FOR OFFICIAL USE

Section B Total Marks

X012/201

NATIONAL QUALIFICATIONS 2006

TUESDAY, 30 MAY
9.00 AM – 11.00 AM

CHEMISTRY
INTERMEDIATE 2

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

Necessary data will be found in the Chemistry Data Booklet for Standard Grade and Intermediate 2 (1999 Edition).

Section A – Questions 1–30 (30 marks)

Instructions for completion of **Section A** are given on page two.

For this section of the examination you must use an **HB pencil**.

Section B (50 marks)

All questions should be attempted.

The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, **and must be written clearly and legibly in ink**.

Rough work, if any should be necessary, should be written in this book, and then scored through when the fair copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the invigilator.

Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the **front** cover of this booklet.

Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

SECTION A

1. Which of the following elements is an alkali metal?

   A Aluminium
   B Calcium
   C Copper
   D Sodium

2. Lemonade can be made by dissolving sugar, lemon juice and carbon dioxide in water. In lemonade, the solvent is

   A water
   B sugar
   C lemon juice
   D carbon dioxide.

3. The mass number of the atom $^{23}_{11}Na$ is

   A 11
   B 12
   C 23
   D 34.

4. Which of the following is the electron arrangement for a halogen atom?

   (You may wish to use page 1 of the data booklet to help you.)

   A 2, 5
   B 2, 6
   C 2, 7
   D 2, 8

5. The table shows information about some atoms.

Atom	Atomic number	Mass number
W	16	34
X	18	36
Y	18	40
Z	20	40

   Which two atoms are isotopes of the same element?

   A W and X
   B X and Y
   C W and Y
   D Y and Z

6. Which of the following pairs of elements combine to form an ionic compound?

   A Lead and fluorine
   B Sulphur and oxygen
   C Carbon and nitrogen
   D Phosphorus and chlorine

7. Which of the following particles contains a different number of electrons from the others?

   (You may wish to use page 1 of the data booklet to help you.)

   A Cl^-
   B S^{2-}
   C Ar
   D Na^+

8. What is the correct formula for aluminium sulphate?

   A $AlSO_4$
   B $Al(SO_4)_3$
   C $Al_2(SO_4)_3$
   D $Al_3(SO_4)_2$

[Turn over

9. Glucose has the molecular formula $C_6H_{12}O_6$.

How many moles are contained in 18 g of glucose?

A 0·01

B 0·1

C 1

D 10

10. 0·2 mol of gas has a mass of 12·8 g.

Which of the following could be the molecular formula for the gas?

A SO_2

B CO

C CO_2

D NH_3

11. Catalytic converters speed up the conversion of harmful gases to less harmful gases. Which of the following reactions is most likely to occur in a catalytic converter?

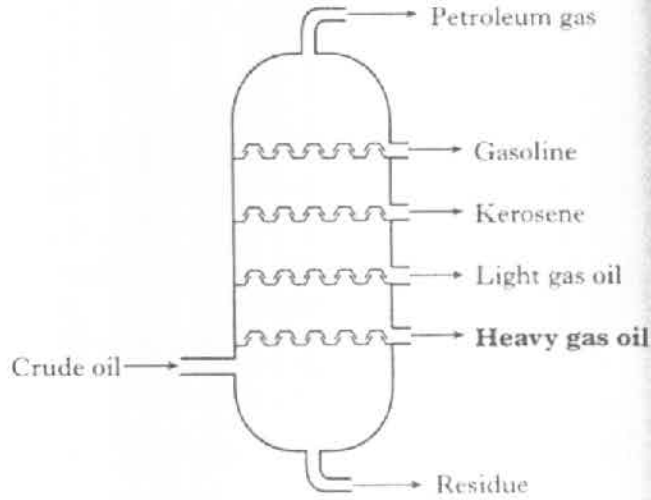
A Carbon dioxide reacting to form carbon monoxide

B Carbon monoxide reacting to form carbon dioxide

C Nitrogen reacting to form nitrogen dioxide

D Oxygen reacting to form hydrogen oxide

12. Heavy gas oil produced by the fractional distillation of crude oil has a high viscosity.



Which of the following properties also apply to heavy gas oil?

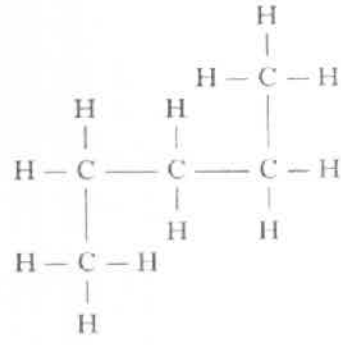
A Low boiling point and high flammability

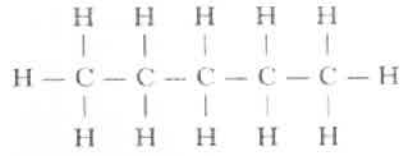
B High boiling point and high flammability

C Low boiling point and low flammability

D High boiling point and low flammability

13.





