

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

40 A colourless mixture is separated by paper chromatography.

The steps below describe the method. These steps are **not** in the correct order.

- 1 Remove the chromatography paper from the solvent when the solvent front is near the top of the paper.
- 2 Place the chromatography paper in the solvent.
- 3 Spray the chromatography paper with a locating agent.
- 4 Place a spot of the mixture on the pencil line.
- 5 Draw a pencil line at the bottom of the chromatography paper.
- 6 Draw a pencil line to mark the position of the solvent front.

What is the correct order for these steps?

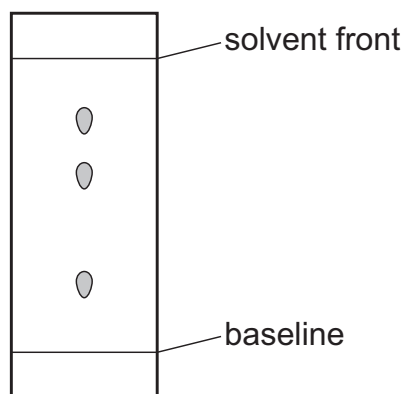
- A** 3 → 5 → 6 → 4 → 2 → 1
- B** 5 → 4 → 3 → 2 → 1 → 6
- C** 3 → 5 → 4 → 1 → 2 → 6
- D** 5 → 4 → 2 → 1 → 6 → 3

The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass																
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 oganeson —	

40 A mixture of four different colourless amino acids is analysed by paper chromatography.

The final chromatogram is shown.



Why does the chromatogram only show three spots?

- A** A locating agent is **not** used.
- B** One of the amino acids is insoluble in the solvent.
- C** The solvent front is too near the top of the paper.
- D** Two of the amino acids have the same R_f value.

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

40 In paper chromatography, what is the equation for the R_f value?

- A** $R_f = \frac{\text{distance travelled by solvent}}{\text{distance travelled by substance}}$
- B** $R_f = \frac{\text{distance travelled by locating agent}}{\text{distance travelled by substance}}$
- C** $R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by locating agent}}$
- D** $R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$

- 40** A mixture of soluble substances can be separated by paper chromatography. Each substance can be identified using its R_f value.

Which formula shows how the R_f value is calculated?

- A** $R_f = \frac{\text{distance travelled by solvent}}{\text{distance travelled by substance}}$
- B** $R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$
- C** $R_f = \text{distance travelled by solvent} - \text{distance travelled by substance}$
- D** $R_f = \text{distance travelled by solvent} \times \text{distance travelled by substance}$

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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 —	

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