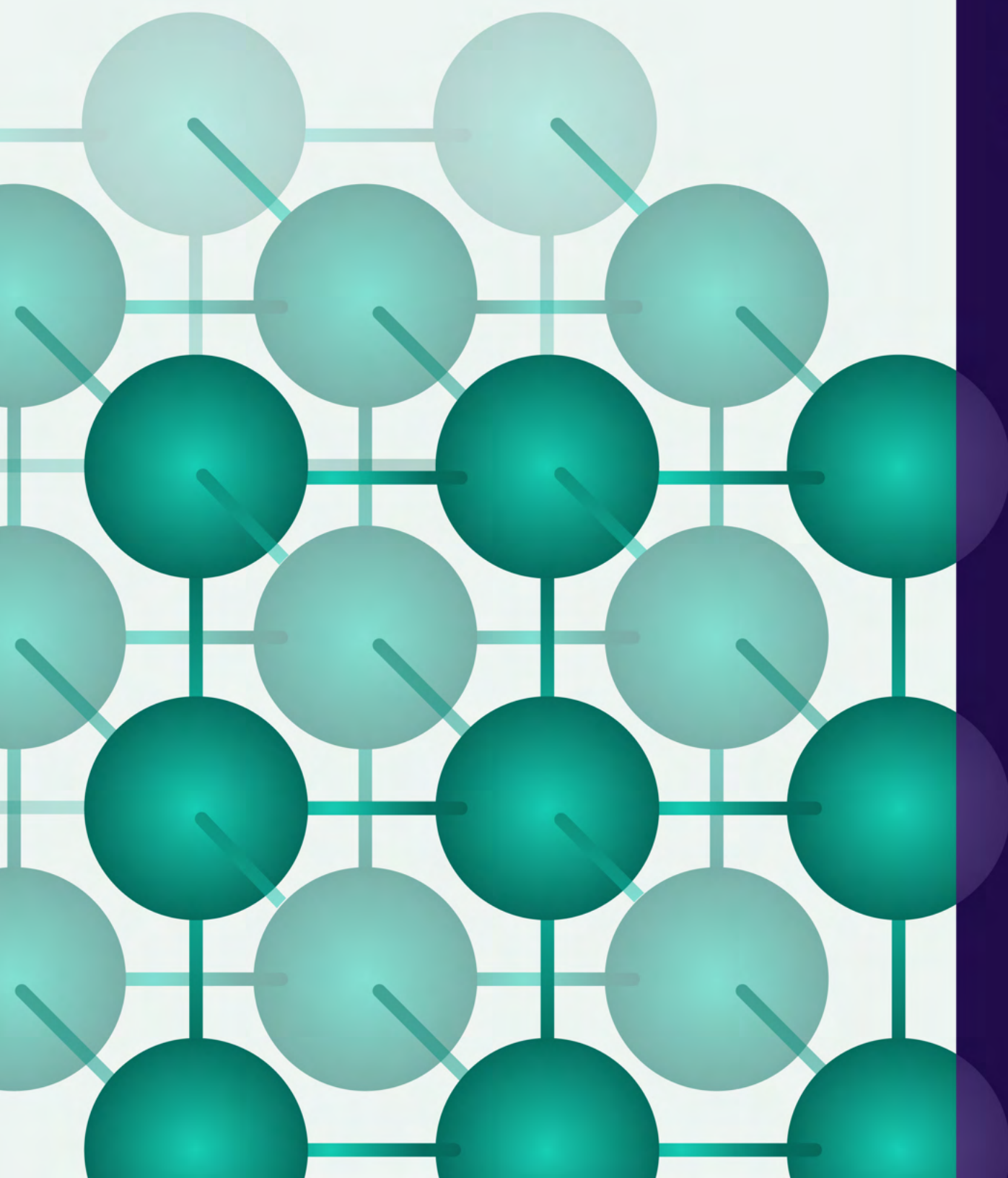


Sparx Science

A Level Transition Booklet
Answers



Chemistry



1. Atomic structure

- 1.1** A: proton
B: electron
C: neutron

1.2

Charge				
-2	-1	0	+1	+2
	✓			
			✓	
		✓		

1.3

Relative mass			
-1	0	$\frac{1}{1836}$	1
		✓	
			✓
			✓

- 1.4** In the nucleus/centre

- 1.5 a)** Accept any one of:

- no empty space
- no nucleus
- no electron shells
- no protons.

