



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
January 2014

Centre Number

71

Candidate Number

## Chemistry

### Assessment Unit AS 2

*assessing*

Module 2: Organic, Physical  
and Inorganic Chemistry

[AC122]



THURSDAY 16 JANUARY, MORNING

#### 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 fifteen** 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 five** 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 **11(d)**.

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
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Section A

1-10	
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Section B

11	
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12	
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13	
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14	
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15	
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Total Marks	
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## Section A

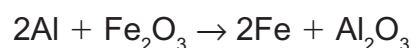
For each of the following questions only **one** of the lettered responses (A–D) is correct.

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

- 1 A solution of an unknown solid when sprayed into the blue flame of a Bunsen burner produced a crimson colour. When silver nitrate solution was added to this solution a white precipitate was observed. The solution contained
- A calcium chloride.
  - B calcium sulfate.
  - C lithium chloride.
  - D lithium sulfate.
- 2 Which one of the following can act as a free radical?
- A Cl
  - B Cl<sup>-</sup>
  - C Cl<sup>+</sup>
  - D Cl<sub>2</sub>
- 3 Propan-2-ol is produced from the reaction of propene and steam. Assuming a 65% yield, which one of the following is the mass of propene required to produce 390g of propan-2-ol?
- A 253.5g
  - B 273.0g
  - C 420.0g
  - D 600.0g

- 4 Which one of the following is the molecular formula of methyl propanoate?
- A  $\text{CH}_3\text{CH}_2\text{COOCH}_3$
- B  $\text{C}_2\text{H}_4\text{O}$
- C  $\text{C}_4\text{H}_8\text{O}_2$
- D  $\text{HCOOCH}_2\text{CH}_2\text{CH}_3$
- 5 Which one of the following reagents could be used to distinguish between propan-1-ol and propan-2-ol?
- A Acidified potassium dichromate
- B Alkaline iodine
- C Ethanoic acid
- D Thionyl chloride

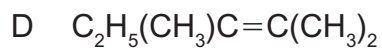
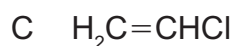
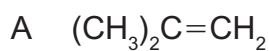
- 6 Which one of the following is the atom economy for the production of iron in the Thermite Process?



- A 25.2%
- B 26.2%
- C 50.1%
- D 52.3%
- 7 Which one of the following sets of observations is **not** correct for the addition of dilute ammonia solution to a solution of the metal ion?

	metal ion solution	addition of drops of dilute ammonia solution	addition of excess dilute ammonia solution
A	$\text{Al}^{3+}$	precipitate formed	precipitate remains
B	$\text{Cu}^{2+}$	precipitate formed	precipitate remains
C	$\text{Mg}^{2+}$	precipitate formed	precipitate remains
D	$\text{Zn}^{2+}$	precipitate formed	precipitate redissolves

8 Which one of the following alkenes will exhibit *cis* and *trans* (E-Z) isomerism?

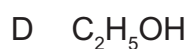


9 Using the bond enthalpies below calculate which one of the following is the enthalpy of combustion of propane.

bond	bond enthalpy/kJ mol <sup>-1</sup>
C — C	347
C — H	413
O — H	464
O = O	498
C = O	805



10 Which one of the following compounds will produce equal volumes of carbon dioxide and water vapour when burnt completely in oxygen?



## Section B

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

**11** Barium oxide is formed by the thermal decomposition of barium carbonate.

**(a) (i)** Write an equation for the decomposition of barium carbonate.

\_\_\_\_\_ [1]

**(ii)** Explain why calcium carbonate will decompose at a lower temperature than barium carbonate.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

**(b)** Barium oxide can also be formed from the combustion of barium. What colour is the flame when barium is burned?

\_\_\_\_\_ [1]

**(c)** Barium hydroxide can be formed from barium oxide.

**(i)** How would you convert barium oxide into barium hydroxide?

\_\_\_\_\_ [1]

**(ii)** State the trend in solubility of the Group II hydroxides.

\_\_\_\_\_ [1]

**(iii)** Write an equation for the reaction between barium hydroxide and sulfuric acid.

\_\_\_\_\_ [1]

**(iv)** What colour is the solid product in the reaction in part **(c)(iii)**?

\_\_\_\_\_ [1]

Examiner Only

Marks

Remark

(d) Describe tests, other than a flame test, to confirm the presence of barium ions and carbonate ions in separate solutions.

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[4]

Quality of written communication

[2]

Examiner Only	
Marks	Remark

12 Paraffin wax is a mixture of alkanes containing 20–40 carbon atoms. The alkane with 20 carbon atoms is known as icosane.

(a) (i) What is the general formula for an alkane?

\_\_\_\_\_ [1]

(ii) What is the molecular formula of icosane?

\_\_\_\_\_ [1]

(iii) Alkanes are **saturated**. What does this term mean?

\_\_\_\_\_ [1]

(b) Explain why icosane is a solid at room temperature whereas ethane is a gas.

