$$\Delta H_{rxn} = \sum(n\Delta H_f \text{ PROD.}) - \sum(n\Delta H_f \text{ REACT.})$$

$$q = mc\Delta T$$

$$q = C\Delta T$$

Key

1A Exam 4 S14

$$E = h\nu$$

$$E = \frac{hc}{\lambda}$$

$$E = R_H\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \quad R_H = 2.179 \times 10^{-18}\ J$$

$$c = \lambda\nu$$

$$h = 6.63 \times 10^{-34}\ J \cdot s$$

$$c = 3.0 \times 10^{8}\ \frac{m}{s}$$

V2 Name:

10 pts

1. Answer the following questions involving quantum numbers:

   a. Energy shell n=3 has what type of orbitals? s, p, d

   b. Energy shell n=2 can hold a maximum of how many electrons?

      s+p = 8e⁻

   c. Give the ml values when l = 1. Explain what they mean specifically.

      m_l = -1, 0, +1 three p orbitals

   d. What is denoted by l = 0, 1?

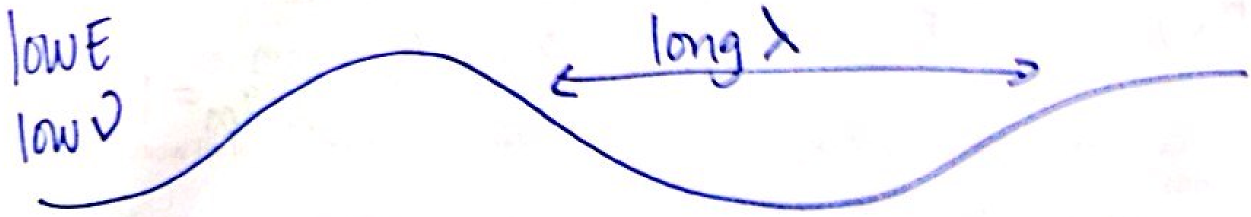
      s p

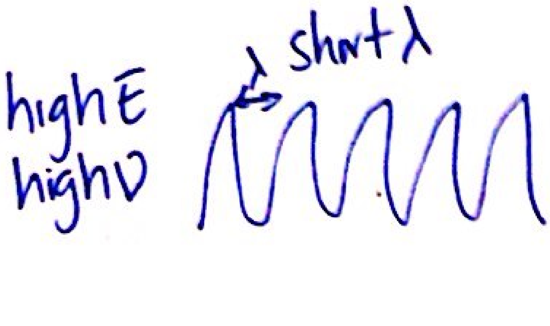
   e. What is the maximum number of electrons depicted by l = 2?

      d = 10e⁻

3pts

2. Draw a low energy "wave" of light and briefly indicate the type of wavelength and frequency associated with it. (V1 = high energy)





4pts

3. Calculate the amount of energy released in Joules when 5.75 moles of A is consumed in the following reaction: 2A + 3B → 5C ΔH = −278 kJ (V1 ΔH = −678 kJ)

V2: $5.75 \text{ mol A} \times \frac{-278 \text{ kJ}}{2 \text{ mol A}} \times \frac{1000 \text{ J}}{1 \text{ kJ}} = -799250 \text{ J}$

V1: $5.75 \text{ mol A} \times \frac{-678 \text{ kJ}}{2 \text{ mol A}} \times \frac{1000 \text{ J}}{1 \text{ kJ}} = -1949250 \text{ J}$

4. An electron transitions from n=6 to n=4. (V1 n=5→3)

a. Calculate the energy released in this transition. Show all work and units.

3pts

V2: $E = 2.179 \times 10^{-18} \text{ J} \left(\frac{1}{4^2} - \frac{1}{6^2}\right) = 7.57 \times 10^{-20} \text{ J}$

V1: $E = 2.179 \times 10^{-18} \text{ J} \left(\frac{1}{3^2} - \frac{1}{5^2}\right) = 1.55 \times 10^{-19} \text{ J}$

b. Calculate the wavelength of light in nm for this transition. Show all work and units.

