

IGCSE Chemistry Review Practice

Suggested time 80 minutes

Name _____ Class _____ Date _____

Complete all questions before checking the answers at the end. Circle one answer letter for each multiple choice question. Show calculation steps. A calculator is allowed.

Suggested timing: multiple choice 25 minutes; written questions 50 minutes; checking 5 minutes. Use Groups I to VII and Group 0. Relative atomic masses: H 1, C 12, N 14, O 16, Na 23, Mg 24, Al 27, S 32, Cl 35.5, K 39, Ca 40, Cu 64.

Multiple choice questions

1 A liquid is poured from a narrow bottle into a wide dish without any being lost. Which property changes?

- A its shape
- B the size of its particles
- C its volume
- D its mass

2 A substance has melting point -15°C and boiling point 45°C . Which row gives its states at -20°C , 20°C and 60°C ?

- A solid, liquid, gas
- B liquid, solid, gas
- C solid, gas, liquid
- D gas, liquid, solid

3 A liquid freezes. Which description of its particles is correct?

- A They gain more energy.
- B They vibrate about fixed positions.
- C They stop all motion.
- D They become smaller.

4 Which observation is best explained by diffusion rather than by melting or bulk movement of air?

- A A liquid flows down a slope.
- B A scent is detected across a still room.
- C A fan blows a paper flag.
- D An ice cube becomes water.

5 A sealed rigid bottle of gas is cooled. Which change explains its lower pressure?

- A The bottle volume increases.
- B There are fewer molecules.
- C Molecules hit the walls less frequently and less forcefully.
- D Each molecule becomes lighter.

6 A pure liquid boils while its temperature stays constant. Where does the supplied energy mainly go?

- A Into making the molecules larger.
- B Into increasing the number of atoms in each molecule.
- C Into overcoming attractions between molecules.
- D Into stopping molecular motion.

Multiple choice questions continued

7 In filtration, chalk remains on the paper and a clear liquid passes through. What are these products called?

- A chalk is the residue; liquid is the filtrate
- B both are filtrates
- C chalk is the filtrate; liquid is the residue
- D both are residues

8 A learner tries to remove dissolved potassium nitrate from water using ordinary filter paper. Why does this fail?

- A The filter turns the salt into a gas.
- B The salt is insoluble in water.
- C The solution cannot pass through paper.
- D The dissolved particles pass through with the water.

9 Which step should follow cooling a concentrated solution until crystals form?

- A Add a large amount of water.
- B Heat every crystal to its boiling point.
- C Filter and dry the crystals.
- D Melt the crystals.

10 A condenser in a distillation apparatus receives a vapour. What does it do?

- A Turns a dissolved salt into a gas.
- B Cools the vapour to form liquid.
- C Raises the boiling point of the mixture.
- D Separates an insoluble solid from a liquid.

11 Two miscible liquids have boiling points 62 °C and 95 °C. In fractional distillation, which fraction is collected first?

- A Neither liquid can be collected.
- B The liquid boiling at 95 °C.
- C Both liquids must be collected in equal amounts.
- D The liquid boiling at 62 °C.

12 A spot moves 2.4 cm while the solvent front moves 6.0 cm from the baseline. What is its R_f?

- A 3.6
- B 0.25
- C 0.40
- D 2.5

Multiple choice questions continued

13 A neutral atom has 12 protons and 14 neutrons. Which pair is correct?

- A 14 electrons; nucleon number 12
- B 26 electrons; nucleon number 14
- C 12 electrons; nucleon number 14
- D 12 electrons; nucleon number 26

14 An ion contains 13 protons and 10 electrons. What is its charge?

- A 3+
- B 3-
- C 1-
- D 1+

15 A neutral atom has electronic configuration 2,8,6. Where is it in the Periodic Table?

- A Group III, Period 6
- B Group II, Period 3
- C Group VI, Period 3
- D Group VI, Period 2

