AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.1.1.2

Mixtures

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**27**
Available paper years	**2018–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.1.1.2 Mixtures

Answer 01 · Mark scheme

June 2018 | 8464/C/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	hydrogen **or** H_2	allow hydrogen gas ignore H without the 2 subscript	1	AO1 5.4.2.1
08.2	filtration / filter	allow magnet **or** decant ignore heating	1	AO1 5.1.1.2
08.3		an answer of 185–190 (mg) scores **5** marks an answer of 0.185–0.19 scores **4** marks		AO2 5.3.2.2
	(Mg) $\frac{0.12}{24}$ or 0.005 (moles)	mark is for ÷ by 24	1	
	(Fe) $\frac{2}{3} \times 0.005 = 0.00333$(moles)	mark is for $\times \frac{2}{3}$	1	
	(mass Fe) = 0.00333×56	mark is for × 56	1	
	= 0.1866 (g)		1	
	= 187 (mg)		1	
		an answer of 280 (mg) scores **4** marks an answer of 0.280 scores **3** marks (no ratio from equation) 184 scores **0** [=(3×24) + (2×56)]		
	OR (Mg) = $\frac{0.12}{(3 \times 24 =)\ 72}$ (1) = 0.00166 **or** $\frac{1}{600}$ (moles) (1) (mass of Fe) = 0.00166 **or** $\frac{1}{600} \times 112\ (2 \times 56)$ (1) = 0.1866 (g) (1) 187 (mg) (1)			

5.1.1.2 Mixtures

Answer 01 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3 cont.	**OR** 72 g Mg → 112g Fe (1) 1 g Mg → $\frac{112}{72}$ **or** 1.56 g Fe (1) 0.12 g Mg → $\frac{112}{72}$ × 0.12 (1) = 0.1866 (g) (1) = 187 (mg) (1)			
08.4	Fe^{3+} (because) reduction is gain <u>of electrons</u> $Fe^{3+} + 3e^{(-)}$ ➔ Fe	allow change in oxidation state / (+)3 to 0	1 1 1	AO2 AO1 AO2 5.4.1.2 5.4.1.4
Total			**10**	

5.1.1.2 Mixtures

Answer 02 · Mark scheme

June 2018 | 8464/C/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	condenses		1	AO1 5.7.1.2
01.2	the fractions have different boiling points		1	AO1 5.7.1.2 5.7.1.3
01.3	propane	do **not** accept propene	1	AO2 5.7.1.1
01.4	C_nH_{2n+2}		1	AO1 5.7.1.1
01.5	CH_4 + **2** $O_2 \rightarrow CO_2$ + **2** H_2O	allow multiples	1	AO2 5.1.1.1 5.7.1.3
01.6	bromine water		1	AO1 5.7.1.4
01.7	to assess the environmental impact (of the stages in the life of a product)	allow to see the effect / harm / damage on the Earth / environment / planet ignore references to energy, pollution, carbon footprint, carbon dioxide, sustainability	1	AO1 5.10.2.1

5.1.1.2 Mixtures

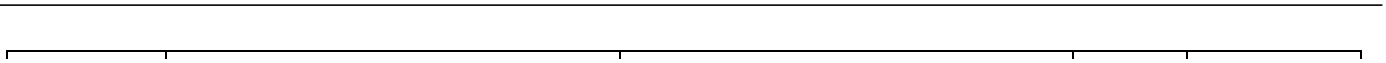
Answer 02 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
01.8	**Level 2:** Scientifically relevant features are identified; the ways in which they are similar / different is made clear and the magnitude of the similarity / difference noted.	3–4	AO3
	Level 1: Relevant features are identified and differences noted.	1–2	AO2
	No relevant content	0	
	Indicative content • burning 10 000 bags produces 10 kg more of carbon dioxide than landfill • putting 10 000 bags in landfill produces 0.02 kg more of solid residue than burning. • putting 10 000 bags in landfill produces 50% more sulfur dioxide than burning • burning 10 000 bags produces 25 kg of carbon dioxide, but landfill only produces15 kg • putting 10 000 bags in landfill produces 0.07 kg of solid residue but burning only produces 0.05 kg • landfill produces less carbon dioxide than burning • landfill produces more solid residue than burning • burning produces less sulfur dioxide than landfill		5.10.2.1 5.10.2.2 5.9.2.2
Total			**11**

5.1.1.2 Mixtures

Answer 02 · Mark scheme

June 2018 | 8464/C/2H | Original Q1



5.1.1.2 Mixtures

Answer 03 · Mark scheme

June 2019 | 8464/C/1H | Original Q5

05.1	metal is too reactive to be extracted using carbon **or** metal reacts with carbon	allow metal is more reactive than carbon	1	AO1 5.4.3.3

05.2		either order		AO1 5.4.3.3
	aluminium oxide	ignore bauxite **or** aluminium ore	1	
	cryolite		1	

05.3		allow multiples		AO2 5.4.3.2 5.4.3.5
	negative electrode: $Cu^{2+} + 2e^- \rightarrow Cu$		1	
	positive electrode: $2Cl^- \rightarrow Cl_2 + 2e^-$	allow $2Cl^- - 2e^- \rightarrow Cl_2$	1	

05.4	any **two** from: • concentration / volume of solution was different • impurities in solution • error in timing • copper falls off (electrode) • copper removed when drying electrode • electrode not dry (when weighed) • voltage / current was different	allow copper at bottom of beaker ignore power supply ignore recorded mass inaccurately	2	AO3 5.4.3.4

5.1.1.2 Mixtures

Answer 03 · Mark scheme

June 2019 | 8464/C/1H | Original Q5

05.5		an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 5.4.3.4
	reading of mass at stated time	allow tolerance of ± ½ small square eg at 30 minutes value is 5.4 (mg)	1	
	factor from time to 24 hours	eg 5.4 × 48 $\left(= \frac{24 \text{ hours}}{30 \text{ minutes}}\right)$ allow correct calculation using incorrectly read value for mass at time quoted	1	
	correct evaluation	eg = 259 (mg)	1	
	alternative approach:			
	calculates the gradient (1)	eg (1.8÷10) = 0.18		
	gradient × time in minutes in 24 hours (1)	eg 0.18 × 24 × 60 **or** eg 0.18 × 1440 allow correct use of incorrectly determined gradient		
	correct evaluation (1)	eg = 259 (mg)		

5.1.1.2 Mixtures

Answer 03 · Mark scheme

June 2019 | 8464/C/1H | Original Q5

05.6	4.75 (g)	allow values in range 4.7–4.8 (g)	1	AO2 5.4.3.4

05.7		an answer in the range 0.18–0.25 scores **2** marks (**3** marks with correct unit)		AO2 5.4.3.4
	(working) Y increase **and** X increase measured from graph	allow ecf from question **05.6**		
	and substitution into $\frac{\text{Y increase}}{\text{X increase}}$	eg = $\frac{2.0}{10}$	1	
	correct evaluation	eg = 0.2	1	
	(units) g/hour	allow g/h **or** g/hr **or** g per hour	1	

Total			**14**

5.1.1.2 Mixtures

Answer 03 · Mark scheme

June 2019 | 8464/C/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.2 Mixtures

Answer 04 · Mark scheme

03.1	a mixture designed as a useful product		1	AO1 5.8.1.2
03.2	dyes distributed differently between the stationary and mobile phase	allow dyes have different solubilities allow dyes have different forces of attraction for stationary phase allow dyes have different forces of attraction for mobile phase allow dyes have different forces of attraction to the paper allow dyes have different forces of attraction to the solvent ignore density	1	AO1 5.8.1.3
	(so dyes) move up the paper at different speeds / rates	allow (so dyes) move different distances up the paper ignore references to time	1	
03.3	(because chromatogram has) different dots / colours		1	AO2 5.8.1.3
	in a (vertical) column	allow above the (original) spot	1	
03.4	run known dyes and food colouring (as a chromatogram)		1	AO2
	compare distances moved **or** compare R_f values		1	AO2
	(so) can identify those that move the same distance as known dyes **or** (so) can identify those that have the same R_f values as known dyes	allow (so) can identify those that move different distances as unknown dyes **or** allow (so) can identify those that have different R_f values as unknown dyes	1	AO2 5.8.1.3
Total			**8**	

5.1.1.2 Mixtures

Answer 04 · Mark scheme

June 2019 | 8464/C/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.2 Mixtures

Answer 05 · Mark scheme

November 2020 | 8464/C/1H | Original Q1

01.1	13 14	this order only	1 1	AO2 5.1.1.4 5.1.1.5
01.2	loss of oxygen	allow (Al^{3+}) gain of electrons allow aluminium oxide loses oxygen	1	AO1 5.4.1.1 5.4.1.3
01.3	 (at high temperature) oxygen reacts with carbon / electrode (so the positive) electrode burns / wears away to produce carbon dioxide	allow anode for (positive) electrode $C + O_2 \rightarrow CO_2$ scores MP1 and MP3	 1 1 1	 AO1 5.4.3.1 5.4.3.2 5.4.3.3
01.4	(delocalised) electron(s) ion(s) (delocalised) electron(s)		1 1 1	AO1 AO2 AO1 5.2.2.3 5.2.2.8 5.2.3.2
Total			**9**	

5.1.1.2 Mixtures

Answer 05 · Mark scheme

November 2020 | 8464/C/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.2 Mixtures

