CHEM 184 – Fall, 2011

Final Exam (Red)

December 15, 2011

Instructions:

Your scantron answer sheet must show your **NAME** and **STUDENT ID NUMBER.** (Begin all these entries at the LEFT end of the space provided.)

In answering the questions, be careful to fill in the corresponding circles according to the number of the question on the exam. USE A SOFT (No.2) PENCIL.

Useful Information

Gas Constant:	**R = 0.08206 L·atm/K·mol = 8.314 J/K·mol**
Conversion factors:	**1 L·atm = 101.3 J**
	1 atm = 760 torr = 1.013 x 10^{5} Pa
Planck's Constant:	**h = 6.63 x 10^{-34} J·s**
Avogadro's Number:	**N_{avo} = 6.022 x 10^{23} molecules/mol**
Speed of light:	**c = 3.00 x 10^{8} m/s**
Rydberg constant	**R_H = 2.18 x 10^{-18} J**
Debeye constant	**1 D = 3.336 × 10^{-30} C·m**
electron charge	***e*** **= 1.6033 × 10^{-19} C**

A periodic chart is given at the end of the exam

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1. The diameter of a neutral hydrogen atom is about 74 pm. Suppose that we could line up hydrogen atoms side by side in contact with one another. Approximately how many hydrogen atoms would it take to make the distance from end to end 1.0 mm?

   A. 1.4 × 10^{4} atoms B. 1.4 × 10^{7} atoms C. 1.4 × 10^{8} atoms

   D. 1.4 × 10^{9} atoms E. 1.4 × 10^{10} atoms

2. If a car travelling at 80 miles per hour has a fuel efficiency of 11 miles per gallon, and a gallon of fuel costs $3.60, what is the **cost of fuel consumed per minute**?

   A. $0.12 B. $0.17 C. $0.24 D. $0.32 E. $0.44

3. Express the **answer** to the following calculation to the correct number of significant figures.

$$\mathbf{128.16 + 2.10 \times 10^{\square 1} =}$$

A. 128 B. 128.3 C. 128.37 D. 128.370 E. none of these

4. A certain element, X, has two naturally occurring isotopes, X_1 (69.15%) and X_2 (30.85%), whose atomic masses are 62.92960 amu and 64.92779 amu, respectively. Calculate the **average atomic mass** of this element.

A. 63.13 amu B. 63.38 amu C. 63.55 amu C. 63.89 amu E. 64.22 amu

5. What is the average **mass**, in grams, of one atom of arsenic (As)?

A. $5.48 \square 10^{-23}$ g B. 33.0 g C. 74.9 g

D. $1.24 \square 10^{-22}$ g E. $8.04 \square 10^{21}$ g

6. One nanogram doesn't seem like a very large number. How many **helium atoms** are there in 1.00 ng of helium?

A. $2.91 \square 10^{12}$ B. $1.08 \square 10^{13}$ C. $5.56 \square 10^{13}$ D. $1.50 \square 10^{14}$ E. $5.97 \square 10^{14}$

7. Combustion of a 1.50 g sample of a hydrocarbon produces 5.07 g of CO_2 and 1.04 g of H_2O. What is the **empirical formula** of this compound?

A. CH B. C_2H_3 C. CH_2 D. CH_3 E. CH_4

8. An unknown compound has the empirical formula CH_2. A 0.050-mol sample of this compound weighs 4.20 g. What is the **molecular formula** of this compound?

A. C_2H_4 B. C_3H_6 C. C_4H_8 D. C_5H_{10} E. C_6H_{12}

9. How many **grams of Na_2SO_4** would be produced by the complete reaction of 20.8 g of NaOH , with an excess of H_2SO_4?

$$H_2SO_4 + 2\ NaOH \square 2H_2O + Na_2SO_4$$

A. 4.61 B. 9.23 C. 18.5 D. 36.9 E. none of these

10. Given the thermochemical equation

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + 92.6\ kJ$$

calculate the enthalpy change, ΔH, for the reaction

$$NH_3(g) \rightarrow 1/2\ N_2(g) + 3/2\ H_2(g)$$

A. –92.6 kJ B. –46.3 kJ C. 0 kJ D. 46.3 kJ E. 92.6 kJ

11. The combustion of coal (*i.e.*, carbon) produces heat according to the equation

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H^\circ_{rxn} = -393.5\ kJ/mol$$

What **mass of coal** (in kg) must be consumed to produce 5.00×10^4 kJ of heat?

A. 0.305 kg B. 1.53 kg C. 3.05 kg D. 15.3 kg E. 30.5 kg

12. Consider the following two reactions:

(1) $A \rightarrow B + C \qquad \Delta H_1 = +100\ kJ$
(2) $B + D \rightarrow E \qquad \Delta H_2 = -200\ kJ$

Determine the enthalpy change, ΔH_3, for the process

(3) $A + D \rightarrow C + E$

A. –300 kJ B. –100 kJ C. 0 kJ D. +100 kJ E. +300 kJ

13. What is the **energy** of a mole of photons associated with light of frequency 1.25×10^{13} Hz?

A. 8.29×10^{-21} J B. 3.69×10^{-20} J E. 1.80 kJ

D. 4.99 kJ E. 22.2 kJ

14. Calculate the **wavelength** (in nanometers) of the photon emitted by a hydrogen atom when its electron drops from the $n = 4$ state to the $n = 2$ state.

A. 103 nm B. 486 nm C. 1280 nm D. 2630 nm E. 4650 nm

15. Which of the following statements about the quantum numbers is **false**?

A. The principal quantum number ***n*** has values from 1 to infinity.
B. The angular momentum quantum number ***l*** has values from 0 to ***n*-1**.
C. The magnetic quantum number m_l has ***n*** values.
D. The magnetic quantum number m_l has values of $-l$ to $+l$, including zero.
E. The spin quantum number m_s has values of +1/2 and –1/2.