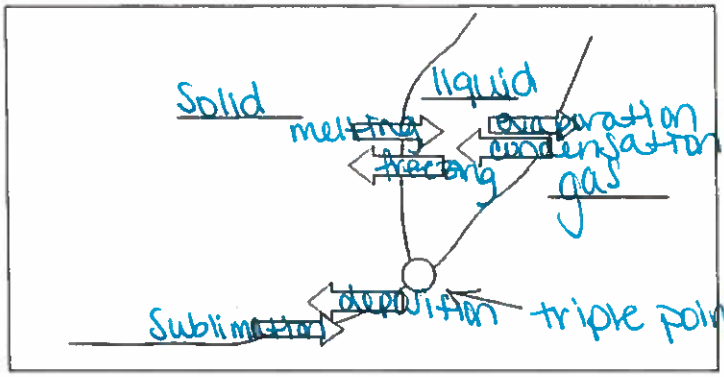
Chemistry-Unit 10 Review

Kinetic Molecular Theory:

1. What are the three states of matter?

a: Label them and all points/transitions given on the phase diagram below.



b: When does a substance boil? (Compare vapor pressure to atmospheric pressure).

When vapor pressure is equal to atmospheric pressure

2. What does 'kinetic' mean? What is kinetic energy?

- kinetic = motion; movement
- energy an object has due to particle motion.

3. What are the main points of the kinetic-molecular theory?

- gas has defined mass and ∅ volume
- all gas particle collisions are elastic
- particles travel randomly in straight lines
- no interaction between particles
- energy proportional to temperature.

4. Convert the temperatures

a: 37.8°C to K $K = 273 + 37.8 = 310.8\ K$

b: 476K to °C $476 = 273 + °C$

Phase Changes:

5. List the properties of the following:

a: Solid

little motion, little energy
defined volume

b: Liquid

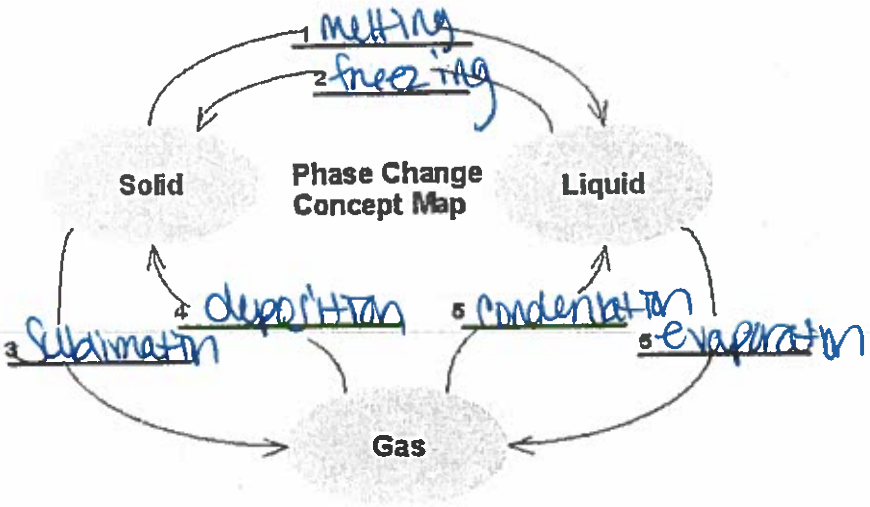
more motion, more energy
defined volume, undefined shape

