PHYSICS HOMEWORK #171 HEAT & THERMODYNAMICS
TEMPERATURE, THERMAL EXPANSION & HEAT CAPACITY

1.Convert each of the following temperatures from Fahrenheit to Centigrade.
a. 35 ^{o}F b. -85 ^{o}F c. 220 ^{o}F d. 2550 ^{o}F e. 1520 ^{o}F

2. Convert each of the following temperatures from Centigrade to Fahrenheit.
a. -40 ^{o}C b. -273 ^{o}C c. 55 ^{o}C d. 110 ^{o}C e. 1220 ^{o}C

3. Convert each of the following to Kelvin temperatures.
a. 72 ^{o}F b. -40 ^{o}C c. -40 ^{o}F d. 110 ^{o}C e. 3500 ^{o}F

4. A piece of copper wire [$\alpha = 1.7 \times 10^{-5}/^{o}C$] has a length of exactly 50.00 meters when at a temperature of 12.0 ^{o}C.
a. What will be the increase in length of this wire if it's temperature is raised to 232 ^{o}C?

b. What will be the length of this wire if its temperature is raised to 232 ^{o}C?

5. A cylinder, which has a diameter of 0.99985 cm, is to be inserted into a hole in a steel plate [$\alpha = 1.2 \times 10^{-5}/^{o}C$]. The hole has a diameter of 0.99970 cm at 30.0 ^{o}C. To what temperature must the plate be heated in order for the cylinder to just barely fit?

6. At 20.0 ^{o}C a steel ball [$\alpha = 1.20 \times 10^{-5}/^{o}C$] has a diameter of 0.9000 cm, while the diameter of a hole in an Aluminum plate [$\alpha = 2.50 \times 10^{-5}/^{o}C$] is 0.8990 cm. At what single temperature will the ball just barely pass through the hole?

7. At 20.0 ^{o}C a steel ball [$\beta = 3.5 \times 10^{-5}/^{o}C$] has a diameter of 0.9000 cm. The temperature of this ball is increased to 55.0 ^{o}C. What will be the new volume for this ball?

8. A cube of Copper [$\rho = 8.9 \times 10^{3}$ kg/m^{3}], each edge of which is 3.50 cm., is floating in a container full of Mercury [$\rho = 13.6 \times 10^{3}$ kg/m^{3}]. Both are initially at a temperature of 20.0 ^{o}C.
a. What is the mass of the cube of Copper?
b. What is the weight of the cube of Copper?
c.What percentage of the copper block is submerged below the surface of the Mercury?
Both the Copper [$\beta = 5.6 \times 10^{-5}/^{o}C$] and the Mercury [$\beta = 1.8 \times 10^{-4}/^{o}C$] are heated to a temperature of 110 ^{o}C.
d. What percentage of the Copper is now submerged below the surface of the Mercury?

9. How much heat must be added to 120 grams of copper [c_p = 390 J/kg ^{o}C] in order to increase its temperature by 145 ^{o}C?

10. 750 Calories of heat are added to 250 grams of Lead [c_p = 0.031 cal/gm^{o}C] initially at a temperature of 28.0 ^{o}C. What will be the final temperature of this piece of Lead?

11. How much heat must be added to 65.0 ml of water in order to increase its temperature from 25 ^{o}C to 95 ^{o}C?

Answers to opposite side: 12. 6190 cal 13a. 32.2 ^{o}C b. 5340 J c. 5340 J 14. 34.0 ^{o}C
15a. 6250 cal b. 39850 cal c. 50,000 cal d. 269,000 cal e. 6250 cal f. 371,350 cal 16. 95,340 cal
17. 0.0 ^{o}C 18. 72.8 ^{o}C 19. 52.5 ^{o}C 20. 534 cal 21. 8420 cal 22. 6.38 x 10^{-21} J 23. 3020 m/s

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SPECIFIC HEAT & HEAT CAPACITY

12. How much heat would be required to raise the temperature of 625 grams of Mercury [c_p = 0.033 cal/gm^{o}C] from room temperature [25.0 ^{o}C] to 325 ^{o}C?

