39 The results of flame tests on three metal salts, X, Y and Z, are shown.

metal salt	flame test colour
X	yellow
Y	lilac
Z	blue-green

Which row identifies the cations present in X, Y and Z?

	X	Y	Z
A	potassium	sodium	calcium
B	potassium	sodium	copper
C	sodium	potassium	calcium
D	sodium	potassium	copper

40 Ethanol can be made by fermentation of sugar, using yeast.

This produces a mixture of ethanol and water.

How is ethanol separated from this mixture?

A distilling the mixture using a fractionating column

B filtering the mixture

C heating to evaporate most of the water, and allowing the ethanol to crystallise

D heating to evaporate the water

The Periodic Table of Elements

Group	I	II											III	IV	V	VI	VII	VIII
																		2 He helium 4
													5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
													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
	3 Li lithium 7	4 Be beryllium 9											31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
	11 Na sodium 23	12 Mg magnesium 24											49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
	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	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
	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	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –
	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	111 Rg roentgenium –	112 Cn copernicium –				
	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 –								

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.).

39 Which item of apparatus is used to measure 13.7 cm^3 of dilute hydrochloric acid?

A a balance

B a burette

C a conical flask

D a volumetric pipette

40 Chromatography is used to separate and analyse mixtures of soluble substances.

The first steps of the process are listed.

- apply sample to baseline
- develop chromatogram in solvent

What is the next step in the process to detect soluble **colourless** substances?

A calculate the R_f values

B compare the results with known substances

C count the number of spots

D use a suitable locating agent

The Periodic Table of Elements

Group	I	II												III	IV	V	VI	VII	VIII
																			2 He helium 4
							1 H hydrogen 1							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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	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 –							

Key

atomic number
atomic symbol
name
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.).

3 A student makes crystals of the salt sodium sulfate, Na_2SO_4. The student reacts 0.200 mol / dm^3 dilute sulfuric acid, $H_2SO_4(aq)$, with aqueous sodium hydroxide, NaOH(aq).

The student uses the following steps.

step 1 The student places 40.0 cm^3 of NaOH(aq) into a conical flask. This volume contains 0.0100 moles of NaOH.

step 2 The student adds a few drops of methyl orange indicator to the NaOH(aq) in the conical flask.

step 3 The student adds 0.200 mol / dm^3 $H_2SO_4(aq)$ to the flask until the end-point is reached.

step 4 The student transfers the mixture from the conical flask to an evaporating basin and obtains dry crystals.

(a) Complete the symbol equation for the reaction. Include state symbols.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(.....) + ...(.....)$$

[2]

(b) State the type of exothermic reaction taking place.

..... [1]

(c) Calculate the concentration of NaOH(aq) used in **step 1**.

concentration of NaOH(aq) = ... mol / dm^3 [1]

(d) Name the item of apparatus the student uses to add $H_2SO_4(aq)$ in **step 3**.

..... [1]

(e) Calculate the volume of $H_2SO_4(aq)$, in cm^3, added in **step 3**.

volume of $H_2SO_4(aq)$ = ... cm^3 [2]

(f) State the colour change observed in **step 3**.

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

(g) The dry crystals formed in **step 4** are coloured and **not** white. This is because the student should do an additional step between **step 3** and **step 4**.

Suggest what the student should do in this additional step to produce white crystals.

.....

..... [1]

(h) In **step 4**, the student gently heats the solution in the evaporating basin until the solution is saturated. The student then stops heating and leaves the hot solution to cool. Crystals start to appear.

(i) Explain the term saturated solution.

.....

.....

..... [2]

(ii) Explain why crystals start to appear as the hot solution cools.

.....

..... [1]

(iii) Suggest the effect, if any, on the mass of crystals collected in **step 4** if the solution in the evaporating basin is allowed to dry without gentle heating.

..... [1]

[Total: 14]

1 Hot concentrated hydrochloric acid reacts with solid manganese(IV) oxide to make chlorine gas. Chlorine gas is toxic and more dense than air. Concentrated hydrochloric acid is corrosive.

