Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/11**

Paper 1 Multiple Choice (Core) **October/November 2017**

45 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

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Write in soft pencil.
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Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
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There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
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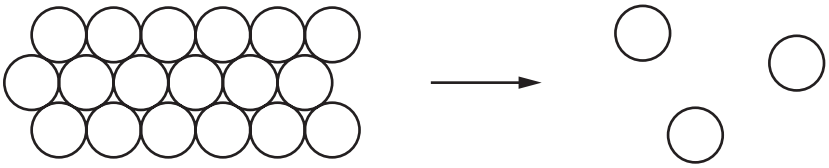
Read the instructions on the Answer Sheet very carefully.

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 printed on page 16.
Electronic calculators may be used.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level1/Level 2 Certificate.

This document consists of **15** printed pages and **1** blank page.

1 The diagram shows how the arrangement of particles changes when a substance changes state.



Which change of state is shown?

A boiling

B condensation

C evaporation

D sublimation

2 Which method can be used to separate a mixture of salt and water to obtain **both** parts of the mixture?

A crystallisation

B distillation

C evaporation

D filtration

3 A student put 25.0 cm^3 of dilute hydrochloric acid into a conical flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use to obtain the most accurate results?

A balance, measuring cylinder, thermometer

B balance, pipette, stopwatch

C balance, pipette, thermometer

D burette, pipette, thermometer

4 Propanone, C_3H_6O, is a liquid at room temperature.

What is the boiling point of pure propanone?

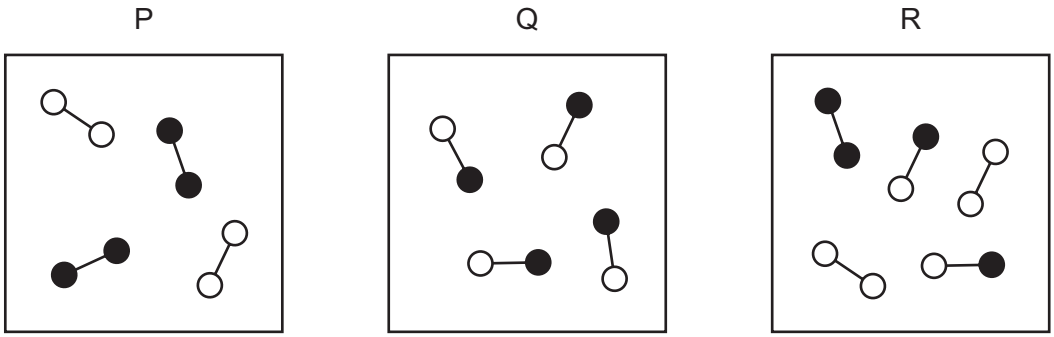
A –61 °C to –51 °C

B –56 °C

C 51 °C to 61 °C

D 56 °C

5 Which statement about the boxes P, Q and R is correct?



A Box P contains two compounds and box R contains two elements.

B Box P contains two elements and box Q contains a mixture.

C Box P contains two elements and box Q contains one compound.

D Box Q contains two compounds and box R contains a mixture.

6 The number of particles in atoms W, X, Y and Z are shown.

	protons	electrons	neutrons
W	6	6	6
X	6	6	7
Y	7	7	7
Z	7	7	8

Which statement is correct?

A W and X are isotopes of carbon.

B X and Y are isotopes of nitrogen.

C X has a mass number of 12.

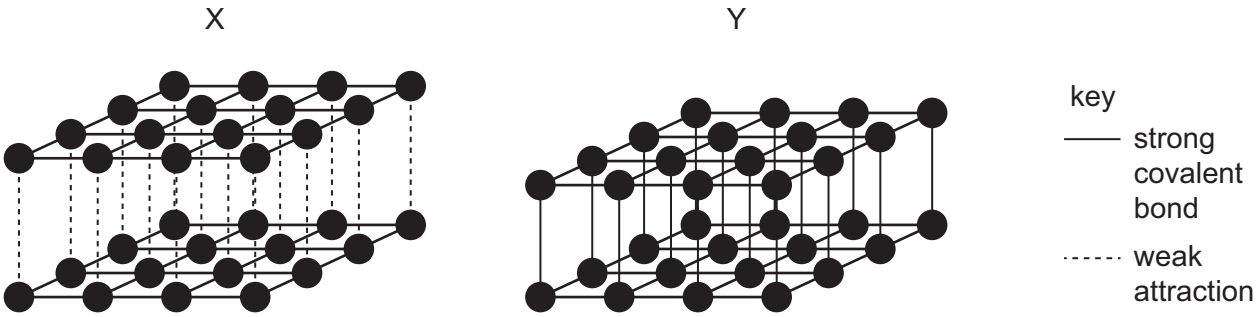
D Z has an atomic number of 8.

7 Which row describes the type of bonding present in substances 1 and 2?

	substance 1	substance 2
A	methane has ionic bonding	graphite has covalent bonding
B	graphite has ionic bonding	potassium chloride has covalent bonding
C	potassium chloride has ionic bonding	methane has covalent bonding
D	potassium chloride has ionic bonding	graphite has ionic bonding

8 Substances with giant covalent structures can be used as lubricants and as cutting tools for hard materials.

The diagram shows how the atoms are arranged in two giant covalent substances, X and Y.



Which statement is correct?

A Only X is used as a cutting tool and only Y is used as a lubricant.

B Only X is used as a lubricant and only Y is used as a cutting tool.

C X and Y are both used as cutting tools.

D X and Y are both used as lubricants.

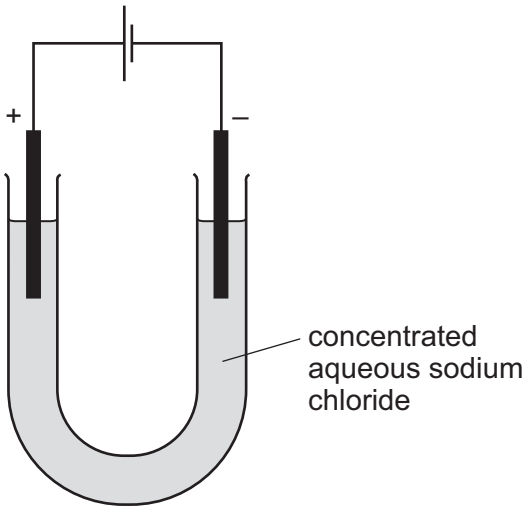
9 The equation shows the thermal decomposition of magnesium carbonate (M_r = 84).

$$MgCO_3 \rightarrow MgO + CO_2$$

Which mass of magnesium oxide is formed when 21.0 g of magnesium carbonate are completely decomposed?

A 1.9 g **B** 4.0 g **C** 10.0 g **D** 40.0 g

10 Electricity is passed through concentrated aqueous sodium chloride. Inert electrodes are used.



What is formed at the negative electrode?

A chlorine

B hydrogen

C oxygen

D sodium

11 Two chemical processes are described.

- During the combustion of gasoline, energy is .....1..... .
- During the electrolysis of sulfuric acid, energy is .....2..... .

Which words complete gaps 1 and 2?

	1	2
A	given out	given out
B	given out	taken in
C	taken in	given out
D	taken in	taken in

12 When dilute sulfuric acid reacts with aqueous sodium hydroxide, the temperature of the solution increases.

Which words describe this reaction?

A endothermic and neutralisation

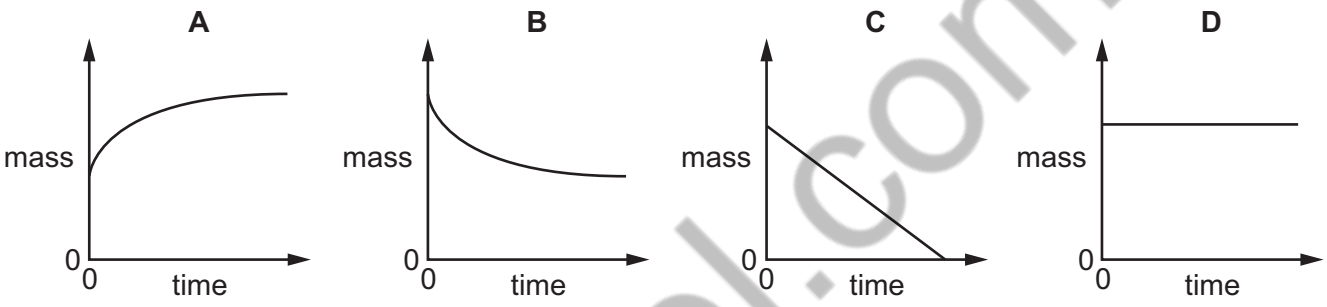
B endothermic and redox

C exothermic and neutralisation

D exothermic and redox

13 The mass of a beaker and its contents is plotted against time.

Which graph represents what happens when sodium carbonate reacts with an excess of dilute hydrochloric acid in an open beaker?



14 When blue copper(II) sulfate is heated, a white solid and water are formed.

The white solid turns blue and gives out heat when water is added to it.

Which terms describe the blue copper(II) sulfate and the reactions?

	the blue copper(II) sulfate is	reactions
A	a mixture	can be reversed
B	a mixture	cannot be reversed
C	hydrated	can be reversed
D	hydrated	cannot be reversed

15 Which changes increase the rate of reaction between calcium carbonate and dilute hydrochloric acid?

1 increasing the concentration of the acid

2 increasing the temperature

3 increasing the size of the pieces of calcium carbonate

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

16 The equations for two reactions P and Q are given.

P $2\underline{NaNO_2} + O_2 \rightarrow 2NaNO_3$

Q $2\underline{Hg}O \rightarrow 2Hg + O_2$

In which of these reactions does oxidation of the underlined substance occur?

	P	Q
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

17 What is **not** a typical characteristic of acids?

A They react with alkalis producing water.

B They react with **all** metals producing hydrogen.

C They react with carbonates producing carbon dioxide.

D They turn blue litmus paper red.

18 Magnesium, phosphorus and chlorine are elements in the same period of the Periodic Table.

Which row describes the type of oxide formed by each of these elements?

	magnesium	phosphorus	chlorine
A	acidic	acidic	basic
B	acidic	basic	basic
C	basic	acidic	acidic
D	basic	basic	acidic

19 Zinc sulfate is made by reacting an excess of zinc oxide with dilute sulfuric acid.

The excess zinc oxide is then removed from the solution.

Which process is used to obtain solid zinc sulfate from the solution?

A crystallisation

B dissolving

C filtration

D fractional distillation

20 What is used to test for chlorine?

A a glowing splint

B damp litmus paper

C limewater

D potassium manganate(VII) solution

21 Which statements about the trends across a period of the Periodic Table are correct?

1 Aluminium is more metallic than sodium.

2 Beryllium is more metallic than carbon.

3 Boron is more metallic than lithium.

4 Magnesium is more metallic than silicon.

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

22 Astatine is an element in Group VII of the Periodic Table.

Astatine is .....1..... reactive than iodine.

The melting point of astatine is .....2..... than the melting point of iodine.

Astatine is .....3..... in colour than bromine.

Which words complete gaps 1, 2 and 3?

	1	2	3
A	less	higher	darker
B	less	lower	lighter
C	more	higher	darker
D	more	lower	lighter

23 Which row describes the properties of a typical transition element?

	melting point	forms coloured compounds	can act as a catalyst
A	high	no	no
B	high	yes	yes
C	low	no	yes
D	low	yes	no

24 Why is argon gas used to fill electric lamps?

A It conducts electricity.

B It glows when heated.

C It is less dense than air.

D It is not reactive.

25 What is a property of **all** metals?

A conduct electricity

B hard

C low melting points

D react with water

26 Which material is **not** involved in the large-scale extraction of iron from iron ore?

A bauxite

B calcium carbonate (limestone)

C carbon (coke)

D hematite

27 Some reactions of three metals are listed in the table.

metal	metal reacts with dilute hydrochloric acid	metal oxide is reduced by carbon
P	yes	no
Q	no	yes
R	yes	yes

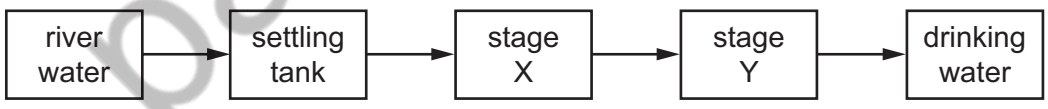
What is the order of reactivity of the metals?

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

28 Which uses of the metals shown are both correct?

	aluminium	stainless steel
A	aircraft bodies	cutlery
B	car bodies	aircraft bodies
C	chemical plant	food containers
D	food containers	car bodies

29 The flow chart shows stages in the treatment of river water to produce drinking water.



What occurs at stages X and Y?

	X	Y
A	distillation	chlorination
B	distillation	filtration
C	filtration	chlorination
D	filtration	distillation

30 Which gas is over 30% of air?

A argon

B carbon dioxide

C nitrogen

D oxygen

31 Iron is a metal that rusts in the presence of oxygen and water.

Mild steel is used for .....1..... and is prevented from rusting by .....2..... .

Stainless steel does not rust. It is produced by .....3..... iron with another metal.

Which words complete gaps 1, 2 and 3?

	1	2	3
A	car bodies	greasing	covering
B	car bodies	painting	mixing
C	cutlery	greasing	covering
D	cutlery	painting	mixing

32 A mixture produces a gas both when it reacts with an acid and when it reacts with an alkali.

Which ions are present in the mixture?

