Name _____

CHAPTER 5 – 6 PRACTICE QUIZ (Sections 5.5 – 5.7, 6.1 – 6.3, 6.5 – 6.8)

MULTIPLE CHOICE – NO CALCULATOR ALLOWED

1. In an insulated cup of negligible heat capacity, 50. g of water at 40.°C is mixed with 30. g of water at 20.°C. The final temperature of the mixture is closest to

   (A) 27°C

   (B) 30.°C

   (C) 33°C

   (D) 38°C

2. A 100 g sample of a metal was heated to 100°C and then quickly transferred to an insulated container holding 100 g of water at 22°C. The final temperature of the water (and the metal) was equal to 35°C. Which of the following can be concluded?

   (A) The metal temperature changed more than the water temperature did; therefore the amount of heat lost by the metal is greater than the amount of heat gained by the water.

   (B) The metal temperature changed more than the water temperature did, but the amount of heat lost by the metal is equal to the amount of heat gained by the water.

   (C) The metal temperature changed more than the water temperature did; therefore the specific heat of the metal is greater than the specific heat of the water.

   (D) The metal temperature changed more than the water temperature did, but the specific heat of the metal is equal to the specific heat of the water.

$$K(s) + \tfrac{1}{2}\,Cl_2(g) \rightarrow KCl(s) \qquad \Delta H^\circ = -440\ kJ/mol_{rxn}$$

3. Based on the thermochemical equation shown above, how much heat is released or absorbed when 0.10 mol of $Cl_2(g)$ is formed from $KCl(s)$?

   (A) 44 kJ is released

   (B) 88 kJ is released

   (C) 44 kJ is absorbed

   (D) 88 kJ is absorbed

$$2\ Na_2O_2(s) + S(s) + H_2O(l) \rightarrow 4\ NaOH(aq) + SO_2(aq) \qquad \Delta H^o = -600\ kJ/mol_{rxn}$$

4. In a certain experiment, 7.8 g $Na_2O_2(s)$ is mixed with 3.2 g $S(s)$ along with excess water. Which of the following identifies the limiting reactant and the heat released, q, for this experiment?

	Limiting Reactant	q
(A)	Na_2O_2	30 kJ
(B)	Na_2O_2	60 kJ
(C)	S	30 kJ
(D)	S	60 kJ

$$4\ NH_3(g) + 3\ O_2(g) \rightarrow 2\ N_2(g) + 6\ H_2O(g)$$

Substance	ΔH_f°
$NH_3(g)$	–50 kJ/mol
$H_2O(g)$	–240 kJ/mol

5. Based on the information in the table above, what is the value of ΔH° for the reaction represented above?

(A) –1640 kJ

(B) –1240 kJ

(C) –290 kJ

(D) –190 kJ

$$\tfrac{1}{2}\ H_2(g) + \tfrac{1}{2}\ I_2(s) \rightarrow HI(g) \qquad \Delta H = 26\ kJ$$

$$\tfrac{1}{2}\ H_2(g) + \tfrac{1}{2}\ I_2(g) \rightarrow HI(g) \qquad \Delta H = -5\ kJ$$

6. Based on the information above, what is the enthalpy change for the sublimation of iodine?

(A) 21 kJ/mol

(B) 31 kJ/mol

(C) 42 kJ/mol

(D) 62 kJ/mol

$$CH_4(g) + 2\,O_2(g) \rightarrow CO_2(g) + 2\,H_2O(l) \qquad \Delta H^\circ = -890\ kJ$$

ΔH_f^o for $CO_2(g)$ = X kJ/mol and ΔH_f^o for $H_2O(l)$ = Y kJ/mol

7. The value of ΔH° for the combustion of methane gas is equal to –890 kJ as shown above. The standard enthalpy of formation for $CO_2(g)$ is equal to X kilojoules per mole. The standard enthalpy of formation for $H_2O(l)$ is equal to Y kilojoules per mole. In terms of X and Y, the standard enthalpy of formation for methane gas is equal to

(A) X + 2Y + 890

(B) X + 2Y – 890

(C) X + Y + 890

(D) X + Y – 890

$$H_2(g) + \tfrac{1}{2}\,O_2(g) \rightarrow H_2O(l) \qquad \Delta H^\circ = A$$

$$2\,Na(s) + \tfrac{1}{2}\,O_2(g) \rightarrow Na_2O(s) \qquad \Delta H^\circ = B$$

$$Na(s) + \tfrac{1}{2}\,O_2(g) + \tfrac{1}{2}\,H_2(g) \rightarrow NaOH(s) \qquad \Delta H^\circ = C$$

8. Based on the information above, what is the standard enthalpy change for the following reaction?

$$Na_2O(s) + H_2O(l) \rightarrow 2\,NaOH(s) \qquad \Delta H^\circ = ?$$

(A) A + B – C

(B) A + B – 2C

(C) C – A – B

(D) 2C – A – B

Type of electromagnetic radiation	Frequency (s^{-1})	Wavelength (m)	Energy (J)
X	3×10^{21}	1×10^{-13}	2×10^{-12}
Y	3×10^{14}	?	?

