

FOR OFFICIAL USE

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Section B **Total Marks**

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**X012/11/02**

NATIONAL QUALIFICATIONS 2013  
FRIDAY, 31 MAY  
1.00 PM – 3.00 PM

CHEMISTRY  
INTERMEDIATE 2

Fill in these boxes and read what is printed below.

Full name of centre

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Town

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Forename(s)

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Surname

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Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

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

**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.



## Read carefully

- 1 Check that the answer sheet provided is for **Chemistry Intermediate 2 (Section A)**.
- 2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) and **Centre Name** printed on it.  
Do not change any of these details.
- 4 If any of this information is wrong, tell the Invigilator immediately.
- 5 If this information is correct, **print** your name and seat number in the boxes provided.
- 6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).
- 7 There is **only one correct** answer to each question.
- 8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.
- 9 At the end of the examination, put the **answer sheet for Section A inside the front cover of this answer book.**

## Sample Question

To show that the ink in a ball-pen consists of a mixture of dyes, the method of separation would be

- A chromatography
- B fractional distillation
- C fractional crystallisation
- D filtration.

The correct answer is **A**—chromatography. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).



## Changing an answer

If you decide to change your answer, carefully erase your first answer and using your pencil, fill in the answer you want. The answer below has been changed to **D**.



## SECTION A

1. In an exothermic reaction
- A there is no energy change
  - B energy is released to the surroundings
  - C energy is absorbed from the surroundings
  - D the energy of the products is greater than the energy of the reactants.

2. When hydrogen chloride gas is dissolved in water a solution containing hydrogen ions and chloride ions is formed.

Which equation correctly shows the state symbols for this change?

- A  $\text{HCl(g)} + \text{H}_2\text{O(l)} \longrightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
  - B  $\text{HCl(l)} + \text{H}_2\text{O(aq)} \longrightarrow \text{H}^+(\text{l}) + \text{Cl}^-(\text{l})$
  - C  $\text{HCl(aq)} + \text{H}_2\text{O(l)} \longrightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
  - D  $\text{HCl(g)} + \text{H}_2\text{O(l)} \longrightarrow \text{H}^+(\text{l}) + \text{Cl}^-(\text{l})$
3. A bottle of whisky contains 40% ethanol by volume.

Which line in the table is the correct description of the mixture?

	Solute	Solvent	Solution
A	ethanol	whisky	water
B	ethanol	water	whisky
C	water	ethanol	whisky
D	whisky	water	ethanol

4. Many chemical processes involve catalysts. Identify the process in which the catalyst could be an enzyme.
- A Hydration of ethene
  - B Hydrolysis of starch
  - C Cracking of hydrocarbons
  - D Formation of alkenes from alkanes

5. Which line in the table correctly describes a proton?

	Mass	Charge	Location
A	negligible	0	outside nucleus
B	negligible	-1	outside nucleus
C	1	+1	in nucleus
D	1	0	in nucleus

6. In a hydrogen fluoride molecule, the atoms share electrons in order to achieve the same electron arrangements as atoms in group

- A 0
- B 1
- C 2
- D 7.

7. What is the name of the compound with the formula  $\text{VO}_2$ ?

- A Vanadium(V) oxide
- B Vanadium(IV) oxide
- C Vanadium(III) oxide
- D Vanadium(II) oxide

8.  $4\text{NH}_3 + x\text{O}_2 \rightarrow 4\text{NO} + y\text{H}_2\text{O}$

The equation will be balanced when

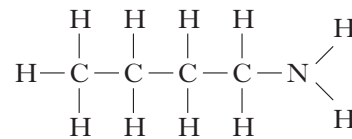
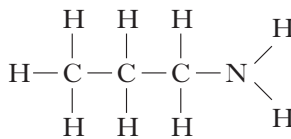
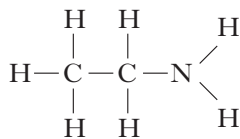
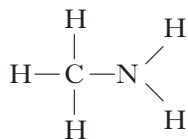
- A  $x = 5, y = 6$
- B  $x = 5, y = 10$
- C  $x = 3, y = 6$
- D  $x = 3, y = 10$ .

9. Which of the following substances has the smallest gram formula mass?

- A CO
- B  $\text{CO}_2$
- C  $\text{N}_2$
- D  $\text{CH}_4$



15. The first four members of the amine homologous series are:



What is the general formula for this homologous series?

- A  $\text{C}_n \text{H}_{n+4} \text{N}$
- B  $\text{C}_n \text{H}_{2n+3} \text{N}$
- C  $\text{C}_n \text{H}_{3n+2} \text{N}$
- D  $\text{C}_n \text{H}_{4n+1} \text{N}$

16. Biopol is a polymer which is

- A natural and biodegradable
- B synthetic and biodegradable
- C natural and non-biodegradable
- D synthetic and non-biodegradable.

17. Which of the following fatty acids contains the most double bonds per molecule?

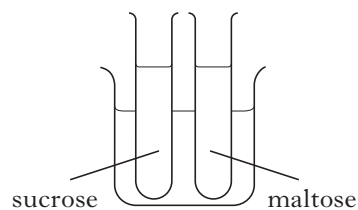
- A  $\text{C}_{17}\text{H}_{35}\text{COOH}$
- B  $\text{C}_{17}\text{H}_{33}\text{COOH}$
- C  $\text{C}_{17}\text{H}_{31}\text{COOH}$
- D  $\text{C}_{17}\text{H}_{29}\text{COOH}$

18. An alkaline solution contains

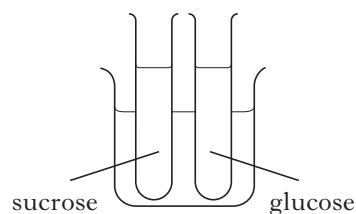
- A hydroxide ions but no hydrogen ions
- B equal numbers of hydrogen and hydroxide ions
- C more hydroxide ions than hydrogen ions
- D more hydrogen ions than hydroxide ions.