16 Which pair are neutral isotopes of one element? Each entry gives protons, neutrons, electrons.

- A (8,8,8) and (9,8,9)
- B (8,8,8) and (8,8,10)
- C (8,8,8) and (8,10,8)
- D (8,8,8) and (10,8,10)

17 Which nucleus belongs to a different element from a nucleus with 9 protons and 10 neutrons?

- A 10 protons, 10 neutrons
- B 9 protons, 11 neutrons
- C 9 protons, 9 neutrons
- D 9 protons, 12 neutrons

18 A magnesium atom forms Mg^{2+} . Which pair of changes is correct?

- A Neutron count increases by 2; electron count stays the same.
- B Electron count increases by 2; proton count stays the same.
- C Electron count decreases by 2; proton count stays the same.
- D Proton count decreases by 2; electron count stays the same.

Multiple choice questions continued

19 Atom X has configuration 2,8,2. Atom Y has configuration 2,7. What is the most likely formula and bonding of their compound?

- A X_2Y ; ionic
- B XY_2 ; covalent
- C XY ; covalent
- D XY_2 ; ionic

20 What holds neighbouring positive and negative ions together in a solid ionic lattice?

- A Attraction between the nuclei and free neutrons.
- B Electrostatic attraction between opposite charges.
- C Attraction between ions with the same charge.
- D A shared pair between every two ions.

21 A covalent bond between two atoms contains what?

- A An electron that has disappeared.
- B A pair of shared electrons.
- C A pair of shared protons.
- D One neutron from each atom.

22 Which diagram description gives the correct outer-electron arrangement in H_2O ?

- A Four O–H shared pairs and no lone pairs.
- B Two O–H shared pairs and no lone pairs.
- C One O–H shared pair and three lone pairs on oxygen.
- D Two O–H shared pairs and two lone pairs on oxygen.

23 Two nitrogen atoms form N_2 . Each atom has five outer electrons. How many pairs are shared between the atoms?

- A two
- B three
- C five
- D one

24 A solid is a poor conductor, but its melt conducts well. Which explanation is most consistent with this?

- A Its ions can move in the melt but not through the solid.
- B Its molecules contain mobile protons.
- C The electrons vanish when it freezes.
- D Its atoms lose their nuclei when heated.

Multiple choice questions continued

25 A material must conduct electricity while solid. Which choice is suitable?

- A sulfur
- B graphite
- C diamond
- D solid calcium fluoride

26 A giant covalent solid is very hard and has a high melting point. Which description explains both properties?

- A Very weak bonds between all neighbouring atoms.
- B Separate molecules held by weak attractions.
- C A continuous network of strong covalent bonds.
- D Widely separated charged particles.

27 Which comparison of carbon atoms in diamond and graphite is correct?

- A Diamond: 4 bonded neighbours; graphite: 3.
- B Both: 2 bonded neighbours.
- C Diamond: 3 bonded neighbours; graphite: 4.
- D Both: 4 bonded neighbours.

28 A simple molecular substance melts at a low temperature. What is mainly overcome when it melts?

- A Strong covalent bonds within every molecule.
- B The attraction holding nuclei together.
- C The mass of the molecules.
- D Weak attractions between molecules.

29 A learner says graphite melts easily because its layers slide easily. Which correction is best?

- A Graphite has no bonds within its layers.
- B Sliding changes every carbon atom into an ion.
- C Graphite is a liquid at room temperature.
- D Sliding overcomes weak interlayer attractions; melting requires much more energy to disrupt its strong network.

30 Why is a solid metal a good electrical conductor?

- A Its delocalised electrons move through the structure.
- B Its molecules evaporate when a current passes.
- C Its positive ions flow freely through the solid.
- D Its neutrons move between atoms.

