Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/21**

Paper 2 Multiple Choice (Extended) **October/November 2023**

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages.

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1 A gas is placed in a sealed container. The gas has a pressure of one atmosphere and a temperature of 50 °C.

It is heated to 100 °C.

Which row describes the cause of the pressure of the gas and the effect of increasing the temperature of the gas?

	cause of gas pressure	the effect of increased temperature of the gas
A	collisions between gas particles	collisions become less frequent
B	collisions between gas particles	the average speed of the gas particles increases
C	collisions between gas particles and the container	collisions become less frequent
D	collisions between gas particles and the container	the average speed of the gas particles increases

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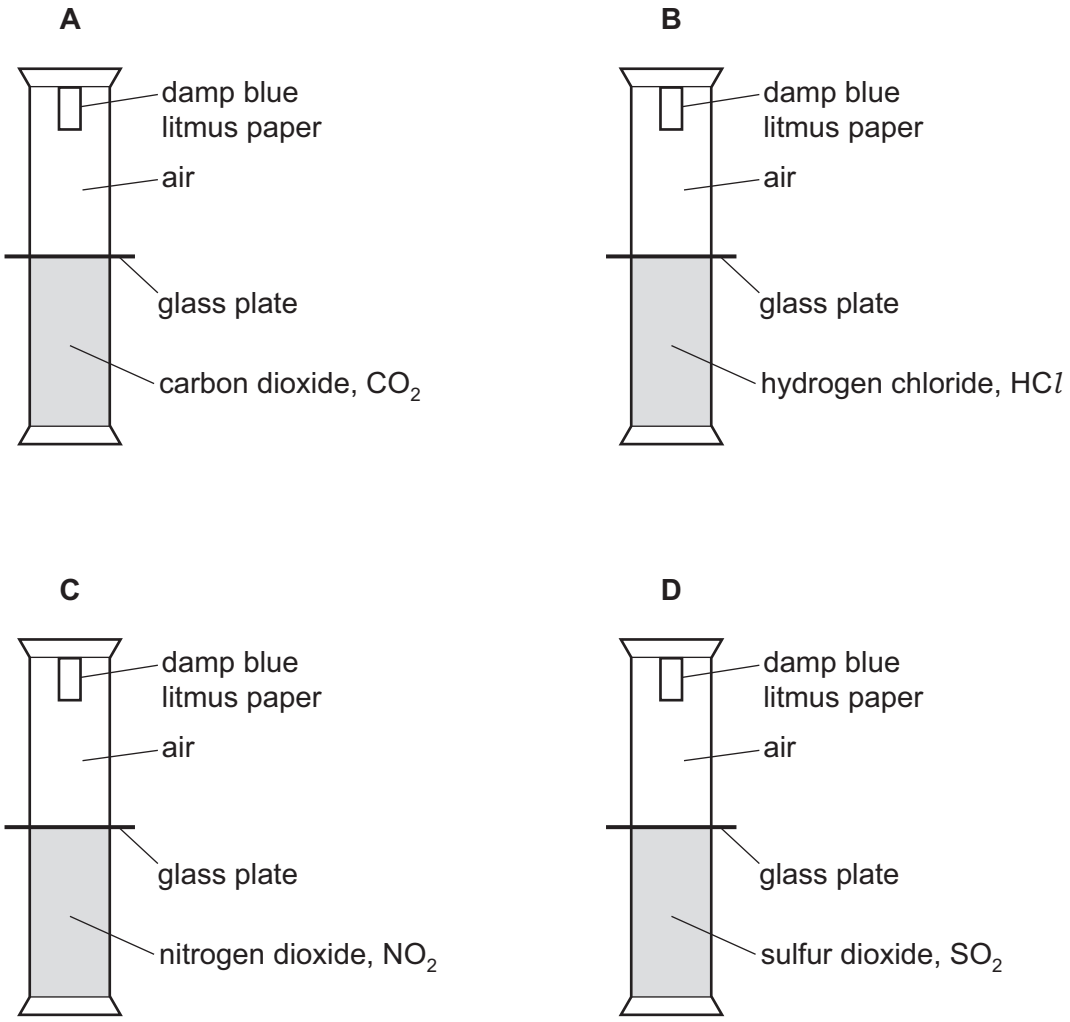
2 Four experiments, each containing a different acidic gas, are set up as shown.