Fig. 1.1 shows the apparatus used to make and collect a sample of chlorine gas.

There is **one** error in the way the apparatus has been set up in Fig. 1.1.

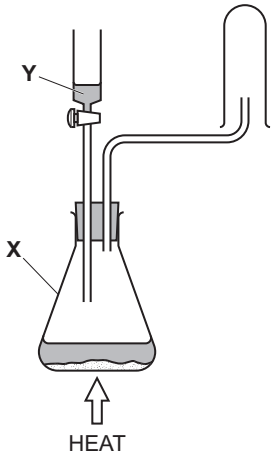

Fig. 1.1

(a) Name the item of apparatus labelled **X** in Fig. 1.1.

..... [1]

(b) Identify the substance labelled **Y** in Fig. 1.1.

..... [1]

(c) Name an item of apparatus that can be used to heat **X** in Fig. 1.1.

..... [1]

(d) There is **one** error in the way the apparatus has been set up.

Describe a change that needs to be made to the apparatus in Fig. 1.1 to correct this error.

.....

..... [1]

(e) Explain why this experiment should be carried out in a fume cupboard.

.....

..... [1]

[Total: 5]

1 Eggshells are made from a mixture of calcium carbonate and other insoluble substances.

Calcium carbonate reacts with dilute hydrochloric acid. The equation for the reaction is shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

The other substances in eggshells do **not** react with dilute hydrochloric acid.

A student finds the percentage by mass of calcium carbonate in an eggshell.

Fig. 1.1 shows the first three steps of the method the student uses.

step 1
Grind the eggshell into small pieces.

step 2
Find the mass of the small pieces of eggshell.

step 3
Add the small pieces of eggshell to excess dilute hydrochloric acid and warm the mixture while stirring it with a glass rod.

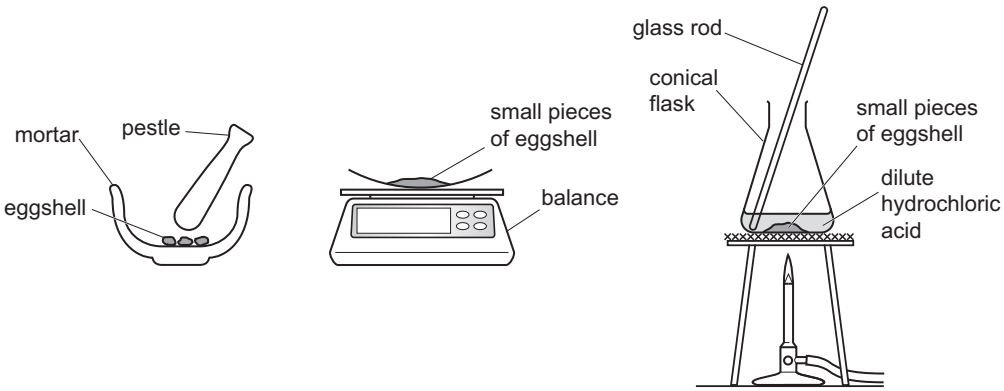

Fig. 1.1

(a) **(i)** Describe what is seen when the calcium carbonate in the eggshell reacts with dilute hydrochloric acid.

..... [1]

(ii) Describe what the student should do to make sure the acid is in excess and all of the calcium carbonate has reacted.

.....

.....

..... [2]

(b) After **step 3**, the student filters the mixture to obtain the unreacted solid left from the eggshell.

(i) Draw a labelled diagram of the apparatus the student should use to filter the mixture.

[2]

(ii) After the filtration, the student washes the residue.

Identify the **two** substances removed from the residue by washing.

substance 1 .....

substance 2 .....

[2]

(iii) After washing the residue, the student dries the residue in an oven.
The student then measures the mass of the dry residue.

The masses the student records are shown in Table 1.1.

Table 1.1

mass of small pieces of eggshell / g	2.00
mass of dry residue after filtration / g	0.11

Use the data in Table 1.1 to calculate the percentage by mass of calcium carbonate in the eggshell.

percentage of calcium carbonate = ... [2]

[Total: 9]