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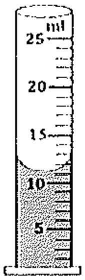
Measurement & Significant Figures: Ch 3-4



1. Record the volume of liquid pictured to the left. Use the correct significant figures and units.

   11.3 mL

2. Someone else measures out 30. mL of liquid and adds it to the liquid you measured in problem 1, above. Calculate the total volume of the combined solution and record the value using significant figures and units.

   30. mL
   11.3mL

   41 mL

Molar Conversions, Percent Composition, Empirical and Molecular Formulas: Ch 7 (pg. 170 – 196)

1. Determine the number of representative particles in each of the following:

a. 1.00 mol $Al(OH)_3$	6.02×10^{23} $Al(OH)_3$	c. 1.00 mol Hf	6.02×10^{23} Hf
b. 1.00 mol $Ca(C_2H_3O_2)_2$	6.02×10^{23} $Ca(C_2H_3O_2)_2$	d. 1.00 mol $C_6H_{12}O_6$	6.02×10^{23} $C_6H_{12}O_6$

2. Determine the number of moles of each of the following:

a. 6.022×10^{23} $Al(OH)_3$ particles	1.000 mol $Al(OH)_3$	c. 178.5 g of Hf	1.000 mol Hf
b. 22.4 L of CO_2 (@STP)	1.00 mol CO_2	d. 180.156 g of $C_6H_{12}O_6$	1 mol $C_6H_{12}O_6$

3. Find the empirical formulas for the given molecular formulas. The first one has been done as an example.

a. C_8H_{18}	÷ 2 C_4H_9	c. $C_2H_4O_2$	CH_2O	e. C_6H_5N	C_6H_5N
b. N_2H_4	NH_2	d. P_4O_{10}	P_2O_5	f. Se_3O_9	SeO_3

4. Determine the percent composition by mass of each element in the following compounds:

   a. LiCl: 6.941gLi + 35.45gCl = 42.39g/mol LiCl

   $\frac{6.941g}{42.39g}\cdot100 = 16.37\%$ Li $\frac{35.45gCl}{42.39g\ LiCl}\times100$

   16.37% Li
   83.6 % Cl

   b. $Al(NO_3)_3$

   molar mass: 213.01g/mol

   12.67% Al, 19.73% N, 67.61% O

   c. $Hg(OH)_2$

   molar mass: 234.6 g/mol

   85.51% Hg, 13.64% O, 0.8593% H

5. Use percent composition by mass to determine the empirical formula of each of the following compounds:

   a. A compound that is 34.43% iron and 65.57% chlorine.

   $34.43gFe\cdot\frac{1mol}{55.85gFe} = 0.6165mol\ Fe$ $65.57gCl\cdot\frac{1molCl}{35.45gCl} = 1.850molCl$

   1.850/0.6165 = 3Cl | Fe

   $FeCl_3$

   b. A compound that contains 85.6% carbon and 14.4% hydrogen.

   $85.6gC\ \frac{1mol}{12.01gC} = 7.13molC$ $14.4gH\cdot\frac{1mol}{1.008gC} = 14.2molC$ $\frac{14.3molH}{7.13molC} = \frac{2H}{1C}$

   CH_2

   c. A compound that is 45.9% potassium, 16.5% nitrogen, and 37.6% oxygen.

   KNO_3

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6. Determine the molecular formulas for each of the following:

   a. A compound with a molecular mass of 78.1 g/mol and an empirical formula of CH

   $\frac{78.1 g/mol}{(12.01+1.008) g/mol} = 5.99$ ↳ C_6H_6

   b. A compound with a molecular mass of 32.1 g/mol and an empirical formula of NH_2

   $\frac{32.1 g/mol}{16.02 g/mol} = 2$ N_2H_4

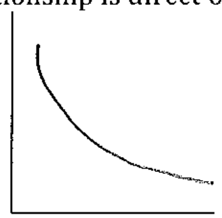
   c. A compound with a molecular mass of 88.0 g/mol and an empirical formula of C_2H_4O

   $C_4H_8O_2$

Unit 2: The Behavior of Gases – Ch 12 (pp. 327 – 355)

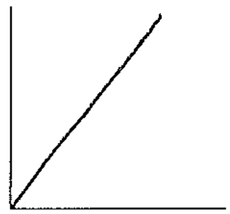
1. Draw a graph showing the general trend for each of the following gas law relationships and identify the whether the relationship is direct or inverse.