The dividing glass plates are removed at the same time.

In which set of apparatus does the litmus turn red first?



3 The Group I element potassium forms an ionic bond with the Group VII element fluorine.

Which two ions are produced?

A K^+ and F^+ **B** K^+ and F^- **C** K^- and F^- **D** K^- and F^+

4 X and Y are atoms.

- X and Y have the same number of electron shells.
- X and Y have the same number of outer electrons.
- X and Y have different mass numbers.

Which statements about X and Y are correct?

1 X and Y are isotopes.

2 X and Y have the same total number of electrons.

3 X and Y have the same chemical properties.

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

5 Lithium chloride is an ionic compound and silicon(IV) oxide is a covalent compound.

Which statement about **both** compounds is correct?

A They are not soluble in water.

B They conduct electricity when melted.

C They do not conduct electricity in solid form.

D They have low melting points.

6 Which equations are balanced?

1 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

2 $ZnCO_3 + 2HCl \rightarrow ZnCl_2 + CO_2 + 2H_2O$

3 $Mg(NO_3)_2 + NaOH \rightarrow Mg(OH)_2 + 2NaNO_3$

4 $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

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

7 Which row shows the formulae of sodium carbonate, zinc nitrate and ammonium sulfate?

	sodium carbonate	zinc nitrate	ammonium sulfate
A	Na_2CO_3	$ZnNO_3$	$(NH_4)_2SO_4$
B	Na_2CO_3	$Zn(NO_3)_2$	$(NH_4)_2SO_4$
C	$NaCO_3$	$ZnNO_3$	$(NH_3)_2SO_4$
D	$NaCO_3$	$Zn(NO_3)_2$	$(NH_3)_2SO_4$

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8 Which statements about hydrogen and oxygen are correct?

	hydrogen and oxygen can react to produce electrical energy	hydrogen and oxygen can be made by the electrolysis of dilute aqueous sodium chloride
A	✗	✗
B	✗	✓
C	✓	✗
D	✓	✓

9 Graphite has a giant covalent structure.

Which statements about graphite are correct?

