GCSE

Rewarding Learning

Revised GCSE

Support Material

Chemistry

ANSWER BOOKLET

Factfile Unit 1 & 2

For first teaching from September 2017

Answers to GCSE Factfiles Unit 1

1.1 Atomic Structure

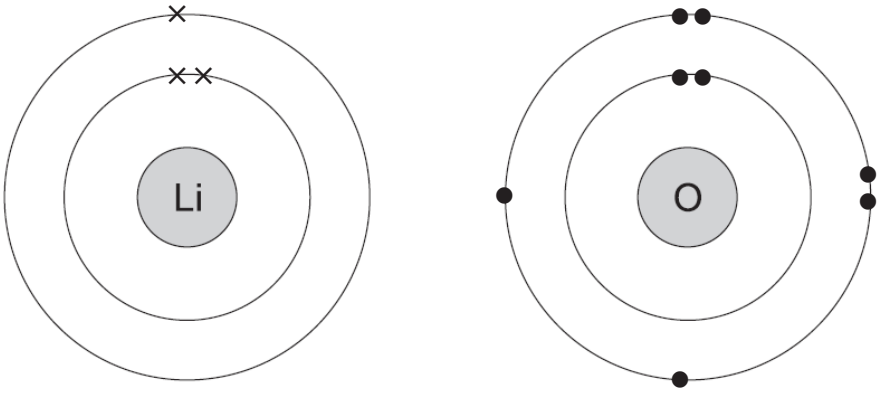
1.(a)

Particles	Relative charge	Relative mass
electron	-1	$\frac{1}{1840}$
proton	+1	1
neutron	0	1

6 correct = [3]; 4 or 5 correct = [2]; 2 or 3 correct = [1] [3]

(b) carbon-14 has 8 neutrons [1]
carbon-12 has 6 neutrons [1]
both have 6 protons and 6 electrons/same number of protons and electrons [1]
[3]

2.(a)



(b) outer electron in lithium atom transferred to oxygen [1]
2 lithium atoms to one oxygen atom [1]
oxygen gains two electrons in its outer shell [1] [3]

3. proton = has a relative mass of 1 and a charge of +1 [1]
mass number = total number of protons and neutrons in an atom [1]
atomic number = the number of protons in an atom [1] [3]

4.(a) 2 [1]

(b) oxygen [1]

(c) 2, 8, 1 [1]

(d) equal numbers of protons and electrons [1]

5.

Atom/Ion	Number of protons	Electronic configuration
N [1]	7	2, 5
O^{2-}	8 [1]	2, 8 [1]
Al^{3+}	13 [1]	2, 8 [1]
Mg^{2+} [1]	12	2, 8

[6]

6.(a)

	Number of protons	Number of electrons	Number of neutrons
Neon-20	10	10	10
Neon-21	10	10	11
Neon-22	10	10	12

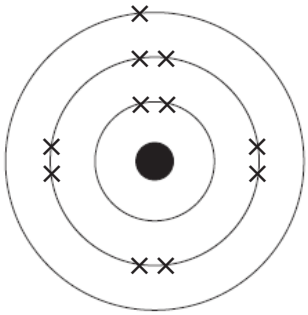
[1] for number of protons and number of electrons correct [1]
[1] for number of neutrons correct [1] [2]

(b) relative atomic mass = $\frac{20\times90.92+21\times0.26+22\times8.82}{100} = \frac{2017.9}{100}$ = 20.179 [1]
answer to 2 decimal places = 20.18 [1] [2]

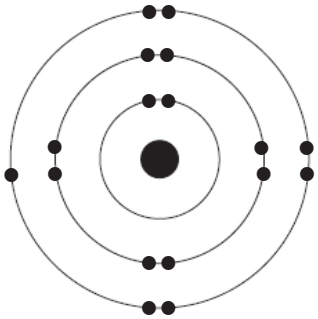
1.2 Bonding

1.(a)

(i) Sodium atom



(ii) Chlorine atom



sodium atom as 2, 8, 1 [1]
chlorine atom as 2, 8, 7 [1] dot and cross not essential [2]

(b) **Indicative content**

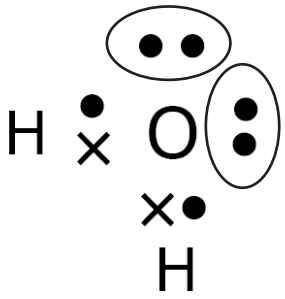
- Transfer of electrons
- Correct direction of transfer from sodium to chlorine
- 1 electron transferred
- electronic structure for sodium ion (2, 8)
- Correct charge on ions as Na^+ and Cl^-
- Correct electronic structure for chloride ion (2, 8, 8)
- Ions held together due to attraction of oppositely charged ions

Band	Response	Mark
A	Candidates must use appropriate scientific terms throughout to describe fully how atoms of sodium and chlorine form sodium chloride using **5–7** of the points in the indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5] – [6]
B	Candidates use **3–4** points from the indicative content to describe how atoms of sodium and chlorine form sodium chloride using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3] – [4]

C	Candidates use **1-2** of the points from the indicative content to describe how atoms of sodium and chlorine form sodium chloride. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1] – [2]
D	Response not worthy of credit	[0]

[6]

2.(a)(i)



correct sharing of electrons [1]
correct lone pairs of electrons [1]
dot and cross diagram [1] [3]

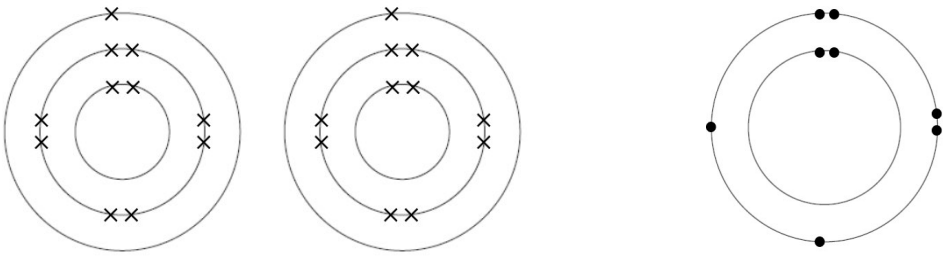
(ii) both circled lone pairs indicated [1]

