

VCE Chemistry 2016 Year 11 Trial Exam Unit 1

SECTION A – Multiple Choice Questions

(20 marks)

*This section contains 20 multiple choice questions.
For each question, choose the response that is correct or best answers the question.
Indicate your answer on the answer sheet provided.
(Choose only **one** answer for each question.)*

Question 1

Moving across (left to right) a period in the Periodic Table, the atomic radii of the elements

- A. increases as there are more electrons in the outer shell.
- B. decreases as the outer shell electrons are more strongly attracted to the nucleus.
- C. are similar because the electrons are occupying the same outer shell.
- D. decreases because the size of the sub-shells decreases with atomic number.

Question 2

The good electrical conductivity of metals in the solid state, can be explained using the metallic bonding model by

- A. the particles in the lattice being able to move.
- B. the positive ions in the lattice being able to move when an electric field is applied.
- C. the particles that make up the lattice being close together.
- D. the valence electrons being able to move through the lattice of positive ions.

Question 3

The chemical formula for a compound formed between magnesium and nitrogen would be

- A. Mg_3N_2
- B. MgN
- C. Mg_2N
- D. Mg_2N_3

Question 4

The percentage by mass of sulfur in sodium sulfite, Na_2SO_3 , would be

- A. 22.90 %
- B. 25.46 %
- C. 25.81 %
- D. 31.13 %

Question 5

In a 19.06 g sample of magnesium chloride, MgCl_2 , there will be

- A. 6.02×10^{22} chloride ions.
- B. 1.204×10^{23} ions.
- C. 2.408×10^{23} magnesium ions.
- D. 3.612×10^{23} ions.

Question 6

Which one of the following statements best describes a significant difference between the properties of main group (p-block) metal elements and transition group (d-block) metal elements?

- A. Most main group metal elements tend to be better electrical conductors.
- B. Most transition group metal elements tend to have lower densities.
- C. Metals that are magnetic are only found among the transition group metal elements.
- D. Main group metal elements are harder and less ductile.

Question 7

Compared to a bulk sample of silver, silver nanoparticles will

- A. be more chemically reactive because there are more sites where a reaction can occur.
- B. have similar chemical properties because the reactions involve the rearrangement of the valence electrons.
- C. be more chemically reactive because there will be more valence electrons available to be rearranged in a chemical reaction.
- D. be less chemically reactive because they are smaller and there is a lower probability for the reactant particles coming into contact with the nanoparticles.

Question 8

An ion of an element with a -2 charge contains 18 electrons and 18 neutrons. The isotopic symbol for the neutral atom that this ion was formed from would be

- A. $^{36}_{18}\text{Ar}$
- B. $^{36}_{16}\text{S}$
- C. $^{34}_{16}\text{S}$
- D. $^{34}_{18}\text{Ar}$

Question 9

The polar characteristics of the compounds, chloromethane, CH_3Cl , dichloromethane, CH_2Cl_2 , trichloromethane, CHCl_3 , and tetrachloromethane, CCl_4 , are best described by

	CH_3Cl	CH_2Cl_2	CHCl_3	CCl_4
A.	polar	non-polar	polar	non-polar
B.	non-polar	non-polar	non-polar	polar
C.	non-polar	polar	non-polar	polar
D.	polar	polar	polar	non-polar

Question 10

In the structure of fullerenes with the formula C_{60} , each carbon atom is covalently bonded to

- A. three adjacent carbon atoms and the material has a low melting point.
- B. four adjacent carbon atoms and the material has a high melting point.
- C. four adjacent carbon atoms and the material has a low melting point.
- D. three adjacent carbon atoms and the material has a high melting point.

Question 11

The structural characteristic that distinguishes but-2-yne from other hydrocarbons containing four carbon atoms is

- A. a carbon-carbon double bond at the end of a four carbon atom chain.
- B. a carbon-carbon triple bond in the middle of a four carbon atom chain.
- C. a carbon-carbon triple bond at the end of a four carbon atom chain.
- D. a carbon-carbon double bond in the middle of a four carbon atom chain.

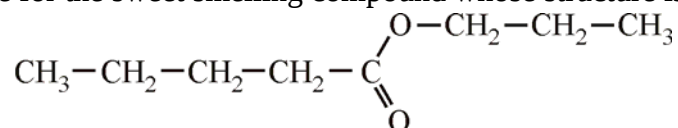
Question 12

A material made from a thermosetting polymer will tend to be rigid as a result of

- A. covalent bonding between the polymer strands.
- B. twisting of the polymer strands into bundles.
- C. polar interactions between the polymer strands.
- D. the branched polymer strands not being able to move over each other.