The above structural formulae represent

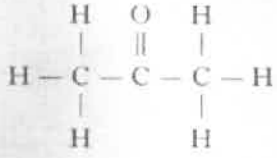
A the same hydrocarbon

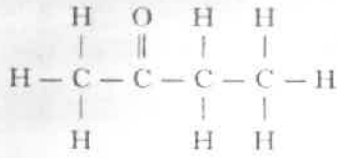
B different hydrocarbons

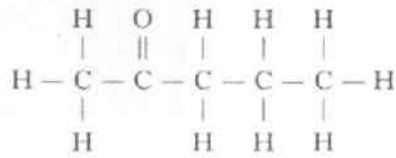
C isomers

D isotopes.

14. The first three members of the alkanone series are:







What is the general formula for this homologous series?

A $C_nH_{2n-2}O$

B $C_nH_{2n}O$

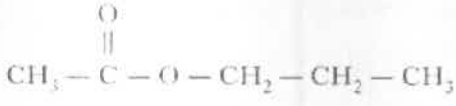
C $C_nH_{2n+1}O$

D $C_nH_{2n+2}O$

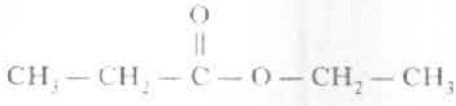
15. Which of the following is a structural formula for propyl ethanoate?

A

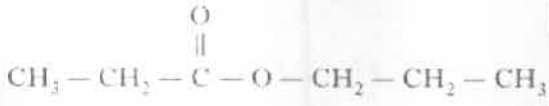
B



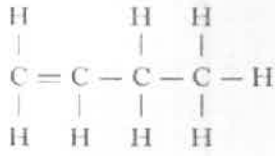
C



D



16. The structural formula for hydrocarbon **X** is



Which of the following statements about hydrocarbon **X** is true?

A **X** is named but-2-ene.

B **X** is a saturated hydrocarbon.

C **X** rapidly decolourises bromine solution.

D **X** belongs to the group of hydrocarbons with general formula C_nH_{2n+2}.

17. A hydrocarbon was cracked.

The equation for one reaction taking place is shown.

$$C_{22}H_{46} \rightarrow C_{18}H_{38} + \mathbf{Y}$$

What is the molecular formula for **Y**?

A C_3H_8

B C_4H_8

C C_4H_{10}

D C_5H_{12}

18. The method used to increase the ethanol concentration of fermentation products is

A cracking

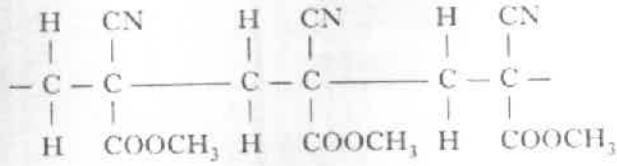
B dehydration

C distillation

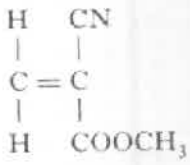
D hydrolysis.

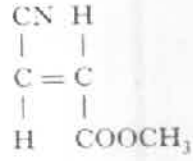
[Turn over

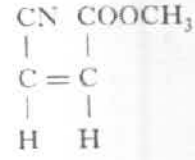
19. The structure below shows a section of an addition polymer.

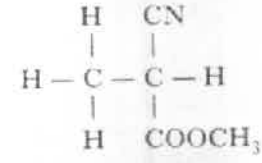


Which molecule is used to make this polymer?

A 

B 

C 

D 

20. To which class of compounds does the hormone insulin belong?

A Carbohydrates

B Fats

C Proteins

D Hydrocarbons

21. amino acids $\xrightarrow{\text{reaction X}}$ protein + water

Which of the following terms describes reaction **X**?

A Hydration

B Hydrolysis

C Dehydration

D Condensation

22. Which compound could be obtained by t hydrolysis of a fat?

A Ethanol

B Glucose

C Glycerol

D Propanol

23. When hydrochloric acid with a pH of 3 is dilu with water to give a solution with a pH of 6, concentration of

A $H^+(aq)$ ions decreases

B $OH^-(aq)$ ions decreases

C $H^+(aq)$ ions and the concentration $OH^-(aq)$ ions become equal

D $H^+(aq)$ ions and the concentration $OH^-(aq)$ ions remain unchanged.