Multiple choice questions continued

31 How many oxygen atoms are represented by one formula unit of $\text{Al}(\text{NO}_3)_3$?

- A 3
- B 6
- C 9
- D 12

32 Which formula gives an electrically neutral compound made from K^+ and O^{2-} ?

- A K_2O
- B KO_2
- C K_2O_2
- D KO

33 What is the relative formula mass of $\text{Mg}(\text{OH})_2$? Use Mg 24, O 16, H 1.

- A 56
- B 58
- C 41
- D 42

34 Which set of coefficients balances $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$ in the order shown?

- A 2, 3, 2
- B 4, 2, 3
- C 2, 1, 1
- D 4, 3, 2

35 For $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$, the reacting mass ratio Cu: O_2 is 128:32. What oxygen mass reacts with 6.40 g of copper?

- A 3.20 g
- B 25.6 g
- C 0.80 g
- D 1.60 g

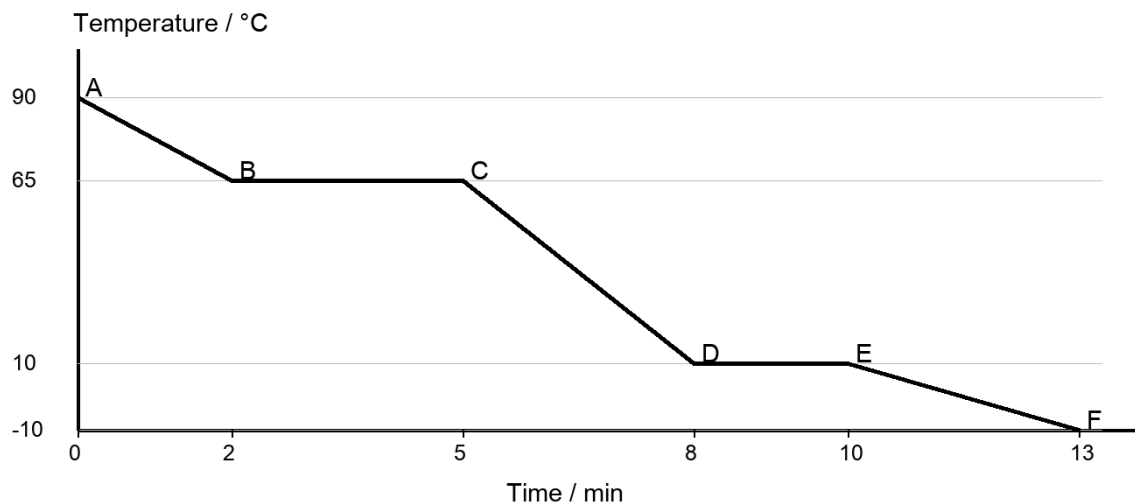
36 In a closed vessel, 9.0 g of a metal reacts with 3.0 g of oxygen. No reactant remains. What is the product mass?

- A 9.0 g
- B 12.0 g
- C 3.0 g
- D 6.0 g

Written questions

37 Cooling and particle arrangements

A pure molecular substance is cooled slowly at constant pressure. Its cooling curve is shown.



(a) Give the physical state in AB, CD and EF.

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(b) Name the changes occurring in BC and DE.

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(c) Explain why energy is removed during BC but the temperature does not fall.

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(d) A small soluble impurity is present in a second sample. Predict two changes to the freezing region DE.

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37 Cooling and particle arrangements continued

(e) Draw three labelled particle diagrams for a solid, a liquid and a gas. Use identical circles for the particles of the same substance.

(f) For each state, describe the motion of its particles.

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(g) A learner claims a solid cannot be compressed easily because its particles are too large. Correct the explanation.

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38 Diffusion and gas pressure

Two identical containers have equal volumes of still water. Container A is at 15 °C and container B at 45 °C. An equal small drop of soluble coloured dye is added to the bottom of each container without stirring.

(a) Define diffusion and state which container should become evenly coloured sooner.

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(b) Explain this prediction in terms of energy and random particle movement.

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(c) Give two variables that must be kept the same to compare the effect of temperature fairly.

