

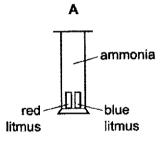
SECONDARY FOUR EXPRESS	
CANDIDATE NAME	
CLASS 4 E	INDEX NUMBER
CHEMISTRY	6092
PAPER 1	2 September 2020
Additional Materials: Multiple Choice Answer Sheet	1 hour
READ THESE INSTRUCTIONS FIRST	
Write your name, class and index number on all the v Write in soft pencil. Do not use paper clips, glue or correction fluid.	vork you hand in.
There are forty questions on this paper. Answer all quanswers, A, B, C and D. Choose the one you consider correct and record you sheet.	•
Read the instructions on the Answer Sheet very care	fully.
Each correct answer will score one mark. A mark will Any rough working should be done in this booklet. A copy of the Periodic Table is printed on page 19. The use of an approved scientific calculator is expect	_

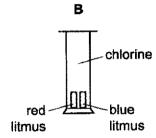
- 1 Which substance would diffuse most quickly?
 - carbon dioxide at 0 °C
 - carbon dioxide at 25 °C В
 - C neon at 0 °C
 - neon at 25 °C D
- A student tested a solution by adding aqueous sodium hydroxide. A precipitate was not seen 2 because the reagent was added too quickly.

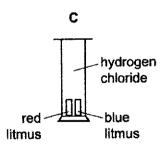
What could not have been present in the solution?

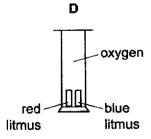
- A/3+
- Ca2+
- C NH_4
- D Zn²⁺
- Four gas jars each contains one of the gases, ammonia, chlorine and oxygen. A strip of damp 3 blue litmus paper and a strip of damp red litmus paper are placed in each jar.

In which gas jar will both the damp blue litmus paper and the damp red litmus paper change colour?





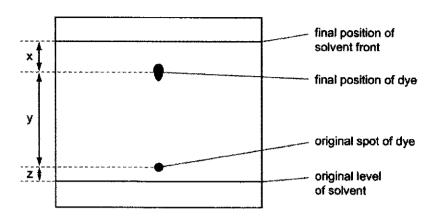




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4 The diagram shows the chromatogram obtained by analysis of a single dye.

Three measurements are shown.



How is the R_f value of the dye calculated?

5 The apparatus shown in Fig. 5.1 can be used to separate pure water from seawater.

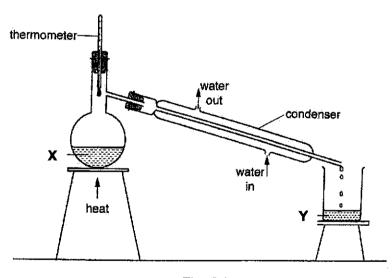


Fig. 5.1

Two samples are taken, one at point X and another at point Y.

Which of the following statements about X and Y is incorrect?

- Α X and Y can be separated into their components by physical methods.
- В When heated to dryness, X leaves a residue while Y does not.
- X boils over a range of temperatures, while Y boils at 100 °C. C
- D X is a mixture while Y is a compound.

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[Turn over

The following statement describes substance X. 6

A chemical reaction takes place and heat is liberated when this white solid, X is formed.

Which of the following correctly classifies X and explains why X is classified as such?

	classification	explanation
A	element	When decomposition takes place, an element, X, is produced.
В	compound	Bond forming takes place to produce X.
С	mixture	The reactants and the product X, form a mixture.
D	either an element or a compound	A chemical reaction can produce either an element or a compound.

- The atoms $^{64}_{29}$ Cu and $^{65}_{30}$ Zn have the same 7
 - nucleon number. A
 - number of electrons. В
 - C number of neutrons.
 - D proton number.
- Which of the following correctly describes what happens when calcium atoms form calcium ions? 8

	calcium atoms	ionic equation for the formation
Α	gain electrons	Ca + 2e ⁻ → Ca ²⁺
В	gain electrons	Ca → Ca ²⁺ + 2e ⁻
С	lose electrons	Ca + 2e ⁻ → Ca ²⁺
D	lose electrons	Ca → Ca ²⁺ + 2e ⁻

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9 Element X has a lattice of positive ions and a 'sea of electrons'.

$$\begin{array}{c} \bigoplus_{e^-} \bigoplus_{e^-}$$

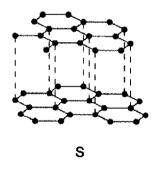
Which property will X have?

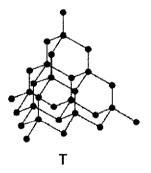
- Α It conducts electricity by the movement of ions and electrons.
- В It has a high melting point.
- C It is decomposed by an electric current.
- D It is not malleable.

10 When a covalent substance in liquid state boils, its molecules become more widely spaced.

Which property of the molecules has the most influence on the amount of energy required to boil a covalent substance?

- Α the forces of attraction between the molecules
- В the reactivity of the molecules
- C the shape of the molecules
- D the strength of the covalent bonds in the molecules
- 11 The diagrams show the structures of two forms of carbon.





Which set of data is correct for these two structures?

	conducts electricity	very hard material	can be used as lubricant
A	Т	Т	S
В	s	Т	s
С	s	S	T
D	Т	S	Т

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[Turn over

- 12 Which statement about ionic compounds is correct?
 - A lonic compounds conduct electricity when solid because they contain charged particles that can move.
 - B lonic compounds consist of a lattice of positive ions and negative ions.
 - C Most ionic compounds are solids at room temperature because of the strong attraction between electrons and positive ions.
 - **D** When molten or in aqueous solution, ionic compounds conduct electricity because they contain electrons that can move.
- 13 Sulfur and selenium (Se) are in the same group of the Periodic Table.

From this, we would expect selenium to form compounds having the formulae

- A SeO, Na₂Se and NaSeO₄.
- B SeO₂, Na₂Se and NaSeO₄.
- C SeO₂, Na₂Se and Na₂SeO₄.
- D SeO₃, NaSe and NaSeO₄.
- 14 Students give their own special symbols to five non-metallic elements. All five non-metals are in the same group of the Periodic Table. These non-metals exist as coloured elements.

The special symbols are shown in Fig. 14.1. The order of chemical reactivity of these non-meals is also shown.

special symbols given by students

decreasing order of chemical reactivity

Aa Bb Cc Dd Ee

Fig. 14.1

A solution containing Cc ions can be displaced by two of the elements in the Group.

Which of the following correctly shows the ionic equation for one such reaction?

- A $Aa(aq) + Cc(aq) \rightarrow Aa(aq) + Cc(aq)$
- B $Bb_2(aq) + 2Cc(aq) \rightarrow 2Bb(aq) + Cc_2(aq)$
- C $Dd(aq) + Cc(aq) \rightarrow Dd(aq) + Cc(aq)$
- **D** Ee₂(aq) + 2Cc (aq) \rightarrow 2Ee (aq) + Cc₂(aq)

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15 The table shows some of the properties of four elements.

Which element is most likely to be a transition metal?

	melting point / °C	density / g/cm³	electrical conductivity
A	3550	3.5	poor
В	1860	7.2	good
С	660	2.7	good
D	232	7.3	good

16 The relative formula masses of four compounds are given.

A student has a 1.0 g sample of each compound.

Which sample contains the highest number of moles of oxygen atoms?

	compound	relative formula mass	
Α	Al ₂ O ₃	102	
В	CuO	80	
С	H₂SO₄	98	
D	HNO₃	63	

- 17 What is the concentration of iodine, I2, molecules in a solution containing 2.54 g of iodine in 250 cm³ of solution?
 - 0.01 mol/dm3
- В 0.02 mol/dm3
- 0.04 mol/dm³
- D
- 0.08 mol/dm3

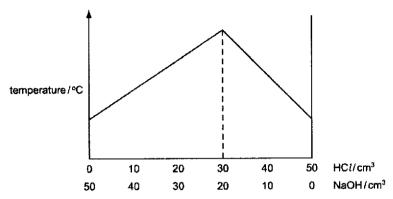
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18 A solution of hydrochloric acid has a concentration of 2 mol/dm³.

Different volumes of the acid are added to different volumes of aqueous sodium hydroxide.

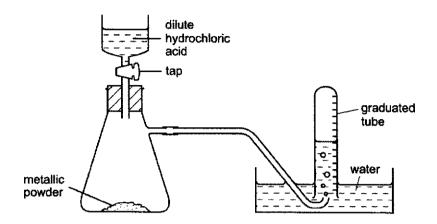
The maximum temperature of each mixture is measured. The graph shows the results.



What is the concentration of the aqueous sodium hydroxide?

- A 0.67 mol/dm³
- **B** 1.3 mol/dm³
- C 1.5 mol/dm³
- **D** 3.0 mol/dm³

19 The diagram shows apparatus for measuring the volume of hydrogen given off when an excess of dilute hydrochloric acid is added to powdered metal. The volume of gas is measured at room temperature and pressure.



The experiment is carried out three times, using the same mass of powder each time but with different powders:

- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume?

	greatest volume of H ₂	least volume of H ₂
A	magnesium	zinc
В	magnesium	the mixture
С	zinc	magnesium
D	zinc	the mixture

- 20 The following statements about dilute sulfuric acid are all correct.
 - Addition of Universal Indicator shows that the solution has a pH value of less than 7.0.
 - 2 A white precipitate is formed when aqueous barium chloride is added.
 - 3 The solution reacts with copper(II) oxide, forming a blue solution.
 - When electrolysed, hydrogen and oxygen gases are produced.

Which two statements confirm the acidic nature of the solution?

1 and 2

В 1 and 3 2 and 4

D 3 and 4

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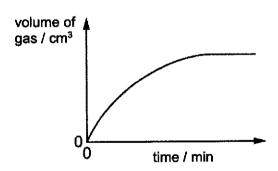
[Turn over

- 21 A solution of W has the following properties.
 - When added in excess to solid ammonium chloride, a gas is given off that turns damp red litmus paper blue.
 - When added in excess to a solution of pH 3, the resulting solution has a pH of 13.

What is W?

