West Spring Secondary School
Preliminary Examination 2020

CHEMISTRY **6092/01**

Paper 1 Multiple Choice

SECONDARY 4 EXPRESS

Name _____ ( ) **Date** **2 Sept 2020**

Class _____ **Duration** **1 hour**

Additional materials: Laminated Periodic Table and Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

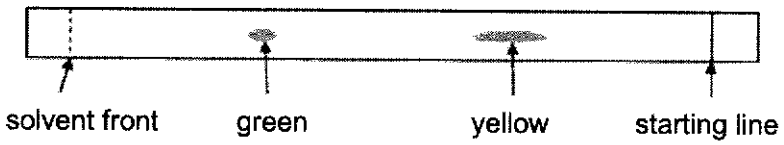
A copy of the Periodic Table is provided separately.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages.

Setter: Mdm Sharena **[Turn over**

1 The chromatogram of a pen ink is shown.

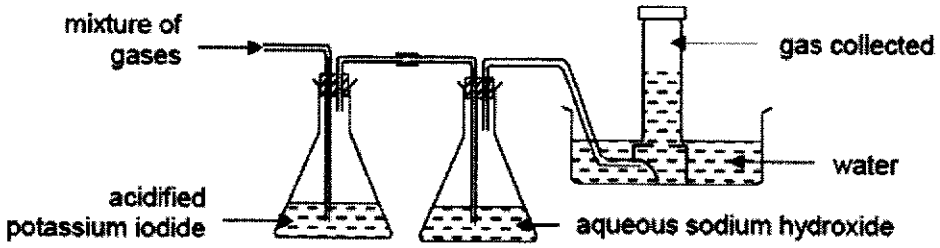


Which of the following statements can be deduced from the chromatogram?

A The pen ink is a pure substance.
B The green dye is more soluble in the solvent than the yellow dye.
C The molecules of the yellow dye are larger than that of the green dye.
D The R_f value of the yellow dye is greater than that of the green dye.

2 A gaseous mixture of hydrogen, ammonia, nitrogen dioxide and chlorine is passed through the apparatus shown.

Only one of the gases is collected at the end.



Which of the following is a property of the gas collected?

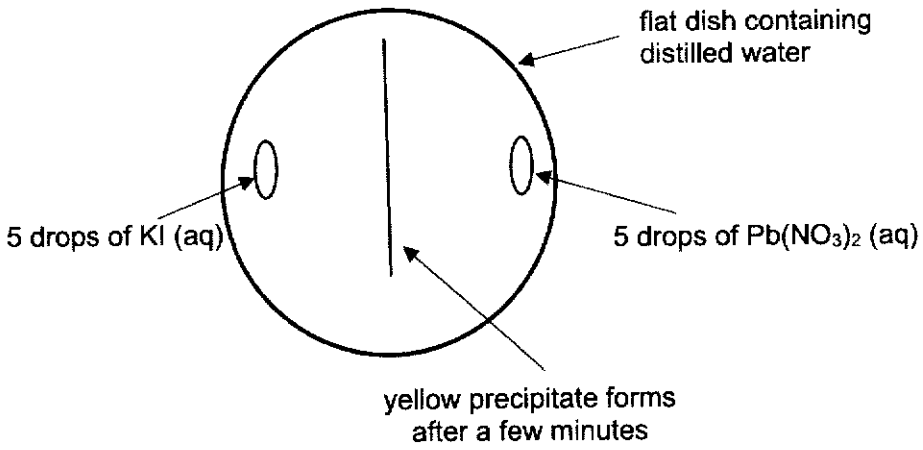
A Gas bleaches damp blue litmus paper.
B Gas turns damp red litmus paper blue.
C Gas extinguishes a lighted splint with a 'pop' sound.
D Gas decolourises acidified potassium manganate(VII) solution.

3 When a saturated aqueous solution of potassium sulfate is cooled from 70°C to room temperature, crystals are formed.

Which of the following statements is true, about what happens during the cooling process?

A the concentration of the solution remains the same.
B the mass of the solute in the solution decreases.
C the mass of the solvent in the solution increases.
D the solubility of potassium sulfate increases as the temperature falls.

4 A yellow precipitate is formed in an experiment as illustrated in the diagram.



Which of the following is a correct sequence of how the precipitate forms?

A Particles collide, diffuse and then react.
B Particles collide, react and then diffuse.
C Particles diffuse, collide and then react.
D Particles diffuse, react and then collide.

5 The table below shows the melting and boiling points of substances W to Z.

substance	melting point / °C	boiling point / °C
W	–120	–15
X	–4	42
Y	40	229
Z	413	899

Which of the following statements are true?

I X is a volatile liquid.
II Particles of Y and Z vibrate and rotate in fixed positions at room temperature.
III Two of the above substances undergo a change of state when heated from room temperature to 80°C.

A I and II only
B II and III only
C I and III only
D All of the above

6 Argon is used to prolong the lifespan of the tungsten filament in electric bulbs.

Argon has three isotopes: argon-36, argon-38 and argon-40.

Which statement is **not** true about these isotopes?

A They have the same arrangement of electrons.
B They have the same chemical properties.
C They have the same number of protons.
D They have the same rate of diffusion.

7 Which element would be expected to form an ion with the largest ionic radius?

A chlorine
B fluorine
C magnesium
D oxygen

8 The table shows information about particles X and Y.

particle	number of protons	number of neutrons	electronic structure
X	12	12	2, 8
Y	20	20	2, 8, 8

Which statement is correct for both X and Y?

A They are positive ions.
B They are atoms of metals.
C They are atoms of noble gases.
D They are isotopes of the same element.

9 Which of the following contains a mixture of a metal and a non-metal?

A brass
B copper
C graphite
D mild steel

10 When blue hydrated copper(II) sulfate crystals are heated, a white solid E and a colourless liquid F are produced.

Which one of the following correctly describes E and F?

	E	F
A	has a variable composition by mass	has a fixed composition by mass
B	has a fixed composition by mass	has a variable composition by mass
C	has a variable composition by mass	has a variable composition by mass
D	has a fixed composition by mass	has a fixed composition by mass

11 Two particles X and Y have the composition shown in the table.

particle	number of electrons	number of neutrons	number of protons
X	10	8	8
Y	10	9	8

Which statement is correct about X and Y?

A X and Y are cations.
B X and Y are isotopes.
C X and Y belong to Group 0.
D X is a metal while Y is a non-metal.

12 The table shows some properties of four substances.

Which substance is an ionic compound?

	melting point/°C	dissolves in water	conducts electricity when solid	conducts electricity when aqueous solution
A	–32	√	x	√
B	301	√	x	x
C	801	√	x	√
D	3550	x	√	x

13 The structural formula of ethylene molecule is shown below.

What is the total number of shared electrons?

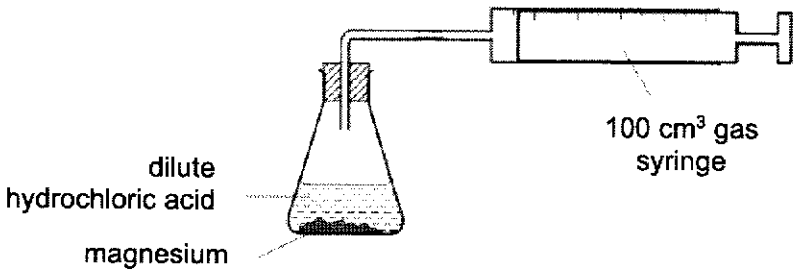
A 3 **B** 5 **C** 6 **D** 10

14 Two elements are in the same group of the Periodic Table.

Which property will be the same for both elements?

A The charge on their ions.
B Their reactivity with water.
C The electronic structure of their ions.
D The number of electrons in their atom.

15 An excess of hydrochloric acid is added to 0.10 mol of magnesium in the apparatus shown.



Why is it impossible to measure the volume of hydrogen produced using this apparatus?

A There is air in the tube.
B The reaction takes place too quickly.
C Hydrogen is soluble in hydrochloric acid.
D The gas syringe is too small to contain the hydrogen gas produced.

16 A substance has the following composition by mass.

C: 41.9%, H: 3.1%, Cl: 55.0%

If its relative molecular mass is 258, what is its molecular formula?

A $C_3H_5Cl_2$
B CH_3Cl_2
C $C_9H_8Cl_4$
D $C_3H_9Cl_6$

17 Rubidium, Rb, is an element in Group I of the Periodic Table.

Which statement(s) about rubidium is/are true?

I Rubidium conducts electricity in both solid and molten state.
II Rubidium has a higher melting point than caesium.
III Rubidium reacts explosively with water.
IV Rubidium reacts with water and forms a solution of pH < 7.

A I only
B I and III only
C I, II and III only
D I, II and IV only

18 An experiment is carried out to determine the change in mass when different copper-based solids are added to excess nitric acid.

Solids of similar masses are added to the nitric acid as shown.

Beaker X: 10.0 g of copper foil added to 1.00 dm^3 of nitric acid
Beaker Y: 10.0 g of powdered copper(II) oxide added to 1.00 dm^3 of nitric acid
Beaker Z: 10.0 g of powdered copper(II) carbonate added to 1.00 dm^3 of nitric acid

Which of the following correctly shows the changes in mass for each beaker?

	Beaker X	Beaker Y	Beaker Z
A	decreases	no change	no change
B	increases	increases	increases
C	no change	decreases	decreases
D	no change	no change	decreases

19 Bromobutane, C_4H_9Br, can be made from butanol, C_4H_9OH, as shown in the following equation.

$$C_4H_9OH + HBr \rightarrow C_4H_9Br + H_2O$$

In an experiment, 10 g of butanol produced 12 g of bromobutane.

What is the percentage yield of bromobutane?
[M_r : C_4H_9OH, 74; C_4H_9Br, 137]

A 45% **B** 54% **C** 65% **D** 83%

20 What volume of 0.10 mol/dm^3 aqueous silver nitrate reacts with 20.0 cm^3 of 0.20 mol/dm^3 barium chloride?

A 10 cm^3 **B** 20 cm^3 **C** 40 cm^3 **D** 80 cm^3

21 The following table gives the colour of various indicators and the pH range at which the indicator changes colour.

indicator	colour in acidic solution	pH range at which indicator changes colour	colour in alkaline solution
methyl orange	red	3 – 5	yellow
quinaldine red	colourless	1 – 3	red
phenolpthalein	colourless	8 – 10	pink

What is the colour of the solution all three indicators are added to pure water?

