Cardiff Sixth Form College
1-3 Trinity Court, 21 – 27 Newport Road
Cardiff, UK, CF24 0AA
Tel: +44 02920 493121
admissions@ccoex.com

Chemistry
60 Minutes

For examiner use only		
Maximum mark	Mark awarded	% achieved
50		

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen

Write your answers in the spaces provided in this booklet. For section A please shade the correct answers

You have been provided with a Periodic Table

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question

STUDENT NAME:	
NATIONALITY:	
DATE OF TEST:	
LOCATION OF TEST:	
ADMINISTERED UNDER EXAMINATION CONDITIONS BY: *(Please state your full name and position)*	

STUDENT DECLARATION:

I declare that I completed the entrance test under exam conditions and without any use of unauthorised materials. I confirm that all the submitted answers are my own work.

STUDENT SIGNATURE: _____ DATE: _____

INVIGILATOR DECLARATION:

I declare that the above named student was fully supervised during the test. The assessment was completed under strict exam conditions and in the time allowed, in accordance with the instructions on the test paper.

INVIGILATOR SIGNATURE: _____ DATE: _____

Multiple Choice Answer Grid.

Shade through the correct answer for each question.

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E
10. A B C D E
11. A B C D E
12. A B C D E
13. A B C D E
14. A B C D E
15. A B C D E
16. A B C D E
17. A B C D E
18. A B C D E
19. A B C D E
20. A B C D E
21. A B C D E
22. A B C D E
23. A B C D E
24. A B C D E
25. A B C D E

Section A - Multiple Choice

Answer all the questions on the grid provided.

1. Which test could be used to show that a sample of water is pure?

A It freezes at exactly 0 °C.

B It turns anhydrous copper(II) sulphate blue.

C It turns cobalt(II) chloride paper pink.

D When it evaporates, it leaves no residue.

2. Hydrogen can form both H^+ ions and H^- ions.

Which statement about these two ions is correct?

A An H^+ ion has no electrons in its first shell.

B An H^+ ion has more protons than an H^- ion.

C An H^- ion has one more electron than an H^+ ion.

D An H^- ion is formed when a hydrogen atom loses an electron.

3. The symbols and electronic structures for some elements are shown below.

silicon, Si (2,8,4) oxygen, O (2,6) hydrogen, H (1)

fluorine, F (2,7) nitrogen, N (2,5)

Which formula is correct for a compound containing silicon?

A Si_4F **B** SiH_4 **C** SiN_5 **D** Si_2O

4. The equation below shows an exothermic reaction.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Which statement about this exothermic reaction is **not** correct?

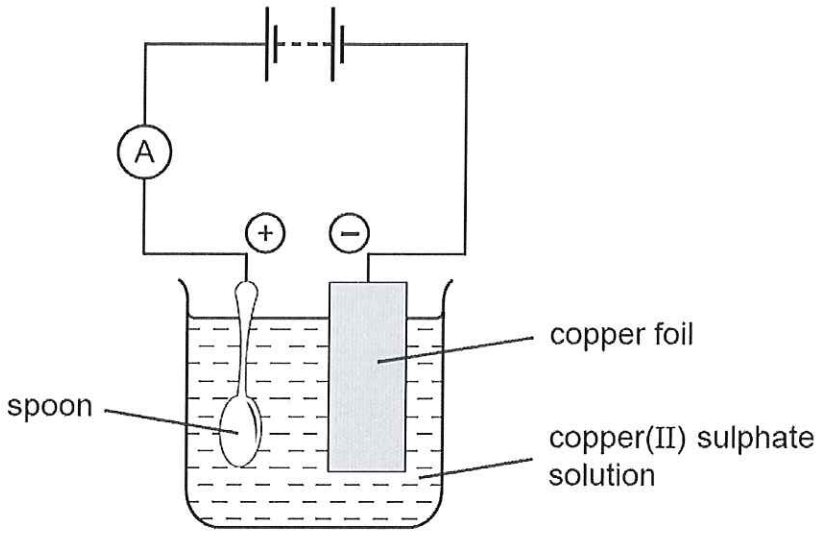
A Magnesium chloride is soluble in water.

B Magnesium is above hydrogen in the reactivity series.

C One mole of magnesium produces one mole of hydrogen gas.

D The total energy of the products is greater than that of the reactants.