(b)(i) two atoms in a molecule [1]

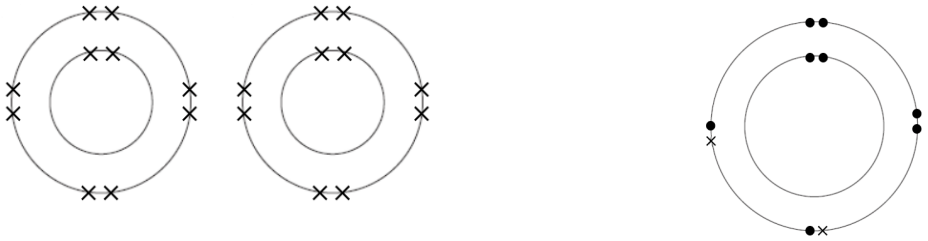
(ii)

correct sharing of electrons [1]
correct lone pairs of electrons [1]
dot and cross diagram [1] [3]

3.(a) 2 × sodium atom as 2, 8, 1 [1] oxygen atom as 2, 6 [1]



2 × sodium ions as 2, 8 [1] oxide ion as 2, 8 [1]



Na^+ [1] O^{2-} [1] [6]

(b) ions are held together by attraction [1] of oppositely charged ions [1] [2]

1.3 Structures

1.(a) C [1]
conducts electricity when molten but not when solid [1] [2]

(b) D [1]

(c) E [1]

(d) A [1] diamond [1] [2]

2.(a) layers [1] of positive ions [1]
held together by a sea of delocalised electrons [1] [3]

(b) delocalised electrons [1] can move and carry charge [1] [2]

(c) layers can slide over each other without disrupting the bonding [1]

3.(a) different forms of the same element [1]
in the same physical state [1] [2]

(b)(i) carbon atoms [1]

(ii) covalent bonds [1]

(c)(i) each carbon atoms is covalently bonded to 4 other carbon atoms/idea of a giant covalent structure [1]
covalent bond require substantial energy to break [1] [2]

(ii) layers can slide off [1]
leaving a mark on the paper [1] [2]

4.(a) a mixture of elements [1] at least one of which is a metal [1] [2]

(b)(i) 0.8+0.6+0.7+0.2+0.4 = 2.7 % [1]

(ii) 100 – 2.7 [1] = 97.3 % [1] [2]

(c)(i) low density [1]
good corrosion resistance/stronger [1] [2]

(ii) car/boats/ships (any suitable based on given properties) [1]

5. weak forces between the molecules [1]
called van der Waals' forces [1]
require little energy to break [1] [3]

1.4 Nanoparticles

1. particles which are 1-100 nm in size [1]

2. transparent [1]
more effective skin coverage [1] [2]

3. may be absorbed into the body with unknown effects [1]
may cause harm in the environment [1] [2]

4. a few hundred [1]

5. different surface area to volume ratio [1]

6. increases by a factor of 10 [1]

1.5 Symbols, formulae and equations

1.(a) O_2 [1]

(b) HNO_3 [1]

(c) $CuSO_4$ [1]

(d) H_2 [1]

(e) MgO [1]

(f) $Al(OH)_3$ [1]

(g) $CaCl_2$ [1]

(h) $Fe_2(SO_4)_3$ [1]

(i) MgI_2 [1]

(j) Ca_3N_2 [1]

(k) $Mg(OH)_2$ [1]

(l) Na_2SO_4 [1]

(m) $Ca(NO_3)_2$ [1]

(n) K_2CO_3 [1]

2.(a) $2Na + Cl_2 \rightarrow 2NaCl$ [1]

(b) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ [1]

(c) $2Li + 2HNO_3 \rightarrow 2LiNO_3 + H_2$ [1]

(d) $4Al + 3O_2 \rightarrow 2Al_2O_3$ [1]

(e) $3Pb + 2O_2 \rightarrow Pb_3O_4$ [1]

(f) $2Na + 2H_2O \rightarrow 2NaOH + H_2$ [1]

(g) $N_2 + 3H_2 \rightarrow 2NH_3$ [1]

(h) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ [1]

3.(a) magnesium + oxygen → magnesium oxide [1]
$2Mg + O_2 \rightarrow 2MgO$ [3]

(b) sulfur + oxygen → sulfur dioxide [1]
$S + O_2 \rightarrow SO_2$ [2]

(c) calcium + nitric acid → calcium nitrate + hydrogen [1]
$Ca + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2$ [3]

(d) sodium hydroxide + sulfuric acid → sodium sulfate + water [1]
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ [3]

(e) calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide [1]
$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ [3]

(f) copper(II) oxide + hydrochloric acid → copper(II) chloride + water [1]
$CuO + 2HCl \rightarrow CuCl_2 + H_2O$ [3]

4.(a) $H^+ + OH^- \rightarrow H_2O$ [2]

(b) $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ [2]

(c) $Ag^+ + Br^- \rightarrow AgBr$ [2]

5.(a) $Cl_2 + 2e^- \rightarrow 2Cl^-$ [3]

(b) $Na^+ + e^- \rightarrow Na$ [2]

(c) $O + 2e^- \rightarrow O^{2-}$ [3]

1.6 Periodic table

1.(a) atomic weight/atomic mass [1]

(b)(i) noble gases [1]

(ii) had not been discovered at this time [1]

(c) copper/zinc/titanium/vanadium/chromium/manganese/iron/cobalt/nickel [1]

(d) atomic number [1]

2.(a)

Elements	Atomic number	Electronic configuration	Group number
A	12	2, 8, 2	2 [1]
B	6	2, 4 [1]	4
C	9 [1]	2, 7	7
D	15	2, 8, 5 [1]	5

[4]

(b) 2 [1]

(c) sulfur [1]

3. stored in oil [1]
remove oil using filter paper [1]
cut it into a small piece [1]
shiny surface is exposed [1]
which quickly tarnishes/goes dull [1]
add to large volume of water [1]
wear safety glasses [1]
handle potassium using tongs [1]
behind a safety screen [1] **max** [6]

4.(a) all have 7 electrons in their outer shell/all gain 1 electron to obtain a full outer shell or to become stable [1]

(b)(i) most reactive: chlorine
bromine
least reactive: iodine [2]