A ammonium ions and carbonate ions

B ammonium ions and oxide ions

C hydrogen ions and carbonate ions

D hydrogen ions and oxide ions

33 Some marble chips (calcium carbonate) are heated strongly and substances X and Y are formed.

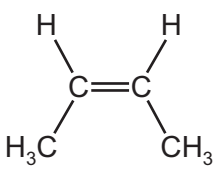
Substance X is a white solid that reacts with water, giving out heat. Substance Y is a colourless gas.

What are substances X and Y?

	X	Y
A	calcium chloride	oxygen
B	calcium hydroxide	carbon dioxide
C	calcium oxide	carbon dioxide
D	calcium sulfate	oxygen

34 The structures of some organic molecules are shown.

1



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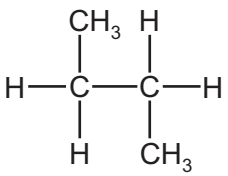

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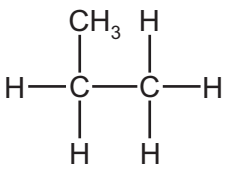

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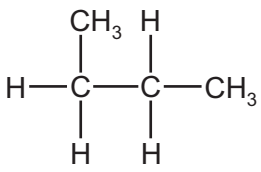


Which structures represent an alkane with four carbon atoms?

A 1 only **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

35 Some of the fractions obtained from the fractional distillation of petroleum are used as fuels for vehicles.

Which two fractions are used as fuels for vehicles?

A bitumen fraction and gasoline fraction

B bitumen fraction and naphtha fraction

C gasoline fraction and kerosene fraction

D kerosene fraction and lubricating fraction

36 Burning fossil fuels releases heat energy.

Which substance is **not** a fossil fuel?

A coal

B hydrogen

C natural gas

D petroleum

37 X, Y and Z are three hydrocarbons.

X $CH_2=CH_2$ Y $CH_3–CH=CH_2$ Z $CH_3–CH_2–CH=CH_2$

What do compounds X, Y and Z have in common?

1 They are all alkenes.

2 They are all part of the same homologous series.

3 They all have the same boiling point.

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

38 The table shows bonds that are present and bonds that are not present in compound X.

bond	
C–C	✓
C=C	✗
C–H	✓
C–O	✓
C=O	✓
O–H	✓

What type of compound is X?

A a carboxylic acid

B an alcohol

C an alkane

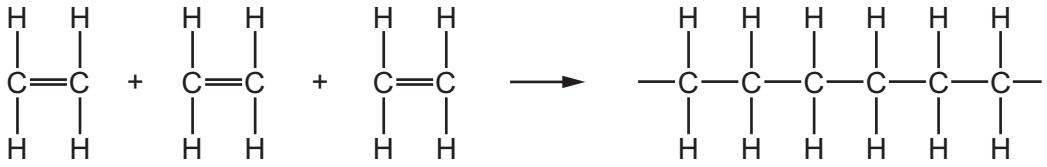
D an alkene

39 The diagram shows a reaction sequence.

Which row names the processes X, Y and Z?

	X	Y	Z
A	cracking	fermentation	respiration
B	cracking	hydration	combustion
C	distillation	fermentation	respiration
D	distillation	hydration	combustion

40 Molecules of a substance react together as shown.



Which type of reaction has taken place?

A cracking

B oxidation

C polymerisation

D reduction

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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CHEMISTRY **0620/21**

Paper 2 Multiple Choice (Extended) **October/November 2017**

45 minutes

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1 Which process causes the greatest increase in the distance between particles?

A condensation

B freezing

C melting

D sublimation

2 A student put 25.0 cm^3 of dilute hydrochloric acid into a conical flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use to obtain the most accurate results?

A balance, measuring cylinder, thermometer

B balance, pipette, stopwatch

C balance, pipette, thermometer

D burette, pipette, thermometer

3 The results obtained from a chromatogram are shown.

	distance travelled / cm
solvent	5.0
substance X	3.0
substance Y	2.5

Which row gives the R_f values of substance X and substance Y?

	R_f (X)	R_f (Y)
A	0.5	0.6
B	0.6	0.5
C	1.6	2.0
D	2.0	1.6

4 Two statements about silicon(IV) oxide are given.

1 It is a hard substance.

2 It has a macromolecular structure with strong covalent bonds.

Which is correct?

A Both statements are correct and statement 2 explains statement 1.

B Both statements are correct but statement 2 does not explain statement 1.

C Statement 1 is correct but statement 2 is not correct.

D Statement 2 is correct but statement 1 is not correct.

5 Which statement explains why isotopes of the same element have the same chemical properties?

A They have a different number of neutrons in the nucleus.

B They have the same number of neutrons in the nucleus.

C They have the same number of outer shell electrons.

D They have the same number of protons as neutrons.

6 Which dot-and-cross diagram shows the outer shell electron arrangement in a molecule of nitrogen?

A

B

C

D

7 The equation for the reaction between barium chloride solution and dilute sulfuric acid is shown.

$$BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$$

Which row shows the state symbols for this equation?

	$BaCl_2$	H_2SO_4	$BaSO_4$	$2HCl$
A	(aq)	(aq)	(s)	(aq)
B	(aq)	(l)	(s)	(aq)
C	(l)	(aq)	(s)	(l)
D	(aq)	(l)	(aq)	(l)

8 A compound is analysed and found to contain 85.7% carbon and 14.3% hydrogen.

What is its empirical formula?

A CH **B** CH_2 **C** C_2H_4 **D** C_6H

9 Which statements about the electrolysis of concentrated copper(II) chloride are correct?

1 Electrons are transferred from the cathode to the copper(II) ions.

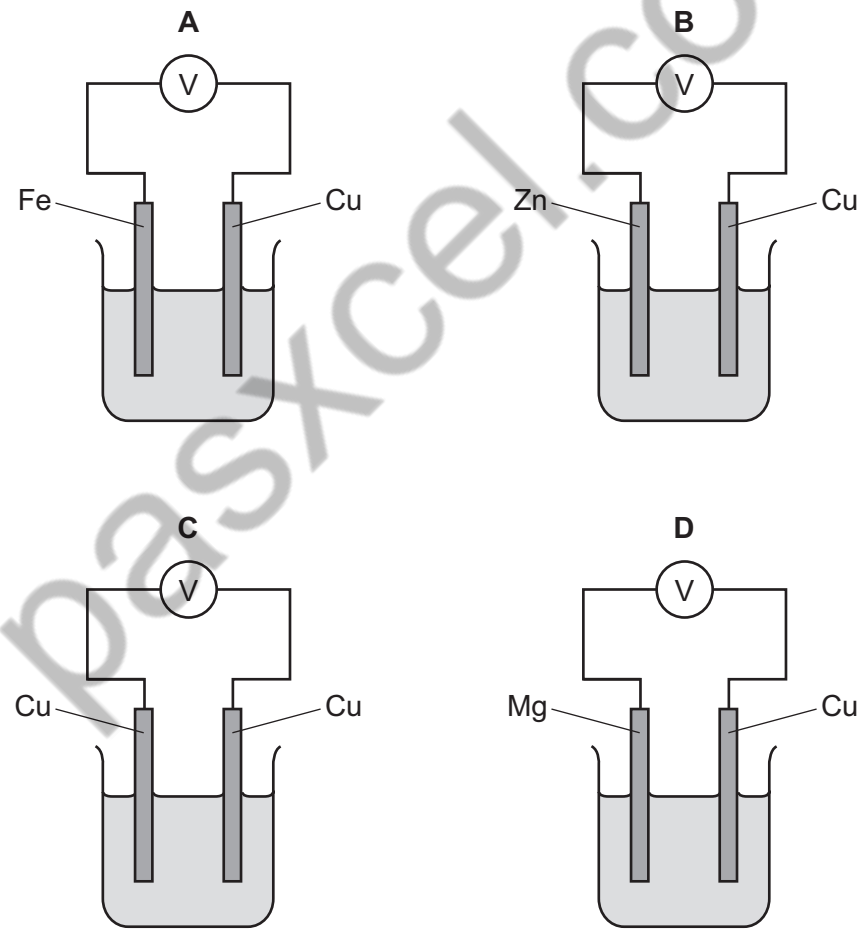
2 Electrons move round the external circuit from the cathode to the anode.

3 Chloride ions are attracted to the anode.

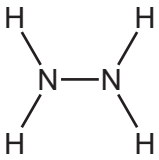
4 Hydroxide ions transfer electrons to the cathode.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

10 Which metal combination produces the highest voltage reading in the cells shown?



11 The compound hydrazine is used as a rocket fuel. It has the structural formula shown.



One of the reactions of hydrazine is shown. This reaction is exothermic.

$$N_2H_4 \rightarrow N_2 + 2H_2$$

The bond energies are shown in the table.

	bond energy in kJ / mol
H–H	+436
N–H	+390
N–N	+160
N≡N	+945

What is the energy change for this reaction?

A –339 kJ / mol **B** –97 kJ / mol **C** +97 kJ / mol **D** +339 kJ / mol

12 Which statement describes an exothermic reaction?

A The energy absorbed for bond breaking is greater than the energy released by bond formation.

B The energy absorbed for bond breaking is less than the energy released by bond formation.

C The energy released by bond breaking is greater than the energy absorbed for bond formation.

D The energy released by bond breaking is less than the energy absorbed for bond formation.

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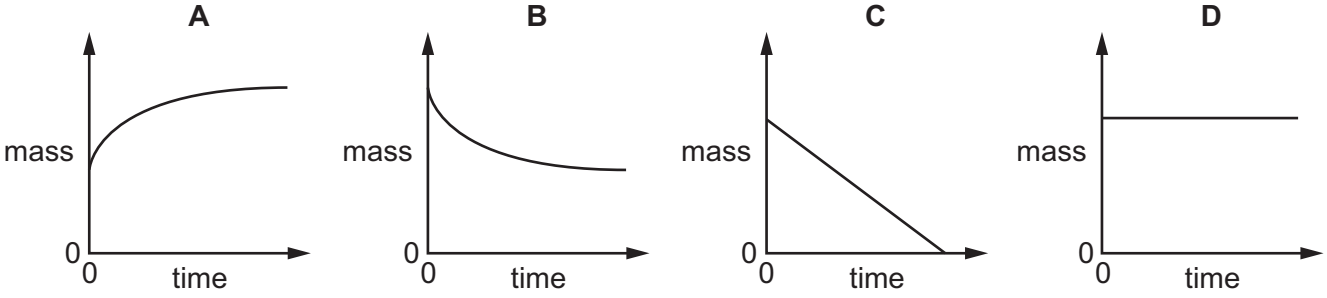
Which graph represents what happens when sodium carbonate reacts with an excess of dilute hydrochloric acid in an open beaker?



14 Copper(II) oxide reacts with hydrogen.

$$CuO + H_2 \rightarrow Cu + H_2O$$

Which row is correct?

	oxidising agent	reducing agent
A	H_2	CuO
B	CuO	H_2
C	H_2O	Cu
D	Cu	H_2O

15 Ethanoic acid reacts slowly with calcium carbonate.

Which statements explain why an increase in temperature increases the rate of the reaction?

1 The activation energy of the reaction is decreased.

2 There is an increase in collision rate.

3 The particles have more energy.

4 There will be fewer successful collisions.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 and 4

16 Methane reacts with steam to produce hydrogen and carbon monoxide.

The equation for the reaction is shown.

$$CH_4(g) + H_2O(g) \rightleftharpoons 3H_2(g) + CO(g)$$

The reaction is reversible. The forward reaction is endothermic.

Which changes in temperature and pressure increase the equilibrium yield of carbon monoxide?

	temperature	pressure
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

17 Some properties of four oxides are listed.

Oxide 1 reacts with both acids and alkalis to form salts.

Oxide 2 reacts with acids to form salts but does not react with alkalis.

Oxide 3 reacts with alkalis to form salts but does not react with acids.

Oxide 4 does not react with acids or alkalis.

Which row describes the oxides?

	oxide 1	oxide 2	oxide 3	oxide 4
A	amphoteric	acidic	basic	neutral
B	amphoteric	basic	acidic	neutral
C	neutral	acidic	basic	amphoteric
D	neutral	basic	acidic	amphoteric

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C They react with carbonates producing carbon dioxide.

D They turn blue litmus paper red.

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B dissolving

C filtration

D fractional distillation

20 What is used to test for chlorine?

A a glowing splint

B damp litmus paper

C limewater

D potassium manganate(VII) solution

21 Which statements about the trends across a period of the Periodic Table are correct?

1 Aluminium is more metallic than sodium.

2 Beryllium is more metallic than carbon.

3 Boron is more metallic than lithium.

4 Magnesium is more metallic than silicon.

A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

22 Astatine is an element in Group VII of the Periodic Table.

Astatine is .....1..... reactive than iodine.

The melting point of astatine is .....2..... than the melting point of iodine.

Astatine is .....3..... in colour than bromine.

Which words complete gaps 1, 2 and 3?

	1	2	3
A	less	higher	darker
B	less	lower	lighter
C	more	higher	darker
D	more	lower	lighter

23 Which row describes the properties of a typical transition element?

	melting point	forms coloured compounds	can act as a catalyst
A	high	no	no
B	high	yes	yes
C	low	no	yes
D	low	yes	no

24 Why is argon gas used to fill electric lamps?

A It conducts electricity.

B It glows when heated.

C It is less dense than air.

D It is not reactive.

25 What is a property of **all** metals?

A conduct electricity

B hard

C low melting points

D react with water

26 Aluminium is extracted by the electrolysis of aluminium oxide.

Which statement is **not** correct?