Question 13

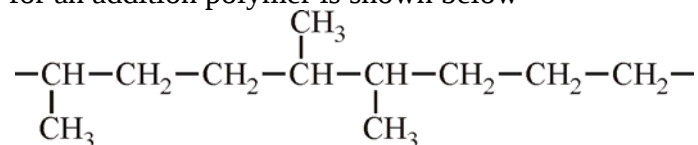
The systematic name for the sweet smelling compound whose structure is shown below is



- A. butyl butanoate.
- B. propyl butanoate.
- C. propyl pentanoate.
- D. pentyl propanoate.

Question 14

Part of the structure for an addition polymer is shown below



This polymer could be synthesised from

- A. but-2-ene.
- B. but-2-ene and propene.
- C. propene.
- D. ethene and propene.

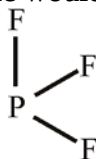
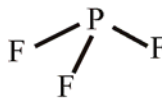
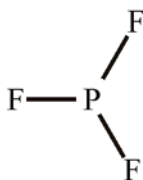
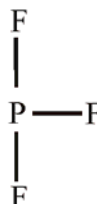
Question 15

A pure substance in the solid state was found to be brittle, hard, a poor electrical and thermal conductor with a melting point of 770 °C. The type of bonding present in the substance would be

- A. metallic bonding.
- B. ionic bonding.
- C. covalent molecular bonding.
- D. covalent network lattice bonding.

Question 16

The diagram that would best represent the structure for a phosphorous trifluoride, PF_3 , molecule would be

A.**B.****C.****D.****Question 17**

The experimental evidence that supports the Bohr and later Schrödinger models is

- A.** the chemical properties of the elements.
- B.** the emission spectra of the elements.
- C.** the decay of radioactive isotopes.
- D.** the nuclear magnetic resonance spectra of the elements.

Question 18

The metal element X and the non-metal element Y form an ionic compound. A sample of the compound contains 1.85×10^{22} ions, of which 7.40×10^{21} are anions. The empirical formula for the compound is

- A.** X_2Y_5
- B.** X_2Y_3
- C.** X_3Y_2
- D.** X_5Y_2

Question 19

One of the products from crude oil refining is liquefied petroleum gas, lpg. The main components of this product are

- A.** alkanes containing three or four carbons.
- B.** alkenes with a least two carbon-carbon double bonds.
- C.** low molecular mass alkynes.
- D.** alkanes with at least six carbons.

Question 20

Two compounds, each with the molecular formula $\text{C}_5\text{H}_{10}\text{O}_2$, but different semi-structural formulae of $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$, respectively are

- A.** a carboxylic acid and an alcohol.
- B.** an ester and a carboxylic acid.
- C.** a carboxylic acid and an ester.
- D.** an ester and an alcohol.

End of Section A

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SECTION B – Short Answer Questions

(50 marks)

*This section contains eight questions, numbered 1 to 8.
All questions should be answered in the spaces provided.
The mark allocation for each question is given.*

Question 1 (8 marks)

a. Beryllium and fluorine are elements in the second period of the Periodic Table.

- i. Explain, with reasoning, how the electronegativity of beryllium would compare with that of fluorine.

2 marks

- ii. The first ionisation energies for beryllium and fluorine are 906 kJ mol^{-1} and 1687 kJ mol^{-1} respectively. Explain what the first ionisation energy of an element is a measure of, and why there is a significant difference between the first ionisation energies for beryllium and fluorine.

2 marks

b. In a class experiment, students placed cleaned and similar sized samples of calcium and magnesium into separate test tubes. 5 mL of deionised water was then added to each test tube. The students noted that the calcium readily reacted, liberating a gas. The magnesium also reacted, but at a very much slower rate.

- i. Explain why there is a difference in the reactivity of these two metals with water.