24. Which of the following sodium compounds base?

A Sodium carbonate

B Sodium chloride

C Sodium nitrate

D Sodium sulphate

25. When nickel(II) chloride solution is added sodium carbonate solution an insoluble soli formed.

A sample of the solid can be separated from mixture by

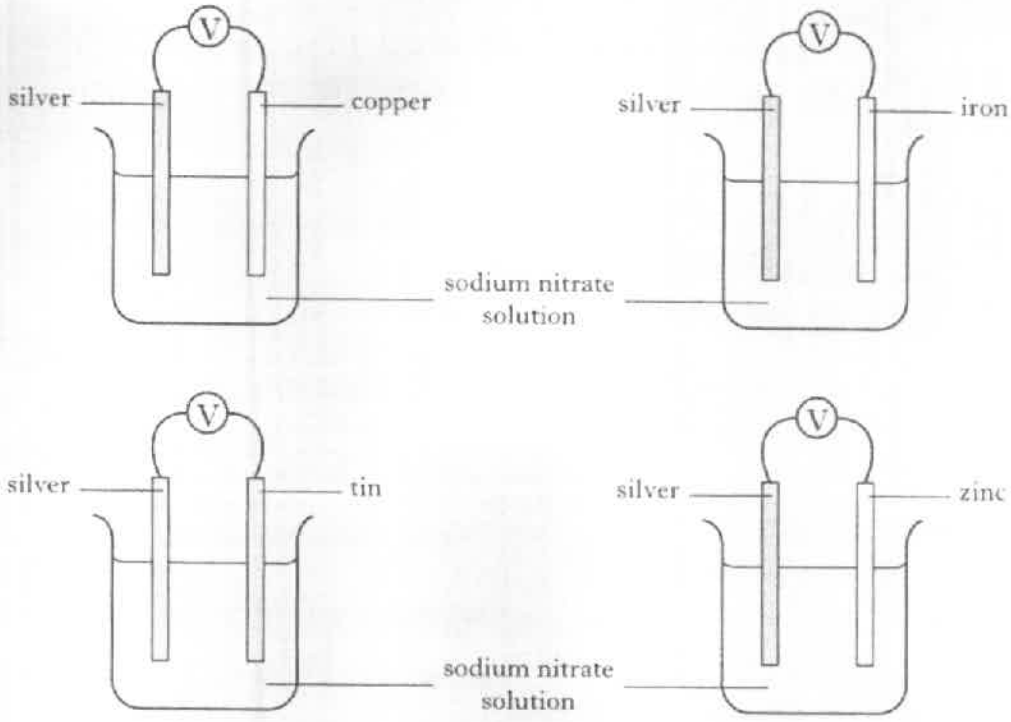
A condensation

B distillation

C evaporation

D filtration.

26. Four cells were made by joining copper, iron, tin and zinc to silver.



Which of the following will be the voltage of the cell containing silver joined to copper?

(You may wish to use page 7 of the data booklet to help you.)

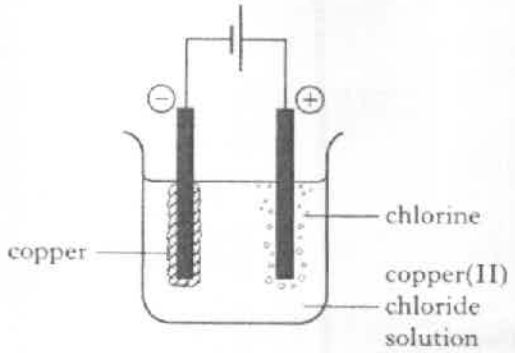
A 0·5 V

B 0·9 V

C 1·2 V

D 1·6 V

27. A copper(II) chloride solution was electrolysed.



Which of the following changes occurred at the negative electrode?

A Copper atoms were reduced.

B Copper atoms were oxidised.

C Copper ions were reduced.

D Copper ions were oxidised.

28. Which metal can be extracted from its oxide by heat alone?

A Lead

B Mercury

C Tin

D Zinc

29. An oil rig can be protected from corrosion by attaching pieces of magnesium to the structure. This method of protection is called

A galvanising

B electroplating

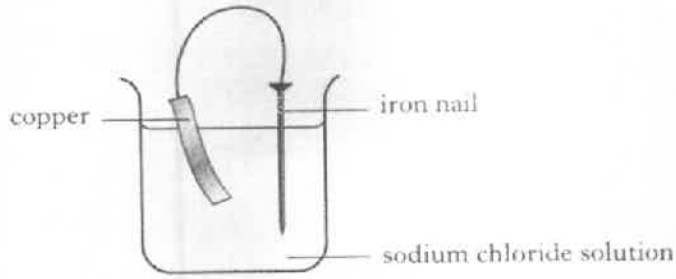
C physical protection

D sacrificial protection.

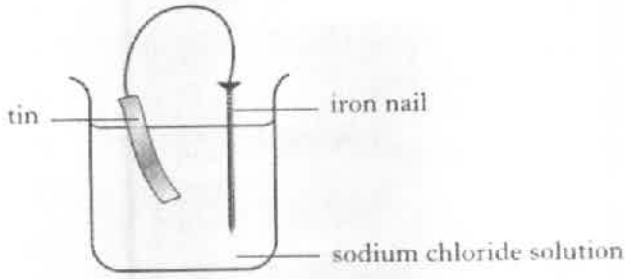
[Turn over

30. In which of the following experiments would the iron nail **not** rust?

A



B



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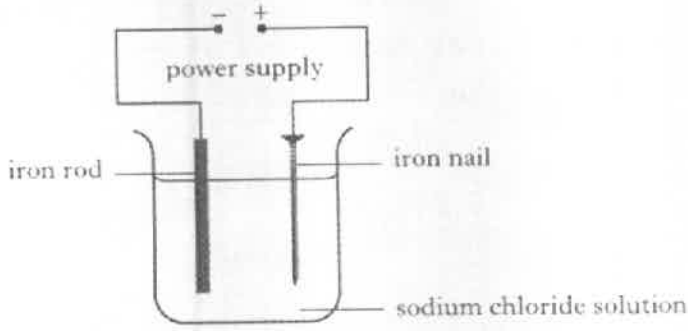