Answer 06 · Mark scheme

04.1	ZnO (**s**) + HCl (**aq**) → $ZnCl_2$ (**aq**) + H_2O (**l**)	allow **1** mark for 2/3 correct state symbols	2	AO2 5.2.2.2 5.4.2.3 RPA8
04.2	any **one** from: • warm / heat the mixture • increase the concentration of the (hydrochloric) acid	ignore add a catalyst ignore stir ignore powder ignore add more zinc oxide do **not** accept volume / amount of (hydrochloric) acid do **not** accept increase the surface area	1	AO1 5.4.2.2 5.4.2.3 RPA8
04.3	zinc oxide remains **or** solid remains	ignore colour allow zinc oxide is added until in excess	1	AO1 5.3.2.4 5.4.2.2 5.4.2.3 RPA8
04.4	filtration / filter		1	AO1 5.4.2.2 5.4.2.3 RPA8
04.5	heat leave to crystallise / cool	do **not** accept heat to dryness allow leave to evaporate some water	1 1	AO1 5.4.2.2 5.4.2.3 RPA8

04.6	(at start) value in range 12–14 (at end) value in range 0–3	must be in this order	1 1	AO1 AO2.2 5.4.2.2 5.4.2.4

04.7	2 NaOH + H_2SO_4 → Na_2SO_4 + 2 H_2O	allow 1 mark for Na_2SO_4 **and** H_2O	2	AO2 5.1.1.1 5.4.2.2

04.8	0.10 mol/dm^3		1	AO3 5.4.2.2 5.4.2.4

Total			**12**

5.1.1.2 Mixtures

Answer 06 · Mark scheme

November 2020 | 8464/C/1H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.2 Mixtures

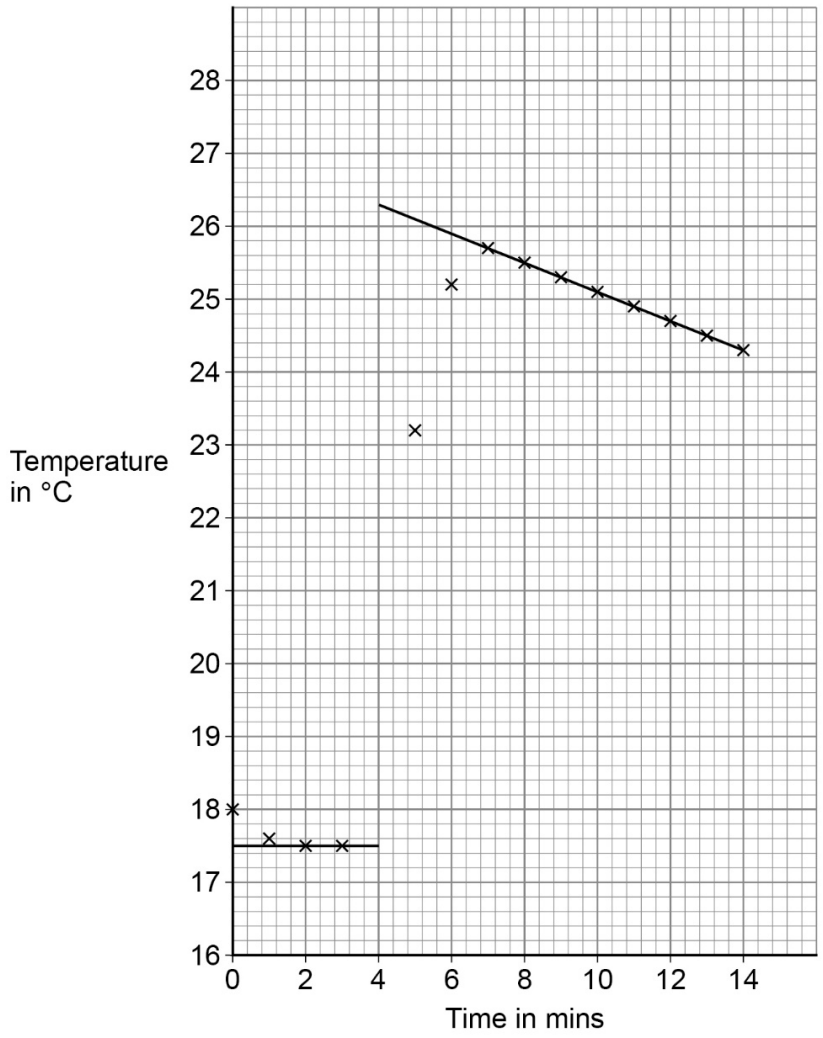
Answer 07 · Mark scheme November 2020 | 8464/C/1H | Original Q5

05.1	temperature (change)		1	AO2 5.4.1.2 5.5.1.1 RPA 10

05.2	to reach a constant temperature	allow to reach room temperature	1	AO3 5.4.1.2 5.5.1.1 RPA 10

5.1.1.2 Mixtures

Answer 07 · Mark scheme

05.3	line of best fit after 7 minutes extends line back to 4 minutes	 ignore extension of line beyond 4 minutes	1 1	AO2 5.4.1.2 5.5.1.1 RPA 10
	the diagram below scores **2** marks  			

5.1.1.2 Mixtures

05.4	(maximum **and** minimum values at 4 minutes) 26.3 (°C) **and** 17.5 (°C) (temperature change at 4 minutes) = 8.8 (°C)	allow ecf from **05.3**	1 1	AO3 5.4.1.2 5.5.1.1 RPA 10
05.5	the reaction finished / stopped (so) energy is lost to surroundings / atmosphere **or** (so the) solution cools (back to room temperature)	allow maximum temperature has been reached allow heat for energy	1 1	AO3 5.4.1.2 5.5.1.1 RPA 10
05.6	aluminium / zinc / iron / beryllium metal **Q** is less reactive (than magnesium) **or** metal **Q** is lower in reactivity series	allow Al / Zn / Fe / Be do **not** accept copper, silver MP2 dependent on a correct answer to MP1 allow converse	1 1	AO3 AO2 5.4.1.2 5.5.1.1 RPA 10

5.1.1.2 Mixtures

Answer 07 · Mark scheme

05.7	(unit conversion) 30.0 cm^3 = 0.030 dm^3 **or** 0.500 dm^3 = 500 cm^3		1	AO2 5.3.2.1 5.4.1.2 5.5.1.1
	(moles = $\frac{30}{500}$ × 0.1 =) 0.006 **or** (moles = $\frac{0.030}{0.50}$ × 0.1 =) 0.006	allow correct use of incorrect / no unit conversion	1	
	mass = 0.006 × 159.5	allow correct use of incorrect value for number of moles	1	
	= 0.957 (g)	allow 0.96 (g)	1	

Total			**14**

5.1.1.2 Mixtures

Answer 07 · Mark scheme

November 2020 | 8464/C/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.2 Mixtures

Answer 08 · Mark scheme November 2020 | 8464/C/2H | Original Q5

05.1	plankton	allow biomass allow (marine) animals / organisms ignore plants	1	AO1 5.7.1.1
	buried in mud	allow compressed under mud allow compressed in sedimentary rock ignore fossilised	1	
	over a long period of time **or** over millions of years		1	

05.2	crude oil heated		1	AO1 5.7.1.2
	(hydrocarbons / liquids) evaporate	allow (hydrocarbons / liquids) vaporise / boil	1	
	vapours / gases condense		1	
	fractions have different boiling points **or** fractions collect at different levels depending upon boiling point		1	

05.3	C_nH_{2n+2}		1	AO1 5.7.1.1

5.1.1.2 Mixtures

Answer 08 · Mark scheme

November 2020 | 8464/C/2H | Original Q5

05.4		max **2** marks for incorrect reference to particles **/** bonds allow converse		
	the boiling point increases as the number of (carbon) atoms increases		1	AO1
	(because the weak) intermolecular forces increase **or** (because the weak) forces between the molecules increase		1	AO2 AO3
	(and these intermolecular forces increase) as the size of the molecules increases		1	5.2.2.4 5.7.1.3

05.5		MP2 dependent on correct response in MP1		AO3 5.7.1.3
	(as number of carbon atoms increase) the time increases		1	
	(because) the viscosity increases		1	

Total			**13**

5.1.1.2 Mixtures

Answer 08 · Mark scheme

November 2020 | 8464/C/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.2 Mixtures

Answer 09 · Mark scheme

November 2020 | 8464/C/2H | Original Q7

07.1	when a reversible reaction occurs in apparatus which prevents the escape of reactants and products (equilibrium is reached) when the forward and reverse reactions occur at (exactly) the same rate	allow when a reversible reaction occurs in a sealed system	1 1	AO1 5.6.2.3

07.2	(as pressure increases) the equilibrium position shifts to the right hand side (because) there are less moles / molecules (of dinitrogen tetroxide) on right hand side	allow (as pressure increases) the percentage of product / dinitrogen tetroxide / N_2O_4 increases allow (because) there are more moles / molecules (of nitrogen dioxide) on left hand side	1 1	AO2 5.6.2.4, 5.6.2.6 5.6.2.7

07.3	(as temperature increases) equilibrium position shifts to left hand side (because the forward) reaction is exothermic **or** (because) the backward reaction is endothermic (so) the percentage of product / dinitrogen tetroxide / N_2O_4 decreases		1 1 1	AO2 AO2 AO3 5.6.2.4 5.6.2.6 5.6.2.7

Total			**7**

5.1.1.2 Mixtures

Answer 10 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	green to red		1	AO1 5.4.2.4
02.2	decreases		1	AO1 5.4.2.4
02.3	(aq)	allow aq ignore aqueous ignore HNO_3	1	AO1 5.2.2.2
02.4	any **two** from: • (white) solid disappears • fizzing **/** bubbles / effervescence • (then) stops fizzing • (white) solid left at the end / bottom	 allow a gas is produced ignore colourless solution	2	AO3 5.4.2.2 5.4.2.3
02.5	$Zn(NO_3)_2$		1	AO2 5.1.1.1 5.4.2.2