A colourless
B orange
C red
D yellow

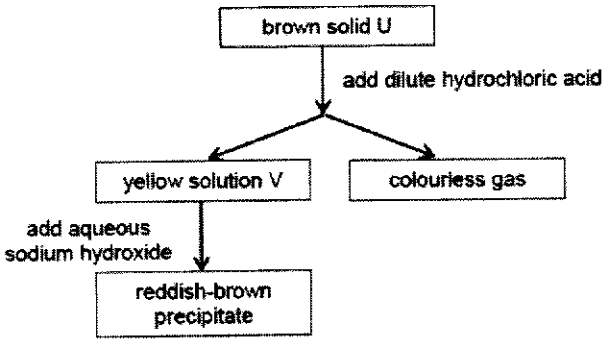
22 An acidic solution contains _____.

A hydrogen ions only
B more hydrogen ions than hydroxide ions
C more hydroxide ions than hydrogen ions
D equal number of hydrogen and hydroxide ions

23 Which of the following salts can be prepared by the methods indicated?

	prepared by the use of an acid and an insoluble carbonate	prepared by the use of two aqueous salts
A	lead(II) sulfate	barium nitrate
B	iron(II) sulfate	calcium sulfate
C	sodium chloride	zinc carbonate
D	copper(II) nitrate	magnesium sulfate

24 The flowchart shows the tests and observations obtained for an unknown salt.



How many of the following observations is(are) **not** obtained when excess sodium metal is added to solution V?

I Sodium metal dissolves and becomes smaller.
II Yellow solution turns colourless.
III Grey solid is formed.
IV Bubbles of gas are produced.

A 0 **B** 1 **C** 2 **D** 3

25 Test on a sample of water gave the following results.

reagent added	observations
aqueous ammonia	white precipitate, insoluble in excess
nitric acid, then barium nitrate	white precipitate

Which compound could have been present in the water?

A zinc chloride
B zinc sulfate
C aluminium chloride
D aluminium sulfate

26 In the Haber process for the manufacture of ammonia, which statements are correct?

I The reaction is never complete.
II The catalyst used is a transition metal.
III An increase in pressure will produce a higher yield of ammonia.
IV Both reactants are obtained from fractional distillation of liquid air.
V An increase in temperature will produce a higher yield of ammonia.

A I, II, III **B** I, III, IV **C** I, II, V **D** I, III, IV, V

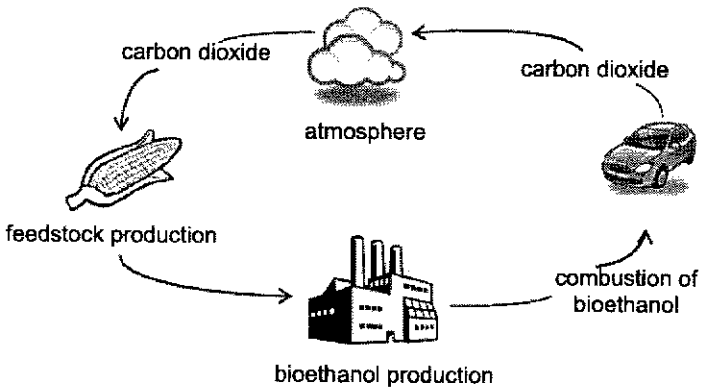
27 The data in the table gives the concentration, in parts of pollutant per million parts of air, of pollutant gases in four different cities.

In which city are limestone structures under the greatest threat from pollution?

	sulfur dioxide	carbon monoxide	nitrogen dioxide
A	15	20	50
B	15	50	40
C	20	20	30
D	25	25	25

28 Biofuels are fuels obtained from biological sources such as plant materials and animal fats.

The diagram shows the stages in the production of bioethanol, an example of biofuel.



Carbon dioxide is released during the production of bioethanol and also when it is used as a fuel in vehicles. However, this does not contribute to an increase in carbon dioxide released to the atmosphere.

Which of the following best explains this advantage of using bioethanol as a fuel?

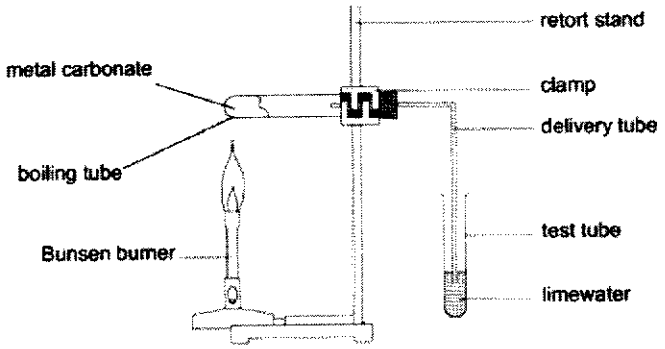
A Carbon dioxide is used up by plants during respiration.

B Less carbon dioxide is removed by plants during photosynthesis than is produced from the production and combustion of bioethanol.

C Plants take in as much carbon dioxide during photosynthesis as it is produced from the production and combustion of bioethanol.

D The carbon dioxide released into the atmosphere dissolves in rainwater.

29 An experiment was carried out to investigate the effect of heat on the carbonates of three metals, X, Y and Z, using the setup shown.



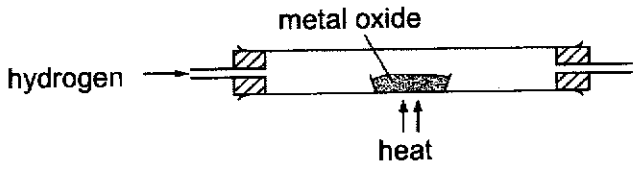
The table shows the results of the experiment.

metal	observations with limewater
X	slight effervescence, white precipitate
Y	no observable change
Z	vigorous effervescence, white precipitate

If the time set for each experiment to take place was the same, what is the order of reactivity of metals X, Y and Z?

	most →		least
A	X	Y	Z
B	Y	X	Z
C	Y	Z	X
D	Z	X	Y

30 The reaction of a metal oxide with hydrogen is shown below.

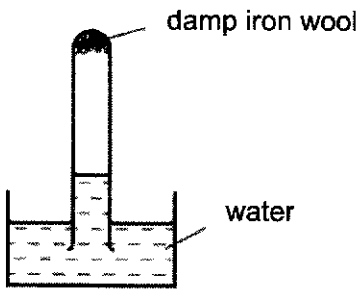


Which of the following is correct?

	metal oxide	mass of solid remaining
A	copper(II) oxide	decrease
B	copper(II) oxide	increase
C	magnesium oxide	decrease
D	magnesium oxide	increase

31 A test-tube containing damp iron wool is inverted in water.

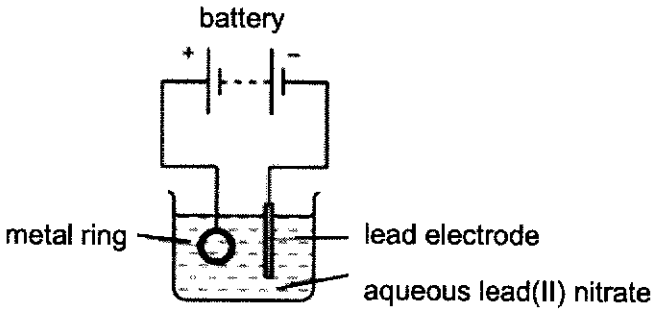
After three days, the water level inside the test-tube has risen.



Which statement correctly explains the rise in the water level inside the test-tube?

A Carbon dioxide has been formed.
B Hydrated iron (III) oxide has been formed.
C Iron wool has been reduced.
D Temperature of the water has increased.

32 The diagram shows an apparatus used in an attempt to electroplate a metal ring with lead.



The experiment did not work. What change should be made to the experiment to make it work?

A Add solid lead (II) sulfate to the electrolyte.
B Increase the temperature of the electrolyte.
C Replace the lead electrode with a carbon electrode.
D Reverse the terminals of the battery.

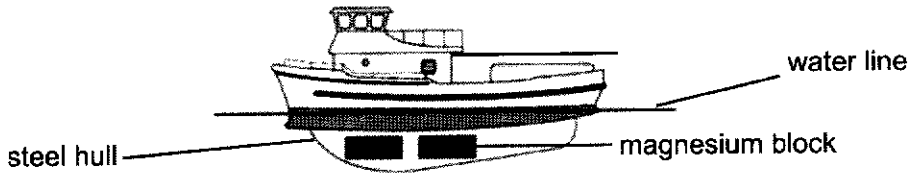
33 When zinc metal is added to the copper(II) sulfate solution, the blue solution gradually fades to a pale blue and a reddish brown metal is formed.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

Which of the following statement is true for the above reaction?

A Copper(II) sulfate is the reducing agent.
B Copper metal reduces to copper(II) sulfate.
C Zinc sulfate is the oxidising agent.
D Zinc metal displaces copper from aqueous copper(II) sulfate.

34 The diagram shows some magnesium blocks attached to the steel hull of a boat below the water line.

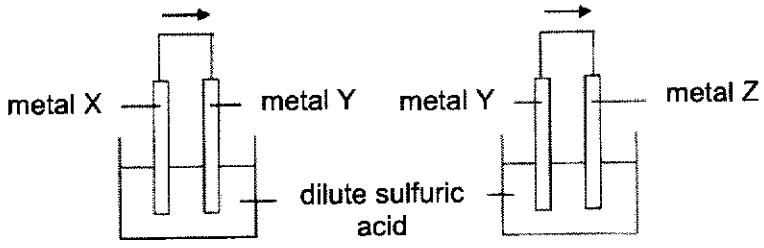


How does the attached magnesium blocks prevent the steel hull from rusting?

A Magnesium reacts with iron to form an alloy.
B Magnesium reacts with oxygen and water in preference to iron.
C Magnesium reacts with oxygen to form an oxide layer on the iron.
D Magnesium stops oxygen in the water from getting to the iron.

35 Two cells were set up as shown in the diagram below.

The arrow shows the direction of electron flow in the external circuit.