A Aluminium ions are oxidised at the cathode.

B Carbon dioxide is made at the anode.

C Cryolite is added to lower the melting point of the aluminium oxide.

D The electrodes are made from graphite.

27 Which row describes how the metals are used?

	mixed with zinc to form brass	used to galvanise iron
A	aluminium	tin
B	aluminium	zinc
C	copper	tin
D	copper	zinc

28 Information about the nitrates and carbonates of two metals, Q and R, is shown.

	appearance	solubility in water	effect of heat
nitrate of Q	white solid	soluble	colourless gas evolved which relights a glowing splint
carbonate of Q	white solid	soluble	no reaction
nitrate of R	white solid	soluble	brown gas evolved
carbonate of R	white solid	insoluble	colourless gas evolved which turns limewater milky

Which statement is correct?

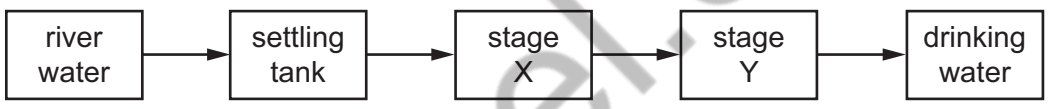
A Q is calcium and R is magnesium.

B Q is magnesium and R is sodium.

C Q is potassium and R is copper.

D Q is sodium and R is calcium.

29 The flow chart shows stages in the treatment of river water to produce drinking water.



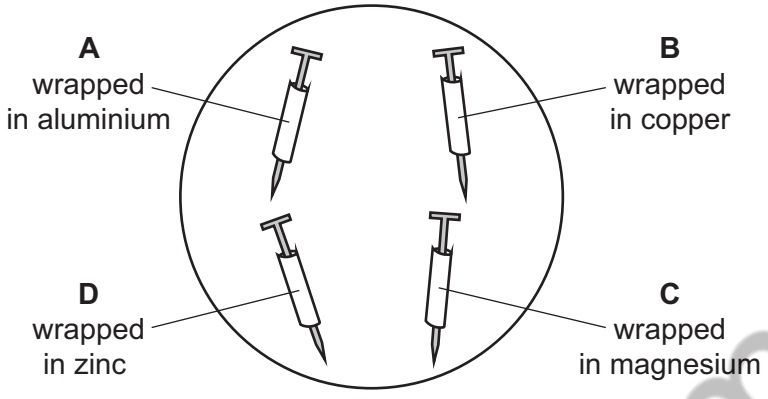
What occurs at stages X and Y?

	X	Y
A	distillation	chlorination
B	distillation	filtration
C	filtration	chlorination
D	filtration	distillation

30 Four iron nails had different metals wrapped around them.

The nails were placed in an open dish filled with water and left for a week.

Which iron nail has no protection against rusting?



31 Ammonia is made by the Haber process.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

What are the sources of the nitrogen and hydrogen used in the Haber process?

	nitrogen	hydrogen
A	fertilisers	reacting methane with steam
B	fertilisers	the air
C	the air	reacting methane with steam
D	the air	the air

32 Which process does **not** produce carbon dioxide?

A combustion of alkanes

B photosynthesis

C respiration

D thermal decomposition of limestone

33 Which row shows the conditions used in the manufacture of sulfuric acid by the Contact process?

	temperature / °C	pressure / atm	catalyst
A	40	200	Fe
B	40	200	V_2O_5
C	400	2	Fe
D	400	2	V_2O_5

34 Some marble chips (calcium carbonate) are heated strongly and substances X and Y are formed.

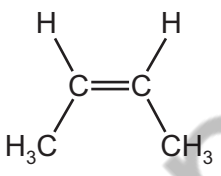
Substance X is a white solid that reacts with water, giving out heat. Substance Y is a colourless gas.

What are substances X and Y?

	X	Y
A	calcium chloride	oxygen
B	calcium hydroxide	carbon dioxide
C	calcium oxide	carbon dioxide
D	calcium sulfate	oxygen

35 The structures of some organic molecules are shown.

1



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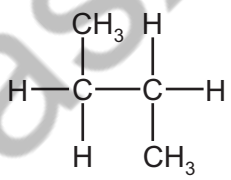

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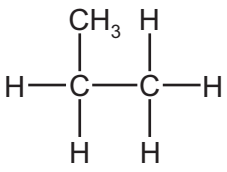

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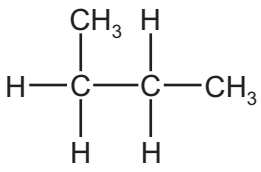


Which structures represent an alkane with four carbon atoms?

A 1 only **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

36 Some of the fractions obtained from the fractional distillation of petroleum are used as fuels for vehicles.

Which two fractions are used as fuels for vehicles?

A bitumen fraction and gasoline fraction

B bitumen fraction and naphtha fraction

C gasoline fraction and kerosene fraction

D kerosene fraction and lubricating fraction

37 X, Y and Z are three hydrocarbons.

X $CH_2=CH_2$ Y $CH_3–CH=CH_2$ Z $CH_3–CH_2–CH=CH_2$

What do compounds X, Y and Z have in common?

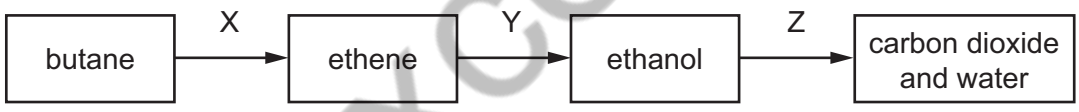
1 They are all alkenes.

2 They are all part of the same homologous series.

3 They all have the same boiling point.

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

38 The diagram shows a reaction sequence.



Which row names the processes X, Y and Z?

	X	Y	Z
A	cracking	fermentation	respiration
B	cracking	hydration	combustion
C	distillation	fermentation	respiration
D	distillation	hydration	combustion

39 Which pair of compounds can be used to prepare $CH_3CH_2COOCH_2CH_3$?

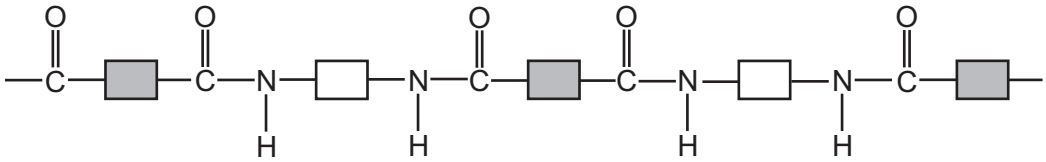
A ethanoic acid and ethanol

B ethanoic acid and propanol

C propanoic acid and ethanol

D propanoic acid and propanol

40 The structure of a synthetic polymer is shown.



The structure shows that it is a .....1..... . It is formed by .....2..... polymerisation.

Which words complete gaps 1 and 2?

	1	2
A	polyamide	addition
B	polyamide	condensation
C	polyester	addition
D	polyester	condensation

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

8786129582

CHEMISTRY **0620/31**

Paper 3 Theory (Core) **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

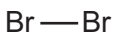
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

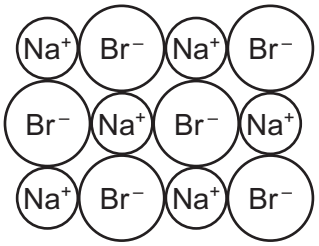
This document consists of **15** printed pages and **1** blank page.

1 The diagram shows the structures of five substances, **A**, **B**, **C**, **D** and **E**.

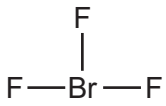
A



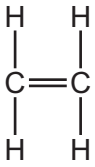
B



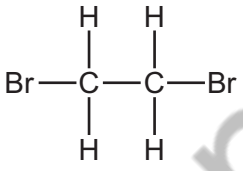
C



D



E



Answer the following questions using only the structures in the diagram.
Each structure may be used once, more than once or not at all.

(a) Which structure, **A**, **B**, **C**, **D** or **E**,

(i) is a diatomic molecule, ... [1]

(ii) contains ions, ... [1]

(iii) decolourises aqueous bromine, ... [1]

(iv) conducts electricity when molten, ... [1]

(v) contains atoms of **two** different halogens? ..... [1]

(b) Bromine is an element.

What is meant by the term *element*?

.....

..... [1]

(c) Bromine melts at –7 °C and boils at 59 °C.

What is the physical state of bromine at –15 °C?
Explain your answer.

.....

..... [2]

[Total: 8]

2 The table shows the composition of the atmosphere of the planet Neptune.

gas present	percentage of gas in Neptune's atmosphere
helium	19.5
hydrogen	78.8
methane	
other gases	0.2

(a) Complete the table to calculate the percentage of methane in Neptune's atmosphere. [1]

(b) Describe how Neptune's atmosphere differs from the Earth's atmosphere.
Give **three** differences.

1 .....

.....

2 .....

.....

3 .....

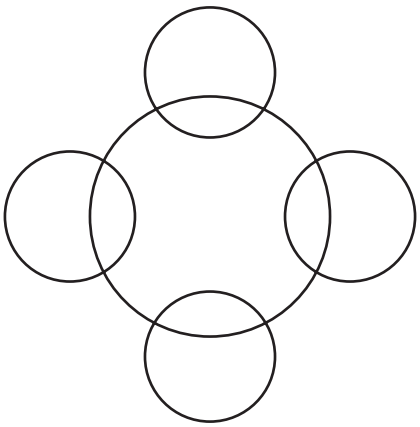
.....

[3]

(c) Methane is a covalent compound.

Complete the diagram to show
- the arrangement of electrons in a molecule of methane,
- the symbols of the atoms present.

Show outer shell electrons only.



[2]

(d) Isotopes of hydrogen are present in Neptune's atmosphere.

(i) What is meant by the term *isotopes*?

.....

..... [1]

(ii) An atom of hydrogen has three nucleons.

Deduce the number of protons and neutrons present in **one** atom of this isotope of hydrogen.
Use your Periodic Table to help you.

number of protons .....

number of neutrons .....
[2]

(e) Other gases present in Neptune's atmosphere include ethane and water vapour.

(i) Calculate the relative molecular mass of ethane, C_2H_6.
Use your Periodic Table to help you.

relative molecular mass = ... [2]

(ii) Describe a chemical test for water.

test .....

result .....
[2]

[Total: 13]

3 The following substances are present in a liquid floor cleaner.

coloured dyes
ethanol
preservatives
sodium carbonate

(a) (i) Balance the chemical equation for the complete combustion of ethanol.

$$C_2H_5OH + 3O_2 \rightarrow .....CO_2 + ...H_2O$$

[2]

(ii) Draw the structure of an ethanol molecule showing all of the atoms and all of the bonds.

[2]

(b) Aqueous sodium carbonate is alkaline.

(i) Which **one** of the following pH values is alkaline?
Put a circle around the correct answer.

pH 3 pH 6 pH 7 pH 10

[1]

(ii) Aqueous sodium carbonate is colourless.

An excess of aqueous sodium carbonate is added to a solution of dilute sulfuric acid and methyl orange.

Describe the colour change.

from ..... to ..... [2]

(iii) The chemical equation for the reaction between sodium carbonate and dilute sulfuric acid is shown.

$$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$$

Write the word equation for this reaction.

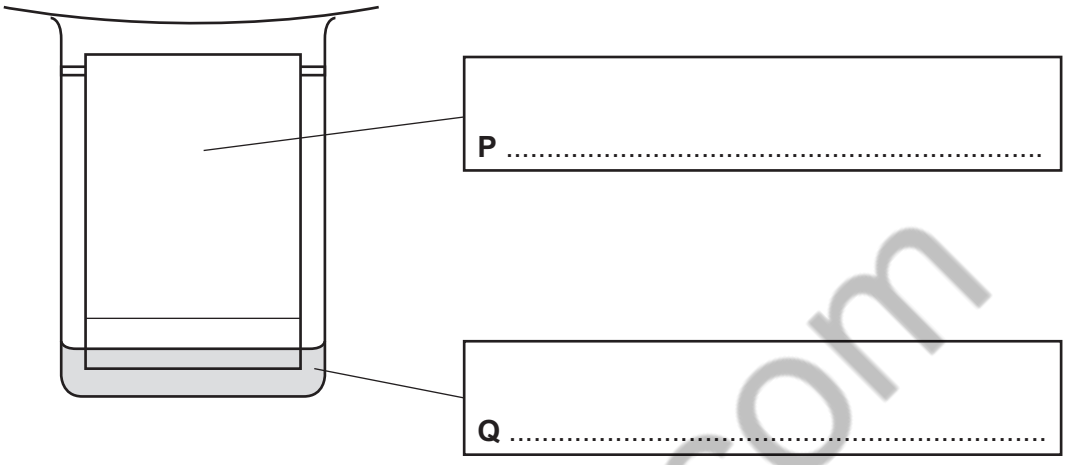
..... [2]

(c) Preservatives stop the growth of bacteria and fungi.

State the name of an acidic gas used to preserve food.

..... [1]

(d) The coloured dyes in the liquid floor cleaner can be separated using the apparatus shown.



(i) Complete the boxes to label **P** and **Q**. [2]

(ii) State the name of this method of separation.

..... [1]

(iii) On the diagram, put an **X** to show where the mixture of coloured dyes is placed at the start of the experiment. [1]

[Total: 14]

4 The table shows the properties of four substances.

substance	boiling point	electrical conductivity of solid	electrical conductivity when molten	density in g / cm^3
graphite				2.25
iodine	low	does not conduct	does not conduct	4.93
potassium	high		conducts	0.86
zinc chloride	high	does not conduct	conducts	2.91

(a) Complete the table to show the electrical conductivity of solid graphite and solid potassium. [2]

(b) Give **one** piece of evidence from the table that shows that iodine is a simple covalent substance.