- A a strong acid
- B a strong base
- C a weak acid
- D a weak base
- 22 Which equation describes the most suitable reaction for making lead(II) sulfate?
 - A Pb + H_2SO_4 \rightarrow PbSO₄ + H_2
 - B $PbCO_3 + H_2SO_4 \rightarrow PbSO_4 + CO_2 + H_2O$
 - C $Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 + 2HNO_3$
 - **D** $Pb(OH)_2 + H_2SO_4 \rightarrow PbSO_4 + 2H_2O$
- 23 Excess marble chips were reacted with dilute hydrochloric acid in an experiment. The volume of gas produced was measured at regular time intervals.

The results obtained are plotted in the graph as follows.



The speed of reaction decreases throughout the reaction until it comes to a stop.

Which of the following explains why the speed of reaction decreases?

- A Marble chips were completely used up.
- **B** Hydrochloric acid was completely used up.
- C The mass of marble chips decreased.
- **D** The concentration of hydrochloric acid decreased.

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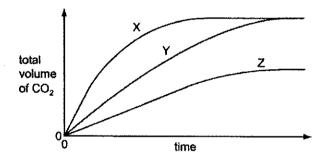
- 24 The following statements describe how the speed of reactions can be increased.
 - increase the amount of kinetic energy reactant particles can possess
 - 2 increase the frequency of effective collisions
 - 3 lower the activation energy of the reaction

Which statements describe the effect when temperature is increased?

- 1 and 2
- В 1 and 3
- 2 and 3
- 1, 2 and 3
- 25 In experiment 1, an excess of finely powdered marble is added to 20 cm3 of dilute hydrochloric acid.

In experiment 2, carried out under the same conditions of temperature and pressure, an excess of marble chips is added to 20 cm³ of dilute hydrochloric acid of the same concentration.

The total volumes of carbon dioxide given off are determined at intervals and plotted against time.



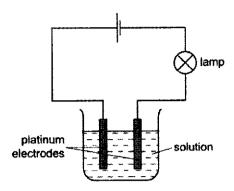
Which pair of curves is obtained in the two experiments?

	experiment 1	experiment 2
Α	X	Z
В	X	Y
С	Y	z
D	Y	x
l ł		

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Turn over

The diagram shows apparatus used to investigate the conductivity of different solutions. 26



Which substance, in aqueous solution of concentration 1 mol/dm³, would cause the lamp to give the brightest light?

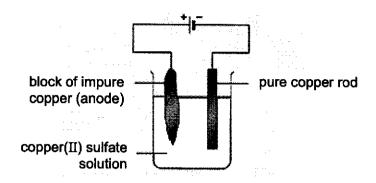
- Α ammonia
- В ethanoic acid
- C dilute sodium chloride solution
- D sulfuric acid
- The heat-reflecting shields of some space rockets are gold-plated, using electrolysis. 27

Which electrodes and electrolyte would be used to gold-plate the heat shield?

	negative electrode	positive electrode	electrolyte
Α	carbon	heat shield	gold compound
В	gold	heat shield	copper compound
С	heat shield	carbon	copper compound
D	heat shield	gold	gold compound

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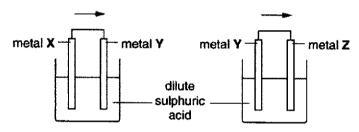
28 The following set-up shows how a block of impure copper can be purified.



The loss in mass of the anode is 50 g and the gain in mass of the cathode is 45 g.

What is the percentage purity of this sample of copper?

- Α 10.0 %
- В 11.1 %
- C 90.0 %
- D 95.0 %
- Two cells were set up as shown in the diagram. The arrow shows the direction of electron flow in 29 the external circuit.



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

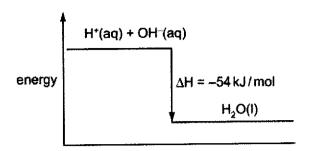
	metal X	metal Y	metal Z
A	Ag	Cu	Zn
В	Ag Ag Cu	Zn	Cu
С	Cu	Zn	Ag Ag
D	Zn	Cu	Ag

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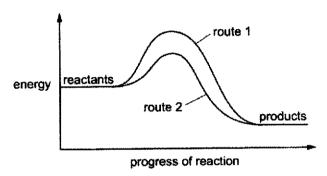
30 The energy diagram for the reaction between sodium hydroxide and hydrochloric acid is shown.



Which quantity of heat is liberated when 100 cm³ of 1 mol/dm³ hydrochloric acid reacts with 100 cm³ of 1 mol/dm³ sodium hydroxide?

- **A** 0.54 kJ
- B 2.70 kJ
- C 5.40 kJ
- **D** 10.8 kJ

31 The diagram shows the energy profile for a reaction.



Which statements about this reaction are correct?

- 1 More energy is absorbed to break the bonds than is released when new bonds are formed.
- 2 Route 1 and route 2 give the same overall equation for the reaction.
- 3 Route 2 involves the use of a catalyst.
- 4 The reaction is exothermic.
- A 1, 2 and 3
- B 1 and 2 only
- 2, 3 and 4
- D 3 and 4 only

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32 The equation shows a reversible reaction.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The forward reaction is endothermic.

Which of these changes will increase the yield of NO₂?

	pressure	temperature
Α	decreased	decreased
В	decreased	increased
С	increased	decreased
D	increased	increased

- 33 Which of the following is not an example of oxidation?
 - Α converting iron(III) salts to iron(II) salts
 - В converting magnesium atoms into magnesium ions
 - C dissolving a copper anode during electrolysis
 - D liberating chlorine from a chloride solution
- 34 Sulfur dioxide reacts with aqueous bromine according to the following equation.

$$SO_2(g) + Br_2(aq) + 2H_2O(I) \rightarrow H_2SO_4(aq) + 2HBr(aq)$$

Which element has been oxidised?

- Α bromine
- В hydrogen
- C oxygen
- D sulfur

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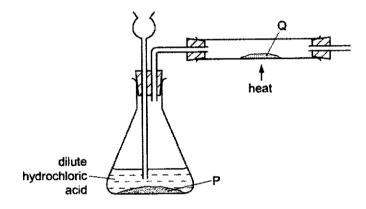
Turn over

Some metals and the compounds in their ores are shown. 35

metal	A <i>l</i>	Ca	Pb	Na	Fe	Mg
compound in their ore	Al ₂ O ₃	CaCO₃	PbS	NaC <i>l</i>	Fe ₂ O ₃	MgCO₃

Which type of reaction occurs in the extraction of all of these metals from their respective ores?

- decomposition by heat
- electrolysis В
- C precipitation
- reduction
- The diagram shows the apparatus in an experiment to reduce substance Q with the gas generated 36 in the flask.



What are substances P and Q?

	Р	Q
A	copper	copper(II) oxide
В	lead	lead(II) oxide
С	magnesium	zinc oxide
D	zinc	copper(II) oxide

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37 Brass is an alloy.

Which statement about brass is correct?

- Α It contains a sea of electrons.
- В It contains positive and negative ions which are free to move.
- C It is a compound of a metal and a non-metal.
- D It is a compound of two or more metals.
- Iron is extracted from its ore haematite, Fe₂O₃, by a reduction process in the blast furnace. 38

Which equation for reactions in the blast furnace shows the formation of the reducing agent?

- Α CaCO₃ → CaO + CO₂
- В CaO + SiO₂ → CaSiO₃
- CO₂ + C → 2CO C
- D $C + O_2 \rightarrow CO_2$
- 39 Cars have catalytic converters fitted to reduce problems caused by some of the exhaust gases. However, cars fitted with catalytic converters still give out environmentally harmful gases.

Which of the following correctly states the harmful gas and the problem the gas causes?

	harmful gas	problem
Α	nitrogen dioxide	dissolves in rain to corrode marble buildings
В	nitrogen dioxide	causes breathing problems when inhaled.
С	carbon dioxide	binds with haemoglobin in blood causing respiratory problems
D	carbon dioxide	causes the greenhouse effect leading to global warming

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Nitrogen monoxide, NO, damages the ozone layer by reacting with ozone in a two-step reaction. 40

$$NO + O_3 \rightarrow NO_2 + O_2$$
 step 1
 $NO_2 + O_3 \rightarrow NO + 2O_2$ step 2

One nitrogen monoxide molecule can destroy thousands of ozone molecules.

Which statement correctly explains why?

- Nitrogen monoxide in step 1 is easily generated through thunderstorms. Α
- Nitrogen monoxide, while is used up in step 1, is regenerated in step 2. В
- Nitrogen dioxide produced can dissolve in rain to react with thousands of ozone molecules.
- Nitrogen monoxide can react continuously with ozone since the ozone layer consists of D thousands of ozone molecules.

End of Paper

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The Periodic Table of Element

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99	۵	dysprosium	163	86	ŭ	californium	ı
65	P	terbium	159	67	奤	berkelium	ı
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57	E	fanthanum	139	89	Ą¢	actinium	ı
anthanoids				actinoids			

The volume of one mole of any gas is $24\,\mathrm{dm}^3$ at room temperature and pressure (r.t.p.).

	JUNYUAN SECONDARY SCHOOL PRELIMINARY EXAMINATION 2020 SECONDARY FOUR EXPRESS
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class 4	E						IND	EX NUMBER	₹
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Paper 2									August 202
Candidates a	nswer on	the C	Question I	Paper.				1 hou	ır 45 minute
READ THES	E INSTRU	JCTIC	ONS FIRS	ST			.,		
Write your na Write in dark You may use Do not use pa	blue or bla a soft per	ack p ncil fo	oen on bo or any dia	th sides of grams, gr	f the pape aphs or ro	er. ough worki			
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Section A Answer all th	e questio	ns in	the space	es provide	d.				
Section B Answer all th Write your ar	ree quest swers in t	ions, the s	, the last o	question is ovided.	in the for	m either/o	r.		
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								Section A	
								Section B	

Section A

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

A1 Use the list of substances to answer the questions.