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Two non-reacting gases, helium ($A_r = 4$) and neon ($A_r = 20$), diffuse separately through the same apparatus at the same temperature.

(d) Predict which gas diffuses faster and explain your choice. A numerical speed ratio is not required.

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(e) A sealed rigid gas container is cooled from 50 °C to 20 °C. Explain why its pressure falls, including the frequency and force of collisions. State whether its particle number changes.

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39 Separating mixtures

(a) Name a suitable technique to obtain each product: (i) dry chalk from chalk mixed with water; (ii) water from potassium nitrate solution; (iii) the lower-boiling fraction from two miscible liquids.

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A dry mixture contains only chalk and potassium nitrate. Chalk is insoluble in water; potassium nitrate is soluble and becomes less soluble on cooling. You need clean dry chalk, pure dry potassium nitrate crystals and a sample of the water.

(b) Describe a complete sequence of steps to obtain all three products. State which fraction you keep at each stage and include washing, drying and crystallisation.

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(c) Why would filtering the potassium nitrate solution a second time not remove the dissolved salt?

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(d) A separate mixture contains liquids L and M with boiling points 68 °C and 106 °C. Explain how fractional distillation gives a first fraction enriched in L. Include the purpose of the condenser.

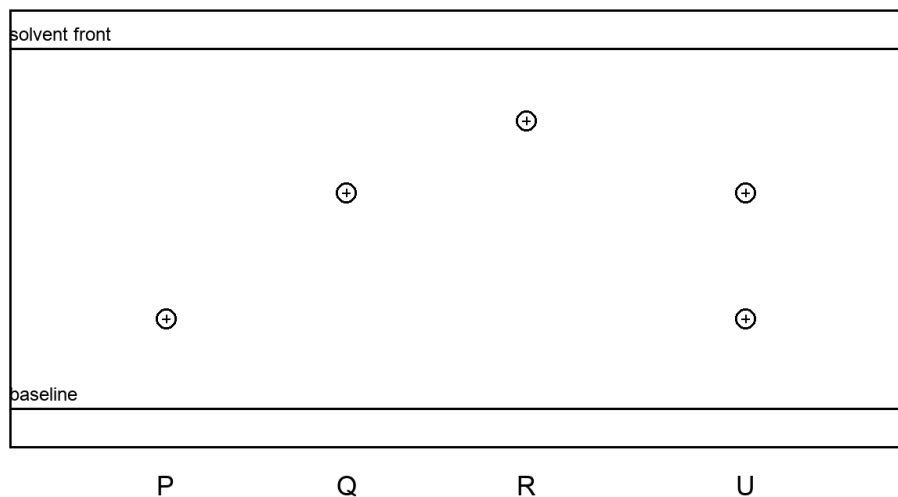
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40 Interpreting chromatography

Pure dyes P, Q and R and unknown sample U are run on the same paper with the same solvent. Crosses mark spot centres. Distances are measured from the baseline. The solvent front moves 10.0 cm.



P, Q and R are pure reference dyes. U is an unknown sample.

Lane	Spot distances / cm
P	2.5
Q	6.0
R	8.0
U	2.5 and 6.0

(a) Calculate R_f for P, Q and R.

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(b) How many components are detected in U? Which reference dyes may be present, and what is the evidence?

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(c) A dye in a second experiment has $R_f = 0.60$ and the solvent moves 7.5 cm. Calculate the distance travelled by the dye.

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40 Interpreting chromatography continued

(d) A student draws the start line with a blue pen. Explain how this could change the chromatogram.

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(e) Another student places the original sample spots below the solvent level. Explain the likely problem.

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(f) Why must reference samples and the unknown be compared under the same conditions?

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(g) A second solvent separates U into three spots. Explain why the first chromatogram showed only two.

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(h) Does one matching R_f prove the identity of a dye? Explain your answer.

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41 Atoms isotopes and ions

Complete every blank cell. Proton numbers: Mg 12, Al 13, O 8. A mass number identifies the isotope.