- b)** Accept any one of:

- there are electrons/negative charges
- there is a positive charge
- it is a sphere.

- 2.1** The number of protons in the nucleus

- 2.2 a)** The mass number/The number of protons and neutrons.

- 2.2 b)** The atomic/proton number/The number of protons.

- 2.3** a) 13
b) 14

- 2.4** protons: 19
neutrons: 20
electrons: 19

- 2.5** $^{12}_6\text{C}$, ^4_2He , $^{24}_{12}\text{Mg}$

- 2.6** The atom contains no neutrons/The atom contains only protons in the nucleus.

- 3.1** Atoms with the same number of protons/same atomic number and different numbers of neutrons/different mass numbers.

- 3.2** nitrogen

- 3.3** 7

- 3.4 a)** B

- 3.4 b)** It has a different atomic number/number of protons

- 3.5** They have the same number of protons/atomic number and different numbers of neutrons/mass numbers.

- 3.6** They have the same number of outer shell electrons.

- 4.1** 85.56

- 4.2** 28.109

- 4.3** 52.1

- 4.4** 39.13

- 4.5** 28.1

- 4.6** Mass number = 22
Percentage abundance = 9.2%

- 5.1 a)** 16

- 5.1 b)** 3

- 5.2** carbon

- 5.3** 2, 8

- 5.4 a)** 2, 3 2, 8, 3

- 5.4 b)** 2, 8, 1 2, 8, 3 2, 8, 7

- 5.5** 3

2. The Periodic Table

1.1

Key term	Definition
Period	The columns in the Periodic Table
Group	The rows in the Periodic Table
	The area in the Periodic Table where metals are found
	The area in the Periodic Table where non-metals are found

1.2 by (increasing) atomic number/
number of protons

1.3

Metals	Non-metals
✓	
✓	
✓	✓
✓	
	✓
	✓

1.4 They have the same number of
outer shell electrons .

1.5 They have different numbers of
electron shells/orbitals.
They have the same number of
outer shell electrons/they have
one electron in their outer shell.

2.1 a) 40 °C

2.1 b) 180 °C

2.2 It increases

2.3 The reactivity increases

2.4 The outer electron shell is further
(from the nucleus)/There is more
shielding. This means there is a
weaker (electrostatic) attraction/
force (between the electrons and
nucleus), so the outer electron is
more easily lost.

3.1

Change down the group		
Increases	Decreases	Stays constant
✓		
✓		
✓		

3.2 Accept any value between 60 °C
and 400 °C

3.3

Element	
Astatine	Iodine
✓	
✓	
✓	

3.4 a) displacement

3.4 b) chlorine

3.5

Reaction	No reaction
	✓
✓	
✓	

3.6 The outer electron is closer to the
nucleus/there is less shielding (in
chlorine), so there is a stronger
(electrostatic) attraction/force
between the outer electrons and
nucleus (in chlorine).

3.7 X, Z, Y

3. Chemical equations

1.1

Reactant	Product
✓	
✓	
	✓
	✓

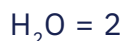
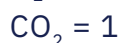
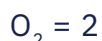
1.2 magnesium + oxygen →
magnesium oxide

1.3 (aq), (aq), (s), (aq)

1.4 copper

1.5

Equation			
A	B	C	D
✓		✓	✓
			✓
	✓		
		✓	✓



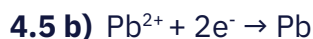
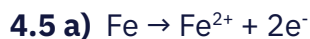
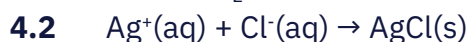
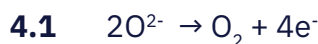
3.1 a)

Term	Definition
Reduction	Loss of electrons
Oxidation	Loss of protons
	Gain of electrons
	Gain of protons

3.1 b) Redox reaction

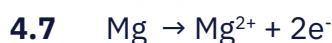
3.2 Copper loses electrons/is oxidised so the silver gains electrons/is reduced.