$P_1V_1 = P_2V_2$



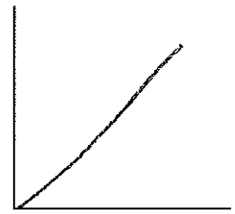
Direct or **(Inverse)**

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$



(Direct) or Inverse

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$



(Direct) or Inverse

2. A rigid container holds a gas at a pressure of 55 kPa and a temperature of –100.0°C (173K). What will the pressure be when the temperature is increased to 200.0°C? (473K)

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $P_2 = \frac{P_1T_2}{T_1} = \frac{(55 kPa)(473K)}{173K} = \boxed{150 kPa}$

3. A helium balloon has a volume of 25.0 L at 102.0 kPa and (24 °C) (297 K). Determine its volume at standard temperature and standard pressure(STP). Standard T: 273 K Standard P: 101.3 kPa

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $V_2 = \frac{P_1V_1T_2}{T_2 \cdot P_2}$ $\boxed{23.1 L}$

4. Calculate the grams of oxygen (O_2) in a 12.5 L tank if the pressure is 25,325 kPa and the temperature is 22.0 °C. 295K

$PV = nRT$ $n = \frac{PV}{RT} = \frac{(25,325 kPa)(12.5 L)}{(8.314 \frac{kPa L}{K mol})(295K)} = 129 mol O_2$

$129 mol O_2 \cdot \frac{32.00 g}{1 mol} = 4130 g$

Unit 3, Part 1: Molarity and Solutions – Ch 18 (pp. 509 – 515)

1. Determine the molarity of a 100. mL solution made by dissolving 4.95 g NaCl in water.

$M = \frac{n}{V}$ $4.95 g NaCl \cdot \frac{1 mol NaCl}{58.44 g NaCl} = 0.0847 mol NaCl$ $M = \frac{0.0847 mol}{0.100 L} = \boxed{0.847 M NaCl}$

2. Determine the mass in grams of H_2SO_4 in 15 mL of a 2.4 M H_2SO_4 solution.

$M = \frac{n}{V}$ $n = M \cdot V = (2.4 \frac{mol}{L})(0.015 L) = 0.036 mol H_2SO_4$ (↳ .015 L)

$0.036 mol H_2SO_4 \cdot \frac{98.09 g}{mol} = \boxed{3.5 g H_2SO_4}$

3. What volume of 12 M HCl solution will contain 1.0 moles of HCl?

$M = \frac{n}{V}$ $V = \frac{n}{M} = \frac{1.0 mol HCl}{12 mol/L} = \boxed{0.083 L}$

4. Determine the final concentration of a solution made by diluting 23.4 mL of 6.0 M NaCl stock solution to a final volume of 250. mL

$M_1V_1 = M_2V_2$ $M_2 = \frac{M_1V_1}{V_2} = \frac{(6.0 M)(23.4 mL)}{250. mL} = \boxed{0.56 M NaCl}$

Unit 3, Part 2: Stoichiometry – Ch 9 (pp. 238 – 259)

1. Balance the chemical equation below, and use it for the questions 2 through 6:

$$\underline{2}\ C_2H_6 + \underline{7}\ O_2 \rightarrow \underline{4}\ CO_2 + \underline{6}\ H_2O$$