9. Two types of electromagnetic radiation, X and Y, are represented in the data table above. Which of the following are the most probable values for wavelength and energy associated with Y ?

(A) 1×10^{-20} m, 2×10^{-5} J

(B) 1×10^{-20} m, 2×10^{-19} J

(C) 1×10^{-6} m, 2×10^{-5} J

(D) 1×10^{-6} m, 2×10^{-19} J

10. Which of the following statements is most closely associated with the photoelectric effect?

(A) Light shining on a clean metal surface causes the surface to emit electrons.

(B) Energy is emitted by electrons as they travel from an higher energy state toward a lower energy state.

(C) Electrons exist only in certain discrete energy levels, which are described by quantum numbers.

(D) The solution to Schrodinger's equation for the hydrogen atom yields a set of wave functions called orbitals.

11. Which of the following represents the ground state electron configuration and an excited state electron configuration for the same element?

	Ground State	Excited State
(A)	$1s^2 2s^2 2p^1$	$1s^2 2s^2 2d^1$
(B)	$1s^2 2s^2 2p^6$	$1s^2 2s^2 2p^5 3s^1$
(C)	$1s^2 2s^2 2p^5$	$1s^2 2s^2 2p^6$
(D)	$1s^2 2s^2 2p^6 3s^2$	$1s^2 2s^2 2p^5 3s^3$

12. There are eight elements located in Period 3 of the periodic table. How many of these elements have a ground state electron configuration that contains exactly two unpaired electrons?

(A) one (B) two (C) three (D) four

13. When electrons are removed from an atom to form a cation, they are always removed first from the occupied orbitals having the largest principal quantum number (*n*).
Which of the following represents the ground state electron configuration for the Co^{2+} ion?

(A) [Ar] $3d^7$ (B) [Ar] $3d^5 4s^2$ (C) [Ar] $3d^6 4s^1$ (D) [Ar] $3d^7 4s^2$

$X(g) \rightarrow X^{+}(g) + e^{-}$ $IE_1 = 740$ kJ/mol

$X^{+}(g) \rightarrow X^{2+}(g) + e^{-}$ $IE_2 = 1450$ kJ/mol

$X^{2+}(g) \rightarrow X^{3+}(g) + e^{-}$ $IE_3 = 7730$ kJ/mol

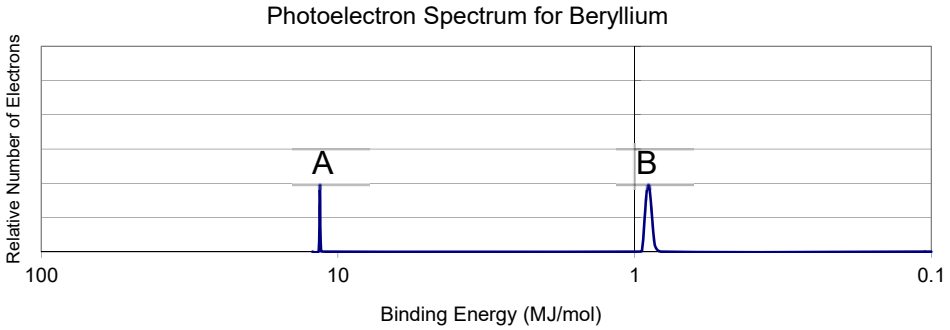
14. For element X represented above, which of the following is the most likely explanation for the large difference between the second and third ionization energies?

(A) The effective nuclear charge decreases with successive ionizations.

(B) The shielding of outer electrons increases with successive ionizations.

(C) The electron removed during the third ionization is, on average, much closer to the nucleus than the first two electrons were.

(D) The electron removed during the third ionization is located in a higher energy level than the first two electrons were.



15. The diagram above represents the photoelectron spectrum for beryllium. Which of the following statements is correct concerning Peak A and Peak B?

(A) The electrons represented by Peak A require more energy to remove because they are located in a full *s* orbital.

(B) The electrons represented by Peak B require more energy to remove because they are located in a full *s* orbital.

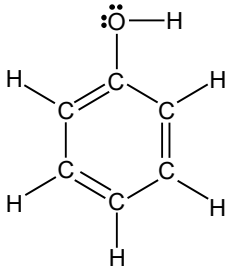
(C) The electrons represented by Peak A require more energy to remove because they are closer to the nucleus.