1 Carbon atoms form four covalent bonds with neighbouring atoms.

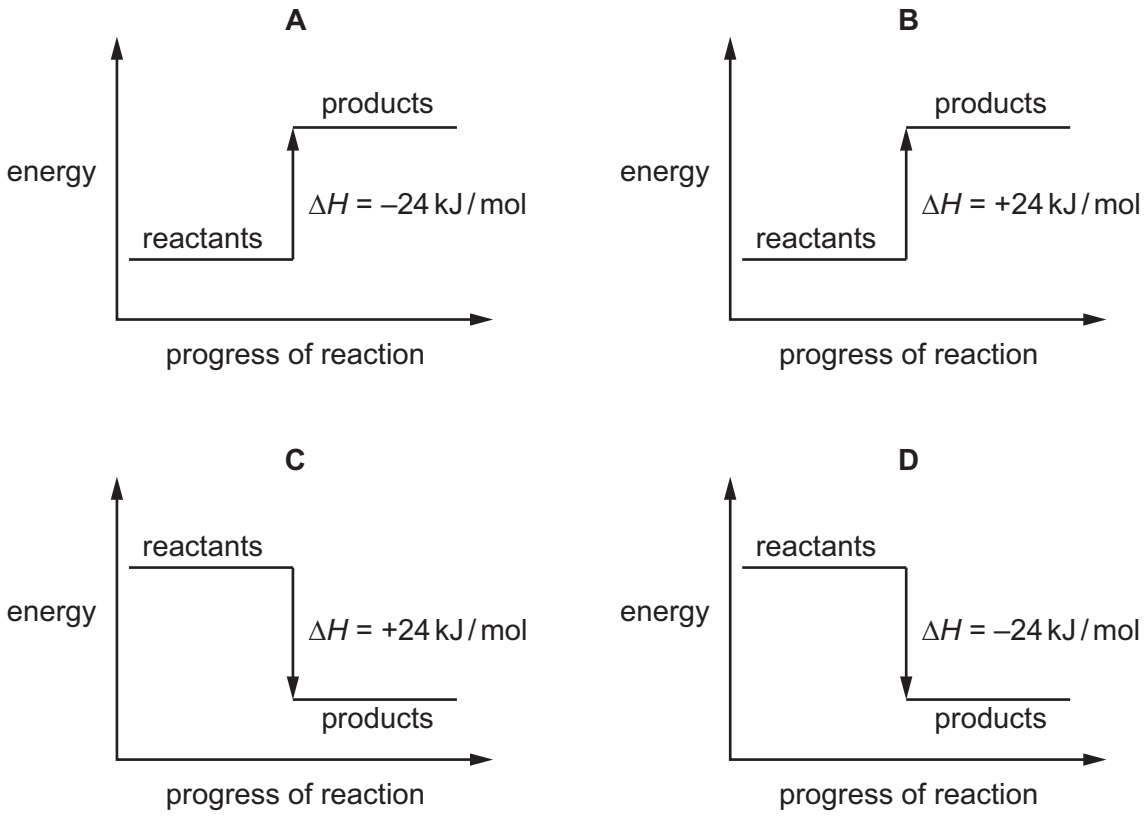
2 There are delocalised electrons between layers of carbon atoms.

3 Graphite is a useful lubricant.

4 Graphite is a good conductor of electricity.

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

10 Which reaction pathway diagram represents an endothermic reaction?



11 Hydrogen burns in oxygen.

The equation for the reaction is shown.

$$2H_2 + O_2 \rightarrow 2H_2O$$

The table shows the bond energies involved.

bond	bond energy in kJ / mol
H–H	436
O=O	498
O–H	464

What is the energy given out during the reaction?

A –3226 kJ / mol

B –884 kJ / mol

C –486 kJ / mol

D –442 kJ / mol

12 Which process involves a chemical change?

A adding sodium to water

B boiling water

C dissolving sodium chloride in water

D producing water from aqueous sodium chloride

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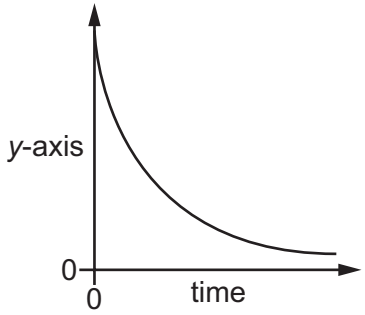
13 An experiment is carried out to find the rate of reaction between hydrochloric acid and zinc.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

The results of the experiment are shown.



What is the label on the *y*-axis?

A amount of $ZnCl_2$ produced

B concentration of HCl

C mass of Zn reacted

D volume of H_2 produced

14 Hydrogen peroxide, H_2O_2, decomposes to form water and oxygen.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

Manganese(IV) oxide catalyses the decomposition reaction.

The reaction is investigated in four experiments.

experiment	volume and concentration of hydrogen peroxide	conditions
1	12.5 cm^3 of 1.0 mol / dm^3	25 °C with manganese(IV) oxide powder added
2	12.5 cm^3 of 2.0 mol / dm^3	40 °C with manganese(IV) oxide powder added
3	25 cm^3 of 1.0 mol / dm^3	40 °C without manganese(IV) oxide powder
4	25 cm^3 of 1.0 mol / dm^3	40 °C with manganese(IV) oxide powder added

All reactions go to completion and all measurements of gas volumes are at room temperature and pressure.