19. In which of the following experiments would both carbohydrates give an orange precipitate when heated with Benedict's solution?

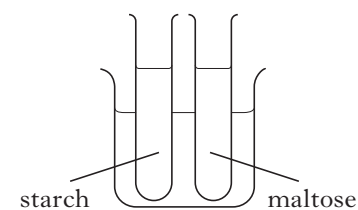
A



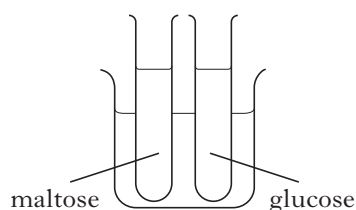
B



C



D



20. When hydrochloric acid with a pH of 3 is diluted with water to give a solution with a pH of 6, the concentration of
- A  $\text{H}^+(\text{aq})$  ions decreases
  - B  $\text{OH}^-(\text{aq})$  ions decreases
  - C  $\text{H}^+(\text{aq})$  ions and the concentration of  $\text{OH}^-(\text{aq})$  ions become equal
  - D  $\text{H}^+(\text{aq})$  ions and the concentration of  $\text{OH}^-(\text{aq})$  ions remain unchanged.

21. 0.25 mol of potassium hydroxide was dissolved in water and the solution made up to  $500\text{ cm}^3$ .  
What was the concentration, in  $\text{mol l}^{-1}$ , of the solution which was formed?

- A 0.0005
- B 0.125
- C 0.5
- D 2.0

22. Which of the following compounds is a base?

- A Sodium carbonate
- B Sodium chloride
- C Sodium nitrate
- D Sodium sulphate

23. Which of the following gases reacts with an alkaline solution?

- A Argon
- B Oxygen
- C Ammonia
- D Nitrogen dioxide

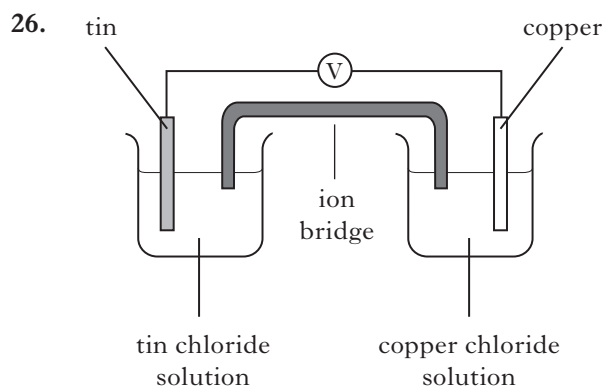
24. Which of the following compounds is a salt?

- A Ammonium chloride
- B Calcium oxide
- C Hydrogen chloride
- D Sodium hydroxide

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

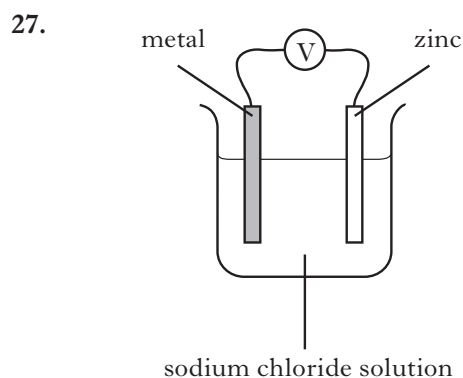
A sample of the solid can be separated from the mixture by

- A condensation
- B distillation
- C evaporation
- D filtration.



In the cell shown electrons flow through

- A the solution from copper to tin
- B the solution from tin to copper
- C the wires from copper to tin
- D the wires from tin to copper.

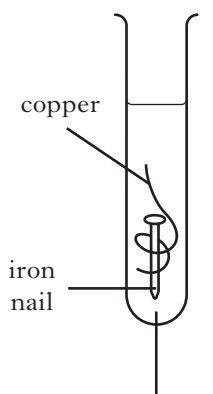


Which of the following metals, when linked to zinc, would give the highest cell voltage?

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

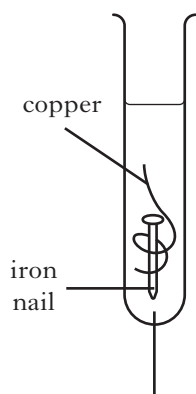
- A Copper
- B Iron
- C Magnesium
- D Tin

28. In which test tube will the iron nail corrode fastest?



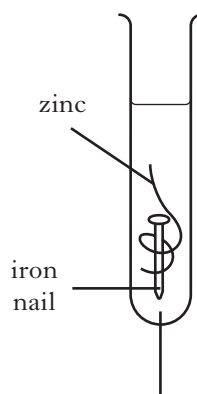
salt water

A



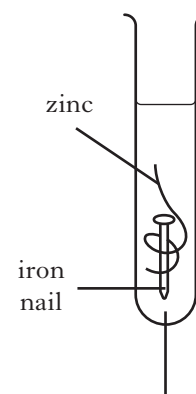
tap water

B



salt water

C



tap water

D

29. When a metal element reacts to form a compound the metal is

- A displaced
- B oxidised
- C precipitated
- D reduced.

30. Which of the following metals can be obtained from its ore by heating with carbon monoxide?  
(You may wish to use the data booklet to help you.)