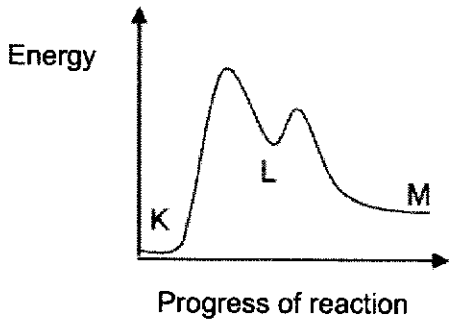
Which set of metals would give the electron flow in the direction shown?

	metal X	metal Y	metal Z
A	Pb	Cu	Zn
B	Cu	Pb	Zn
C	Zn	Pb	Cu
D	Cu	Zn	Pb

36 In the conversion of compound K to compound M, it was found that the use of a catalyst caused the reaction to proceed through the formation of an intermediate compound L.

The following graph shows the energy profile diagram for the reactions.

Step 1: Compound K → Compound L
Step 2: Compound L → Compound M



Which of the following can be deduced from the diagram?

A Both Steps 1 and 2 are endothermic.
B The overall reaction to convert K to M is exothermic.
C Step 1 has a lower activation energy as compared to Step 2.
D Step 1 requires more energy for bond breaking than Step 2.

37 When 1 g of ethane is burnt, 52 kJ of energy is released.

How much heat is released when 1 mole of ethane burns? [M_r of ethane = 30]

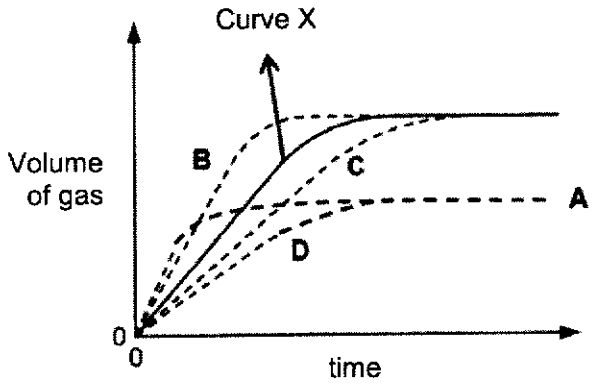
A 1.7 kJ/mol
B 52 kJ/mol
C 1456 kJ/mol
D 1560 kJ/mol

38 Which of the following conditions will cause the reaction between the dilute acid and zinc to produce the slowest rate of reaction?

A zinc chips and 40.0 cm^3 of 2.0 mol/dm^3 hydrochloric acid
B zinc powder and 20.0 cm^3 of 2.0 mol/dm^3 hydrochloric acid
C zinc chips and 20.0 cm^3 of 2.0 mol/dm^3 sulfuric acid
D zinc powder and 40.0 cm^3 of 2.0 mol/dm^3 sulfuric acid

39 A student decided to conduct an experiment by reacting 5.0 g of sodium with 0.05 mol of water.

The volume of hydrogen gas produced during the reaction was recorded in fixed time intervals and Curve X was obtained.



Which graph would be obtained if 5.0 g of potassium metal was reacted with 0.05 mol of water instead?

40 Which of the following statements about the effect of a catalyst is correct?

A It decreases the activation energy of the reaction by providing an alternative pathway.

B It decreases the enthalpy heat of reaction but increases the speed of reaction.

C It increases the speed of the reacting particles and frequency of effective collisions.

D It increases the yield of the products and the speed of reaction.

END OF PAPER 1

West Spring Secondary School
PRELIMINARY EXAMINATION 2020

CHEMISTRY **6092/02**

Paper 2

SECONDARY 4 EXPRESS

Name _____ ( ) **Date** 28 August 2020

Class _____ **Duration** 1 h 45 min

Additional Materials: Laminated Periodic Table

READ THESE INSTRUCTIONS FIRST

Section A (50 Marks)
Answer **all** questions in the spaces provided.

Section B (30 Marks)
Answer all **three** questions, the last question is in the form either/or.
Answer **all** questions in the spaces provided.

Information for Candidates
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is provided.

The use of an approved scientific calculator is expected, where appropriate.

FOR EXAMINER'S USE	
Section A	/50
Section B	/30
Total	/80

This document consists of **16** printed pages including the cover page.

Setter(s) Mdm Sharena

Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

A1 Choose from the following elements to answer the questions below.

ammonia	bromine	calcium
chlorine	copper	fluorine
hydrogen	iron	nitrogen
silver	sodium	zinc

Each element can be used once, more than once or not at all.

Which element

(a) is found in Group VII and Period 2 of the Periodic Table, ... [1]

(b) can form a charge of 2+ and more reactive than zinc, ... [1]

(c) is a liquid at room temperature, ... [1]

(d) is a metal with low density, ... [1]

(e) has the highest percentage composition in air, ... [1]

(f) is used for galvanising? ..... [1]

A2 **(a)** Which of the following statements about carbon monoxide is(are) **true** and which is(are) **false**?

Put a tick (✓) in one box for each row.

	true	**false**
It is the main reducing agent in iron extraction in the Blast Furnace.		
It is not an acidic oxide.		
It is removed in a catalytic converter by reaction with nitrogen.		
It can be detected by smell when incomplete combustion of carbon-containing fuels occurs.		

[2]

(b) Carbon reacts with sulfur to form carbon disulfide, CS_2, which is a simple covalent compound used in manufacturing polymers and fibres.

Draw a 'dot-and-cross' diagram to show the bonding in carbon disulfide.

Show the outer shell electrons only.

[2]

(c) Sulfur reacts with magnesium to form an ionic compound called magnesium sulfide.

Draw 'dot-and-cross' diagrams to show the arrangement of outer shell electrons in magnesium sulfide.

[2]

A3 Elements in the same group in the Periodic Table can show different physical properties.

For example, Group VII elements chlorine and bromine exist in different physical states.

In another example, the melting points of Group IV elements are shown in the table.

element	C	Si	Ge	Sn	Pb
melting point / °C	>3550	1410	937	232	327

(a) State the melting point trend of the Group VII elements from chlorine to iodine.

..... [1]

(b) Carbon, silicon and germanium are solids with the same type of structure.

(i) What type of structure is present in carbon, silicon and germanium?

..... [1]

(ii) Suggest why the melting point of these elements decreases from carbon to germanium.

.....

..... [1]

(iii) State the physical states of bromine and germanium at room temperature.

Explain, in terms of bonding, why the physical states of bromine and germanium are different.

.....

.....

.....

..... **[4]**

A4 Aspirin is a medicine that is used as a painkiller. It is made from salicylic acid.

(a) A student makes a sample of aspirin. He thinks it contains impurities.
The student tests the melting point of his sample of aspirin.

Explain how he can use the result of the test to find out whether his sample contains impurities.

.....

..... [2]

(b) Aspirin is a *weak* acid.

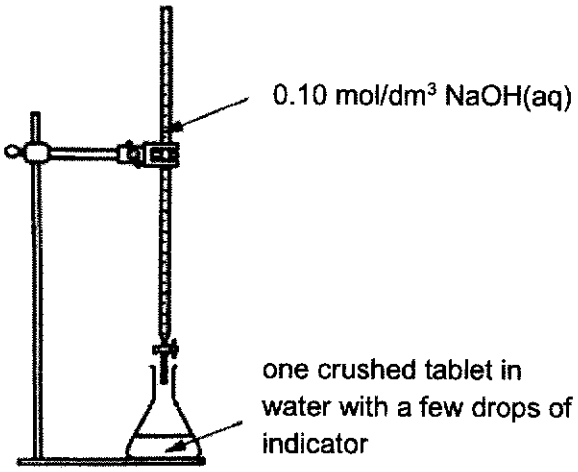
Explain what is meant by the term *weak* acid.

.....

..... [1]

(c) The student buys and tests some tablets that contain aspirin.

He performs a titration using a crushed tablet and aqueous sodium hydroxide.



The formula for aspirin can be represented as [redacted]—COOH. The equation for the reaction between aspirin and aqueous sodium hydroxide is shown.

[redacted]—COOH + NaOH → [redacted]—COONa + H_2O

The table shows the results of the student's titration.

concentration of aqueous sodium hydroxide	0.10 mol/dm^3
volume of aqueous sodium hydroxide needed for neutralisation	16.70 cm^3
relative molecular mass of aspirin	180

The label on the bottle of tablet states that each tablet contains 300 mg of aspirin.
(1000 mg = 1g)

Do the student's results agree with this value? Show your working.

[3]

(d) Some tablets that contain aspirin also contains citric acid.

The student does another titration using one of these tablets.

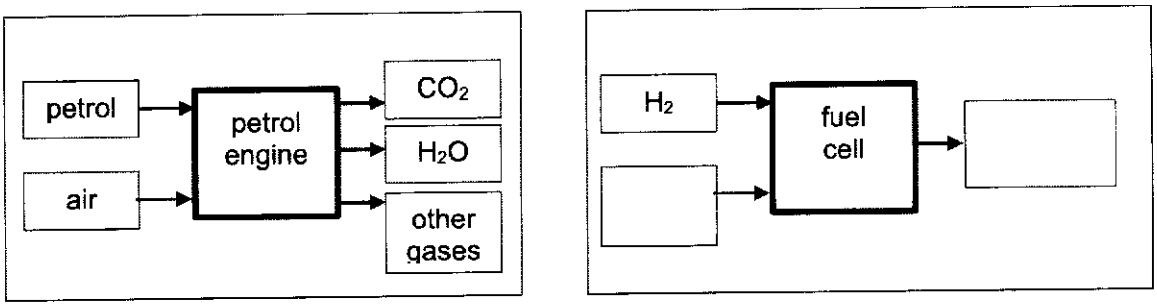
Explain why the mass of aspirin he calculates from his titration results is incorrect.

.....

..... [2]

A5 Most vehicles have petrol or diesel engines, but some use fuel cells.

The flow charts show the substances entering and leaving a petrol engine and a fuel cell.