5.1.1.2 Mixtures

Answer 10 · Mark scheme

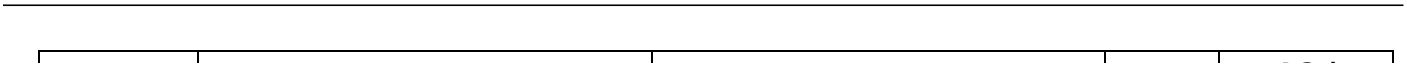
November 2021 | 8464/C/1H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.6	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 5.4.2.2 5.4.2.3 RPA8
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative Content: • react hydrochloric acid • (with) copper oxide • in a suitable container • warm (hydrochloric) acid • add copper oxide • until is in excess **or** until solid remains • stir • filter excess copper oxide • pour solution / filtrate into evaporating basin • use of water bath **or** use of electric heater • to heat gently **or** partially evaporate • leave to cool / crystallise For level 3 the correct chemicals must have been selected.		
Total		**12**	

5.1.1.2 Mixtures

Answer 10 · Mark scheme

November 2021 | 8464/C/1H | Original Q2



5.1.1.2 Mixtures

Answer 11 · Mark scheme

November 2021 | 8464/C/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	particles collide		1	AO3 5.5.1.2
	(but at room temperature) particles have insufficient energy **or** (but) have energy less than the activation energy (so collisions are not successful)		1	
07.2	2120 (kJ/mol)		1	AO3 5.5.1.2 5.5.1.3
07.3		allow C–C for **X**		AO2 5.5.1.3
	(bonds broken = (8 × 410) + 2 **X** + (5 × 500) = 5780 + 2 **X**	allow (bonds broken = (8 × 410) + (5 × 500) = 5780	1	
	(bonds formed = (6 × 740) + (8 × 460) = 8120		1	
	(bonds broken – bonds formed = energy released) (5780 + 2 **X**) – 8120 = – 1640	allow correct use of incorrect values from step 1 and/or step 2	1	
	(2 **X** =) 700	allow correct use of incorrect value from step 3	1	
	(**X** =) 350 (kJ/mol)		1	
Total			**8**	

5.1.1.2 Mixtures

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	add water to anhydrous copper sulfate	allow a description of heating hydrated copper sulfate to produce anhydrous copper sulfate, followed by addition of water	1	AO2
	colour changes from white		1	AO1
	to blue		1	AO1 5.6.2.1
03.2	a single element or compound	allow an element or compound not (mixed) with any other substance ignore only one type of substance	1	AO1 5.8.1.1
03.3	(% impurity = $\frac{0.6}{0.12}$) = 5		1	AO2 5.8.1.1
	(mass impurity =) $\frac{5}{100}$ × 250		1	
	= 12.5 (g)		1	
03.4	heat salty water	allow boil salty water	1	AO1 5.10.1.2 RPA13
	(so) water evaporates (as water vapour)		1	
	cool the (water) vapour		1	
	(which) condenses to form potable / liquid water		1	

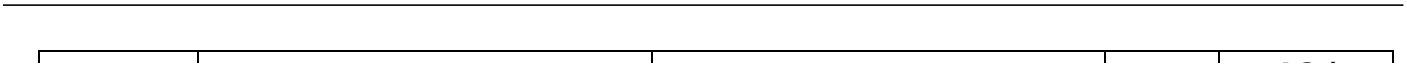
5.1.1.2 Mixtures

03.5	distillation requires energy (to boil salty water) (but) ground water only needs filtering **and** sterilising	allow distillation requires fuel (to boil salty water)	1 1	AO1 5.10.1.3 RPA13
Total			**13**	

5.1.1.2 Mixtures

Answer 12 · Mark scheme

November 2021 | 8464/C/2H | Original Q3



5.1.1.2 Mixtures

Answer 13 · Mark scheme

November 2021 | 8464/C/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	use limewater **or** use calcium hydroxide solution (which) does not turn milky / cloudy	 allow (which) stays colourless	1 1	AO2 5.8.2.3
06.2	provides an alternative pathway (which has) a lower activation energy		1 1	AO1 5.6.1.4
06.3	(when) the apparatus prevents the escape of reactants and products (and the) forward and reverse reactions occur at same rate	allow (in a) closed system	1 1	AO1 5.6.2.3
06.4	equilibrium position stays the same increases the rate of the forward and the reverse reaction by the same amount	allow no effect	1 1	AO3 5.6.1.4 5.6.2.3
06.5	the yield of ammonia increases		1	AO2 5.6.2.4 5.6.2.7

5.1.1.2 Mixtures

Answer 13 · Mark scheme

06.6	yield of ammonia decreases (because) system shifts in endothermic direction	 allow (because) system shifts to counteract the change allow (because) system shifts to transfer in energy (from the surroundings)	1 1	AO2 5.6.2.4 5.6.2.6
Total			**11**	

5.1.1.2 Mixtures

Answer 14 · Mark scheme

June 2022 | 8464/C/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** pairs from: (start) line drawn in ink (1) (so ink) will mix with solvent (1) the solvent is above the (start) line (1) (so) colours / ink will dissolve (1) no lid on tank (1) (so) solvent will evaporate (1)	 allow (start) line should be drawn in pencil allow the ink will move up the paper allow the solvent should be below the (start) line	4	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **two** from: • (the brown ink) contains the blue, yellow and red (colours) • (the brown ink) contains an unknown colour • (the brown ink) does not contain green ink • blue (colour) is the most soluble **or** red (colour) is the least soluble	 allow blue (colour) has the highest R_f value allow red (colour) has the lowest R_f value ignore green colour is insoluble	2	AO3 5.8.1.3 RPA12

5.1.1.2 Mixtures

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	the green colour was insoluble in the solvent		1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$0.24 = \frac{1.8}{\text{distance moved by solvent}}$ (distance moved by solvent =) $\frac{1.8}{0.24}$ = 7.5 (cm)		1 1 1	AO2 5.8.1.3 RPA12

Total Question 1		10

5.1.1.2 Mixtures

Answer 15 · Mark scheme

June 2023 | 8464/C/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	filter (to remove excess magnesium) (then) crystallisation (of magnesium chloride solution)	 allow (then) evaporation (of water from magnesium chloride solution)	1 1	AO1 5.1.1.2 5.4.2.1 5.4.2.3 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(magnesium atoms are) oxidised (because the atoms) lose (two) electrons		1 1	AO2 5.4.1.4 5.4.2.1 5.4.2.3 RPA8

5.1.1.2 Mixtures

Answer 15 · Mark scheme

June 2023 | 8464/C/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(moles Mg =) $\frac{0.72}{24}$		1	AO2 5.3.1.1 5.3.2.2 5.4.2.1 5.4.2.3 RPA8
	= 0.03		1	
	(moles Mg = moles $MgCl_2$) (so mass $MgCl_2$ =) 0.03 × 95	allow a correct calculation using an incorrectly calculated value of moles of magnesium allow a correct calculation using an incorrectly calculated value of moles of magnesium chloride	1	
	= 2.85 (g)		1	
	(100.0 cm^3 = 0.100 dm^3 concentration = $\frac{\text{mass}}{\text{volume}}$)			
	= $\frac{2.85}{0.100}$	allow correct use of incorrectly calculated mass of magnesium chloride	1	
	= 28.5 (g/dm^3)		1	

Total Question 6	10

5.1.1.2 Mixtures

Answer 16 · Mark scheme

June 2023 | 8464/C/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$CH_4 + 2\,O_2 \rightarrow CO_2 + 2\,H_2O$		1	AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	hydrocarbon molecules in petrol have fewer carbon atoms than those in diesel petrol has a lower boiling point (range) than diesel	allow converse throughout allow petrol is more flammable than diesel allow petrol is less viscous than diesel	1 1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	oxygen		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	air	allow the atmosphere allow from volcanoes	1	AO1 5.9.1.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	global dimming		1	AO2 5.9.3.1

5.1.1.2 Mixtures

Answer 16 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	(carbon monoxide is) colourless **or** (carbon monoxide is) odourless	ignore clear	1	AO1 5.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	(diesel) burns at a high temperature **or** (diesel) burns at a temperature greater than 100 °C		1	AO2
	(which is) above the boiling point of water		1	AO3 5.2.2.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	sulfur dioxide (is produced when diesel is burnt)		1	AO1 5.9.3.1 5.9.3.2
	(which causes) acid rain		1	
	(which results in) any **one** from: • damage to buildings / statues / bridges • damage to trees / plants • damage to aquatic life • acidification of lakes / rivers / soil • respiratory problems	allow (which affects) asthma	1	

Total Question 1	12

5.1.1.2 Mixtures

Answer 17 · Mark scheme

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	stationary phase		1	AO1 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	any **one** from: (the substances) • move at different speeds • have different solubilities • have different attractions for the (chromatography) paper		1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	1		1	AO1 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	(R_f =) $\frac{4.77}{5.30}$ = 0.9		1 1	AO2 5.8.1.3 RPA12

5.1.1.2 Mixtures

Answer 17 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.5	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 5.8.1.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • **draw a pencil line** • near the bottom edge of the (chromatography) paper • **put a small dot of black ink on the pencil line** • put a small volume of water / solvent in a beaker • **place the (chromatography) paper in the solvent** • the dots of ink should be above the level of the water / solvent • support the paper in this position • put a lid on the beaker • **leave to run** • mark position of solvent front • remove from beaker and leave to dry • **determine R_f values** • measure distance of all dots from start line • measure distance of solvent front from start line • calculate R_f values for all dots • compare with known R_f values		