- A Aluminium
- B Calcium
- C Magnesium
- D Nickel

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

**[Turn over**

**[BLANK PAGE]**



## SECTION B

50 marks are available in this section of the paper.

All answers must be written clearly and legibly in ink.

1. (a) Strontium compounds have many uses.

(i) Strontium nitrate is used in warning flares.

What colour of flame will strontium nitrate give?

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

\_\_\_\_\_

1

(ii) Strontium chloride hexahydrate can be used in toothpaste for sensitive teeth as it plugs the holes in the tooth enamel.

This is possible because strontium has similar chemical properties to calcium.

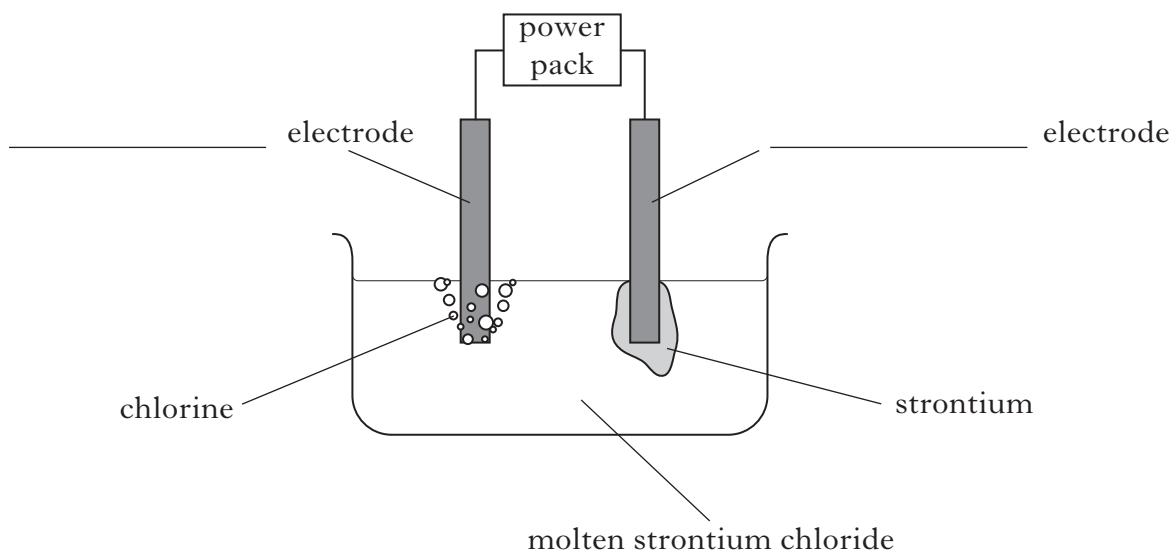
Why does strontium have similar chemical properties to calcium?

\_\_\_\_\_

1

(b) Strontium can be extracted from the compound strontium chloride using electrolysis.

Label the diagram to show the **charge** on each electrode.



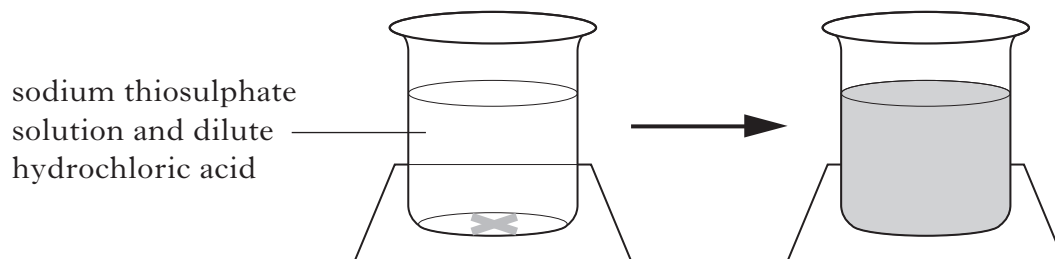
1

(3)

[Turn over

Marks

2. In the PPA, “Effect of temperature on reaction rate”, the reaction between sodium thiosulphate solution and dilute hydrochloric acid is investigated.



- (a) How is the rate of the reaction determined?

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1

- (b) State a factor which should be kept constant.

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1

- (c) Apart from wearing safety glasses, state another safety precaution which must be taken when carrying out this experiment.

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1

- (d) The equation for the reaction taking place is



Circle a spectator ion in the equation.

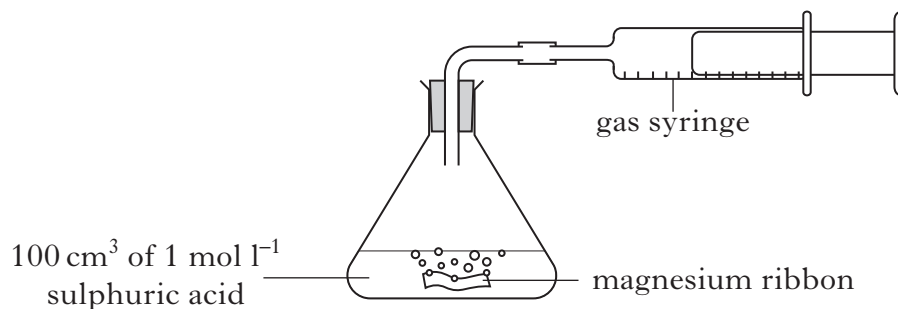
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(4)