Which substance

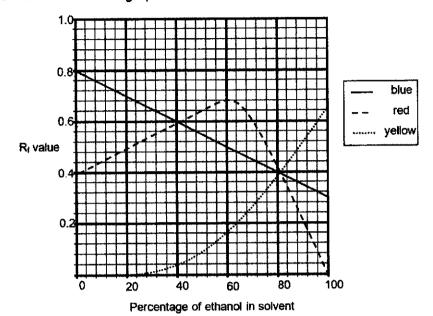
ammonia	iodine	copper
hydrochloric acid	calcium chloride	nitrogen
argon	sulfur dioxide	magnesium

(a)	reacts with gaseous hydrogen chloride to give a white solid?
	[1]
(b)	changes directly into a gas when gently heated?
	[1]
(c)	displaces iron from its salt solution?
	[1]
(d)	exists as a monatomic gas?
	[1]
(e)	is a colourless solution which can be used to distinguish between aqueous silver nitrate and aqueous zinc nitrate?
	741
	[1]
	[Total: 5]
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Partnerial carning

A sample of black ink contains a mixture of red, blue and yellow dyes. Usually, the **A2** solvent used to separate the dyes in black ink is a mixture of ethanol and water. The coloured dyes have different Rf values in solvents with different proportions of ethanol in the mixture as shown in the graph.



Deduce the R_f value of the blue dye on the chromatogram when the solvent is a (a) mixture of 32 cm³ of ethanol and 168 cm³ of water.

R _r value	1]

Based on the graph, justify whether a pure solvent of water is suitable for the (b) separation of the black ink using paper chromatography.

[2]	 ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
[2]	
[2]	
	[2]

A student carried out chromatography on the black ink using a mixture of ethanol (c) and water as the solvent. He discovered only one spot forming on the resulting chromatogram.

Using evidence from the graph, explain why he cannot conclude that the black ink is a pure substance.

 	***************************************	***************************************

_____[2]

Draw a labelled set up for the separation above. (d)

[2]

[Total: 7]

Elemental phosphorus exists as two forms - white and black phosphorus. The **A3** different forms display strikingly different properties.

The table shows the structures and properties of white and black phosphorus.

_	white phosphorus	black phosphorus
structure		
properties at room temperature	waxy white solid	black crystalline solid with a greasy touch
melting point / °C	44.2	610

(a)	Give one similarity and one difference in the bonding and structure between the two forms of phosphorus.
	similarity:
	difference:
	[2]

b)	Explain, in terms of bonding, why the melting point of black phosphorus is much higher than the melting point of white phosphorus.
	[3
(c)	White phosphorus reacts with chlorine to form phosphorus chloride, PCl_3 . Drav a 'dot-and-cross' diagram to show the bonding in a molecule of PCl_3 .
	Show only valence electrons.

[2]

[Total: 7]

A4 The relative positions of the elements rubidium (Rb), beryllium (Be) and bismuth (Bi) in the reactivity series are shown in the table below.

position in the reactivity series (highest to lowest)
rubidium
sodium
magnesium
beryllium
iron
hydrogen
bismuth
copper
silver

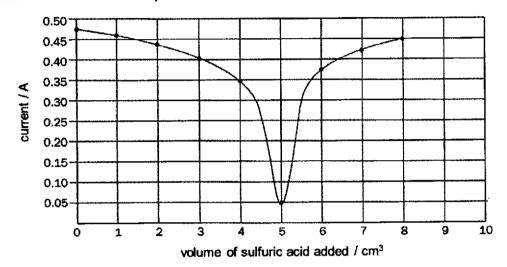
You may assume that these elements do not show variable valencies.

"Pure rubidium found on a tiny island in the Pacific Ocean" was posted in the early morning of August 16, 2016, on social media. The post has since gone viral.
Using the information above and your knowledge of metals in the reactivity series, discuss the validity of this post.
[2]
Predict, with reasons, the reactions of beryllium with cold water and steam.
[4]
Suggest a suitable method to extract bismuth from its ore.
[1]
[Total: 7]

Barium hydroxide reacts with sulfuric acid to form barium sulfate precipitate. The **A5** equation for this reaction is as shown.

$$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(I)$$

In an experiment, 0.500 mol/dm3 sulfuric acid was gradually added to 25.0 cm3 of barium hydroxide solution in a conical flask. The mixture was continuously stirred with an iron stirrer covered in plastic. The mixture was connected to an ammeter. The reading was taken after the addition of every 1.00 cm3 of sulfuric acid. The graph below shows the results obtained from the experiment.



Ignoring the ions contributed by the ionisation of water, state the formulae of the (a) ions present in the conical flask when the following volumes of sulfuric acid were added to the barium hydroxide solution:

(i)	0.00 cm ³	
(ii)	8.00 cm ³	 [2]

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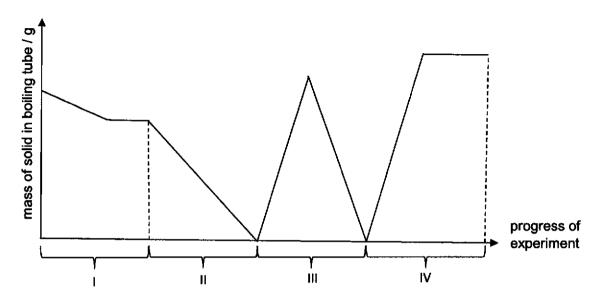
>

ici
[3]

(c)	Calculate the concentration, in mol/dm³, of barium hydroxide so	olution used.
(d)	Suggest why the iron stirrer was covered in plastic.	[2]
		[1]
		[Total: 8]

A6 Solid P is a metal carbonate.

The graph shows how the mass of the solid in a boiling tube changes as the experiment progresses.



There are four stages for the experiment.

stages	description
I	solid P is heated strongly with a non-luminous flame to form solid Q.
11	excess dilute hydrochloric acid is added to solid Q.
III	aqueous ammonia is added to the reaction mixture from stage II.
IV	aqueous silver nitrate is added to the reaction mixture from stage III.

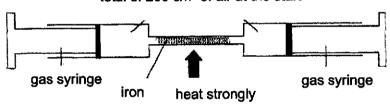
(a)	Suggest a possible identity of the cation present in solid P.
	Explain your answer.
	[3

(b)	Do you expect any carbon dioxide to be evolved in stage II?	
	Explain your answer.	
		[1]
(c)	Write the ionic equation for the formation of the solid in stage IV.	
		[2]
		[Total: 6]

An experiment was set up to determine the percentage of oxygen in air.

Two gas syringes were connected to a small tube containing excess iron, as shown in the diagram below.

total of 200 cm3 of air at the start



At the start of the experiment, the apparatus contained a total of 200 cm³ of air. During heating, the iron reacted with oxygen in the air to form black iron(II) oxide.

$$2Fe(s) + O_2(g) \rightarrow 2FeO(s)$$

The iron was heated until the volume of gas, measured at room temperature and pressure, remained constant.

(a)	Explain why it was remained constant.	important	to	continue	heating	until	the	volume	of	gas
										[1]

(b) The volume of gas left after the reaction was complete was 160 cm³.

Calculate the percentage of oxygen in the air.

[1]

(c) Iron(II) oxide can be obtained by the thermal decomposition of iron(II) oxalate.

$$FeC_2O_4(s) \rightarrow FeO(s) + CO_2(g) + CO(g)$$

(i) Determine the oxidation states of carbon in the following substances.

	oxidation state of carbon
FeC ₂ O ₄	
CO ₂	
со	

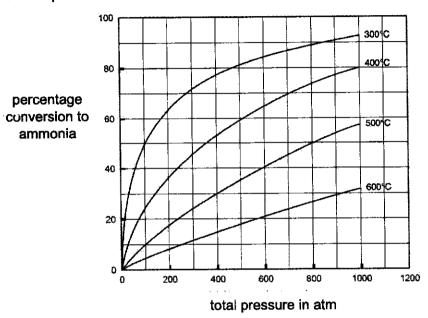
[2]

(ii)	Explain, in terms of oxidation states, why the above reaction reaction.	n is a redox
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
		[2]
		[Total: 6]

Ammonia is prepared industrially from hydrogen and nitrogen in the presence of a suitable **8**A catalyst according to the equation below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The graph below shows the variation of the equilibrium yield of ammonia with pressure at different temperatures.



(a)	A particular industrial plant uses a pressure of 400 atm and a temperature of
	500 °C. From the graph, determine the percentage yield of ammonia under these
	conditions.

b)	The gases leaving the reactor contain unreacted nitrogen and hydrogen, and about
-,	15% ammonia by volume. Unreacted nitrogen and hydrogen are fed back into the
	1010 0000000000000000000000000000000000

reactor. Give two reasons why the unreacted gases are fed back into the reactor.

	• •
ľ	זכ

(c)	Temperatures less than 400 °C are not used for this industrial reaction even though such temperatures give a greater equilibrium yield of ammonia.
	Suggest why this is so.
	[1]
	[Total: 4]

SECTION B

Answer all three questions from this section.

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

The total mark for this section is 30.

A fuel cell is a chemical cell in which reactants are continuously supplied to produce **B9** electricity.

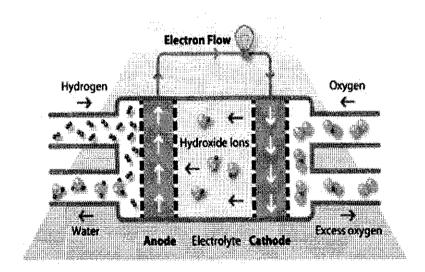
Two such cells are the Alkaline Fuel Cell (AFC) and the Proton Exchange Membrane Fuel Cell (PEMFC)

Alkaline Fuel Cell

AFCs use an alkaline electrolyte such as potassium hydroxide in water and are generally fuelled with pure hydrogen. Typical operating temperatures are around 70 °C. As a result of the low operating temperature, a variety of non-precious metals can be used as catalysts to speed up the reactions occurring at the anode and cathode.

At the anode, the hydrogen gas reacts with the hydroxide ions to form water. The water then travels through the membrane to the cathode side of the cell where they then react with oxygen to form hydroxide ions. The electrons travel in an external circuit, generating the electrical output of the cell.

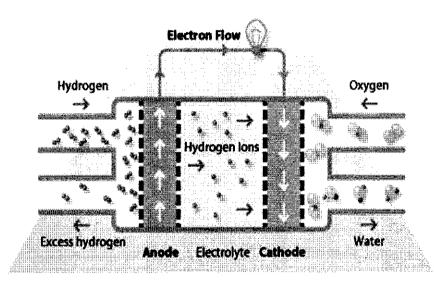
AFC cell type is easily poisoned by carbon dioxide (CO₂). In fact, even the small amount of CO2 in the air can affect this cell's operation, making it necessary to purify both the hydrogen and oxygen used in the cell. This purification process is costly.