2. Determine the molar masses (with units) of each reactant and product:

C_2H_6: 30.06 g/mol	O_2: 32.00 g/mol	CO_2: 44.01 g/mol	H_2O: 18.02 g/mol

3. How many moles of CO_2 are formed when 3.7 moles of C_2H_6 are reacted with excess oxygen?

$$3.7\text{ mol } C_2H_6 \cdot \frac{4\text{ mol } CO_2}{2\text{ mol } C_2H_6} = \boxed{7.4\text{ mol } CO_2}$$

4. Determine the mass of water produced if 64.8 grams of C_2H_6 combust with excess oxygen.

$$64.8\text{ g } C_2H_6 \cdot \frac{1\text{ mol } C_2H_6}{30.06\text{ g } C_2H_6} \cdot \frac{6\text{ mol } H_2O}{2\text{ mol } C_2H_6} \cdot \frac{18.02\text{ g } H_2O}{1\text{ mol } H_2O} = \boxed{117\text{ g } H_2O}$$

5. How many liters of oxygen are needed to react with 12.5 L of C_2H_6? Assume standard temperature and pressure.

$$12.5\text{ L } C_2H_6 \cdot \frac{1\text{ mol } C_2H_6}{22.4\text{ L } C_2H_6} \cdot \frac{7\text{ mol } O_2}{2\text{ mol } C_2H_6} \cdot \frac{22.4\text{ L } O_2}{1\text{ mol } O_2} = \boxed{43.8\text{ L } O_2}$$

6. What mass of carbon dioxide gas will be produced when 15.6 g of C_2H_6 is reacted with excess oxygen?

$$15.6\text{ g } C_2H_6 \cdot \frac{1\text{ mol } C_2H_6}{30.06\text{ g } C_2H_6} \cdot \frac{4\text{ mol } CO_2}{2\text{ mol } C_2H_6} \cdot \frac{44.01\text{ g } CO_2}{1\text{ mol } CO_2} = \boxed{45.7\text{ g } CO_2}$$

If this reaction were carried out and only 40.6 g of carbon dioxide were produced, what would be the percent yield?

$$\frac{\text{actual}}{\text{theoretical}} \cdot 100 = \frac{40.6\text{ g}}{45.7\text{ g}} \cdot 100 = \boxed{88.8\%}$$

7. Balance chemical equation for the single-replacement reaction between aluminum and iron (II) sulfate, and use it to complete the following problems:

$$\underline{2}\ Al\ (s) + \underline{3}\ FeSO_4 \rightarrow \underline{3}\ Fe + \underline{\quad}\ Al_2(SO_4)_3$$

8. Determine the molar masses of each reactant and product:

Al: 26.98 g/mol	$FeSO_4$: 151.92 g/mol	Fe: 55.85 g/mol	$Al_2(SO_4)_3$: 342.17 g/mol

9. Calculate the number of aluminum atoms need to react with 2.56 moles of iron (II) sulfate.

$$2.56\text{ mol } FeSO_4 \cdot \frac{2\text{ mol Al}}{3\text{ mol } FeSO_4} \cdot \frac{6.022\times10^{23}\text{ Al}}{1\text{ mol Al}} = \boxed{1.03\times10^{24}\text{ Al atoms}}$$

10. How many grams of iron can be produced if 1.25 g of aluminum and 9.05 g of iron (II) sulfate are reacted?

$$1.25\text{ g Al} \cdot \frac{1\text{ mol Al}}{26.98\text{ g Al}} \cdot \frac{3\text{ mol } FeSO_4}{2\text{ mol Al}} \cdot \frac{55.85\text{ g Fe}}{1\text{ mol Fe}} = 3.88\text{ g Fe}$$

$$9.05\text{ g } FeSO_4 \cdot \frac{1\text{ mol } FeSO_4}{151.92\text{ g } FeSO_4} \cdot \frac{3\text{ mol Fe}}{3\text{ mol } FeSO_4} \cdot \frac{55.85\text{ g Fe}}{1\text{ mol Fe}} = 3.32\text{ g Fe}$$

$$\boxed{3.32\text{ g Fe}}$$

Which reactant is the limiting reactant? $\underline{FeSO_4}$ Which is the excess reactant? $\underline{Al}$

