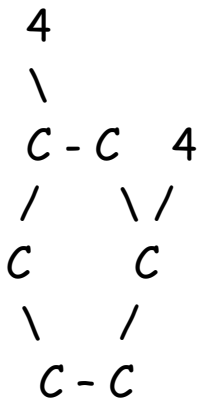
CHEM 1050 SLG

Mondays & Wednesdays 1:30 - 3 pm
@ LIB 120A

Session # 5

Q: What is the chemical name of the following benzene-like molecule?



A: Metaphor

Remember to Complete Quiz #1 by Thursday!

Agenda:

1) Work and Heat
2) More Calorimetry Questions
3) Entropy
4) Review of EVERYTHING!!!

WORK AND HEAT

1. Fill in the following grid:

Process	q	w
Piston compresses reaction vessel and heat is released		
	-	-
	-	+
Hot air balloon expands as it absorbs heat from inflation device		

2. Calculate ΔU for a system that does 200 kJ of work on the surroundings when 350 kJ of heat are absorbed by the system.

CALORIMETRY QUESTIONS

3. How much heat is released when 50 g of pure water is cooled from 56 ^0C to 25^0C (C_w = 4.18 J/(g x ^0C)

4. An electric heater is used to supply 30.0 kJ to a 30 g sample of water initially at 10 ^{0}C. Calculate the final temperature of the water sample. The specific heat capacity of water is 4.184 $J \cdot (^\circ C)^{-1} \cdot g^{-1}$

ENTROPY

1. In the following reactions does the entropy (ΔS) increase or decrease?

$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

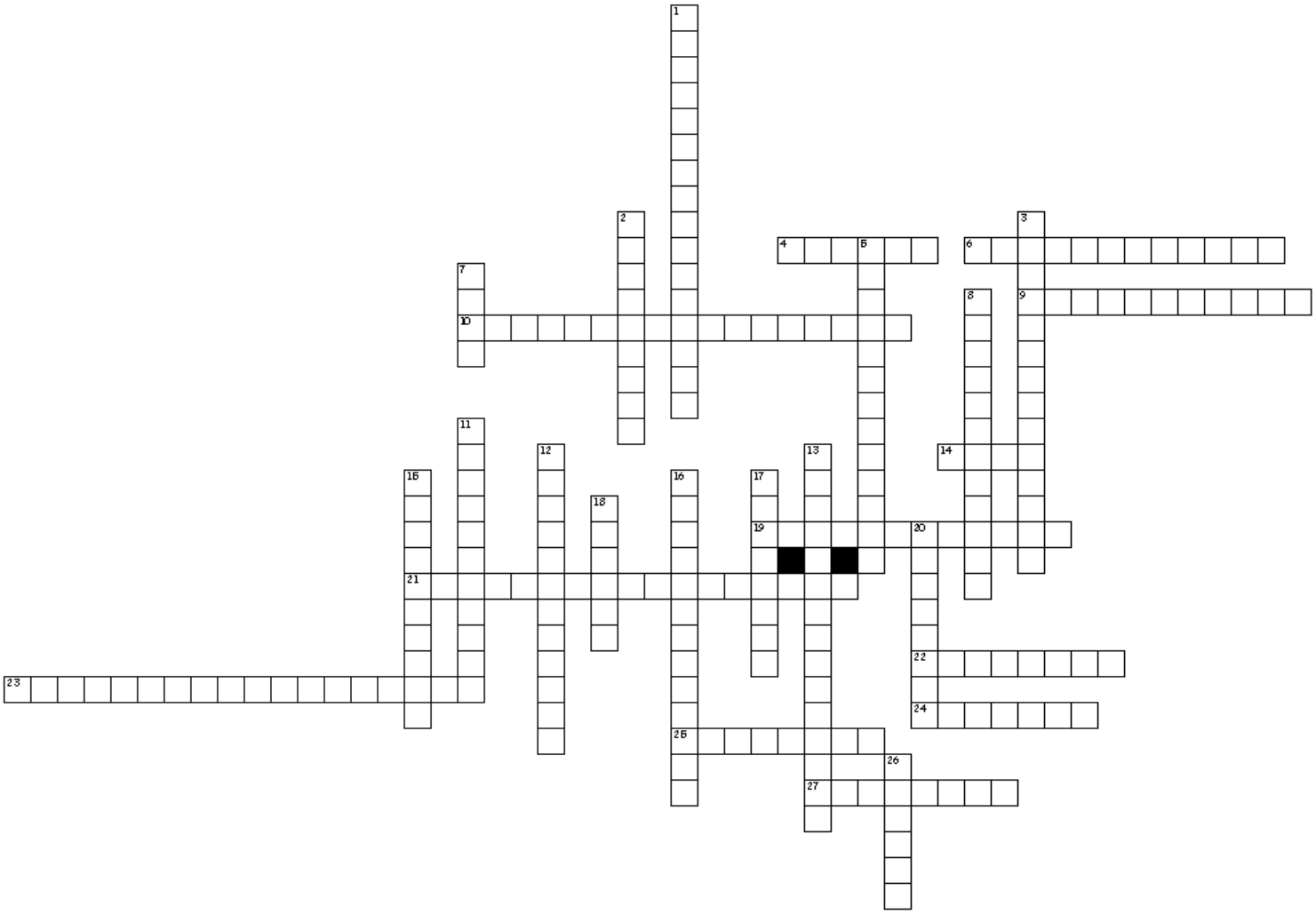
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

