UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	INORGANIC CHEMISTRY I
COURSE CODE	:	BWK10203
PROGRAMME CODE	:	BWK
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK.**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) According to Max Planck, the wavelength of electromagnetic radiation depends on the temperature of the object.

(i) By referring to **Figure Q1(a)**, label the **TWO (2)** spectrums representing the objects that are heated at the highest and lowest temperature.

(2 marks)

(ii) Give **ONE (1)** example of general color observed for each object that heated at high and low temperature.

(2 marks)

(b) (i) An electron in an atom is basically described by a set of quantum numbers. Define all **FOUR (4)** quantum numbers.

(4 marks)

(ii) Determine the subshell for the electrons with the quantum numbers represented in **Table Q1(b)(ii)**.

(3 marks)

(c) (i) An isoelectronic series is a group of atoms / ions that have the same number of electrons with different sizes of ionic radius. Explain with examples the size comparison in terms of ionic radius.

(5 marks)

(ii) Consider a compound consists of two elements. Illustrate in detail the atomic diagram of elements showing the tendency of the atoms to attract and form bonds.

(4 marks)

Q2 (a) Write the Lewis dot symbol for sulfur atom and sulfur ion.

(2 marks)

(b) Nitrous acid, HNO_2, has two possible structures as shown in **Figure Q2(b)**.

(i) Calculate formal charge for each atom in both HNO_2 structures to determine the most dominant and stable structure for this compound.

(7 marks)

(ii) Justify your answer in **Q2(b)(i)**.

(1 mark)

(c) List out the types of cubic cells in terms of their atomic packing factor.

(3 marks)

(d) Band theory was used to explain the bonding in metals and semiconductors, which generates a set of molecular orbitals of the solid.

(i) Relate the relationship of energy band with the interaction strength between orbitals on adjacent atoms.

(4 marks)

(ii) Based on your understanding on the band theory, describe the shiny and lustrous properties of metal surface.

(3 marks)

Q3 (a) Most bases are metals oxides and hydroxides such as sodium hydroxide, NaOH and copper (II) oxides, CuO. Name **ONE (1)** base and explain why the compound will only show alkali properties in the presence of water.

(5 marks)

(b) Hard and Soft Acids and Bases (HSAB) Principle is a qualitative concept introduced by Ralph Pearson to explain the stability of metal complexes and the mechanisms of their reactions. Estimate whether OH^- or S^{2-} is more likely to form insoluble salts with 3^+ transition metal ions or not. Consider HSAB principle in your answer.

(5 marks)

(c) The tendency of an atom in a molecule to attract the shared pair of electrons towards itself is known as electronegativity. Based on **Figure Q3(c)**,

(i) show the order of electronegativity for both molecules.

(4 marks)

(ii) explain your answer in terms of their polarity and electronegativity.

(6 marks)

(d) **Figure Q3(d)** shows a circuit for a simple cell. Copper (II) sulphate solution is used as an electrolyte. Based on the information given in **Table Q3(d)**, calculate the value of the unknown voltage.

(10 marks)

Q4 (a) Although it is an injurious pollutant in the lower atmosphere, ozone is an essential protective agent in the stratosphere. The formation of ozone as shown below:

$$O_2 + h\upsilon \rightarrow O + O^* \qquad \textbf{Equation 1}$$

The destruction of this layer leads to many atmospheric problems. According to **Equation 1**, identify related atmospheric problem and explain your answer.

(5 marks)

(b) Oxygen makes up 46.1% of the mass of Earth's crust, silicon makes up 28.5% while hydrogen, the most abundant element in the universe, makes up only 0.14% of Earth's crust and carbon makes up lesser than hydrogen on earth. However, carbon element makes up 23% of human body.
Explain the reasons for the differences in the percentage of carbon element in the earth and human body.

(5 marks)

(c) Metal ions serve as many critical functions in human body, thus metals are widely used in medical application. An established company in Johor, Maju Jaya Sdn Bhd is a company which has expertise in producing metal as inorganic drugs for all kind of disease. As the manager, you are assigned to sort out metal ions that cannot be utilized in medical drug application. Discuss potential solutions to solve the problem.

(10 marks)

(d) Many elements, particularly those of transition metals, readily change the oxidation states. As presumed, the atmospheric oxygen content varied very much over the course of the Earth's history, and that would have affected the oxidation states of the elements present in the ocean and the upper part of crust. That in turn would affect the availability of the elements to organisms because organisms would utilize elements readily available in dissolved state. Relate the concept with the variation of the atmospheric oxygen and the readily available elements which might have had significant effects on the evolution of various organisms.

(10 marks)

-END OF QUESTIONS-

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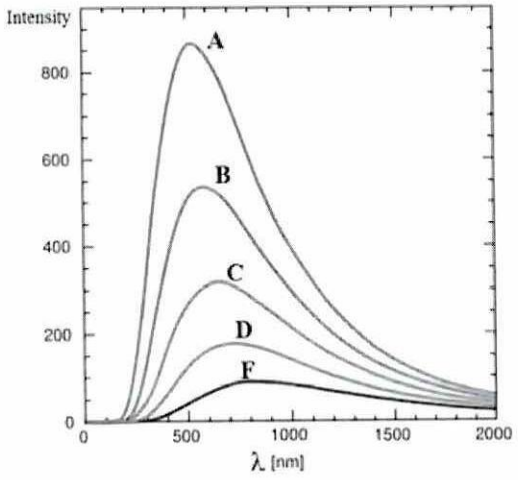

Figure Q1(a): Electromagnetic radiation of object.

(I) (II)

Figure Q2(b): Possible structures for nitrous acid, HNO_2.

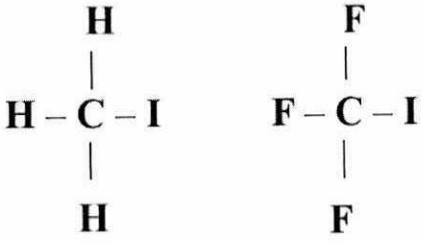

Figure Q3(c): Molecular structures of CH_3I and CF_3I.

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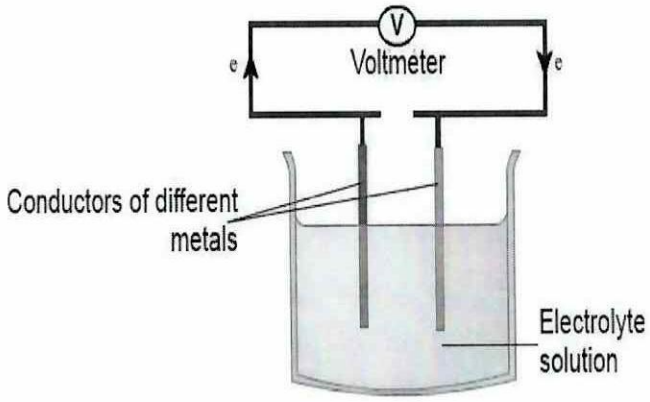

Figure Q3(d): A simple electrolytic cell

Table Q1(b)(ii): Quantum Number

(n)	(ℓ)
3	0
5	3
3	1

Table Q3(d): Voltage values for different electrolytes

Electrode I	Electrode II	Voltage (V)
Ferum	Zinc	0.2
Copper	Ferum	0.8
Copper	Magnesium	2.6
Zinc	Magnesium	Unknown