13. A ball of Copper [c_p = 390 J/kg^{o}C] has a mass of 165 grams and is initially at a temperature of 115 ^{o}C. This ball is quickly inserted into an insulated cup containing 125 ml of water at a temperature of 22.0 ^{o}C.
    a. What will be the final, equilibrium temperature of the ball and the water?
    b. How much heat did the copper ball lose to the water?
    c. How much heat did the water gain from the ball?

14. A ball of Aluminum [c_p = 0.22 cal/gm^{o}C] has a mass of 82.0 grams and is initially at a temperature of 145 ^{o}C. This ball is quickly inserted into an insulated cup containing 330 ml of water at a temperature of 28.0 ^{o}C. What will be the final, equilibrium temperature of the ball and the water?

15. Assume that you have 500 gm of ice at -25.0 ^{o}C.
    a. How much heat would be required to raise the temperature of this ice to 0.0 ^{o}C?
    b. How much heat is required to melt this ice into water at 0.0 ^{o}C?
    c. How much heat would be required to bring this water to the boiling point 100 ^{o}C?
    d. How much heat would be required to convert this water into steam at 100 ^{o}C?
    e. How much heat would be required to raise the temperature of this steam to 125 ^{o}C?
    f. How much total heat is required to heat 500 gm of ice at -25.0 ^{o}C into 500 gm of steam at 125 ^{o}C?

INFORMATION FOR 15 & 16

ice	c_p = .50 cal/gm^{o}C
water	c_p = 1.0 cal/gm^{o}C
steam	c_p = .50 cal/gm^{o}C
	L_{fusion} = 79.7 cal/gm
	L_{vapor} = 538 cal/gm

16. How much heat would be required to convert 125 grams of ice at -40.0 ^{o}C into steam at 150 ^{o}C?

17. A ball of copper [c_p = .093 cal/gm^{o}C] has a mass of 125 grams and is at a temperature of 145 ^{o}C. This ball is placed into a calorimeter which contains 25.0 grams of ice at -35.0 ^{o}C. What will be the final temperature of the copper ball?

18. What will be the final temperature if 15.0 grams of steam at 125 ^{o}C is mixed with 55.0 grams of ice at -10.0 ^{o}C?

19. What will be the final temperature if 85.0 grams of water at 90.0 ^{o}C is mixed with 22.0 grams of ice at -25 ^{o}C?

20. How much heat would be required to melt a 35.0 gm piece of lead initially at 25.0 ^{o}C?
    [c_p = 0.031 cal/gm^{o}C, L_{fusion} = 5.9 cal/gm, melting point = 327 ^{o}C]

21. How much heat would be required to melt a 115 gm piece of silver initially at 28.0 ^{o}C?
    [c_p = 0.056 cal/gm^{o}C and L_{fusion} = 21.0 cal/gm, melting point = 961 ^{o}C]

22. What will be the average linear kinetic energy of the molecules in an ideal gas at 35.0 ^{o}C?

23. What will be the average RMS velocity of the molecules in Helium gas at 1200 ^{o}C?

Answers to opposite side: 1a. 1.70 ^{o}C b. -65.0 ^{o}C c. 104 ^{o}C d. 1400 ^{o}C e. 827 ^{o}C
2a. -40.0 ^{o}F b. -459 ^{o}F c. 131 ^{o}F d. 230 ^{o}F e. 2230 ^{o}F 3a. 295 ^{o}K b. 233 ^{o}K c. 233 ^{o}K d. 383 ^{o}K
3e. 2200 ^{o}K 4a. 0.19 m b. 50.19 m 5. 42.5 ^{o}C 6. 106 ^{o}C 7. 0.382 cm^3 8a. 0.382 kg b. 3.74 N c. 65.4 %
8d. 66.1 % 9. 6790 J 10. 125 ^{o}C 11. 4550 cal