$2NH_4Cl(s) \rightarrow N_2(g) + 4H_2(g) + Cl_2(g)$

$NaCl(s) \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$

2. Calculate the ΔS_{rxn} for the formation reaction of CO_2 (look up values in your textbook).

Definition Cross Word Review



Across

4. In this system there is no transfer of matter across the boundary but energy can transfer
6. The process of going from vapour to liquid
9. An _____ process requires heat as they occur
10. Amount of heat required to raise temperature of one mole of element or compound by 1 K or 10C
14. In this system energy and matter can be transferred
19. The rest of the universe
21. Enthalpy change when 1 mole of element in standard state is converted to 1 mole of gas phase atoms
22. In this system there is no transfer of matter or energy across the boundary
23. Enthalpy change when we vaporize 1 mole liquid at 1.01 x 105 Pa
24. A quantitative measure of randomness or disorder
25. Forming bonds _____ energy
27. Breaking bonds _____ energy

Down

1. Enthalpy change when we burn 1 mole completely in O2
2. A _____ calorimeter is at constant pressure
3. The sum of the kinetic and potential energies of the particles making up the system
5. Depend only on state of system difference between start and end
7. A _____ calorimeter is at constant volume
8. Amount of heat required to raise temp of a body by 1 K or 10C
11. The process of going from ice to vapour
12. The amount of heat required to raise 1gram of material by1 K or 10C
13. _____ is concerned with the flow of heat from the system to its surroundings, and vice-versa
15. An _____ process releases heat as they occur
16. energy required to break up 1 mole of solid into gas phase ions
17. For an endothermic process the enthalpy change is _____
18. The part of the universe that undergoes a change and whose energy is of interest to us.
20. For an exothermic process the enthalpy change is _____
26. The process of going from ice to liquid

LET' END OFF WITH A SHORT QUIZ!

1. Calculate the ΔU of a system that does 300 kJ of work on the surroundings when 150 kJ of heat are absorbed by the system.

   (a) +450 kJ (b) 0 kJ (c) –450 kJ (d) –150 kJ (e) +150 kJ

2. For a certain reaction at constant pressure, ΔU= +65 kJ and 23 kJ of expansion work is done by the system. What is the ΔH for this process?