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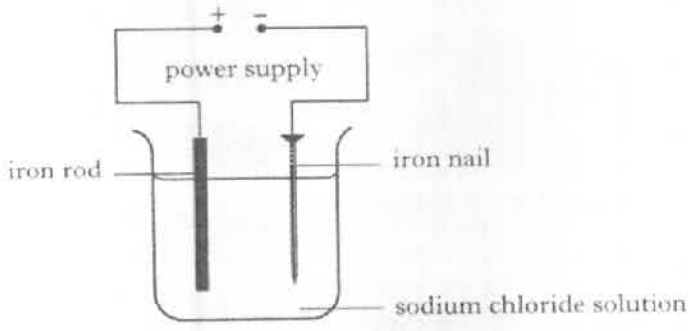


Candidates are reminded that the answer sheet for Section A MUST be placed INSIDE the front cover of this answer book.

DO NOT WRITE IN THIS MARGIN

Marks

SECTION B

50 marks are available in this section of the paper.

All answers must be written clearly and legibly in ink.

1. Natural gas contains unwanted sulphur compounds.

(*a*) Burning sulphur compounds releases sulphur dioxide into the atmosphere. What problems can be caused by releasing sulphur dioxide into the atmosphere?

_____

_____ 1

(*b*) The sulphur can be removed from compounds found in natural gas by reacting the compounds with hydrogen gas.

(i) The equation for the removal of sulphur from one compound is shown.

$$CH_3SH + H_2 \rightarrow C_2H_6 + H_2S$$

Balance this equation. 1

(ii) The hydrogen sulphide produced can be reacted to form sulphur gas. The sulphur gas is cooled and forms liquid sulphur.

At what temperature will sulphur gas change to liquid?

(You may wish to use page 3 of the data booklet.)

_____ °C 1

(3)

[Turn over

Marks

2. In ammonia molecules, the atoms are held together by three covalent bonds.

(*a*) What is a covalent bond?

_____

_____ 1

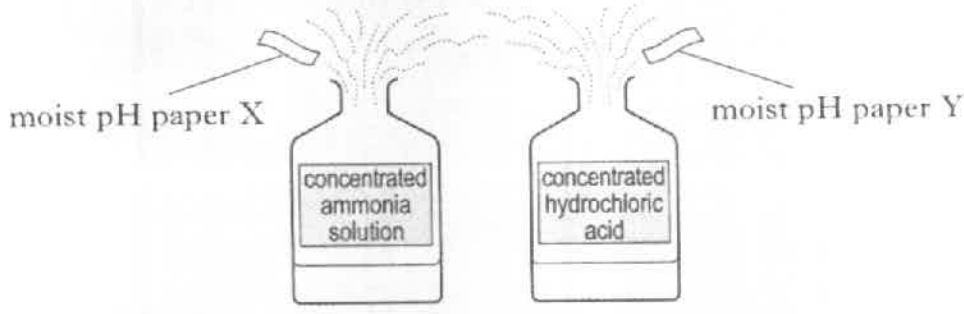
(*b*) The formula of ammonia is NH_3.
Draw a diagram to show the **shape** of an ammonia molecule.

1

(*c*) Ammonia gas $NH_3(g)$, can be dissolved in water to form concentrated ammonia solution.

Hydrogen chloride gas HCl(g), can be dissolved in water to form concentrated hydrochloric acid.

If both bottles are placed next to each other in a fume cupboard and the stoppers removed, both liquids evaporate and a white cloud is formed where the two gases meet.



(i) State the colour of the pH paper at X and Y.

pH paper X _____ pH paper Y _____ 1

(ii) The white cloud appears because the gases react to form a salt.
Name the salt formed.

_____ 1

(4)

DO NOT WRITE IN THIS MARGIN

Marks

3. The formula for iron(III) oxide is Fe_2O_3.

(*a*) What is the charge on the oxide ion?
(You may wish to use the data book to help you.)

_____ **1**

(*b*) The iron(III) oxide can be reduced to give iron metal.
Write an ion-electron equation to show iron(III) ions changing to iron atoms.

_____ **1**

(*c*) Complete the table to show the numbers of particles in the iron ion $^{56}_{26}Fe^{3+}$.

