1. D The amount of heat lost by the hot water must equal the amount of heat gained by the cold water. Since all water has the same specific heat capacity, we can calculate the change in temperature of the cold water, , in terms of the change in temperature of the hot water, :At thermal equilibrium, the hot water and the cold water will be of the same temperature. With this in mind, we can set up a formula to calculate the value of :Since the hot water loses 10 Cº, we can determine that the final temperature of the mixture is 65ºC – 10 Cº = 55ºC.

2. D If a block of ice at 0ºC is heated, it will begin to melt. The temperature will remain constant until the ice is completely transformed into liquid. The amount of heat needed to melt a certain mass of ice is given by the latent heat of fusion for water. The specific heat of water is only relevant when the temperature of the ice or water is changing, and the density of the water is not relevant.

3. D Asphalt, like most materials, has a positive coefficient of linear expansion, meaning that it expands as temperatures rise in summer and shrinks as temperatures fall in winter. This effect is called the law of thermal expansion, D. The gaps in the sidewalk allow the blocks to expand without pushing against each other and cracking.

4. E Convection is a form of heat transfer where a large number of molecules move from one place to another. An overhead fan works precisely by this method: it sends cooler air molecules down into a hot room, cooling the temperature of the room. The heat of the sun and the cooking action of a microwave are both forms of radiation, while the heat on a frying pan and the cooling action of ice cubes are both forms of conduction.

5. A Since the gas is in a closed container, its volume remains constant, so the correct answer is A.When the gas is heated, its temperature increases, meaning that the average speed of the gas molecules increases. An increase in temperature also means there are more collisions between molecules.According to the ideal gas law, when volume is constant and temperature is increased, then pressure will also increase. Pressure is determined by the rate of collisions of the gas molecules with the walls of the container.

6. A According to the ideal gas law, temperature is directly proportional to volume and pressure. Since the volume of the container is constant, that means that doubling the temperature will double the pressure.R is a constant: it doesn’t vary under different circumstances, so C is wrong. Also, we are looking at a random sample of the gas, so there won’t be a heavier isotope in one or the other of the containers: E is also wrong.

7. D The ideal gas law states that temperature is directly proportional to pressure and volume. Since the gas is in a closed container, the volume is fixed, so an increase in temperature leads to an increase in pressure. The correct answer is D.The atomic mass and the number of molecules are fixed properties of the gas sample, and cannot change with heat. The density depends on the mass and the volume. The mass is also a fixed property of the gas sample, and the volume is being held constant, since we are dealing with a closed container. Therefore, the density must also remain constant. Because the number of molecules and the volume are constant, the average space between the molecules must remain constant.

8. D The First Law of Thermodynamics tells us that : the change in internal energy is equal to the change in heat plus the work done on the system. The value of is 24 J, since that much heat is added to the system, and the value of is –6 J, since the system does work rather than has work done on it. With this in mind, calculating is a simple matter of subtraction:

9. E The Second Law of Thermodynamics tells us that the total amount of disorder, or entropy, in the universe is increasing. The entropy in a particular system can decrease, as with water molecules when they turn to ice, but only if the entropy in the surroundings of that system increases to an equal or greater extent. The Second Law of Thermodynamics holds, but only because the surroundings are gaining entropy, so the correct answer is E. Answer D refers to the key part of the answer, but gives the wrong information about the change in entropy of the surroundings.Be careful not to fall for answer C. This is an explanation for why the water does not lose heat when it freezes: it is, in fact, losing internal energy. This is an instance of the First Law of Thermodynamics, which states that the change in a system’s internal energy is equal to the value of the heat transfer in the system minus the work done by the system.

10. E The efficiency of a heat engine is defined as , where is the amount of heat output into the cold reservoir and is the amount of heat produced by the heat engine. Plugging the numbers in the question into this formula, we find that:An efficiency of 0.3 is the same thing as 30%.