Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/21**

Paper 2 Multiple Choice (Extended) **October/November 2016**

45 minutes

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

* 6 9 4 2 4 7 5 0 4 1 *

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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 20.
Electronic calculators may be used.

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 **20** printed pages.

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1 ‘Particles moving **very slowly** from an area of higher concentration to an area of lower concentration.’

Which process is being described?

A a liquid being frozen

B a solid melting

C a substance diffusing through a liquid

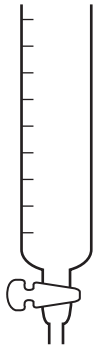
D a substance diffusing through the air

2 A student mixes 25 cm^3 samples of dilute hydrochloric acid with different volumes of aqueous sodium hydroxide.

In each case, the student measures the change in temperature to test if the reaction is exothermic.

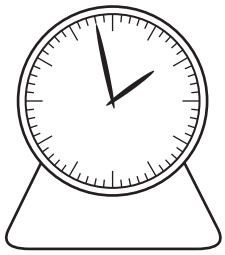
Which piece of apparatus is **not** needed?

A



burette

B



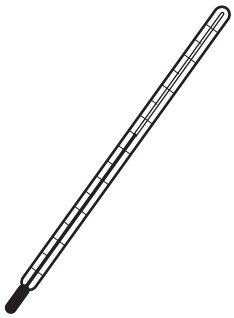
clock

C



pipette

D



thermometer

3 Information about the solubility of four solids, P, Q, R and S, is given in the table.

	P	Q	R	S
solubility in water	dissolves	insoluble	insoluble	dissolves

A student attempted to separate mixtures of these solids using the following method.

1 Add the mixture to a beaker of water and stir.

2 Filter the mixture.

3 Crystallise one of the solids from the filtrate.

Which of the following mixtures could **not** be separated by this method?

A a mixture of P and R

B a mixture of Q and P

C a mixture of Q and R

D a mixture of R and S

4 The table shows information about atoms of three different elements.

element	proton number	nucleon number	number of protons	number of neutrons	number of electrons
chlorine	17	35	17	W	17
chlorine	17	X	17	19	17
argon	Y	40	18	22	18
potassium	19	39	19	20	Z

What are the values of W, X, Y and Z?

	W	X	Y	Z
A	18	35	18	19
B	18	36	18	19
C	19	35	19	18
D	19	36	19	18

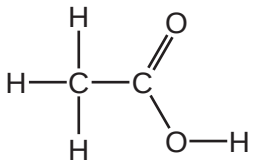
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5 Metal P reacts with non-metal Q to form a compound.

Which process takes place and which type of compound is formed?

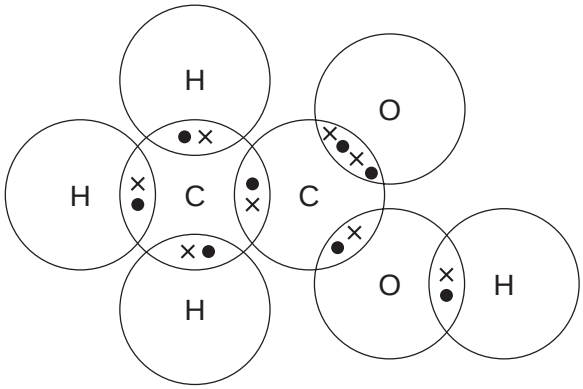
	process	type of compound
A	electrons are transferred from P to Q	covalent
B	electrons are transferred from P to Q	ionic
C	electrons are transferred from Q to P	covalent
D	electrons are transferred from Q to P	ionic