**[Turn over for Question 3 on *Page twelve***

Marks

3. Magnesium reacts with dilute sulphuric acid to produce a gas.

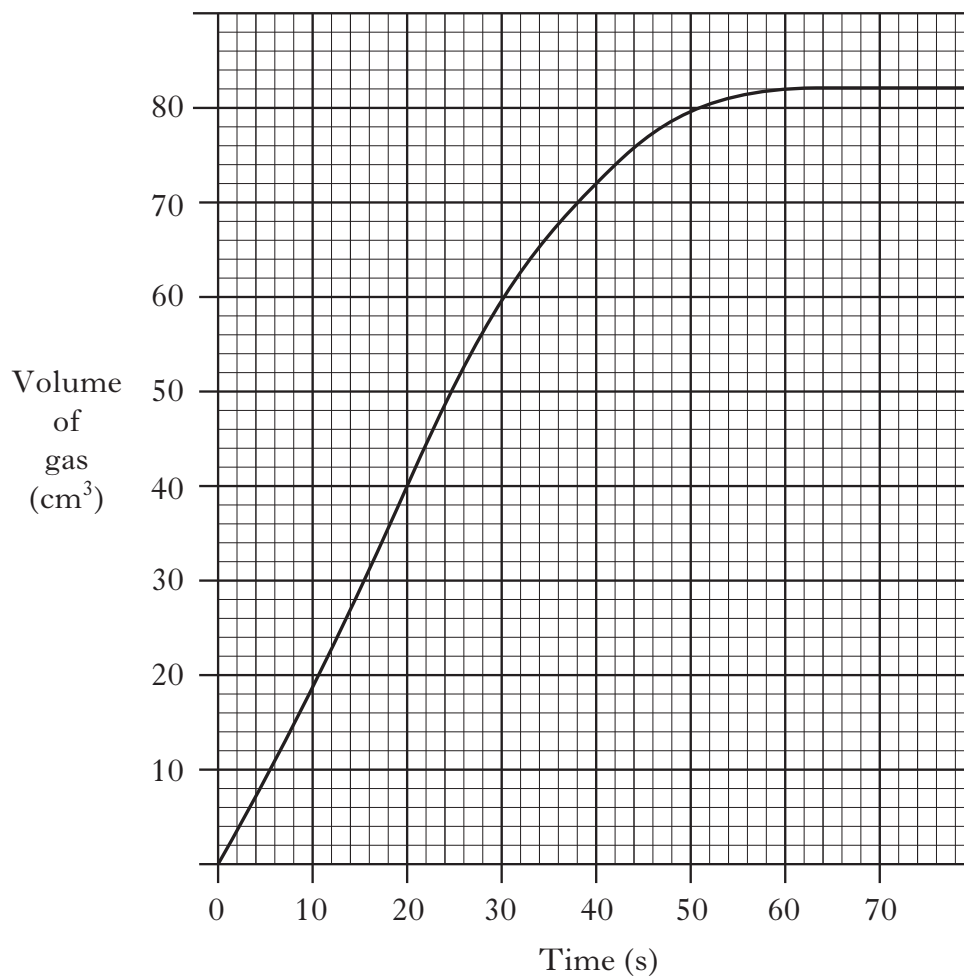


- (a) Name the gas produced in this reaction.

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1

- (b) A student carried out the experiment. A graph of the results was plotted.



Calculate the average rate of the reaction, in cm<sup>3</sup> s<sup>-1</sup>, for the first 40 seconds.

\_\_\_\_\_ cm<sup>3</sup> s<sup>-1</sup> 1

Marks

**3. (continued)**

- (c) Predict the total volume of gas produced if the experiment was repeated using silver.

\_\_\_\_\_ cm<sup>3</sup>.

**1**

- (d) The student repeated the experiment using 100 cm<sup>3</sup> of 1 mol l<sup>-1</sup> ethanoic acid solution and the same mass of magnesium ribbon.

How would this affect the rate of the reaction?

\_\_\_\_\_

**1****(4)****[Turn over**

Marks

4. Tritium is a naturally occurring isotope of hydrogen. It can be represented as



- (a) Complete the table to show the number of particles in an atom of tritium.

Type of particle	Number of particles
proton	
neutron	
electron	

1

- (b) Hydrogen has three isotopes.

Isotope of hydrogen	Mass number
protium	1
deuterium	2
tritium	3

The relative atomic mass of hydrogen is 1.

Which isotope of hydrogen is the most abundant?

\_\_\_\_\_

1

(2)