Determine the grams of unreacted excess reactant that remain after the reaction is complete.

$$3.32\text{ g Fe} \cdot \frac{1\text{ mol Fe}}{55.85\text{ g Fe}} \cdot \frac{2\text{ mol Al}}{3\text{ mol Fe}} \cdot \frac{26.98\text{ g Al}}{1\text{ mol Al}} = 1.07\text{ g Al}$$

$$1.25 - 1.07 \qquad \boxed{0.18\text{ g Al}}$$

11. In the lab, 0.55 grams of aluminum are reacted with excess iron (II) sulfate. Calculate the percent yield if the reaction produces 1.52 grams of iron.

$$0.55\text{ g Al} \cdot \frac{1\text{ mol Al}}{26.98\text{ g Al}} \cdot \frac{3\text{ mol Fe}}{2\text{ mol Al}} \cdot \frac{55.85\text{ g Fe}}{1\text{ mol Fe}} = 1.71\text{ g Fe}$$

$$\frac{1.52\text{ g}}{1.71\text{ g}} \cdot 100 = \boxed{89.0\%}$$

12. Solid carbon and liquid water react to produce carbon tetrahydride gas and carbon dioxide gas. The balanced chemical reaction is written below.

$$2\,C(s) + 2\,H_2O \rightarrow CH_4(g) + CO_2(g)$$

a. 35.0 g of solid carbon react with excess water. Determine the theoretical yield (in liters) of carbon tetrahydride gas produced at STP.

g C → mol C → mol CH_4 → L CH_4

$35.0\,g\,C \cdot \frac{1\,mol\,C}{12.01\,g\,C} \cdot \frac{1\,mol\,CH_4}{2\,mol\,C} \cdot \frac{22.4\,L\,CH_4}{1\,mol\,CH_4} =$ 28.0 L CH_4

b. How many grams of carbon dioxide can be expected from the reaction if the percent yield is 85.0 %? actual / theoretical · 100

$35.0\,g\,C \cdot \frac{1\,mol\,C}{12.01\,g\,C} \cdot \frac{1\,mol\,CO_2}{2\,mol\,C} \cdot \frac{44.01\,g\,CO_2}{1\,mol\,CO_2} = 64.1\,g$ is theoretical

0.85 · 64.1 g = 54.5 g CO_2

Unit 4: Covalent Compounds and Intermolecular Forces – Ch 16 &17 (pp. 436 – 466 & 474 – 477)

1. According to the octet rule, most atoms become more stable when they have 8 valence electrons. The exception to this rule is hydrogen, which is most stable with 2 valence electrons.

2. How do you know whether a molecule will experience:

a. dispersion forces — all molecules

b. dipole-dipole attractions — polar molecules

c. hydrogen bonding — polar w/ H-F, H-O, H-N

3. State whether the following compounds contain polar covalent bonds, non-polar covalent bonds, or ionic bonds, based on their electronegativities.

a. KF 4.0-0.8=3.2; ionic

b. SO_2 3.5-2.5=1.0, mod/very polar

c. NO_2 3.5-3.0=0.5, mod polar

d. Cl_2 nonpolar

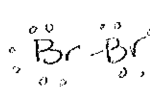
e. Na_2O ionic

f. O_2 nonpolar

ΔEN	bond type
0.0 – 0.4	nonpolar covalent
0.4 – 1.0	moderately polar covalent
1.0 – 2.0	very polar covalent
≥ 2.0	ionic

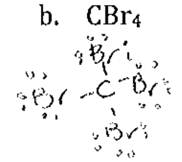
4. Draw the Lewis dot structures for the following compounds, and identify the strongest type of cohesive intermolecular attraction each molecule will experience.