6 The structure of ethanoic acid is shown.

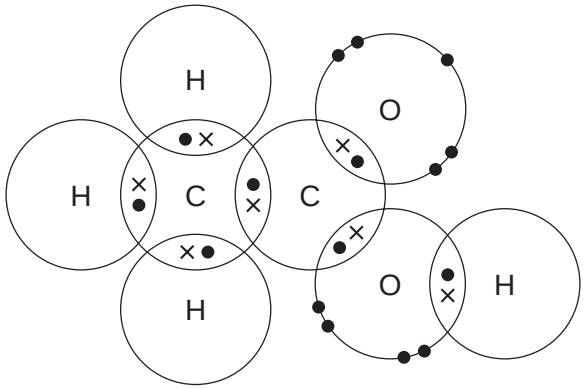


Which diagram shows the arrangement of outer shell electrons in a molecule of ethanoic acid?

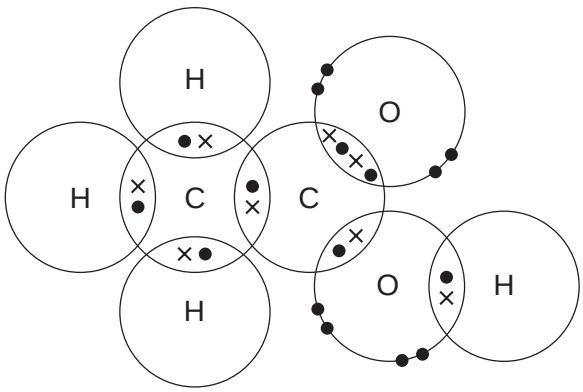
A



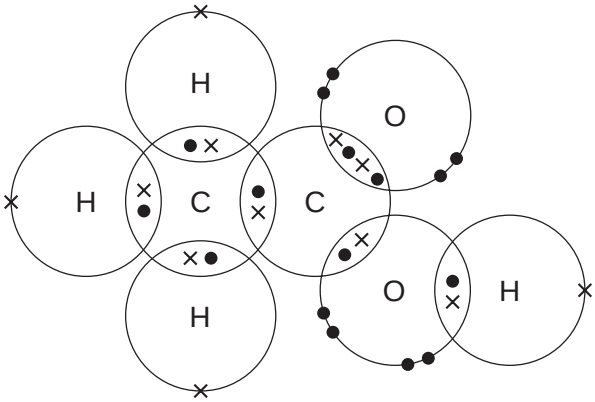
B



C



D



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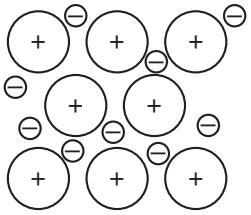
7 X is a solid at room temperature.

X has a high melting point.

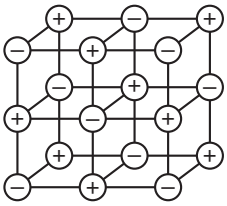
Solid X conducts electricity.

Which diagram shows how the particles are arranged in solid X?

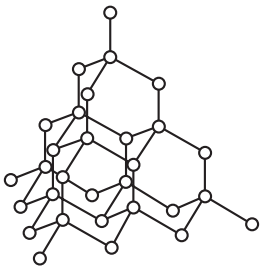
A



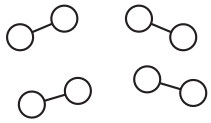
B



C



D



8 Benzene is a liquid with molecular formula C_6H_6.

Ethene is a gas with molecular formula C_2H_4.

Which statement is correct?

A 1 mole of benzene and 1 mole of ethene contain the same number of atoms.

B 1 mole of benzene and 1 mole of ethene both have a volume of 24 dm^3 at room temperature and pressure.

C Both benzene and ethene have the same empirical formula.

D The number of carbon atoms in 0.5 moles of ethene is equal to the Avogadro constant.