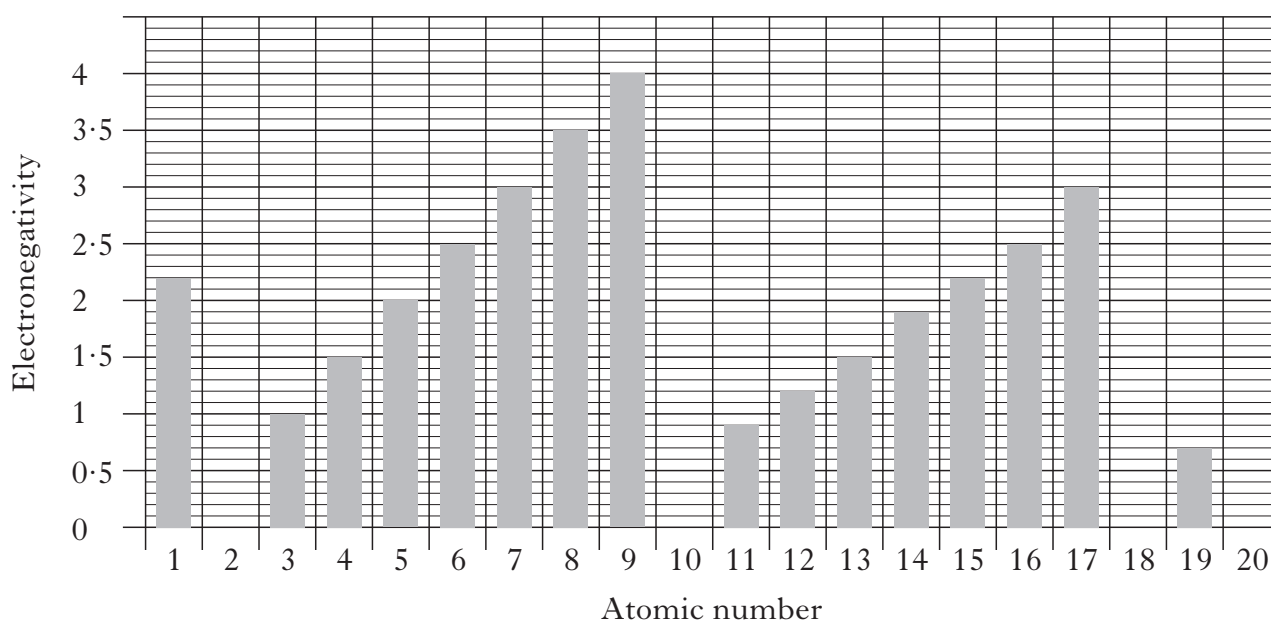
Marks

5. Electronegativity is a measure of the attraction that an atom has for the bonded electrons.

(a) What type of bond is formed when the attraction of the atoms for the bonded electrons is different?

\_\_\_\_\_ **1**

(b) The chart shows the electronegativity values for some elements in the Periodic Table.



(i) Describe what happens to the electronegativity values going across a period in the Periodic Table.

\_\_\_\_\_  
\_\_\_\_\_

**1**

(ii) Draw a bar on the chart to show the electronegativity value for the element calcium, atomic number 20.

**1****(3)****[Turn over**

Marks

6. Dishwasher tablets contain many different types of chemicals.



- (a) A dishwasher tablet was found to contain 1.57 g of the bleaching agent, sodium percarbonate.

How many moles are there in 1.57g of sodium percarbonate?

(Formula mass of sodium percarbonate = 157.)

\_\_\_\_\_ moles      **1**

- (b) Many dishwasher tablets contain sand which can help to remove food deposits. Sand contains the covalent compound silicon dioxide.

What type of **structure** does silicon dioxide have?

(You may wish to use page 6 of the data booklet to help you.)

\_\_\_\_\_      **1**

- (c) Phosphate ions, present in some types of dishwasher tablets, react with calcium ions in water forming calcium phosphate.

Write the formula for calcium phosphate.

\_\_\_\_\_      **1**  
**(3)**



7. The car industry and the Government have taken a number of steps to reduce the emissions of pollutant gases from cars.

Marks

- (a) Catalytic converters reduce the emission of carbon monoxide by converting it to a harmless gas.

Name this harmless gas.

\_\_\_\_\_

1

- (b) Car tax is based on the mass of carbon dioxide gas produced per kilometre travelled by a car.

- (i) The volume of carbon dioxide produced by a car is measured and then converted into mass using the following equation.

$$\text{Mass of carbon dioxide gas (g)} = \frac{100 \times \text{volume of carbon dioxide gas (l)}}{56.3}$$

Calculate the mass of carbon dioxide gas which is produced by a car emitting 70.4 l of carbon dioxide gas.

\_\_\_\_\_ g 1

- (ii) Information about car tax bands is shown in the tables.

Car tax band	Mass of carbon dioxide gas emitted per kilometre (g)
A	Up to 100
B	101–110
C	111–120
D	121–130
E	131–140
F	141–150
G	151–165

Car tax band	12 month rate (£)
A	0.00
B	20.00
C	30.00
D	95.00
E	115.00
F	130.00
G	165.00

What would it cost to tax a car, for 12 months, which emits 146 g of carbon dioxide per kilometre travelled?

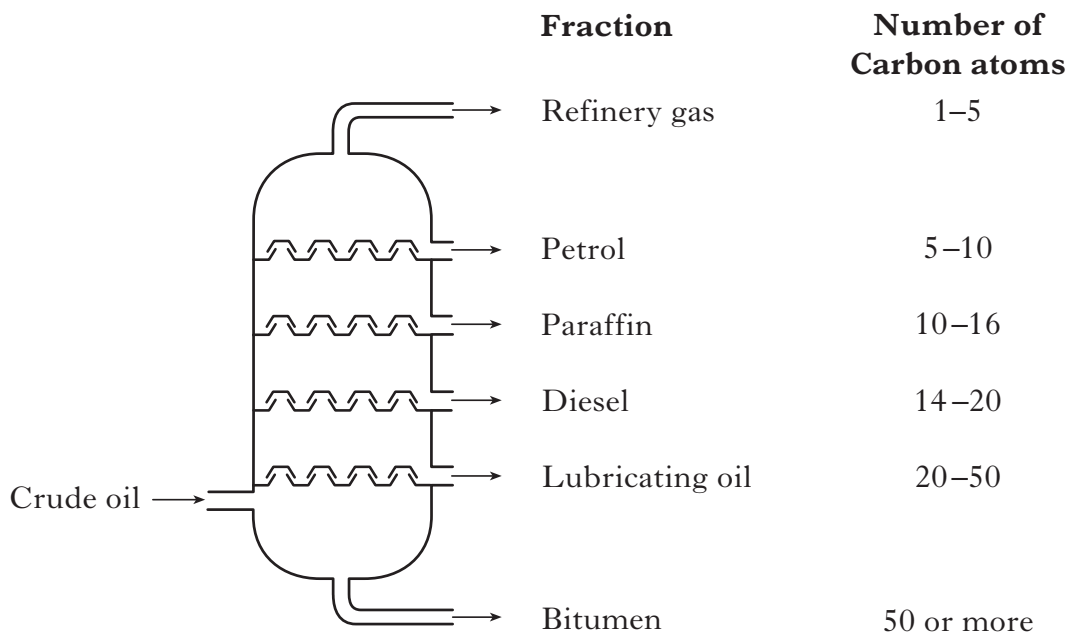
£ \_\_\_\_\_

1

(3)

Marks

8. Crude oil is a mixture of hydrocarbons which can be separated into fractions by fractional distillation.



- (a) What property of hydrocarbons is used to separate crude oil into fractions?