Proton Exchange Membrane Fuel Cell

The PEMFC uses a water-based, acidic polymer membrane as its electrolyte, with platinum-based electrodes. PEMFC cells operate at relatively low temperatures (below 100 °C). Due to the use of precious metal-based electrodes, these cells must operate on pure hydrogen.

Hydrogen gas is processed at the anode where electrons are separated to form hydrogen ions on the surface of a platinum-based catalyst. The hydrogen ions pass through the membrane to the cathode side of the cell where they then react with oxygen to form water. The electrons travel in an external circuit, generating the electrical output of the cell



Compare the reactions at the electrodes for AFC and PEMFC. Complete the table (a) below with the relevant half-equations.

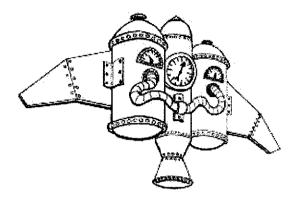
	cathode	anode
AFC		
PEMFC		
		[4

(b)	Write the overall equation, with state symbols, for both cells.
	[2]

(c)		in, with reference to the nature of CO ₂ , why it poisons AFC . Write an ion to support your answer.
		[2]
(d)	Sugg <i>PEM</i>	est one reason why the operation of AFC is more economical than that of FC .
		[1]
(e)	this p	of the hydrogen produced today is made via steam-methane reforming. In process, high temperature steam reacts with methane (CH_4), in the presence catalyst to produce hydrogen and carbon monoxide.
	(i)	Hydrogen fuel cells are environmentally-friendly.
		Explain why.
		[1]
	(ii)	Suggest why some environmentalists argue against the use of hydrogen fuel cells.
		[1]
		Поtal: 11ī

B10 Rocket belts, also known as jetpacks, can be used to lift people into the air and transport them over short distances.

The picture below shows a rocket belt, usually strapped onto a person's back.



Rocket belts contain concentrated hydrogen peroxide solution as a fuel. An exothermic change occurs when the hydrogen peroxide decomposes rapidly to form oxygen and water.

This rapid release of oxygen from the rocket belt lifts the person off the ground.

(a)	Write a balanced chemical equation for the decomposition of hydrogen peroxide in the rocket belt.
	[1]
(b)	Explain why the decomposition of hydrogen peroxide is exothermic, in terms of the energy changes that take place during bond breaking and bond forming.
	[2]

(c) The decomposition of hydrogen peroxide is very slow at room temperature.In a rocket belt, silver powder is present to speed up this decomposition reaction.The silver powder remains unchanged at the end of the reaction.

(i) Draw an energy profile diagram below to show how the silver powder speeds up the decomposition of hydrogen peroxide.

energy (kJ)

progress of reaction

[3]	Explain the shape of the energy profile diagram.	(ii)
[2]		
ecomposition of hydrogen	Suggest another way to increase the rate of deperoxide in the rocket belt.	(iii)
[1]		

[Total: 9]

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EITHE B11			nsition element. It is manufactured in a four-stage process from nickel(II)
	Stage	1 - nick	$el(\mathrm{II})$ sulfide is heated in air to form $nickel(\mathrm{II})$ oxide and sulfur $dioxide$
	Stage	2 - nick	$el(\Pi)$ oxide is heated with carbon to give impure nickel
	Stage Ni(CO)		ure nickel is reacted with carbon monoxide to make nickel tetracarbonyl,
	Stage	4 - nick	el tetracarbonyl is decomposed to give pure nickel
	(a)	(i)	Construct the balanced equation for the reaction in stage 1.
			[1]
		(ii)	Calculate the volume of sulfur dioxide formed if 182 kg of nickel($\!\Pi\!$) sulfide is used.
			volume of sulfur dioxide = dm³ [2]
	(b)	in tem	ns of structure and bonding, explain why pure nickel is a good electrical

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In an experiment, small amounts of three metals were added to three aqueous (c) metal nitrate solutions. The observations are shown in the table.

' "	aqueous zinc nitrate	aqueous nickel(II) nitrate	aqueous copper(II) nitrate
zinc	no visible reaction	green solution turns colourless and zinc gets coated with a grey solid	blue solution turns colourless and zinc gets coated with a pink solid
nickel	?	no visible reaction	?
copper	no visible reaction	no visible reaction	no visible reaction

Predict the observations when nickel is added to separate solutions of zinc nitrate

and copper(II) nitrate. with zinc nitrate with copper(II) nitrate Explain why this four-stage process cannot be used to manufacture magnesium.

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(d)

[Total: 10]

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B11 Cleaning solutions usually contain the acid salt, sodium dihydrogen phosphate. It is known as an 'acid salt' as it can behave as both an acid and a salt. This salt can be made by reacting sodium hydroxide with phosphoric acid, H₃PO₄.

Sodium dihydrogen phosphate contains the anion, H₂PO₄-.

(a)	Write an equation, phosphate.	with state	symbols,	for the	formation	of sodium	dihydrogen
						••••••	[2]

(b) The table shows information about other acidic compounds.

name	pH of a 1.0 mol/dm³ solution
phosphoric acid	4.7
sodium dihydrogen phosphate	4.5
ethanoic acid	3.8
sulfuric acid	1.0

Identify a strong acid and a weak acid.
Explain your reasoning.
.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
[3]

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(i)

Describe an experiment, other than measuring pH, that you could carry out to show that the named acids in (b)(i) is a strong acid and weak acid respectively.
State what measurements you would make and what results you would expect. Include in your answers two variables to be kept constant.
You may include diagrams in your answer.
[5]
[Total: 10]

End of paper

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The Periodic Table of Elements

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					umber	ō		nass					74	ວັ	chromium	52	42	Š	motybdenum 96	74	≥	tungsten	184	106	Ŝ	seaborgium	ı
***************************************				Key	proton (atomic) number	atomic symbol	name	relative atomic mass					23						niobium 93	İ			1			dubnium	***
***************************************					proton	ato		relativ					22	Ë	titanium	4 8	40	Ż	zirconium 91	72	Ī	hamum	178	104	ž	Rutherfordium	ı
***************************************													21	တ္တ	scandium	45	36	>	yttrium 88	57 - 71	lanthanoids			89 – 103	actinoids		
***************************************	=				4	Be	peryllium	o	12	δ	nagnesium	24							strontium 88	-		Danum				radium	ı
	_				3														rubidium 85	-				87	ij.	francium	1

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	×	neodymium	promethium	samarium	europium	mniulopea	terbium	dysprosium	holmium	erbium	majiam	ytterbium	Intelium
	i	144	1	150	152	157	159	- -	165	167	169	173	175
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			웊	Pu	Am	Ę	益	ਠ	ន	Ę	ΜQ	S	ב
	ä	E E	neptunium	plutonium	americium	curum	berkelium	californium	sinsteinium	fermium	шендемиш	nobelium	lawrencium
	સં	<u>چ</u>	ı	ŧ	1.	1	ŀ	ŀ	1	ı	1	ŀ	ı

The volume of one mole of any gas is $24\,\mathrm{dm}^3$ at room temperature and pressure (r.t.p.).

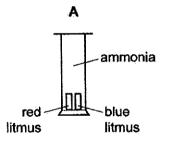
SECONDARY FOUR EXPRESS	U2U
CANDIDATE NAME	
CLASS 4 E	INDEX NUMBER
CHEMISTRY	6092
PAPER 1	2 September 2020
Additional Materials: Multiple Choice Answer Sheet	1 hour
READ THESE INSTRUCTIONS FIRST	
Write your name, class and index number on all the Write in soft pencil. Do not use paper clips, glue or correction fluid.	work you hand in.
There are forty questions on this paper. Answer all quanswers, A, B, C and D. Choose the one you consider correct and record you sheet.	·
Read the instructions on the Answer Sheet very care	efully.
Each correct answer will score one mark. A mark will Any rough working should be done in this booklet. A copy of the Periodic Table is printed on page 19. The use of an approved scientific calculator is expect	

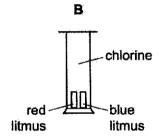
- Which substance would diffuse most quickly? 1
 - carbon dioxide at 0 °C
 - carbon dioxide at 25 °C В
 - neon at 0 °C C
 - neon at 25 °C D
- A student tested a solution by adding aqueous sodium hydroxide. A precipitate was not seen 2 because the reagent was added too quickly.

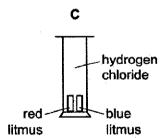
What could not have been present in the solution?

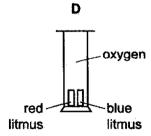
- A/3+
- Ca²⁺ В
- C NH₄+
- Zn²⁺ D
- Four gas jars each contains one of the gases, ammonia, chlorine and oxygen. A strip of damp 3 blue litmus paper and a strip of damp red litmus paper are placed in each jar.

In which gas jar will both the damp blue litmus paper and the damp red litmus paper change colour?





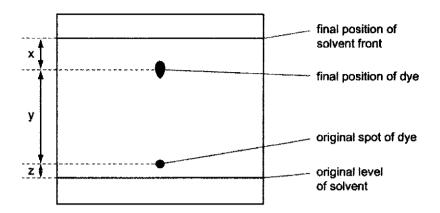




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The diagram shows the chromatogram obtained by analysis of a single dye.

Three measurements are shown.



How is the R_f value of the dye calculated?

The apparatus shown in Fig. 5.1 can be used to separate pure water from seawater. 5

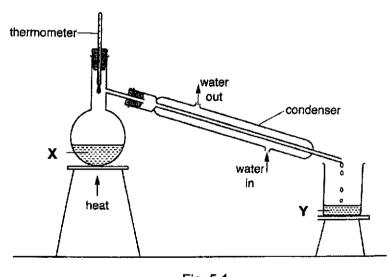


Fig. 5.1

Two samples are taken, one at point X and another at point Y.

Which of the following statements about X and Y is incorrect?

- X and Y can be separated into their components by physical methods. A
- When heated to dryness, X leaves a residue while Y does not. В
- X boils over a range of temperatures, while Y boils at 100 °C. C
- X is a mixture while Y is a compound. D

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Turn over

The following statement describes substance X. 6

A chemical reaction takes place and heat is liberated when this white solid, X is formed.

