

Past-paper walk-through

Separation and purification ■ 12.4

eXercise

Questions in this set

- 0620/21 N25 Q40 ■ 1 mark
- 0620/42 N25 Q3 ■ 13 marks
- 0620/21 J25 Q39 ■ 1 mark
- 0620/22 J25 Q39 ■ 1 mark
- 0620/22 J25 Q40 ■ 1 mark
- 0620/23 J25 Q38 ■ 1 mark
- 0620/23 J25 Q39 ■ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 40

0620/21 N25 ■ Q40 ■ 1 mark

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

Question 40

	IV	V	VI	VII	VIII
					2 He helium 4
	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —
	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —

	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

— III —

5 B 30r 11 13 17 27 31 35 40 49 53 57 61 65 69 73 77 81 85 89 93 97 101 105 109 113 117 121 125 129 133 137 141 145 149 153 157 161 165 169 173 177 181 185 189 193 197 201 205 209 213 217 221 225 229 233 237 241 245 249 253 257 261 265 269 273 277 281 285 289 293 297 301 305 309 313 317 321 325 329 333 337 341 345 349 353 357 361 365 369 373 377 381 385 389 393 397 401 405 409 413 417 421 425 429 433 437 441 445 449 453 457 461 465 469 473 477 481 485 489 493 497 501 505 509 513 517 521 525 529 533 537 541 545 549 553 557 561 565 569 573 577 581 585 589 593 597 601 605 609 613 617 621 625 629 633 637 641 645 649 653 657 661 665 669 673 677 681 685 689 693 697 701 705 709 713 717 721 725 729 733 737 741 745 749 753 757 761 765 769 773 777 781 785 789 793 797 801 805 809 813 817 821 825 829 833 837 841 845 849 853 857 861 865 869 873 877 881 885 889 893 897 901 905 909 913 917 921 925 929 933 937 941 945 949 953 957 961 965 969 973 977 981 985 989 993 997 1001 1005 1009 1013 1017 1021 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9825 9829 9833 9837 9841 9845 9849 9853 9857 9861 9865 9869 9873 9877 9881 9885 9889 9893 9897 9901 9905 9909 9913 9917 9921 9925 9929 9933 9937 9941 9945 9949 9953 9957 9961 9965 9969 9973 9977 9981 9985 9989 9993 9997 10001 10005 10009 10013 10017 10021 10025 10029 10033 10037 10041 1

The Periodic Table of Elements

[illegible]

ure and pressure (r.t.p.).

Question 40

| | |

| % | E | _ | _ | | E | n | at

II	

Key	
atomic number	
atomic symbol	
name	
relative atomic mass	

4 Be beryllium 9										
12 Mg magnesium 24										
20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55					
38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –					
56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186					
88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –					

Is	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –
	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –

ie of one mole of any gas is 24 dm³ at room temper;

Question 40

Question 40

	I								
3	Li lithium 7								
11	Na sodium 23								
19	K potassium 39								
37	Rb rubidium 85								
55	Cs caesium 133								
87	Fr francium —								

lanthano

actinoids

The volu

Solution 40

Answer: **A**

Why

- Ethanol and water mix completely, so filtering achieves nothing.
- They boil at different temperatures, 78°C and 100°C .
- A fractionating column separates them by repeated evaporation and condensation.

Question 3

0620/42 N25 ■ Q3 ■ 13 marks

- 3** A student prepares a sample of the insoluble salt barium sulfate, BaSO_4 .
The student adds aqueous sodium sulfate, $\text{Na}_2\text{SO}_4(\text{aq})$, to aqueous barium chloride, $\text{BaCl}_2(\text{aq})$.

The student carries out the following steps.

step 1 Dissolve 0.100 moles of solid BaCl_2 in 100cm^3 of distilled water in a beaker to form $\text{BaCl}_2(\text{aq})$.

step 2 Add an aqueous solution which contains 0.100 moles of $\text{Na}_2\text{SO}_4(\text{aq})$ to the beaker containing the $\text{BaCl}_2(\text{aq})$ from **step 1**.

step 3 Stir the mixture and then filter it.

step 4 Dry the solid left in the filter paper.

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

Question 3

[2]

(b) Calculate the mass of solid BaCl_2 dissolved in **step 1**.

Question 3

(c) The concentration of $\text{Na}_2\text{SO}_4(\text{aq})$ in **step 2** is 1.25 mol/dm^3 .

Calculate the volume, in cm^3 , of 1.25 mol/dm^3 $\text{Na}_2\text{SO}_4(\text{aq})$ added in **step 2** which contains 0.100 moles of Na_2SO_4 .

Question 3

(d) State the colour of the solid formed in **step 2**.

Question 3

(e) The mixture is filtered in **step 3**.

State the general term given to a solid left in the filter paper after filtration.

Question 3

- (f) The actual mass of dry BaSO_4 collected in **step 4** is greater than the expected mass. 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, and explain why the actual mass collected is greater than the expected mass.

Question 3

(g) State the name of this method of salt preparation.