\_\_\_\_\_

\_\_\_\_\_

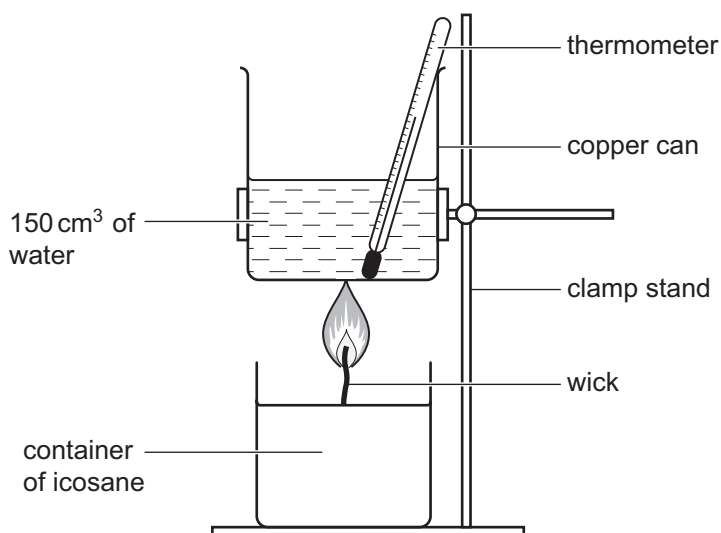
\_\_\_\_\_ [2]

Examiner Only

Marks

Remark

- (c) A calorimeter is set up as shown in the diagram below using a container of icosane with a wick in it. A student carried out an experiment and recorded all measurements in a table.



- (i) Complete the table.

Initial mass of icosane	26.2 g
Final mass of icosane	25.3 g
<b>Mass of icosane burned</b>	
Initial water temperature	19 °C
Final water temperature	80 °C
<b>Temperature change</b>	
Mass of water	150 g

[1]

Examiner Only

Marks Remark



- (ii) Use the following headings to calculate the enthalpy of combustion of icosane (RMM = 282).

Calculate the number of moles of icosane burned.

\_\_\_\_\_ [1]

Calculate the amount of heat energy in joules transferred to the water as the icosane is burned (the specific heat capacity of water is  $4.18 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ ).

\_\_\_\_\_  
\_\_\_\_\_ [1]

Calculate the enthalpy of combustion of icosane in  $\text{kJ mol}^{-1}$ .

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

- (iii) Give one practical reason why the experimental value you calculated is significantly different from a value quoted in a data book.

\_\_\_\_\_  
\_\_\_\_\_ [1]

(d) Icosane needs a plentiful supply of air to burn completely.

- (i) Write an equation for the complete combustion of icosane.

\_\_\_\_\_ [2]

- (ii) Give the chemical formula of a different compound that is formed in the incomplete combustion of icosane.

\_\_\_\_\_ [1]

Examiner Only

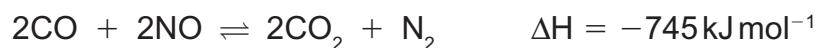
Marks Remark

13 A catalytic converter is a device in a car exhaust system in which a catalyst is spread thinly over a honeycomb structure.

(a) Explain, in terms of energy, what is meant by the term **catalyst**.

\_\_\_\_\_  
\_\_\_\_\_ [2]

(b) The following equilibrium reaction takes place in a catalytic converter.



(i) State and explain the effect of a decrease in temperature on the above equilibrium.

\_\_\_\_\_  
\_\_\_\_\_ [2]

(ii) State and explain the effect of an increase in pressure on the above equilibrium.

\_\_\_\_\_  
\_\_\_\_\_ [2]

(iii) Use the following headings to calculate the total volume of gas produced when 5.6 g of carbon monoxide passes through a catalytic converter.

Relative molecular mass of carbon monoxide

\_\_\_\_\_

Number of moles of carbon monoxide

\_\_\_\_\_

Number of moles of gas produced

\_\_\_\_\_

Volume of gas produced

\_\_\_\_\_ [4]

(c) Explain why cars fitted with catalytic converters must not be fuelled with leaded petrol.

\_\_\_\_\_  
\_\_\_\_\_ [1]

Examiner Only

Marks Remark

14 Ethanol is the main alcohol found in alcoholic drinks. It is produced by the fermentation of sugars.

(a) Ethanol is a **primary** alcohol. What does this term mean?

\_\_\_\_\_  
\_\_\_\_\_ [1]

(b) State **one** effect of alcohol on an individual's ability to drive.

\_\_\_\_\_  
\_\_\_\_\_ [1]

(c) Early breathalysers involved the motorist blowing into a tube containing crystals of potassium dichromate mixed with concentrated sulfuric acid.

(i) What colour change occurs when acidified potassium dichromate reacts with ethanol?

\_\_\_\_\_ [2]

(ii) Write an equation for the oxidation of ethanol using [O] to represent the acidified potassium dichromate.

\_\_\_\_\_ [2]

(d) In the case of a positive breathalyser test the motorist is tested a second time using infrared spectroscopy.

