

**UNIVERSITY OF VICTORIA**

**CHEMISTRY 101**  
**Properties of Materials**

**Midterm Test 1**  
**September 28, 2018**  
**6-7 pm**  
**ECS 123, BWC B150, BWC A104 or DTB A120**

**VERSION B**

Display your student ID card on your desk.

Do not begin until instructed by the invigilator.

Print and code your last name, first name, and your student ID number on the blue bubble sheet.

This test has 22 multiple choice questions on 7 pages.

A Data Sheet is provided.

The Sharp EL510 is the only approved calculator for this test.

Select the best response for each question and record your answer on the blue bubble sheet.

Hand in the blue bubble sheet at the end of the test.

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1. A natural sample of chlorine contains 24.2%  $^{37}\text{Cl}$ , which has an isotopic mass of 36.96 amu and 75.8%  $^{35}\text{Cl}$ . What is the isotopic mass of  $^{35}\text{Cl}$  in amu?

$$\text{amu} = 35.453$$

- A) 34.0      B) 34.5      C) 35.0      D) 35.5      E) 36.0

$$35.453 = (0.242)(36.96) + X(0.758)$$

$$26.50868 = 0.758X$$

$$X = 34.97$$

2. How many protons and electrons are there in  $\text{V}^{3+}$ ?

- A) 51 protons, 48 electrons  
 B) 23 protons, 20 electrons  
 C) 23 protons, 26 electrons  
 D) 51 protons, 54 electrons  
 E) 28 protons, 25 electrons

3. How many protons, neutrons and electrons are there in a thallium-205 ( $^{205}\text{Tl}$ ) atom?

- A) 81 protons, 81 electrons, 81 neutrons  
 B) 81 protons, 81 electrons, 205 neutrons  
 C) 81 protons, 81 electrons, 124 neutrons  
 D) 205 protons, 205 electrons, 205 neutrons  
 E) 124 protons, 124 electrons, 124 neutrons

$$204$$

4. How many moles of water are there in 2.50 g of  $\text{H}_2\text{O}$ ?

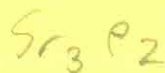
- A) 0.156      B) 18.0      C)  $6.02 \times 10^{23}$       D) 0.139      E) 1.00

$$\frac{2.50 \text{ g}}{18 \text{ g/mol}}$$

$$= 0.1388 = 0.139$$

5. Which of the following is the formula for strontium phosphide?

- A)  $\text{Sr}_3\text{P}_2$       B)  $\text{SrP}$       C)  $\text{SrP}_2$       D)  $\text{Sr}_2\text{P}$       E)  $\text{Sr}_2\text{P}_2$



6. What is the empirical formula of a compound that contains mass percentages of 52.2% C, 13.1% H and 34.7% O?



$62$   
 $C = 12 g/mol$   
 $44$   
 $H = 1 g/mol$   
 $42$   
 $O = 16 g/mol$   
 $58$   
 $46$   
 $total = 29 g/mol$   
 $for C_2H_6O$

$$C = 6.24 + 0.131 + 5.552$$

7. How many grams of iron are there in 0.340 g of  $FeSO_4$ ?

A) 0.0125

B) 0.271

C) 0.079

D) 0.0271

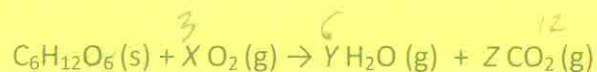
E) 0.125

$FeSO_4$   
 $55.845$   
 $32.1$

$= 103.9$   
 $152$   
 $Fe = 36\%$

$Fe = 0.125$   
 $53.7\%$

8. For the reaction:



What values of X, Y and Z balance the equation?

A)  $X = 3, Y = 3$  and  $Z = 3$

B)  $X = 2, Y = 4$  and  $Z = 6$

C)  $X = 6, Y = 4$  and  $Z = 2$

D)  $X = 2, Y = 2$  and  $Z = 2$

E)  $X = 6, Y = 6$  and  $Z = 6$

15. What is the wavelength of light emitted as a result of an electronic transition from  $n = 5$  to  $n = 4$  in a hydrogen atom?

- A)  $4 \times 10^{-6}$  m  
 B)  $4 \times 10^{-6}$  nm  
 C) 400 nm  
 D) 4 m  
 E)  $4 \times 10^{-20}$  m

$$f = 3.29 \times 10^{15} \text{ Hz} \left( \frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

16      25

$$f = 7.4 \times 10^{13}$$

$$v = \lambda f$$

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

16. Which of the following terms is most appropriate to describe an electronic transition from  $n = 3$  to  $n = 4$  in an atom?