9 Sodium hydrogencarbonate undergoes thermal decomposition as shown.

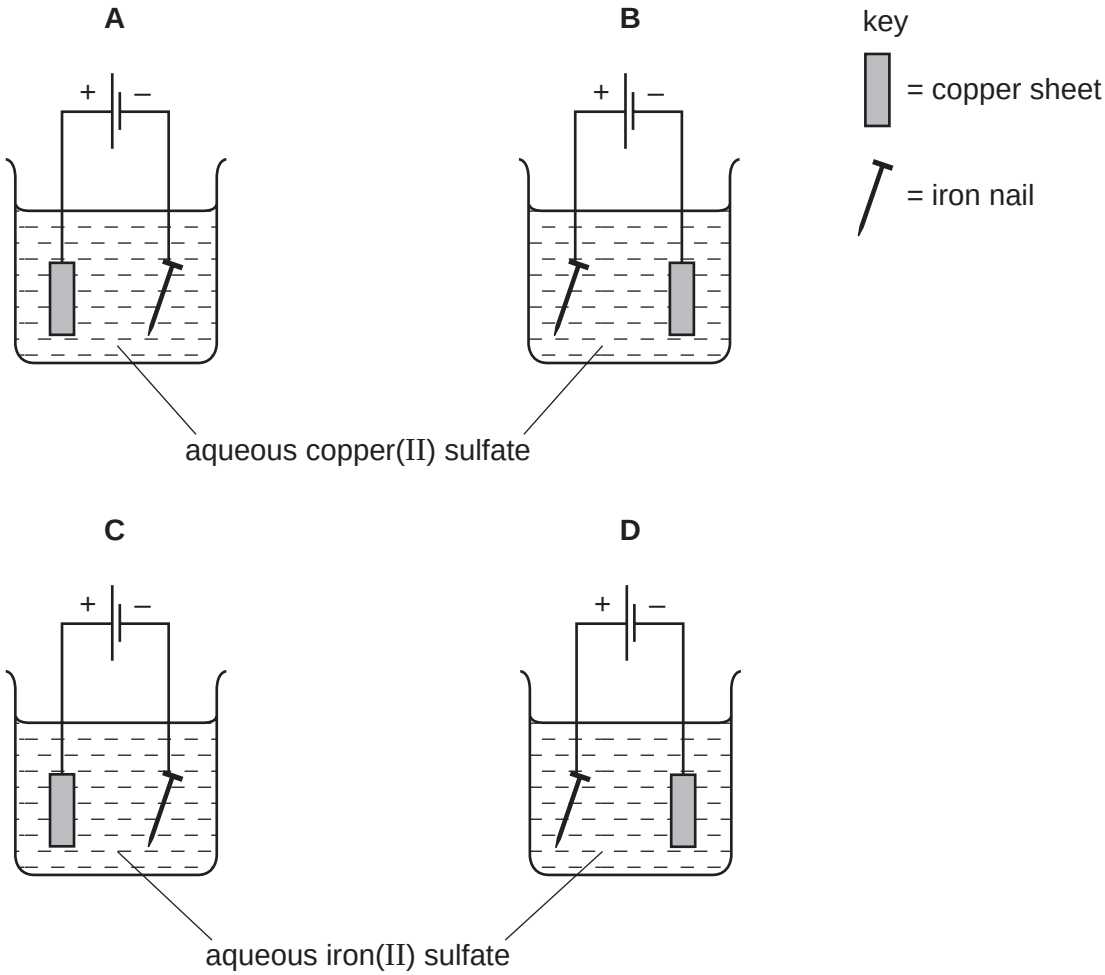
$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

What is the maximum mass of sodium carbonate that can be made from 0.100 moles of sodium hydrogencarbonate?