a. Br_2



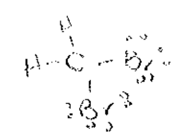
dispersion

b. CBr_4



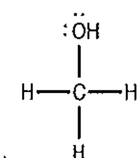
dispersion

c. CH_2Br_2



dipole-dipole

d. CH_3OH



H-bonding

5. Which of the compounds in problem 4 do you expect to have the *highest* boiling point? CH_3OH

6. Predict the order these compounds will evaporate in at room temperature. Which will be the most *volatile?*

fastest Br_2 ____ CBr_4 ____ CH_2Br_2 ____ CH_3OH ____ slowest

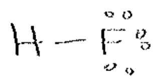
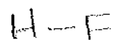
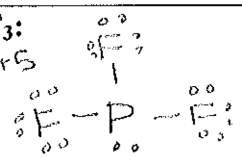
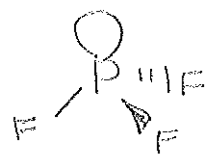
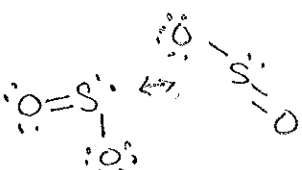
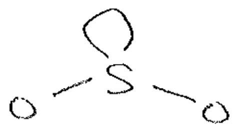
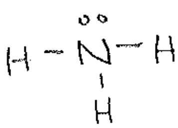
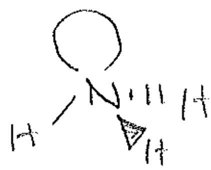
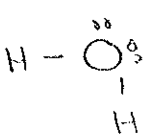
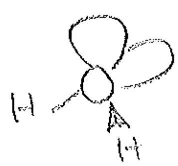
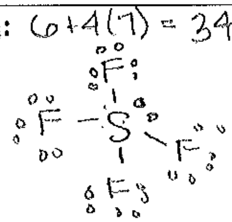
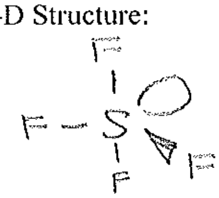
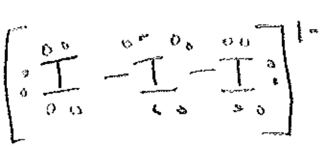
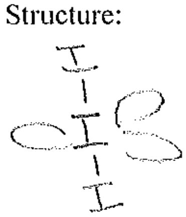
7. Define the following terms and explain how they are related to intermolecular attractions.

Cohesion: attraction between molecules that are the same. Stronger IMFS → stronger cohesion.

Adhesion: attraction between molecules that are different. If the strongest IMFs match, adhesion will be stronger

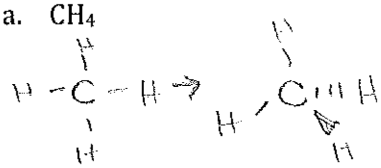
Surface Tension: Caused by cohesion. inward pull of molecules results in high surface tension when adhesive forces are weak

Complete the Table: *If a compound has resonance, be sure to draw all possible structures.

Draw the Dot Structure	Draw the 3-D structure	Name the VSEPR Shape, and indicate polarity	*Check*(✓) all forces present & *Circle or box* the ☑ to identify the **strongest** force.	
HF: 	3-D Structure: 	Shape Name: linear	dispersion	✓
		Polar or Nonpolar? polar	dipole-dipole	✓
			hydrogen bonding	(✓)
PF_3: 21+5 	3-D Structure: 	Shape Name: trigonal pyramid	dispersion	✓
		(Polar) or Nonpolar?	dipole-dipole	(✓)
			hydrogen bonding	
SO_2: 6+2(6)=18 	3-D Structure: 	Shape Name: bent	dispersion	✓
		(Polar) or Nonpolar?	dipole-dipole	(✓)
			hydrogen bonding	
NH_3: 5+3(1)=8 	3-D Structure: 	Shape Name: trigonal pyramid	dispersion	✓
		Polar or Nonpolar? polar	dipole-dipole	✓
			hydrogen bonding	(✓)
H_2O : 2(1)+6=8 	3-D Structure: 	Shape Name: bent	dispersion	✓
		Polar or Nonpolar? polar	dipole-dipole	✓
			hydrogen bonding	(✓)
SF_4: 6+4(7)=34 	3-D Structure: 	Shape Name: seesaw or irregular tetrahedron	dispersion	✓
		Polar or Nonpolar? polar	dipole-dipole	(✓)
			hydrogen bonding	
I_3^{1-}: 3(7)+1=22e- 	3-D Structure: 	Shape Name: linear	dispersion	(✓)
		Polar or (Nonpolar)?	dipole-dipole	
			hydrogen bonding	