Type of particle	Number
Protons	
Neutrons	
Electrons	

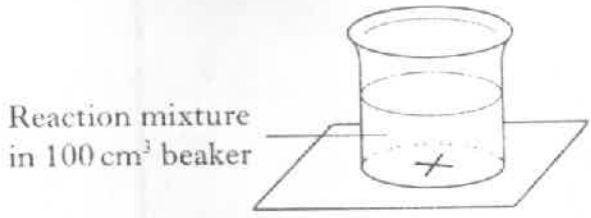
2

(4)

[Turn over

Marks

4. In the **PPA "Effect of Temperature Changes on Reaction Rate"**, the rate of reaction between sodium thiosulphate and hydrochloric acid was investigated.



$$S_2O_3^{2-}(aq) + 2H^+(aq) \rightarrow SO_2(g) + S(s) + H_2O(\ell)$$

(*a*) Describe the change that would take place in the beaker.

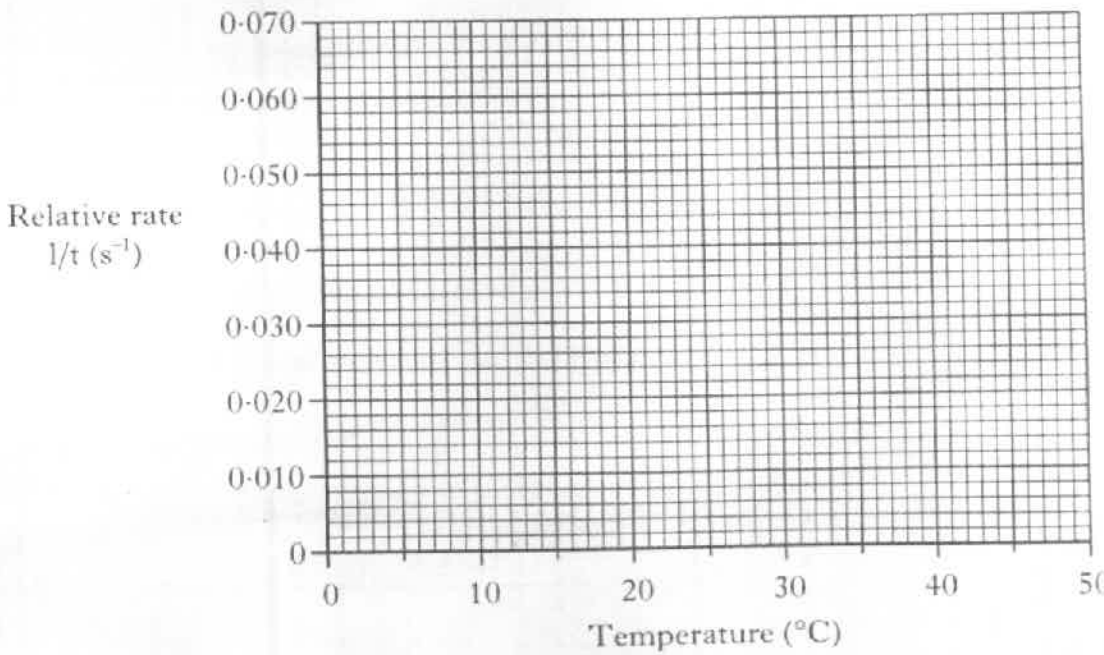
_____

_____ 1

(*b*) The results obtained during this PPA are shown in the table.

Temperature (°C)	Reaction time (s)	Relative rate 1/t (s^{-1})
24	68	0·015
33	43	0·023
40	28	0·036
50	15	0·067

Plot these results as a line graph.
(Additional graph paper, if required, can be found on page 24).



1

DO NOT WRITE IN THIS MARGIN

Marks

4. (continued)

(*c*) (i) Use the graph to find the relative rate that would be expected if the reaction was carried out at 45 °C.

_____ s^{-1} 1

(ii) At 60 °C the relative rate was 0·125 s^{-1}. Use this rate to calculate the reaction time at 60 °C.

_____ seconds 1

(*d*) When the experiment was carried out at the different temperatures, either the same beaker or identical beakers had to be used. Why is it important to use the same or identical beakers in this experiment?

_____

_____ 1

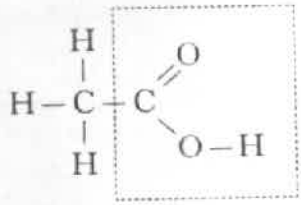
(5)

[Turn over

Marks

5. Ethanoic acid is a member of the family of alkanoic acids.

(*a*) The functional group in ethanoic acid has been highlighted.



Name the functional group.

_____ 1

(*b*) Ethanoic acid can be produced by reacting methanol with carbon monoxide.

$$CH_3OH(\ell) + CO(g) \longrightarrow CH_3COOH(\ell)$$

Calculate the mass of ethanoic acid produced from 16 grams of methanol.

_____ g 2

(3)

DO NOT WRITE IN THIS MARGIN

Marks

6. Carbohydrates are an essential part of our diet.

(*a*) Why are carbohydrates an important part of our diet?