5. The apparatus shown below was set up to copper plate the metal spoon.



The experiment did **not** work.

What was the mistake in the apparatus?

A A variable resistor should be included in the electrical circuit.

B Dilute sulphuric acid should be used as the electrolyte.

C The copper electrode should all be in the solution.

D The spoon should be the negative electrode.

6. Which substance does **not** form copper(II) sulphate with warm, dilute sulphuric acid?

A copper

B copper(II) carbonate

C copper(II) hydroxide

D copper(II) oxide

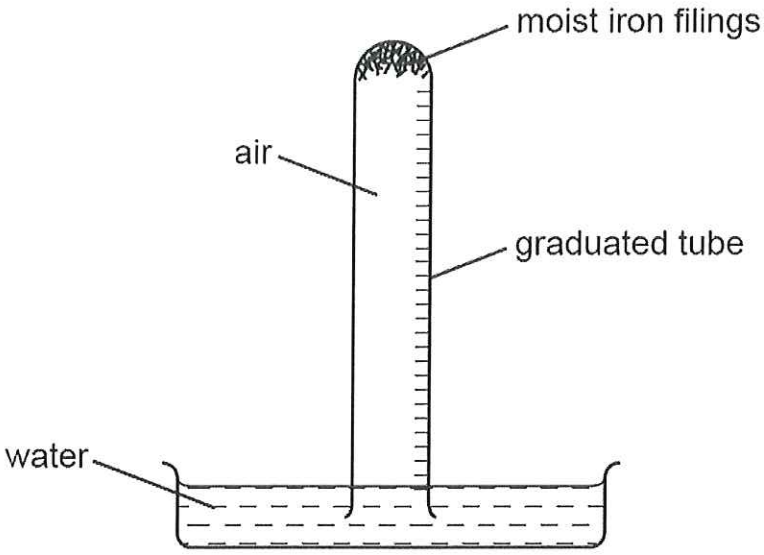
7. An inert gas **X** is used to fill weather balloons.

Which descriptions of **X** are correct?

	number of outer electrons in atoms of **X**	structure of gas **X**
A	2	single atoms
B	2	diatomic molecules
C	8	single atoms
D	8	diatomic molecules

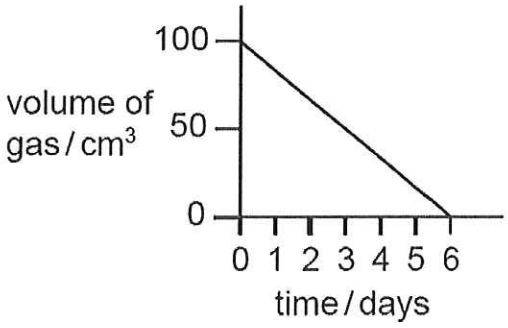
8. The apparatus shown was set up with 100 cm^3 volume of air in the tube.

The volume of gas in the tube was measured at intervals for six days.

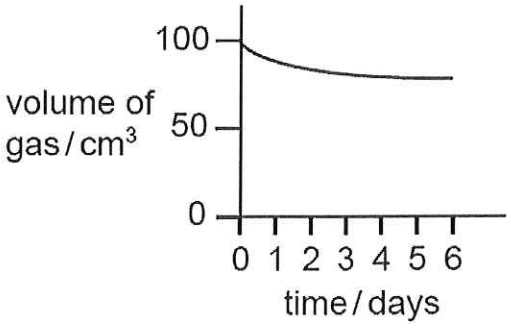


Which graph best represents how the volume of gas changes with time?

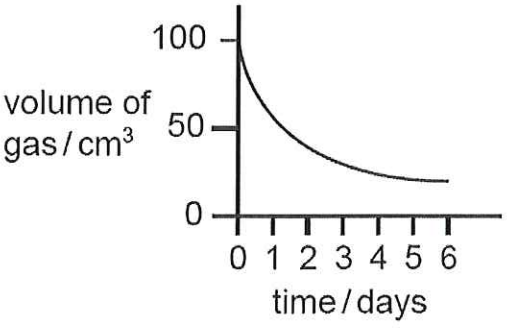
A



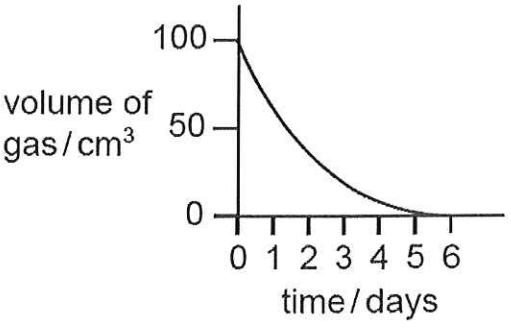
B



C



D



9. Gas **X**

- has no effect either on damp red litmus paper or on damp blue litmus paper,
- puts out both a glowing splint and a burning splint.

