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ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Centre Number	
71	

Candidate Number

Chemistry

Assessment Unit AS 2

assessing

Module 2: Organic, Physical and Inorganic Chemistry

[AC122]

AC122

TUESDAY 17 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Answer **all seventeen** questions.
Answer **all ten** questions in **Section A**. Record your answers by marking the appropriate letter on the answer sheet provided. Use only the spaces numbered 1 to 10. Keep in sequence when answering.
Answer **all seven** questions in **Section B**. Write your answers in the spaces provided in this question paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Quality of written communication will be assessed in Question **13(b)(ii)**.
In Section A all questions carry equal marks, i.e. **two** marks for each question.
In Section B the figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Periodic Table of the Elements, containing some data, is included in this question paper.

For Examiner's use only	
Question Number	**Marks**
Section A	
1–10	
Section B	
11	
12	
13	
14	
15	
16	
17	
Total Marks	

Section A

For each of the following questions only **one** of the lettered responses (A–D) is correct.

Select the correct response in each case and mark its code letter by connecting the dots as illustrated on the answer sheet.

1 Equal volumes of 1-chlorobutane and 1-iodobutane are warmed with aqueous silver nitrate in the presence of ethanol. Which one of the following is the reason why the 1-chlorobutane reacts more slowly?

A The C–Cl bond is more polar than the C–I bond

B The C–Cl bond is stronger than the C–I bond

C The C–I bond is more polar than the C–Cl bond

D The C–I bond is stronger than the C–Cl bond

2 Which one of the following is correct as Group II is descended?

	Solubility of hydroxides	**Solubility of sulfates**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

3 Which one of the following is the colour of the flame produced when a barium compound is placed in a blue Bunsen burner flame?

A Crimson

B Green

C Lilac

D Orange

4 Which one of the following shows the effect on the yield of ammonia in the Haber process?

	Pressure increase	**Temperature increase**
A	yield decreases	yield decreases
B	yield decreases	yield increases
C	yield increases	yield decreases
D	yield increases	yield increases

5 Which one of the following mixtures will react to produce a compound with molecular formula C_4H_7N?

A 1-bromobutane and ammonia

B 1-bromobutane and potassium cyanide

C 1-bromopropane and ammonia

D 1-bromopropane and potassium cyanide

6 The reaction shown below

$$C_2H_5Br + KOH \rightarrow C_2H_4 + KBr + H_2O$$

is an example of

A dehydration.

B elimination.

C free radical substitution.

D nucleophilic substitution.

7 Which one of the following is the mass of magnesium required to react with 50.0 cm^3 of 0.1 mol dm^{-3} hydrochloric acid?

A 0.005 g

B 0.060 g

C 0.120 g

D 0.240 g

8 Which one of the following lists the compounds in order of increasing boiling point?

A $CH_3CH_2CH_3$ CH_3CH_2F CH_3CH_2OH

B $CH_3CH_2CH_3$ CH_3CH_2OH CH_3CH_2F

C CH_3CH_2F CH_3CH_2OH $CH_3CH_2CH_3$

D CH_3CH_2OH CH_3CH_2F $CH_3CH_2CH_3$

9 When an organic compound was reacted with chlorine, the organic product was found to have a relative molecular mass which had increased by 69. Which one of the following is the reaction mechanism?