8. Identify the types of intermolecular forces each of these compounds will exert. Then identify the compounds from the table above that the compound is likely to adhere strongly to.

a. CH_4



I_3^{1-}

dispersion

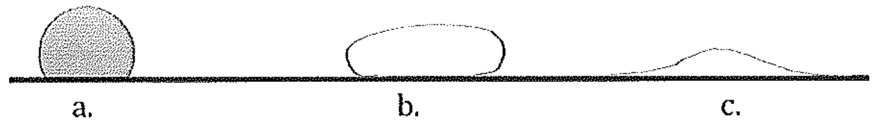
b. H_2O

dispersion
dipole-dipole
H-bonds

HF, NH_3,

Page 6

9. The figure below indicates the shape of a droplet with high surface tension.
   a. For the droplet pictured, which is stronger, the adhesive forces or the cohesive forces? Cohesive
   b. Sketch how the shape of the droplet will change if something is added to weaken the cohesive forces.
   c. Sketch how the shape of the droplet will change if it is put on a surface with stronger adhesive forces.



Unit 5: Thermodynamics: Ch 11 (pg. 293 – 218)

1. In which direction does heat flow when two objects of different temperatures come into contact with one another? Give an example from your own experience.
   hot to cold — Hot oven bakes cookies (heat flows)

2. Is freezing a popsicle an endothermic or an exothermic process? Explain your answer.
   Heat must be removed to freeze (solidify) something

3. Complete the following table: Fill in what you'd expect to see for exothermic versus endothermic systems.

	Exothermic	Endothermic
Sign of ΔH_{system}	negative	positive
Heat flow (in/out of system)	out	in
Measured ΔT of Surroundings	↑	↓
2 Examples	• fire feels warm • steam burns when it condenses	sweat cools (takes heat) when evaporating cold paks

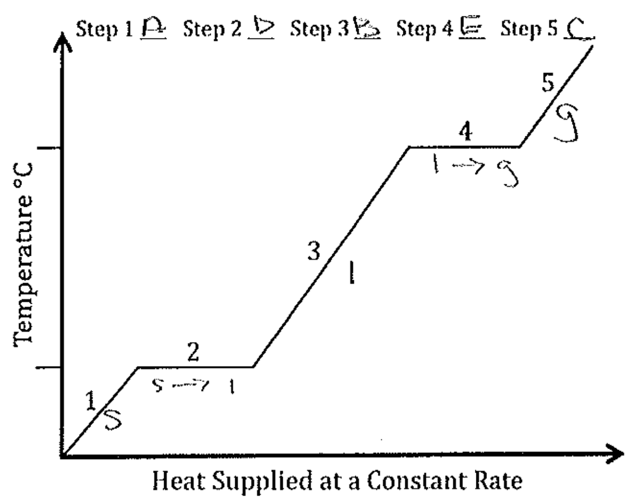
A heating curve is shown to the right.