..... [1]

(c) What information in the table shows that zinc chloride is an ionic compound?

.....

..... [2]

(d) Molten zinc chloride can be electrolysed.

Predict the products of this electrolysis at

the positive electrode (anode), ...

the negative electrode (cathode). ..... [2]

(e) Aqueous iodine is formed when aqueous chlorine is added to aqueous potassium iodide.

Use ideas about reactivity to explain why this reaction occurs.

.....

..... [1]

[Total: 8]

5 Titanium is extracted from an ore which contains titanium(IV) oxide, TiO_2.

(a) (i) Balance the chemical equation for the first step in this extraction.

$$TiO_2 + ...C + ...Cl_2 \rightarrow TiCl_4 + 2CO$$

[2]

(ii) Explain why the conversion of carbon to carbon monoxide is an oxidation reaction.

..... [1]

(b) Titanium is a transition element.
Sodium is a Group I element.

Describe **two** differences in the physical properties of titanium and sodium.

1 .....

.....

2 .....

.....

[2]

(c) The properties and relative reactivity with water of some Group I elements are shown in the table.

element	density in g / cm^3	melting point in °C	relative reactivity with water
lithium	0.53	181	
sodium		98	forms bubbles rapidly but does not burst into flames
potassium	0.86		forms bubbles very rapidly and bursts into flames
rubidium	1.53	39	reacts explosively

(i) Complete the table
- for the relative reactivity of lithium with water,
- to predict the melting point of potassium.

[2]

(ii) Describe the general trend in the density of the Group I elements.

..... [1]

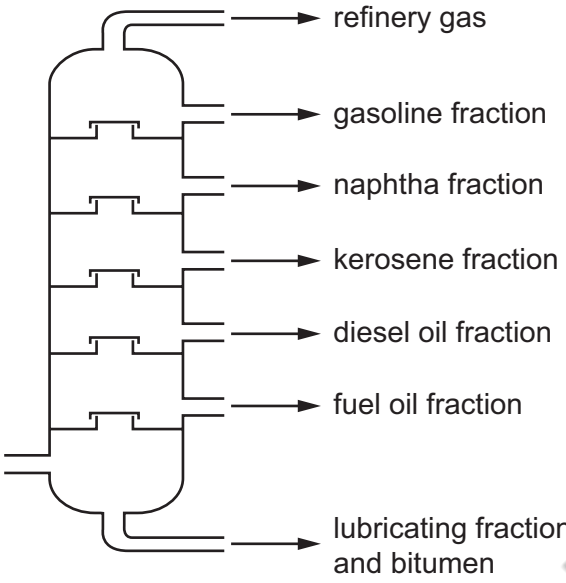
(d) Is lithium oxide an acidic oxide or a basic oxide?
Explain your answer.

.....

..... [1]

[Total: 9]

6 The diagram shows a fractionating column used for the fractional distillation of petroleum.



(a) Describe the fractional distillation of petroleum.

In your answer, include

- where the petroleum enters the fractionating column,
- the relative temperatures in the fractionating column (higher or lower),
- the relative boiling points of the fractions (higher or lower),
- the changes in physical state which occur.

.....

.....

.....

.....

.....

.....

..... [4]

(b) Alkenes can be made by cracking the kerosene fraction.

(i) What is meant by the term *cracking*?

.....

..... [2]

(ii) When butane is cracked, ethene and gas **X** are produced.

$$C_4H_{10} \rightarrow 2C_2H_4 + \mathbf{X}$$

State the name of gas **X**.

..... [1]

(c) Complete the sentence about the bonding in butane.

All the bonds in butane are single ..... chemical bonds. [1]

(d) Ethene is used to make poly(ethene).

Which **one** of the following words describes poly(ethene)?
Put a circle around the correct answer.

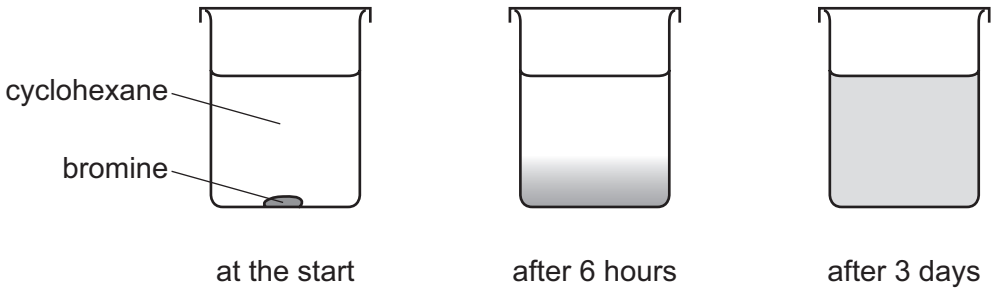
gas **monomer** **polymer** **solvent**

[1]

[Total: 9]

7 Bromine is a red-brown liquid which is soluble in cyclohexane.

(a) A few drops of liquid bromine were placed at the bottom of a beaker containing cyclohexane. After 3 days, a red-brown colour had spread throughout the beaker.



Explain these observations using the kinetic particle model.

.....

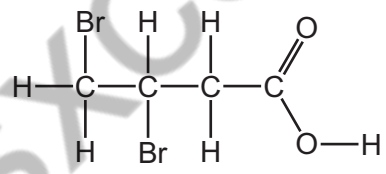
.....

.....

.....

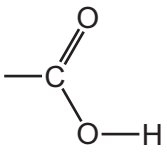
..... [3]

(b) The structure of a compound containing bromine is shown.



(i) Deduce the molecular formula of this compound showing the number of carbon, hydrogen, oxygen and bromine atoms.

..... [1]

(ii) State the name of the  functional group.

..... [1]

(c) The relative atomic mass of bromine is 80.

Complete the definition of relative atomic mass using terms from the list.

6

12

an atom

an element

a molecule

average

carbon

hydrogen

total

Relative atomic mass is the ..... mass of naturally occurring atoms of ..... on a scale where ..... of the ^{12}C isotope has a mass of exactly ..... units. [4]

(d) Dilute hydrobromic acid reacts with magnesium ribbon.

(i) Suggest **three** ways of increasing the rate of this reaction.

1 .....

2 .....

3 .....

[3]

(ii) Hydrobromic acid reacts with oxygen. The products are water and bromine.

Balance the chemical equation for this reaction.

$$.....HBr + O_2 \rightarrow 2H_2O + 2Br_2$$

[1]

[Total: 13]

8 Ammonia is manufactured by combining nitrogen and hydrogen at high temperature and pressure.

$$\text{nitrogen} + \text{hydrogen} \overset{\text{catalyst}}{\rightleftharpoons} \text{ammonia}$$

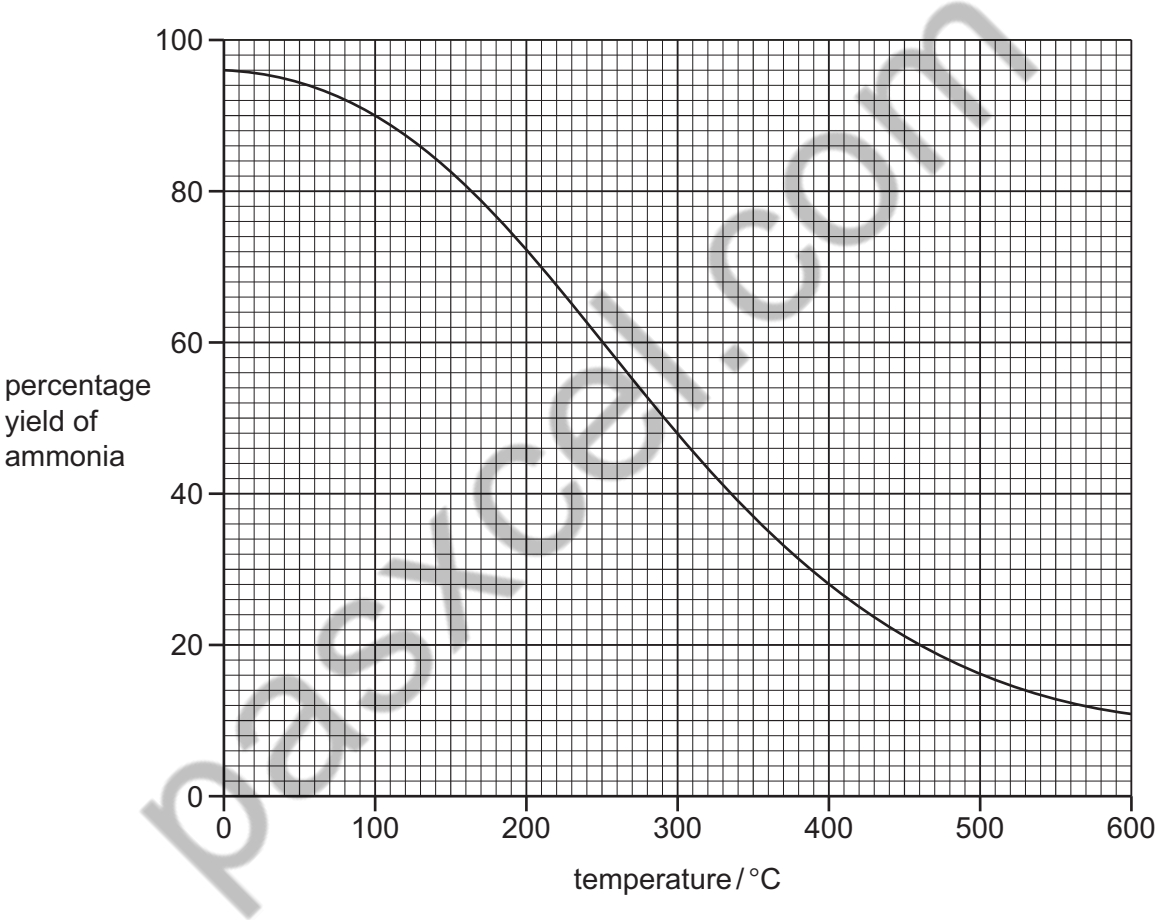
(a) (i) What is the meaning of the symbol $\rightleftharpoons$?

..... [1]

(ii) What is the purpose of the catalyst?

..... [1]

(b) The graph shows the percentage yield of ammonia at different temperatures.



(i) Describe how the percentage yield of ammonia changes with temperature.

..... [1]

(ii) Deduce the percentage yield of ammonia at 400 °C.

..... [1]

(c) Copper(II) oxide reacts with ammonia.

copper(II) oxide + ammonia → copper + nitrogen + water

When 20 g of copper(II) oxide react with an excess of ammonia, 16 g of copper are formed.

Calculate the mass of copper formed when 140 g of copper(II) oxide react with an excess of ammonia.

..... g [1]

(d) Ammonia is used in the manufacture of nylon.

Give **one** use of nylon.

..... [1]

[Total: 6]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

1311966589

CHEMISTRY **0620/41**

Paper 4 Theory (Extended) **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 16.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **16** printed pages.

1 The table gives information about five particles. The particles are all atoms or ions.

particle	number of protons	number of neutrons	number of electrons
A	6	8	6
B	12	12	12
C	13	14	10
D	8	8	10
E	11	12	11

Answer the following questions using the information in the table.
Each particle may be used once, more than once or not at all.

(a) Which particle, **A**, **B**, **C**, **D** or **E**,

(i) is an atom with atomic number 12,

..... [1]

(ii) is an atom with nucleon number 14,

..... [1]

(iii) is an ion with a positive charge,

..... [1]

(iv) has only **one** electron in its outer shell?

..... [1]

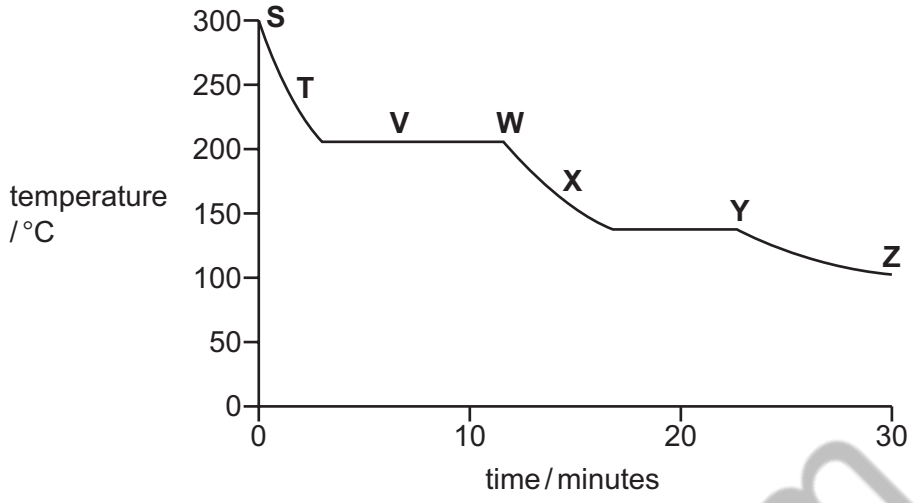
(b) **D** is an ion of an element.

Identify the element and write the formula of **D**.

..... [2]

[Total: 6]

2 The graph shows how the temperature of a substance changes as it is cooled over a period of 30 minutes. The substance is a gas at the start.