   (a) +42 kJ (b) –88 kJ (c) –42 kJ (d) +88 kJ (e) +65 kJ

3. A piece of metal of mass 20.0g at 100.0°C is placed in a Styrofoam cup calorimeter containing 50.7g of water at 22.0°C. The final temperature of the mixture is 25.7°C. What is the specific heat capacity of the metal? Assume all the energy lost by the metal is gained by the water.

4. Bond Dissociation Enthalpies are ALWAYS:

   a. Small and Negative
   b. Large and Positive
   c. Large and Negative
   d. Small and Positive

5. To measure BDE the species must be in:
   a. gaseous state
   b. solid state
   c. liquid state
   d. standard state

6. The enthalpy of sublimation of sulfur dioxide is 32.3 kJ/mol and its enthalpy of vapourization is 24.9 kJ/mol. Calculate the enthalpy of freezing.

   a. –7.4 kJ/mol
   b. +57.2 kJ/mol
   c. –57.2 kJ/mol
   d. +7.4 kJ/mol
   e. –32.3 kJ/mol

7. Identify the true statement: The _____the bond length, the _____ the Bond Enthalpy

   a. longer, larger
   b. shorter, smaller
   c. shorter, larger
   d. longer, smaller
   e. two of the above
   f. the length of the bond has no affect on the size of the enthalpy

8. Find the bond enthalpy of the C=C bond. Given:
   ΔH°_f (C_2H_4) = +52.26 kJ/mol ΔH°_{BE} (C-H) = +412 kJ/mol
   $\Delta H^\circ_{dissociation}$ ($H_{2(g)}$) = + 436 kJ/mol ΔH°_{sub} ($C_{(s)}$) = +720 kJ/mol

7. The enthalpy of combustion of benzoic acid, C_6H_5COOH, which is often used to calibrate calorimeters, is –3227 kJ/mol. When 1.236 g of benzoic acid was burned in a calorimeter, the temperature increased by 2.345°C. What is the heat capacity of the calorimeter?

8. Calculate the standard reaction enthalpy for the synthesis of hydrogen chloride gas

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

From the following data:

$$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s) \qquad \Delta H^\circ = -176.0 \text{ kJ}$$
$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) \qquad \Delta H^\circ = -92.22 \text{ kJ}$$
$$N_2(g) + 4H_2(g) + Cl_2(g) \rightarrow 2NH_4Cl(s) \qquad \Delta H^\circ = -628.86 \text{ kJ}$$

9. Calculate the average H-S bond enthalpy in $H_2S(g)$ given the data below.

	ΔH_f°, kJ.mol^{-1}
$H_2S(g)$	-20.1
$H(g)$	217.9
$S(g)$	222.8

10. If the standard enthalpy of combustion of ethanol, $C_2H_5OH(l)$, is –1368 kJ/mol, calculate the heat output if 0.50 kg of ethanol is burned.

11. If the standard enthalpy of combustion of coal is –394 kJ/mol, calculate the mass of coal needed to supply 6.50×10^2 kJ of heat.

13. Calculate the standard enthalpy of combustion of hydrazine, $N_2H_4(l)$, given

$H_2O(l) \Rightarrow H_2(g) + 1/2O_2(g)$ $\quad \Delta H^\circ = +285.83$ kJ
$N_2(g) + 2H_2(g) \Rightarrow N_2H_4(l)$ $\quad \Delta H^\circ = +50.63$ kJ

Important Equations to Remember!!

$\Delta U = q + w = E_{final} - E_{initial}$

$w = -P\,\Delta V = -\Delta nRT$

$PV = nRT$

$q = \Delta U + P\Delta V = \Delta H$

$\Delta H_{rxn} = \sum \Delta H_p - \sum \Delta H_r$

$\Delta H_{rxn} = \sum \Delta H_{\text{(BE reactants)}} - \sum \Delta H_{\text{(BE products)}}$

$\Delta S = q_{rev}/T$ & $T = \Delta H/\Delta S$ (at constant temperature ex. Melting and boiling point)

$$\Delta S_{rxn} = \sum \Delta S_p - \sum \Delta S_r$$