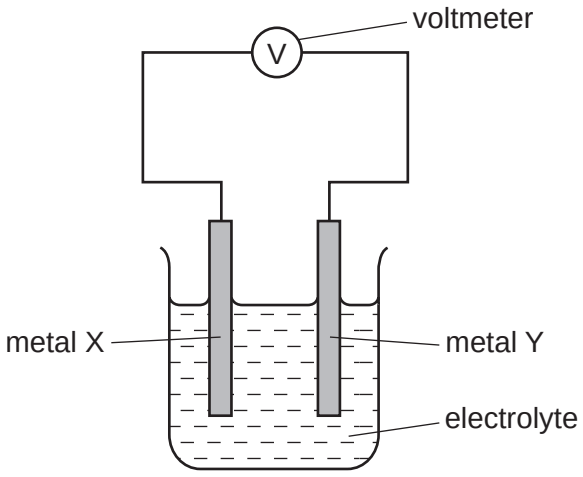
A 4.15 g **B** 5.30 g **C** 10.6 g **D** 21.2 g

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10 Which apparatus could be used to electroplate an iron nail with copper?



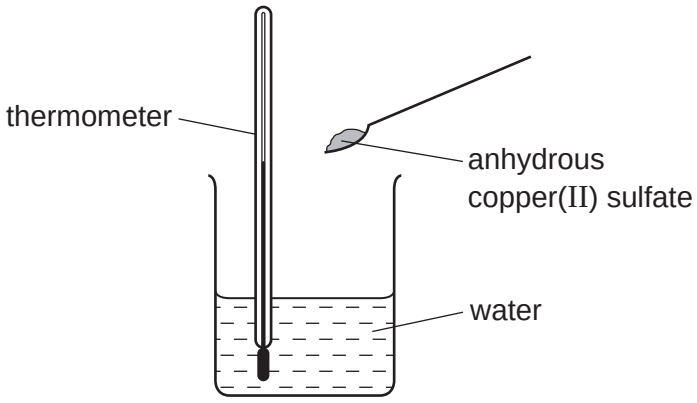
11 The diagram shows a simple cell.



Which two metals produce the highest reading on the voltmeter?

	X	Y
A	magnesium	copper
B	magnesium	iron
C	zinc	copper
D	zinc	iron

12 When anhydrous copper(II) sulfate is added to water a solution is formed and heat is given out.



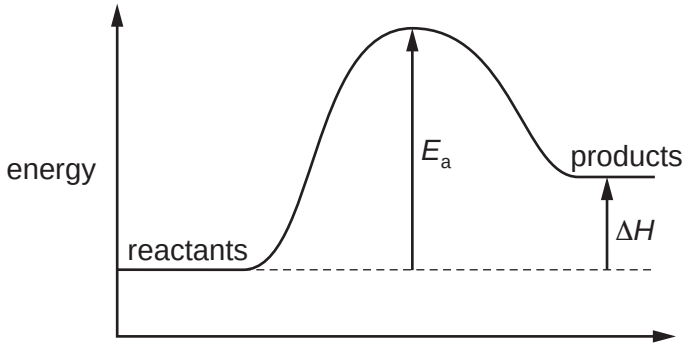
Which row shows the temperature change and the type of reaction taking place?

	temperature change	type of reaction
A	decrease	endothermic
B	decrease	exothermic
C	increase	endothermic
D	increase	exothermic

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[Turn over

13 The energy level diagram for a reaction is shown.



Which statement is **not** correct for this energy level diagram?

A It could be the energy level diagram for the reaction when petrol is burnt.

B Less energy is released in bond forming than is needed for bond breaking.

C The activation energy, E_a, has a positive value.

D The energy change, ΔH, for the reaction is positive.

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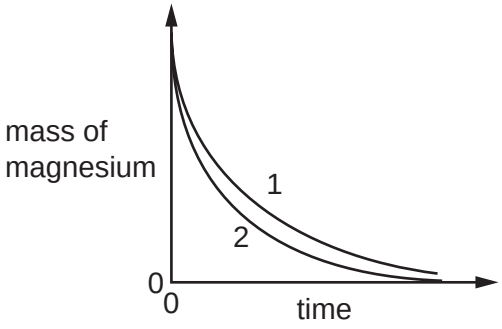
14 The rate of reaction between magnesium and excess dilute hydrochloric acid was followed by measuring the mass of magnesium present at regular time intervals.