_____

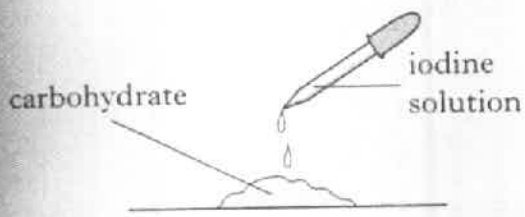
_____ 1

(*b*) Name the elements present in carbohydrates.

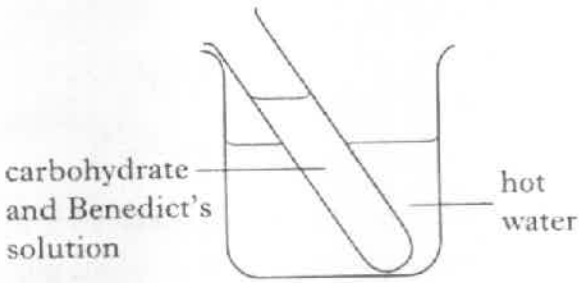
_____ 1

(*c*) A student tested the carbohydrates **glucose**, **sucrose** and **starch** as shown.

Test 1



Test 2



Complete the table by identifying each carbohydrate.

Carbohydrate	**Results**	
	Test 1	**Test 2**
	brown → black	no change
	no change	no change
	no change	blue → orange/red

2

(4)

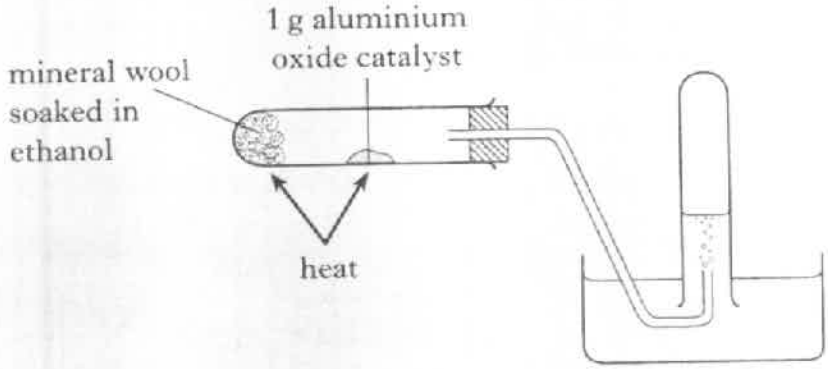
[Turn over

Marks

7. (*a*) Draw the full structural formula for ethanol.

1

(*b*) The dehydration of ethanol to ethene was carried out using the following apparatus.



(i) Complete the word equation for the reaction.

Ethanol → Ethene + _____ 1

(ii) As a safety precaution, the delivery tube was removed from the water before heating was stopped.
Why was this done?

_____

_____ 1

(iii) Why is the aluminium oxide catalyst described as being heterogenous?

_____

_____ 1

(iv) What would the mass of aluminium oxide catalyst be after the reaction was complete?

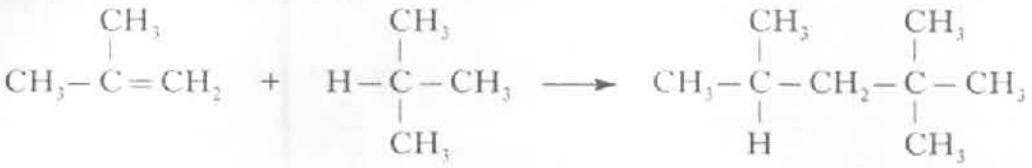
_____ 1

(5)

DO NOT WRITE IN THIS MARGIN

Marks

8. Methylpropene and an alkane can be used to produce 2,2,4-trimethylpentane, a molecule added to petrol.



methylpropene alkane 2,2,4-trimethylpentane

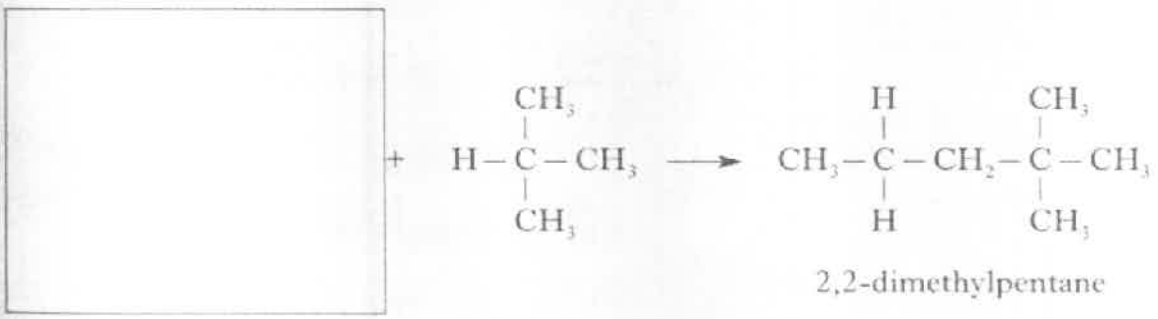
(*a*) (i) Give the systematic name for the alkane used to produce 2,2,4-trimethylpentane.

_____ 1

(ii) Name the type of chemical reaction shown above.