(a) Complete the flowchart for the fuel cell by filling in the empty boxes. [1]

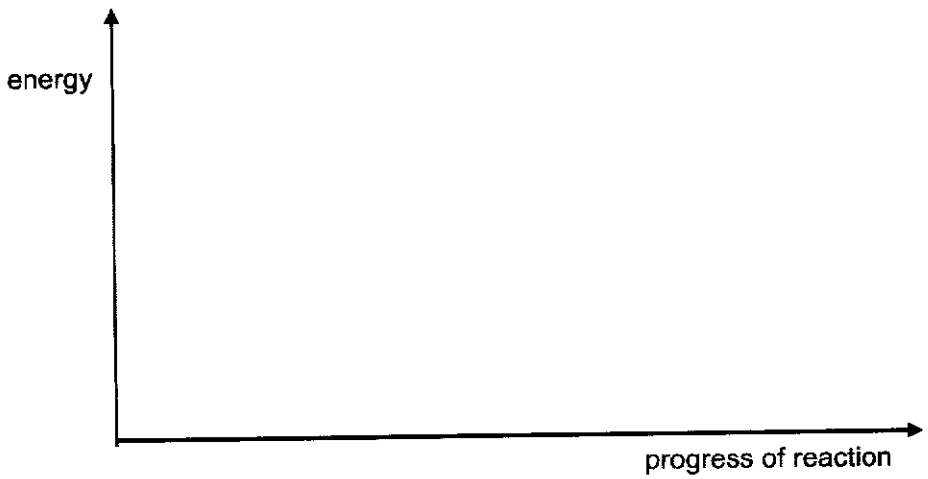
(b) Hydrogen for fuel cells can be obtained from electrolysis of water.

Electricity is used to provide energy for the electrolysis.

Complete the energy profile diagram for the electrolysis of water.

Your diagram should include

- the **formulae of the reactant and products** of electrolysis,
- a label for the **activation energy**,
- a label for the **enthalpy change of reaction**.



[3]

(c) The waste products from vehicles with petrol engines cause more harm to human health than those from vehicles with fuel cells.

Explain why this statement is true.

.....

.....

.....

.....

..... [3]

A6 An alloy was found to be containing a mixture of two metals. Two separate samples of the alloy were brought to the laboratory for further tests.

The first sample of the alloy dissolved completely in excess concentrated nitric acid to form a blue solution.

The second sample was divided and placed in two test tubes. Excess sodium hydroxide solution and aqueous ammonia was added to the test tubes separately, producing white precipitate which dissolved in excess to give a colourless solution.

(a) Identify the blue solution and white precipitate.

blue solution : .....

white precipitate : ..... [2]

(b) Construct a balanced chemical equation, with state symbols, for the formation of the blue solution.

..... [2]

A7 The reaction of iron(III) sulfate with potassium iodide is a redox reaction.

$$Fe_2(SO_4)_3 + 2KI \rightarrow 2FeSO_4 + I_2 + \textbf{product X}$$

(a) At the end of the reaction, the solution turns brown.

Explain why.

..... [1]

(b) Give the formula and name of **product X**.

formula .....

name ..... [2]

(c) **(i)** Complete the table to show the oxidation states of iron and iodine.

element	oxidation state in reactants	oxidation state in products
iron		
iodine		

[2]

(ii) Which substance has been reduced in the reaction?

With the aid of an equation, explain your answer in terms of **electron transfer**.

.....

..... [2]

A8 A 'barium meal' is used in radiology to improve X-ray images of the gastrointestinal tract (the gut). It also helps to observe digestion and to detect ulcers and tumours in the stomach.

The 'barium meal' is administered to the patient as follows:

I. The patient takes some citric acid and sodium hydrogen carbonate ($NaHCO_3$) tablets. This produces a salt, sodium citrate, water and a gas which helps to expand the stomach and gut walls.

II. The patient drinks a suspension of barium sulfate, which will not be absorbed by the body.

III. Barium sulfate prevents X-rays from passing through and thus images can be clearly seen.

(a) State a word or phrase in the information given above which tells you that barium sulfate is insoluble in water.

..... [1]

(b) Describe a chemical test to identify the gas produced in step (I).

.....

..... [1]

(c) Describe briefly how a dry sample of barium sulfate can be prepared in the laboratory. Include the names of the reagents in your answer.

.....

.....

.....

..... [3]

Section B

Answer all **three** questions in this section.

The last question is in the form of an either/or and only one of the alternatives should be attempted.

B9 The table below gives the current estimate percentage by mass of some of the elements found in the Earth's crust and the Earth's core.

Earth's crust		Earth's core	
element	**% by mass**	**element**	**% by mass**
oxygen	40.6	iron	31.0
silicon	24.7	oxygen	24.0
nickel	8.1	magnesium	16.0
aluminium	8.1	silicon	13.0
iron	5.0	nickel	11.7
calcium	3.6	aluminium	0.1
sodium	2.8	sodium	0.1
potassium	2.6	hydrogen	0.05
magnesium	2.1	potassium	0.04
zinc	0.0078	calcium	0.04
copper	0.0068		
tin	0.00022		

(a) Which metallic elements are more abundant in the Earth's crust compared to the Earth's core?

..... [1]

(b) Suggest a reason why oxygen is the most abundant element in the Eath's crust.

.....

.....

..... [1]

(c) The estimated mass of the Earth's crust is 2.125×10^{16} kg. The annual production of iron is 3.32×10^{9} tonnes. Assuming that the demand for this metal is the same each year, determine the number of years before the supply of iron from the Earth's crust runs out.
[I tonne = 1000 kg]

[2]

(d) Briefly describe one advantage and one disadvantage of recycling metals.

Advantage : .....

.....

Disadvantage : .....

..... [2]

(e) Globally, iron and aluminium are the most recycled metals because of the ease of recycling them. Suggest a property of each of these two metals that accounts for this.

iron : .....

.....

aluminium : .....

..... [2]

A student studied the action of heat on four different substances (A, B, C and D). He knew that two of them were metals, and the other two were carbonates of the same two metals. He weighed out 5.00 g of each of the four solids and heated them in separate crucibles.

The table below shows the appearances and masses of the four solids before and after strong heating for some time.

solid	appearance		mass / g	
	before	after	before	after
A	brown	black	5.00	6.25
B	green	black	5.00	3.22
C	white	white	5.00	5.00
D	silvery	white	5.00	6.73

(f) Based on the data given above, suggest which two of the metals and which two were the metal cabonates. Explain your answers.

Metals : solid ..... and solid .....

Metal carbonates : solid ..... and solid ..... [1]

Explanation : .....

.....

.....

.....

..... [3]

B10 Some companies make products to sell to farmers as soil improvers.

Some compounds in the products neutralise acidity.

The table shows information about some substances that companies use to make these products.

substance	chemical composition	effectiveness at neutralising acidity	other points
limestone	$CaCO_3$	fair	Insoluble in water. Needs to be ground to a very fine powder.
quicklime	CaO	very high	Made by heating limestone to a high temperature. Reacts exothermically with water to make an alkaline solution.
slaked lime	$Ca(OH)_2$	very high	Made by adding water to quicklime. Slaked lime is an alkali.
blast furnace slag (solid waste from the blast furnace)	Mixture of $CaCO_3$ and $CaSiO_3$ with other impurities.	fair	Insoluble in water. Impurities include silicon oxides and other non-metal compounds. Composition of mixture varies.

(a) Use the information in the table to suggest why limestone is less effective at neutralising acidity than quicklime and slacked lime.

.....

.....

..... [2]

(b) **(i)** Suggest an advantage of making products from blast furnace slag rather than the other substances.

.....

..... [1]

(ii) Blast furnace slag may contain impurities of Group IV and Group V oxides. These impurities cause the slag to be less effective at neutralising acidity.

Explain why Group IV and Group V oxides are less effective at neutralising acidity.

.....

..... [2]

(c) One mole of gas occupies 24 dm^3 at room temperature and pressure (r.t.p)

Quicklime is made by strongly heating limestone in a kiln. The reaction produces calcium oxide and carbon dioxide as shown in the equation.

$$CaCO_3\ (s) \rightarrow CaO\ (s) + CO_2\ (g)$$

A kiln can hold 25 tonnes of limestone. (1 tonne = 1 000 000 g)

Assuming that limestone is pure calcium carbonate, calculate the volume of carbon dioxide (at r.t.p) that is produced when 25 tonnes of limestone are heated.

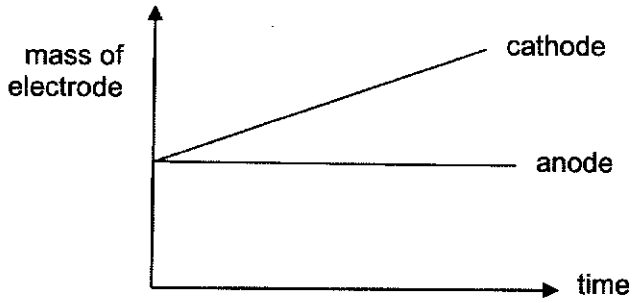
[3]

Either

B11 A student was given two different types of electrodes (carbon and copper electrodes), a fixed volume of 1.0 mol/dm^3 of copper(II) sulfate solution, some electrical wires and batteries.

He carried out the electrolysis of copper(II) sulfate solution using the different electrodes.

First, he carried out the experiment with carbon electrodes. At regular intervals, the cathode and anode were removed, dried and weighed. The results were plotted on the graph below.



(a) **(i)** Give the formulae of all the ions present in the electrolyte.

..... [2]

(ii) Explain why the cathode shows an increase in mass.

.....

..... [1]

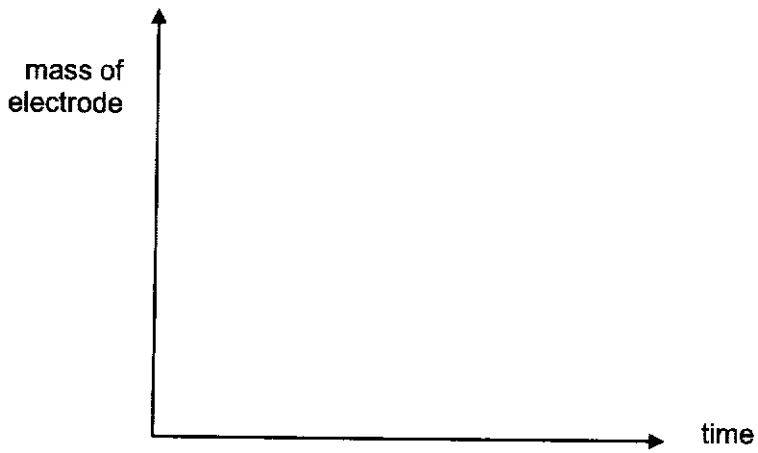
(iii) Describe what is observed at the anode, with an appropriate equation.

