Rewarding Learning

71

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2014

Chemistry

Assessment Unit AS 2

assessing

Module 2: Organic, Physical and Inorganic Chemistry

[AC122]

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
Section A	
1–10	
Section B	
11	
12	
13	
14	
15	
Total Marks	

Section A

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

Select the correct response in each case and mark its code letter by connecting the 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^-

C Cl^+

D Cl_2

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 390 g of propan-2-ol?

A 253.5 g

B 273.0 g

C 420.0 g

D 600.0 g

4 Which one of the following is the molecular formula of methyl propanoate?

A $CH_3CH_2COOCH_3$

B C_2H_4O

C $C_4H_8O_2$

D $HCOOCH_2CH_2CH_3$

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?

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

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	Al^{3+}	precipitate formed	precipitate remains
B	Cu^{2+}	precipitate formed	precipitate remains
C	Mg^{2+}	precipitate formed	precipitate remains
D	Zn^{2+}	precipitate formed	precipitate redissolves

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

A $(CH_3)_2C=CH_2$

B $CH_3CH=CHCH_3$

C $H_2C=CHCl$

D $C_2H_5(CH_3)C=C(CH_3)_2$

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

bond	bond enthalpy/kJ mol^{-1}
C — C	347
C — H	413
O — H	464
O═O	498
C═O	805

A -198 kJ mol^{-1}

B -361 kJ mol^{-1}

C -1707 kJ mol^{-1}

D -2054 kJ mol^{-1}

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

A C_2H_2

B C_2H_4

C C_2H_6

D C_2H_5OH

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]

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

_____

_____

_____

_____

_____

_____ [4]

Quality of written communication [2]

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]

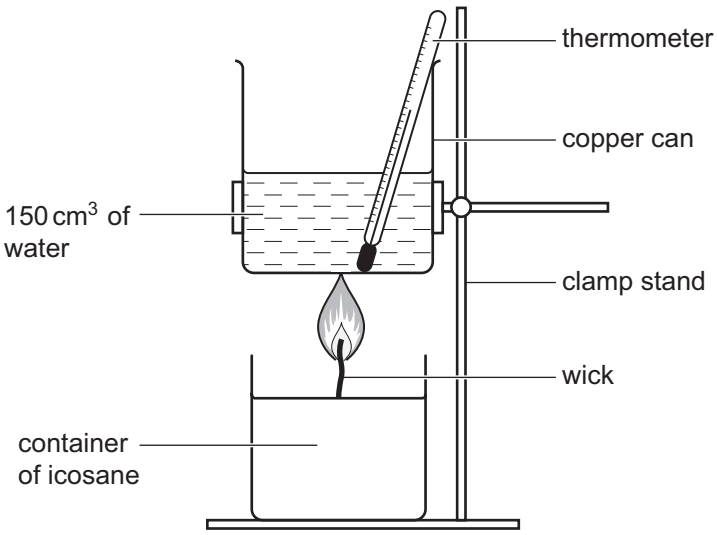
(b) Explain why icosane is a solid at room temperature whereas ethane is a gas.

_____

_____

_____ [2]

(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
Mass of icosane burned	
Initial water temperature	19 °C
Final water temperature	80 °C
Temperature change	
Mass of water	150 g

[1]

(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 J g^{-1} °C^{-1}).

_____

_____ [1]

Calculate the enthalpy of combustion of icosane in 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]

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.

$$2CO + 2NO \rightleftharpoons 2CO_2 + N_2 \qquad \Delta H = -745\,kJ\,mol^{-1}$$

(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]

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.

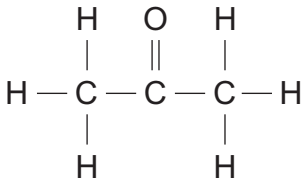
_____

_____

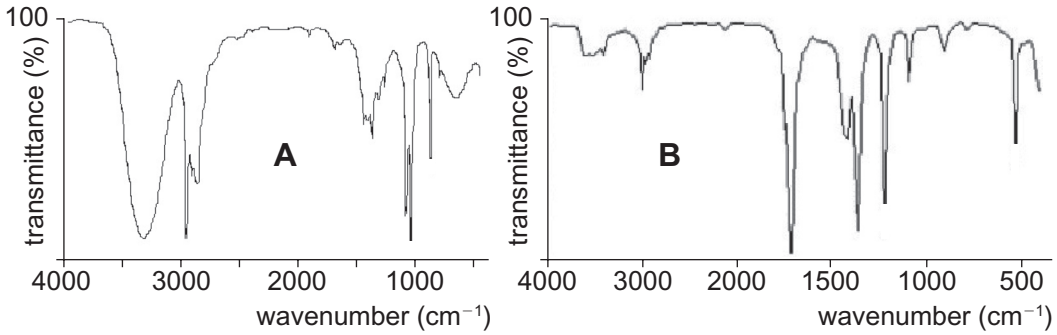
_____ [2]

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

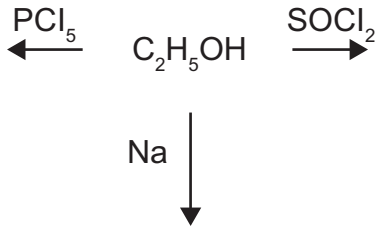


propanone



[3]

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



[3]

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

$$C_2H_5OH + C_2H_5COOH \rightleftharpoons C_2H_5COOC_2H_5 + H_2O$$

(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**.

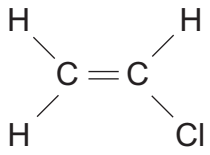
_____

_____ [2]

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

_____ [1]

15 Vinyl chloride, CH_2CHCl, is an important compound as it is used to manufacture polyvinylchloride (PVC).



vinyl chloride

(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]

(b) A by-product of PVC production is chloroethane.

(i) Draw a dot and cross diagram showing all the outer shell electrons in a chloroethane molecule.

[1]

(ii) Draw a flow scheme to show the mechanism for the reaction of hydrogen chloride with ethene which is similar to the reaction of hydrogen bromide with ethene.

[3]

(iii) What is the name given to this mechanism?

_____ [2]

(iv) What type of covalent bond in ethene is broken during this reaction?

_____ [1]

(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]

THIS IS THE END OF THE QUESTION PAPER