_____ 1

(*b*) A similar reaction can be used to prepare 2,2-dimethylpentane.
Draw a structural formula for the alkene used to form this molecule.



2,2-dimethylpentane

1

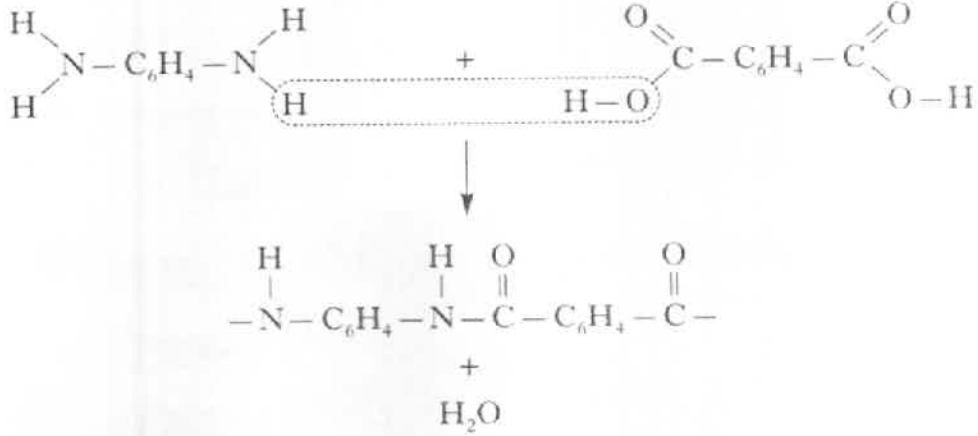
(3)

[Turn over

Marks

9. Kevlar is a thermosetting polymer which can be used to make bullet-proof vests.

(*a*) The diagram below shows how the monomers used to make Kevlar link together.



(i) What type of polymerisation takes place?

_____ 1

(ii) Name the type of link formed.

_____ 1

(iii) Why is it important that the monomers have functional groups at each end of the molecule?

_____

_____

_____ 1

(*b*) What property of Kevlar makes it suitable for use in bullet-proof vests?

_____

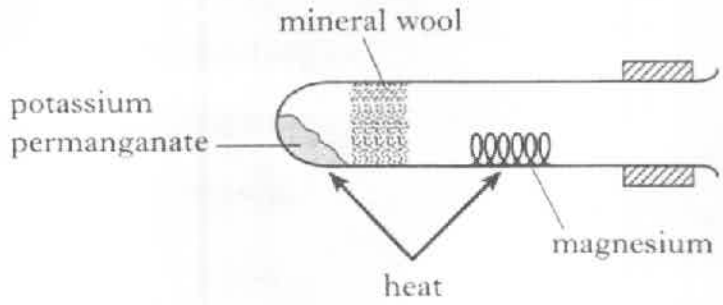
_____ 1

(4)

DO NOT WRITE IN THIS MARGIN

Marks

10. The **PPA "Reactions of Metals with Oxygen"** was carried out using the apparatus shown below.



Three metals were used.

(*a*) Complete the table to show what would be observed when zinc was used.

Metal	Observation
Copper	Dull red glow
Magnesium	Very bright white light
Zinc	

1

(*b*) Complete the aim of the experiment.

The aim of the experiment was to _____

_____

_____

1

(*c*) Two safety precautions are wearing safety glasses and making sure the mouth of the test tube is not pointing at anyone.

State **one** other safety precaution which must be taken when using magnesium.

_____

_____

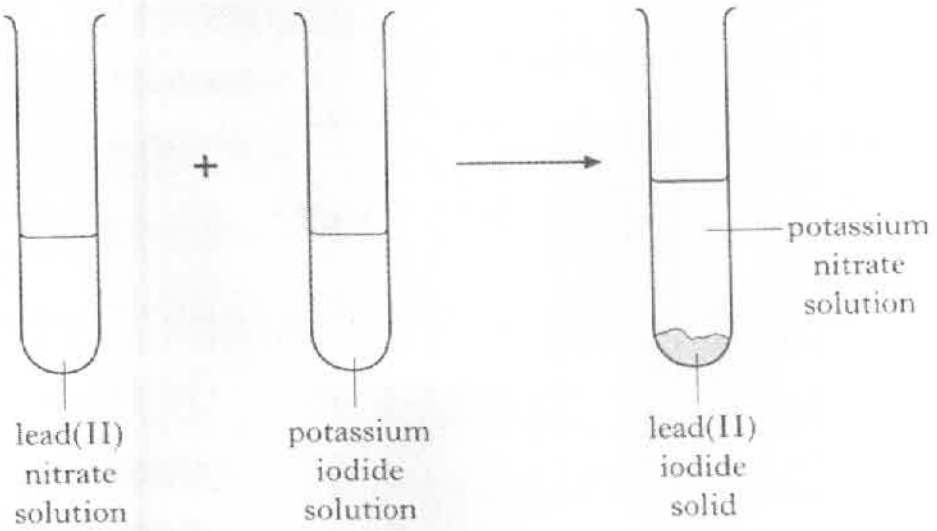
1

(3)

[Turn over

Marks

11. A student carried out the following experiment.



(*a*) During the reaction, a solid was formed.
Name the type of chemical reaction taking place.