(ii) chlorine displaces bromine/bromine is formed [1]

(iii) $2KBr + Cl_2 \rightarrow 2KCl + Br_2$ [3]

5.(a) 20.947 + 78.084 = 99.031 [1]
100 – 99.031 = 0.969 [1] [2]

(b)(i) two atoms in a molecule [1]

(ii) full outer shell of electrons [1]

is stable [1] [2]

6.(a) under oil [1]

(b) to have controlled reaction/larger piece could pose a danger [1]

(c) sodium causes burning of skin [1]
as sodium reacts with water on the skin [1] [2]

(d) melts into a silver ball ✓ [1]
moves quickly across the surface of the water ✓ [1]
eventually disappears ✓ [1] [3]

(e) product is alkaline [1]

(f) all have 1 electron in their outer shell/all lose 1 electron to obtain a full outer shell or to become stable [1]

(g) Rb is too reactive/too dangerous/risk of explosion [1]

1.7 Quantitative chemistry

1.(a)
(i) thermal [1] decomposition [1] [2]

(ii) moles of $Mg(NO_3)_2 = \frac{4.44}{148} = 0.03$ [1]
moles of $NO_2 = 0.03 \times 2 = 0.06$ [1]
mass of $NO_2 = 0.06 \times 46 = 2.76$ g [1] [3]

(b)(i) to ensure heating to constant mass/ensure all the water removed [1]

(ii) mass of water = 13.96 – 13.33 = 0.63 g [1]

(iii) moles of water = $\frac{0.63}{18} = 0.035$ [1]

(iv) mass of $MgSO_4$ = 13.33 – 12.73 = 0.6 g [1]

(v) moles of $MgSO_4 = \frac{0.6}{120} = 0.005$ [1]

(vi) $\frac{0.035}{0.005} = 7$ [1]

(c) moles of $Al_2O_3 = \frac{2.04}{1.2} = 0.02$ [1]
mass of water = 3.12 – 2.04 = 1.08 g [1]
moles of water = $\frac{1.08}{18} = 0.06$ [1]
n = $\frac{0.06}{0.02} = 3$ [1] [4]

2.(a) moles of C = $\frac{20}{12} = 1.67$ [1]
moles of H = $\frac{6.66}{1}$ 6.66 [1]
moles of N = $\frac{46.67}{14} = 3.33$ [1]
moles of O = $\frac{26.67}{16} = 1.67$ [1]
simplest ratio = C:H:N:O = 1:4:2:1 [1]
empirical formula = CH_4N_2O [1] [5]

(b) moles of $H_2O_2 = \frac{5.1}{34} = 0.15$ [1]
moles of $O_2 = \frac{0.15}{2} = 0.075$ [1]
mass of $O_2 = 0.075 \times 32 = 2.4$ g [1] [3]

(c)(i) water which is bonded into the crystalline structure [1]

(ii) % of water = $\frac{36}{96} \times 100$ [1] = 37.5 % [1] [2]

1.8 Acids, bases and salts

1.(a) acid reacting with an alkali/base [1]
to produce water [1] [2]

(b) black [1]

(c) blue [1]

(d) H^+ [1]

2.(a) 14 [1]

(b) 25 (cm^3) [1]

(c) it cannot give a pH value/idea that litmus can only indicate If the solution is an acid or an alkali [1]

(d) $NaCl + H_2O$ [2]

3.(a) copper ethanoate [1]

(b) neutralisation [1]

(c) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ [2]

(d) black solid disappears [1]
blue solution forms [1] [2]

4.(i) only two colours/can only identify an alkali [1]

(ii) different colours [1] for acid, alkali (and neutral) [1] [2]

(iii) indicate the strength of an acid/give pH [1]

5.(i) comparison to pH chart [1]

(ii) pH of a weak acid 3 – 6/orange with universal indicator [1]

(iii) ethanoic acid/carbonic acid (or other correct weak acid) [1]

(iv) concentration [1]

6.(a)

(i) **indicative content:**

- place hydrochloric acid in a suitable container
- add calcium carbonate
- stir/swirl/heat/warm
- until no further reaction occurs/no more reacts/no more fizzing/**excess** solid remains
- filter (the reaction mixture)
- to remove excess calcium carbonate/filtrate is calcium chloride solution

Band	Response	Mark
A	Candidates must use appropriate scientific terms throughout to describe fully the preparation of calcium chloride solution using **5–6** of the points in the indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5] – [6]
B	Candidates use **3–4** points from the indicative content to describe fully the preparation of calcium chloride solution using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3] – [4]
C	Candidates use **1-2** of the points from the indicative content to describe fully the preparation of calcium chloride solution. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1] – [2]
D	Response not worthy of credit	[0]

[6]

(ii) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ [3]

(iii) heat to concentrate/to half volume [1]
allow to cool and crystallise [1]
filter the crystals [1]
dry between two sheets of filter paper/in a desiccator/in a low temperature oven [1] **max** [3]

(b)(i) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ [3]

(ii) pink [1] to colourless [1]
wrong way round = [1] [2]

(iii) limewater [1]

(c)(i) compare to colour chart [1]

(ii) red litmus is red with neutral solutions [1]

(iii) pH meter/pH = 1.82 and pH range of 0 – 2 means a strong acid [1]
red with universal indicator indicates a strong acid [1] [2]

1.9 Chemical analysis

1.(a)
(i) method 3 [1]

(ii) method 2 [1]

(iii) copper(II) sulfate is soluble in water [1]

(iv) **A** = filtrate [1]
B = distillate [1] [2]

(v) not pure/impure [1]
melts over a range [1] [2]

(b)(i) blue [1]

(ii) blue [1]

(iii) blue and yellow [1]

(iv) liquid in which the solute/dyes/components dissolve [1]

(v) green [1]

(vi) single element or compound not mixed with any other substance [1]

(vii) spot moved = 4 cm and solvent front moved = 9 cm [1]
$R_f = \frac{4}{9}$ = 0.444 [1] [2]

(viii) paper [1]

2.(a) water which is safe to drink [1]

(b) filtration = removes insoluble particles [1]
sedimentation = clumps together small particles [1]
chlorination = kills bacteria [1] [3]

(c) making seawater potable [1]