(D) The electrons represented by Peak B require more energy to remove because they are closer to the nucleus.

Name _____

CHAPTER 5 – 6 PRACTICE QUIZ (Sections 5.5 – 5.7, 6.1 – 6.3, 6.5 – 6.8)

FREE RESPONSE – CALCULATOR IS ALLOWED



1. The structural formula of phenol is shown above. Answer the following questions concerning phenol.

   (a) Write a balanced chemical equation for the complete combustion of <u>1 mole</u> of phenol.

   (b) In a calorimetry experiment, 2.00 g of pure solid phenol is completely burned in a bomb calorimeter. The temperature of the calorimeter increased from 25.00°C to 33.62°C. The heat capacity of the calorimeter is 7.54 kJ/°C.

      (i) Calculate the amount of heat (in units of kJ) that was released to the calorimeter during the combustion experiment. Show your work below in order to receive full credit.

      (ii) Calculate the enthalpy change, ΔH^{o}_{comb}, for the chemical equation you wrote in part (a) in units of kJ/mol_{rxn}. Show your work below in order to receive full credit.

(c) Use your answer from (b)(ii) and the data in the table below to calculate the standard enthalpy of formation for phenol (in units of kJ/mol). Show your work below in order to receive full credit.

Substance	Standard Enthalpy of Formation, ΔH_f^o (kJ/mol)
$CO_2(g)$	–393.5
$H_2O(l)$	–285.8
phenol (*s*)	?

2. A certain light source produces yellow light with a wavelength of 580 nm.

(a) Calculate the frequency of this light in units of s^{-1}. Show your work below in order to receive full credit.

(b) Calculate the energy of a single photon of this light in units of joules. Show your work below in order to receive full credit.

(c) The Br–Br bond has a bond energy of 192 kJ/mol. Does light with a wavelength of 580 nm have sufficient energy to break the Br–Br bond? Justify your answer with a calculation. Show your work below in order to receive full credit.

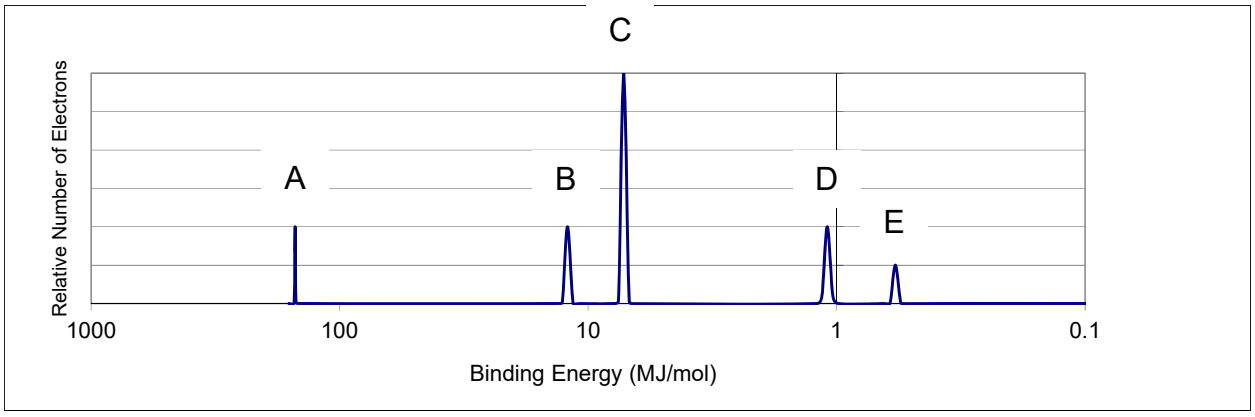
(d) A different light source that emits infrared light is shined on a sample of Br_2 molecules.

(i) The wavelength of infrared light is (shorter longer) than 580 nm.

(ii) The frequency of infrared light is (lower higher) than the frequency of yellow light.

(iii) Therefore, the energy associated with infrared light is (lower higher) than the value that was calculated in part (b) for yellow light.

(iv) It is likely that infrared radiation (would wouldn't) have sufficient energy to break the Br–Br bond.



3. The diagram shown above represents the photoelectron spectrum of a pure element.

(a) Write the chemical symbol for this element. _____

(b) Label each peak in the diagram with the name of the orbital in which the electrons are located. Identify the orbital with its principal quantum number (*n*) and orbital type, such as 1s or 3p.

A _____ B _____ C _____ D _____ E _____

3. (c) Explain why peak D is twice as high as peak E.

(d) Explain why peak C has a higher binding energy than peak D.