Each letter on the graph may be used once, more than once or not at all.

(a) Which letter, **S**, **T**, **V**, **W**, **X**, **Y** or **Z**, shows when

(i) the particles in the substance have the most kinetic energy,

..... [1]

(ii) the particles in the substance are furthest apart,

..... [1]

(iii) the substance exists as both a gas and a liquid?

..... [1]

(b) Use the graph to estimate the freezing point of the substance.

..... °C [1]

(c) Name the change of state directly from a solid to a gas.

..... [1]

(d) When smoke is viewed through a microscope, the smoke particles in the air appear to jump around.

(i) What term describes this movement of the smoke particles?

..... [1]

(ii) Explain why the smoke particles move in this way.

.....

.....

..... [2]

[Total: 8]

3 **(a)** When magnesium is added to aqueous copper(II) sulfate a reaction occurs.
The ionic equation for the reaction is shown.

$$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$$

(i) Give **one** change you would observe during this reaction.

..... [1]

(ii) Explain why this is a redox reaction.

.....

..... [1]

(iii) Identify the oxidising agent in this reaction. Give a reason for your answer.

.....

..... [2]

(iv) A redox reaction occurs when magnesium is heated with iron(III) oxide.

Write a chemical equation for the reaction between magnesium and iron(III) oxide.

..... [2]

(b) The metal iron and the alloy steel are commonly used materials. A problem with them is that they rust.

(i) How does painting iron and steel prevent rusting?

.....

..... [1]

(ii) Magnesium blocks can be attached to the bottom of steel boats.

Explain how the magnesium blocks prevent the whole of the bottom of the boat from rusting.

.....

.....

.....

..... [2]

(iii) Replacing the magnesium blocks with copper blocks does not prevent rusting.

Explain why the copper blocks do **not** prevent rusting.

.....

..... [1]

[Total: 10]

4 **(a)** Ethanol, C_2H_5OH, can be made by fermentation.

(i) Complete the chemical equation for the formation of ethanol by fermentation.

$$C_6H_{12}O_6 \rightarrow \text{.....}C_2H_5OH + \text{.....}$$

[2]

(ii) State **two** conditions required for fermentation.

1 .....

2 .....

[2]

(b) Ethanol can also be made by the catalytic hydration of ethene. The equation for the reaction is shown.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

(i) Name a suitable catalyst for this reaction.

..... [1]

(ii) Calculate the maximum mass of ethanol that can be made from 56 g of ethene.

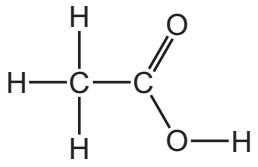
maximum mass of ethanol = ... g [2]

(c) Ethanol can be oxidised to form ethanoic acid.

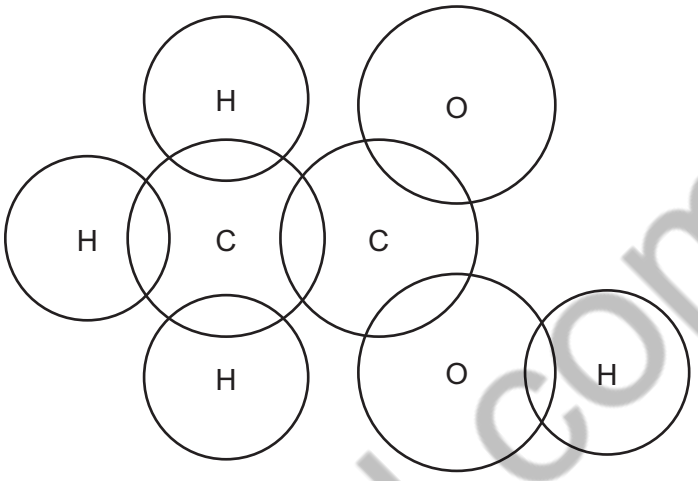
(i) Name a suitable oxidising agent for this reaction.

..... [1]

(ii) A molecule of ethanoic acid has the structure shown.



Complete the dot-and-cross diagram to show the electron arrangement in ethanoic acid. Show outer shell electrons only.



[3]

(d) Ethanoic acid is a weak acid.

(i) When referring to an acid, what is meant by the term *weak*?

.....

..... [1]

(ii) Describe how you could show that ethanoic acid is a weaker acid than hydrochloric acid.

.....

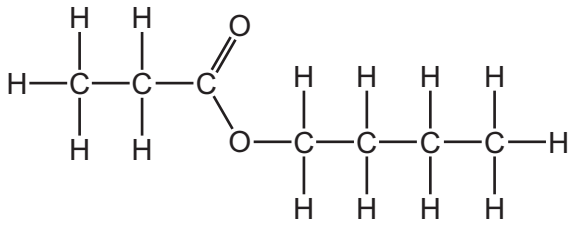
.....

.....

..... [3]

(e) Carboxylic acids react with alcohols to make esters.

The structure of an ester is shown.



Draw the structures of the carboxylic acid and alcohol from which this ester can be made.
Give the names of the carboxylic acid and alcohol.

structure of the carboxylic acid

name of the carboxylic acid .....

structure of the alcohol

name of the alcohol .....

[4]

[Total: 19]

5 **(a)** Solid copper(II) carbonate undergoes thermal decomposition. One of the products of the thermal decomposition is copper(II) oxide.

(i) State the colour change of the solid seen during the reaction.

start colour .....

end colour .....
[1]

(ii) Write a chemical equation for the thermal decomposition of copper(II) carbonate.

..... [1]

(b) Copper(II) carbonate reacts with dilute nitric acid. One of the products of the reaction is a solution of copper(II) nitrate.

(i) Describe tests for copper(II) ions and nitrate ions. Include the results of the tests.

copper(II) ions .....

.....

.....

nitrate ions .....

.....

.....
[4]

(ii) Copper(II) nitrate undergoes thermal decomposition.

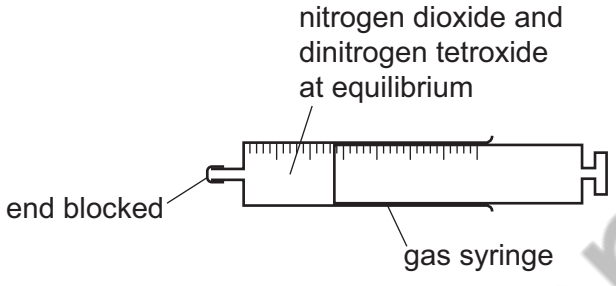
Balance the chemical equation for the thermal decomposition of copper(II) nitrate.

$$\text{.....}Cu(NO_3)_2 \rightarrow \text{.....}CuO + \text{.....}NO_2 + \text{.....}O_2$$
[1]

(c) Nitrogen dioxide, NO_2, exists in equilibrium with dinitrogen tetroxide, N_2O_4.
Nitrogen dioxide is brown and dinitrogen tetroxide is colourless.

$$\underset{\text{brown}}{2NO_2(g)} \rightleftharpoons \underset{\text{colourless}}{N_2O_4(g)}$$

(i) A sample of nitrogen dioxide and dinitrogen tetroxide at equilibrium was placed in a closed gas syringe.
The syringe plunger was pushed in. This increased the pressure in the gas syringe. The temperature was kept constant.



State how the colour of the gas in the syringe changed. Explain your answer in terms of the position of the equilibrium.

.....

.....

.....

..... [3]

(ii) A sealed tube containing nitrogen dioxide and dinitrogen tetroxide at equilibrium was cooled in an ice bath at constant pressure. The contents of the tube became paler.

Suggest an explanation for this observation in terms of the position of the equilibrium.

.....

.....

..... [2]

[Total: 12]

6 Aluminium is extracted from aluminium oxide by electrolysis.

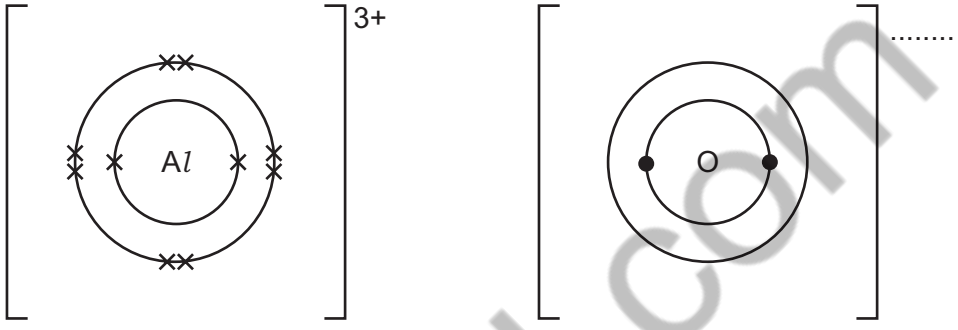
(a) Why is aluminium **not** extracted by heating aluminium oxide with carbon?

.....

..... [1]

(b) Aluminium oxide is an ionic compound with a high melting point.

(i) Complete the dot-and-cross diagram to show the electron arrangement in **one** of the oxide ions present in aluminium oxide. Include the charge on the oxide ion.
One of the aluminium ions is shown.



[2]

(ii) The melting point of aluminium oxide is above 2000 °C.

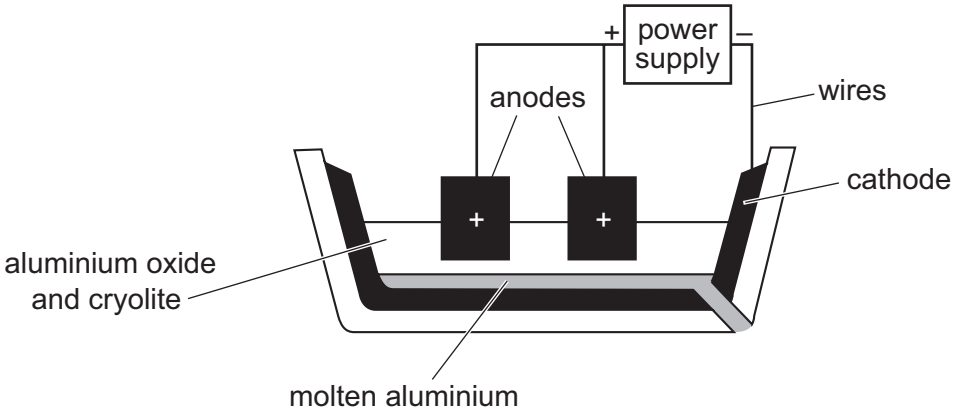
Explain why aluminium oxide has a high melting point.

.....

.....

..... [2]

(c) Aluminium can be extracted by electrolysis using the apparatus shown.



(i) Name the type of particle responsible for the transfer of charge in

the wires, ...

the electrolyte. .....
[2]

(ii) Give **two** reasons why cryolite is used.

1 .....

2 .....
[2]

(iii) Write the ionic half-equation for the formation of aluminium during the electrolysis.

..... [1]

(iv) Explain how carbon dioxide gas is formed at the anodes.

.....

.....

..... [3]

(d) When a piece of aluminium is placed in dilute hydrochloric acid, there is no immediate visible reaction.
If the aluminium is left in the dilute hydrochloric acid for several hours, bubbles start to form.

Explain why aluminium does **not** react immediately with dilute hydrochloric acid.

.....

..... [1]

[Total: 14]

Question 7 starts on the next page.

7 Copper(II) oxide reacts with dilute hydrochloric acid.

$$CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$$

6.00 g of copper(II) oxide were added to 50.0 cm^3 of 1.00 mol / dm^3 hydrochloric acid. This was an excess of copper(II) oxide.

(a) The rate of the reaction can be increased by increasing the concentration of the hydrochloric acid or by heating it.

(i) In terms of collisions, explain why increasing the concentration of the hydrochloric acid increases the rate of the reaction.

.....

.....

.....

..... [2]

(ii) In terms of collisions, explain why heating the hydrochloric acid increases the rate of the reaction.

.....

.....

.....

..... [2]

(b) (i) Calculate the number of moles of copper(II) oxide added to the hydrochloric acid.

moles of copper(II) oxide = ... mol [2]

(ii) Calculate the number of moles of hydrochloric acid used.

moles of hydrochloric acid = ... mol [1]

(iii) Calculate the mass of copper(II) oxide that did **not** react.

mass of copper(II) oxide that did **not** react = ... g [2]

(c) Crystals of hydrated copper(II) chloride were obtained from the solution at the end of the reaction.

The crystals had the following composition by mass: C*l*, 41.52%; Cu, 37.43%; H, 2.34%; O, 18.71%.

Calculate the empirical formula of the crystals.

empirical formula = ... [2]

[Total: 11]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
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19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
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Key

atomic number
atomic symbol
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relative atomic mass

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actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

8318292337

CHEMISTRY **0620/51**

Paper 5 Practical Test **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
Notes for use in qualitative analysis are provided on pages 11 and 12.

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.

For Examiner's Use	
Total	

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **10** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

[Turn over

1 You are going to investigate what happens to the temperature when two different solids, **W** and **X**, dissolve in water.

Read all the instructions carefully before starting the experiments.

Instructions
You are going to carry out two experiments.