Two experiments were performed.

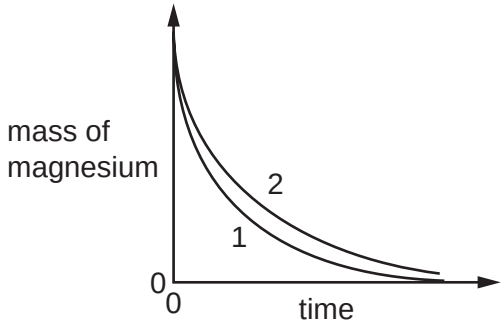
Both experiments used 0.1 g of magnesium ribbon. The acid in experiment 1 was less concentrated than in experiment 2.

Which graph shows the results of the experiments?

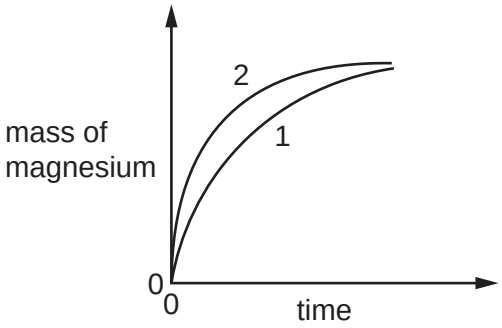
A



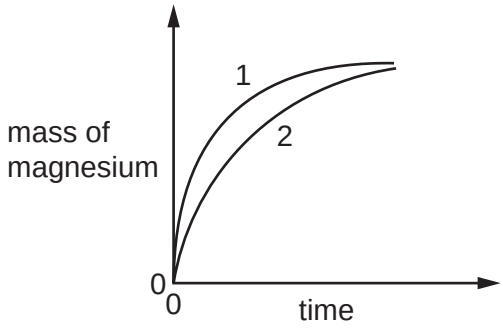
B



C



D



15 Which statement explains why coal dust forms an explosive mixture with air?

A Coal dust catalyses the explosion.

B Coal dust has a large surface area.

C Crushing coal increases the concentration of the coal.

D Crushing coal increases the temperature of the coal.

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[Turn over

16 The following reversible reaction takes place in a closed vessel at constant temperature.

$$P(g) + Q(g) + R(g) \rightleftharpoons S(g) + T(g)$$

When the system has reached equilibrium, more T is added.

After the addition of T, which substances increase in concentration?

A P, Q, R and S

B P and Q only

C P, Q and R only

D S only

17 Four ionic half-equations are shown.

1 $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

2 $2I^-(aq) \rightarrow I_2(aq) + 2e^-$

3 $Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$

4 $Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$

Which statement is correct?

A In equation 1, copper(II) ions are oxidised to copper.

B In equation 2, iodide ions are reduced to iodine.

C In equation 3, iron(II) ions are oxidised to iron(III) ions.

D In equation 4, chlorine is oxidised to chloride ions.

18 Germanium oxide is a white powder.

Germanium oxide reacts with concentrated hydrochloric acid.

Germanium oxide reacts with concentrated aqueous sodium hydroxide.

Germanium oxide does not dissolve when added to water.

Which type of oxide is germanium oxide?

A acidic

B amphoteric

C basic

D neutral

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19 Hydrogen chloride gas reacts with water to produce an acidic solution. The equation for the reaction is shown.

$$HCl + H_2O \rightarrow Cl^- + H_3O^+$$

Which statement describes what happens during the reaction?