Particle	Protons	Neutrons	Electrons	Charge
magnesium-24 atom				0
magnesium-26 atom				0
magnesium-24 ion, Mg^{2+}				
aluminium-27 ion, Al^{3+}				
oxygen-18 ion, O^{2-}				

(a) Explain which two neutral particles are isotopes and why.

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(b) Write the electronic configurations of a magnesium atom, Mg^{2+} and O^{2-} .

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(c) Explain why the two neutral magnesium isotopes have the same chemical properties.

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(d) A neutral atom has configuration 2,8,3. State its group, period and proton number.

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(e) An ion of another element has 16 protons, 18 neutrons and 18 electrons. State its charge and nucleon number. Explain whether it is an isotope of any magnesium particle above.

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42 Ionic and covalent bonding

Magnesium has configuration 2,8,2 and chlorine has configuration 2,8,7.

(a) Explain electron loss and gain when magnesium chloride forms. Include how many chlorine atoms are needed for each magnesium atom and the formula of the compound.

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(b) Draw a dot-and-cross diagram for magnesium chloride. Show the outer electrons of both chloride ions, distinguish the transferred electrons and show all ion charges. Inner shells are not required.

(c) Describe the structure of solid magnesium chloride and explain its high melting point.

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(d) Explain its electrical conductivity as a solid and as a melt.

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42 Ionic and covalent bonding continued

Nitrogen has five outer electrons and hydrogen has one. They form ammonia, NH_3 .

(e) Draw a dot-and-cross diagram for ammonia showing every shared pair and every lone pair. Use dots for nitrogen electrons and crosses for hydrogen electrons.

(f) How many covalent bonds and how many lone pairs does nitrogen have in NH_3 ?

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(g) Ammonia is a simple molecular substance. Explain why pure liquid ammonia does not conduct electricity.

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(h) Explain why a simple molecular substance usually has a much lower melting point than an ionic lattice. Identify the attractions overcome, rather than only naming the bonding types.

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43 Structures and material choices

The table describes four substances. All are solids at 20 °C.

Substance	Melting point / °C	Conduction when solid	Conduction when molten
J	850	good	good
K	95	poor	poor
L	720	poor	good
M	1700	poor	poor

(a) Identify the substance most likely to have (i) a metallic structure, (ii) a simple molecular structure, (iii) an ionic lattice and (iv) a giant covalent structure.

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(b) Use particles and charge carriers to explain your choices for J and L.

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(c) Explain why high-melting M can be a poor electrical conductor.

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(d) Choose diamond or graphite for (i) an electrically conducting solid contact and (ii) a hard cutting edge. Link each choice to its structure.

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(e) Graphite can leave a mark on paper while diamond does not readily flake off. Explain the difference using the bonding within and between layers.

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44 Formulae and mass calculations

(a) Write the formula of each compound using the ions given.

Compound	Ions	Formula
sodium oxide	Na^+ , O^{2-}	
potassium sulfate	K^+ , SO_4^{2-}	
magnesium nitrate	Mg^{2+} , NO_3^-	
aluminium hydroxide	Al^{3+} , OH^-	
ammonium carbonate	NH_4^+ , CO_3^{2-}	

(b) Calculate M_r for $\text{Mg}(\text{NO}_3)_2$ and $(\text{NH}_4)_2\text{CO}_3$. Show your substitutions, including the bracket multipliers.

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Calcium reacts with oxygen to form calcium oxide, CaO . Exactly 12.0 g of calcium reacts completely. Initially 6.00 g of oxygen is present and all the CaO formed is collected.

(c) Write the balanced equation using the smallest whole-number coefficients.

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(d) Calculate the mass of oxygen that reacts. Use the balanced equation and relative atomic masses.

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44 Formulae and mass calculations continued

(e) Calculate the mass of CaO produced and the mass of oxygen remaining. Then check the total initial and final masses.