3.(a) dip nichrome wire [1]
into concentrated hydrochloric acid [1]
dip into sample and into blue Bunsen burner flame [1]
green-blue flame [1] [4]

(b) dissolve copper(II) chloride in water [1]
add sodium hydroxide solution [1]
blue ppt [1]
ppt is not soluble in excess sodium hydroxide solution [1]

or

dissolve copper(II) chloride in water [1]
add ammonia solution [1]
blue ppt [1]
ppt is soluble in excess ammonia solution forming
a dark blue/deep blue solution [1] [4]

(c) dissolve copper(II) chloride in water [1]
add silver nitrate solution [1]
white ppt [1] [3]

(d) **Indicative content:**

$Mg^{2+} + 2OH^- \rightarrow Mg(OH)_2$ [3]
white precipitate [1]
does not dissolve in excess ammonia solution [1]
$Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$ [3]
blue precipitate [1]
does dissolve in excess sodium hydroxide solution to form a deep blue/dark blue solution [1]

Band	Response	Mark
A	Candidates must use appropriate scientific terms throughout to describe fully the tests for the cations and associated equations using **8–10** of the points in the indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5] – [6]
B	Candidates use **4–7** points from the indicative content to describe fully the tests for the cations and associated equations using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3] – [4]
C	Candidates use **2-3** of the points from the indicative content to describe fully the tests for the cations and associated equations. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1] – [2]
D	Response not worthy of credit	[0]

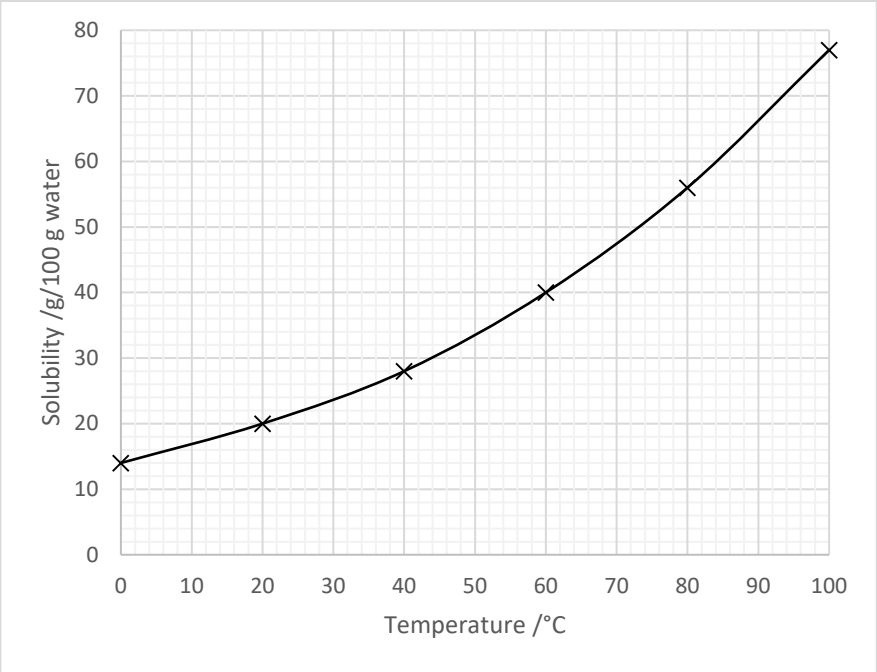
[6]

1.10 Solubility

1.(a)

(i) mass of solute [1]
which saturates 100 g of water [1]
at a particular temperature [1] [3]

(ii)



all point plotted correctly [3]
4-5 points plotted correctly [2]
2-3 points plotted correctly [1]
0 -1 points plotted correctly [0]
curve (dependent on gaining at least 1 mark above) [1] [4]

(b)(i) 47 g/100 g water [1] allow ± 1
per 10 g of water = 4.7 [1] [2]

(ii) solubility at 75 °C = 52 ± 1 [1]
solubility at 45 °C = 31 ± 1 [1]
mass which crystallises from 100 g of water = 52 – 31 = 21 [1]
mass which crystallises from 200 g = 21 × 2 = 42 [1] [4]

Answers to Factfiles Unit 2

2.1 Metals and the reactivity series

1(a) same volume of solution [1]
same concentration of solution [1]
same moles of metal [1]
same level of division of metal [1] **max** [2]

(b) magnesium as greatest difference between two temperatures [1]

(c) magnesium [1]
greatest temperature increase [1] [2]

(d) silver is less reactive than copper/no reaction [1]

(e) gold and silver both do not react [1]

(f) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ [2]

2.(a)
(i) $2AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + 2Ag$ [3]

(ii) below copper [1]

(iii) blue [1]

(iv) copper is more reactive [1] than silver [1] [2]

2.2 Redox, rusting and iron

Redox questions

1.(a) magnesium is oxidised [1]
water/hydrogen is reduced [1] [2]

(b) copper is reduced [1]
hydrogen is oxidised [1] [2]

(c) methane/carbon is oxidised [1]
chlorine is reduced [1] [2]

2.(a) iron(III) oxide is reduced as iron(III) oxide loses oxygen and loss of oxygen is reduction [1]
carbon monoxide is oxidised as carbon monoxide gains oxygen and gain of oxygen is oxidation [1] [2]

(b) copper(II) oxide is reduced as copper(II) oxide loses oxygen and loss of oxygen is reduction [1]
hydrogen is oxidised as hydrogen gains oxygen and gain of oxygen is oxidation [1] [2]

(c) hydrogen sulfide is oxidised as hydrogen sulfide loses hydrogen and loss of hydrogen is oxidation [1]
chlorine is reduced as chlorine gains hydrogen and gain of hydrogen is reduction [1] [2]

(d) lead(II) oxide is reduced as lead(II) oxide loses oxygen and loss of oxygen is reduction [1]
carbon is oxidised as carbon gains oxygen and gain of oxygen is oxidation [1] [2]

(e) iron is oxidised as iron gains oxygen and gain of oxygen is oxidation [1]
water is reduced as water loses oxygen and loss of oxygen is reduction [1] [2]

(f) magnesium is oxidised as magnesium gains oxygen and gain of oxygen is oxidation [1]
sulfur dioxide is reduced as sulfur dioxide loses oxygen and loss of oxygen is reduction [1] [2]