4. Label each section of the curve with the corresponding phases (s, l, g, etc).

5. Match each step on the heating curve for water to the corresponding behavior (write the letters by the steps).

Description of Behavior

A. Energy is used to increase the temperature of solid ice.
B. Energy is used to increase the temperature of liquid water.
C. Energy is used to increase the temperature of gaseous water (steam).
D. Energy is used to melt ice ($S \rightarrow L$).
E. Energy is used to vaporize water ($L \rightarrow G$)



6. Identify the steps (1 to 5) on the heating curve above that correspond to each of the terms listed below - some terms refer to multiple steps.
   a. heat of fusion step (s) 2
   b. heat of vaporization step (s) 4
   c. heat of solidification step (s) 2
   d. heat of condensation step (s) 4
   e. latent heat step (s) 2, 4
   f. sensible heat step (s) 1, 3, 5

For the following questions, refer to the table of specific heat values to the right.

Specific Heat $\frac{J}{g \cdot °C}$	
Ethanol	2.44
Mercury	0.14
Hydrogen	14.30
Radon	0.094
Water	4.18

7. Compare the specific heats of ethanol and mercury. Which substance requires less energy to heat to a higher temperature? Why? (Assume equal masses.)

Mercury has a lower specific heat than Ethanol. To raise the temperature by 1°C, Hg requires only 0.14 J/g compared to ethanol, which requires 2.44 J/g.

8. Which requires more energy to increase the temperature by 1 °C? Explain why.

1 g ethanol　　(1000 g ethanol)　　1 g mercury　　1000 g mercury

ethanol has a higher specific heat than mercury, and it takes 1000 times more energy to change the temp of 1000g by 1°C as to change the temp of 1 g.

9. The element hydrogen has the highest specific heat of all elements. Determine the amount of energy needed to raise the temperature of a 340.0 g sample of hydrogen by 30 °C.

$\Delta H = mC\Delta T$

$= 340.0g \cdot 14.30 \frac{J}{g°C} \cdot 30°C = 145860 J$

$\rightarrow \boxed{146 kJ}$

10. Brass is an alloy made from copper and zinc. A 590.0 g brass candlestick has an initial temperature of 98.0°C. When 2.11×10^4 J of energy is removed from the candlestick, its temperature decreases to 6.8 °C. Determine the specific heat of brass.

$\Delta H = m \cdot C \Delta T$

$C = \frac{\Delta H}{m \Delta T} = \frac{-2.11 \times 10^4 J}{(590.0g)(6.8°C - 98.0°C)} = \boxed{0.392 J/g°C}$

11. The element radon has the lowest specific heat of all naturally occurring elements. Calculate the change in heat needed to cool 35.0 g of radon by 10.0 °C.

$\Delta H = mC\Delta T$

$= 35.0g \cdot 0.094 \frac{J}{g°C} (-10°C)$

$= \boxed{-32.9 J}$

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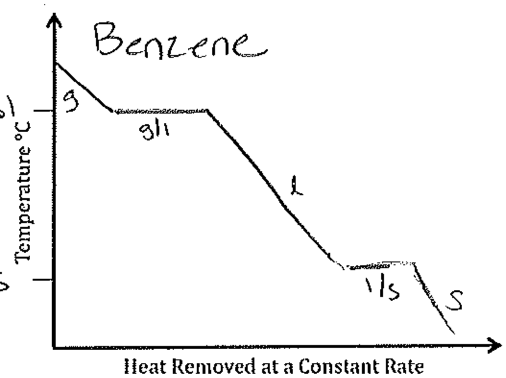
Thermodynamic Properties of Various Substances

Substance	$C_{solid}\left(\frac{J}{g\cdot°C}\right)$	Melting Point (°C)	$\Delta H_{fus}\ \frac{J}{g}$	$C_{liq.}\left(\frac{J}{g\cdot°C}\right)$	Boiling Point (°C)	$\Delta H_{vap}\ \frac{J}{g}$	$C_{gas}\left(\frac{J}{g\cdot°C}\right)$
Water	2.10	0.00	334	4.18	100.0	2260	2.00
Ethanol	2.47	– 117	109	2.49	78	838	1.74
Benzene	1.51	5.5	444	1.73	80.1	390	1.06

12. Sketch a ***cooling curve*** for benzene.
    a. Label the temperature axis with the melting point and the boiling point, and identify the phases for each section of the curve.
    b. Using only variables, write the equation you would use to calculate the change in energy when 35.0 g of benzene is cooled from 85.4 °C to 10.2 °C (don't solve them).