.....

..... [2]

He carried out the same experiment with copper electrodes. Similarly, at regular intervals, the cathode and anode were removed, dried and weighed.

(b) **(i)** Predict and draw on a separate graph how the anode and cathode will change as electrolysis takes place.



[2]

(ii) Explain how the graph for the anode is derived with a relevant equation.

.....

.....

..... [2]

(iii) The student noticed that the colour of the electrolyte remained the same as electrolysis took place.

Explain why.

.....

..... [1]

Or

B11 A student investigated the rate of reaction when dilute acid reacts with excess solid copper(II) carbonate.

He used the same volume of acid each time. He measured the time taken to collect 10 cm^3 of gas at room temperature and pressure. He also measured the total volume of gas at the end of the experiment at room temperature and pressure.

The table shows his results.

experiment	acid	concentration in mol/dm^3	time taken to collect 10 cm^3 of gas / s	total volume of gas / cm^3
1	hydrochloric	0.5	15	150
2	hydrochloric	1.0	6	300
3	hydrochloric	0.5	7	150
4	nitric	0.5	15	150

(a) Give the formula of the salt which forms in experiment 4.

..... [1]

(b) **(i)** The student carried out three experiments using acid at room temperature and one experiment using acid at a higher temperature.

Which experiment was carried out at a higher temperature?

Explain your reasoning.

.....

.....

.....

..... [2]

(ii) Explain, in terms of collisions between reacting particles, why a higher temperature affects the rate of reaction.

.....

.....

.....

..... [3]

(c) The student carried out another experiment at room temperature using 0.5 mol/dm^3 sulfuric acid.

He used the same volume of acid as in the previous experiments with excess solid copper(II) carbonate.

Complete the table to predict what results he should expect and explain how you arrived at your answers.

experiment	acid	concentration in mol/dm^3	time taken to collect 10 cm^3 of gas / s	total volume of gas / cm^3
5	sulfuric	0.5		

.....

.....

.....

.....

.....

..... [4]

END OF PAPER 2

West Spring Secondary School
Preliminary Examination 2020

CHEMISTRY **6092/01**

Paper 1 Multiple Choice

SECONDARY 4 EXPRESS

Name _____ ( ) **Date** **2 Sept 2020**

Class _____ **Duration** **1 hour**

Additional materials: Laminated Periodic Table and Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

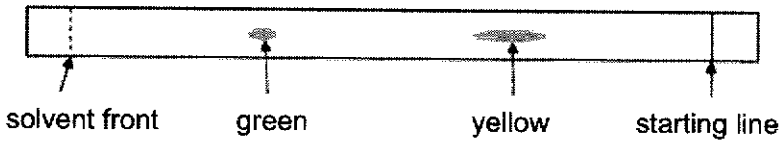
A copy of the Periodic Table is provided separately.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages.

Setter: Mdm Sharena **[Turn over**

1 The chromatogram of a pen ink is shown.

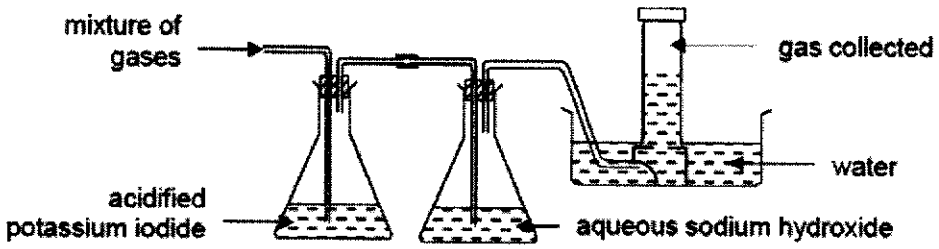


Which of the following statements can be deduced from the chromatogram?

A The pen ink is a pure substance.
B The green dye is more soluble in the solvent than the yellow dye.
C The molecules of the yellow dye are larger than that of the green dye.
D The R_f value of the yellow dye is greater than that of the green dye.

2 A gaseous mixture of hydrogen, ammonia, nitrogen dioxide and chlorine is passed through the apparatus shown.

Only one of the gases is collected at the end.



Which of the following is a property of the gas collected?

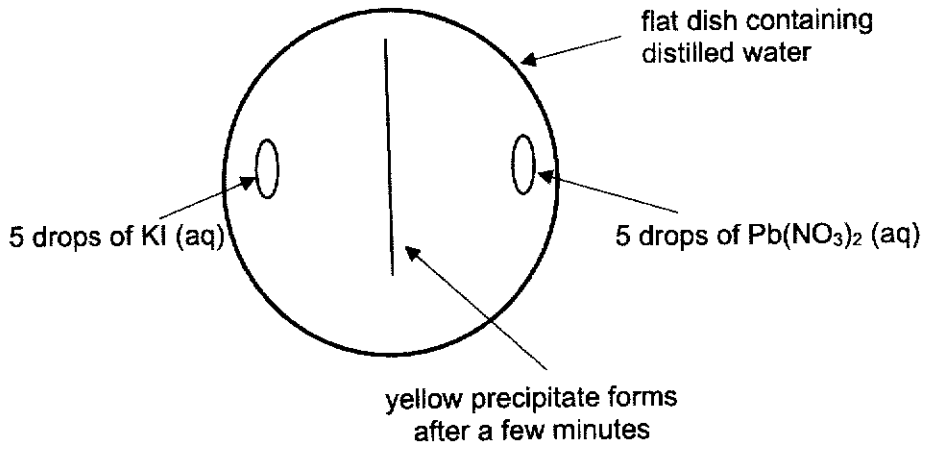
A Gas bleaches damp blue litmus paper.
B Gas turns damp red litmus paper blue.
C Gas extinguishes a lighted splint with a 'pop' sound.
D Gas decolourises acidified potassium manganate(VII) solution.

3 When a saturated aqueous solution of potassium sulfate is cooled from 70°C to room temperature, crystals are formed.

Which of the following statements is true, about what happens during the cooling process?

A the concentration of the solution remains the same.
B the mass of the solute in the solution decreases.
C the mass of the solvent in the solution increases.
D the solubility of potassium sulfate increases as the temperature falls.

4 A yellow precipitate is formed in an experiment as illustrated in the diagram.



Which of the following is a correct sequence of how the precipitate forms?

A Particles collide, diffuse and then react.
B Particles collide, react and then diffuse.
C Particles diffuse, collide and then react.
D Particles diffuse, react and then collide.

5 The table below shows the melting and boiling points of substances W to Z.

substance	melting point / °C	boiling point / °C
W	–120	–15
X	–4	42
Y	40	229
Z	413	899

Which of the following statements are true?

I X is a volatile liquid.
II Particles of Y and Z vibrate and rotate in fixed positions at room temperature.
III Two of the above substances undergo a change of state when heated from room temperature to 80°C.

A I and II only
B II and III only
C I and III only
D All of the above

6 Argon is used to prolong the lifespan of the tungsten filament in electric bulbs.

Argon has three isotopes: argon-36, argon-38 and argon-40.

Which statement is **not** true about these isotopes?

A They have the same arrangement of electrons.
B They have the same chemical properties.
C They have the same number of protons.
D They have the same rate of diffusion.

7 Which element would be expected to form an ion with the largest ionic radius?

A chlorine
B fluorine
C magnesium
D oxygen

8 The table shows information about particles X and Y.

particle	number of protons	number of neutrons	electronic structure
X	12	12	2, 8
Y	20	20	2, 8, 8

Which statement is correct for both X and Y?

A They are positive ions.
B They are atoms of metals.
C They are atoms of noble gases.
D They are isotopes of the same element.

9 Which of the following contains a mixture of a metal and a non-metal?

A brass
B copper
C graphite
D mild steel

10 When blue hydrated copper(II) sulfate crystals are heated, a white solid E and a colourless liquid F are produced.

Which one of the following correctly describes E and F?

	E	F
A	has a variable composition by mass	has a fixed composition by mass
B	has a fixed composition by mass	has a variable composition by mass
C	has a variable composition by mass	has a variable composition by mass
D	has a fixed composition by mass	has a fixed composition by mass

11 Two particles X and Y have the composition shown in the table.

particle	number of electrons	number of neutrons	number of protons
X	10	8	8
Y	10	9	8

Which statement is correct about X and Y?

A X and Y are cations.
B X and Y are isotopes.
C X and Y belong to Group 0.
D X is a metal while Y is a non-metal.

12 The table shows some properties of four substances.

Which substance is an ionic compound?

	melting point/°C	dissolves in water	conducts electricity when solid	conducts electricity when aqueous solution
A	–32	√	x	√
B	301	√	x	x
C	801	√	x	√
D	3550	x	√	x

13 The structural formula of ethylene molecule is shown below.

What is the total number of shared electrons?

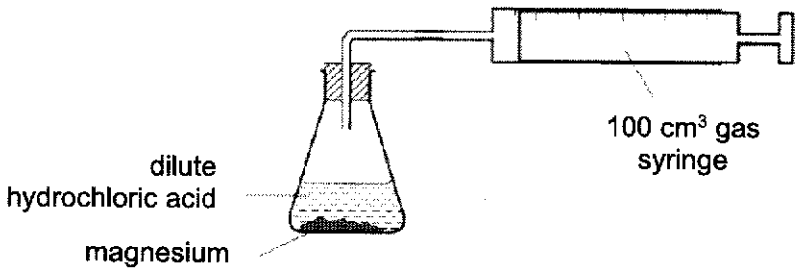
A 3 **B** 5 **C** 6 **D** 10

14 Two elements are in the same group of the Periodic Table.

Which property will be the same for both elements?

A The charge on their ions.
B Their reactivity with water.
C The electronic structure of their ions.
D The number of electrons in their atom.

15 An excess of hydrochloric acid is added to 0.10 mol of magnesium in the apparatus shown.



Why is it impossible to measure the volume of hydrogen produced using this apparatus?