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(f) Calculate the percentage by mass of calcium in CaO. Give your answer to three significant figures.

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In a separate experiment, 25.0 g of pure calcium carbonate decomposes completely: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$. Relative formula masses: CaCO_3 100, CaO 56, CO_2 44. All CaO remains in the heated container and all CO_2 escapes.

(g) Calculate the CaO mass left in the container and the CO_2 mass released.

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(h) Explain why the mass measured in the heated container decreases although mass is conserved.

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End of practice questions. Check your work before turning to the answers.

Answers

Multiple choice answers

Question range	Answers
1 to 6	1 A 2 A 3 B 4 B 5 C 6 C
7 to 12	7 A 8 D 9 C 10 B 11 D 12 C
13 to 18	13 D 14 A 15 C 16 C 17 A 18 C
19 to 24	19 D 20 B 21 B 22 D 23 B 24 A
25 to 30	25 B 26 C 27 A 28 D 29 D 30 A
31 to 36	31 C 32 A 33 B 34 D 35 D 36 B

- 1 A A liquid takes the shape of its container but retains its volume.
- 2 A Compare each temperature with the melting and boiling points.
- 3 B Solid particles still vibrate; they do not travel freely through the solid.
- 4 B Random particle motion spreads the scent through the still air.
- 5 C Cooling reduces molecular speed; particle number and volume stay constant.
- 6 C Energy separates molecules rather than raising their average kinetic energy.
- 7 A Residue is retained; filtrate passes through the paper.
- 8 D Ordinary filtration separates suspended solids, not dissolved ions.
- 9 C Separate crystals from the remaining solution and dry them.
- 10 B The vapour loses energy and condenses.
- 11 D The lower-boiling liquid gives the first fraction, enriched in that liquid.
- 12 C $R_f = 2.4 / 6.0 = 0.40$.
- 13 D Neutral atoms have equal proton/electron counts; $12 + 14 = 26$ nucleons.
- 14 A There are three more positive protons than negative electrons.
- 15 C Three occupied shells give Period 3; six outer electrons give Group VI.
- 16 C Isotopes have the same proton number and different neutron numbers.
- 17 A Changing proton number changes element identity.
- 18 C A positive ion forms by electron loss; its nucleus is unchanged.

Multiple choice answers continued

- 19 D X loses two electrons and two Y atoms each gain one.
- 20 B Ionic bonding is electrostatic attraction between oppositely charged ions.
- 21 B Two electrons are shared between the bonded atoms.
- 22 D Oxygen forms two single bonds and retains two lone pairs.
- 23 B A triple bond contains three shared pairs; each N also retains one lone pair.
- 24 A Mobile ions carry charge in the melt.
- 25 B Graphite has mobile delocalised electrons.
- 26 C Many strong bonds in a rigid extended network must be overcome.
- 27 A Diamond has a four-connected network; graphite has three-connected layers.
- 28 D The molecules remain intact when intermolecular attractions are overcome.
- 29 D Easy sliding does not imply a low melting point.
- 30 A Mobile delocalised electrons carry charge.
- 31 C There are three nitrate groups, each containing three O atoms.
- 32 A Two K^+ ions balance one O^{2-} ion.
- 33 B $24 + 2(16 + 1) = 58$.
- 34 D $4Al + 3O_2 \rightarrow 2Al_2O_3$ conserves both elements.
- 35 D $6.40 \times 32 / 128 = 1.60$ g.
- 36 B All reactant mass becomes product: $9.0 + 3.0 = 12.0$ g.

37 Cooling and particle arrangements Answers

- a AB gas; CD liquid; EF solid.
- b BC condensation; DE freezing.
- c Energy is released as attractions form and gas becomes liquid. The average kinetic energy does not decrease during the change of state, so temperature remains constant.
- d Freezing starts at a lower temperature and takes place over a temperature range.
- e Solid: touching or very close circles in a regular arrangement. Liquid: close circles in an irregular arrangement. Gas: widely spaced circles in an irregular arrangement. Particle size must stay the same in all three drawings.
- f Solid particles vibrate about fixed positions. Liquid particles move randomly past one another. Gas particles move freely and randomly through the available space.
- g Solid particles are already closely packed, with very little empty space between them; compression would require bringing them much closer. Particle size is not the reason.