(a) *Experiment 1*

- Put the polystyrene cup into the 250 cm^3 beaker for support.
- Use the measuring cylinder to pour 30 cm^3 of distilled water into the polystyrene cup.
- Measure the initial temperature of the water and record it in the table at time = 0 seconds.
- Add all of solid **W** to the water, start the timer and stir the solution continuously with the thermometer.
- Measure the temperature of the solution every 10 seconds for 90 seconds.
- Record your results in the table.

time / s	0	10	20	30	40	50	60	70	80	90
temperature of the solution / °C										

[2]

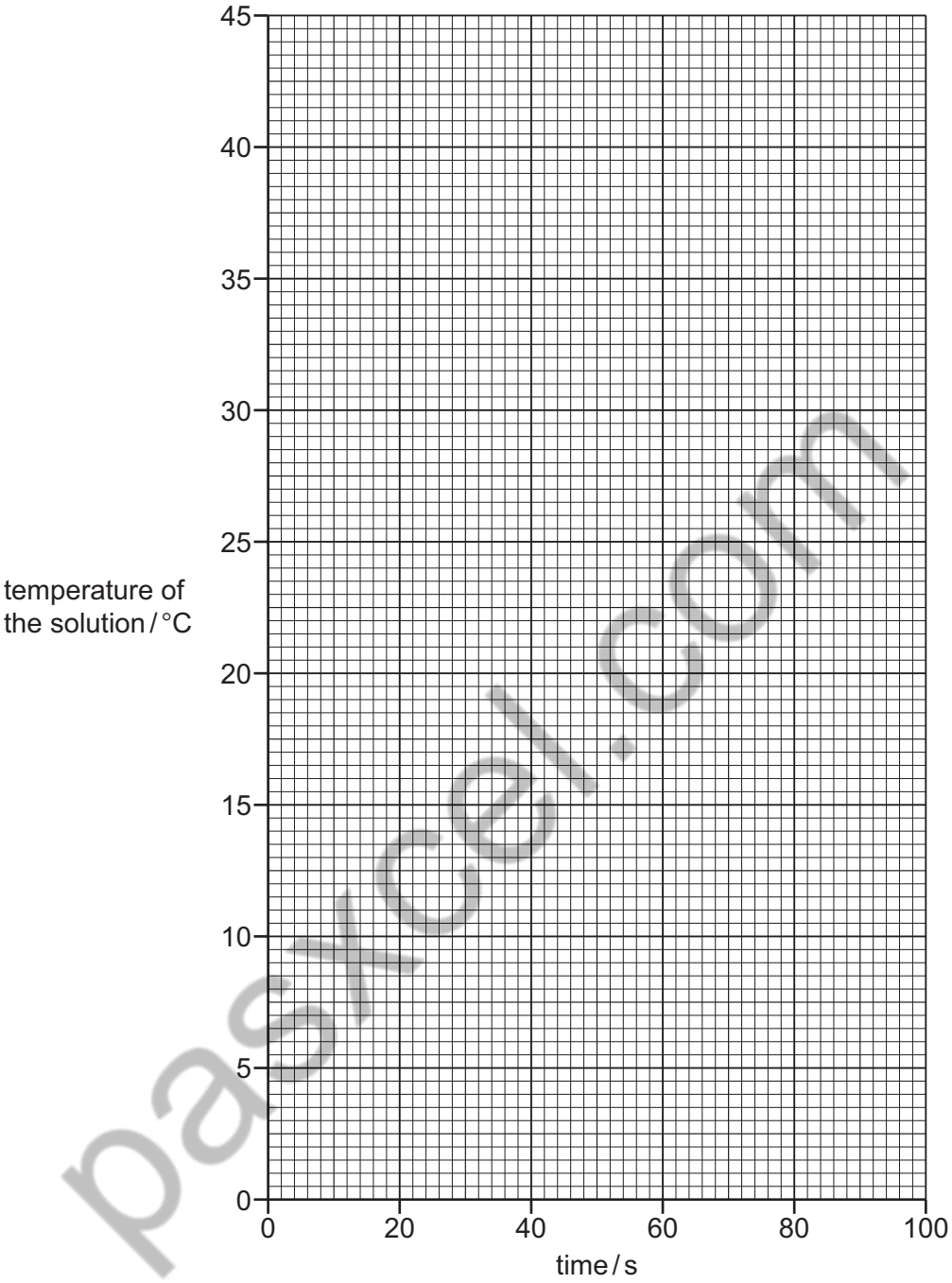
(b) *Experiment 2*

- Empty the polystyrene cup and rinse it with water. Put the polystyrene cup back into the 250 cm^3 beaker.
- Use a measuring cylinder to pour 30 cm^3 of distilled water into the polystyrene cup.
- Measure the initial temperature of the water and record it in the table at time = 0 seconds.
- Add all of solid **X** to the water, start the timer and stir the solution continuously with the thermometer.
- Measure the temperature of the solution every 10 seconds for 90 seconds.
- Record your results in the table.

time / s	0	10	20	30	40	50	60	70	80	90
temperature of the solution / °C										

[2]

(c) Plot your results for Experiments 1 and 2 on the grid. Draw **two** smooth line graphs. Clearly label your lines.



[4]

(d) (i) **From your graph**, deduce the temperature of the solution in Experiment 1 after 15 seconds. Show clearly **on the grid** how you worked out your answer.

..... °C [2]

(ii) **From your graph**, deduce the time taken for the temperature of the solution in Experiment 2 to change by 6 °C from the initial temperature.
Show clearly **on the grid** how you worked out your answer.

..... s [2]

[Turn over

(e) Use your results to identify the type of energy change that occurs when solid **X** dissolves in water.

..... [1]

(f) Predict the temperature of the solution in Experiment 2 after 1 hour. Explain your answer.

.....

..... [1]

(g) State **two** sources of error in these experiments. Give **one** improvement to reduce each of these sources of error.

source of error 1 .....

improvement 1 .....

source of error 2 .....

improvement 2 .....

[4]

(h) When carrying out the experiments, what would be a disadvantage of taking the temperature readings only every 30 seconds?

.....

..... [1]

[Total: 19]

Question 2 starts on the next page.

2 You are provided with two solutions, **Y** and **Z**.
Carry out the following tests on the solutions, recording all of your observations at each stage.

tests on solution Y

Divide the solution into two equal portions in two test-tubes.

(a) Describe the appearance of solution **Y**.

..... [1]

(b) (i) Add a few drops of aqueous sodium hydroxide to the first portion of solution **Y** and shake the test-tube to mix the solutions.
Record your observations.

..... [2]

(ii) Now add an excess of aqueous sodium hydroxide to the mixture.
Record your observations.

..... [1]

(iii) Pour the mixture from **(b)(ii)** into a boiling tube and add a small piece of aluminium foil. Heat the mixture carefully. Test the gas produced with indicator paper.
Record your observations.

.....

..... [2]

Keep the second portion of solution **Y** for the test in **(e)**.

tests on solution Z

Divide the solution into three equal portions in three test-tubes.

(c) Test the pH of the first portion of solution **Z**.
Record your observations.

..... [1]

(d) (i) Add a few drops of aqueous copper(II) sulfate to the second portion of solution **Z**.
Record your observations.

..... [1]

(ii) Now add an excess of aqueous copper(II) sulfate to the mixture.
Record your observations.

..... [2]

(e) To the third portion of solution **Z**, add the second portion of solution **Y**.
Record your observations.

..... [2]

(f) Identify solution **Y**.

..... [2]

(g) Identify solution **Z**.

..... [1]

[Total: 15]

3 Washing soda crystals are crystals of hydrated sodium carbonate, $Na_2CO_3.10H_2O$. When exposed to the air, some of the water is lost from the crystals and a new substance is formed. This process occurs faster in hotter climates.

Plan an experiment to determine the percentage of water by mass present in the new substance.

You are provided with common laboratory apparatus.

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 6]

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Notes for use in qualitative analysis
Tests for anions

anion	test	test result
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide (Br^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.
sulfite (SO_3^{2-})	add dilute hydrochloric acid, warm gently and test for the presence of sulfur dioxide	sulfur dioxide produced will turn acidified aqueous potassium manganate(VII) from purple to colourless

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium (Al^{3+})	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt., or very slight white ppt.
chromium(III) (Cr^{3+})	green ppt., soluble in excess	grey-green ppt., insoluble in excess
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	test and test results
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium (Li^+)	red
sodium (Na^+)	yellow
potassium (K^+)	lilac
copper(II) (Cu^{2+})	blue-green

Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

4473552331

CHEMISTRY **0620/61**

Paper 6 Alternative to Practical **October/November 2017**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

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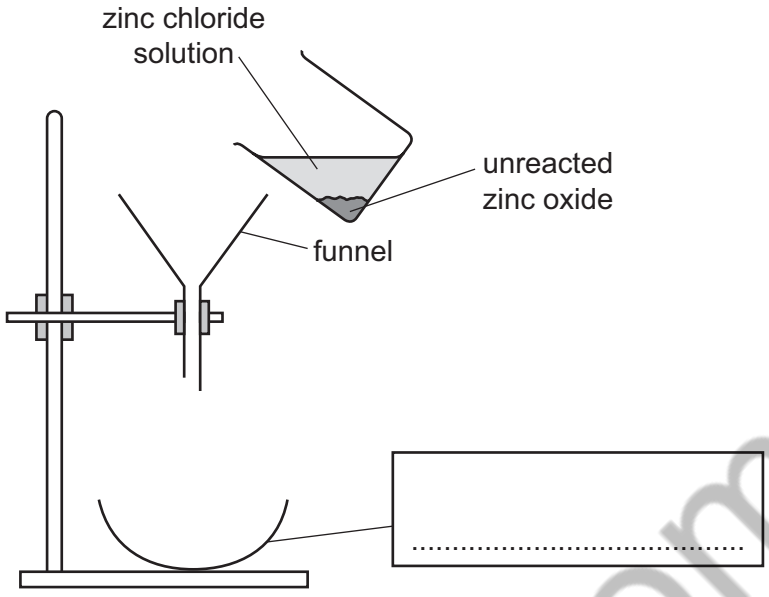
This document consists of **8** printed pages.

CAMBRIDGE International Examinations

1 A student reacted dilute hydrochloric acid with zinc oxide to prepare zinc chloride solution. The diagram shows part of the procedure.



(a) Complete the box to name the apparatus. [1]

(b) Which of the reactants was in excess?

..... [1]

(c) **(i)** Name the separation process this apparatus is used for.

..... [1]

(ii) Suggest why this apparatus would **not** work.

.....

..... [1]

(d) Describe how crystals of zinc chloride could be obtained from the zinc chloride solution.

.....

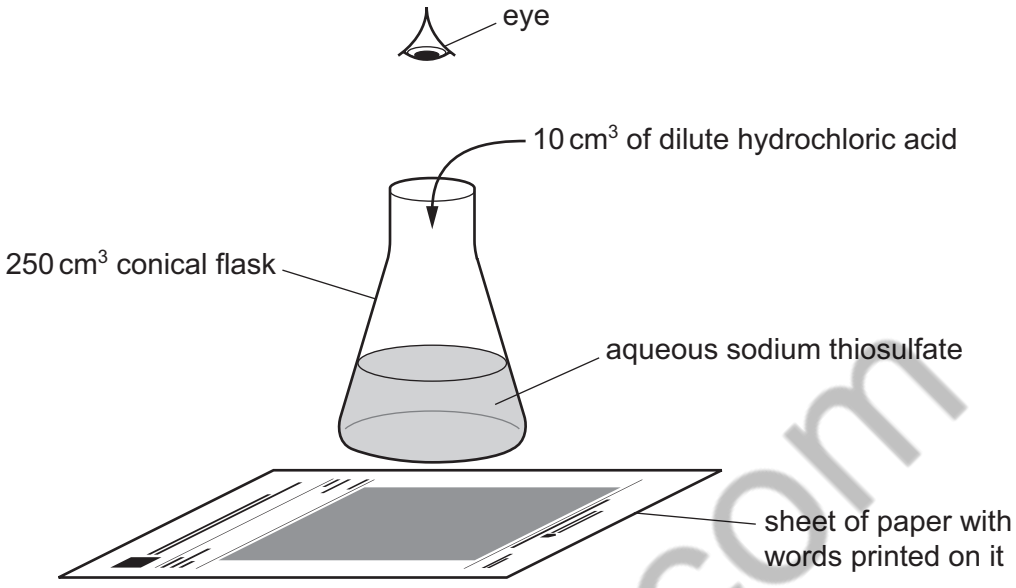
.....

..... [3]

[Total: 7]

2 A student investigated the rate of reaction between dilute hydrochloric acid and aqueous sodium thiosulfate. When these chemicals react they form a precipitate which makes the solution go cloudy. The formation of this precipitate can be used to show how fast the reaction proceeds.

Five experiments were carried out using the apparatus shown.



Experiment 1

- Using a measuring cylinder, 50 cm^3 of aqueous sodium thiosulfate were poured into a conical flask. The initial temperature of the solution was measured. The conical flask was placed on a sheet of paper with words printed on it.
- Using a measuring cylinder, 10 cm^3 of dilute hydrochloric acid were added to the solution in the conical flask and a stopclock was started.
- The time taken for the printed words to disappear from view was measured.
- The final temperature of the mixture was measured.

Experiment 2

- Using a measuring cylinder, 50 cm^3 of aqueous sodium thiosulfate were poured into a conical flask. The solution was heated to about **30 °C** and the temperature was measured. The conical flask was placed on a sheet of paper with words printed on it.
- Using a measuring cylinder, 10 cm^3 of dilute hydrochloric acid were added to the solution in the conical flask and a stopclock was started.
- The time taken for the printed words to disappear from view was measured.
- The final temperature of the mixture was measured.

Experiment 3

- Experiment 2 was repeated but the 50 cm^3 of aqueous sodium thiosulfate were heated to about **40 °C** before adding the dilute hydrochloric acid.