3.3 B



4.6

Half equation	
$\text{Zn}(\text{s}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{e}^-$	$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$
✓	
	✓
	✓



4. Quantitative Chemistry

1.1 100

1.2 158

1.3 a) 23

1.3 b) Sodium

2.1 39.3%

2.2 CH_4

2.3 29%

3.1 a) 0.25 dm^3

3.1 b) 13.12 g/dm^3

3.2 17.75 g/dm^3

3.3 0.15 dm^3

3.4 60 g

3.5 0.13 mol/dm^3

3.6 1.26 mol/dm^3

3.7 0.12 mol/dm^3

3.8 0.72 g

4.1 a) 6.02×10^{23}

4.1 b) 1.204×10^{24}

4.1 c) 6.02×10^{24}

4.2 a) 0.467 mol

4.2 b) 161 mol

4.3 0.60 mol

4.4 6.923×10^{24}

4.5 1.3 mol

4.6 3.01×10^{22}

4.7 2.28×10^{25}

5.1 28 g

5.2 36 g

5.3 21 g

5.4 32 kg

6.1 $x = 2, y = 1$

6.2 $x = 2, y = 3, z = 2$

6.3 6 : 6 : 1 : 6

6.4 a) 1 : 3



5. Bonding and Properties of Materials

1.1

Formula	Name
F^-	bromide
S^{2-}	chloride
Br^-	sulfide
Cl^-	oxide
O^{2-}	fluoride

1.2

Name ending		
-ide	-ate	-ine
✓	✓	
✓		✓

1.3 a) hydroxide

1.3 b) sulfate

1.3 c) nitrate

1.4 a) potassium fluoride

1.4 b) copper sulfide

1.4 c) zinc sulfate

1.4 d) lithium nitrate

2.1 18

2.2 It loses two (outer shell) electrons

2.3 18

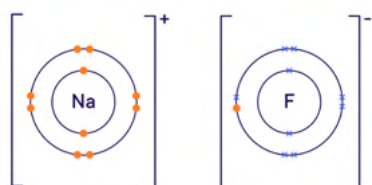
2.4 number of protons = 4
number of electrons = 2
number of neutrons = 5

2.5 F^- , Na^+ , Mg^{2+}

2.6 number of protons = 56
number of neutrons = 81

3.1 One electron is transferred from lithium (to fluorine).

3.2



3.3 a) One electron from each (outer shell) of the sodium atoms/two sodium atoms each transfer one electron to oxygen.

3.3 b) 2

3.4

Ion			
A	B	C	D
		✓	
✓			
			✓

4.1

Type of bonding	
Covalent	Not covalent
	✓
	✓
✓	

4.2 A pair of /two electrons are shared (between atoms).

4.3 number of single covalent bonds:

4

number of double covalent bonds:

1

4.4

Substance	Description
Covalent element	A single neon atom
Non-covalent element	Two oxygen atoms bonded together
Non-covalent compound	One hydrogen and one iodine atom bonded together
Covalent compound	One sodium ion and one chloride ion bonded together

4.5 16

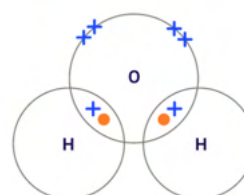
4.6 a) $C_2H_4O_2$

4.6 b) 6

4.6 c) 1

4.7 The bond should contain one dot and one cross/There should be one electron from each atom (in the bond)/Both electrons come from the same (hydrogen) atom.

4.8



5.1 a) A

5.1 b) C

5.1 c) B

5.2 carbon, giant, covalent

5.3

Type of substance	
Simple molecular	Giant covalent
✓	✓
✓	
	✓

5.4

Diamond	Graphite
✓	
	✓
	✓
✓	✓

5.5 Carbon has four electrons (in its outer shell)/needs four electrons (to fill its outer shell). Single covalent bonds share two electrons (between carbon atoms) so, carbon forms four single covalent bonds to achieve a full outer shell/a stable electron configuration.

5.6

Feature	Property
Strong covalent bonds within layers	Good electrical conductor
Delocalised electrons	Soft and slippery
No covalent bonds between layers	High melting point

5.7 Diamond has a giant structure/lattice/each atom forms four bonds where bonds are strong/covalent bonds.

5.8 Each atom forms three covalent bonds, forming layers/hexagonal rings which can slide over each other. There are delocalised/free electrons between the layers.

6.1 Metallic bonding is a giant structure/lattice with a regular pattern of atoms/ions, containing delocalised/free electrons.

6.2 Low melting point

6.3 a) Melting point decreases down the group.

6.3 b) The metallic bonding becomes weaker (down the group).

6.4 The number of delocalised/free electrons increases, so the conductivity increases with more (delocalised/free) electrons to carry a charge.