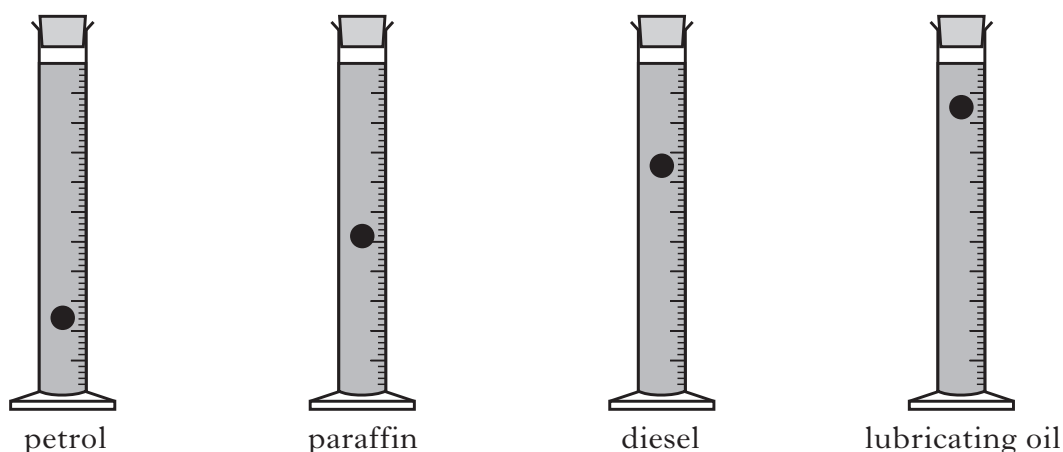
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1

- (b) The viscosity of four fractions was compared by measuring the rate of fall of a ball bearing. The diagram shows the position of the ball bearings 10 seconds after being dropped.



What effect does the number of carbon atoms have on the viscosity of a fraction?

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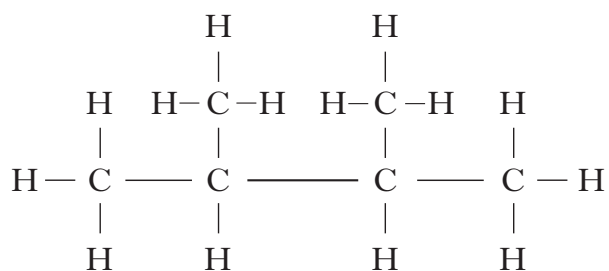
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1

Marks

## 8. (continued)

(c) Petrol contains the following molecule.



Name this molecule.

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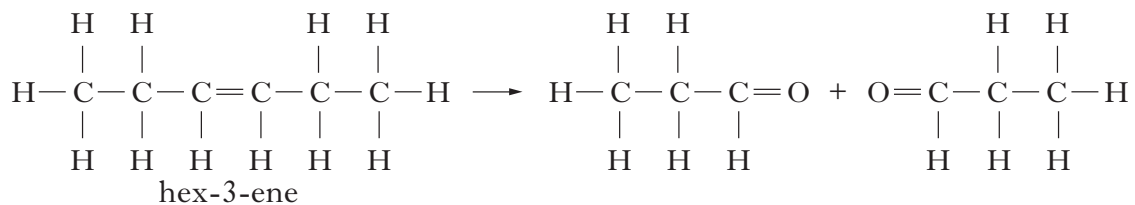
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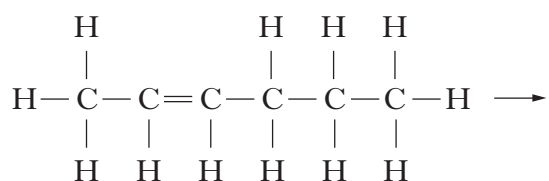
Marks

9. Alkenes can undergo different reactions.

(a) In ozonolysis an alkene reacts with ozone forming two molecules. The ozonolysis of hex-3-ene is shown.

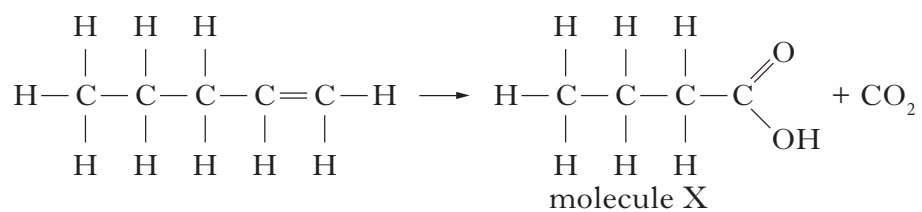


Draw the products formed by the ozonolysis of hex-2-ene.



1

(b) Potassium permanganate can be used to convert alkenes into two molecules. The conversion of pent-1-ene is shown.



(i) Name molecule X.

\_\_\_\_\_

1

(ii) State the test for carbon dioxide.