- A) Photoelectric  
 B) Demotion  
 C) Excitation  
 D) Promotion  
 E) Emission

↑ gaining energy

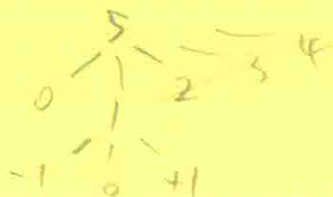
17. What is the value of  $\ell$  for a 3p atomic orbital?

- A) 0      B) 1      C) 2      D) 3      E) 4



18. How many angular nodes exist in a 5p atomic orbital?

- A) 0      B) 1      C) 2      D) 3      E) 4





12. What is the energy (in J) of a microwave photon that has a wavelength of  $3 \times 10^{-2}$  m?

- A)  $2 \times 10^{-32}$
- B)  $7 \times 10^{-24}$
- C)  $2 \times 10^{-35}$
- D)  $7 \times 10^{24}$
- E)  $7 \times 10^{-34}$

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$$v = \lambda f$$

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

$$E = h\nu$$

$$E = hf$$

$$E = 6.63 \times 10^{-24}$$

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

13. What is the energy change (in J) resulting from an electronic transition from  $n = 3$  to  $n = 4$  in a hydrogen atom?

- A)  $-1.06 \times 10^{-19}$
- B)  $2.18 \times 10^{-18}$
- C)  $1.06 \times 10^{-19}$
- D)  $-2.18 \times 10^{-18}$
- E)  $1.06 \times 10^{-18}$

$$\Delta E = -2.18 \times 10^{-18} \left( \frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$n_i = 3$   
 $n_f = 4$

14. What is the wavelength (in m) of an electron that has a velocity of  $1 \times 10^8$  m/s?

- A)  $3 \times 10^{-12}$
- B)  $4 \times 10^{-12}$
- C)  $7 \times 10^{-9}$
- D)  $7 \times 10^{-12}$
- E)  $6 \times 10^{-12}$

$$v =$$

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.63 \times 10^{-34}}{(9.109 \times 10^{-31})(1 \times 10^8)}$$

$$\lambda = 7.28 \times 10^{-12} \text{ m}$$

1. What is the wavelength of light emitted as a result of an electronic transition from  $n = 5$  to  $n = 4$  in a hydrogen atom?

- A)  $4 \times 10^{-6}$  m  
 B)  $4 \times 10^{-6}$  nm  
 C) 400 nm  
 D) 4 m  
 E)  $4 \times 10^{-20}$  m

$$f = 3.29 \times 10^{15} \text{ Hz} \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$16 \quad 25$$

$$f = 7.4 \times 10^{13}$$

$$v = \lambda f$$

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

6. Which of the following terms is most appropriate to describe an electronic transition from  $n = 3$  to  $n = 4$  in an atom?

- A) Photoelectric  
 B) Demotion  
 C) Excitation  
 D) Promotion  
 E) Emission

↑ gaining energy

7. What is the value of  $\ell$  for a 3p atomic orbital?

- A) 0      B) 1      C) 2      D) 3      E) 4



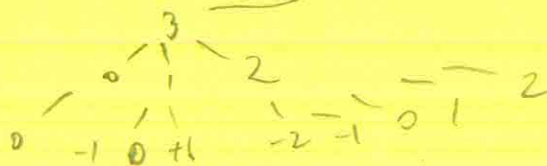
18. How many angular nodes exist in a 5p atomic orbital?

- A) 0      B) 1      C) 2      D) 3      E) 4



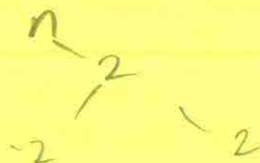
1! How many atomic orbitals are there in the  $n = 3$  level of an atom?

- A) 1      B) 3      C) 4      D) 9      E) 16



2C What is the maximum value of  $m_\ell$  for an electron in the  $n = 3$  level of an atom?

- A) 0      B) 1      C) 2      D) 3      E) 4



21 Which of the following sets of quantum numbers describes an electron in an s atomic orbital?

- A)  $n = 3, \ell = 0, m_\ell = 1, m_s = 1/2$   
 B)  $n = 2, \ell = 1, m_\ell = 1, m_s = -1/2$   
 C)  $n = 3, \ell = 1, m_\ell = -1, m_s = -1/2$   
 D)  $n = 1, \ell = 0, m_\ell = -1, m_s = 1/2$   
E)  $n = 3, \ell = 0, m_\ell = 0, m_s = 1/2$

$\ell = 0$

22. Which of the following drawings represents a  $d_{yz}$  orbital?