Total Question 2	11

5.1.1.2 Mixtures

Answer 18 · Mark scheme

June 2023 | 8464/C/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(crude oil is a mixture but) not a useful product	allow (crude oil is) not designed for a specific purpose	1	AO2 5.7.1.1 5.8.1.2
	(and) not mixed in carefully measured quantities	allow not the same composition all the time	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(crude oil) is heated to vaporise (the hydrocarbons)	allow (crude oil) is heated to evaporate the hydrocarbons	1	AO1 5.7.1.2
	temperature (of column) decreases from bottom to top	allow the column gets cooler going up	1	
	(so) the fractions / hydrocarbons condense at different heights (in the column)		1	
	(because) the fractions / hydrocarbons have different boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(to make) smaller (hydrocarbon) molecules		1	AO1 5.7.1.4
	any **one** from: (which are) • more useful molecules • useful as fuels • starting materials	allow (which are) in higher demand allow (which are) alkenes for the production of other chemicals	1	

5.1.1.2 Mixtures

Answer 18 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(test) burning / lit splint	MP2 is dependent upon MP1 being awarded allow flame do **not** accept glowing splint	1	AO2
	(result) burns with a (squeaky) pop sound	allow pops	1	AO1 5.8.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	C_2H_4		1	AO2 5.7.1.1 5.7.1.4

Total Question 3	11

5.1.1.2 Mixtures

Answer 19 · Mark scheme

June 2024 | 8464/C/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** from: • mass of copper produced increased (from 1900 to 2010) • before 1930 the mass of copper produced increased slightly • after 1930 the mass of copper produced increased rapidly • the highest mass of copper was produced in 2010 • the lowest mass of copper was produced in 1900 • the increase in the mass of copper produced was not linear	 allow a value in the range 1925 to 1930 allow a value in the range 1925 to 1930 allow the highest mass of copper produced was 15.8 ($\times 10^9$ kilograms) allow the lowest mass of copper produced was 0.2 ($\times 10^9$ kilograms)	2	AO3 5.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(alloy of copper and zinc is harder because) the atoms are different sizes (so the) layers are distorted (so the) layers cannot easily slide	 allow (so the) atoms cannot slide over each other	1 1 1	AO2 5.2.2.7

5.1.1.2 Mixtures

Answer 19 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(% copper = 100 – 13.5 =) 86.5 (%)		1	AO2 5.2.2.7
	(mass of copper =) $\frac{86.5}{100}$ × 5.25	allow correct use of an incorrectly determined percentage of copper	1	
	= 4.54125 (g)		1	
	= 4.54 (g)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question	1	
	OR			
	(mass of zinc =) $\frac{13.5}{100}$ × 5.25 (1)			
	= 0.70875 (g) (1)			
	(mass of copper = 5.25 – 0.70875) = 4.54125 (g) (1)	allow correct use of an incorrectly determined mass of zinc		
	= 4.54 (g) (1)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question		

Total Question 1	9

Answer 20 · Mark scheme

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	completely ionised in aqueous solution	allow completely ionised (when dissolved) in water allow fully dissociated in aqueous solution	1	AO1 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	low concentration of (nitric) acid dissolved in water	allow low concentration of solute / solid / gas dissolved in water	1	AO1 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	decreases by a factor of 100		1	AO2 5.4.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	$H^+ + OH^- \rightarrow H_2O$	ignore state symbols	1	AO1 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	1 : 2		1	AO2 5.3.2.3

5.1.1.2 Mixtures

Answer 20 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	red		1	AO3 5.3.2.4 5.4.2.2 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(for each mass of magnesium carbonate) repeat the experiment (discard anomalous results) **and** calculate the mean		1	AO3 5.5.1.1 RPA10
	measure the highest temperature		1	

Total Question 4	**8**

5.1.1.2 Mixtures

Answer 21 · Mark scheme

June 2024 | 8464/C/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(molecules) made up of carbon and hydrogen (atoms only)		1	AO1 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	$C_{10}H_{22}$		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(crude oil) is heated		1	AO1 5.7.1.2
	(so some of the hydrocarbons) vaporise		1	
	the column has a temperature gradient	allow the column gets cooler going up	1	
	(so) the hydrocarbons / fractions condense at different heights / temperatures in the column **or** (and) the hydrocarbons / fractions condense at their boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$C_{14}H_{30} \rightarrow C_8H_{18} + \mathbf{2}\,C_3H_6$		1	AO2 5.1.1.1 5.7.1.4

5.1.1.2 Mixtures

Answer 21 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	add bromine (water) (bromine water) changes (from orange) to colourless	 allow (bromine water) decolourises ignore clear MP2 is dependent on MP1 being awarded	1 1	AO1 5.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	polymer	allow plastic allow hydrocarbon	1	AO1 5.2.1.4 5.7.1.4

Total Question 1	10

5.1.1.2 Mixtures

Answer 22 · Mark scheme

June 2024 | 8464/C/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	red colour is insoluble (in the solvent) (so) does not move with the solvent		1 1	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$0.87 = \frac{6.4}{\text{distance moved by solvent}}$ (distance moved by solvent =) $\frac{6.4}{0.87}$ = 7.356 = 7.4 (cm)	 allow a correctly calculated answer to 2 significant figures using the values in the question	1 1 1 1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	any **one** from: • (the two dyes) may have the same R_f value (as the blue / yellow colour) • (the two dyes) may have spots in the same place • two of the colours may be insoluble • the other colour may be white	ignore colourless	1	AO3 5.8.1.3 RPA12

5.1.1.2 Mixtures

Answer 22 · Mark scheme

June 2024 | 8464/C/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	use a different solvent		1	AO3 5.8.1.3 RPA12

Total Question 4	**8**

5.1.1.2 Mixtures

Answer 23 · Mark scheme

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	large amounts of energy required	ignore references to time and/or cost	1	AO1 5.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	reverse osmosis using membranes	ignore desalination	1 1	AO1 5.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(heat) until the mass is constant to ensure that all the water has evaporated		1 1	AO3 5.10.1.2 RPA13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(mass =) $\frac{77.8}{100} \times 3.50$ = 2.72 (g)	 allow 2.723 (g)	1 1	AO2 5.10.1.2 RPA13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	displacement using (scrap) iron electrolysis		1 1	AO1 5.10.1.4

Answer 23 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	plants are harvested and burned to produce ash (that contains metal compounds)		1 1 1	AO1 5.10.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	(area =) $\frac{750}{215}$ = 3.49 (hectares) (conversion = 3.49 × 10 000 =) 34 900 (m^2) **alternative approach** (conversion = $\frac{215}{10000}$ =) 0.0215 (kg/m^2) (1) (area =) $\frac{750}{0.0215}$ (1) = 34 900 (m^2) (1)	 allow 3.488372093 correctly rounded to at least 2 significant figures allow 3.49 × 10^4 (m^2) allow a correct conversion of an incorrectly determined area allow correct use of an incorrect conversion	1 1 1	AO2 5.10.1.4

Total Question 6	15

5.1.1.2 Mixtures

Answer 24 · Mark scheme

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(a reaction) which transfers energy to the surroundings	allow heat for energy allow (a reaction) which releases energy (to the surroundings)	1	AO1 5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(mass of oxygen = 2 × 16 =) 32		1	AO2 5.3.1.2
	(percentage =) $\frac{32}{74}$ × 100	allow correct use of an incorrectly determined mass of oxygen	1	
	= 43.2 (%)	allow 43.2432 (%) correctly rounded to at least 2 significant figures	1	

5.1.1.2 Mixtures

Answer 24 · Mark scheme

June 2025 | 8464/C/1H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 5.5.1.1 RPA10
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	

	Indicative content
	• measure volume of water
	  ○ using a measuring cylinder
	  ○ pour into a suitable container eg insulated cup
	• measure initial temperature of water
	  ○ using a thermometer
	• add known mass of calcium oxide
	  ○ measured with a balance
	  ○ stir
	• measure the highest temperature reached by the mixture
	or
	measure temperature reached after set time period
	  ○ determine the temperature change
	• repeat with different masses of calcium oxide
	or
	add successive masses to the same mixture
	• use the same volume of water
	  ○ use the same initial temperature of water
	
	for **Level 3** all key steps should be described and the control variable the same volume of water must be given		

Total Question 2	**10**

5.1.1.2 Mixtures

Answer 25 · Mark scheme

June 2025 | 8464/C/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	iron is less reactive than carbon		1	AO1 5.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the **mixture** has a lower melting point (than aluminium oxide) (so) less energy is used (to melt the electrolyte)		1 1	AO1 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$2\ O^{2-} \rightarrow O_2 + 4\ e^-$	allow multiples allow **1** mark for $O^{2-} \rightarrow O_2 + e^-$ with no / incorrect balancing numbers	2	AO2 5.4.3.3 5.4.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	Cr_2O_3 **or** chromium oxide	allow Cr^{3+} ions	1	AO2 5.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	extracting aluminium uses more energy (so costs more)		1	AO3 5.4.1.3 5.4.3.3

5.1.1.2 Mixtures

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(extracting chromium costs more because) aluminium is used in the extraction of chromium		1	AO3 5.4.1.3 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	alloys contain different sized atoms	allow alloys contain different sized (positive) ions	1	AO1 5.2.2.7
	(so the) layers are distorted		1	
	(so the) layers (of atoms) slide less easily	allow (so the) atoms cannot slide over each other	1	

