PHYS 1400 Sample Exams: Temperature

1. Temperature is
   A) the same as heat.
   B) the measure of the total kinetic energy of a substance.
   C) the measure of the total internal energy of a substance.
   D) the measure of the average kinetic energy per molecule of a substance.

2. What is the difference between the Celsius and Kelvin temperature scales?
   A) Degrees Celsius are larger than degrees Kelvin.
   B) 0°C is much warmer than 0°C.
   C) Celsius is a relative scale is based on the freezing and boiling of water; Kelvin is an absolute scale.
   D) There is no difference whatsoever between them.

3. What is the difference between the Celsius and Fahrenheit temperature scales?
   A) Degrees Celsius are larger than degrees Fahrenheit.
   B) 100°F is much warmer than 100°C.
   C) Celsius is a relative scale is based on the freezing and boiling of water; Fahrenheit is an absolute scale.
   D) There is no difference whatsoever between them.

4. The Kelvin scale of temperature
   A) is relative. The degrees are the same size as degrees Celsius, but the scale places 0° at the freezing point of ammonia instead of the freezing point of water.
   B) is relative. The degrees are the same size as degrees Fahrenheit, but the scale uses 100° as the boiling point of water instead of 212°.
   C) is relative. The size of a degree Kelvin is determined by the ratio of boiling temperature to freezing temperature of water, so it is 212/32 = 6.6°.
   D) is absolute. The degrees are the same size as degrees Fahrenheit, but all temperatures are negative. 0K is literally as hot as anything can possibly get.
   E) is absolute. The degrees are the same size as degrees Celsius, but there are no negative temperatures. 0K is literally as cold as anything can possibly get.

5. A mercury thermometer
   A) depends on gravity to operate. The liquid in the tube is pulled up by the force of gravity, and the force is greater when the temperature is higher.
   B) works on the same principle as a mercury barometer. Higher air pressure forces the mercury farther up the glass tube of the thermometer. This is related to temperature, because higher temperatures create higher pressures.
   C) uses the principle of thermal expansion. The liquid in the glass tube expands when heated. The amount of expansion is proportional to the increase in the temperature, regardless of the scale you use.
   D) is based on the idea that a liquid will expand to fill any closed container. The mercury seeps up the tube, but the air in the end of the tube keeps it from getting all the way to the end. When the air in the tube is cooled, it contracts, which allows the mercury to flow farther up the tube.

6. You have two 100 ml beakers of water. One is 20°C and the other is 10°C.
   A) The 20°C beaker has twice as much heat as the 10°C beaker.
   B) The 20°C beaker has half as much heat as the 10°C beaker.
   C) The 20°C beaker has more heat, but not twice as much, as the the 10°C beaker.
   D) Either beaker may have more heat; you don’t have enough information to determine.

7. Heat is
   A) the energy transferred from one substance to another because of a temperature difference.
   B) the temperature of an object.
   C) the internal kinetic energy of a substance.
   D) full of sound and fury, signifying nothing. Or so I’ve read.

8. There is more heat in a 5 gallon pail of warm water than in a teacupful of boiling water.
   A) True; there is less energy per molecule in the pail, but there are many more molecules.
   B) True; there is more energy per molecule in the pail, and more molecules as well.
   C) False; there is more energy per molecule in the teacup; the number of molecules doesn’t matter.
   D) False; the temperature does not matter. The teacup, being smaller, has a higher “heat density.”
9. One beaker holds 1 liter of boiling water; a second beaker holds 2 liters of boiling water.
   A) Because they have the same temperature, they contain the same amount of heat.
   B) The two liter beaker has a higher temperature because it has more heat.
   C) The one liter beaker has half as much heat as the two liter beaker.
   D) The two liter beaker has half as much heat as the one liter beaker.

10. Fifty calories of energy is added to 50g of water (beaker 1). At the same time, 50 calories of energy is added to 100g of water (beaker 2). Both are initially at room temperature.
    A) Beaker 1 has the higher final temperature because more heat was added.
    B) Beaker 1 has the higher final temperature because it contained fewer molecules of water.
    C) Beaker 1 has the higher final temperature because it had more heat to start with.
    D) Beaker 2 has the higher final temperature because it has more mass.

11. Fifty calories of energy is added to 50g of water. At the same time, 50 calories of energy is added to a 50 g cube of iron. Both are initially at room temperature.
    A) The water has the higher final temperature because it has higher specific heat.
    B) The iron has the final higher temperature because it takes less energy per gram to heat it.
    C) They both have the same final temperature, because they have the same mass.
    D) The water has a higher final temperature because it has more volume.