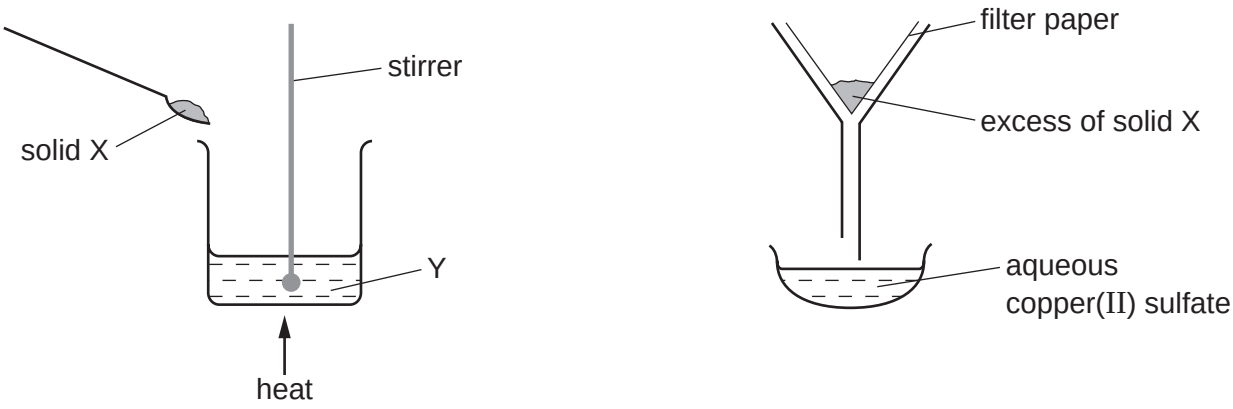
A The chloride ion is formed by accepting an electron from the water.

B The hydrogen chloride loses an electron to form the chloride ion.

C The water accepts a proton from the hydrogen chloride.

D The water donates a proton to the hydrogen chloride.

20 The apparatus shown is used to prepare aqueous copper(II) sulfate.



What are X and Y?

	X	Y
A	copper	aqueous iron(II) sulfate
B	copper(II) chloride	sulfuric acid
C	copper(II) oxide	sulfuric acid
D	sulfur	aqueous copper(II) chloride

21 Information about some silver compounds is shown in the table.

compound	formula	solubility in water
silver carbonate	Ag_2CO_3	insoluble
silver chloride	AgCl	insoluble
silver nitrate	$AgNO_3$	soluble
silver oxide	Ag_2O	insoluble

Which equation shows a reaction which **cannot** be used to make a silver salt?

A $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$

B $Ag_2O(s) + 2HNO_3(aq) \rightarrow 2AgNO_3(aq) + H_2O(l)$

C $Ag_2CO_3(s) + 2HNO_3(aq) \rightarrow 2AgNO_3(aq) + H_2O(l) + CO_2(g)$

D $2Ag(s) + 2HCl(aq) \rightarrow 2AgCl(s) + H_2(g)$

22 What is **not** a property of Group I metals?

A They are soft and can be cut with a knife.

B They react when exposed to oxygen in the air.

C They produce an acidic solution when they react with water.

D They react rapidly with water producing hydrogen gas.

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23 Four substances, P, Q, R and S, are tested as shown.

test	substance			
	P	Q	R	S
dilute hydrochloric acid added	gas given off which 'pops' with a lighted splint	gas given off which turns limewater milky	no reaction	no reaction
dilute aqueous sodium hydroxide added and warmed gently	no reaction	no reaction	gas given off which turns damp, red litmus paper blue	no reaction

What are P, Q, R and S?

	P	Q	R	S
A	Mg	Na_2CO_3	NH_4Cl	$NaCl$
B	Mg	NH_4Cl	Na_2CO_3	$NaCl$
C	Mg	Na_2CO_3	$NaCl$	NH_4Cl
D	Na_2CO_3	Mg	$NaCl$	NH_4Cl

24 Which statement about transition elements and their compounds is correct?

A All the transition elements have an oxidation state of +2 only.

B Aqueous solutions of the salts of transition elements are generally coloured.