Which of the following correctly classifies X and explains why X is classified as such?

	classification	explanation
A	element	When decomposition takes place, an element, X, is produced.
В	compound	Bond forming takes place to produce X.
С	mixture	The reactants and the product X, form a mixture.
D	either an element or a compound	A chemical reaction can produce either an element or a compound.

- The atoms $^{64}_{29}$ Cu and $^{65}_{30}$ Zn have the same 7
 - nucleon number. Α
 - В number of electrons.
 - number of neutrons.
 - proton number.
- Which of the following correctly describes what happens when calcium atoms form calcium ions?

	calcium atoms	ionic equation for the formation
Α	gain electrons	Ca + 2e ⁻ → Ca ²⁺
В	gain electrons	Ca → Ca ²⁺ + 2e ⁻
С	lose electrons	Ca + 2e ⁻ → Ca ²⁺
D	lose electrons	Ca → Ca ²⁺ + 2e ⁻

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9 Element X has a lattice of positive ions and a 'sea of electrons'.

$$\begin{array}{c} \oplus^{e^-} \oplus_{e^-} \oplus^{e^-} $

Which property will X have?

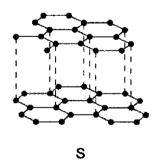
- Α It conducts electricity by the movement of ions and electrons.
- В It has a high melting point.
- C It is decomposed by an electric current.
- D It is not malleable.

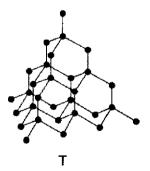
10 When a covalent substance in liquid state boils, its molecules become more widely spaced.

Which property of the molecules has the most influence on the amount of energy required to boil a covalent substance?

- the forces of attraction between the molecules
- В the reactivity of the molecules
- C the shape of the molecules
- D the strength of the covalent bonds in the molecules

11 The diagrams show the structures of two forms of carbon.





Which set of data is correct for these two structures?

	conducts electricity	very hard material	can be used as lubricant
A	Т	Т	S
В	S	Т	s
С	s	S	Т
D	т	S	Т

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[Turn over

- Which statement about ionic compounds is correct? 12
 - lonic compounds conduct electricity when solid because they contain charged particles that Α can move.
 - lonic compounds consist of a lattice of positive ions and negative ions. В
 - Most ionic compounds are solids at room temperature because of the strong attraction C between electrons and positive ions.
 - When molten or in aqueous solution, ionic compounds conduct electricity because they D contain electrons that can move.
- Sulfur and selenium (Se) are in the same group of the Periodic Table. 13

From this, we would expect selenium to form compounds having the formulae

- SeO, Na₂Se and NaSeO₄. Α
- SeO₂, Na₂Se and NaSeO₄. В
- C SeO₂, Na₂Se and Na₂SeO₄.
- SeO₃, NaSe and NaSeO₄. D
- Students give their own special symbols to five non-metallic elements. All five non-metals are in 14 the same group of the Periodic Table. These non-metals exist as coloured elements.

The special symbols are shown in Fig. 14.1. The order of chemical reactivity of these non-meals is also shown.

decreasing order of chemical reactivity Cc DdЕe Rh Aa special symbols given by students Fig. 14.1

A solution containing Cc ions can be displaced by two of the elements in the Group.

Which of the following correctly shows the ionic equation for one such reaction?

- $Aa(aq) + Cc(aq) \rightarrow Aa(aq) + Cc(aq)$ Α
- $Bb_2(aq) + 2Cc(aq) \rightarrow 2Bb(aq) + Cc_2(aq)$ В
- $Dd(aq) + Cc(aq) \rightarrow Dd(aq) + Cc(aq)$ C
- D $Ee_2(aq) + 2Cc(aq) \rightarrow 2Ee(aq) + Cc_2(aq)$

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<u>Partnerini earnina</u>

15 The table shows some of the properties of four elements.

Which element is most likely to be a transition metal?

	melting point / °C	density / g/cm³	electrical conductivity
A	3550	3.5	poor
В	1860	7.2	good
С	660	2.7	good
D	232	7.3	good

16 The relative formula masses of four compounds are given.

A student has a 1.0 g sample of each compound.

Which sample contains the highest number of moles of oxygen atoms?

	compound	relative formula mass
A	Al ₂ O ₃	102
В	CuO	80
С	H₂SO₄	98
D	HNO ₃	63

- What is the concentration of iodine, I2, molecules in a solution containing 2.54 g of iodine in 250 17 cm³ of solution?
 - 0.01 mol/dm³
- В 0.02 mol/dm³
- C 0.04 mol/dm³
- D
- 0.08 mol/dm3

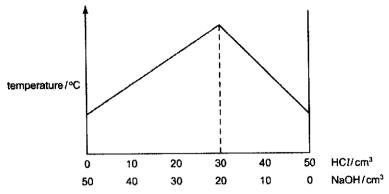
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[Turn over

A solution of hydrochloric acid has a concentration of 2 mol/dm³. 18

Different volumes of the acid are added to different volumes of aqueous sodium hydroxide.

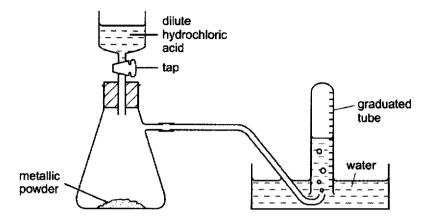
The maximum temperature of each mixture is measured. The graph shows the results.



What is the concentration of the aqueous sodium hydroxide?

- 0.67 mol/dm3 Α
- 1.3 mol/dm³ В
- 1.5 mol/dm³ C
- 3.0 mol/dm³ D

19 The diagram shows apparatus for measuring the volume of hydrogen given off when an excess of dilute hydrochloric acid is added to powdered metal. The volume of gas is measured at room temperature and pressure.



The experiment is carried out three times, using the same mass of powder each time but with different powders:

- pure magnesium
- pure zinc
- a mixture of magnesium and zinc

Which powder gives the greatest volume of hydrogen and which the least volume?

	greatest volume of H₂	least volume of H ₂
A	magnesium	zinc
В	magnesium	the mixture
С	zinc	magnesium
D	zinc	the mixture

- 20 The following statements about dilute sulfuric acid are all correct.
 - 1 Addition of Universal Indicator shows that the solution has a pH value of less than 7.0.
 - 2 A white precipitate is formed when aqueous barium chloride is added.
 - 3 The solution reacts with copper(II) oxide, forming a blue solution.
 - When electrolysed, hydrogen and oxygen gases are produced.

Which two statements confirm the acidic nature of the solution?

1 and 2 В 1 and 3 2 and 4 D 3 and 4

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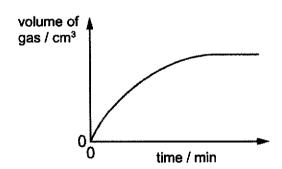
Turn over

- 21 A solution of W has the following properties.
 - When added in excess to solid ammonium chloride, a gas is given off that turns damp red litmus paper blue.
 - When added in excess to a solution of pH 3, the resulting solution has a pH of 13.

What is W?

- A a strong acid
- B a strong base
- C a weak acid
- D a weak base
- 22 Which equation describes the most suitable reaction for making lead(II) sulfate?
 - A Pb + H_2SO_4 \rightarrow PbSO₄ + H_2
 - **B** PbCO₃ + H_2SO_4 \rightarrow PbSO₄ + CO_2 + H_2O
 - C $Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 + 2HNO_3$
 - D Pb(OH)₂ + H_2SO_4 \rightarrow PbSO₄ + $2H_2O$
- 23 Excess marble chips were reacted with dilute hydrochloric acid in an experiment. The volume of gas produced was measured at regular time intervals.

The results obtained are plotted in the graph as follows.



The speed of reaction decreases throughout the reaction until it comes to a stop.

Which of the following explains why the speed of reaction decreases?

- A Marble chips were completely used up.
- B Hydrochloric acid was completely used up.
- C The mass of marble chips decreased.
- **D** The concentration of hydrochloric acid decreased.

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Dartnerini earning

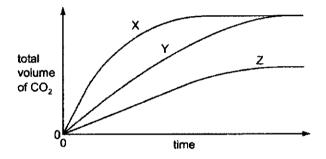
- 24 The following statements describe how the speed of reactions can be increased.
 - increase the amount of kinetic energy reactant particles can possess
 - 2 increase the frequency of effective collisions
 - 3 lower the activation energy of the reaction

Which statements describe the effect when temperature is increased?

- 1 and 2
- В 1 and 3
- 2 and 3
- D 1, 2 and 3
- 25 In experiment 1, an excess of finely powdered marble is added to 20 cm³ of dilute hydrochloric

In experiment 2, carried out under the same conditions of temperature and pressure, an excess of marble chips is added to 20 cm³ of dilute hydrochloric acid of the same concentration.

The total volumes of carbon dioxide given off are determined at intervals and plotted against time.



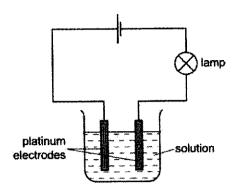
Which pair of curves is obtained in the two experiments?

	experiment 1	experiment 2
Α	x	Z
В	X	Y
С	Y	z
D	Y	×

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[Turn over

The diagram shows apparatus used to investigate the conductivity of different solutions. 26



Which substance, in aqueous solution of concentration 1 mol/dm3, would cause the lamp to give the brightest light?

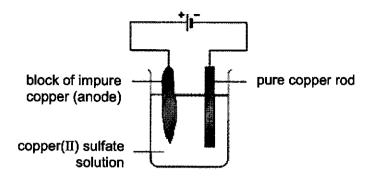
- ammonia
- В ethanoic acid
- dilute sodium chloride solution C
- D sulfuric acid
- The heat-reflecting shields of some space rockets are gold-plated, using electrolysis. 27

Which electrodes and electrolyte would be used to gold-plate the heat shield?

	negative electrode	positive electrode	electrolyte
A	carbon	heat shield	gold compound
В	gold	heat shield	copper compound
С	heat shield	carbon	copper compound
D	heat shield	gold	gold compound

Partnerini earning

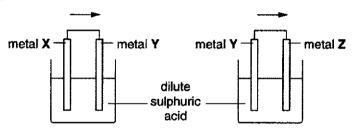
28 The following set-up shows how a block of impure copper can be purified.