12. An iron thumbtack and an iron horseshoe are each removed from a 300° oven and dropped into separate pails of water at room temperature.
    A) Each object raises the temperature of its water by the same amount.
    B) The thumbtack raises the temperature of its water more.
    C) The horseshoe raises the temperature of its water more.
    D) Neither raises the water temperature at all.

13. Specific heat is
    A) the energy required to change the phase of a substance from solid to liquid.
    B) the energy required to change the phase of a substance from liquid to gas.
    C) the energy released by a substance when it fuses with another in a nuclear reaction.
    D) the energy transferred from one substance to another because of a temperature difference.
    E) the energy required to raise the temperature of one gram of a substance by one degree Celsius.

14. The mashed potatoes on your plate stay warm long after the peas have cooled because
    A) the specific heat of the potatoes is much smaller than that of the peas.
    B) the specific heat of the potatoes is much greater than that of the peas.
    C) the specific heats are the same; it’s the plate that is the problem.
    D) you have no intention of eating the peas, so they will sit on your plate forever.

15. Water has a higher specific heat than sand.
    A) True; you know this because the water heats up and cools down more slowly than the sand.
    B) False; water heats and cools more slowly, and this shows that it has a lower specific heat!
    C) False, but it’s because the sand heats and cools more slowly than the water.
    D) True, but the real reason is because sand is less dense than water.

16. A metal ring is plunged into a dewar (a fancy thermos) of liquid nitrogen, at ~196°C. As it cools,
    A) the hole in the middle will get smaller.
    B) the hole stays exactly the same size.
    C) the hole in the middle will get larger.
    D) the entire ring evaporates, leaving only the hole.

17. An iron ring is held in the flame of a gas burner. As it gets hotter,
    A) the hole in the middle will get smaller.
    B) the hole stays exactly the same size.
    C) the hole in the middle will get larger.
    D) the entire hole disappears.

18. The lid on the pickle jar is stuck again, and you can't find that rubber grippy thing to open it. You should run it under
    A) hot water. The lid will expand, the opening will get larger, and the lid will loosen.
    B) cold water. As the lid contracts, the opening will get larger so you can unscrew it easily.
C) room-temperature water. The water acts as a lubricant, and the lid twists more easily. It is not a question of thermal expansion at all.
D) no water. The lid will not expand or contract. You should probably get that easy-squeeze bottle of Heinz ketchup out instead. It’s much better on ice cream than pickles anyway.

19. A metal ingot has dimensions L=length, W=width, and H=height. It is placed in a furnace and heated. 
A) It’s length L increases, but W and H remain the same.
B) The length L increases, while W and H actually get smaller as a result.
C) Unless you heat it up enough to melt it, all the dimensions of the bar stay the same.
D) All three dimensions of the bar will increase as the temperature increases.

20. Two rods of unknown metal are each 1 m long. Each is raised from room temperature to 100° C.
A) Since the change in temperature is the same, they must expand by the same amount.
B) Since their original lengths were the same, they must expand by the same amount.
C) If the coefficient of thermal expansion is the same for each, they will expand by the same amount.
D) The rod with the smaller coefficient of thermal expansion expands more, regardless of other factors.

21. A brass rod 1m long is raised from room temperature to 100°C. It expands by 1.54 mm. If a second brass rod, 2m long, is raised from room temperature to 100°C, the expansion will be
A) 0 mm B) 0.77 mm C) 1.54 mm D) 3.08 mm

22. For most substances, the density decreases as the temperature increases.
A) False; like water, the density of most substances actually increases between 0° and 4°C.
B) False; density increases as temperature increases.
C) True; this is because as you increase the temperature, the molecules “lock” into a crystal structure that holds them farther apart, making the substance less dense.
D) True; at higher temperatures, increased molecular motion creates greater distances between molecules. The mass stays the same, but the volume increases, making the density less.

23. At what temperature is the density of water the greatest?
A) At 0°, because ice is as dense as water gets.
B) At 4°, because molecular motion is small, and crystallization hasn’t started yet.
C) At 100°, because the transition from water to steam is very dense.
D) Trick question; the density is constant, no matter what the temperature.

24. Ice is less dense than liquid water.
A) False; the density of water actually increases with decreasing temperature.
B) False; the density of water remains constant at exactly 1g/cm³, no matter what the temperature.
C) True; this is because as you decrease the temperature, the water molecules “lock” into a crystal structure that holds them farther apart, making the ice less dense.
D) True; at lower temperatures, increased molecular motion creates greater distances between molecules. The mass stays the same, but the volume increases, making the density less.