Experiment 4

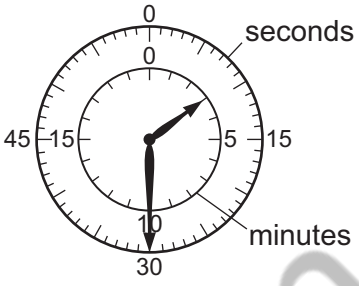
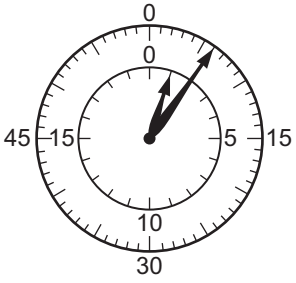
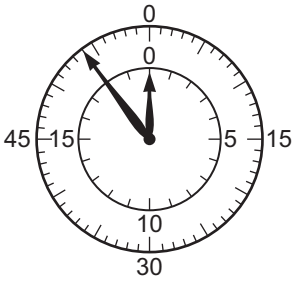
- Experiment 2 was repeated but the 50 cm^3 of aqueous sodium thiosulfate were heated to about **50 °C** before adding the dilute hydrochloric acid.

Experiment 5

- Experiment 2 was repeated but the 50 cm^3 of aqueous sodium thiosulfate were heated to about **60 °C** before adding the dilute hydrochloric acid.

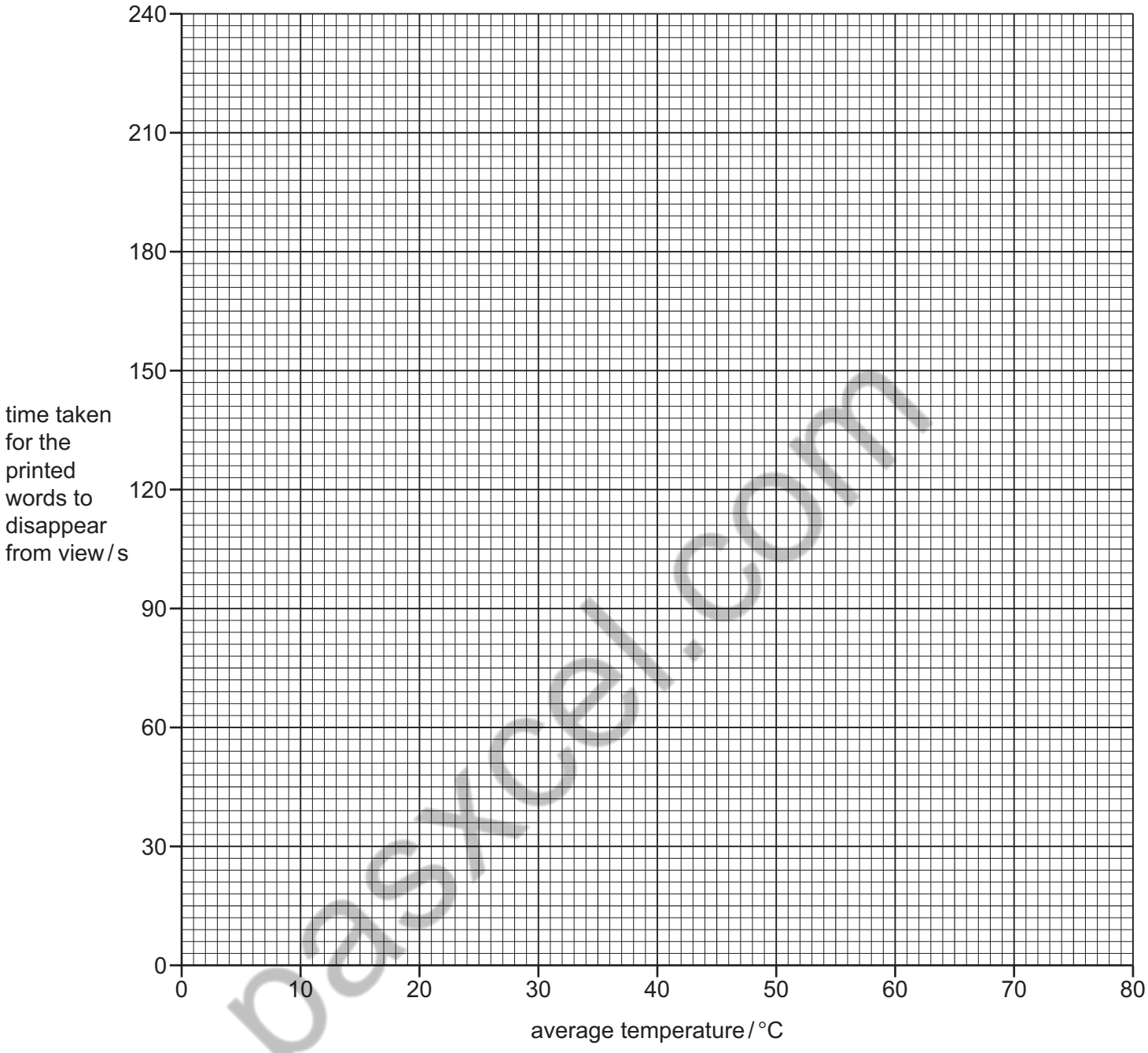
[Turn over

(a) Calculate the average temperatures and record them in the table.
Use the stopclock diagrams to record the times in the table.

experiment number	initial temperature of the solution / °C	final temperature of the mixture / °C	average temperature / °C	stopclock diagram	time taken for the printed words to disappear from view / s
1	19	17			
2	32	30			
3	42	40			
4	54	52			
5	65	61			

[3]

(b) Plot the results of Experiments 1–5 on the grid. Draw a smooth line graph.



[4]

(c) **From your graph**, deduce the time taken for the printed words to disappear from view when Experiment 2 was repeated at an initial temperature of 73 °C. The final temperature of the mixture was 71 °C.

Show clearly **on the grid** how you worked out your answer.

..... [3]

(d) Sketch **on the grid** the graph you would expect if all of the experiments were repeated using a more dilute solution of aqueous sodium thiosulfate. [1]

[Turn over

(e) (i) In which experiment, 1, 2, 3, 4 or 5, was the rate of reaction greatest?

..... [1]

(ii) Explain, in terms of particles, why the rate of reaction was greatest in this experiment.

.....

.....

.....

..... [2]

(f) Suggest and explain the effect on the results of using

(i) a burette to measure the volumes,

.....

.....

..... [2]

(ii) a 100 cm^3 conical flask instead of a 250 cm^3 conical flask.

.....

.....

..... [2]

[Total: 18]

3 Two solid salts, **F** and **G**, were analysed. Solid **F** was iron(III) nitrate.
Tests were carried out on each solid.

tests on solid F

Complete the expected observations.

Solid **F** was dissolved in distilled water to produce solution **F**. Solution **F** was divided into three equal portions in three test-tubes.

(a) (i) A few drops of aqueous sodium hydroxide were added to the first portion of solution **F** until a change was seen.

observations ..... [2]

(ii) An excess of aqueous sodium hydroxide was then added to the mixture from **(a)(i)**.

observations ..... [1]

(b) An excess of aqueous ammonia was added to the second portion of solution **F** until a change was seen.

observations ..... [1]

(c) Aluminium foil and aqueous sodium hydroxide were added to the third portion of solution **F**. The mixture was heated and the gas which was produced was tested.

test for gas .....

test result .....
[2]

(d) Identify the gas produced in **(c)**.

..... [1]

tests on solid G

Tests were carried out and the following observations made.

tests on solid **G**	observations
test 1 A flame test was carried out on solid **G**.	red colour
test 2 Dilute nitric acid was added to solid **G**. The gas produced was passed through limewater.	rapid effervescence limewater turned milky

(e) Identify solid **G**.

..... [2]

[Total: 9]

4 Iron, tin and zinc all react with dilute hydrochloric acid to produce hydrogen.
Plan an experiment to determine the order of reactivity of iron, tin and zinc.
You are provided with powdered samples of the metals and common laboratory apparatus.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 6]

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/11**

Paper 1 Multiple Choice (Core) **October/November 2017**

MARK SCHEME

Maximum Mark: 40

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Question	Answer	Marks
1	D	**1**
2	B	**1**
3	C	**1**
4	D	**1**
5	C	**1**
6	A	**1**
7	C	**1**
8	B	**1**
9	C	**1**
10	B	**1**
11	B	**1**
12	C	**1**
13	B	**1**
14	C	**1**
15	B	**1**
16	B	**1**
17	B	**1**
18	C	**1**
19	A	**1**
20	B	**1**
21	C	**1**
22	A	**1**
23	B	**1**
24	D	**1**
25	A	**1**
26	A	**1**
27	A	**1**
28	A	**1**
29	C	**1**

Question	Answer	Marks
30	C	**1**
31	B	**1**
32	A	**1**
33	C	**1**
34	C	**1**
35	C	**1**
36	B	**1**
37	B	**1**
38	A	**1**
39	B	**1**
40	C	**1**

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/21**

Paper 2 Multiple Choice (Extended) **October/November 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1	D	**1**
2	C	**1**
3	B	**1**
4	A	**1**
5	C	**1**
6	B	**1**
7	A	**1**
8	B	**1**
9	A	**1**
10	D	**1**
11	B	**1**
12	B	**1**
13	B	**1**
14	B	**1**
15	C	**1**
16	C	**1**
17	B	**1**
18	B	**1**
19	A	**1**
20	B	**1**
21	C	**1**
22	A	**1**
23	B	**1**
24	D	**1**
25	A	**1**
26	A	**1**
27	D	**1**
28	D	**1**

Question	Answer	Marks
29	C	**1**
30	B	**1**
31	C	**1**
32	B	**1**
33	D	**1**
34	C	**1**
35	C	**1**
36	C	**1**
37	B	**1**
38	B	**1**
39	C	**1**
40	B	**1**

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/31**

Paper 3 Core Theory **October/November 2017**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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Question	Answer	Marks
1(a)(i)	**A**	**1**
1(a)(ii)	**B**	**1**
1(a)(iii)	**D**	**1**
1(a)(iv)	**B**	**1**
1(a)(v)	**C**	**1**
1(b)	substance containing only one type of atom / substance containing atoms (each) with the same number of protons / substance which cannot be broken down further by chemical means	**1**
1(c)	solid	**1**
	–15 °C is below the melting point	**1**

Question	Answer	Marks
2(a)	1.5 (%)	**1**
2(b)	any 3 from: • greater percentage of helium (on Neptune) / more helium on Neptune / less helium on Earth • greater percentage of hydrogen (on Neptune) / more hydrogen on Neptune / no hydrogen on Earth / (very) little hydrogen on Earth • no oxygen on Neptune / little oxygen on Neptune (but Earth has 21% oxygen) • greater percentage of methane (on Neptune) / more methane on Neptune / less methane on Earth / more methane on Neptune • more argon on Earth / less argon on Neptune • no nitrogen on Neptune / little nitrogen on Neptune	**3**
2(c)	labels ‘C’ and ‘H’ in the correct circles and no non-bonding electrons or extra bonding electrons	**1**
	one pair of electrons in each overlap area	**1**

Question	Answer	Marks
2(d)(i)	atoms of the same element with the same number of protons but a different number of neutrons	**1**
2(d)(ii)	number of protons: 1	**1**
	number of neutrons: 2	**1**
2(e)(i)	30 IF full credit is not awarded, allow 1 mark for (C =) 12 and (H =) 1	**2**
2(e)(ii)	anhydrous / white copper(II) sulfate **OR** anhydrous / blue cobalt(II) chloride	**1**
	(anhydrous copper(II) sulfate) turns blue **OR** (anhydrous cobalt(II) chloride) turns pink	**1**

Question	Answer	Marks
3(a)(i)	2 (CO_2)	**1**
	3 (H_2O)	**1**
3(a)(ii)	correct structure showing all of the atoms and all of the bonds including O–H IF full credit is not awarded, allow 1 mark for structure with OH	**2**
3(b)(i)	pH 10	**1**
3(b)(ii)	red / pink	**1**
	to yellow	**1**
3(b)(iii)	sodium carbonate + sulfuric acid → sodium sulfate + carbon dioxide + water IF full credit is not awarded, allow 1 mark for either sodium sulfate **OR** carbon dioxide + water	**2**

Question	Answer	Marks
3(c)	sulfur dioxide	**1**
3(d)(i)	**P**: chromatography paper / filter paper	**1**
	Q: solvent	**1**
3(d)(ii)	chromatography	**1**
3(d)(iii)	**X** drawn on the baseline	**1**

Question	Answer	Marks
4(a)	graphite: conducts	**1**
	potassium: conducts	**1**
4(b)	low boiling point	**1**
4(c)	does not conduct when solid but conducts when molten IF full credit is not awarded, allow 1 mark for conducts when molten	**2**
4(d)	positive electrode (anode): chlorine / Cl_2	**1**
	negative electrode (cathode): zinc / Zn	**1**
4(e)	chlorine is more reactive than iodine	**1**

Question	Answer	Marks
5(a)(i)	2 (C)	**1**
	2 (Cl_2)	**1**
5(a)(ii)	carbon gains oxygen / oxidation number of carbon increases / carbon loses electrons	**1**

Question	Answer	Marks
5(b)	any 2 from: • titanium has a high melting / boiling point **ORA** • titanium has a high density **ORA** • titanium is hard / strong **ORA**	**2**
5(c)(i)	relative reactivity with water: forms bubbles slowly / slower than sodium	**1**
	melting point of potassium: any value between 45–90 (°C) inclusive	**1**
5(c)(ii)	increases down the group / decreases up the group	**1**
5(d)	basic because it is a metal (oxide)	**1**