Which statement is correct?

A Experiment 1 produces less gas than experiment 4, but at the same rate.

B Experiment 2 produces more gas than experiment 1, but at the same rate.

C Experiment 2 and experiment 4 each produce the same volume of gas, but at different rates.

D Experiment 3 and experiment 4 each produce the same volume of gas and at the same rate.

15 Sulfuric acid is produced by the Contact process.

Which row shows the typical conditions used in the process?

	catalyst	pressure / kPa	temperature / °C
A	iron	200	300
B	iron	20 000	450
C	vanadium(V) oxide	200	450
D	vanadium(V) oxide	20 000	300

16 Which equation shows the reduction of copper?

A $CuO + C \rightarrow Cu + CO$

B $2CuS + 3O_2 \rightarrow 2CuO + 2SO_2$

C $Cu(g) \rightarrow Cu(l)$

D $Cu(l) \rightarrow Cu(s)$

17 Which statement about acids is correct?

A A weak acid partially dissociates in aqueous solution.

B An acid accepts protons when added to water.

C Ethanoic acid acts as a strong acid when added to water.

D Hydrochloric acid is a strong acid that ionises in water to form H^- ions.

18 Copper(II) sulfate is formed by reacting excess solid copper(II) carbonate with dilute sulfuric acid.

Which processes are part of the preparation of solid copper(II) sulfate?

1 crystallisation

2 distillation

3 filtration

4 titration

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

19 Which type of reaction is represented by the equation shown?

$$Pb^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + 2I^-(aq) \rightarrow PbI_2(s) + 2Na^+(aq) + 2NO_3^-(aq)$$

A addition

B redox

C neutralisation

D precipitation

20 Which compound is likely to be coloured?

A $KMnO_4$ **B** KNO_3 **C** K_2CO_3 **D** K_2SO_4

21 Which statements about the metal zinc are correct?

1 It is extracted from the ore bauxite.

2 It is used to galvanise steel.

3 It is used to make the alloy brass.

4 It reacts with dilute hydrochloric acid to produce hydrogen gas.

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

22 The electronic configurations of four elements, P, Q, R and S, are shown.

element	electronic configuration
P	2
Q	2,2
R	2,6
S	2,8

Which elements are unreactive monatomic gases?

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

23 Which row compares the strength of alloys with pure metals and explains the difference in strength?

	strength of an alloy compared to a pure metal	explanation
A	weaker	larger atoms slide more easily over smaller atoms
B	weaker	larger atoms make it harder for layers to slide over one another
C	stronger	larger atoms slide more easily over smaller atoms
D	stronger	larger atoms make it harder for layers to slide over one another

24 Zinc oxide reacts with carbon to produce zinc.

Which equation represents this reaction?

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

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

C $ZnO + C \rightarrow Zn + CO$

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

25 When a piece of aluminium foil is added to dilute hydrochloric acid, no effervescence is seen.

Which statement explains why no effervescence is seen?

A Aluminium does not make a gas when it reacts with an acid.

B Aluminium has a surface layer of aluminium oxide.

C Aluminium is less reactive than hydrogen.

D Aluminium only reacts with concentrated acid.

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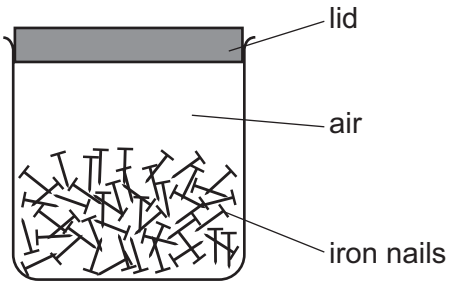
26 Iron nails are stored in an airtight container.



The nails begin to rust after a few days.

How can the rusting of the nails be prevented?

A Leave the lid off.

B Replace the air with argon.

C Put the container in a warm place.

D Seal the container in a bag.