Total Question 4	11

5.1.1.2 Mixtures

Answer 26 · Mark scheme

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	a mixture that has been designed as a useful product		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	91 kJ/mol		1	AO2 5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	Le Chatelier		1	AO1 5.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	the proportion of methanol decreases		1	AO2 5.6.2.4 5.6.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	the proportion of methanol stays the same		1	AO3 5.6.1.4 5.6.2.4

5.1.1.2 Mixtures

Answer 26 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(increasing the pressure) increases the proportion of methanol		1	AO2 5.6.2.4 5.6.2.7
	(because) there are more molecules / moles of reactant (than product)		1	
	(so) the equilibrium (position) shifts to the side with fewer molecules / moles		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(the catalyst) increases the rate of the reaction		1	AO1 5.6.1.4
	(by) providing an alternative pathway (for the reaction)		1	
	(with) a lower activation energy		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	reduces the costs		1	AO2 5.6.1.4 5.9.2.2
	(because) less energy is used		1	5.9.2.4
	OR			
	less fuels burned (1)			
	(so) less contribution to global warming (1)	allow (so) less carbon dioxide produced		

5.1.1.2 Mixtures

Answer 26 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.9	$CO_2 + 3\,H_2 \rightarrow CH_3OH + H_2O$	allow multiples allow **1** mark for $CO_2 + H_2 \rightarrow CH_3OH + H_2O$ with no / incorrect balancing numbers	2	AO2 5.3.1.1

Total Question 4	**15**

5.1.1.2 Mixtures

Answer 27 · Mark scheme

June 2025 | 8464/C/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	time taken (for the cross to be no longer visible)		1	AO1 5.6.1.2 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	sulfur (is produced)		1	AO2 5.2.2.2 5.6.1.2
	(which is a) solid	allow (which is) insoluble allow (which is) a precipitate	1	RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3		allow converse throughout		AO1 5.6.1.2 5.6.1.3
	increasing the concentration increases the rate of reaction		1	
	(because) there are more particles in the same volume (of solution)	allow (because) the particles are closer together do **not** accept the particles have more energy	1	
	(so) there are more frequent collisions		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	to reduce loss of gas	allow to reduce loss of hydrogen do **not** accept to stop loss of gas / hydrogen	1	AO3 5.6.1.2 RPA11

5.1.1.2 Mixtures

Answer 27 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(test) add a burning splint (result) (hydrogen burns with) a pop sound	do **not** accept glowing splint MP2 is dependent upon MP1 being awarded	1 1	AO1 5.8.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	tangent drawn at 75 s		1	AO2 5.6.1.1 RPA11
	value of *x*-step **and** *y*-step from tangent	allow evidence of use of two points on tangent either on the graph or in the text allow a tolerance of ± ½ a small square	1	
	$(\text{rate}=)\ \frac{\text{value for y-step}}{\text{value for x-step}}$	allow correct use of incorrectly determined value(s) for *x*-step and/or *y*-step from a drawn tangent	1	
	correct calculation of rate		1	

Total Question 5	13

5.1.1.2 Mixtures

Answer 01 · Examiner comments

Question 8 (standard, standard / high & high demand)

08.1 66% of students answered this question correctly. The most common incorrect answer was water.

08.2 47% of students appreciated the need for filtration or the use of a magnet. The most common incorrect responses were electrolysis, distillation, heating / evaporation or displacement using carbon.

Students need to understand the list principle. If they give two answers (one correct and one incorrect) when only one is required, no mark can be awarded. This was the case with those students who gave filter and another method that was incorrect eg simple distillation.

08.3 Students found this question tough, but it discriminated well with higher-attaining students being able to achieve four or five marks (10%). 74% of students scored zero marks.

The most common mistake found in correct calculation methods was the absence of a conversion from g to mg. Some got to 0.185 g and then stopped or converted g to mg incorrectly. Common errors were dividing by 1000 rather than multiplying by 1000 or using a factor of 10 or 100 to convert g to mg.

Stoichiometry was not well understood which resulted in students obtaining an answers of:

- 280 mg or 0.280 g due to the omission of the stoichiometric ratio (× 2/3) or
- 124 mg or 0.124 g where they had divided by 72 and multiplied by 112, and had multiplied by 2/3 as well, so they had taken the ratio into account twice.

Some students got as far as 0.12/24 or 0.12/72 and then no further. Others tried to calculate RFMs for the compounds involved and got no further and gained no marks.

08.4 The most common mark achieved was for stating that reduction was the gaining of electrons. Many students quoted OILRIG but gave an incomplete answer of ‘reduction was gain’, without stating what it was that was being gained.

Few students specifically identified the ‘reduced species’ being reduced. Some did identify iron was reduced but didn’t say which ion of iron, others gave magnesium or iron chloride.

Only a small number of students correctly wrote the half equation. 1% of students achieved two or three marks.

5.1.1.2 Mixtures

Answer 01 · Examiner comments

June 2018 | 8464/C/1H | Original Q8

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

5.1.1.2 Mixtures

Answer 02 · Examiner comments

June 2018 | 8464/C/2H | Original Q1

Question 1 (standard demand)

01.1 83% of students achieved this mark. None of the other three possible answers proved to be dominant.

01.2 79% of students achieved this mark. 'The fractions have different melting points' proved to be dominant wrong answer.

01.3 49% of students gained credit, recognising the alkane to be propane. Most popular incorrect answer was butane. Some students gave a formula even though the question asked for the name of the alkane.

01.4 The correct answer of C_nH_{2n+2} was the most commonly selected response by students (77%) although C_nH_{2n} proved to be the most effective distractor.

01.5 56% of students successfully balanced equation for the combustion of methane. Multiples were regularly seen, and credit accordingly given.

01.6 The correct answer of bromine water was chosen by 67% of students. Anhydrous copper sulfate proved to be the most effective distractor.

01.7 28% of students knew the definition from the specification or were able to give an equivalent statement. A large number of vague incorrect responses were seen encompassing issues such as pollution, sustainability, energy and carbon footprint.

5.1.1.2 Mixtures

Answer 02 · Examiner comments June 2018 | 8464/C/2H | Original Q1

01.8 In this 'extended response' question students were asked to compare the two methods for the disposal of biodegradable plastic bags using information given in Table 1.

26% of students gained full marks on this question and a further 38% of students achieved marks at level 2. To access level 2, students were expected to 'note the magnitude' of the differences, as stated in the generic level descriptor in the mark scheme.

17% of students achieved marks in level 1 by giving some comparisons of the gases and residue either in qualitative terms or by quoting values from Table 1.

The least creditworthy responses discussed in general terms the effect on the environment of burning waste plastic or the benefits of burning plastic bags to generate electricity. Students writing these responses made little reference to the information in Table 1 and many of these students ignored the key command word, 'Compare'. However, the higher-attaining students had logically worked their way down the information in Table 1, comparing and calculating differences when constructing their answer.

5.1.1.2 Mixtures

Answer 03 · Examiner comments

June 2019 | 8464/C/1H | Original Q5

Question 5

As well as an increase in demand through each question in the paper, there was a ramping of demand in this question from standard/high demand to high demand.

05.1 A fifth of students were able to give the reason that electrolysis was used when a metal was more reactive than carbon. Many answers were too vague in terms of metals being reactive, rather than including the comparison with carbon. It was very rare to see a response showing that a student knew that some metals might react with carbon.

05.2 Students found this question challenging. Cryolite was usually the answer that gained one mark. Very few students gave two-mark answers. The most common incorrect responses mentioned a wide variety of elements including the products of electrolysis ‘aluminium’ and ‘oxygen’.

05.3 This high demand question discriminated very well. Students should recognise that electrons are negatively charged. To balance ‘charges’, electrons need to be added as a reactant in the first equation and are produced as a product in the second; the negative charge on the electron must be shown. The first equation was more successfully attempted than the second. Symbols should always have the second letter as lower case.

05.4 Many students answered for a standard yield type question without considering the circumstances of the experiment. Common non-creditworthy responses included:

- not all reacted
- some lost as a gas
- unexpected products formed.

Many thought the electrode being made from copper would affect the mass measured. A number questioned the power supply without specifying voltage or current.

05.5 This question was very well answered with more than two-thirds of students scoring all 3 marks. There were 2 common approaches to this question. Many students read the mass and scaled up. A mass of 5.4g at 30 minutes was a common starting point, which resulted in an answer of 259 mg. A tolerance was allowed reading the graph which led to a range of

5.1.1.2 Mixtures

Answer 03 · Examiner comments June 2019 | 8464/C/1H | Original Q5

results, which was narrower at longer initial times. Others calculated the gradient (0.18) and then used this value to determine the mass after 24 hours. Students used many variations of both methods to obtain a valid and correct answer. A common error was to misread the graph (e.g. mass of 5.2 g at 30 minutes); 2 of the remaining 3 marks were awarded for a subsequent correct evaluation.

05.6 Over three-quarters of students were able to determine the mass of the electrode from the graph.

05.7 This question was well answered and discriminated well. The increases in Y and X were usually calculated correctly. However, a small number of students then inverted the values when calculating the gradient. Some did not evaluate the calculation giving an answer for the gradient as 1/5 for example. The unit mark was generally correct.

Answer 04 · Examiner comments June 2019 | 8464/C/2H | Original Q3

Question 3 (standard/high demand)

03.1 A minority of students knew the definition of a formulation from the specification or were able to give an equivalent statement. Often students mentioned that it was ‘a mixture’ or ‘chemicals mixed together’ but omitted the idea of ‘to form a useful product’. Some students were able to give examples, but not a definition.