\_\_\_\_\_

1

(3)

Marks

10. Some waterproof clothing contains a thin layer of the plastic PTFE.



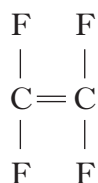
- (a) PTFE is heated and reshaped to make thin layers.

What term is used to describe a plastic which can be heated and reshaped?

\_\_\_\_\_

1

- (b) (i) PTFE is a polymer made from the monomer shown.



Draw a section of the PTFE polymer, showing three monomer units joined together.

1

- (ii) Name this type of polymerisation reaction.

\_\_\_\_\_

1

- (c) Name a toxic gas produced when PTFE is burned.

\_\_\_\_\_

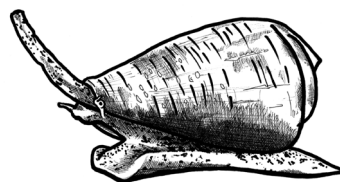
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(4)

Marks

11.

Migraine, a type of headache, is caused when calcium ions promote the release of a chemical called CGRP in the nervous tissues. Scientists are using cone snails to develop a treatment for migraine. Cone snails produce a chemical which can be used to prevent the release of CGRP.

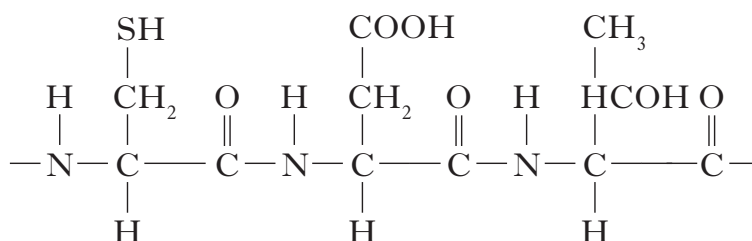


- (a) What is the electron arrangement for a calcium ion,  $\text{Ca}^{2+}$ ?

\_\_\_\_\_ 1

- (b) CGRP is formed from different amino acids.

A short sequence of CGRP is shown.

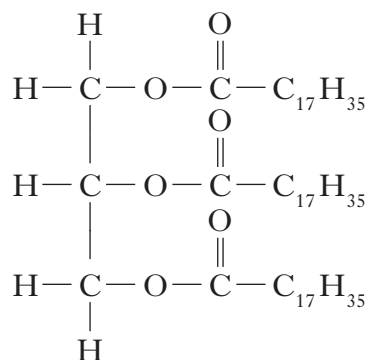


- (i) Circle a peptide link in the above section. 1
- (ii) Draw **one** of the amino acids used to form the above section. 1

1  
(3)

Marks

12. Fats and oils are examples of esters. The structure of the fat glyceryl tristearate is shown below.



- (a) Draw an ester group.

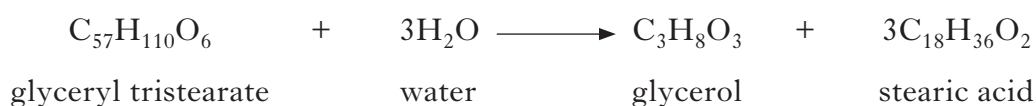
1

- (b) Fats and oils can be broken down to form glycerol and fatty acids.  
Name this type of chemical reaction.

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1

- (c) The equation below shows the breakdown of glyceryl tristearate to form glycerol and stearic acid.



GFM = 890 g

Calculate the mass of stearic acid produced from 8.9 g of glyceryl tristearate.

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 g

2

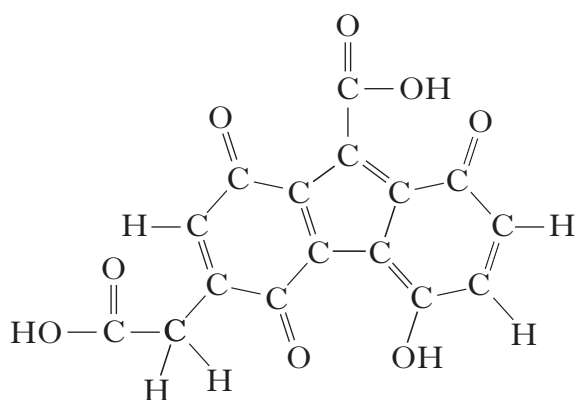
(4)

Marks

13.



When a hippopotamus is seen out of water it looks as though it is bleeding. This is due to a red coloured secretion which protects the hippopotamus against sunburn caused by UVB radiation. Scientists have found that one of the active ingredients in this natural sunscreen is a chemical called hipposudoric acid.



hipposudoric acid

- (a) (i) Suggest a pH value for hipposudoric acid.

\_\_\_\_\_

1

- (ii) Hipposudoric acid contains a hydroxyl group.

Circle the hydroxyl group in the structure of hipposudoric acid.