7.1 Ionic

7.2 A

7.3 a) The melting point increases (down the group).

7.3 b) Barium chloride

7.4 Ions (in magnesium carbonate) cannot move/are held in a lattice/are in fixed positions. (Magnesium) contains delocalised/free electrons which can flow/move/carry a charge.

7.5 Simple molecular

7.6 a) Covalent bonds

7.6 b) Intermolecular forces

7.7

Property	Explanation
Low melting point	Ions are free to move
Do not conduct electricity	No charged particles free to move
	Weak intermolecular forces
	Strong covalent bonds

7.8 There are weak forces between the molecules that need little energy to overcome/break.

7.9 Giant covalent

7.10 a) The boiling points increase.

7.10 b) The size of the molecules increases.

7.11

Structure	Name
A	Graphite
B	Diamond
C	Polythene
D	Silicon dioxide

7.12 a) A

7.12 b) B

7.13 There are strong covalent bonds (between atoms), which require lots of energy to overcome/break.

7.14 Silicon dioxide contains strong (covalent) bonds/has a giant covalent structure.
Carbon dioxide has weak intermolecular forces between (small) molecules.
Large amounts of energy are needed to break covalent bonds/less energy is needed to break/overcome the intermolecular forces.

7.15 C

7.16 Metallic

6. Energetics and kinetics

1.1

Reaction	Definition
Endothermic	A reaction that does not involve energy
Exothermic	A reaction that transfers equal amounts of energy to and from the surroundings
	A reaction that transfers energy to the surroundings
	A reaction that takes in energy from the surroundings

1.2 a) Neutralisation

1.2 b) Exothermic reaction

1.3 a) Temperature change for salt C:

6.2°C

Temperature change for salt D:

-2.2°C

1.3 b) D

1.4

Process or reaction	Description
Displacement	A reaction between an acid and a base.
Dissolving	A more reactive metal takes the place of a less reactive metal.
Neutralisation	Two solutions react to produce an insoluble solid.
Precipitation	A soluble salt mixes completely with a liquid.

1.5 The products contain 55 kJ less energy than the reactants.

1.6 a) 0.8 g

1.6 b) The reaction is endothermic because the temperature decreases/energy is taken in (from the surroundings).

1.7 a) They added the magnesium/mixed the reactants.

1.7 b) The reaction is exothermic because the temperature increases when the reaction occurs.

2.1 The activation energy: B
The overall energy change of the reaction: C

2.2

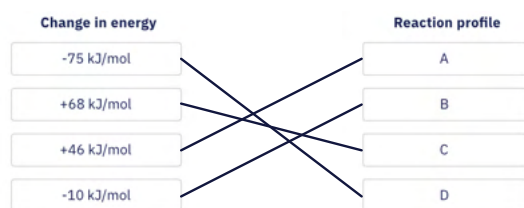
Endothermic	Exothermic
✓	
	✓
✓	
	✓

2.3 The minimum energy that particles need to react.

2.4 A

2.5 The activation energy should be drawn from the reactants. The products line should be below the reactants line/should have less energy than the reactants.

2.6



2.7 A catalyst lowers the activation energy so more particles have the minimum energy (needed to react)/activation energy. This results in more frequent successful collisions.

2.8 The products have more energy than the reactants, showing energy has been taken in/the energy change is positive.

3.1 C, B, D, A

3.2 2057 kJ

3.3 3432 kJ

3.4 -184 kJ/mol

3.5 -806 kJ/mol

3.6 460 kJ/mol

4.1 1.3 cm³/s

4.2 0.12 cm³/s

4.3 0.6 cm³/s

4.4 0.0013 g/s

4.5 a) Test 3

4.5 b) 0.85 cm³/s

4.6 61 s

4.7 Accept any answer between 0.004 and 0.006 g/s

5.1 There are more frequent collisions and the particles are closer together

5.2 The rate of mass loss increases/ mass is lost more quickly.

5.3 Using more dilute hydrochloric acid

5.4 There are more frequent collisions

The particles are closer together

5.5 As the reaction proceeds, there are fewer particles per unit volume/the number of reactant particles decreases. Therefore, the frequency of collisions decreases so there are fewer successful collisions.

5.6 If the concentration of acid increases, there are more particles of acid are present (in the same volume). This results in more frequent successful collisions.