c: Gas

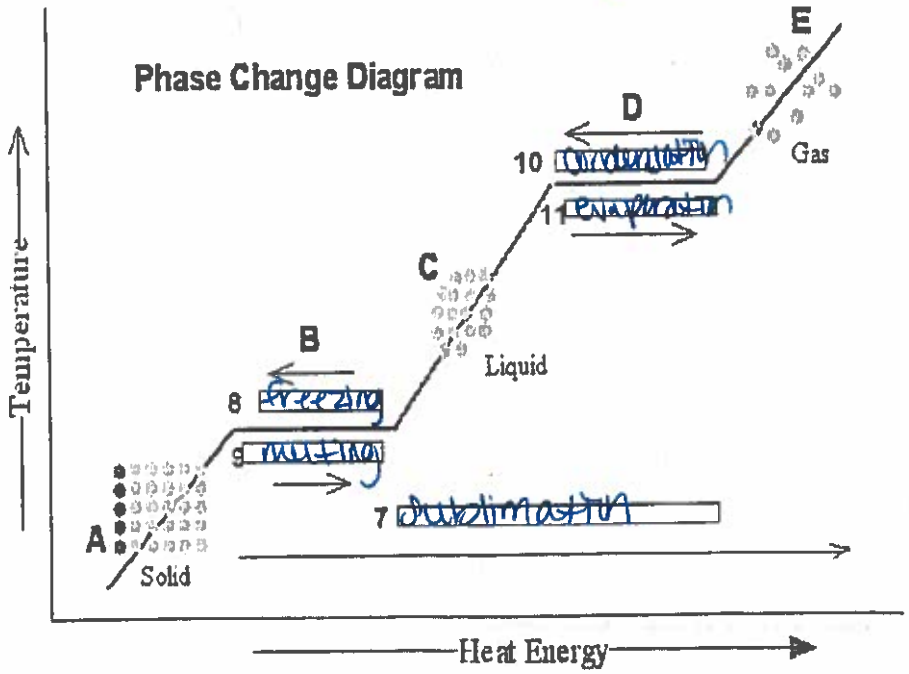
random motion, tons of energy
no volume

6. melting is the process that goes from a solid to a liquid.
7. sublimation is the process that goes from a solid to a gas.
8. deposition is the process that goes from a gas to a solid.
9. freezing is the process that goes from a liquid to a solid.
10. evaporation is the process that goes from a liquid to a gas.
11. condensation is the process that goes from a gas to a liquid.
12. Using the charts below, please fill in the following blanks...

a:



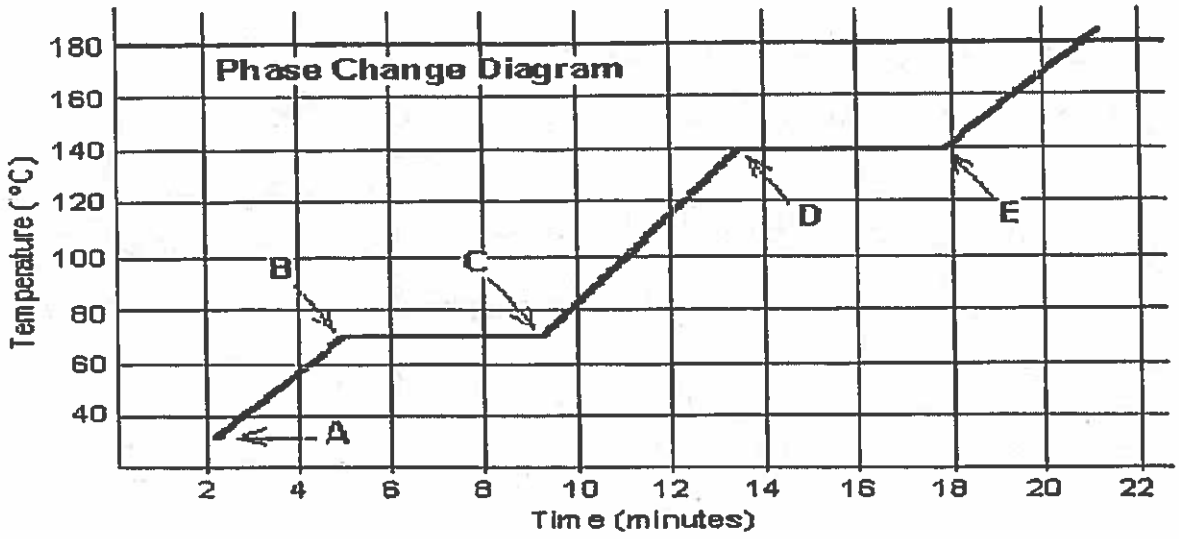
b:



13. Please use the following graph to answer the prompts in the paragraph below.

Phase Change Worksheet

The graph was drawn from data collected as a substance was heated at a constant rate. Use the graph to answer the following questions.



At **point A**, the beginning of observations, the substance exists in a solid state. Material in this phase has a defined volume and defined shape. With each passing minute, heat is added to the substance. This causes the molecules of the substance to move more rapidly which we detect by a temperature rise in the substance. At **point B**, the temperature of the substance is 70 °C. The solid begins to melt. At point C, the substance is completely melted or in a liquid state. Material in this phase has defined volume and no shape. The energy put to the substance between minutes 5 and 9 was used to convert the substance from a solid to a liquid. This heat energy is called the **latent heat of fusion.** (An interesting fact.)

Between 9 and 13 minutes, the added energy increases the motion of the substance. During the time from **point D to point E**, the liquid is evaporated. By **point E**, the substance is completely in the gaseous phase. Material in this phase has no volume and no shape. The energy put to the substance between minutes 13 and 18 converted the substance from a liquid to a gas state. This heat energy is called the **latent heat of vaporization.** (An interesting fact.) Beyond point E, the substance is still in the gaseous phase, but the molecules are moving faster as indicated by the increasing temperature.

Substance	Melting point	Boiling point
Bolognium	20 °C	100 °C
Unobtainium	40 °C	140 °C
Foosium	70 °C	140 °C

Which of these three substances was likely used in this phase change experiment?