1



Marks

**13. (continued)**

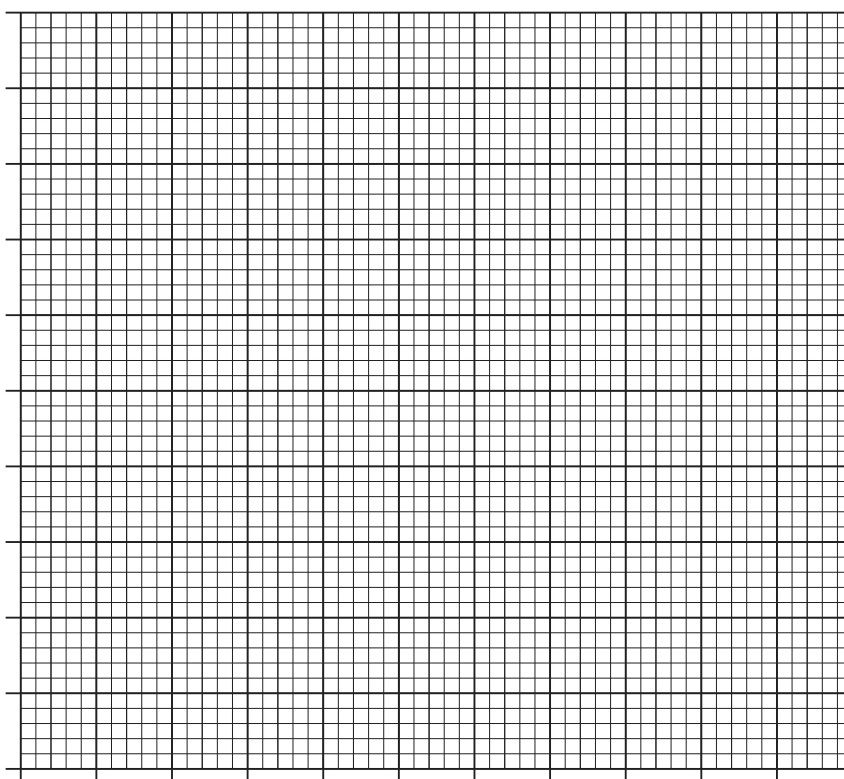
- (b) Bottles of sun cream display a sun protection factor which gives an indication of how well the sun cream protects against UVB radiation.

The table gives information about sun protection factors.

Sun protection factor	0	2	4	8	15	30	50
UVB radiation screened (%)	0	50	70	88	94	97	98

Draw a line graph to show the percentage of UVB radiation screened by different sun protection factors.

(Additional graph paper, if required, can be found on *Page twenty-eight*.)

2  
(4)**[Turn over**

Marks

14. A student's report is shown for the PPA "Reaction of metals with oxygen".

<b>Title</b>	Reactions of Metals with Oxygen	<b>Date</b>	15/11/12
<b>Aim</b>			
<b>Procedure</b>	The apparatus required to carry out the experiment was collected and assembled as shown.		
<b>Results</b>			
	<b>Metal</b>	<b>Observations</b>	
	zinc	moderately fast reaction	
	magnesium		
	copper		

- (a) State the aim of the experiment.

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- (b) Why is potassium permanganate used in this experiment?

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- (c) Complete the table to show the observations for magnesium and copper.

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- (d) For safety reasons this experiment would not be carried out with potassium metal.

Suggest a reason for this.

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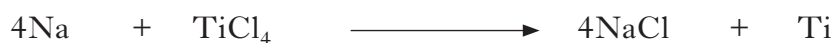
Marks

15. Titanium metal is used to make dental braces.



Titanium is extracted from its ore in the Kroll process. One step in this process involves the displacement of titanium chloride by sodium metal.

The equation is shown.



- (a) What does this method of extraction tell you about the reactivity of titanium metal compared to sodium metal?

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- (b) During the displacement, sodium atoms, Na, form sodium ions, Na<sup>+</sup>.  
Write the ion-electron equation for this change.

1

- (c) The displacement reaction is carried out in an atmosphere of the noble gas, argon.

Suggest why an argon atmosphere is used.

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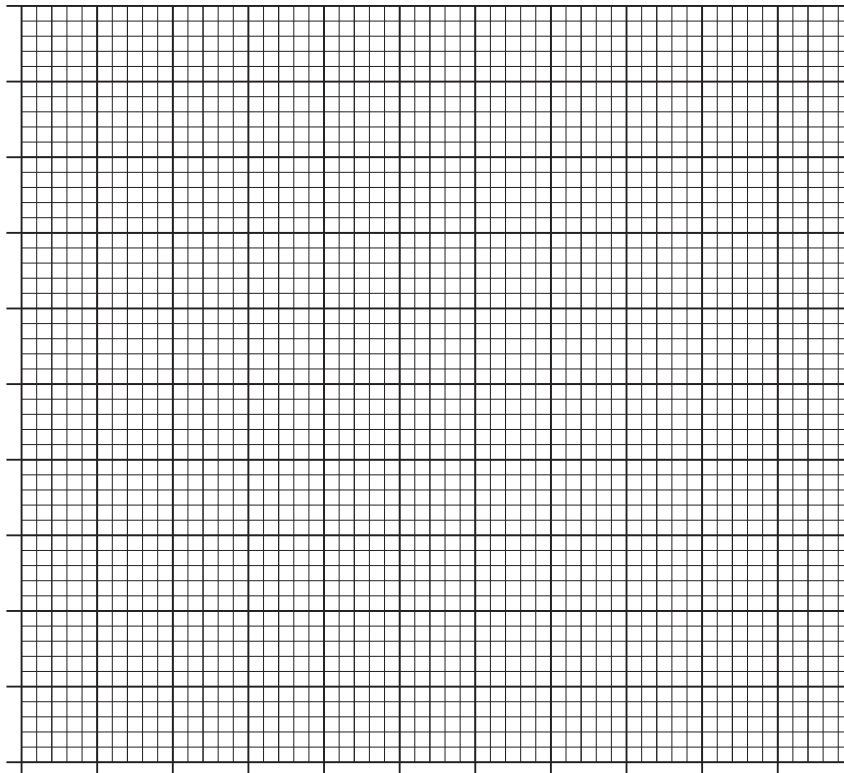
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(3)

[END OF QUESTION PAPER]

**ADDITIONAL SPACE FOR ANSWERS**

ADDITIONAL PAPER FOR QUESTION 13(b)



**ADDITIONAL SPACE FOR ANSWERS**

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**ADDITIONAL SPACE FOR ANSWERS**

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