The loss in mass of the anode is 50 g and the gain in mass of the cathode is 45 g.

What is the percentage purity of this sample of copper?

- 10.0 %
- В 11.1 %
- C 90.0 %
- D 95.0 %
- 29 Two cells were set up as shown in the diagram. The arrow shows the direction of electron flow in the external circuit.



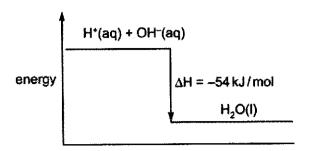
Which set of metals would give the electron flows in the direction shown?

	metal X	metal Y	metal Z
A	Ag	Cu	Zn
В	Ag Cu	Zn	Cu
С	Cu	Zn	Ag
D	Zn	Cu	Ag

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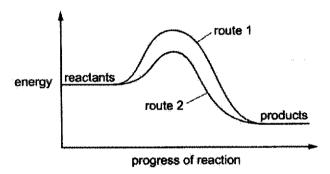
30 The energy diagram for the reaction between sodium hydroxide and hydrochloric acid is shown.



Which quantity of heat is liberated when 100 cm³ of 1 mol/dm³ hydrochloric acid reacts with 100 cm³ of 1 mol/dm³ sodium hydroxide?

- A 0.54 kJ
- **B** 2.70 kJ
- C 5.40 kJ
- **D** 10.8 kJ

31 The diagram shows the energy profile for a reaction.



Which statements about this reaction are correct?

- More energy is absorbed to break the bonds than is released when new bonds are formed.
- 2 Route 1 and route 2 give the same overall equation for the reaction.
- 3 Route 2 involves the use of a catalyst.
- 4 The reaction is exothermic.
- A 1, 2 and 3
- B 1 and 2 only
- C 2, 3 and 4
- D 3 and 4 only

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Portnorial coming

32 The equation shows a reversible reaction.

$$N_2O_4(g) \iff 2NO_2(g)$$

The forward reaction is endothermic.

Which of these changes will increase the yield of NO₂?

	pressure	temperature
A	decreased	decreased
В	decreased	increased
С	increased	decreased
D	increased	increased

- 33 Which of the following is not an example of oxidation?
 - A converting iron(III) salts to iron(II) salts
 - B converting magnesium atoms into magnesium ions
 - C dissolving a copper anode during electrolysis
 - D liberating chlorine from a chloride solution
- 34 Sulfur dioxide reacts with aqueous bromine according to the following equation.

$$SO_2(g) + Br_2(aq) + 2H_2O(I) \rightarrow H_2SO_4(aq) + 2HBr(aq)$$

Which element has been oxidised?

- A bromine
- B hydrogen
- C oxygen
- D sulfur

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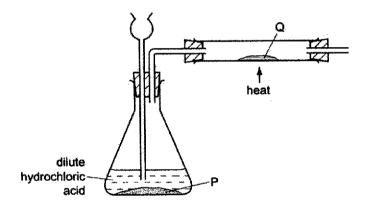
Turn over

Some metals and the compounds in their ores are shown. 35

metal	Al	Ca	Pb	Na	Fe	Mg
compound in their ore	Al ₂ O ₃	CaCO₃	PbS	NaC <i>i</i>	Fe₂O₃	MgCO₃

Which type of reaction occurs in the extraction of all of these metals from their respective ores?

- decomposition by heat
- electrolysis В
- precipitation C
- reduction
- The diagram shows the apparatus in an experiment to reduce substance Q with the gas generated 36 in the flask.



What are substances P and Q?

	Р	Q
Α	copper	copper(II) oxide
В	lead	lead(II) oxide
С	magnesium	zinc oxide
D	zinc	copper(II) oxide

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37 Brass is an alloy.

Which statement about brass is correct?

- It contains a sea of electrons.
- В It contains positive and negative ions which are free to move.
- C It is a compound of a metal and a non-metal.
- D It is a compound of two or more metals.
- 38 Iron is extracted from its ore haematite, Fe₂O₃, by a reduction process in the blast furnace.

Which equation for reactions in the blast furnace shows the formation of the reducing agent?

- CaCO₃ → CaO + CO₂ Α
- В CaO + SiO₂ → CaSiO₃
- C CO₂ + C → 2CO
- D $C + O_2 \rightarrow CO_2$
- 39 Cars have catalytic converters fitted to reduce problems caused by some of the exhaust gases. However, cars fitted with catalytic converters still give out environmentally harmful gases.

Which of the following correctly states the harmful gas and the problem the gas causes?

	harmful gas	problem
Α	nitrogen dioxide	dissolves in rain to corrode marble buildings
В	nitrogen dioxide	causes breathing problems when inhaled.
С	carbon dioxide	binds with haemoglobin in blood causing respiratory problems
D	carbon dioxide	causes the greenhouse effect leading to global warming

Nitrogen monoxide, NO, damages the ozone layer by reacting with ozone in a two-step reaction. 40

$$NO + O_3 \rightarrow NO_2 + O_2 \qquad \text{step 1}$$

 $NO_2 + O_3 \rightarrow NO + 2O_2$ step 2

One nitrogen monoxide molecule can destroy thousands of ozone molecules.

Which statement correctly explains why?

- Nitrogen monoxide in step 1 is easily generated through thunderstorms.
- Nitrogen monoxide, while is used up in step 1, is regenerated in step 2. В
- Nitrogen dioxide produced can dissolve in rain to react with thousands of ozone molecules. C
- Nitrogen monoxide can react continuously with ozone since the ozone layer consists of D thousands of ozone molecules.

End of Paper

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The Periodic Table of Element

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The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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	5 q			Although students were
solvent -			•	not penalized, need to
chromatography set up (spot above solvent, paper stopper/lid) - boiling tube solvent, stopper/lid) Solvent Spot of black dye labelling (minimally minimally above solvent)			1m for correct	highlight that since
chromatography above solvent, paper stopper/lid) 1 m for correct labelling solvent pencil line pencil line			set up (spot	ethanol, a volatile solvent,
Solvent Spot of black dye stopper/lid) Solvent Spot of black dye labelling (minimally fine solvent)			above solvent,	is used, a lid needs to be
Spot of black dye labelling solvent (minimally pencil line			stopper/lid)	used to prevent it from
solvent (minimally pencil line			1m for correct	evaporating.
pencil line			minimally.	Solved to highlight that
The state of the s		•	(IIIIIIIII)	SAME as start line
		Michigan Company		

line

		solvent, spot on pencil line)	
32	Similarity – both are made of phosphorus atoms covalently bonded together / both involve each phosphorus atom being bonded to 3 other atoms.	-	Many wrote that black phosphorus has a simple molecular structure.
	Difference – white phosphorus has a simple molecular structure while black phosphorus has a glant molecular / covalent structure.	~	Need to highlight that students need to name the type of bond – stating 'held together by strong bonds' is insufficient
3b	In black phosphorus, a large amount of energy is needed to break the extensive network of strong covalent bonds. This accounts for its high melting point.	~	Got ecf from 3a. Some students panicked and forgot the
	However, in white phosphorus, a small amount of energy is needed to overcome the weak intermolecular forces of attraction between the molecules. Hence, it has a much lower melting point.	1m	bonds/forces of attraction that needs to be overcome during melting.
		im for comparing the relative amount of energies needed.	
30	CI & P & CI	1m for correct bonding and	A handful of students separated the unbonded electrons in phosphorus.
	CI S X : electrons of CI X : electrons of P	arrangement of atoms	

		1m for correct arrangement of electrons (-1m for drawing all electron shells)	
4a	This post is not valid. Sodium will react in air/water since it is very reactive. Hence, since rubidium is even more reactive than sodium, the possibility of it reacting in air/water is higher. Therefore, it cannot be found as silvery deposits. OR Rubidium is on top of the series. Hence it is highy reactive.	1m for explaining that it will react in air 1m for drawing comparison with sodium	Generally well done
;		-	
6	Magnesium reacts very slowly with cold water while iron does not react with cold water. Since beryllium is in between these two metals, it might not even react / react extremely slowly (slower than Mg) with cold water	-	Poorly done. Need to highlight that the question's intent is for them to explain the vigour
	wignesium reacts violently with steam whereas iron reacts slowly with steam. Since beryllium is between these two metals, it might react quickly/rapidly/slowly (slower than Mg) with steam.		of the reaction, and also that they need to draw comparisons with magnesium and iron, since these two are the located
40	Heating bismuth oxide with coke (carbon) / hydrogen		the closes with beryllium.
5a(l)	Ba ²⁺ , OH	-	To go through 5a and 5b in detail since it was very
5a(II)	H ⁺ , SO ₄ 2-		badly done.
2 p	At the start of the experiment, the ammeter reading was the highest as there was highest number of ions present (concentration of ions is at its maximum) to carry a current.	~	Even for 5a, many students stated the formula of the substance though they have been clearly

	ions were used up to form solid BaSO4. Therefore, there are fewer mobile ions present to carry a current.	4	ions. Many failed to interpret the curve
	When 5.00 cm³ of sulfuric acid is added, all the Ba²* ions have reacted to form solid barium sulfate, which is poor electrical conductor.	-	
50	No. of moles of sulfuric acid needed for complete reaction = $0.500 \times 0.005 = 0.0025$	-	Generally well done.
	Concentration = 0.0025 / 0.025 = 0.1 mol/dm ³	•	
	OR		
	$M_1V_1/M_2V_2 = na/nb$		
	$M_1 \times 25 / (0.5 \times 5) = 1/1$	~	
	$M_1 = 0.1 \text{ mol/dm}^3$	~ -	
2q	Plastic prevents the iron from coming into contact with oxygen	-	Generally well done. Vaque response will be to
			just state that iron will react with the mixture.
6а	Zn²+ or Cu²+	-	Very poorly done. Need to highlight to students that
		4-	since question is asking
	As aqueous ammonia is added, a precipitate of the metal hydroxide	7	them to identify cation, they need to zoom in
	When aqueous ammonia is added in excess, the precipitate dissolves and the mass of solid decreases.	-	straight to the cations test.
q9	No.	~	Many failed to give the
<u> </u>			proper explanation, just
	The reaction of the metal oxide obtained from stage I with budgeshoric acid will not produce carbon dioxide		stating that there is no more carbonate left.'