What is gas **X**?

A ammonia

B carbon dioxide

C chlorine

D nitrogen

10. What is the structure of the ion $^{90}_{38}Sr^{2+}$?

	protons	neutrons	electrons
A	38	52	36
B	38	52	38
C	38	90	36
D	52	38	36

11. Metals have positive ions in a 'sea of electrons'.

Which metal atom provides most electrons for the sea?

A aluminium

B calcium

C magnesium

D sodium

12. Which equation represents the reaction of calcium with cold water?

A $Ca + H_2O \rightarrow CaO + H_2$

B $2Ca + 2H_2O \rightarrow 2CaOH + H_2$

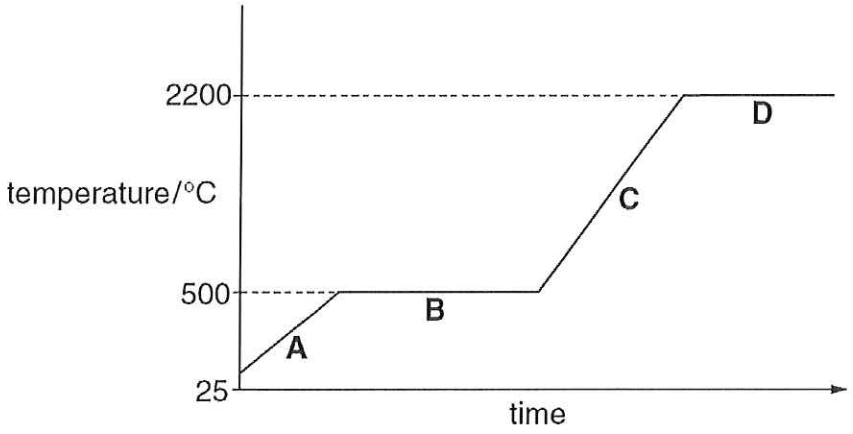
C $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

D $Ca + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$

13. A solid metal is heated until it turns to vapour.

The graph shows the temperature of the metal during this process.

Which part of the graph shows the melting of the metal?



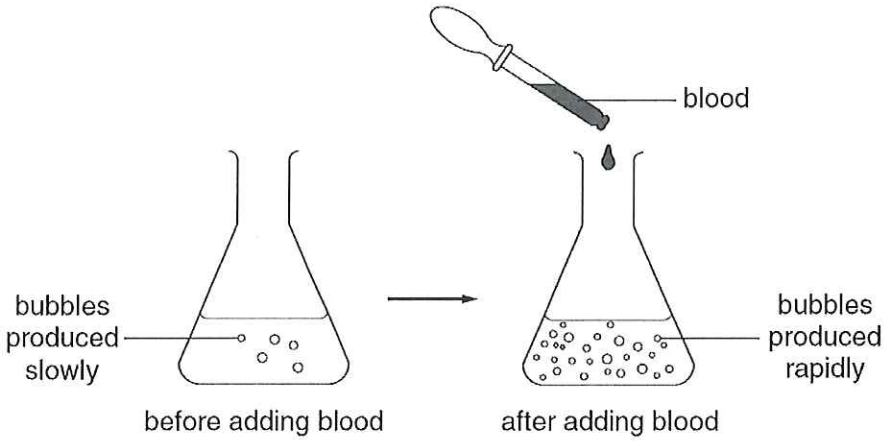
14. What is the electronic structure of an atom with a proton number 5 and a nucleon number 11?

A 1, 8, 2 **B** 2, 8, 1 **C** 2, 3 **D** 3, 2

15. A solution of hydrogen peroxide releases oxygen slowly at room temperature.

hydrogen peroxide → water + oxygen

The diagrams show the effect of adding blood to the solution.



What could be the reason for the observed change?

A Blood contains an enzyme.

B Blood contains water.

C The hydrogen peroxide becomes more concentrated.