27 Four substances present in the blast furnace during iron extraction are listed.

1 calcium carbonate

2 carbon dioxide

3 carbon monoxide

4 iron(III) oxide

Which substances are both a reactant and a product during the reactions occurring in the blast furnace?

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

28 Aluminium is extracted from purified bauxite by electrolysis.

Which row shows the ionic half-equations for the reaction at each electrode?

	anode	cathode
A	$Al \rightarrow Al^{3+} + 3e^-$	$2O^{2-} + 4e^- \rightarrow O_2$
B	$Al^{3+} + 3e^- \rightarrow Al$	$2O^{2-} \rightarrow O_2 + 4e^-$
C	$2O^{2-} + 4e^- \rightarrow O_2$	$Al \rightarrow Al^{3+} + 3e^-$
D	$2O^{2-} \rightarrow O_2 + 4e^-$	$Al^{3+} + 3e^- \rightarrow Al$

29 Which test is used to show that a sample of water is pure?

A Evaporate the water to see if any solids remain.

B Heat the water to check its boiling point.

C Test with anhydrous cobalt(II) chloride.

D Use universal indicator paper to check its pH.

30 Catalytic converters in car exhausts change polluting gases into non-polluting gases.

Which statements about oxides of nitrogen and car engines are correct?

1 The nitrogen in oxides of nitrogen comes from compounds in gasoline.

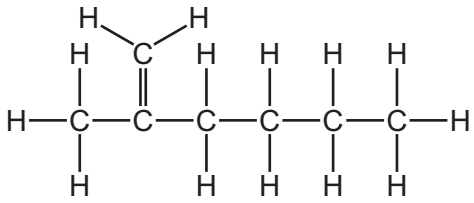
2 The oxygen in oxides of nitrogen comes from the air in the car engine.

3 Catalytic converters convert oxides of nitrogen into nitrogen.

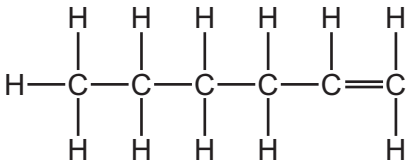
A 1 and 2 **B** 2 and 3 **C** 2 only **D** 3 only

31 The structures of two molecules, X and Y, are shown.

X



Y

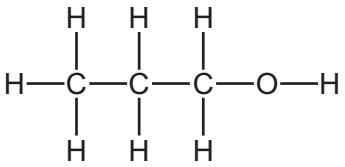


Which row describes X and Y?

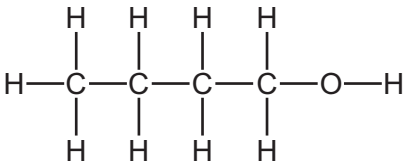
	structural isomers	belong to same homologous series
A	no	no
B	no	yes
C	yes	no
D	yes	yes

32 What is the structure of butanoic acid?

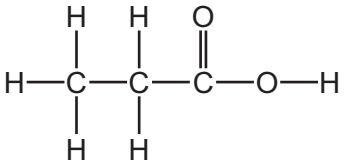
A



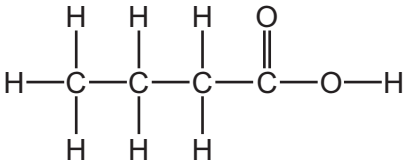
B



C



D



33 When a mixture of methane and chlorine is exposed to ultraviolet light, a reaction takes place.

Which statements about this reaction are correct?

1 It is an addition reaction.

2 The ultraviolet light provides the activation energy.

3 An equation for the reaction is $CH_4 + Cl_2 \rightarrow CH_2Cl_2 + H_2$.

4 CH_3Cl is made in the reaction.

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

34 Esters are formed when a carboxylic acid reacts with an alcohol.

What is the catalyst for this reaction?