03.2 A large number of students did not explain how chromatography separates the dye. Instead they explained in detail how a chromatography experiment would be undertaken to separate the dyes.

Just over a third of students gained some credit, mostly for the idea that different dyes had different solubilities. A significant number of students incorrectly stated the reason was related to the densities of the dyes. The second marking point was for conveying the idea that the different dyes travel up the chromatography paper at different rates/speeds or distances. However, there were many vague responses referring to different points or places.

5.1.1.2 Mixtures

Answer 04 · Examiner comments June 2019 | 8464/C/2H | Original Q3

03.3 The majority of students gained at least one mark but only a small minority gained both marks. Responses referred to the food colouring separating into more than one colour/spot/dot on the chromatogram but rarely indicated that these colours/spots would appear vertically above the original dye. Some students described how it was possible to identify the colours separated by 'matching them against other colours', which was not asked for in the question.

03.4 Many students failed to gain the first marking point due to not elaborating on 'do the chromatography experiment' rather than explain (as requested by the command word) how to conduct the experiment.

Students gained credit for stating that the distances travelled needed to be measured or the R_f values calculated, but then omitted to state how these values could be used to either confirm the identity of the unknown dyes or identify which dyes remained unidentified.

Answer 10 · Examiner comments November 2021 | 8464/C/1H | Original Q2

Question 2 (standard demand)

02.1 Just under half of students correctly choose 'green to red' as the colour change observed when nitric acid is added to a mixture of universal indicator and water.

02.2 Just over one half of students knew that the pH of water decreases when nitric acid was added.

5.1.1.2 Mixtures

Answer 10 · Examiner comments November 2021 | 8464/C/1H | Original Q2

02.3 Few students were able to give (aq) as the state for a substance dissolved in water.

02.4 The required practical activity of making a soluble salt starts by reacting either an insoluble metal oxide or metal carbonate with an acid. The word equation was provided to help students with this question although many students found difficulty in making links between this and the resulting observations. Since carbon dioxide is produced, initial observations would be fizzing and white solid disappearing. Excess zinc carbonate would result in all the nitric acid reacting; fizzing would stop and excess solid would collect at the bottom. Very few students scored two marks.

02.5 Students found difficulty in determining the formula for zinc nitrate. Just over one third of students gained the mark.

02.6 Students had difficulty in describing the essential steps of the required practical activity of making a soluble salt from an insoluble metal oxide and an acid. Many failed to select the correct chemicals, copper oxide and hydrochloric acid; without these the method would not lead to a valid outcome. Very few students got into level three. Approximately four fifths of students produced a level one answer.

Answer 11 · Examiner comments November 2021 | 8464/C/1H | Original Q7

Question 7 (standard / high and high demand)

07.1 One mark was gained by approximately one fifth of students, usually for stating that particles collide. Very few appreciated that at room temperature the particles had insufficient energy to react.

07.2 Approximately two thirds of students gained this mark. They were able to deduce the trend in increase of energy released as the number of carbon atoms increased.

Answer 11 · Examiner comments

November 2021 | 8464/C/1H | Original Q7

07.3 Approximately one third of students were able to score at least one mark but only a small number scored all five marks. Students had to calculate the energy required to break all bonds and also the energy released when all bonds are formed. However, many made mistakes in these calculations. Few then were able to subsequently evaluate the difference in bonds broken (including the two C-C bonds), bonds made, and the energy released (1640 kJ/mol).

Concluding Remarks

The demand of this paper was similar to those previously set for this specification. Students should note that two-mark questions, for example, require two answer points.

15% of marks are based upon the required practical activities; students should question 'what and why' is happening in each step of these procedures. Answers should be chemically accurate, e.g. crystals are produced from salt solutions when the solution is heated (partially evaporated to produce a more concentrated solution) and then left to crystallise, rather than implying that 'all the water was evaporated'.

In chemistry 20% are marks are for questions assessing mathematical skills. In these questions, students should show their working for each step. If an error is made, such as an incorrect evaluation of values in the question, credit is awarded for each correct step shown. In **01.5** not all students used all the data provided to evaluate the relative atomic mass, a weighted mean of the mass numbers. In **04.4** most students calculated the percentage and mass of the other elements. Fewer were able to use the ratio of percentages to evaluate the mass of iron. In **06.4** students found difficulty in converting moles to a formula or to simple whole number ratios in equations. In **07.3** the displayed formula was provided to help students calculate the energy required to break all the bonds and the energy released when all the bonds are formed. Many failed to link the energy released as the difference in bonds broken (including the two C-C bonds) and bonds made.

5.1.1.2 Mixtures

Answer 11 · Examiner comments

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

5.1.1.2 Mixtures

Answer 12 · Examiner comments November 2021 | 8464/C/2H | Original Q3

Question 3 (standard, standard / high and high demand)

It is insufficient to simply state that a pure substance is only made up of one type of substance. Answers need to indicate that it is a single element or compound.

The principles of distillation were well known. Many students successfully described how water could be separated from the solution but often did not go on to explain how the water vapour was changed into a liquid. Cooling of the water vapour to bring about condensation was rarely seen. Many students did not link question 03.4 with question 03.5 to explain why obtaining potable water from salty water is more expensive than from ground water. No credit was given the latter being an easier process or taking less time. Some students were able to recognise that costs were linked to energy consumption. Ground water needed to be both filtered and sterilised to gain the second marking point in question 03.5

Answer 13 · Examiner comments

November 2021 | 8464/C/2H | Original Q6

Question 6 (standard / high and high demand)

Students have a good understanding of what catalysts are and what they do, but they failed to explain how they work and instead gave a list of features of catalysts. Some students recognised that the activation energy was lowered but that this was achieved by following an alternative pathway was rarely seen.

Likewise, students were able to successfully apply Le Chatelier's Principle to an equilibrium but were unable to explain those changes.

A common misconception is that the quantities of reactants and products are equal rather than the rates of the forward and the backward reactions. That catalysts speed up both of these rates equally was rarely seen. Students tended to describe the action of a catalyst but then failed to address the question of their effect upon the equilibrium position, for which they gained no credit.

Concluding Remarks

The demand of this paper was similar to that of papers set for this specification in previous series.

Students scored well on questions involving the use of data and knowledge of atmospheric pollution. They are advised to look at the number of marks allocated. If the question is asking to describe a trend in a graph, comments are not only required for the general trend but also the rate of change.

A range of methods were used to answer the mathematical questions. Students are always advised to show working - credit can be gained for correct working in the event that the final answer given is not correct. They should also take careful note of any additional instructions. In question 04.6, the final mark was often not gained as the answer was not given to 3 significant figures.

Practical work is at the heart of the specification. The importance of the use of variables in experiments is paramount. In question 02.1, when identifying control variables, students should refer back to the method provided where in this instance the volume of hydrochloric acid was given. Many answers referred to the "amount" of acid or metal which is insufficient to gain credit, likewise, adding a "piece" of magnesium which does not indicate that either the length or mass has been controlled. Reading through the method will also reveal what is being changed in subsequent repeats as the independent variable.

In questions, such as 02.3, where comparisons are to be made from given data, students should be encouraged to answer accordingly using a comparative and not rewrite the information that is provided without elaboration - this does not gain any credit as the student has not added any value to their answer. Some excellent answers were seen where the students expanded upon the data, for example, to explain why the molecules had different melting and boiling points or to explain how the length of the hydrocarbon chain was linked to a trend in physical properties, such as flammability.

5.1.1.2 Mixtures

Answer 13 · Examiner comments

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

5.1.1.2 Mixtures

Answer 14 · Examiner comments — June 2022 | 8464/C/2H | Original Q1

Question 1

This Required Practical Activity is a familiar context on examination papers and most students were able to make some progress.

01.1 Often students gave solutions as opposed to the problems the errors would lead to. The start line being drawn in ink was the most common correct response, however, the problems encountered were often vague such as the experiment would not work. Nearly 95% of students gained at least 1 mark, with over 1 in 5 gaining all 4 marks.

Answer 14 · Examiner comments — June 2022 | 8464/C/2H | Original Q1

01.2 Conclusions were often poorly expressed or incomplete. The conclusion needed to be in terms of what was in brown ink. Common incorrect responses referred to the amount of a colour being linked to where it is found on a chromatogram.

01.3 Just over 90% of students were able to identify that the green colour was insoluble in the solvent.

01.4 The calculation of the R_f value relied on the skill that students were able to rearrange the given equation which was successfully achieved by nearly 80% of students. Where an incorrect answer was obtained, no further credit was given when there was no working. Students should be encouraged to show their working in calculations so that appropriate credit can be awarded if a final answer is not given or is incorrect.

5.1.1.2 Mixtures

Answer 15 · Examiner comments

June 2023 | 8464/C/1H | Original Q6

Question 6 (standard/high and high demand)

06.1 Students found difficulty in describing how to obtain magnesium chloride from the reaction solution. Just over one third of students gained at least one mark. A number of students did not filter out the excess magnesium before crystallising the solution and many referred to magnesium displacing hydrogen.

06.2 A common response was that magnesium displaces the hydrogen without any explanation; many students did not appreciate that this is a redox reaction. Students should realise that metals always undergo oxidation which can be related to dot and cross diagrams in ionic bonding. In this question identifying what is oxidised (ie the metal) is easier than identifying what is reduced ie H+ ion (not hydrogen). Magnesium is oxidised during the reaction with hydrochloric acid as magnesium atoms lose two electrons. Students found it challenging to describe what happens to the magnesium atoms with only a quarter gaining more than one mark. Many students who stated that magnesium atoms were oxidised then went on to state it was because they gained oxygen. A common mistake was to say that atoms (not electrons) were lost.