D The hydrogen peroxide is neutralised by blood.

16. The table gives information about the reactivity of three metals P, Q and R.

metal	reaction with air	reaction with steam	reaction with dilute hydrochloric acid
P	burns with sparks	forms an oxide	forms hydrogen
Q	slowly forms an oxide	no reaction	no reaction
R	slowly forms an oxide	no reaction	forms hydrogen

What is the order of reactivity of P, Q and R?

	most reactive ⟶		least reactive
A	P	Q	R
B	P	R	Q
C	Q	R	P
D	R	Q	P

17. Some students are asked to describe differences between gases and liquids.

Three of their suggestions are:

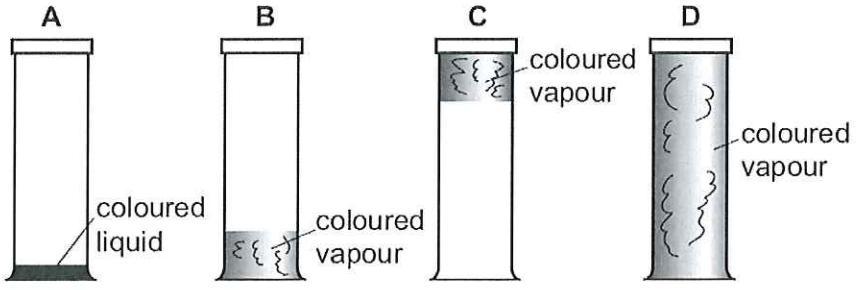
1	gas molecules are further apart;
2	gas molecules are smaller;
3	liquid molecules vibrate around fixed positions.

Which suggestions are correct?

A 1 only **B** 2 only **C** 3 only **D** 1, 2 and 3

18. A coloured liquid vaporises easily at room temperature. Some of the liquid is placed at the bottom of a sealed gas jar.

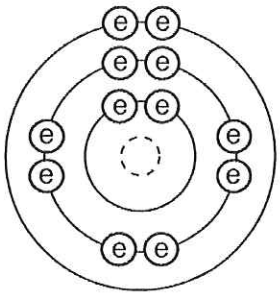
Which diagram shows the appearance of the jar after several hours?



19. Which properties does a Group VI element have?

	forms covalent bonds	forms ionic bonds	conducts electricity when solid
A	✓	✓	✓
B	✗	✓	✓
C	✓	✓	✗
D	✓	✗	✗

20. The electronic structure of an element is shown.



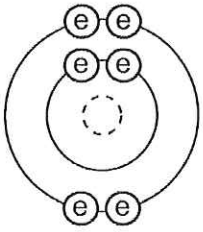
key

e electron

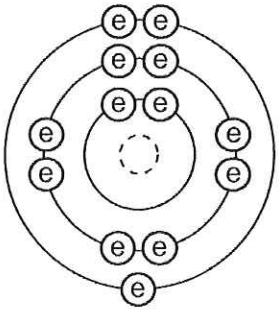
nucleus

Which diagram shows the electronic structure of another element in the same group in the Periodic Table?

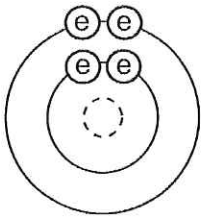
A



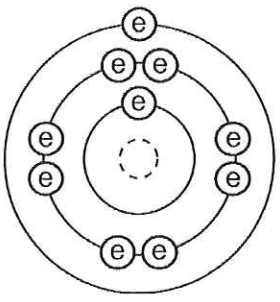
B



C

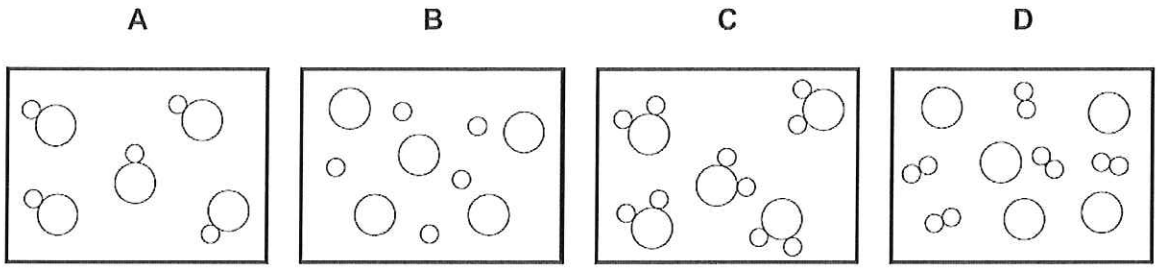


D



21. In the diagrams, circles of different sizes represent atoms of different elements.

Which diagram can represent hydrogen chloride gas?