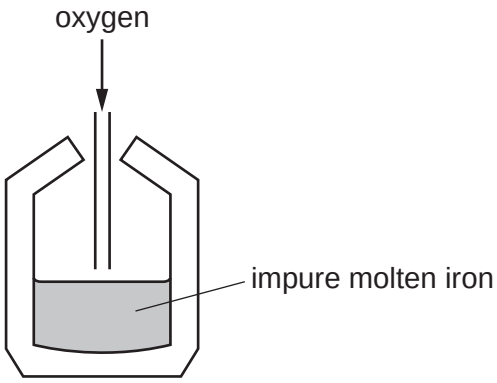
C Transition elements change from metal to non-metal across the period.

D Transition elements can act as catalysts but their compounds cannot.

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[Turn over

25 Impure iron from the blast furnace is converted to steel as shown.



Which statement about the process is correct?

A Acidic oxides are added to remove alkaline impurities.

B Coke is added as a reducing agent.

C Oxygen is blown in to oxidise the impure iron.

D The steel produced contains less carbon than the impure iron.

26 The ionic equations represent the reactions between four metals, P, Q, R and S, and solutions of the salts of the same metals.

$$P + Q^{2+} \rightarrow \text{no reaction}$$

$$R + P^{2+} \rightarrow R^{2+} + P$$

$$Q + S^{2+} \rightarrow Q^{2+} + S$$

$$S + P^{2+} \rightarrow S^{2+} + P$$

$$S + R^{2+} \rightarrow S^{2+} + R$$

$$S + Q^{2+} \rightarrow \text{no reaction}$$

What is the correct order of reactivity of the metals?

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

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27 Aluminium is extracted by electrolysis.

From which ore is aluminium extracted and at which electrode is aluminium deposited during electrolysis?

	ore	electrode
A	bauxite	negative
B	bauxite	positive
C	cryolite	negative
D	cryolite	positive

28 Zinc oxide can be reacted with carbon to produce zinc metal.

Which equation for this reaction is correct?

A $2ZnO + C \rightarrow 2Zn + CO$

B $2ZnO + 2C \rightarrow 2Zn + 2CO_2$

C $ZnO + C \rightarrow Zn + CO$

D $ZnO + 2C \rightarrow Zn + 2CO_2$

29 Air is a mixture of gases.

Which gas is present in the largest amount?

A argon

B carbon dioxide

C nitrogen

D oxygen

30 Which information about carbon dioxide and methane is correct?

		carbon dioxide	methane
A	formed when vegetation decomposes	✓	✗
B	greenhouse gas	✓	✓
C	present in unpolluted air	✗	✗
D	produced during respiration	✗	✓

key

✓ = true

✗ = false

31 Underwater steel pipes can be protected from corrosion by attaching magnesium blocks to them.

Which equation represents the reaction that prevents corrosion?

A $Fe \rightarrow Fe^{2+} + 2e^-$

B $Fe^{2+} \rightarrow Fe^{3+} + e^-$

C $Mg \rightarrow Mg^{2+} + 2e^-$

D $Mg^{2+} + 2e^- \rightarrow Mg$

32 Ammonia is manufactured by the Haber process. The reaction is exothermic.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92\,kJ/mol$$

Which statement about the Haber process is correct?

A The reaction is irreversible and produces only one product.

B The reaction is reversible and produces less ammonia at high pressure.

C The reaction is reversible and produces less ammonia at high temperature.

D The reaction is slow because a catalyst is not used in the Haber process.