3.(a) water is reduced [1] as water loses oxygen and loss of oxygen is reduction [1] [2]

(b) iodide ions are oxidised [1] as iodine ions lose electrons and loss of electrons is oxidation [1] [2]

(c) copper(II) ions are reduced [1] as copper(II) ions gain electrons and gain of electrons is reduction [1] [2]

(d) hydrogen sulfide loses hydrogen [1] as hydrogen sulfide is oxidised as loss of hydrogen is oxidation [1] [2]

(e) hydrogen peroxide is reduced [1] as hydrogen peroxide loses oxygen and loss of oxygen is reduction [1] [2]

(f) sin(II) ions are oxidised [1] as tin(II) ions lose electrons and loss of electrons is oxidation [1] [2]

(g) iron(III) ions are reduced [1] as iron(III) ions gain electrons and gain of electrons is oxidation [1] [2]

Rusting questions

1.(a) it is s drying agent [1]

(b) anhydrous calcium chloride removes water/moisture [1]
no moisture/water [1] [2]

(c) oxygen/air [1]

(d) no oxygen/air [1]

(e) water/moisture [1]
oxygen/air [1] [2]

2.(a) hydrated iron(III) oxide [1]

(b) zinc is more reactive than iron [1]
zinc reacts first instead of the iron [1] [2]

3.(a) coated in zinc [1]

(b) provided a barrier to water and oxygen [1]

4.(a) maintain the strength of the iron [1]

(b) oxidation [1]

Extraction of iron questions

1.(a) coke [1]
limestone [1]
iron ore [1] [3]

(b) $CaCO_3 \rightarrow CaO + CO_2$ [2]
$CaO + SiO_2 \rightarrow CaSiO_3$ [2] [4]

(c) carbon monoxide [1]

(d) tapped off as molten iron at the bottom [1]

2.(a) A = coke [1]
B = limestone [1] [2]

(b) hot air [1]

(c) $CO_2 + C \rightarrow 2CO$ [3]

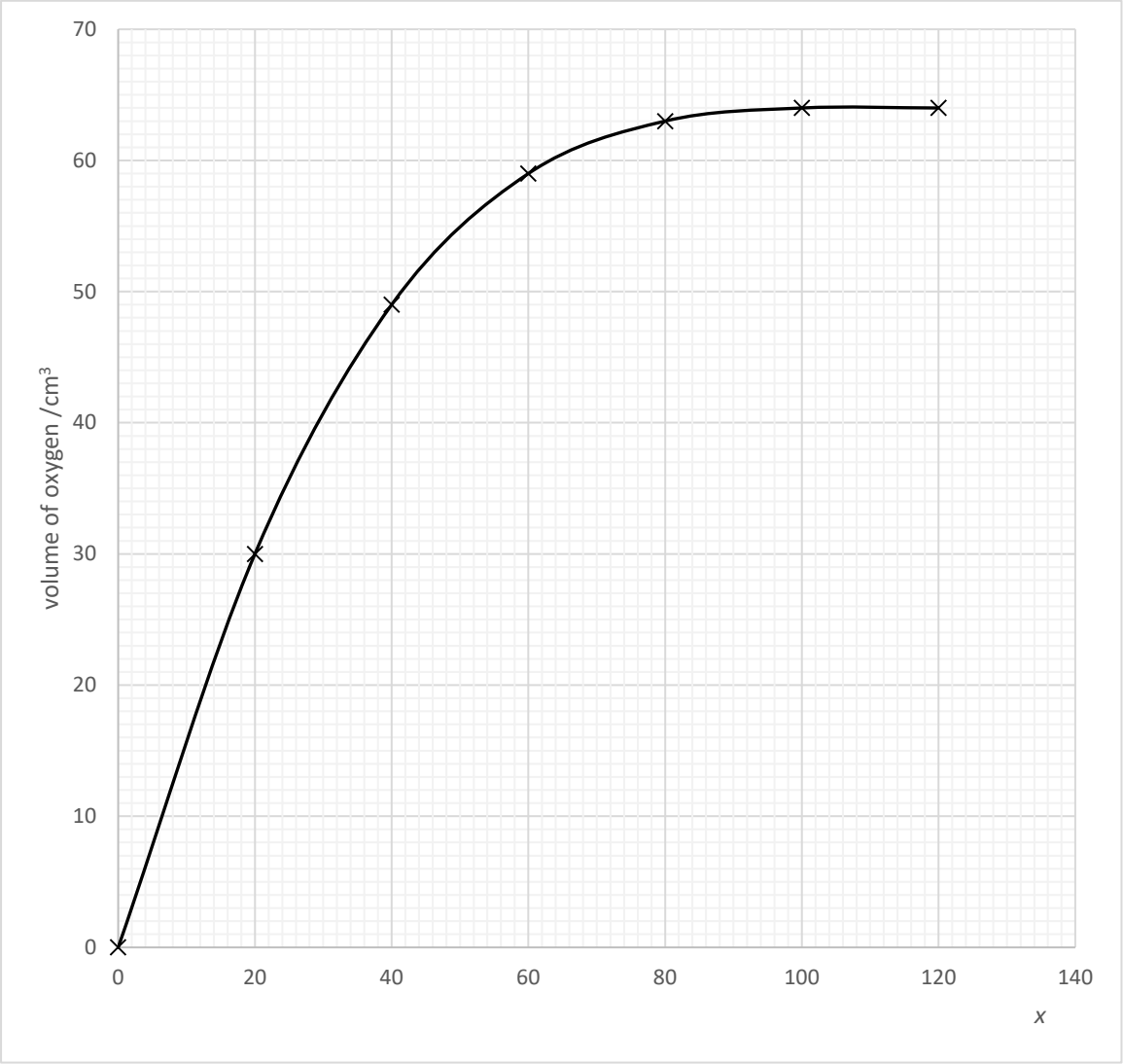
(d) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ [3]

2.3 Rates of reaction

1.(a) higher concentration = increase [1]
lower temperature = decrease [1]
solid particles made smaller = increase [1]
catalyst added = increase [1]

(b)(i) time /s [1]

(ii)



all point plotted correctly [2]
smooth curve [1] [3]