A There is air in the tube.
B The reaction takes place too quickly.
C Hydrogen is soluble in hydrochloric acid.
D The gas syringe is too small to contain the hydrogen gas produced.

16 A substance has the following composition by mass.

C: 41.9%, H: 3.1%, Cl: 55.0%

If its relative molecular mass is 258, what is its molecular formula?

A $C_3H_5Cl_2$
B CH_3Cl_2
C $C_9H_8Cl_4$
D $C_3H_9Cl_6$

17 Rubidium, Rb, is an element in Group I of the Periodic Table.

Which statement(s) about rubidium is/are true?

I Rubidium conducts electricity in both solid and molten state.
II Rubidium has a higher melting point than caesium.
III Rubidium reacts explosively with water.
IV Rubidium reacts with water and forms a solution of pH < 7.

A I only
B I and III only
C I, II and III only
D I, II and IV only

18 An experiment is carried out to determine the change in mass when different copper-based solids are added to excess nitric acid.

Solids of similar masses are added to the nitric acid as shown.

Beaker X: 10.0 g of copper foil added to 1.00 dm^3 of nitric acid
Beaker Y: 10.0 g of powdered copper(II) oxide added to 1.00 dm^3 of nitric acid
Beaker Z: 10.0 g of powdered copper(II) carbonate added to 1.00 dm^3 of nitric acid

Which of the following correctly shows the changes in mass for each beaker?

	Beaker X	Beaker Y	Beaker Z
A	decreases	no change	no change
B	increases	increases	increases
C	no change	decreases	decreases
D	no change	no change	decreases

19 Bromobutane, C_4H_9Br, can be made from butanol, C_4H_9OH, as shown in the following equation.

$$C_4H_9OH + HBr \rightarrow C_4H_9Br + H_2O$$

In an experiment, 10 g of butanol produced 12 g of bromobutane.

What is the percentage yield of bromobutane?
[M_r : C_4H_9OH, 74; C_4H_9Br, 137]

A 45% **B** 54% **C** 65% **D** 83%

20 What volume of 0.10 mol/dm^3 aqueous silver nitrate reacts with 20.0 cm^3 of 0.20 mol/dm^3 barium chloride?

A 10 cm^3 **B** 20 cm^3 **C** 40 cm^3 **D** 80 cm^3

21 The following table gives the colour of various indicators and the pH range at which the indicator changes colour.

indicator	colour in acidic solution	pH range at which indicator changes colour	colour in alkaline solution
methyl orange	red	3 – 5	yellow
quinaldine red	colourless	1 – 3	red
phenolpthalein	colourless	8 – 10	pink

What is the colour of the solution all three indicators are added to pure water?

A colourless
B orange
C red
D yellow

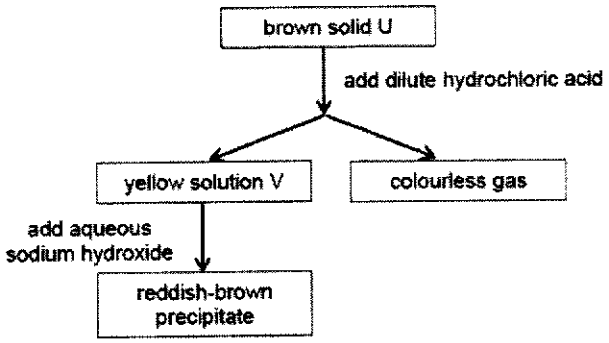
22 An acidic solution contains _____.

A hydrogen ions only
B more hydrogen ions than hydroxide ions
C more hydroxide ions than hydrogen ions
D equal number of hydrogen and hydroxide ions

23 Which of the following salts can be prepared by the methods indicated?

	prepared by the use of an acid and an insoluble carbonate	prepared by the use of two aqueous salts
A	lead(II) sulfate	barium nitrate
B	iron(II) sulfate	calcium sulfate
C	sodium chloride	zinc carbonate
D	copper(II) nitrate	magnesium sulfate

24 The flowchart shows the tests and observations obtained for an unknown salt.



How many of the following observations is(are) **not** obtained when excess sodium metal is added to solution V?

I Sodium metal dissolves and becomes smaller.
II Yellow solution turns colourless.
III Grey solid is formed.
IV Bubbles of gas are produced.

A 0 **B** 1 **C** 2 **D** 3

25 Test on a sample of water gave the following results.

reagent added	observations
aqueous ammonia	white precipitate, insoluble in excess
nitric acid, then barium nitrate	white precipitate

Which compound could have been present in the water?

A zinc chloride
B zinc sulfate
C aluminium chloride
D aluminium sulfate

26 In the Haber process for the manufacture of ammonia, which statements are correct?

I The reaction is never complete.
II The catalyst used is a transition metal.
III An increase in pressure will produce a higher yield of ammonia.
IV Both reactants are obtained from fractional distillation of liquid air.
V An increase in temperature will produce a higher yield of ammonia.

A I, II, III **B** I, III, IV **C** I, II, V **D** I, III, IV, V

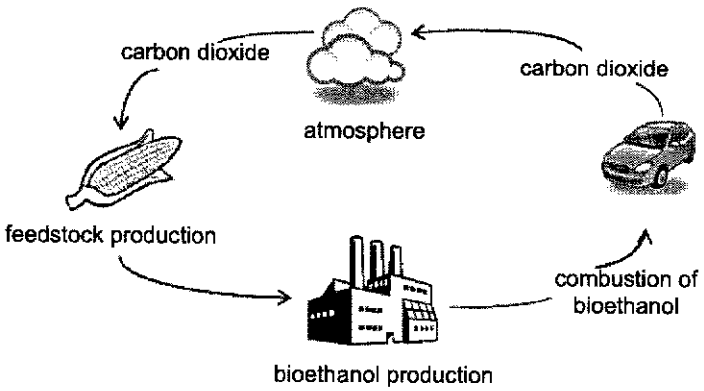
27 The data in the table gives the concentration, in parts of pollutant per million parts of air, of pollutant gases in four different cities.

In which city are limestone structures under the greatest threat from pollution?

	sulfur dioxide	carbon monoxide	nitrogen dioxide
A	15	20	50
B	15	50	40
C	20	20	30
D	25	25	25

28 Biofuels are fuels obtained from biological sources such as plant materials and animal fats.

The diagram shows the stages in the production of bioethanol, an example of biofuel.



Carbon dioxide is released during the production of bioethanol and also when it is used as a fuel in vehicles. However, this does not contribute to an increase in carbon dioxide released to the atmosphere.

Which of the following best explains this advantage of using bioethanol as a fuel?

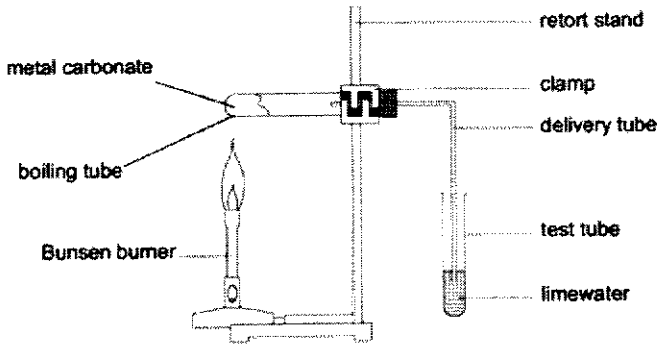
A Carbon dioxide is used up by plants during respiration.

B Less carbon dioxide is removed by plants during photosynthesis than is produced from the production and combustion of bioethanol.

C Plants take in as much carbon dioxide during photosynthesis as it is produced from the production and combustion of bioethanol.

D The carbon dioxide released into the atmosphere dissolves in rainwater.

29 An experiment was carried out to investigate the effect of heat on the carbonates of three metals, X, Y and Z, using the setup shown.



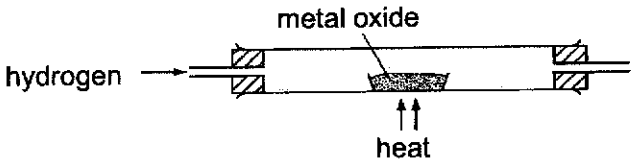
The table shows the results of the experiment.

metal	observations with limewater
X	slight effervescence, white precipitate
Y	no observable change
Z	vigorous effervescence, white precipitate

If the time set for each experiment to take place was the same, what is the order of reactivity of metals X, Y and Z?

	most →		least
A	X	Y	Z
B	Y	X	Z
C	Y	Z	X
D	Z	X	Y

30 The reaction of a metal oxide with hydrogen is shown below.

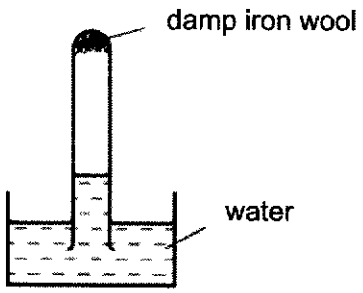


Which of the following is correct?

	metal oxide	mass of solid remaining
A	copper(II) oxide	decrease
B	copper(II) oxide	increase
C	magnesium oxide	decrease
D	magnesium oxide	increase

31 A test-tube containing damp iron wool is inverted in water.

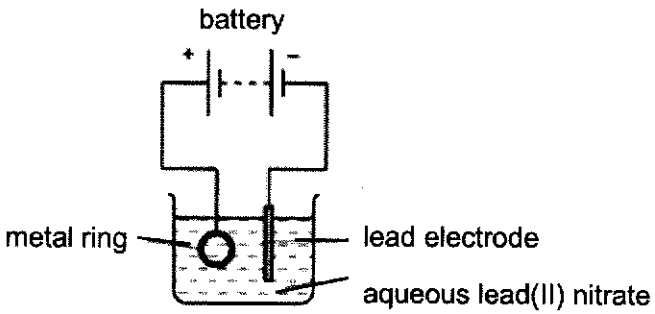
After three days, the water level inside the test-tube has risen.



Which statement correctly explains the rise in the water level inside the test-tube?

A Carbon dioxide has been formed.
B Hydrated iron (III) oxide has been formed.
C Iron wool has been reduced.
D Temperature of the water has increased.

32 The diagram shows an apparatus used in an attempt to electroplate a metal ring with lead.



The experiment did not work. What change should be made to the experiment to make it work?