Ag¹(aq) + Ci¹(aq) → AgCi(s) This is to ensure that all of the oxygen has reacted. Volume of oxygen = 200 – 160 = 40 cm³ % of oxygen = 40 / 200 × 100% = 20% FeC₂O₂ The oxidation state of C has increased from +3 (in FeC₂O₄) to +4 (in CO₂). The oxidation state of C has also decreased from +3 (lin FeC₂O₄) to +2 (in CO). Since both oxidation and reduction happens at the same time, this is a redox reaction.							
This is to ensure that all of the oxygen has reacted. Volume of oxygen = 200 – 160 = 40 cm³ % of oxygen = 40 / 200 x 100% = 20% FeC ₂ O ₄ CO ₂ The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 (in FeC ₂ O ₄) to +2 (in CO ₂). Since both oxidation and reduction happens at the same time, this is a redox reaction.	၁	Ag⁺(aq) +	Cl(aq) →	AgCl(s)	 - □ © © ©	1m for correct balanced equation, 1m for correct state symbols	Poorly done. Tried to award ecf but tough
Volume of oxygen = 200 – 160 = 40 cm³ % of oxygen = 40 / 200 x 100% = 20% FeC ₂ O ₄ +3 CO ₂ +2 The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 (in FeC ₂ O ₄) to +2 (in CO). Since both oxidation and reduction happens at the same time, this is a redox reaction.	7 a	This is to e	insure that a	all of the oxygen has reacted.	~		Generally well done. Vague responses will include 'ensuring that all reactants has reacted'.
% of oxygen = 40 / 200 x 100% = 20% FeC ₂ O ₂ The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation and reduction happens at the same time, this is a redox reaction. Since both oxidation and reduction happens at the same time, this is a redox reaction.	Q	Volume of	oxygen = 2($30 - 160 = 40 \text{ cm}^3$	-		
FeC ₂ O ₄ +3 CO ₂ +4 The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation and reduction happens at the same time, this is a redox reaction.		% of oxyge	sn = 40 / 20(
The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). Since both oxidation and reduction happens at the same time, this is a redox reaction.	(j)			oxidation state of carbon	~	1m for FeC,O4	Very poorly done for FeC ₂ O ₄
The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 (in FeC ₂ O ₄) to +2 (in CO). Since both oxidation and reduction happens at the same time, this is a redox reaction.			FeC ₂ O ₄	+3	- 0	1m for the other 2 substances	
The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 ((in FeC ₂ O ₄) to +2 (in CO). Since both oxidation and reduction happens at the same time, this is a redox reaction.			COS	+4			
The oxidation state of C has increased from +3 (in FeC ₂ O ₄) to +4 (in CO ₂). The oxidation state of C has also decreased from +3 ((in FeC ₂ O ₄) to +2 (in CO). Since both oxidation and reduction happens at the same time, this is a redox reaction.			8	+2			
The oxidation state of C has also decreased from +3 ((in FeC ₂ O ₄) to +2 (in CO). Since both oxidation and reduction happens at the same time, this is a redox reaction.	(II)	The oxidat CO ₂).	ion state of	C has increased from +3 (in FeC ₂ O₄) to			Decent
Since both oxidation and reduction happens at the same time, this is a redox reaction.		The oxidat +2 (in CO)	ion state of	C has also decreased from +3 ((in FeC₂	.O ₄) to		
%UE		Since both redox redox	oxidation a	_	his is a		
0/00	8a	30%					Well done

8b	This is to incl This also helt	This is to increase the yield of hydrogen and nitrogen into ammonia.	and nitrogen into ammonia.	-	Well done
				•	
80	When the temperature is slow.		too low, the speed of reaction will be too	-	Well done
9a		cathode	anode		Extremely poorly done. Really need to teach
	AFC	O ₂ (g) + 2H ₂ O(l) + 4e → 4OH ⁻ (aq)	H₂(g) + 2OH·(aq) → 2H₂O(l) + 2e	1 each	students to read and process passage
	PEMFC	4H⁺(aq) + O₂(g) + 4e → 2H₂O(l)	H₂(g) → 2H⁺(aq) + 2e		
				1 for correct	Poorly done
q6	2H ₂ (g) + O ₂	$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$		balanced	•
				equation, 1 for state symbols	
96	Carbon dioxide, being an		acidic oxide, reacts with the electrolyte	-	Even though many were able to state that carbon
					dioxide is an acidic oxide,
	CO ₂ + 2KOH → K ₂ CO ₃	H → K ₂ CO ₃ + H ₂ O		\-	many falled to write the correct equation; instead
					they wrote the equation for
					the tormation of carbonic acid which doesn't explain
					why carbon dioxide
					poisons the electrolyte at all.
p6	The operation contrast to P	The operation of AFC requires non-precious metal as catalyst in contrast to PEMFC which requires expensive platinum catalysts	ous metal as catalyst in sive platinum catalysts	-	Well done.
i i	and precion	and precious metal-based electrodes as well.	s well.		

9e(i)	They produce only water as the waste product.		Many wrote 'they do not produce greenhouse gases'; there are many other ways that a fuel can pollute the environment.
(ii)e6	Methane is used in the production of hydrogen.		Students need to discuss the impact.
	If methane leaks into the atmosphere, it can trap heat and cause greenhouse effect.		For CO, many just stated that it is a toxic gas without
	OR		expidining its impact.
	Carbon monoxide, which is produced, is toxic as it binds to the haemoglobin, resulting in it being unable to bind to oxygen, which may lead to breathing difficulties that may result in death.		
10a	2H ₂ O ₂ → O ₂ + 2H ₂ O	_	Many did not know the formula of hydrogen
10b	More energy is released to form O=O bonds and O-H bonds than	_	Many did not split up the
	the energy taken in to break O-H bonds and O-O bonds.	_	atoms. For e,g 'H-O-H bonds'.
	OR		
	Less energy is taken in to break O-H bonds and O-O bonds than the energy released to form O=O bonds and O-H bonds.	-	

rrect Generally well done. energy gram, elling tion both ofile 1 he and		Many failed to realise that since this is a part question, their answer needs to be linked to c(i).		Many wrote 'increase temperature' without considering the feasibility of it in this context.	A few did not balance correctly.	Many did not convert the mass to grams! Ecf awarded (grudgingly)
1m for correct shape of energy profile diagram, 1m for labelling the activation energy on both energy profile diagrams, 1m for correctly labelling the reactants and products		-	1	τ	-	- -
2H,02 E	2.	The catalyst lowers the activation energy of the reaction and this increases the number of particles having energy higher than or equal to the new activation energy.	Hence, the frequency of effective collisions increases, thereby speeding up the reaction.	increase the concentration of the hydrogen peroxide	2NiS + 3O ₂ → 2NiO + 2SO ₂	No. of moles of NiS = 182 000 / 91 = 2000 No. of moles of SO ₂ formed = 2000 Volume = 2000 × 24 dm ³ = 48 000 dm ³
10c(1)		10c(ii)		10c(iii)	EITHER 11a(i)	11a(II)

