

# Chemistry Lab C

Science Olympiad North Regional  
Tournament at the University of Florida

Rank: \_\_\_\_\_

Points: \_\_\_\_\_



Name(s): \_\_\_\_\_

Team Name: \_\_\_\_\_

School Name: \_\_\_\_\_

Team Number: \_\_\_\_\_

Chemistry Lab

North Regional Science Olympiad Tournament

1/13/18

Names \_\_\_\_\_

Team # \_\_\_\_\_

Answers:

|      |      |      |      |      |      |
|------|------|------|------|------|------|
| 1:   | 2:   | 3:   | 4:   | 5:   | 6:   |
| 7:   | 8:   | 9a:  | 9b:  | 9c:  | 9d:  |
| 9e:  | 9f:  | 10:  | 11:  | 12:  | 13:  |
| 14a: | 14b: | 14c: | 14d: | 14e: | 14f: |
| 15   | 16   | 17   | 18   | 19   | 20   |

- 1.) What are the units for Conductivity?
  
- 2.) Rank the following in terms of increasing Molar Conductivity:  
 $\text{Na}^+$ ,  $\text{NH}_4^+$ ,  $\text{OH}^-$ ,  $\text{Br}^-$
  
- 3.) An object weighing 46.2g displaces 0.34 Liters of water when submerged in a tank. What is the object's density?
  
- 4.) A golden-colored cube is handed to you. The person wants you to buy it for \$100, saying that is a gold nugget. You pull out your old geology text and look up gold in the mineral table, and read that its density is 19.3 g/cm<sup>3</sup>. You measure the cube and find that it is 2 cm on each side, and weighs 40 g. What is its density? Is it gold? Should you buy it?
  
- 5.) The density of two liquids (A and B) is given as 1000 kg/m<sup>3</sup> and 600 kg/m<sup>3</sup>, respectively. The two liquids are mixed in a certain proportion and the density of the resulting liquid is 850 kg/m<sup>3</sup>. How much of liquid B (in grams) does 1 kg of the mixture contain? Assume the volume of the two liquids is additive when mixed.

6.) Rank the Following in terms of increasing heat capacity: Water, Lead, Copper, Gold.

7.) How many Joules of energy are required to raise the temperature of 3 liters of water by  $4.5^{\circ}\text{K}$ ?

8.) The same energy used in the previous question is applied to 4 liters of an unknown liquid of density  $1.47\text{ g/ml}$ . The temperature of the liquid is raised by  $19.3^{\circ}\text{K}$ . What is the heat capacity of the liquid?

9.) Identify the following as either Extensive or Intensive properties.