Question 3

(h) State the name of a different:

Question 3

[3]

[Total: 13]

Solution 3

(a)

Mark scheme

- $\rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$ (M1)
- 2NaCl (only) (M2)
- (s) and (aq)
- 2

Solution 3

(b)

Mark scheme

- M1 Mr $\text{BaCl}_2 = 208$ (M2)
- $208 \times 0.1 = 20.8$
- 2

Solution 3

(c)

Mark scheme

- $0.100 \div 1.25 (\times 1000) = 80 \text{ (cm}^3\text{)}$
- 1

Solution 3

(d)

Mark scheme

- white
- 1

Solution 3

(e)

Mark scheme

- residue
- 1

Solution 3

(f)

Mark scheme

- M1 rinsing the residue (with water) **M2**
- (mass was greater) because (dry) residue contains solid sodium chloride / NaCl adds to the mass (of residue)
- 2

Solution 3

(g)

Mark scheme

- precipitation
- 1

Solution 3

(h)

Mark scheme

- M1 named soluble barium salt other than barium chloride e.g. (barium) nitrate (M2)
- named soluble sulfate salt other than sodium sulphate e.g. potassium (sulfate) / ammonium (sulfate) (M3)
- named insoluble barium salt other than barium sulfate e.g. (barium) carbonate
- 3

Question 39

0620/21 J25 ■ Q39 ■ 1 mark

39 Which method is used to obtain copper(II) sulfate crystals from an aqueous solution of copper(II) sulfate?

- A** chromatography
- B** condensation
- C** evaporation
- D** filtration

Solution 39

Answer: **C**

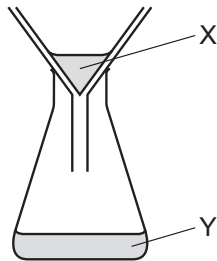
Why

- The salt is already dissolved, so there is nothing to filter out.
- Evaporating some of the water gives a saturated solution that crystallises on cooling.
- Chromatography separates mixtures and condensation collects a distillate instead.

Question 39

0620/22 J25 ■ Q39 ■ 1 mark

39 A mixture containing an aqueous salt and an insoluble salt is filtered.



Which row describes X and Y?

Question 39

	X	Y
A	solute	pure water
B	solute	filtrate
C	residue	pure water
D	residue	filtrate

Solution 39

Answer: **D**

Why

- Filtration separates an insoluble solid from a solution.
- The solid caught in the filter paper is the residue.
- The liquid that passes through is the filtrate – and it is a solution, not pure water.

Question 40

0620/22 J25 ■ Q40 ■ 1 mark

40 Pure ethanol has a melting point of -114°C and a boiling point of 78°C .

What are the melting and boiling points of a sample of ethanol with glucose dissolved in it?

	melting point/ $^{\circ}\text{C}$	boiling point/ $^{\circ}\text{C}$
A	-116	77
B	-116	79
C	-112	77
D	-112	79

Question 40

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 aluminum 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —
113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganesson —

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
72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 187	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 —

The Periodic Table of Elements

[illegible]

ature and pressure (r.t.p.).

II	
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		Key													
		atomic number													
		atomic symbol													
		name													
		relative atomic mass													
4	Be beryllium 9	12	Mg magnesium 24	20	Ca calcium 40	21	Sc scandium 45	22	Ti titanium 48	23	V vanadium 51	24	Cr chromium 52	25	Mn manganese 55
38	Sr strontium 88			39	Y yttrium 89			40	Zr zirconium 91	41	Nb niobium 93	42	Mo molybdenum 96	43	Tc technetium —
56	Ba barium 137			57–71	lanthanoids	72		72	Hf hafnium 178	73	Ta tantalum 181	74	W tungsten 184	75	Re rhenium 186
88	Ra radium —			89–103	actinoids	104			Rf rutherfordium —	105	Db dubnium —	106	Sg seaborgium —	107	Bh bohrium —

57	La lanthanum 139	58	Ce cerium 140	59	Pr praseodymium 141	60	Nd neodymium 144	61	Pm promethium —
89	Ac actinium —	90	Th thorium 232	91	Pa protactinium 231	92	U uranium 238	93	Np neptunium —

me of one mole of any gas is 24 dm³ at room temper

Question 40

[illegible]

lanthano

actinoids

The volu

Solution 40

Answer: **B**

Why

- Dissolving a solute widens the range over which a substance stays liquid.
- So the melting point falls *below* -114°C .
- And the boiling point rises *above* 78°C .

Question 38

0620/23 J25 ■ Q38 ■ 1 mark

38 The steps used to separate a mixture of a soluble solid and an insoluble solid are listed.

- A solution is made by adding the mixture to a suitable1..... .
- The mixture is stirred and then poured through a filter funnel lined with filter paper.
- The insoluble solid is collected on the filter paper as the2..... .

Which words complete gaps 1 and 2?

	1	2
A	solute	filtrate
B	solute	residue
C	solvent	filtrate
D	solvent	residue

Question 38



Solution 38

Answer: **D**

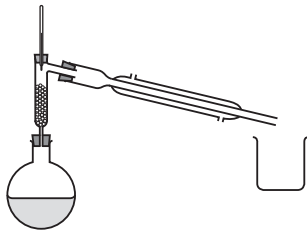
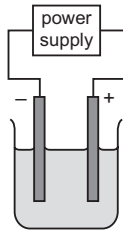
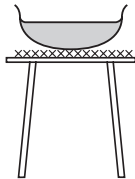
Why

- Add the mixture to a solvent that dissolves only the soluble solid.
- Filter to leave the insoluble solid as the residue.
- Then evaporate or crystallise the filtrate to recover the soluble solid.

Question 39

0620/23 J25 ■ Q39 ■ 1 mark

39 Which items of apparatus are used to separate a mixture of liquids with different boiling points?

A**B****C****D**

Solution 39

Answer: **A**

Why

- Liquids with different boiling points are separated by distillation.
- That needs a flask to heat the mixture, a thermometer at the neck, and a condenser.
- Electrolysis apparatus and filter funnels do not separate by boiling point.