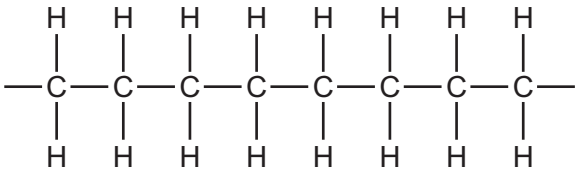
A aqueous potassium manganate(VII)

B iron

C sulfuric acid

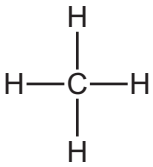
D vanadium(V) oxide

35 The diagram shows part of a polymer.

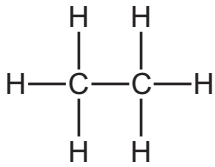


Which diagram shows the monomer from which this polymer is made?

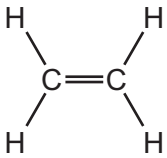
A



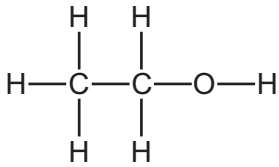
B



C



D



36 Nylon and PET are polymers.

Which statements about these polymers are correct?

1 They are both condensation polymers.

2 $HOCH_2CH_2CH_2OH$ could be a monomer for both polymers.

3 The complete combustion of both polymers gives two products only.

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

37 Ethane is used as a fuel.

Which equation shows the complete combustion of ethane?

A $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

B $2C_2H_6 + 5O_2 \rightarrow 4CO + 6H_2O$

C $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

D $C_2H_4 + 2O_2 \rightarrow 2CO + 2H_2O$

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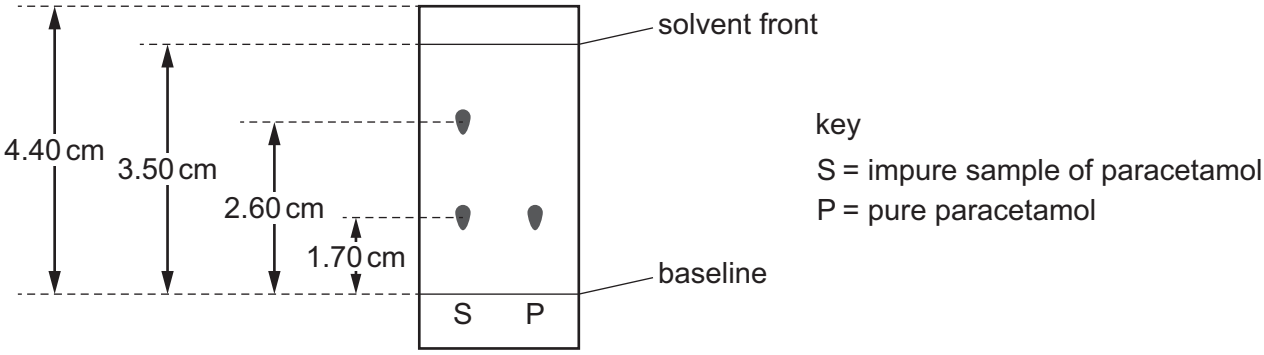
38 The painkiller paracetamol is synthesised from 4-aminophenol.

Chromatography is done on an impure sample of paracetamol. The results are shown. The diagram is not drawn to scale.



The sample of paracetamol is contaminated with 4-aminophenol only.

What is the R_f value of 4-aminophenol?

A 0.49 **B** 0.65 **C** 0.74 **D** 1.35

39 The equation for the reaction of aqueous calcium nitrate and aqueous sodium hydroxide is shown.

$$Ca(NO_3)_2(aq) + 2NaOH(aq) \rightarrow Ca(OH)_2(s) + 2NaNO_3(aq)$$

Which process is used to remove calcium hydroxide from the mixture?

A chromatography

B crystallisation

C distillation

D filtration

40 The results of two tests on aqueous compound X are given.

test	result
warm with aluminium foil and aqueous sodium hydroxide	ammonia is produced
aqueous sodium hydroxide	brown precipitate

What is X?

A iron(III) nitrate

B iron(II) nitrate

C iron(III) sulfate

D iron(II) sulfate

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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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