a.) Boiling Point \_\_\_\_\_

b.) Color \_\_\_\_\_

c.) Volume \_\_\_\_\_

d.) Weight \_\_\_\_\_

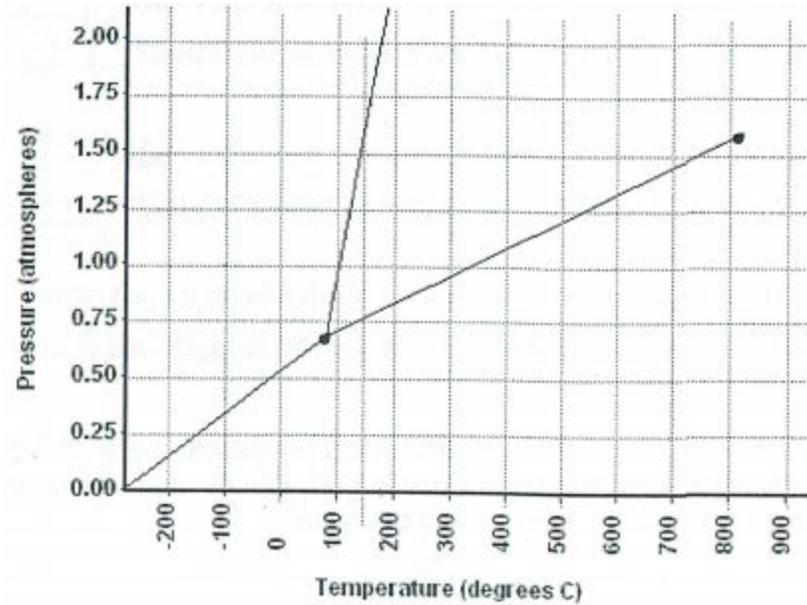
e.) Odor \_\_\_\_\_

f.) Malleability \_\_\_\_\_

- 10.) What is the unit for elasticity?
- 11.) Marie Curie was very particular about her bathwater temperature. It had to be exactly  $38.7^{\circ}\text{C}$ . You are her butler, and one morning while checking her bath temperature, you notice that it's  $43.0^{\circ}\text{C}$ . You plan to cool the  $104.7\text{ kg}$  of water to the desired temperature by adding an Gold-duckie originally at a temperature of  $-44.2^{\circ}\text{C}$ . Of what mass should the Gold-duckie be? [Specific heat of Au =  $0.13\text{ J}/(\text{g}^{\circ}\text{C})$ ; density of water =  $1.00\text{ g/ml}$ ]. Assume that no heat is lost to the air.
- 12.) A certain material's(environment) temperature increases by  $1.0^{\circ}\text{C}$  for every  $2018\text{ J}$  that it gains. A  $0.1321\text{ g}$  sample of liquid (molar mass =  $108.1\text{ g/mole}$ ) was burnt, and the surrounding material's temperature increased from  $20.9^{\circ}\text{C}$  to  $23.5^{\circ}\text{C}$ . Find the molar heat of combustion for the liquid.

13.) A 1.55 g of  $\text{CH}_4\text{O}$  sample is burnt in a calorimeter. If the molar heat of combustion of  $\text{CH}_4\text{O}$  is  $-725 \text{ kJ/mole}$ , and assuming that the 2.0 L of water absorbed all of the heat of combustion, what temperature change did the water experience?

Use the following diagram to answer question 14.



14.)

- What is the normal freezing point of this substance?
- What is the normal boiling point of this substance?
- What is the phase of the substance at 1.5 atm and 50 °C?
- What are the conditions of the triple point of this substance?
- What is the phase of the substance at .5 atm and 100 °C?
- If the substance was initially at 1.25 atm and 300 °C and then was lowered to a pressure of 0.25 atm what transition would occur?

- 15.) Calculate the total amount of heat absorbed (in kJ) when 2.00 mol of ice at  $-30.0^{\circ}\text{C}$  is converted to steam at  $140.0^{\circ}\text{C}$ .
- 16.) How many grams of Gold (Heat Capacity of  $0.13 \text{ J/}^{\circ}\text{C}$ ) could be heated from  $23.6^{\circ}\text{C}$  to  $43.3^{\circ}\text{C}$  using the same amount of energy needed to melt 25 grams of ice?
- 17.) How many kJ are required to heat 45.0 g of  $\text{H}_2\text{O}$  at  $25.0^{\circ}\text{C}$  and then boil it all away?
- 18.) Lead has a melting point of  $327.5^{\circ}\text{C}$ , its specific heat is  $0.128 \text{ J/g} \cdot ^{\circ}\text{C}$ , and its molar enthalpy of fusion is  $4.80 \text{ kJ/mol}$ . How much heat, in kilojoules, will be required to heat a 500.0 g sample of lead from  $23.0^{\circ}\text{C}$  to its melting point and then melt it?
- 19.) The specific heat capacity of silver is  $0.235 \text{ J/g}\cdot\text{K}$ . Its melting point is  $962.0^{\circ}\text{C}$ , and its enthalpy of fusion is  $11.3 \text{ kJ/mol}$ . What quantity of energy, in Joules, is required to change 9.10 g of silver from a solid at  $25.0^{\circ}\text{C}$  to a liquid at  $962^{\circ}\text{C}$ ?

20.) Calculate the amount of energy in kilojoules needed to change 207.0 g of water ice at  $-10.0\text{ }^{\circ}\text{C}$  to steam at  $125.0\text{ }^{\circ}\text{C}$ . The following constants for water may be helpful.

$$C_{p, \text{ice}} = 36.39 \text{ J mol}^{-1}\text{ }^{\circ}\text{C}^{-1}$$

$$C_{p, \text{liquid}} = 75.375 \text{ J mol}^{-1}\text{ }^{\circ}\text{C}^{-1}$$

$$C_{p, \text{steam}} = 37.11 \text{ J mol}^{-1}\text{ }^{\circ}\text{C}^{-1}$$

$$\Delta H_{\text{fus}} = 6.02 \text{ kJ mol}^{-1}$$

$$\Delta H_{\text{vap}} = 40.7 \text{ kJ mol}^{-1}$$