22. The proton number of helium is 2.

What information does this give about helium?

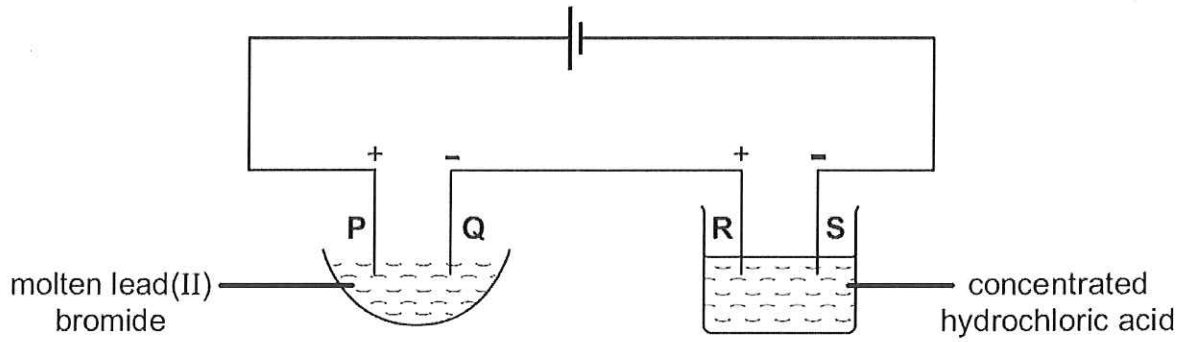
A Its atom has two electrons.

B Its atom is twice as heavy as a hydrogen atom.

C It is a Group II element.

D Its molecule has two atoms.

23. The following electrolysis circuit is set up, using inert electrodes **P, Q, R** and **S**.



At which of the electrodes is a Group VII element produced?

A P only **B** P and R **C** Q only **D** Q and S

24. The table compares the strengths of the bonds for reactions of the type below.

$$X_2 + Y_2 \rightarrow 2XY$$

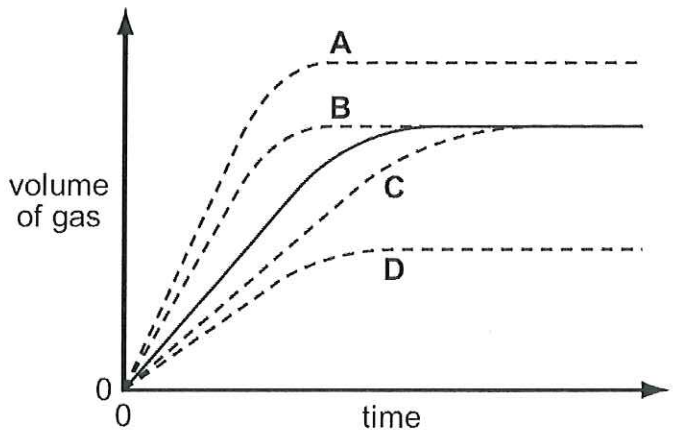
Which reaction is most exothermic?

	bonds in X_2	bonds in Y_2	bonds in XY
A	strong	strong	strong
B	strong	strong	weak
C	weak	weak	strong
D	weak	weak	weak

25. In an experiment, a 2g lump of zinc and 2g of powdered zinc are added separately to equal volumes of dilute sulphuric acid.

The solid line on the graph shows the volume of gas given off when the 2g lump is used.

Which dotted line is obtained when the zinc is powdered?