(iii) 52 s

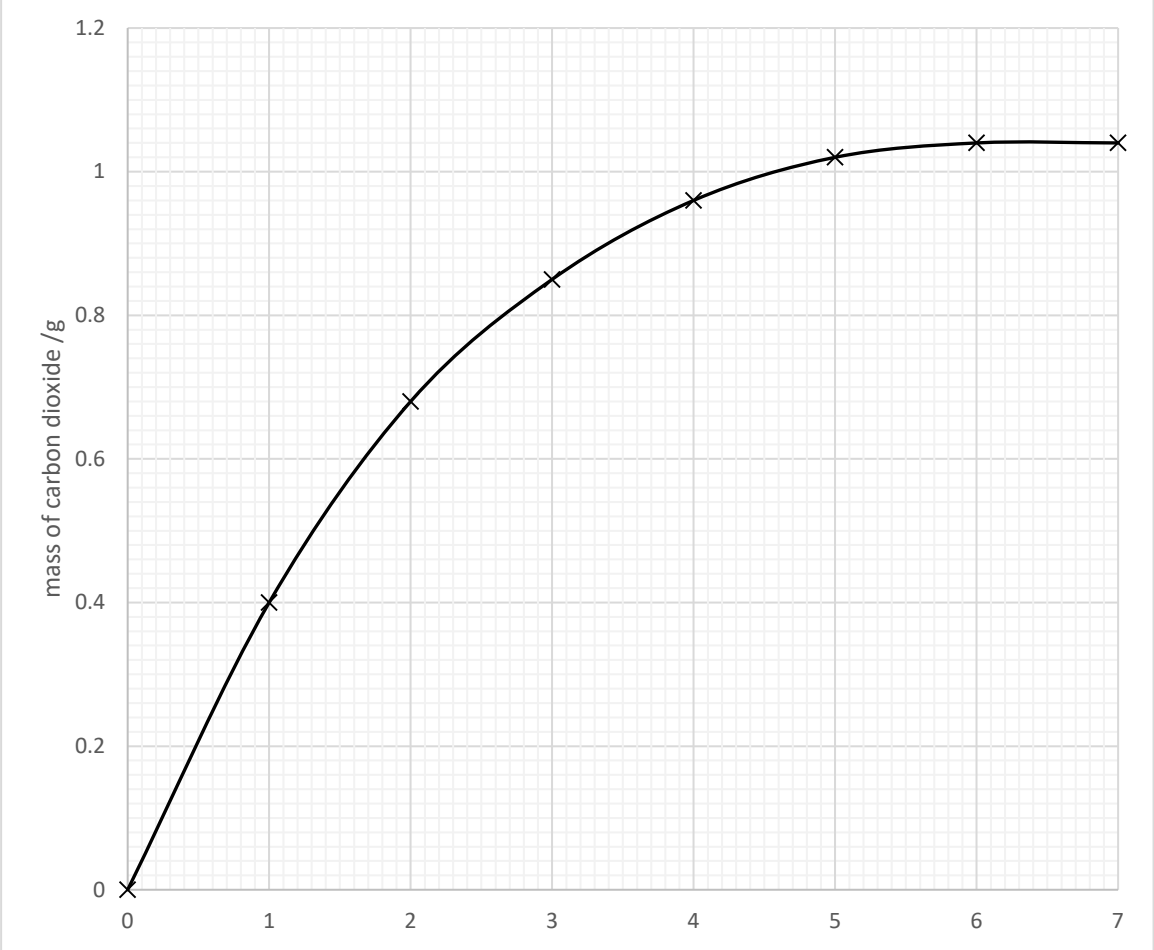
(iv) particles gain energy/move faster [1]
more successful collisions per unit time [1]
increased rate of reaction [1] [3]

(c)(i) lower concentration of acid [1]
lower temperature [1]
larger zinc solid particles [1] [3]

(ii) no more bubbles [1]

2.(i) time /mins [1]

(ii)



all points plotted correctly [2]
smooth curve [1] [3]

(iii) 5.6 to 6 minutes [1]

(iv) 1.3 minutes [1]

(v) smaller surface area [1]
less successful collisions per unit time [1]
decreased rate of reaction [1] [3]

(vi) no effect [1]

2.4 Equilibrium

1.(a)

(i) rate of the forward reaction equals the rate of the reverse reaction [1]
amounts of reactants and products remain constant [1] [2]

(ii) position of equilibrium would move to the right [1]
to remove the added oxygen [1] [2]

(iii) position of equilibrium would move to the right [1]
to replace the removed ammonia [1] [2]

(iv) position of equilibrium would move to the right [1]
forward reaction is endothermic so would absorb the heat [1] [2]

(v) no effect [1]
equal moles of gas on both sides of equation/2 moles of gas both sides [1] [2]

2.(a) temperature increased
position of equilibrium moves to the left [1]
reverse reaction is endothermic and so would absorb the heat [1]
pressure increased
position of equilibrium moves to the right [1]
fewer moles of gas on the right-hand side of equation/4 moles of gas on left and 2 moles of gas on right [1] [4]

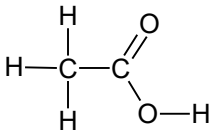
(b) position of equilibrium moves to the right [1]
to replace the removed water [1] [2]

(c) compromise between rate and yield/higher rate [1]

2.5 Organic chemistry

1.(a) family of organic compounds with the same general formula [1]
each member differs by a CH_2 [1]
similar chemical properties [1]
gradation in physical properties [1] max [2]

(b)



[1]

(c) cracking [1]

(d)(i) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ [2]

(ii) fermentation [1]

(iii) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ [3]

(iv) alcoholic drinks/solvent [2]

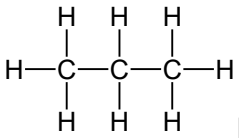
(v) any **two** from:
bubbles
solution remains colourless [2]

(vi) magnesium ethanoate + water [2]

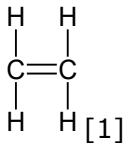
2.(i) alkanes [1]

(ii) breaking down large less useful hydrocarbon molecules [1]
into smaller more useful ones where at least one is unsaturated [1] [2]

(iii) propane ethene



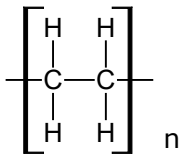
[1]