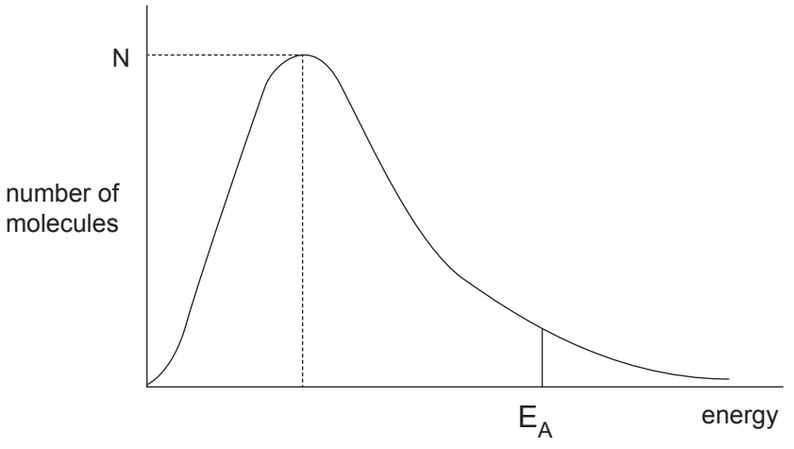
A elimination

B electrophilic addition

C free radical substitution

D nucleophilic substitution

10 The Maxwell–Boltzmann distribution for a reaction mixture is shown below. N is the number of molecules with the most probable energy and E_A is the activation energy.



Which one of the following shows the effect on E_A and on N of increasing the temperature?

	E_A	**N**
A	constant	decreases
B	constant	increases
C	decreases	decreases
D	decreases	increases

Section B

Answer all **seven** questions in the spaces provided.

Examiner Only	
Marks	Remark

11 Butan-1-ol is used to prepare 1-bromobutane according to the following equation:

$$C_4H_9OH + HBr \rightarrow C_4H_9Br + H_2O$$

(a) (i) Give an equation to explain the term **percentage yield**.

percentage yield =

[1]

(ii) Assuming a 40 % yield, what mass of butan-1-ol would be required to produce 5.48 g of 1-bromobutane?

moles of 1-bromobutane

moles of butan-1-ol

mass of butan-1-ol

[3]

(b) (i) Give an equation to explain the term **atom economy**.

atom economy =

[1]

(ii) Calculate the atom economy for the formation of 1-bromobutane from butan-1-ol.

[1]

12 Qualitative analysis can be used to distinguish between aqueous solutions containing different metal ions.

(a) For each of the following pairs of metal ions, give an aqueous reagent which can be used to distinguish between the aqueous solutions and state the expected observations for each ion.

(i) Iron(II) ions and iron(III) ions.

Reagent _____ [1]

Observations _____

_____

_____ [2]

(ii) Aluminium ions and zinc ions.

Reagent _____ [1]

Observations _____

_____

_____ [2]

(b) Addition of an aqueous solution of potassium chromate can be used to test for the presence of barium ions.

(i) What is observed when barium ions react with chromate ions?

_____ [1]

(ii) Write an ionic equation, including state symbols, for the reaction of barium ions with chromate ions.

_____ [2]

Examiner Only	
Marks	Remark

13 The fluorohydrocarbon below exists in two stereoisomeric forms.

$$CH_3CH_2CH{=}CFCH_2CH_3$$

(a) Name this fluorohydrocarbon using IUPAC rules.

_____ [2]

(b) **(i)** Draw and label the structures of the E and Z isomers of this fluorohydrocarbon.

[1]

(ii) Explain why one of the structures you have drawn is classified as the Z isomer.

_____

_____

_____

_____

_____ [3]

Quality of written communication [2]

Examiner Only	
Marks	Remark

(c) (i) Draw a structural isomer of the fluorohydrocarbon which does **not** exist as stereoisomers.

[1]

(ii) Explain, in terms of the structure of this molecule, why it does not exist as stereoisomers.

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

14 Propene reacts with hydrogen bromide to form two isomers, the major product being 2-bromopropane.

(a) Explain why hydrogen bromide is attracted to propene.

_____

_____

_____ [2]

(b) Suggest flow schemes for the mechanisms of the reaction of hydrogen bromide with propene to form 1-bromopropane and 2-bromopropane, showing the structure of both intermediates.

[4]

(c) **(i)** Suggest how you would separate a mixture of 1-bromopropane and 2-bromopropane.