3pts

$E = \frac{hc}{\lambda}$ $\lambda = \frac{hc}{E}$

V2: $2.63 \times 10^{-6} \text{ m} \times \frac{1 \text{ nm}}{10^{-9} \text{ m}} = 2627 \text{ nm}$

V1: $1.28 \times 10^{-6} \text{ m} \times \frac{1 \text{ nm}}{10^{-9} \text{ m}} = 1283 \text{ nm}$

5. Calculate the frequency of light emitted with a wavelength of 580nm. Show all work and units. (V1 680 nm)

4pts

$\frac{c}{\lambda} = \frac{\lambda \nu}{\lambda}$

V2: $\nu = \frac{3.0 \times 10^8 \frac{m}{s}}{5.80 \times 10^{-7} \text{ m}} = 5.17 \times 10^{14} \text{ s}^{-1}$ Hz

V1: $\nu = \frac{3.0 \times 10^8 \frac{m}{s}}{6.80 \times 10^{-7} \text{ m}} = 4.41 \times 10^{14} \text{ s}^{-1}$ Hz

(6pts) 6. Calculate ΔH for the reaction $4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$, from the following Data. Show all work below – equations must be re-written to show how they sum to the overall.

($N_2\ (g) + O_2\ (g) \rightarrow 2\ NO\ (g)$ $\Delta H = -180.5$ kJ) × 2

($N_2\ (g) + 3\ H_2\ (g) \rightarrow 2\ NH_3\ (g)$ $\Delta H = -91.8$ kJ) Rev × 2

($2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$ $\Delta H = -483.6$ kJ) × 3

$2N_2 + 2O_2 \rightarrow 4NO$ -361 kJ

$4NH_3 \rightarrow 2N_2 + 6H_2$ $+183.6$ kJ

$6H_2 + 3O_2 \rightarrow 6H_2O$ -1450.8

(−1628.2)

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

(5pts) 7. When potassium chloride reacts with oxygen under the right conditions, potassium chlorate is formed: $2\ KCl + 3\ O_2 \rightarrow 2KClO_3$

R P

Given that the enthalpy of the reaction is 90 kJ, and the heat of formation of potassium chloride is –436 kJ/mol, calculate the heat of formation of potassium chlorate. Show all work and units.

$\Delta H_{rxn} = \Sigma\ \Delta H_f\ PROD - \Sigma\ \Delta H_f\ REACT$

$90\text{ kJ} = 2x - (2\text{ mol} \times -436\text{ kJ/mol})$

$90\text{ kJ} = 2x - (-872\text{ kJ})$

$90\text{ kJ} = 2x + 872\text{ kJ}$

$-872 \qquad -872$

$\frac{-782}{2} = \frac{2x}{2}$

(−391 kJ/mol = x)

6

8. 5.00 g of a metal was heated to 100.0°C and then plunged into 100.0 g of water at 24.0 °C. The temperature of the resulting mixture became 28.0°C. The specific heat capacity of water is 4.184 J/g°C. Show all work and units.

a) How many joules did the water absorb?

$q = mc\Delta T = 100.0g \times 4.184 \frac{J}{g°C} \times (28.0°C - 24.0°C)$

$= \pm 1673.6J$

b) How many joules did the metal lose?

$-1673.6J$

c) What is the specific heat capacity of the metal?

$\frac{q}{m\Delta T} = \frac{mc\Delta T}{m\Delta T}$

$c = \frac{-1673.6 J}{5.00g \times (28.0°C - 100°C)} = 4.65 \frac{J}{g°C}$

6

9. 4.5 grams of KI was dissolved in 120 grams of water in a calorimeter. The temperature of the solution in the calorimeter fell from 27.0°C to 19.0°C. Calculate the enthalpy in kJ/mol for the solution process and label it as endo- or exo-thermic. The specific heat capacity of the solution is 1.15 J/g°C. Show all work and units.

KI

$4.5g \times \frac{mol}{166g}$

$\frac{kJ}{mol}$?

Calorimeter solution

$m_{solution} = 120g + 4.5g = 124.5g$

$T_f = 19.0$

$T_i = 27.0°C$

$c = 1.15 \frac{J}{g°C}$

$q = (124.5g)(1.15 \frac{J}{g°C})(19 - 27°C)$

$= -1145.4J$

$+1145.4J$

$= \frac{+1.1454 kJ}{0.02711 mol}$

$= (+) 42.3 \frac{kJ}{mol}$

endo

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