06.3 Students found this calculation challenging but the question proved to be a good discriminator. A third of students gained at least one mark for initially calculating the number of moles of magnesium. About 20% went on to calculate the mass of magnesium chloride produced as 2.85 grams. Only a small percentage of students then went on to determine the concentration of the magnesium chloride solution produced; students struggled with the conversion of 100 cm^3 into dm^3 so a wide variety of answers were seen where a mass of 2.85 grams had been multiplied by ‘some factor of 10’.

5.1.1.2 Mixtures

Answer 16 · Examiner comments June 2023 | 8464/C/2H | Original Q1

Question 1

01.1 Four in five students successfully balanced the equation.

01.2 Just over two in five students gained both marks for comparing petrol and diesel. A further third gained one mark. On this occasion, students needed to interpret what the table headings meant, so many weren't able to gain credit as they referred to the range of numbers of carbons, rather than the number of carbons and similarly, though more infrequent, for the boiling points.

01.3 Nearly nine in ten students identified oxygen as the common element in the compounds released from a car engine.

01.4 Just over a third of students were able to identify that nitrogen came from the air. Much more common suggestions were from the engine or the diesel fuel.

01.5 This question tested a little known part of the specification, with fewer than a quarter identifying global dimming as a consequence of particulates in the atmosphere. By far the most common incorrect response was for global warming.

01.6 Just below three quarters of students answered that carbon monoxide is either colourless or odourless. Many students gave both, despite being asked for one.

Answer 16 · Examiner comments June 2023 | 8464/C/2H | Original Q1

01.7 Around one in ten gained two marks on this question, with a further quarter gaining one. The question was applying ideas from across the specification. Just a statement that water evaporates was insufficient for credit, as there needed to be a realisation that water is produced as a vapour, rather than turning into a vapour during the process.

01.8 Around half of students gained at least one mark on this question, usually for recognising that sulfur is responsible for acid rain. The consequences of acid rain were known by about a quarter, however, around than one in ten knew that sulfur enters the atmosphere as sulfur dioxide and so gained all marks. Again, global warming was the most common incorrect response here.

5.1.1.2 Mixtures

Answer 17 · Examiner comments

June 2023 | 8464/C/2H | Original Q2

Question 2

02.1 Nearly nine in ten students knew that the stationary phase was the other phase in chromatography.

02.2 Approximately one in five students knew that separation of inks in chromatography was due to either a difference in solubility or different attractions for the paper. Many students thought that the separation was dependent on melting point, concentration, density, or formula mass.

02.3 Just under three quarters were able to deduce that there would be one spot. Lots of random numbers were seen for this question, with little pattern.

02.4 Just under three quarters of students were able to correctly calculate the R_f from the values given. There were examples of multiplying the numbers, subtracting them, or dividing them upside down.

02.5 Students were asked to plan an experiment using paper chromatography to separate the colours in black ink and to subsequently identify the colours from their R_f values.

To access level 3, which was done by around two in five students, the plan needed to lead to a valid outcome. This required students to identify the key steps in the indicative content. Students were able to explain how to determine the R_f values but few recognised that the values needed to be compared to known R_f values and how this should be done.

To access level 2, which was done by nearly half of students, the method did not necessarily lead to a valid outcome. Common mistakes included the idea that the pencil line should be submerged in the solvent and that the experiment should be left for too long, for example until the ink reached the top of the paper.

Common weaker responses usually gained credit for identifying that the line needed to be drawn in pencil.

5.1.1.2 Mixtures

Answer 18 · Examiner comments

June 2023 | 8464/C/2H | Original Q3

Question 3

03.1 This question required an application of the definition of a formulation, which students found difficulty with. Only a quarter of students gained at least one mark, usually for the idea that a formulation is made for a specific purpose. Few went on to give the idea that crude oil has a variable composition.

03.2 The steps in fractional distillation were not well known and often produced muddled sequencing. Two thirds of students gained at least one mark, usually for the idea that fractions have different boiling points (though some referred to melting points). Fewer than two in five went on with further descriptions, and one in five gained either three or four marks.

03.3 About one third of students gained two marks, with a further one in five getting one mark. This was usually for the idea that cracking produces smaller molecules. A specific use such as fuels or as a starting material for making polymers was credited for the second mark, whilst many students said that smaller molecules were more useful, were more in demand, or had more uses, all of which were creditworthy.

03.4 About half of students were able to describe the test for hydrogen, which had to be identified from the given equation. The gas tests are not well known and need to be learnt, so that they are expressed clearly.

03.5 Four in five students correctly identified the alkene.

Answer 19 · Examiner comments

June 2024 | 8464/C/1H | Original Q1

Question 1 (standard demand)

01.1 Nearly three-quarters of students scored at least 1 mark. The graph showed that the mass of copper produced each year slowly increased from 1900 to 1930 and then rapidly increased until 2010. Students were asked to give two conclusions, so statements that merely quoted numerical values and years from the graph or made predictions of the future were insufficient.

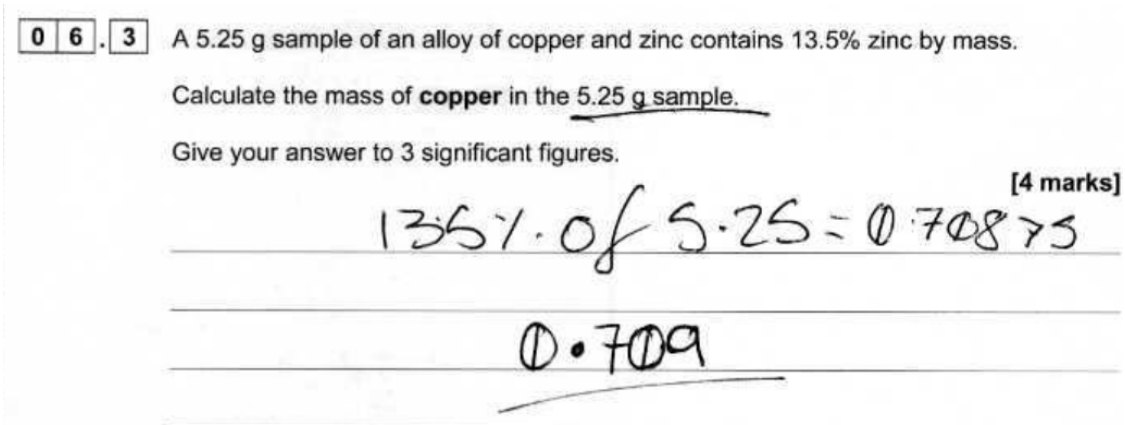
Non-creditworthy responses referred to use or demand of copper or involved incorrect readings, for example 'rapid increase from 1950' (rather than from 1925 to 1930) was common.

01.2 Students should know that metals are soft so are mixed with other metals to make alloys, which are harder. A diagram representing the structures of pure copper and of an alloy of copper and zinc was given that showed larger zinc atoms disrupting the layers of atoms in the alloy, thus the layers of atoms cannot easily slide. Some students did not read the question carefully and talked about copper rather than the alloy.

Just under half of students gained 1 mark or more and approximately a quarter of students scored 2 marks or more. Those who gained a mark usually referred to the difference in the sizes of the atoms and the second most common mark was for layers not being able to slide. The diagram showed that the layers are distorted in the alloy compared to the pure metal but this marking point was less frequently given.

01.3 In this calculation students were told that the alloy contains 13.5% zinc by mass and were asked to calculate the mass of copper in the alloy. As always there are a number of approaches students took and those who showed their working often gained credit even after making errors. In the calculation working with an accompanying percentage sign, such as 13.5% or 86.5% are considered to be equivalent to 13.5 ÷ 100 and 86.5 ÷ 100 respectively eg 13.5% of 5.25 gains marking point 1 in the second method.

Nearly two-thirds of students scored 4 marks. Those who only gained 3 marks either failed to round their answer to 3 significant figures or determined the mass of zinc rather than the mass of copper.



This response (from a Foundation tier paper) used mark scheme method 2. The student correctly determined the mass of zinc to 3 significant figures but did not subtract this from the mass of the sample. They achieved marking points 1, 2 and 4 so scored 3 of the 4 marks.