[1] [2]

(iv) bromine water [1]
with propane remains orange [1]
with ethene changes from orange to colourless/decolourises [1] [3]

3.(i)



structure in brackets [1]
repeat indicated after polymer [1] [2]

(ii) compound containing only carbon and hydrogen (atoms) [1]

(iii) coal/natural gas/lignite/peat/fuel oil [1]

(iv) heated to form a gas [1]
fractions condensed at different temperatures [1] [2]

(v) cracking [1]

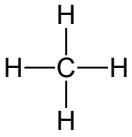
(vi) alkenes [1]

4.(i) **question to be removed** [1]

(ii) addition polymerisation [1]

(iii) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 3H_2O$ [3]

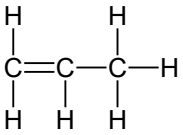
(iv) methane [1]



[1] [2]

(v) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ [3]

5.(i) molecular formula: C_3H_6 [1]
structural formula:



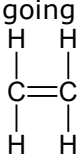
(ii) carbon [1]

(iii) cannot be replaced in a human lifetime/will eventually run out [1]

(iv) **any two from:**
coal/natural gas/crude oil [2]

(v) heated to form a gas [1]
fractions condensed at different temperatures [1] [2]

(vi) going down the table:

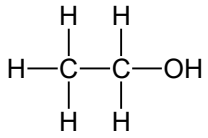


[1]

propene [1]
C_4H_{10} [1] [3]

(vii) solvent/alcoholic drinks [1]

(viii)



[1]

2.6 Quantitative chemistry

1. moles of HCl = $\frac{13.5\times0.10}{1000}$ = 1.35 × 10^{-3} [1]
moles of KOH in 10.0 cm^3 = 1.35 × 10^{-3} [1]
concentration of KOH in mol/dm^3 = 0.135 [1]
concentration of KOH in g/dm^3 = 0.135 × 56 = 7.56 [1] [4]

2. $CaCO_3$ + 2HCl → $CaCl_2$ + CO_2 + H_2O [3]
moles of HCl = $\frac{50\times2.0}{1000}$ = 0.1 [1]
moles of $CaCO_3$ = $\frac{0.1}{2}$ = 0.05 [1]
mass of $CaCO_3$ = 0.05 × 100 = 5 g [1] [6]

3.(i) moles of Sr = $\frac{0.438}{88}$ = 4.98 ×10^{-3} [1]

(ii) moles of H_2 = 4.98 × 10^{-3} [1]
volume of H_2 = 4.98 × 10^{-3} × 24000 = 119.5 cm^3 [1] [2]

(iii) moles of $Sr(OH)_2$ = 4.98 × 10^{-3} [1]
concentration of $Sr(OH)_2$ in mol/dm^3 = 4.98 × 10^{-3} × 5 = 0.0249 [1] [2]

4. moles of Na_2CO_3 = $\frac{23.45\times0.0614}{1000}$ = 1.44 × 10^{-3} [1]
moles of HX in 25.0 cm^3 = 1.44 × 10^{-3} × 2 = 2.88 × 10^{-3} [1]
moles of HX in 250 cm^3 = 2.88 × 10^{-3} × 10 = 0.0288 [1]
M_r of HX = $\frac{3.686}{0.0288}$ = 128 [1]
A_r of X = 128 − 1 = 127 so X = iodine [1] [5]

5. average titre = 21.35 cm^3 [1]
moles of HCl = $\frac{21.35\times0.10}{1000}$ = 2.135 × 10^{-3} [1]
moles of Na_2CO_3 in 25.0 cm^3 = 1.0675 × 10^{-3} [1]
moles of Na_2CO_3 in 100 cm^3 = 1.0675 × 10^{-3} × 4 = 4.27 × 10^{-3} [1]
M_r of $Na_2CO_3.xH_2O$ = $\frac{1.22}{4.27\times10^{-3}}$ = 286 [1]
M_r of xH_2O = 286 − 106 = 180
x = $\frac{180}{18}$ = 10 [1] [6]

6. % atom economy = $\frac{23\times2\ [1]}{2\times58.5\ [1]}$ × 100 = 39.3 % [1] [3]

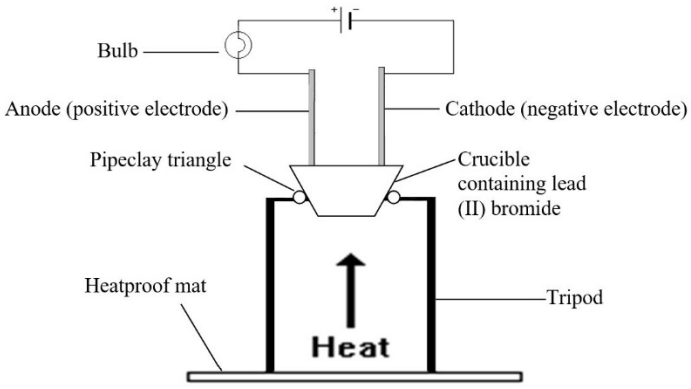
7. % atom economy = $\frac{2\ [1]}{65+2\times36.5\ [1]}$ × 100 = 1.45 % [1] [3]

8. moles of H_2 = $\frac{100\ [1]}{24000\ [1]}$ = 4.17 × 10^{-3} [1]
moles of Mg = 4.17 ×10^{-3} [1]
mass of Mg = 4,17 × 10^{-3} × 24 = 0.1 g [1] [3]

2.7 Electrochemistry

1.(a) ions can move [1]
and carry charge [1] [2]

(b)



crucible containing lead(II) bromide [1]
on a pipeclay triangle on a tripod [1]
heat/Bunsen burner in correct position below crucible [1]
electrodes in molten compound in crucible [1]
external circuit (bulb not needed) [1] [5]

(c) breakdown (of an ionic compound) using (a direct current of) electricity [1]

(d) graphite [1]

(e) red-brown [1] gas [1] [2]

(f) lead [1]
bromine [1]

(g) $Pb^{2+} + 2e^- \rightarrow Pb$ [3]

(h) lead/bromine [1] is toxic [1] [2]

2.(a) bauxite [1]

(b) cryolite [1]

(c) $Al^{3+} + 3e^- \rightarrow Al$ [3]