Foosium

14. Calculate the heat needed to raise 27.0 g of water from 10.0 °C to 90.0 °C.

$q = 27g(4.18 J/g°C)(80°C) = 9{,}029 J$

15. How many kJ are required to heat 45.0 g of H_2O at 25.0°C and then boil it all away?

① $45g(4.18 J/g°C)(75°C) = 14107.5 J$

② $45g(2260) = 101700 J$

} ~116 kJ

16. Calculate the amount of energy used when 33.3 grams of ***ice*** at 0.00 °C is converted to ***steam*** at 150.0 °C.

① $(33.3g)(334 J/g) = 11122 J$

② $(33.3g)(4.18 J/g°C)(100°C) = 13919 J$

③ $(33.3g)(2260 J/g) = 75258 J$

④ $(33.3g)(2.00)(50°C) = 3330 J$

103629 J → 104 kJ

17. How many joules of heat are needed to change 50.0 grams of ice at -15.0 °C to steam at 120.0 °C?

① $(50)(2.06)(15) = 1545$

② $50(334) = 16700$

③ $(50)(4.18)(100) = 20900$

④ $50(2260) = 113000$

⑤ $50(2.00)(20) = 2000$

154145 J

Calorimetry:

18. A 12gram piece of aluminum with an initial temperature of 100°C is placed into 100grams of water at 25°C. The final temperature of the system was 27.2oC.

a: What was the students experimental specific heat of the aluminum?

$(100g)(4.18 J/g°C)(2.2°C) = (12g)C_p(75°C)$

$C_p = 1.02 J/g°C$

b: If the actual specific heat of the aluminum is 0.90 J/g°C, what is the students % error?

$\left|\frac{0.90 - 1.02}{0.90}\right| \times 100 = 13.3\%$

Heats of Reactions: Please answer the following in complete sentences.

19. Contrast the terms endothermic and exothermic. (make sure to include where energy is moving and whether the enthalpy values is positive or negative).

endothermic - absorbing energy; positive enthalpy

exothermic - releasing energy; negative energy

20. If you where to touch a test tube in which two substances where mixed to produce an endothermic reaction, how would it feel? Explain. What if the reaction was exothermic? Explain.

endothermic - warm; absorbing energy = absorbing heat

exothermic - cool; releasing energy = releasing heat

21. What is the relationship between the calorie and the joule? What about the Calorie and the joule? Kilojoule and joule?

4.184 J = 1 calorie

1000 J = 1 kJ

$-478 \longrightarrow -1930.2$

$2(-239) + 0 \longrightarrow 2(-393.5) + 4(-285.8)$

For the following equations, you will need to use the table of values posted on Moodle. PLEASE PAY ATTENTION TO PHYSICAL STATES.

22. Using • H_f values calculate the enthalpy change for the following reaction.

$$2\ CH_3OH\ (l) + 3\ O_2\ (g) \rightarrow 2\ CO_2\ (g) + 4\ H_2O\ (l)$$

(−239) 0 (−393.5) (−285.8)

- Is the reaction exo or endothermic?

exothermic; released energy

- Rewrite the equation as a thermochemical equation below.

$2\ CH_3OH_{(l)} + 3O_2\ (g) + 1452.2\ kJ \longrightarrow 2\ CO_2\ (g) + 4\ H_2O(l)$

180.0 g

23. Using • H_f values calculate the enthalpy change for the decomposition of <u>one mole</u> of SO_3 (g) into SO_2 (g) and O_2 (g). (hint-write a balanced chemical equation first).

$2\ SO_3(g) \longrightarrow 2SO_{2(g)} + O_{2(g)}$

$2(-395.7) \longrightarrow 2(-296.8) + 0$

$-791.4 \longrightarrow -593.6 \qquad \Delta H = +197.8\ kJ$

$\frac{80.06\ g}{160.12\ g\ SO_3} = \frac{x}{197.8\ kJ}$

$x = 98.9\ kJ$

24. Calculate the enthalpy change in kilojoules when 54.7g of $MgCO_3$ decomposes according to the following equation: $MgCO_3$ (s) --> MgO (s) + CO_2 (g) Use the following parts to help you. −1095.8 kJ −601.6 kJ −393.5 kJ

- Determine the amount of energy associated with the whole reaction. This is the amount of energy per ONE mole of $MgCO_3$.

$-1095.8\ kJ \longrightarrow -601.6\ kJ + (-393.5)\ kJ$

$-1095.8 \longrightarrow -995.1 \qquad \Delta H' = +100.7\ kJ$

- Using that information, determine the amount associated with 54.7g of $MgCO_3$.

$\frac{54.7\ g}{84.31\ g} = \frac{x}{100.7\ kJ}$

65.3 kJ

25. Calculate the enthalpy for the following reaction: $4NH_3$ (g) + $5O_2$ (g) --> 4NO (g) + $6H_2O$(g).
L R

You may ***only use*** the following information:

$2(N_2\ (g) + O_2\ (g) \rightarrow 2\ NO\ (g))$ • $H_f = (180.6\ kJ)2 = 361.2\ kJ$

$2(N_2\ (g) + 3\ H_2\ (g) \rightarrow 2\ NH_3\ (g))$ • $H_f = (91.8\ kJ)2 = 183.6\ kJ$

$3(2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g))$ • $H_f = (483.7\ kJ)3 = -1451.1\ kJ$

$2N_2 + 2O_2 \longrightarrow 4NO$

$4NH_3 \longrightarrow 2N_2 + 6H_2$

$6H_2 + 3O_2 \longrightarrow 6H_2O$

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

$-906.3\ kJ$