$\Delta H = mC_{gas}\Delta T + m\Delta H_{cond} + mC_{liq}\Delta T$



Determine the amount of heat gained or lost during each of the following changes. (Use the values provided above.)

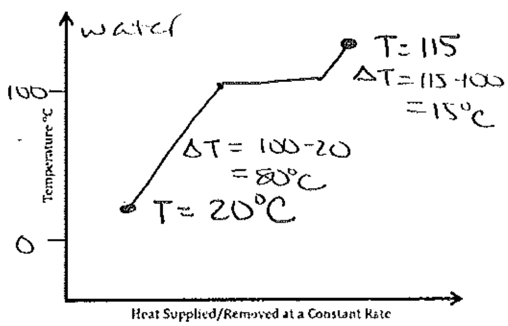
13. 45.0 g of liquid water at 20 °C is converted to steam at 115 °C.

$\Delta H = mC_l\Delta T_l + m\cdot\Delta H_{vap} + mC_g\Delta T$

$= 45.0g(4.18\frac{J}{g°C})(80°C) + 45.0g(2260\frac{J}{g})$

$+ 45.0g(2.00\frac{J}{g°C})(15°C)$

$= \boxed{118\ kJ}$



14. 220.0 g of solid water at -35.0 °C is heated to form liquid water at 50.0 °C.

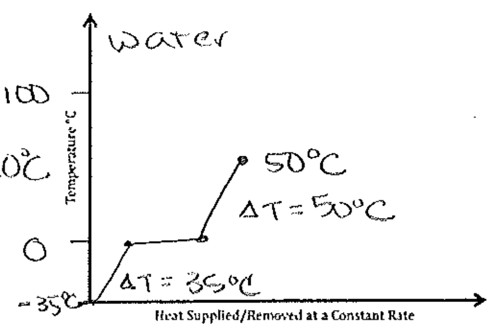
$\Delta H = m\cdot C_s\Delta T_s + m\Delta H_{fus} + mC_l\Delta T_l$

$220.0g\cdot 2.10\frac{J}{g°C}\cdot 35.0°C + 220.0g\cdot 334\frac{J}{g} + 220.0g\cdot 4.18\frac{J}{g°C}\cdot 50.0°C$

$16170J + 73480J + 45980J$

$=$

$136\ kJ$

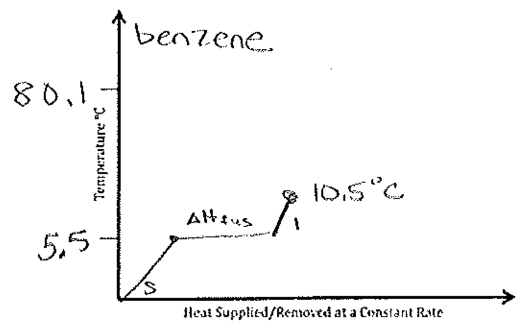


15. 20.0 g of **benzene** at –45.0 °C is heated to 10.5 °C.

$\Delta H = m\cdot C_s\Delta T + m\Delta H_{fus} + mC_l\Delta T$

$5.5°C - (-45.0°C) = 50.5°C$ $\quad$ $10.5°C - 5.5°C = 5.0°C$

$\boxed{\Delta H = 10.6\ kJ}$



16. 5.00 g of **ethanol** at 155 °C is cooled to 60.0 °C.

$\Delta H = m\cdot C_g\Delta T_g + m\cdot\Delta H_{cond} + m\cdot C_l\Delta T_l$

$= 5.00g\cdot 1.06\frac{J}{g°C}(-77°C) + 5.00g(-390\ J/g) + 5.00g\cdot 1.73\frac{J}{g°C}(-18°C)$

$= \boxed{-2.5\ kJ}$