38 Diffusion and gas pressure Answers

- a Diffusion is the net movement of particles from higher to lower concentration due to random motion. Container B becomes evenly coloured sooner.
- b At 45 °C the particles have greater average kinetic energy and move faster. Random motion spreads dye particles through the water more quickly.
- c Any two suitable controls: water volume, container size/shape, amount or concentration of dye, type of dye, position where the drop is added, and no stirring in either container.
- d Helium diffuses faster: its atoms have lower mass and a higher average speed at the same temperature.
- e Cooling reduces average kinetic energy and particle speed. Collisions with the walls become less frequent and less forceful, reducing pressure. The particle number stays the same because the container is sealed.

39 Separating mixtures Answers

- a (i) Filtration, then drying the residue. (ii) Simple distillation. (iii) Fractional distillation.
- b Add water and stir to dissolve potassium nitrate. Filter: keep chalk as the residue and potassium nitrate solution as the filtrate. Wash the chalk with clean water, then dry it. Combine suitable washings with the filtrate. Distil some water from the salt solution and collect the condensed water separately; stop before the salt solution becomes dry. Cool the concentrated solution so potassium nitrate crystallises. Filter the crystals and dry them, for example between filter papers.
- c Dissolved ions pass through ordinary filter paper with the solvent.
- d L is more volatile because its boiling point is lower. Repeated vaporisation and condensation in the fractionating column enrich the first vapour in L. The condenser cools that vapour into a collected liquid.

40 Interpreting chromatography Answers

- a $R_f(P) = 2.5/10.0 = 0.25$; $R_f(Q) = 6.0/10.0 = 0.60$; $R_f(R) = 8.0/10.0 = 0.80$. R_f has no units.
- b Two components are detected. P and Q may be present: the spots in U have the same heights/ R_f values as those references on the same chromatogram.
- c Spot distance = $0.60 \times 7.5 = 4.5$ cm.
- d The pen ink may dissolve in the solvent and separate into extra spots, contaminating or obscuring the sample result.
- e The sample can dissolve directly into the solvent reservoir and wash off the start line instead of travelling up the paper.
- f R_f depends on experimental conditions, especially the solvent and stationary phase. Matching values from different conditions are not a reliable comparison.
- g Two components in U travelled together/overlapped in the first solvent but were separated in the second solvent.
- h No. Different dyes can share the same R_f in one solvent; a second solvent or other evidence is needed.

41 Atoms isotopes and ions Answers

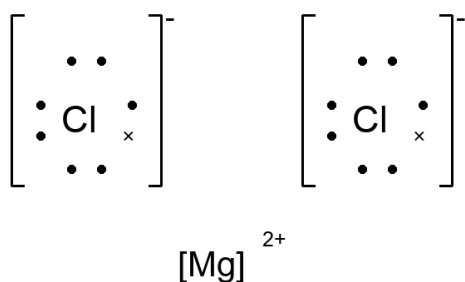
Particle	Protons	Neutrons	Electrons	Charge
Mg-24 atom	12	12	12	0
Mg-26 atom	12	14	12	0
Mg-24 ion	12	12	10	2+
Al-27 ion	13	14	10	3+
O-18 ion	8	10	10	2-

- a Magnesium-24 and magnesium-26 atoms: both have 12 protons but have 12 and 14 neutrons.
- b Mg atom 2,8,2; Mg^{2+} 2,8; O^{2-} 2,8.
- c The isotopes have the same electron configuration and outer-shell electron count.
- d Group III; Period 3; proton number 13.
- e Charge 2-; nucleon number $16 + 18 = 34$. It is not a magnesium isotope because its proton number is 16 rather than 12.