A Add solid lead (II) sulfate to the electrolyte.
B Increase the temperature of the electrolyte.
C Replace the lead electrode with a carbon electrode.
D Reverse the terminals of the battery.

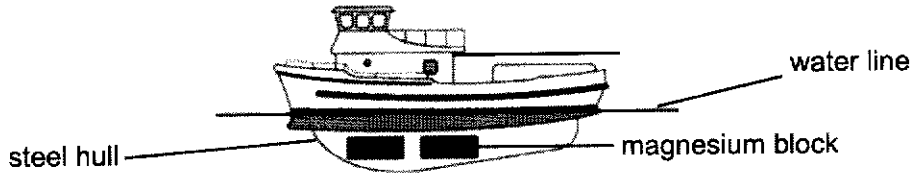
33 When zinc metal is added to the copper(II) sulfate solution, the blue solution gradually fades to a pale blue and a reddish brown metal is formed.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

Which of the following statement is true for the above reaction?

A Copper(II) sulfate is the reducing agent.
B Copper metal reduces to copper(II) sulfate.
C Zinc sulfate is the oxidising agent.
D Zinc metal displaces copper from aqueous copper(II) sulfate.

34 The diagram shows some magnesium blocks attached to the steel hull of a boat below the water line.

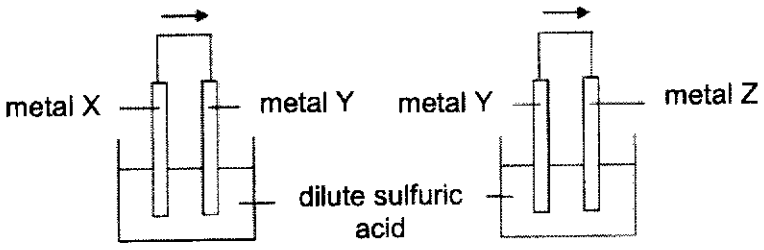


How does the attached magnesium blocks prevent the steel hull from rusting?

A Magnesium reacts with iron to form an alloy.
B Magnesium reacts with oxygen and water in preference to iron.
C Magnesium reacts with oxygen to form an oxide layer on the iron.
D Magnesium stops oxygen in the water from getting to the iron.

35 Two cells were set up as shown in the diagram below.

The arrow shows the direction of electron flow in the external circuit.



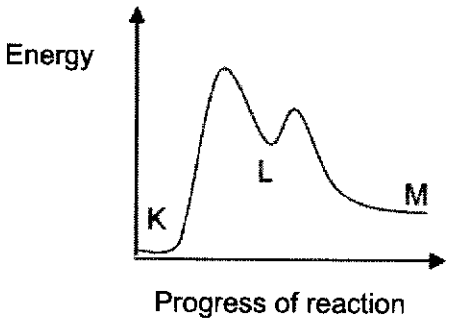
Which set of metals would give the electron flow in the direction shown?

	metal X	metal Y	metal Z
A	Pb	Cu	Zn
B	Cu	Pb	Zn
C	Zn	Pb	Cu
D	Cu	Zn	Pb

36 In the conversion of compound K to compound M, it was found that the use of a catalyst caused the reaction to proceed through the formation of an intermediate compound L.

The following graph shows the energy profile diagram for the reactions.

Step 1: Compound K → Compound L
Step 2: Compound L → Compound M



Which of the following can be deduced from the diagram?

A Both Steps 1 and 2 are endothermic.
B The overall reaction to convert K to M is exothermic.
C Step 1 has a lower activation energy as compared to Step 2.
D Step 1 requires more energy for bond breaking than Step 2.

37 When 1 g of ethane is burnt, 52 kJ of energy is released.

How much heat is released when 1 mole of ethane burns? [M_r of ethane = 30]

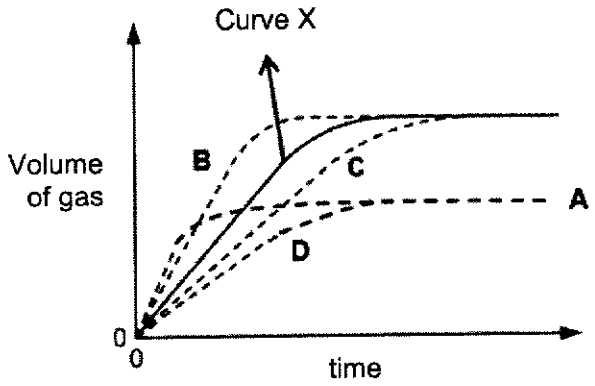
A 1.7 kJ/mol
B 52 kJ/mol
C 1456 kJ/mol
D 1560 kJ/mol

38 Which of the following conditions will cause the reaction between the dilute acid and zinc to produce the slowest rate of reaction?

A zinc chips and 40.0 cm^3 of 2.0 mol/dm^3 hydrochloric acid
B zinc powder and 20.0 cm^3 of 2.0 mol/dm^3 hydrochloric acid
C zinc chips and 20.0 cm^3 of 2.0 mol/dm^3 sulfuric acid
D zinc powder and 40.0 cm^3 of 2.0 mol/dm^3 sulfuric acid

39 A student decided to conduct an experiment by reacting 5.0 g of sodium with 0.05 mol of water.

The volume of hydrogen gas produced during the reaction was recorded in fixed time intervals and Curve X was obtained. B



Which graph would be obtained if 5.0 g of potassium metal was reacted with 0.05 mol of water instead?

40 Which of the following statements about the effect of a catalyst is correct?

A It decreases the activation energy of the reaction by providing an alternative pathway.
B It decreases the enthalpy heat of reaction but increases the speed of reaction.
C It increases the speed of the reacting particles and frequency of effective collisions.
D It increases the yield of the products and the speed of reaction.

END OF PAPER 1

4 Express Preliminary Examination 2020
Chemistry 6092
Marking Scheme (Paper 2)

Paper 1

1	B	11	B	21	B	31	B
2	C	12	C	22	B	32	D
3	B	13	D	23	B	33	D
4	C	14	A	24	A	34	B
5	D	15	D	25	D	35	C
6	D	16	C	26	A	36	D
7	A	17	C	27	A	37	D
8	A	18	D	28	C	38	A
9	D	19	C	29	B	39	B
10	D	20	D	30	A	40	A

Paper 2

SECTION A

A1	**(a)**	Fluorine	1
	(b)	Calcium	1
	(c)	Bromine	1
	(d)	Sodium	1
	(e)	Nitrogen	1
	(f)	Zinc	1
		Total	**[6]**

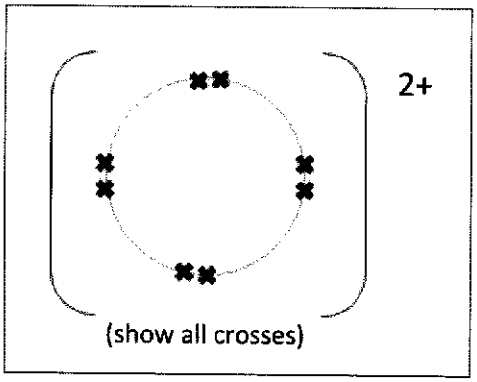
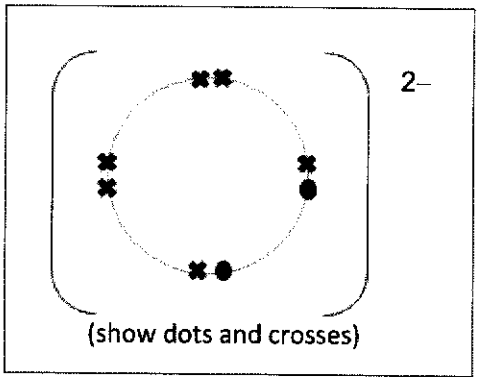
A2 (a)

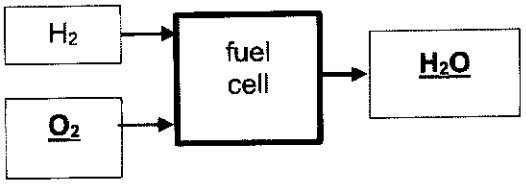
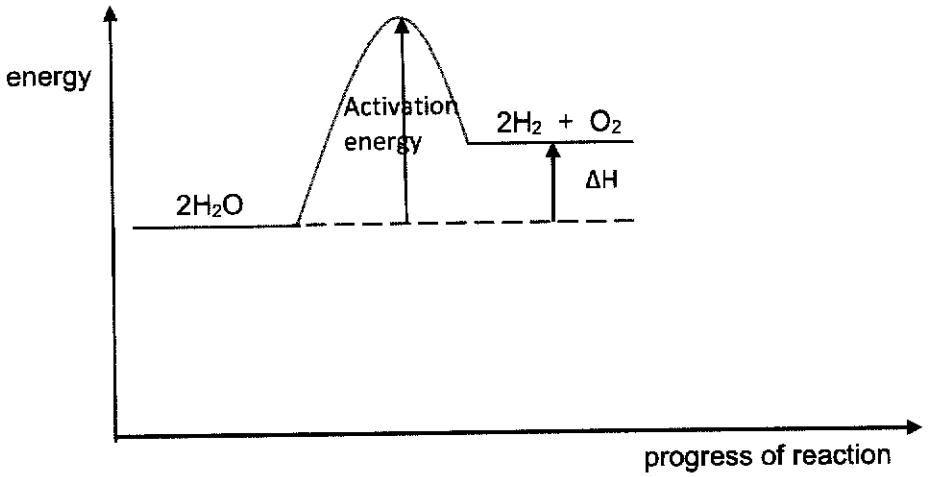
	true	**false**
It is the main reducing agent in iron extraction in the Blast Furnace	√	
It is not an acidic oxide.	√	
It is removed in a catalytic converter by reaction with nitrogen.		√
It can be detected by smell when incomplete combustion of carbon-containing fuels occurs.		√