33 Sulfuric acid is manufactured by the Contact process.

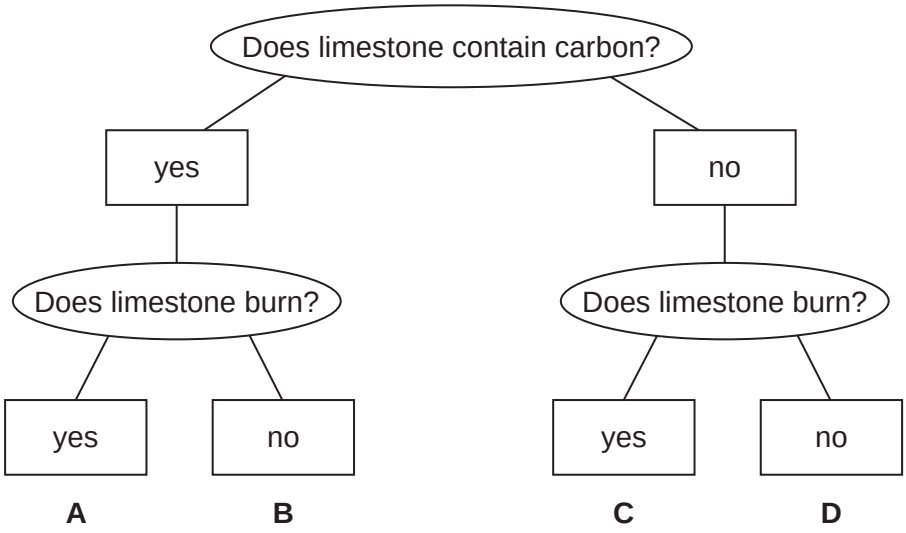
The most important reaction takes place in the presence of a catalyst.

What are the reactants and the catalyst for this reaction?

	reactants	catalyst
A	sulfur and oxygen	vanadium(V) oxide
B	sulfur dioxide and oxygen	vanadium(V) oxide
C	sulfur dioxide and steam	iron
D	sulfur trioxide and water	platinum

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34 Which box corresponds to limestone?



35 Petroleum is an important fossil fuel.

Which row correctly describes petroleum?

	type of substance	composition
A	compound	mainly hydrocarbons
B	compound	only hydrogen and carbon
C	mixture	mainly hydrocarbons
D	mixture	only hydrogen and carbon

36 Butane reacts as shown.

$$\text{butane} \xrightarrow[\text{and heat}]{\text{catalyst}} \text{butene} + \text{hydrogen}$$

What is this type of reaction?

A combustion

B cracking

C polymerisation

D reduction

37 Substance Z has the following characteristics.

1 It burns in an excess of oxygen to form carbon dioxide and water.

2 It is oxidised by air to form a liquid smelling of vinegar.

3 It reacts with carboxylic acids to form esters.

What is substance Z?

A ethane

B ethanoic acid

C ethanol

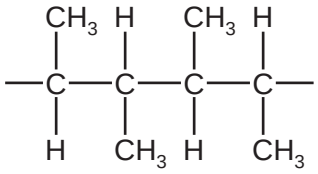
D ethyl ethanoate

38 Ethanol is manufactured by the catalytic addition of steam to ethene and by fermentation.

Which row shows an advantage and a disadvantage of using the catalytic addition of steam to ethene compared to fermentation?

	advantage	disadvantage
A	fast	the product is impure
B	fast	uses non-renewable materials
C	the product is pure	slow
D	uses renewable materials	slow

39 The partial structure of addition polymer X is shown.



Which monomer is used to form polymer X?

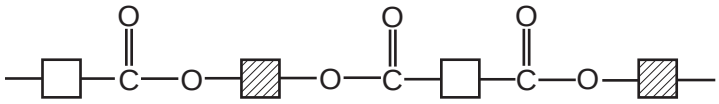
A $CH_2=CH_2$

B $CH_3CH=CH_2$

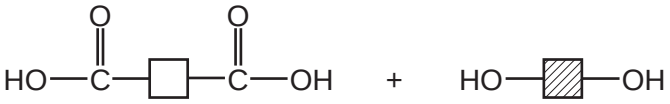
C $CH_3CH=CHCH_3$

D $CH_3CH_2CH=CH_2$

40 The diagram shows the partial structure of *Terylene*.



From which pair of compounds is it made?

A 

B 

C 

D 

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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.)