5.7 There is a larger surface area to volume ratio, so there are more frequent successful collisions.

6.1 A substance that increases the rate of a reaction without being used up/changed (during the reaction).

6.2 a) I do **not** agree with Amir

6.2 b) Catalysts are not used up/changed (during a reaction).

6.3 carbon monoxide + nitrogen monoxide $\xrightarrow{\text{platinum}}$ nitrogen + carbon dioxide

6.4 a) Manganese dioxide

6.4 b) The largest volume of gas/oxygen was released (in a given time).

6.5 The catalyst is not used up so they only need to buy the catalyst once/is only an initial cost.

7.1 a) Both the forward and reverse reactions

7.1 b) The amounts of both reactants and products will stay constant

7.2 The amounts of each substance remain constant.

The rates of the forward and reverse reactions are equal.

7.3 -93 kJ/mol

7.4 When a reversible reaction occurs in a sealed system/when no reactants or products can escape, the forward and reverse reactions will (eventually) occur at the same rate.

7.5

Change in mass at equilibrium		
Increases	Decreases	Stays constant
		✓
		✓
		✓

7.6

Change	Effect on equilibrium
Increasing temperature	Shifts to favour the exothermic reaction.
Decreasing pressure	Shifts to the side with fewer molecules of gas.
Increasing pressure	Shifts to favour the endothermic reaction.
Decreasing temperature	Shifts to the side with more molecules of gas.

7.7 a) The yield would decrease

7.7 b) The reaction would shift to the endothermic direction.

7.8 left, increase

7.9 reactants, right, products, increase

7.10 It would have no effect (on the equilibrium position) as it would increase the rates of the forward and reverse reactions equally.

7.11 a) Exothermic

7.11 b) As temperature increases, the yield of sulfur trioxide decreases, showing a higher temperature favours the reverse reaction/endothermic reaction.

7. Acids and Bases

1.1 a) hydrogen/ H^+ ions

1.1 b) hydroxide/ OH^- ions

1.2 a) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$

1.2 b) Neutralisation

1.3 There are hydrogen ions (in the reactants).

2.1 6

2.2 1/10 000 OR 0.0001

2.3 6.0

2.4 (Decreases by) 3

2.5 0.1 mol/dm^3

2.6 3

3.1 strong, weak

3.2 A dilute solution of a strong acid

3.3 There is incomplete dissociation/ionisation because the reaction is reversible.

3.4 There is a higher percentage of HCl molecules ionised, so there is a higher concentration of hydrogen ions (in HCl).

8. Organic Chemistry

1.1 carbon and hydrogen

1.2

Molecule	Name
	Methane
	Ethane
	Butane
	Propane

2.1 a) Fractional distillation

2.1 b) Boiling point

2.2 a) The greater the number of carbon atoms, the higher the boiling point.

Accept converse argument

2.2 b) Octane has the highest boiling point so condenses where the temperature is higher.

2.3 The fractions condense at different points in the column as there is a temperature gradient (in the column), so fractions separate according to their boiling point.

3.1 Accept any two of:

- High temperatures/Heating (to 250-990°C)
- With a catalyst/zeolite
- With no air/oxygen/steam

3.2 C_2H_4

4.1 a) oxygen

4.1 b) carbon dioxide and water (vapour)

4.2 a) incomplete

4.2 b) carbon/particulates/soot

4.3 a) combustion

4.3 b) Blackening of buildings

Respiratory problems

Global dimming

4.4 a) Sulfur dioxide

4.4 b) Acid rain

4.5 It is oxidised/reacts with oxygen

4.6 Sulfur can form sulfur dioxide which is a pollutant/causes acid rain/smog/respiratory problems.

4.7 a) Sulfur dioxide is removed which reduces the chance of acid rain/respiratory problems/smog.

4.7 b) Carbon dioxide is produced which causes global warming/climate change/is a greenhouse gas.

9. Experimental Techniques

1.1 a) pencil

1.1 b) Pencil is insoluble/does not dissolve (in the solvent).

1.2 a) solvent

1.2 b) chromatography paper

1.3 Using a different solvent

1.4 A, B

1.5 0.75

2.1 a) Ethanol

2.1 b) Condensation

2.2 The gases will not condense/cool.

2.3 a)

State		
Solid	Liquid	Gas
		✓
	✓	
	✓	

2.3 b) Condensation

2.4 Accept any temperature between 44 and 100°C.