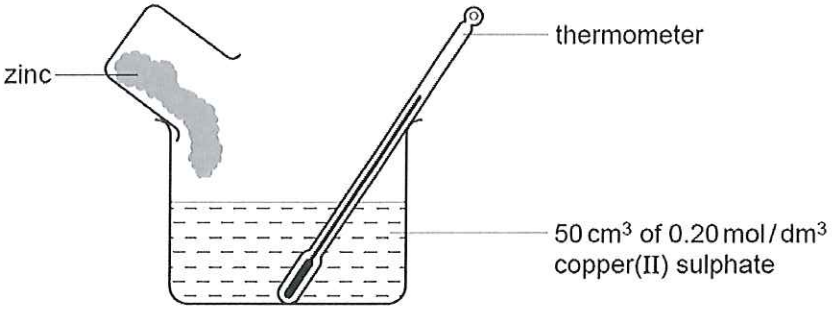


Section B - Structured Questions

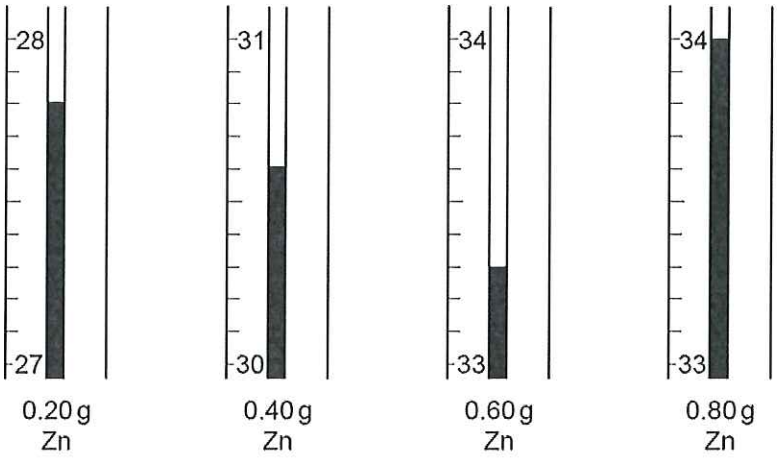
Answer all the questions in the spaces provided.

1. A student investigated the temperature change produced when increasing amounts of powdered zinc were added to 50 cm^3 of 0.20 mol/dm^3 copper(II) sulphate in a beaker as shown in the diagram below.

The initial temperature in each case was 25.0 °C.



The diagrams below show the thermometer stems when the thermometer recorded the highest temperature reached after each addition of zinc.