1 mark

- ii. Describe what the students would have seen if they had also placed a piece of barium in another test tube and added the deionised water. **1 mark**
- c. Write the ground state electronic configurations, in terms of sub-shells, for the following particles:
- i. an arsenic atom **1 mark**
- ii. an aluminium ion, Al^{3+} **1 mark**

Question 2 (6 marks)

- a. One of the minerals present in iron ore is haematite, Fe_2O_3 . The production of iron involves heating the ore together with coke, C, and limestone, CaCO_3 , in a blast furnace.
- i. In the furnace the coke reacts with oxygen to produce carbon monoxide, which then reacts with the solid iron oxide to form molten iron. Write an appropriate balanced chemical equation for this reaction including the states of the materials. **1 mark**
- ii. What would be one significant environmental impact of the production of iron in this way? **1 mark**
- iii. The iron produced in the blast furnace is not pure iron metal but an alloy of iron and carbon. The atomic radii of carbon and iron are 71 pm and 124 pm ($1 \text{ pm} = 1 \times 10^{-12} \text{ m}$) respectively. Explain the type of alloy that this material would be. **1 mark**

- b.** The hardness and ductility of a metal can be altered by various heat treatments.
- i.** Quenching is a process where the metal object is heated to red hot then rapidly cooled. Explain what effect this process would have on the crystal structure (or microstructure) of the metal and how it would affect these properties of the metal. **2 marks**
- ii.** An alternative process, annealing, cools the metal slowly from red hot. Explain how the physical properties of an annealed metal sample would compare with those of one that had been quenched. **1 mark**

Question 3 (7 marks)

- a.** Explain why molten sodium chloride and aqueous solutions of sodium chloride will conduct an electric current, whereas sodium chloride is a non-conductor in the solid state. **2 marks**
- b.** Draw an appropriate electron shell diagram **and** write a simple equation to represent the bonding that would occur when calcium and fluorine react. **2 marks**
- c.** Explain, giving an example, what a polyatomic ion is. **1 mark**

- d. i. Write the complete chemical formula for copper(II) sulfate pentahydrate. **1 mark**
- ii. Explain what would occur when a sample of this solid is heated in a crucible. **1 mark**

Question 4 (6 marks)

- a. An element has two isotopes with relative isotopic masses of 68.93 and 70.93 respectively. The relative abundance of the heavier isotope was determined by mass spectrometry to be 39.9 %.
Determine the relative atomic mass for this element. **2 marks**
- b. Determine the molar mass for sodium carbonate decahydrate, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. **1 mark**
- c. An experiment determined that a 9.572 g sample of a chromium oxide contained 6.549 g of chromium.
Determine the empirical formula for this compound. **3 marks**

Question 5 (7 marks)

- a. Draw the chemical structures and give the systematic names for two alkenes that contain four carbon atoms.

4 marks

- b. The elemental analysis of an organic compound showed that it contained carbon, hydrogen and oxygen.
The percentage by mass of the three elements were: 54.5 %, 9.1 % and 36.4 % respectively.
The molar mass of the compound was found to be 88.0 g mol^{-1} .

- i. Determine the empirical formula for the compound.

2 marks

- ii. Determine the molecular formula for the compound.

1 mark

Question 6 (6 marks)

- a.** Diamond and graphite are two different structures for carbon.
Explain with reference to the structures why:
- i.** graphite is a significantly better electrical conductor than diamond. **1 mark**

 - ii.** diamond is significantly harder than graphite. **1 mark**
- b.** Methanol, CH_3OH , is a liquid at room temperature.
- i.** Draw an appropriate diagram to represent the arrangement of the atoms in a methanol molecule, showing all bonding and non-bonding electrons. **1 mark**

 - ii.** Explain all of the different types of bonding that would occur between methanol molecules. **2 marks**

 - iii.** Use the structural and bonding data to predict the solubility of methanol in water. **1 mark**

Question 7 (5 marks)

- a.** Draw a structure showing four repeating units present in the polymer that would be formed from propene. **2 marks**
- b.** The physical properties of a sample of a polymer can be altered by a number of different factors.
- i.** Explain the effect that increasing the length of the polymer molecule chain would have on the physical properties of the material. **1 mark**
- ii.** Explain why a sample of a polymeric material that is highly crystalline would be harder than one that is less crystalline. **1 mark**
- iii.** What are plasticisers and how does their presence affect the physical properties of a polymeric material? **1 mark**

Question 8 (5 marks)

Organic compounds play vital roles in many areas of society.

- a. Many vehicles have now been tuned to run on a blend of petrol and ethanol as a fuel. Write appropriate chemical equations to describe the complete combustion of octane and ethanol.

2 marks

- b. Alkenes are extensively used in the production of other organic compounds.

i. What is the key structural feature present in alkenes?

1 mark

ii. Write an appropriate chemical equation to describe the reaction of propene with chlorine.

1 mark

iii. What type of chemical process occurs when propene reacts with chlorine?

1 mark

End of Section B

End of Trial Exam