Question	Answer	Marks
6(a)	any 4 from: • petroleum vaporised / heated • petroleum enters the fractionating column at the bottom • vapours move up the fractionating column • column is hotter at the bottom / cooler at the top • idea of vapours condensing in different parts of the fractionating column • idea of different fractions having different boiling ranges • fractions (condensing) higher up have lower boiling points **ORA**	**4**
6(b)(i)	breaking down / decomposing / splitting hydrocarbons	**1**
	into smaller hydrocarbons / into alkanes and alkenes / by heating / using a high temperature	**1**
6(b)(ii)	hydrogen	**1**
6(c)	covalent	**1**
6(d)	polymer	**1**

Question	Answer	Marks
7(a)	any 3 from: • diffusion • molecules move (from place to place) • (molecules move) randomly • molecules collide • molecules spread out / mix up • (bulk) movement of molecules from areas of where they are at higher concentration to where they are at lower concentration	3
7(b)(i)	$C_4H_6O_2Br_2$	1
7(b)(ii)	carboxylic acid	1
7(c)	average	1
	an element	1
	an atom	1
	12	1
7(d)(i)	increasing the concentration of the acid	1
	increasing the temperature	1
	using magnesium powder / using smaller pieces of magnesium	1
7(d)(ii)	4 (HBr)	1

Question	Answer	Marks
8(a)(i)	reversible reaction	1
8(a)(ii)	speed up the reaction / increase the rate of reaction / speed of reaction faster	1

Question	Answer	Marks
8(b)(i)	decreases as the temperature increases **ORA**	**1**
8(b)(ii)	28%	**1**
8(c)	112 (g)	**1**
8(d)	clothing / named clothing / fishing lines	**1**

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/41**

Paper 4 Extended Theory **October/November 2017**

MARK SCHEME

Maximum Mark: 80

Published

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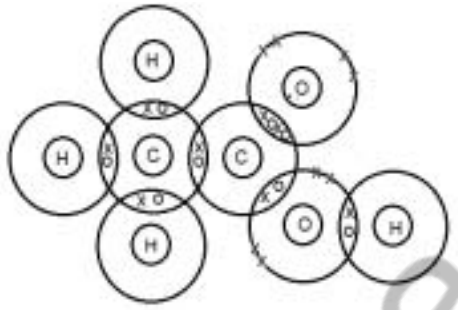
Question	Answer	Marks
1(a)(i)	**B**	**1**
1(a)(ii)	**A**	**1**
1(a)(iii)	**C**	**1**
1(a)(iv)	**E**	**1**
1(b)	O^{2-} **M1** O **M2** $^{2-}$	**2**

Question	Answer	Marks
2(a)(i)	**S**	**1**
2(a)(ii)	**S**	**1**
2(a)(iii)	**V**	**1**
2(b)	any value in the range 130–145 °C	**1**
2(c)	sublimation	**1**
2(d)(i)	Brownian motion	**1**
2(d)(ii)	nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles	**1**
	(the bombarding particles) move randomly	**1**

Question	Answer	Marks
3(a)(i)	brown / orange solid (forms / is made) **OR** solution becomes paler / colourless	**1**
3(a)(ii)	magnesium is oxidised **AND** copper ions are reduced **OR** magnesium loses electrons **AND** copper ions gain electrons **OR** magnesium increases in oxidation number **AND** copper decreases in oxidation number	**1**
3(a)(iii)	Cu^{2+} **OR** copper(II) ions **OR** copper ions	**1**
	gains electrons	**1**
3(a)(iv)	$3Mg + Fe_2O_3 \rightarrow 3MgO + 2Fe$ **M1** Fe_2O_3 **AND** MgO **M2** fully correct	**2**
3(b)(i)	prevents air / oxygen **AND** water from reaching the steel	**1**
3(b)(ii)	magnesium is more reactive than iron / steel	**1**
	the magnesium corrodes (before the iron / steel) **OR** the magnesium corrodes preferentially	**1**
3(b)(iii)	copper is less reactive than iron / steel	**1**

Question	Answer	Marks
4(a)(i)	→ $2(C_2H_5OH)$ + $2CO_2$ **M1** carbon dioxide made as product **M2** balanced	**2**
4(a)(ii)	any 2 from: • 37 °C • anaerobic • glucose is aqueous • yeast	**2**
4(b)(i)	(concentrated) phosphoric acid	**1**
4(b)(ii)	92 If full credit is not awarded, allow 1 mark for M_r of ethene = 28	**2**
4(c)(i)	(acidified) potassium manganate(VII) **OR** potassium (di)chromate(VI)	**1**
4(c)(ii)	 **M1** all shared pairs of electrons correct for single bonds **M2** 2 shared pairs of electrons for the C=O bond **M3** total of 8 electrons on each O including 4 non-bonding electrons and no additional non-bonding electrons	**3**
4(d)(i)	partially ionised / dissociated	**1**

Question	Answer	Marks
4(d)(ii)	**M1** (acids) have same concentration	**1**
	M2: measure pH **OR** describe how to measure pH (such as use Universal Indicator) **M3**: lower pH corresponds to the stronger acid / hydrochloric acid **OR** **M2**: add calcium / magnesium / zinc / iron **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid **OR** **M2**: rate of reaction with (metal) carbonate **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid **OR** **M2**: rate of reaction with (named) metal oxide **M3**: dissolves faster means that reaction is with the stronger acid / hydrochloric acid **OR** **M2**: electrical conductivity **M3**: greater conductivity corresponds to the stronger acid / hydrochloric acid **OR** **M2**: add sodium hydroxide (or other named alkali) **M3**: greater temperature change corresponds to the stronger acid / hydrochloric acid	**2**
4(e)	structure of propanoic acid	**1**
	propanoic acid	**1**
	structure of butan-1-ol	**1**
	butan-1-ol	**1**

Question	Answer	Marks
5(a)(i)	*start colour:* green *end colour:* black	**1**
5(a)(ii)	$CuCO_3 \rightarrow CuO + CO_2$	**1**
5(b)(i)	(*copper(II) ions)* add sodium hydroxide (solution)	**1**
	(*copper(II) ions)* blue ppt.	**1**
	(*nitrate ions*) add aluminium **AND** aqueous sodium hydroxide **AND** warm	**1**
	ammonia given off / gas turns damp (red) litmus blue	**1**
5(b)(ii)	2 / 2 / 4 / 1	**1**
5(c)(i)	becomes paler	**1**
	equilibrium moves right	**1**
	(because) fewer moles (of gas) on right	**1**
5(c)(ii)	equilibrium moved right / more N_2O_4 / less NO_2	**1**
	(forward) reaction exothermic	**1**

Question	Answer	Marks
6(a)	aluminium is more reactive than carbon	**1**
6(b)(i)	oxide ion has an outer shell with six dots and two crosses	**1**
	oxide ion has a charge of 2^-	**1**

Question	Answer	Marks
6(b)(ii)	(electrostatic) forces of attraction between ions	**1**
	(are) strong **OR** require lots of energy to overcome	**1**
6(c)(i)	*the wires:* electrons	**1**
	the electrolyte: ions	**1**
6(c)(ii)	any 2 from: • increases conductivity • as a solvent • lowers the operating temperature	**2**
6(c)(iii)	$Al^{3+} + 3e^- \rightarrow Al$	**1**
6(c)(iv)	oxygen is made at the anode	**1**
	the anodes are made of carbon	**1**
	oxygen (made) reacts with carbon	**1**
6(d)	aluminium coated with layer of (unreactive) aluminium oxide	**1**

Question	Answer	Marks
7(a)(i)	more particles (of acid) in a given volume / dm^3 / cm^3	**1**
	more collisions per second / unit time **OR** greater collision rate	**1**

Question	Answer	Marks
7(a)(ii)	particles have more energy / particles move faster / more collisions per second / more collisions per unit time / greater collision rate	**1**
	more (of the) particles / collisions have energy greater than the activation energy / more particles have sufficient energy to react / more collisions have sufficient energy to react / a greater percentage of collisions are successful	**1**
7(b)(i)	0.075 If full credit is not awarded, allow 1 mark for M_r of CuO = 80	**2**
7(b)(ii)	0.05	**1**
7(b)(iii)	4 (g) **M1** moles copper(II) oxide that reacted = (0.05 / 2) = 0.025 mol **M2** mass copper(II) oxide = ((0.075 – 0.025) × 80) = 4 g	**2**
7(c)	$CCl_2CuH_4O_2$ **M1** 41.52 / 35.5; 37.43 / 64; 2.34 / 1; 18.71 / 16 **OR** 1.17 : 0.58 : 2.34 : 1.17 **M2** appropriate scaling to give whole number ratios	**2**

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/51**

Paper 5 Practical **October/November 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)	temperature boxes completed correctly with decreasing trend shown	**1**
	results comparable to the supervisor's	**1**
1(b)	temperature boxes completed correctly with increasing trend shown	**1**
	results comparable to the supervisor's	**1**
1(c)	all points plotted	**2**
	two smooth line graphs	**1**
	both graphs appropriately labelled	**1**
1(d)(i)	value from graph	**1**
	shown clearly	**1**
1(d)(ii)	value from graph	**1**
	shown clearly	**1**
1(e)	exothermic	**1**
1(f)	room temperature / initial temperature from table **AND** reaction has finished / all the solid has dissolved	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(g)</td><td>
<table>
<tr><th>source of error</th><th>improvement</th></tr>
<tr><td>heat losses</td><td>use a lid / lag the apparatus</td></tr>
<tr><td>use of a measuring cylinder</td><td>use a pipette/burette</td></tr>
<tr><td>wet cup in the second experiment</td><td>use new/another cup OR dry the cup</td></tr>
<tr><td>the solid absorbs water from the air</td><td>store in a sealed container / airtight container / desiccator</td></tr>
<tr><td>only done once</td><td>repeat and average</td></tr>
<tr><td>different masses of solids used / masses of solids not measured</td><td>use same mass of solid / weigh the solids</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(h)</td><td>fewer data / less detail / fewer readings / graph not as good / not enough readings taken whilst the solid is reacting</td><td>1</td></tr>
</table>

Question	Answer	Marks
2(a)	blue (liquid)	**1**
2(b)(i)	green	**1**
	precipitate	**1**
2(b)(ii)	green solution / precipitate dissolves	**1**
2(b)(iii)	(red) litmus paper / Universal Indicator paper	**1**
	(red litmus paper) turns blue / (Universal Indicator paper) turns purple	**1**
2(c)	pH 8–11	**1**
2(d)(i)	dark / deep blue (solution)	**1**
2(d)(ii)	blue	**1**
	precipitate	**1**
2(e)	grey-green	**1**
	precipitate	**1**
2(f)	chromium	**1**
	nitrate	**1**
2(g)	ammonia / NH_3	**1**

Question	Answer	Marks
3	*heating to dryness method* max [6]: **M1** weigh (any) sample of washing soda **M2** heat (to remove water of crystallisation) **M3** in named container **M4** cool **M5** reweigh **M6** repeat heating **M7** to constant mass **M8** appropriate calculation suggested for the percentage of water *mass of water method* max [6]: **M1** weigh (any) sample of washing soda **M2** heat to remove water of crystallisation **M3** in named container **M4** using apparatus capable of collecting water (vapour) **M5** cool / condense (water vapour) **M6** continue until no more collects **M7** weigh water **M8** appropriate calculation suggested for the percentage of water	**6**

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/61**

Paper 6 Alternative to Practical **October/November 2017**

MARK SCHEME

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Question	Answer	Marks
1(a)	evaporating basin / dish	1
1(b)	zinc oxide	1
1(c)(i)	filtration	1
1(c)(ii)	no filter paper	1
1(d)	heat / boil / evaporate	1
	to crystallising point	1
	cool / leave to stand	1

Question	Answer	Marks
2(a)	average temperatures completed for all five experiments: 18, 31, 41, 53, 63	1
	times completed for all five experiments: 210, 111, 84, 66, 54	1
	all times in seconds	1
2(b)	all five points plotted	3
	smooth line graph	1
2(c)	value from graph for average temperature 72 °C	1
	unit (s)	1
	shown clearly	1
2(d)	line above experimental line	1
2(e)(i)	Experiment 5	1

Question	Answer	Marks
2(e)(ii)	particles move faster / particles have more energy	1
	more (frequent) collisions / greater chance of collisions	1
2(f)(i)	more accurate	1
	comparison to measuring cylinder	1
2(f)(ii)	time shorter / cross disappears faster	1
	depth greater	1

Question	Answer	Marks
3(a)(i)	red-brown	1
	precipitate	1
3(a)(ii)	insoluble / no change	1
3(b)	red-brown precipitate	1
3(c)	(red) litmus paper	1
	turns blue	1
3(d)	ammonia	1
3(e)	lithium	1
	carbonate	1

Question	Answer	Marks
4	*reaction with acid method* max [6]: **M1** fixed volume of acid **M2** to fixed mass of metal **M3** measure volume of gas / temperature change **M4** named apparatus for the measurement **M5** after time **M6** repeat with other metals **M7** compare / conclude *displacement method* **M1** add each metal to named tin salt solution **M2** observe if deposit is formed **M3** results, e.g. Zn and Fe positive **M4** repeat with named iron salt **M5** results, e.g. Zn positive **M6** conclude	**6**