_____ 1

(*b*) The equation for the reaction is

$Pb^{2+}(aq) + 2NO_3^-(aq) + 2K^+(aq) + 2I^-(aq) \rightarrow Pb^{2+}(I^-)_2(s) + 2K^+(aq) + 2NO_3^-(aq)$

(i) Rewrite the equation showing only the ions which react.

1

(ii) What term is used to describe the ions which do not react?

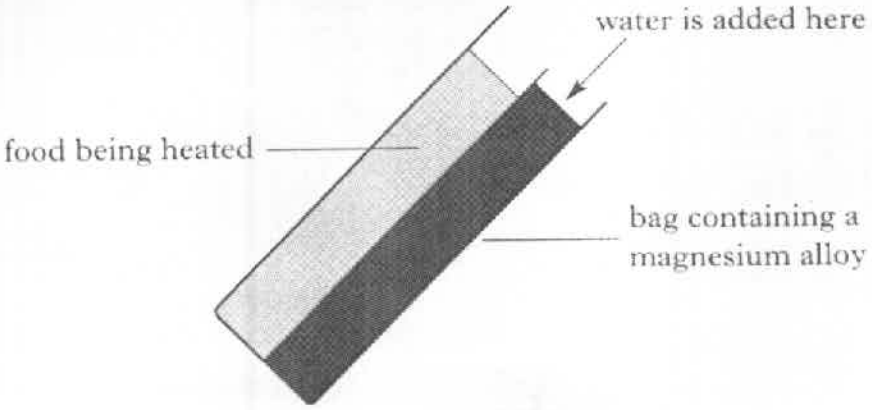
_____ 1

(3)

DO NOT WRITE IN THIS MARGIN

Marks

12. Scientists have developed self-heating food packs. They use the heat given out by the reaction of magnesium with water to warm food.



(*a*) What term is used to describe reactions which give out heat?

_____ 1

(*b*) The reaction is started by the addition of water to the pouch containing magnesium alloy. The equation for the reaction is shown.

$$Mg(s) + 2H_2O(\ell) \longrightarrow Mg(OH)_2(s) + H_2(g)$$

(i) Why is it necessary to keep the food bag away from flames when the food is being heated?

_____

_____ 1

(ii) In this reaction, magnesium atoms lose electrons.

$$Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$$

What name is given to this type of chemical reaction?

_____ 1

(*c*) In the alloy, magnesium is in contact with iron. This contact speeds up the reaction and produces heat more quickly.

Suggest why the magnesium being in contact with iron speeds up the reaction.

_____

_____ 1

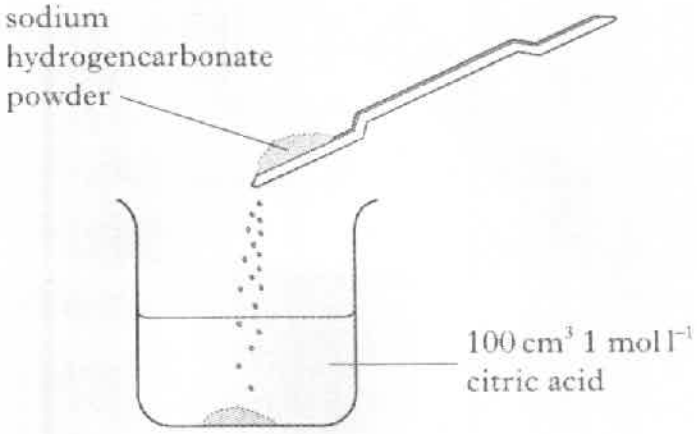
(4)

[Turn over

Marks

13. Some medicines are made into tablets which fizz when they dissolve in water. The fizzing is caused by carbon dioxide gas which is produced when citric acid and sodium hydrogencarbonate in the tablet react.

The reaction can be demonstrated as shown.



(*a*) (i) Calculate the number of moles of citric acid in 100 cm^3 of 1 mol l^{-1} citric acid.

_____ mol 1

(ii) 1 mole of citric acid reacts with 3 moles of sodium hydrogencarbonate.

How many moles of sodium hydrogencarbonate react with 100 cm^3 of 1 mol l^{-1} citric acid?

_____ mol 1

DO NOT WRITE IN THIS MARGIN

Marks

13. (continued)

(*b*) (i) Citric acid is a weak acid.
What is meant by a weak acid?

1

(ii) Hydrochloric acid is a strong acid.
A student was given a bottle of 1 mol l^{-1} hydrochloric acid and a bottle of 1 mol l^{-1} citric acid.
Describe an experiment that could be carried out to show that citric acid is a weak acid and hydrochloric acid is a strong acid.
State the result that would be expected.

2

(5)

[END OF QUESTION PAPER]