General Chemistry (Chem1006) Test 2 (Year I, Sem I)

Date: 22 Jul 2022

Name: _____ **ID.**_____ **Sec**_____

Given: Speed of light (c) = 3 × 10⁸ m s⁻¹. $^{26}_{13}Al$ $^{16}_{8}O$ $^{24}_{12}Mg$ $^{20}_{10}Ne$

Part I: Choose the best answer and put the letter in BOLD on the space provided. (1 point each)

C 1. In balancing the chemical equation given below, the correct value of the coefficients a, b, c and d respectively is:

$$aC_2H_6(g) + bO_2(g) \rightarrow cCO_2(g) + dH_2O(l)$$

A) 1, 7, 2, 3 B) 2, 4, 4, 6 C) 2, 7, 4, 6 D) 1, 2, 1, 3

C 2. Sheger FM, an FM radio station, broadcasts at a frequency of 102.1 MHz (1.021×10^7 s^{-1}. What is the wavelength of these radio waves in meters?

A) 2.938×10^{-1} B) 3.403×10^{-1} C) 2.938 D) 3.063×10^{16}

C 3. _____ is the distance between two consecutive peaks or troughs in a wave.

A) Amplitude B) Frequency C) Wavelength D) Photon

B 4. Which orbital is occupied by the last electron in the Aluminium atom?

A) s B) p C) d D) f

C 5. Which one is the correct net ionic equation for the reaction between $AgNO_3$ and $CaCl_2$?

A) $Ca^{2+}(aq) + 2Cl^-(aq) \rightarrow CaCl_2(s)$ B) $Ag + Cl \rightarrow AgCl$

C) $2Ag^+(aq) + 2Cl^-(aq) \rightarrow 2AgCl(s)$ D) $Ag^+(aq) + Ca^{2+}(aq) \rightarrow Ag_2Ca(s)$

D 6. What is/are the spectator ion(s) in **question number 5** above?

A) Ag^+ and Ca^{2+} B) Ag^+ and NO^- C) Ca^{2+} and Cl^- D) Ca^{2+} and NO^{3-}

A 7. What is the oxidation number of Phosphorus in Na_3PO_4?

A) +5 B) -5 C) +4 D) -4

D 8. Which of the following is isoelectronic with Na^+?

A) O^{2-} B) Ne C) Mg^{2+} D) All

C 9. How many orbitals are found in a shell with principal quantum number n = 3?

A) 2 B) 6 C) 9 D) 18

C 10. H_2SO_4 acts as an oxidizing agent. In which of the following reaction, is it not acting as an oxidizing agent?

A) $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$ C) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

B) $S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$ D) $Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$

Part II: Give short answers to the following questions.

1. Given an atom with atomic number of 15.

   a) Write its electron configuration as per the Aufbau principle. (1 point)

   $1s^2 2s^2 2p^6 3s^2 3p^3$

   b) Identify the core and valence electrons in the configuration. (0.5 point)

   $1s^2 2s^2 2p^6 \; 3s^2 3p^3$ → (2, 8), (3)

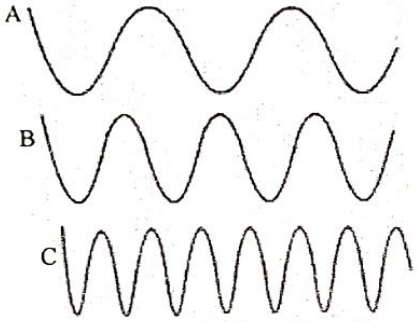
   Core e⁻s: 2+8 = 10

   Valence e⁻: 3

   c) Write the configuration in (a) in shorthand version using the nearest noble gas configuration. (0.5 point)

   $[Ne]\, 3s^2 3p^3$

2. Given the following electromagnetic waves.



Arrange the waves A, B and C in order of:

   a) increasing wavelength (0.5 point) $C < B < A$

   b) increasing energy (0.5 point) $A < B < C$

Part III: Workout. Show the necessary steps clearly.

1. For the given reaction

$$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$$

If the reactants C_5H_{12} & O_2 are 2 moles and 8 moles of initial feeds respectively,

   a) What is the limiting reactant? (0.5 point)

For C_5H_{12}, $2\ mol\ C_5H_{12} \times \frac{5\ mol\ CO_2}{1\ mol\ C_5H_{12}} = 10\ mol\ CO_2$

For O_2, $8\ mol\ O_2 \times \frac{5\ mol\ CO_2}{8\ mol\ O_2} = 5\ mol\ CO_2$ ← true amount of CO_2 produced

(*) O_2 is the limiting reactant, because it produces less product than C_5H_{12}.

   b) How many moles of C_5H_{12} are there when the reaction completes? (0.5 point)

$8\ mol\ CO_2 \times \frac{1\ mol\ C_5H_{12}}{5\ mol\ CO_2} = 1\ mol\ C_5H_{12}$ was used.

Remaining moles of C_5H_{12} = total − used

$= 2\ mol\ C_5H_{12} - 1\ mol\ C_5H_{12}$

$= 1\ mol\ C_5H_{12}$

   c) If the reaction results in the production of 3 moles of H_2O, What will be the percent yield? (1 point)

→ We use O_2 to calculate theoretical yield of H_2O, because it is the limiting reactant.

$8\ mol\ O_2 \times \frac{6\ mol\ H_2O}{8\ mol\ O_2} = 6\ mol\ H_2O$

$\%\ yield\ of\ H_2O = \frac{3\ mol\ H_2O}{6\ mol\ H_2O} \times 100\% = 50\%$