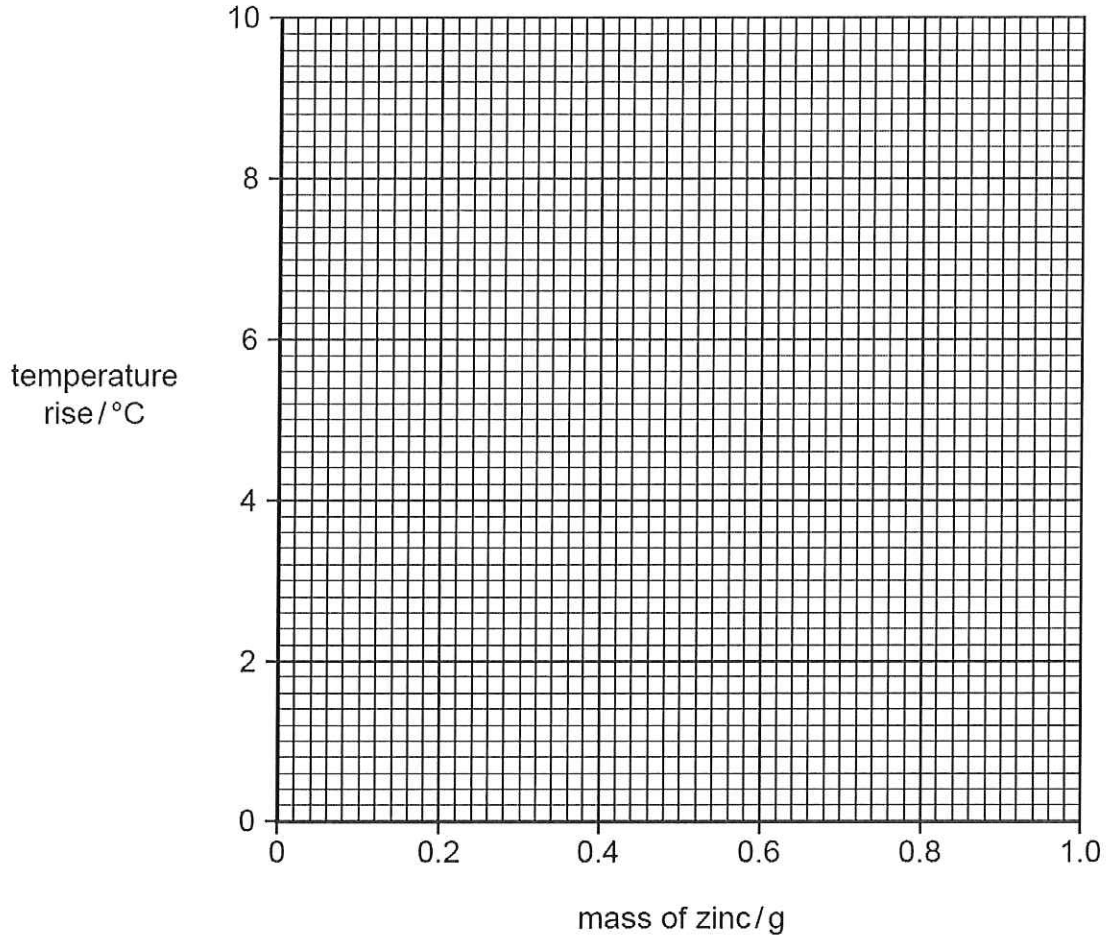


(a) Use the diagrams to complete the table below.

volume / cm^3 of 0.20 mol / dm^3 copper(II) sulphate	mass / g of zinc	maximum temperature / °C	temperature rise / °C
50	0.2		
50	0.4		
50	0.6		
50	0.8		
50	1.0	34.0	

[2]

(b) Plot these results on the grid below and connect the points with two straight lines.



[3]

(c) **(i)** Use your graph to find the mass of zinc required to produce a temperature of 29.0 °C.

.....g

(ii) Deduce, from your graph, the mass of zinc required to react completely with 50 cm^3 of 0.20 mol/dm^3 copper(II) sulphate.

.....g

(iii) Why was the temperature rise the same in the last two experiments?

.....

.....

[3]

(d) State two observations, other than a rise in temperature, which could be made when zinc reacted with aqueous copper(II) sulphate.

.....

.....[2]

2 **(a)** Ammonia and hydrogen chloride are each passed into different samples of water and a few drops of litmus solution added to each.

Describe the colour of the litmus

(i) in the ammonia solution,

.....

(ii) in the hydrogen chloride solution.

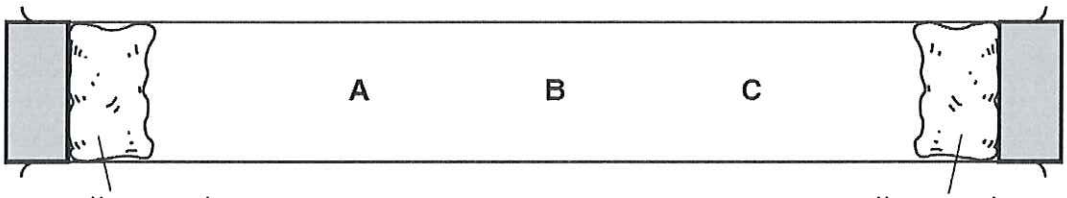
.....

(iii) By what name is aqueous hydrogen chloride more commonly known?

.....

[3]

(b) Two pieces of cotton-wool, soaked separately in concentrated aqueous solutions of ammonia (M_r = 17) and hydrogen chloride (M_r = 36.5) were placed at opposite ends of a horizontal tube, as shown in the diagram below.



cotton-wool soaked in concentrated aqueous ammonia

cotton-wool soaked in concentrated aqueous hydrogen chloride

After a few minutes, a white solid was produced on the side of the tube.

(i) At which position, **A**, **B** or **C**, was the white solid formed? Explain your answer.

position .....

explanation .....

.....

(ii) What process was occurring in the tube **before** the white solid was formed?

.....