(d) $2O^{2-} \rightarrow O_2 + 4e^-$ [3]

(e) carbon anode reacts with oxygen/carbon anode wear away [1]

(f) tapped off at the bottom [1]

3.(a) platinum [1]

(b) hydrogen [1]

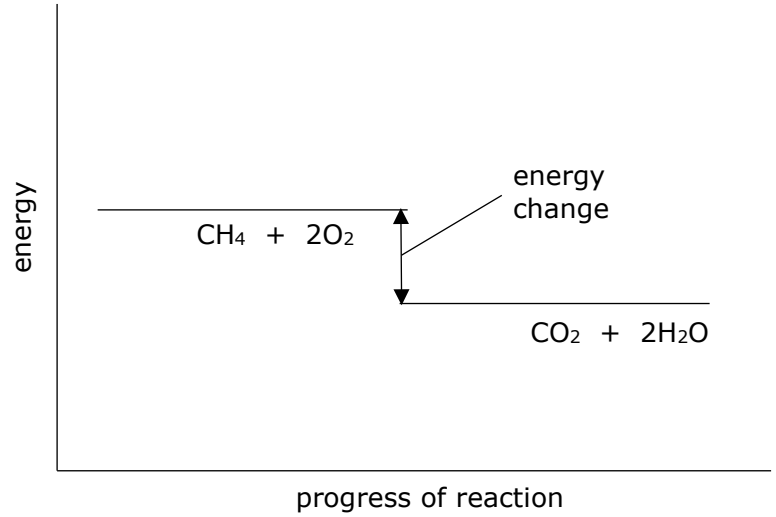
(c) lit splint [1]
pop sound [1] [2]

(d) $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ [3]

(e) volume of hydrogen is twice [1] the volume of oxygen [1] [2]

2.8 Energy changes in chemistry

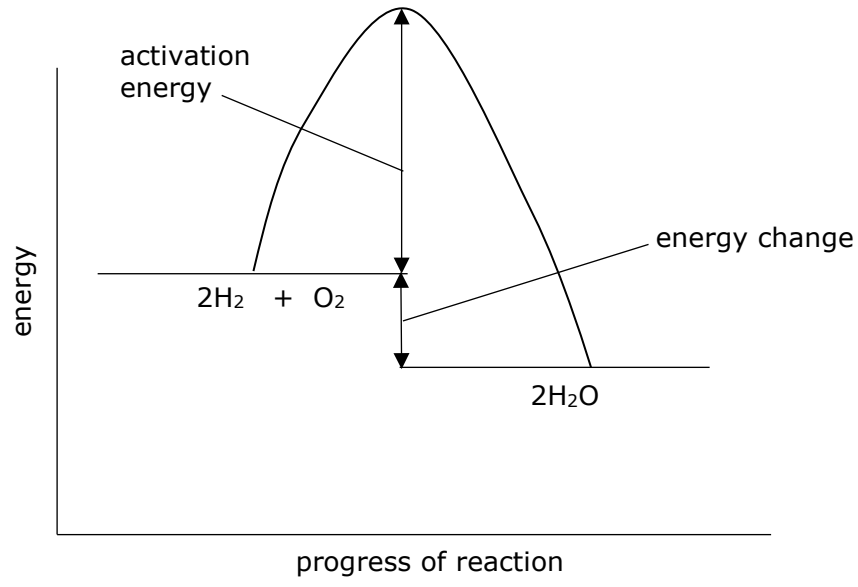
1.



axes labels [1]
energy of products at lower level than energy of reactants [1]
correct labels on levels [1]
energy change labelled [1] [4]

2.(a) energy of bonds broken = 2(436) + 498 = 1370 kJ [1]
energy of bonds made = 4(464) = 1865 kJ [1]
energy change = 1370 – 1865 = - [1] 486 kJ [1] [4]

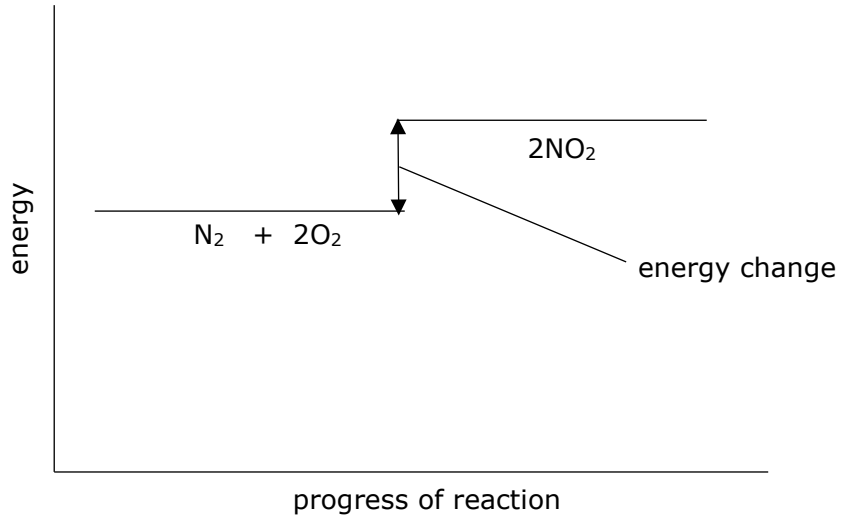
(b)



axes labels [1]
energy of products at lower level than energy of reactants [1]
correct labels on levels with reaction pathway [1]
energy change labelled [1]
activation energy labelled [1] **max** [4]

3.(a) the energy required to break the bonds in nitrogen and oxygen [1]
is greater than [1]
the energy released when bonds form in nitrogen dioxide [1] [3]

(b)



axes labels [1]
energy of products at higher level than energy of reactants [1]
correct labels on levels [1]
energy change labelled [1] **max** [4]

2.9 Gas chemistry

1.(i) helium [1]

(ii) nitrogen [1]

2.(i) gas syringe [1]

(ii) starts at 0, 0 [1]
stays lower but finished off at same level later [1] [2]

(iii) increase the rate of reaction [1]

3.(a) less dense than air [1]

(b) helium is not flammable [1]
hydrogen is flammable [1] [2]

(c) $2H_2 + O_2 \rightarrow 2H_2O$ [3]

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