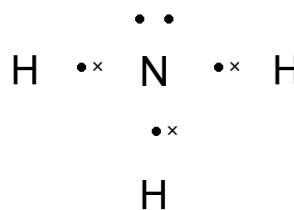
42 Ionic and covalent bonding Answers

- a One magnesium atom loses two electrons to form Mg^{2+} . Two chlorine atoms each gain one electron to form two Cl^- ions. The formula is MgCl_2 .
- b Show $[\text{Mg}]^{2+}$ and two chloride ions, each with seven original chlorine electrons plus one transferred magnesium electron, in brackets with a 1– charge. Each chloride has an octet.
- c A giant regular lattice of oppositely charged ions, held by strong electrostatic attractions. Much energy is needed to overcome these attractions.
- d In the solid, ions cannot move through the lattice; in the melt, ions are mobile and carry charge.
- e Nitrogen forms three single N–H bonds. Each bond is one dot-and-cross shared pair. Nitrogen retains one lone pair of dots. See the example below.
- f Three covalent bonds and one lone pair.
- g Pure liquid ammonia consists of neutral molecules and has no mobile ions or delocalised electrons to carry charge.
- h Melting a simple molecular substance overcomes relatively weak attractions between molecules; its internal covalent bonds remain intact. Melting an ionic lattice requires much more energy to overcome strong electrostatic attractions between ions.

Magnesium chloride



Ammonia



MgCl_2 : dot = Cl electron; cross = Mg electron. NH_3 : dot = N electron; cross = H electron.

43 Structures and material choices Answers

- a (i) J metallic; (ii) K simple molecular; (iii) L ionic; (iv) M giant covalent.
- b J has mobile delocalised electrons that carry charge in both states. L has fixed ions in the solid and mobile ions in the melt, so it conducts only when molten.
- c A giant covalent network has many strong covalent bonds, giving a high melting point. In this example there are no mobile ions or delocalised electrons, so it does not conduct.
- d (i) Graphite: delocalised electrons move through its structure and carry charge. (ii) Diamond: each carbon is bonded to four neighbours in a rigid three-dimensional network of strong covalent bonds, making it very hard.
- e Graphite has strong covalent bonds within each layer but weak attractions between layers. Layers can slide and detach onto the paper. Diamond has a rigid network of strong bonds throughout, with no equivalent weakly held layers.

44 Formulae and mass calculations Answers

- a Na_2O ; K_2SO_4 ; $\text{Mg}(\text{NO}_3)_2$; $\text{Al}(\text{OH})_3$; $(\text{NH}_4)_2\text{CO}_3$.
- b $\text{Mg}(\text{NO}_3)_2$: $24 + 2[14 + 3(16)] = 148$. $(\text{NH}_4)_2\text{CO}_3$: $2[14 + 4(1)] + 12 + 3(16) = 96$. Relative masses have no units.
- c $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$.
- d Reacting mass ratio $\text{Ca}:\text{O}_2 = 80:32$. Oxygen used = $12.0 \times 32/80 = 4.80 \text{ g}$.
- e $\text{CaO} = 12.0 + 4.80 = 16.8 \text{ g}$. Oxygen remaining = $6.00 - 4.80 = 1.20 \text{ g}$. Initial total = $12.0 + 6.00 = 18.0 \text{ g}$; final total = $16.8 + 1.20 = 18.0 \text{ g}$.
- f Calcium percentage = $40/(40 + 16) \times 100 = 71.4\%$ (3 significant figures).
- g $\text{CaO} = 25.0 \times 56/100 = 14.0 \text{ g}$. $\text{CO}_2 = 25.0 \times 44/100 = 11.0 \text{ g}$.
- h The CO_2 gas leaves the measured container. The remaining solid has less mass, but solid plus escaped gas still totals 25.0 g ; matter is not destroyed.