of mobile delocalized free moving electrons. This sea of mobile electrons can move to carry the charge of an 1 electric current when a potential difference is applied. No visible reaction Blue solution turns green Nickel gets coated with a pink solid Magnesium is more reactive than nlckel/carbon Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Strong acid - sulfuric acid Strong acid - sulfuric acid sation dihydrogen phosphate / stating the types of ionisation that strong and weak acid - phosphoric acid / socilum dihydrogen phosphate / ethanoic acid sation dihydrogen phosphate / ethanoic acid sation water that results in a high concentration in water to form a low water that only dihydrogen phosphate / ethanoic acid is a strong acid as it undergoes partial ionisation in water to form a low water was acid as it undergoes partial ionisation in water to form a low water high p.H. In for stating if the relative concentration of hydrogen is a relatively resulting in a low p.H. In for stating the relative concentration of hydrogen in a relatively of hydrogen in the relative concentrations of hydrogen in a relatively relative concentrations of hydrogen in the relative concentrations of hydrogen in a relatively relative concentration in a relative concentration in a relative concentration in	11b	Metals consist of a lattice of positive ions that are surrounded by a sea	1	Well done. Those who did
This sea of mobile electrons can move to carry the charge of an electric current when a potential difference is applied. No visible reaction No visible reaction Blue solution turns green Nickel gets coated with a pink solid Magnesium is more reactive than nickel/carbon Its oxide cannot be reduced by carbon to form magnesium; however, nickel(III) oxide can be reduced by carbon in stage 2. Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Strong acid - sulfuric acid Weak acid - phosphoric acid / sodium dihydrogen phosphate / the formation in a low ph. Sulfuric acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen lons, thereby resulting in a low ph. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a weak acid as it undergoes partial ionisation in water high ph. The for stating the relative concentrations of hydrogen lons, thereby resulting in a relatively concentrations of hydrogen lons, thereby resulting in a relatively concentrations of hydrogen		of mobile delocalized free moving electrons.		not get the full marks did
electric current when a potential difference is applied. No visible reaction Blue solution turns green Nickel gets coated with a pink solid Magnesium is more reactive than nickel/carbon Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. ORR Magnesium can only be obtained by electrolysis Magnesium can only be obtained by electrolysis NaOH(aq) + H₃DO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Strong acid - sulfuric acid Weak acid - phosphoric acid / sodium dihydrogen phosphate / the form a redistrong and weak acid so in a low p.H. Sulfuric acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen lons, thereby resulting in a low p.H. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a weak acid as it undergoes partial ionisation in water to form a low weak acid as it undergoes partial ionisation in water high p.H. In for stating the relative concentrations of hydrogen lons, thereby resulting in a relatively of hydrogen lons, thereby resulting in a relatively concentrations of hydrogen lons.		This sea of mobile electrons can move to carry the charge of an	τ-	not explain metal structure.
Blue solution turns green Blue solution turns green Nickel gets coated with a pink solid Magnesium is more reactive than nickel/carbon Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Magnesium can only be obtained by electrolysis Im for correctly stating at undergoes partial ionisation in water that resulting in a low pH. Thosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a that ionisation weak acid as it undergoes partial ionisation in water that results in a high pH. Thosphoric acid / sodium dihydrogen lons, thereby resulting in a relatively the relative concentrations of hydrogen On hydrogen The relative concentrations of hydrogen lons, thereby resulting in a relatively concentrations of hydrogen Magnesium is more properties and the relative concentrations of hydrogen Magnesium is more properties. The relative concentrations of hydrogen The relative concentrations of hydrogen lons is a magnesium in the relative concentrations of hydrogen.		electric current when a potential difference is applied.		
Blue solution turns green Nickel gets coated with a pink solid Magnesium is more reactive than nickel/carbon Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Strong acid - sulfuric acid Strong acid - sulfuric acid / sodium dihydrogen phosphate / ethanoic acid Weak acid - phosphoric acid / sodium dihydrogen phosphate / ethanoic acid Sulfuric acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen ions, thereby resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a strong and weak acid as it undergoes partial ionisation in water concentration of hydrogen ions, thereby resulting in a relatively high pH. In for stating the relative concentrations of hydrogen ions, the relative concentrations of hydrogen	110	No visible reaction	-	Many wrote blue solution
Nickel gets coated with a pink solid Magnesium is more reactive than nickel/carbon Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Strong acid − sulfuric acid Strong acid − sulfuric acid Weak acid − sulfuric acid Sulfuric acid is a strong acid as it undergoes complete ionisation that strong and weak water that results in a high concentration of hydrogen lons, thereby resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a weak acid as it undergoes partial ionisation in water that results in a high concentration of hydrogen lons, thereby resulting in a relatively high pH. Im for stating the types of ionisation in water that results in a high concentrations of hydrogen lons, thereby resulting in a relatively in the relative concentrations of hydrogen lons, thereby resulting in a relatively of hydrogen lons, thereby resulting in a relative concentrations of hydrogen lons.		i		tums colourless'
Nickel gets coated with a pink solid Magnesium is more reactive than nickel/carbon Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) ⇒ NaH₂PO₄(aq) + H₂O(I) Strong acid - sulfuric acid Weak acid - phosphoric acid / sodium dihydrogen phosphate / ethanoic acid Sulfuric acid is a strong acid as it undergoes complete ionisation in strong and weak water that resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a water that resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a water that resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a that ionization weak acid as it undergoes partial ionisation in water that realtively high pH. Im for stating the relative concentrations of hydrogen lons, thereby resulting in a relatively fite relative concentrations of hydrogen		Blue solution turns green	,	
Magnesium is more reactive than nickel(II) oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Strong acid - sulfuric acid Weak acid - phosphoric acid / sodium dihydrogen phosphate / ethanoic acid Sulfuric acid is a strong acid as it undergoes complete ionisation in strong and weak water that results in a high concentration of hydrogen phosphate / ethanoic acid sodium dihydrogen phosphate / ethanoic acid m for stating the types of ionisation in water to form a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a strong acid as it undergoes partial ionisation in water to form a low water concentration of hydrogen lons, thereby resulting in a relatively high pH. If m for stating the types of ionisation in water that ionization that sating the relative concentrations of hydrogen lons, thereby resulting in a relatively of hydrogen phosphate / ethanoic acid is a fraction of hydrogen lons, thereby resulting in a relatively of hydrogen lons, thereby resulting in a relatively of hydrogen lons.		Nickel gets coated with a pink solid	•	
Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(I) Strong acid − sulfuric acid Weak acid − phosphoric acid / sodium dihydrogen phosphate / ethanoic acid Sulfuric acid is a strong acid as it undergoes complete ionisation that strong and weak acid acid is a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a trading and weak acid as it undergoes partial ionisation in water to form a low water that cach acid as it undergoes partial ionisation in water to form a low water high pH. Im for stating the relative concentrations of hydrogen Im for stating the relative concentration of hydrogen in a relatively of hydrogen	11d	Magnesium is more reactive than nickel/carbon	•	Need to highlight to
Its oxide cannot be reduced by carbon to form magnesium; however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) ⇒ NaH₂PO₄(aq) + H₂O(I) Strong acid − sulfuric acid Weak acid − phosphoric acid / sodium dihydrogen phosphate / ethanoic acid Sulfuric acid is a strong acid as it undergoes complete ionisation in strong and weak acid acid is a solium dihydrogen phosphate / ethanoic acid is a strong acid weak acid as it undergoes partial ionisation in water to form a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a that ionization weak acid as it undergoes partial ionisation in water to form a low water high pH. Im for stating the relative concentrations of hydrogen of hydrogen			,	students that they need to
however, nickel(II) oxide can be reduced by carbon in stage 2. OR Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(!) Strong acid - sulfuric acid Weak acid - phosphoric acid / sodium dihydrogen phosphate / stating the types Sulfuric acid is a strong acid as it undergoes complete ionisation in strong and weak water that results in a high concentration of hydrogen lons, thereby resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a water to concentration of hydrogen lons, thereby resulting in a relatively water high pH. Im for stating the relative concentrations of hydrogen lons, thereby resulting in a relatively the relative concentrations of hydrogen.		Its oxide cannot be reduced by carbon to form magnesium;		compare magnesium to
Magnesium can only be obtained by electrolysis NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(l) Strong acid - sulfuric acid Weak acid - phosphoric acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen phosphate / ethanoic acid is a strong acid sodium dihydrogen phosphate / ethanoic acid is a strong acid sodium dihydrogen phosphate / ethanoic acid is a water that results in a high concentration of hydrogen ions, thereby resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a water concentration of hydrogen ions, thereby resulting in a relatively high pH. Im for stating the rypes of ionisation that stating the tone acid so a strong and weak acid as it undergoes partial ionisation in water to form a low water high pH.		however, nickel(II) oxide can be reduced by carbon in stage 2. OR		either Ni or C.
NaOH(aq) + H₃PO₄(aq) → NaH₂PO₄(aq) + H₂O(l) Strong acid – sulfuric acid Weak acid – phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen lons, thereby resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a tundergoes partial ionisation in water to form a low weak acid as it undergoes partial ionisation in water concentration of hydrogen lons, thereby resulting in a relatively high pH. Im for stating the types of ionisation that strong and weak acid so it undergoes partial ionisation in water that ionization water high pH.		Magnesium can only be obtained by electrolysis		
Strong acid – sulfuric acid Weak acid – phosphoric acid / sodium dihydrogen phosphate / ethanoic acid Weak acid – sulfuric acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a weak acid as it undergoes partial ionisation in water to form a low water high pH. Im for stating the types of ionisation that strong and weak acid so it undergoes partial ionisation in water that ionization water high pH. Im for stating the types of ionisation that strong and weak acid so it undergoes partial ionisation in water the relative concentrations of hydrogen	S R	NaOH(aq) + H ₃ PO ₄ (aq) → NaH ₂ PO ₄ (aq) + H ₂ O(I)	1m for correct	Not many attempted this
Strong acid – sulfuric acid Weak acid – phosphoric acid / sodium dihydrogen phosphate / thereby results in a high concentration of hydrogen ions, thereby resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a strong and weak acid as it undergoes partial ionisation in water to form a low water that results in a high concentration of hydrogen lons, thereby resulting in a relatively high pH. Im for stating the relative concentrations of hydrogen of hydrogen	11a		equation, 1m for	question.
Strong acid – sulfuric acid Weak acid – phosphoric acid / sodium dihydrogen phosphate / thereby resulting in a low pH. Phosphoric acid / sodium dihydrogen phosphate / ethanoic acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen lons, thereby resulting in a relatively high pH. Strong acid said weak acid as it undergoes partial ionisation in water to form a low water that ionization takes place in weak acid as it undergoes partial ionisation in water that ionization takes place in water high pH.			correct state	
Strong acid – sulfuric acid Weak acid – phosphoric acid / sodium dihydrogen phosphate / ethanoic acid Sulfuric acid is a strong acid as it undergoes complete ionisation in water that results in a high concentration of hydrogen phosphate / ethanoic acid / sodium dihydrogen phosphate / ethanoic acid is a tundergoes partial ionisation in water to form a low water concentration of hydrogen ions, thereby resulting in a relatively high pH. Im for stating the types of ionisation that strong and weak acid as it undergoes partial ionisation in water had ionisation in the relative concentrations of hydrogen			symbols	
tion in id is a a low vely	11b(i)	Strong acid - sulfuric acid		Many missed out 'in water'
tion in id is a a low vely		Weak acid – phosphoric acid / sodium dihydrogen phosphate /	1m for correctly	
		ethanoic acid	stating the types	
			of ionisation that	
		Sulfuric acid is a strong acid as it undergoes complete ionisation in	strong and weak	
dihydrogen phosphate / ethanoic acid is a partial ionisation in water to form a low an lons, thereby resulting in a relatively		water that results in a high concentration of hydrogen ions,	acids undergo	
dihydrogen phosphate / ethanoic acid is a partial ionisation in water to form a low an lons, thereby resulting in a relatively		thereby resulting in a low pH.	1m for stating	
partial ionisation in water to form a low an ions, thereby resulting in a relatively			that ionination	
partial ionisation in water to form a low an lons, thereby resulting in a relatively			that lonization	
			takes place in	
		concentration of nyarogen lons, thereby resulting in a relatively high pH.	water	
the relative concentrations of hydrogen			1m for stating	
concentrations of hydrogen			the relative	
ue position in the second seco			concentrations	
			of hydrogen	

(E)	Place the chosen acids of same, known volume and same, known concentration into separately into a conical flask.	1	Setup: 1 Reagents: 1 Measurements: 1
	Add a known mass of zinc carbonate / zinc (any plausible carbonate or metal) into the acids.		Conclusion: 1 Variables kept constant: 1
	Immediately attach a well-oiled gas syringe to the flask to collect the carbon dioxide gas / hydrogen gas formed.	-	Correct approach – 1m Correct
	Stop the experiment for both acids at the same time. Record the volume of gas produced.	-	- 1m Correct variable fixed - 1m Correct conclusion - 1m
	The strong acid will give a higher volume of gas whereas the weak acid will give a lower volume of gas.	-	Those who attempted this did guite well.
	(other accepted methods – measuring current, measuring speed of reactions, measuring mass loss)	1m for stating at least 2 variables that are kept constant	