2

(b) 2

1m – correct electronic structure of C
1m – correct electronic structure of S

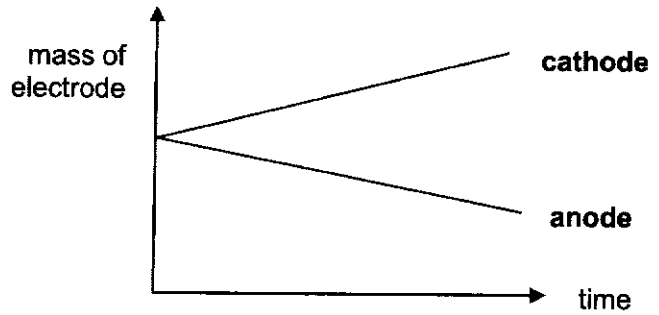
	(c)	  Magnesium ion [1] sulfide ion [1] [Penalise if ion is not labelled.]	[2]
		Total	**[6]**
A3	**(a)**	Melting point <u>increases</u> from chlorine to iodine.	1
	(b)	(i) Giant molecular structure / Giant covalent structure / Macromolecular structure [R : Giant lattice structure]	1
		(ii) The <u>covalent bonds (between the atoms) or forces of attraction between atoms become weaker</u> from carbon to germanium. OR <u>Lesser amount of energy is absorbed/required</u> to break the covalent bonds.	1
	(c)	• Bromine is a <u>liquid</u> and germanium is a <u>solid</u> at room temperature. • Bromine has <u>weak intermolecular forces of attraction</u> but • germanium has <u>strong covalent bonds</u> between atoms. • Hence, <u>lesser heat (energy) is required</u> to overcome the weak intermolecular forces of attraction than the strong covalent bonds.	1 1 1 1 [4]
		Total	**[7]**
A4	**(a)**	• Pure aspirin will have a <u>fixed melting point / melts at a fixed temperature.</u> • Impure aspirin will melt at a <u>lower melting point and over a range of temperature</u>. [any 2 points – 2m]	
	(b)	A substance that <u>dissociates partially in water/solution to produce hydrogen ions</u>.	1
	(c)	Aspirin : NaOH 1 : 1 No. of moles of aspirin = 0.3g ÷ 180 = 1.67×10^{-3} mol No. of moles of NaOH = $0.10 \times 0.167 = 1.67 \times 10^{-3}$ mol The ratio of number of moles of aspirin : number of moles of NaOH = 1:1 Hence, the student's results is agreeable with the value given. [Accept : proof of mass of tablet = 300 mg / ratio of 1:1] 2m – Calculations ; 1m – conclusion of results	1 1 1

	(d)	Citric acid will also react with sodium hydroxide / greater volume of sodium hydroxide is required to neutralize aspirin and citric acid. Hence, the mass of aspirin calculated will be higher than actual.	1 1
		Total	**[8]**
A5	(a)		1
	(b)	 1m - correct direction of ΔH 1m – correct direction of 'activation energy' 1m – correct balanced equation of product. [Accept : $H_2O \rightarrow H_2 + ½ O_2$]	3
	(c)	• Water from vehicles with fuel cell is non-polluting. • Carbon monoxide formed from incomplete combustion of petrol can cause death due to carboxyhaemoglobin in the blood /prevent the blood from absorbing and transporting oxygen to the rest of the body. **or** • Sulfur dioxide and oxides of nitrogen from the internal combustion around the engine can cause acid rain/ breathing difficulties/irritate eyes and lungs.	1 1 1
		Total	**[7]**
A6	(a)	Blue solution : copper(II) nitrate, $Cu(NO_3)_2$ White precipitate : zinc hydroxide, $Zn(OH)_2$	1 1
	(b)	$Cu\ (s) + 2HNO_3\ (aq) \rightarrow Cu(NO_3)_2\ (aq) + H_2\ (g)$ 1m – balanced equation 1m – state symbols (only if formulae is correct)	[2]
		Total	**[4]**
A7	(a)	Iodide has oxidized to **form iodine, which is brown.**	1

	(b)	formula : K_2SO_4 name : potassium sulfate	1 1 [2]
	(c)	**(i)** <table><tr><th>element</th><th>oxidation state in reactants</th><th>oxidation state in products</th></tr><tr><td>iron</td><td>+3</td><td>+2</td></tr><tr><td>iodine</td><td>-1</td><td>0</td></tr></table> [Penalise if +3 is written as 3+, etc]	1 1 [2]
		(ii) Iron / iron(III) sulfate is reduced due to gain in electrons. $Fe^{3+} + e \rightarrow Fe^{2+}$	1 1 [2]
		Total	**[7]**
A8	**(a)**	Suspension	1
	(b)	The gas produced in step (i) forms a **white precipitate in limewater**. [R : 'chalky']	1
	(c)	• Mix **barium nitrate/chloride** and **sodium sulfate/sulfuric acid** together in a boiling tube. [Accept any 2 suitable soluble salts or any soluble salt with dilute sulfuric acid.' • **Filter the precipitate** of barium sulfate. • **Rinse with distilled water** and **pat dry between sheets of filter papers**.	1 1 1 [3]
		Total	**[5]**
		Grand Total	**[50]**

Section B

B9		
(a)	Aluminium, calcium, sodium, potassium (can include zinc, copper, tin)	1
(b)	Oxygen is combined with other elements to form an oxide.	1
(c)	Mass of iron in Earth's crust = (5/100) x 2.125×10^{16} = $\underline{1.0625 \times 10^{15}kg}$ **1m** 3.32×10^{9} tonnes = 3.32×10^{12} kg Hence no. of years Earth's crust can supply iron = $1.0625 \times 10^{15}kg \div 3.32 \times 10^{12}$ = $\underline{320 \text{ years}}$ **1m**	2
(d)	Advantage : conserve natural resources / reduce environmental pollution or problems related to mining of land / save cost of extracting metals from the ores. Disadvantage : High costs related marketing and advertising to get people to do recycling or in transporting and sorting of materials at the recycling centre. / environmental issues related to release of harmful substances into the environment. [any 1 each]	1 1 [2]
(e)	Iron : magnetic property of iron enables it to be easily separated from other metals. Aluminium : it is corrosion resistant due its layer of oxide	1 1 [2]
(f)	Metals : solid **A** and solid **D** Metal carbonates : solid **B** and **C**. [all correct answers]	1
	Explanation : [Accept correct explanation even if solids are wrong.] • Solids A and D **increase in mass** due to **formation of metal oxide**. • Solid B **decreased in mass** due to **decomposition** of the metal carbonate to **form metal oxide and carbon dioxide**. • Solid C **did not decompose** as it consists of a **reactive metal carbonate** and thus, **(thermally) stable** upon heating.	1 1 1 [3]
	Total	**[12]**

B10		
(a)	Limestone is **insoluble in water** and **reacts slower** than quicklime and slaked lime.	1, 1 [2]
(b)	**(i)** Using slag, waste from blast furnace, will be **less costly / no cost** as compared to buying/using the other substances.	1
	(ii) Group IV and V oxides are non-metals which form **acidic oxides**. Therefore, they **cannot neutralize acidity / can neutralize alkalinity**.	1 1 [2]
(c)	25 tonnes = 25 x 10^6 g Moles of $CaCO_3 = \frac{25\,000\,000}{40+12+16x3}$ = 2.5 x 10^5 mols $CaCO_3$: CO_2 = 1 : 1 Moles of CO_2 = 2.5 x 10^5 mols Volume of CO_2 = 2.5 x 10^5 mols x 24 dm^3 = 6 000 000 dm^3 or 6x10^6 dm^3 [Penalise 1m for no/wrong unit of volume.]	1 1 1
	Total	**[8]**
B11	**Either**	
(a)	**(i)** Cu^{2+} , SO_4^{2-} , H^+ , OH^- Any 2 or 3 correct ions – 1m; all correct 2m	[2]
	(ii) Copper(II) ions are discharged at cathode as solid copper. Hence, mass of cathode will increase.	1
	(iii) Bubbles / Effervescence of colourless and odourless gas observed at the anode. $\mathbf{4OH^- \rightarrow O_2 + 2H_2O + 4e^-}$	1 1 [2]
(b)	**(i)**  No marks if graph(s) is/are unlabeled.	1 1 [2]
	(ii) Impure copper anode dissolved in electrolyte to form copper(II) ions. Cu (s) → Cu^{2+} (aq) + $2e^-$	1 1 [2]

	(iii) Concentration of copper(II) ions remains the same as the **ions discharged at the cathode are replaced** when copper anode dissolves to form copper(II) ions in the electrolyte.	owtte 1
	Total	**[10]**

B11	**OR**	
(a)	$Cu(NO_3)_2$	1
(b)	**(i)** Experiment 3. Comparing experiments 1 and 3 the **time taken to collect 10 cm³ of gas** in experiment 3 was **shorter by about half** of experiment 1 / expt 3 is faster by 2 times than Expt 1/ Expt 3 took 7s whilst Expt 1 took 15s – faster in expt 3. [R: if did not include data or analysed data]	1 1 [2]
	(ii) When temperature is increased, **kinetic energy of the (reactant) particles increases / particles move faster.** This **increases the frequency / rate of effective / successful collisions**. Hence, the **rate of reaction also increases.**	1 1 1 [3]
(c)	<table><tr><th>experiment</th><th>acid</th><th>concentration in mol/dm³</th><th>time taken to collect 10 cm³ of gas / s</th><th>total volume of gas / cm³</th></tr><tr><td>5</td><td>sulfuric</td><td>0.5</td><td><u>7.5</u></td><td><u>300</u></td></tr></table>	1
	Sulfuric acid is a dibasic acid, which **produces two times the concentration of hydrogen ions** compared to hydrochloric acid, of the same concentration and volume. Or $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$; $HCl \rightarrow H^+ + Cl^-$	1
	The **rate of reaction will increase by 2 times** so time taken will be half of 15s. Due to <u>double concentration of H^+</u> , the **volume of gas will also be doubled** since the <u>number of moles of CO_2 gas will also double, compared to using hydrochloric acid</u>. or $H_2SO_4 + CuCO_3\ (s) \rightarrow CuSO_4\ (aq) + H_2O\ (l) + CO_2\ (g)$ $H_2SO_4 : CO_2$ 1 : 1 $2HCl + CuCO_3\ (s) \rightarrow CuCl_2\ (aq) + H_2O\ (l) + CO_2\ (g)$ $HCl : CO_2$ 1 : 0.5	1, 1 [4]
	[Accept if students explain with reference to equations]	
	Total	**[10]**

END OF PAPER