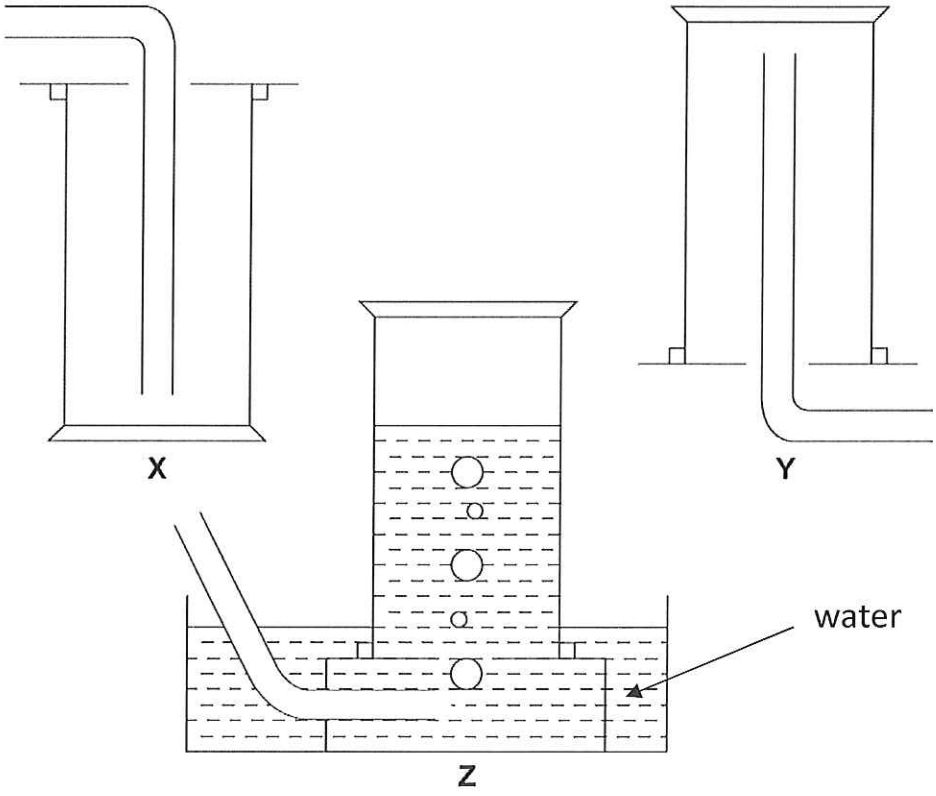
(iii) Name and give the formula of the white solid.

name .....

formula .....

[5]

(c) Suggest which method of collection, **X**, **Y** or **Z**, is most suitable for each of the gases. Explain your answers.



NH_3 .....

HC*l* .....

explanation .....

.....

..... [3]

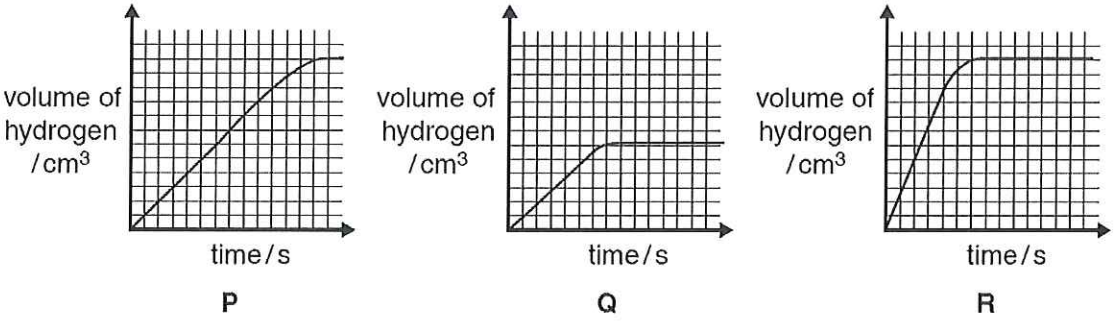
3. A student did two experiments to produce hydrogen.

Experiment 1
5.0 g of granulated zinc (an excess) and 10 cm^3 of 1.0 mol/dm^3 hydrochloric acid

Experiment 2
5.0 g of powdered zinc (an excess) and 20 cm^3 of 1.0 mol/dm^3 hydrochloric acid

The temperature was the same at the start of each experiment. Graphs were drawn of the volume of hydrogen produced against time.

Which two graphs best represent the two experiments?



	experiment 1	experiment 2	
(a)	**P**	**Q**	☐
(b)	**P**	**R**	☐
(c)	**Q**	**R**	☐
(d)	**Q**	**P**	☐

[1]

4. Use ideas about electronic structure to explain why the noble gases are unreactive.

.....

.....[1]

5. Complete the table to show the number of particles in two isotopes of argon.

isotope	number of protons	number of electrons	number of neutrons
$^{36}_{18}Ar$			
$^{40}_{18}Ar$			

[2]

THE PERIODIC TABLE