10 °C, we can expect that

   a. the sugar molecules will be moving much faster than the water molecules
   b. the water molecules will be moving much faster than the sugar molecules
   c. the water and sugar molecules must be moving at the same speed because they are at the same temperature
   d. the molecules in the kool-aid slow down when they come into contact with the child's mouth
   e. nothing can be concluded about the speed of the molecules because not enough information is given

2. You place some frozen ethanol in a beaker of liquid ethanol and the frozen ethanol melts. Select the correct statement regarding this process.

   a. There can be no temperature change as the ethanol melts, so there is no heat flow.
   b. As your ethanol melts, there can be no change in temperature inside your beaker.
   c. The heat lost by the liquid ethanol is equal to the heat gained by the melting frozen ethanol.
   d. The heat gained by the liquid ethanol is equal to the heat lost by the melting frozen ethanol.
   e. The specific heat is zero because there is no flow of heat.

3. If the heat capacity of water were lower than it actually is, then in the winter we would see

   a. our ponds take longer to freeze.
   b. our ponds freeze more easily.
   c. no change in how quickly our ponds freeze.
   d. frozen water (ice) would sink to the bottom of a lake

e. the temperature of water would be harder to change

4. When water freezes

a. heat must flow into the water.

b. heat must flow out of the water.

c. there can be no heat flow.

d. molecules ($H_20$) of water are formed.

e. the temperature of the freezing water drops.

5. The specific heat capacities for some substances are listed below. If the same amount of heat was added to samples of each of these metals such that each underwent the same temperature change, which sample must be the larger mass?

| | |
|---|---|
| Copper | 0.385 J/(g °C) |
| Gold | 0.129 J/(g °C) |
| Chromium | 0.447 J/(g °C) |
| Cobalt | 0.418 J/(g °C) |

a. copper

b. gold

c. chromium

d. cobalt

e. impossible to determine

6. If 50 g of water at 40 °C and 75 g of water at 80 °C are mixed, the final temperature of the mixture will be

a. 60 °C

b. greater than 60 °C

c. less than 60 °C

d. 80 °C

e. impossible to determine from information given

7. A ball is thrown upward with an initial speed of 7.5 m/s. Which of the following are zero when it is at its peak?

a. velocity, acceleration, momentum, kinetic energy
b. velocity, momentum, kinetic energy
c. acceleration, potential energy, kinetic energy
d. acceleration, momentum, potential energy
e. none of the above

8. An object that is 20 feet above the ground falls, strikes the ground and stops. Select the correct statement about this falling object.

a. AFTER the object strikes the ground, it must have the same potential energy that it did when it was 20 feet in the air.
b. AFTER the object strikes the ground, it must have kinetic energy equal to the potential energy that it had when it was 20 feet in the air.
c. The object must have the same momentum after it strikes the ground as it had before it struck the ground.
d. When it strikes the ground, the object must transfer its kinetic energy.
e. AFTER the object strikes the ground, its total kinetic and potential energy must equal its total potential and kinetic energy when it was 20 feet above the ground.

9. You notice a boat bobbing up and down on the ocean's waves. The boat is at the high point of its cycle every 2 s, and the waves are 3 m apart. What is the frequency of the waves?

a. 2 s
b. 3 m
c. 2 Hz
d. 0.5 Hz

e. 6 Hz

10. You notice a boat bobbing up and down on the ocean's waves. The boat is at the high point of its cycle every 2 s, and the waves are 3 m apart. What is the speed of the waves?

a. 2 m/s
b. 6 m/s
c. 0.5 m/s
d. 3 m/s
e 1.5 m/s

11. If the momentum of a 5-kg object doubles, by what factor will its kinetic energy change?

a. 2
b. 4
c. one-half
d. one-fourth
e. no change because momentum is conserved

12. The density of aluminum is 2.70 g/mL and the density of copper is 8.96 g/mL. What mass of copper would occupy the same volume as 5.00 g of aluminum?

a. 1.51 g
b. 16.6 g
c. 5.00 g
d. 2.70 g
e. 8.96 g

13. Hydrogen has three isotopes: H-1, H-2, and H-3. Which of these is most abundant in a naturally occurring sample?

a. H-1

b. H-2

c. H-3

d. Could be any of the three.

e. Could be either H-2 or H-3, but not H-1.

**Part II**: Answer each of the following. Problems are to be worked on these pages. If you need more space, use the back of the sheet. **YOU MUST SHOW ALL WORK FOR CREDIT!!! You must explain clearly for full credit!!!**

1. A sample of water is at 90 °C. A hot block of metal is placed in the water. Some of the water is changed to a gas. From a nanoscale point of view, explain what is happening.

2. 1950 J of heat were added to a 5.00 g sample of ice. The initial temperature of the ice was 0.0 °C.

   For water: heat of fusion = 333 J/g at 0°C
   heat of vaporization = 2260 J/g at 100°C
   specific heat capacity of ice = 2.06 J/(g °C)
   specific heat capacity of liquid water = 4.184 J/(g °C)

   a. How much heat is required to melt the ice?

   b. What was the final temperature of the water that was formed?

3. A biker initially going 4.5 m/s west slows down constantly at a rate of 1.5 $m/s^2$ for 2.0 seconds.

   a. What is the biker's final velocity?

   b. How far does the biker go in the 2.0 seconds?

4. Suppose there are two stationary astronauts outside a spaceship. The astronaut on the left has a mass of 90 kg while the astronaut on the right has a mass of 60 kg. All of a sudden the astronaut on the left pushes on the other astronaut causing the astronaut on the right to

move with a speed of 2 m/s.

a. What is the initial momentum of the astronauts before the push?

b. What is the momentum of the astronaut on the right after the push?

c. How fast is the astronaut on the left moving after the push?

5. Starting from rest, a 0.250-kg toy car rolls down a 2-m high hill. The toy car then continues to roll across the level ground then up a 1-m hill.

a. Draw a diagram of this situation.

b. Calculate the potential energy of the toy car before it starts rolling.

c. Calculate the speed of the car at the bottom of the 2-m hill.

d. Calculate the speed of the car at the top of the 1-m hill.