(i) State and explain the effect of infrared radiation on molecules.

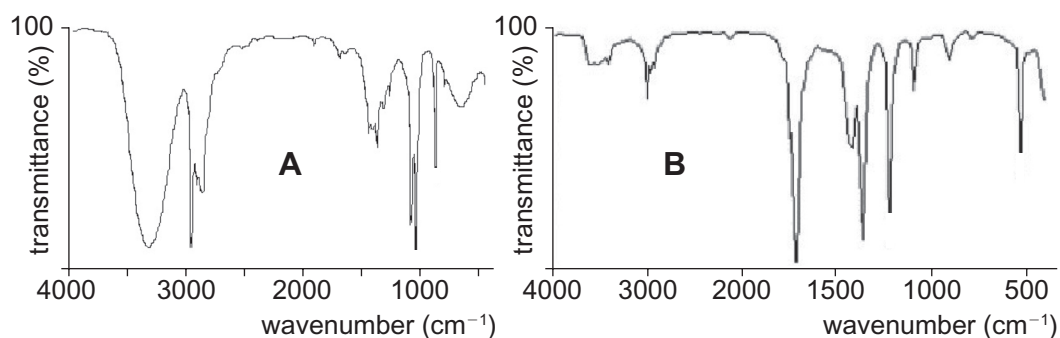
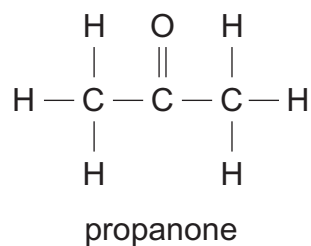
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

Examiner Only

Marks Remark

- (ii) The infrared spectrum must be carefully read to distinguish between ethanol and propanone, which is found in the breath of diabetics. Use the data in the following table to determine which spectrum, A or B, is for ethanol. Explain your choice and refer to both spectra in your answer.

bond	wavenumber ( $\text{cm}^{-1}$ )
C — H	2850–3300
C = O	1680–1750
C — O	1000–1100
O — H	3230–3550




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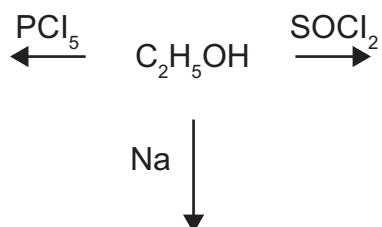
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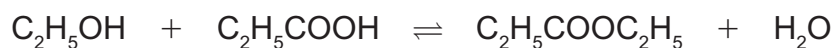
- (e) Give the structure of the organic product formed when ethanol reacts with each of the following reagents.



[3]

Examiner Only	
Marks	Remark

- (f) Ethanol reacts with propanoic acid in a dynamic equilibrium to form an ester according to the following equation.



- (i) Name the ester that is formed in the reaction.

\_\_\_\_\_ [1]

- (ii) Name the catalyst used in the reaction.

\_\_\_\_\_ [1]

- (iii) Explain the term **dynamic equilibrium**.

\_\_\_\_\_  
\_\_\_\_\_ [2]

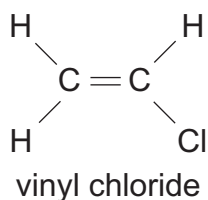
- (iv) Suggest another reagent that could be used in place of propanoic acid to produce the same ester.

\_\_\_\_\_ [1]

Examiner Only

Marks Remark

- 15 Vinyl chloride,  $\text{CH}_2\text{CHCl}$ , is an important compound as it is used to manufacture polyvinylchloride (PVC).



- (a) The first stage in the production of vinyl chloride is the reaction of ethene with chlorine. The product from this reaction then undergoes thermal cracking to form vinyl chloride.

- (i) Write an equation for the reaction of ethene with chlorine.

\_\_\_\_\_ [1]

- (ii) Name the product formed when ethene reacts with chlorine.

\_\_\_\_\_ [2]

- (iii) What is meant by the term **thermal cracking**?

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (iv) When the product of the reaction in (a)(i) is thermally cracked to produce vinyl chloride what is the other product formed?

\_\_\_\_\_ [1]

- (v) What type of polymerisation is used to convert the monomer vinyl chloride to the polymer PVC?

\_\_\_\_\_ [1]

Examiner Only

Marks Remark



(c) Chloroethane can also be made by reacting chlorine with ethane in a reaction that is similar to that of chlorine with methane.

(i) Name the experimental condition required for this reaction to take place.

\_\_\_\_\_ [1]

(ii) Write equations for the propagation steps for this reaction.

\_\_\_\_\_  
\_\_\_\_\_ [2]

(iii) Name the alkane produced in a termination step of this reaction.

\_\_\_\_\_ [1]

(d) Chloroethane will react with ammonia in solution. Write an equation for this reaction and name the organic product.

Equation \_\_\_\_\_ [1]

Name \_\_\_\_\_ [1]

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**THIS IS THE END OF THE QUESTION PAPER**

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Marks

Remark









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