_____ [1]

(ii) Suggest how you would use infra-red spectroscopy to identify an unknown sample of bromopropane as either 1-bromopropane or 2-bromopropane.

_____

_____ [1]

(d) Suggest why 2-bromopropane is the major product.

_____ [1]

(e) Name the mechanism of these reactions.

_____ [1]

(f) Propene undergoes addition polymerisation to form polypropene.
Draw the structure of polypropene showing **three** repeating units.

[2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

15 Under a particular set of conditions incomplete combustion of propane occurred according to the following equation:

$$C_3H_8(g) + 4O_2(g) \rightarrow CO_2(g) + 2CO(g) + 4H_2O(l)$$

The total volume of gases produced occupied a volume of 9000 dm^3. The molar gas volume, under these conditions, is 30 dm^3.

(a) Define the term **molar gas volume**.

_____

_____ [2]

(b) (i) Calculate the number of moles of carbon monoxide produced in this combustion.

_____

_____ [2]

(ii) Calculate the number of moles of oxygen used in this combustion.

_____

_____ [1]

(iii) Calculate the mass of propane, in kg, burned.

_____

_____ [3]

(iv) Calculate the number of molecules of propane burned.

_____

_____ [1]

(c) Under a different set of conditions, methane undergoes incomplete combustion to produce carbon dioxide and carbon monoxide in a 2:1 ratio. Write an equation for this incomplete combustion.

_____ [2]

Examiner Only	
Marks	Remark

16 Butane is sold commercially as “bottled gas”. It undergoes complete combustion according to the following equation:

$$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$$

and has a standard enthalpy of combustion of –2876.5 kJ mol^{-1}.

(a) Calculate the amount of energy released for every kilogram of carbon dioxide released.

[3]

(b) Hess’s Law can be used to calculate enthalpy changes, such as the standard enthalpy of formation of butane, which cannot be measured by experiment.

(i) Define the term **standard enthalpy of formation**.

[3]

(ii) Write an equation, with state symbols, which represents the standard enthalpy of formation of butane.

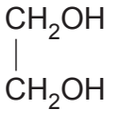
[2]

(iii) Use the standard enthalpy of combustion of butane and the following data to calculate the standard enthalpy of formation of butane.

	Standard enthalpy of combustion (kJ mol^{-1})
Carbon (C)	–393.5
Hydrogen (H_2)	–285.8

[3]

17 The formula for ethylene glycol is shown below:



(a) Use IUPAC rules to give the systematic name of ethylene glycol.

_____ [1]

(b) What is the empirical formula of ethylene glycol?

_____ [1]

(c) Ethylene glycol reacts vigorously with an *excess* of ethanoyl chloride.

(i) Suggest **two** observations in this reaction.

_____

_____ [2]

(ii) Name the type of reaction occurring.

_____ [1]

(iii) Draw the structure of the organic product.

[2]

(iv) Suggest a test for the inorganic product formed in this reaction.

_____

_____ [2]

Examiner Only	
Marks	Remark

(d) Ethylene glycol contains primary alcohol groups. When heated under reflux with excess acidified potassium dichromate the solution changes from orange to green.

Examiner Only	
Marks	Remark

(i) Why are the alcohol groups in ethylene glycol classified as primary?

_____

_____ [1]

(ii) Name the type of reaction occurring.

_____ [1]

(iii) Draw the structure of the organic product.

[1]

(iv) Name the functional group present in the organic product.

_____ [1]

(v) What would be the most significant difference between the infra-red spectrum of the organic product and that of ethylene glycol?

_____

_____ [1]

(e) Write an equation for the reaction of ethylene glycol with an excess of phosphorus pentachloride.

[2]

(f) Explain, in terms of structure, why an iodoform test does not give a positive result with ethylene glycol.

_____

_____ [1]

(g) The boiling point of ethylene glycol is 197 °C and that of ethanol is 78 °C. Explain this large difference in boiling points.

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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