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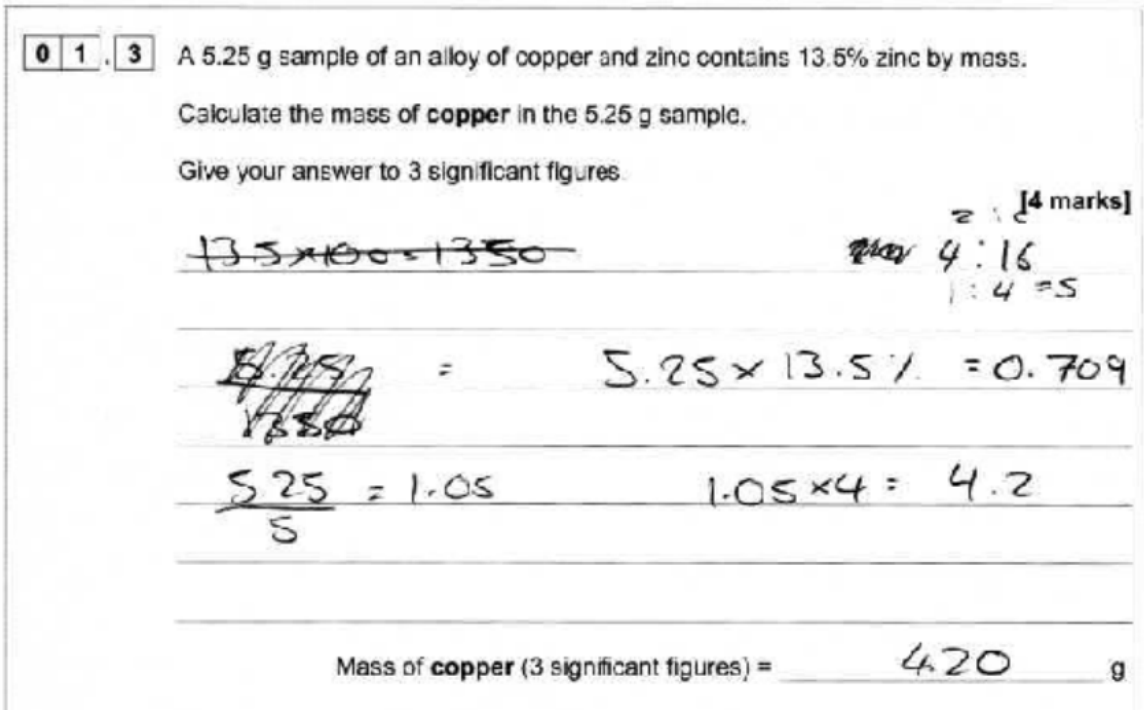
5.1.1.2 Mixtures

Answer 19 · Examiner comments

June 2024 | 8464/C/1H | Original Q1



0 1 . 3 A 5.25 g sample of an alloy of copper and zinc contains 13.5% zinc by mass.

Calculate the mass of **copper** in the 5.25 g sample.

Give your answer to 3 significant figures.

[4 marks]

~~13.5×100=1350~~ 4 : 16

1 : 4 = 5

~~5.25/1350~~ = 5.25 × 13.5% = 0.709

$\frac{5.25}{5}$ = 1.05 1.05×4 = 4.2

Mass of **copper** (3 significant figures) = 4.20 g

This response (from a Higher tier paper) has several different methods in the answer box. Initially the student might gain marking points 1, 2 and 4 from method 2 (as the previous example did). However, the student then gives a totally different method which gives the answer on the answer line and this is the one that takes precedence so the method attached to this is the one that is marked. Although 4.20 is correctly rounded to 3 significant figures it does not come from a calculation using all values in the question (ie 13.5% has not been used) so gains no credit.

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Answer 20 · Examiner comments

Question 4 (standard & standard/high demand)

04.1 Many students stated that strong acids completely ionise but omitted to include that this happens in water or in aqueous solution. 10% of students gave the correct definition.

04.2 Less than 5% of students gave a correct explanation for 'dilute aqueous solution'. Very few students made reference to being dissolved in water or used the term (low) concentration.

Common incorrect responses made reference to reducing the concentration of the acid or stating that there would be a small volume of acid per unit volume or small volume of acid in aqueous solution. A number of students stated that a high concentration of substance/acid had been dissolved.

04.3 This question proved challenging. To deduce the change in the hydrogen ion concentration students need to know that as the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10. A third of students gained the mark with approximately equal numbers choosing the alternative responses.

04.4 Nearly one-fifth of students were able to recall an ionic equation to represent the neutralisation between an acid and an alkali. This question had the highest not attempted rate at 12.5%, which was nearly double that of any other question. A common response was 'acid + alkali → salt' suggesting that students were not familiar with the ions present in acid or alkaline solutions or that this involved neutralisation to produce water.

04.5 Most students were able to deduce the correct ratio of moles from the equation. The most common distractor was 2:1 where the correct ratio was reversed.

04.6 Just over half of students recognised that universal indicator would turn red in the acidic solution produced when magnesium carbonate and excess nitric acid were reacted. Green was the most common distractor which was not correct as excess acid was used in the reaction.

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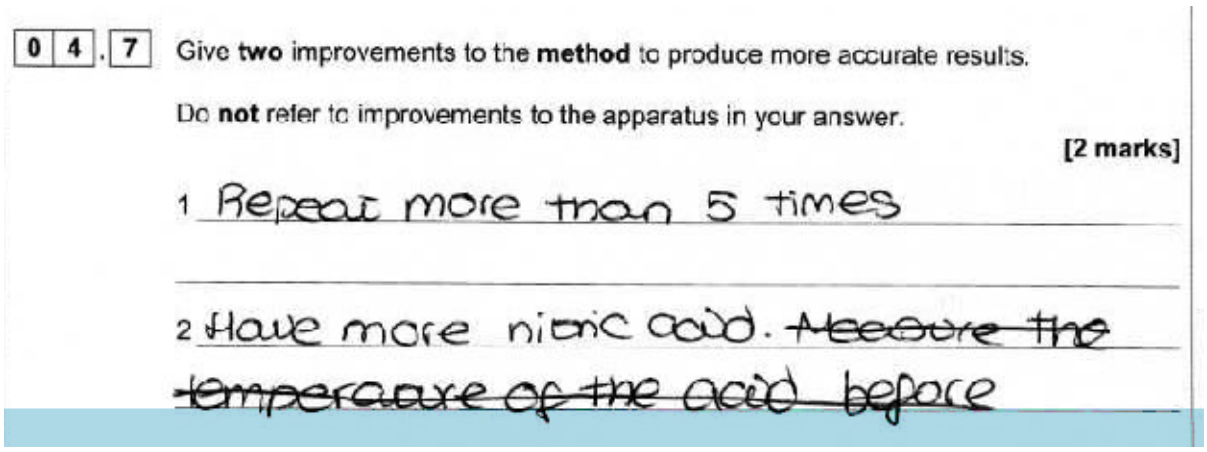
5.1.1.2 Mixtures

Answer 20 · Examiner comments June 2024 | 8464/C/1H | Original Q4

04.7 This question required improvements to the method, so references to changing the volume or concentration of solution were insufficient. Many students wrote that the experiment should be repeated but to be creditworthy they needed to include that the mean should be calculated. 'Measuring until the temperature stopped increasing' was taken as equivalent to 'measure the highest temperature'. However, 'measuring until the temperature is constant' is insufficient as this may not be the highest temperature or the mixture may have cooled to room temperature.

Just under a quarter of students gained 1 mark and 1% gained 2 marks.


0 4 . 7 Give **two** improvements to the **method** to produce more accurate results.

Do **not** refer to improvements to the apparatus in your answer.

[2 marks]

1 Repeat more than 5 times

2 Have more nitric acid. ~~Measure the temperature of the acid before~~

This student did not gain any credit: repeating the experiment on its own is insufficient as the mean is not calculated (after anomalous results are discarded).

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Answer 21 · Examiner comments

Question 1 (standard demand)

01.1 About two thirds of students knew the definition of a hydrocarbon. Those who did not achieve the mark often used words such as 'atom' or 'mixture' instead of compound so were not credited. Similarly, students who gave answers in terms of carbon or hydrogen molecules (instead of atoms) were not given any marks.

01.2 Three-quarters of students achieved the mark for correctly determining the formula of decane. The most common incorrect response was $C_{10}H_{20+2}$.

01.3 This question has typically been targeted at high demand in previous years. However, this year it was set at standard demand, with the diagram containing more detail and the mark scheme for loosened a little to separate the first two marking points. Nearly all students on this tier were able to start the explanation of fractional distillation.

Four marks were available for this question. Most students who gained 1 mark did so for correctly identifying that the crude oil is heated. Some students indicated that the crude oil was heated once it was in the fractional distillation column itself, which was not creditworthy. Fewer students were able to explain that some of the hydrocarbons were vaporised/evaporated/boiled or turned into a gas for marking point 2. A third of students explained that there was a temperature gradient in the column. This could have been explained as a comparative statement, for example, the column is cooler at the top or by using sensible temperature values. Some students were able to explain that the hydrocarbons/fractions condensed or were able to give a clear description of condensation at different heights in the column or at different temperatures.

The most common responses that gained no marks referred to the different sizes and boiling points of the hydrocarbons/fractions.

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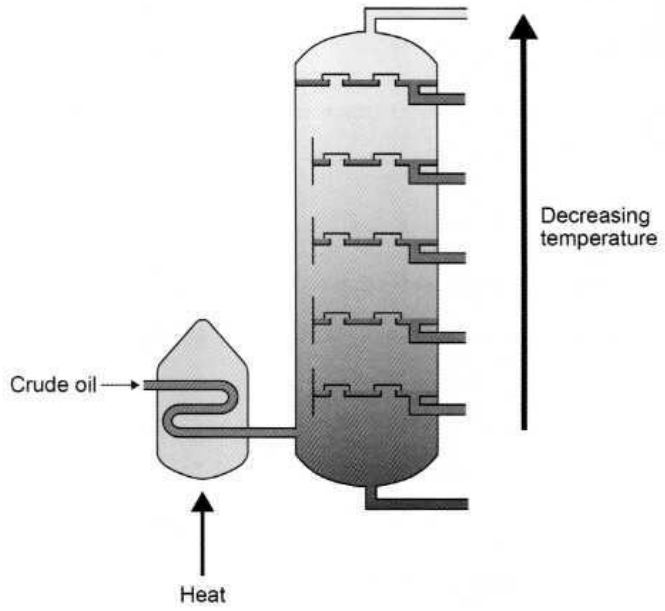
5.1.1.2 Mixtures

Answer 21 · Examiner comments

0 1 . 3 Crude oil is a mixture of hydrocarbons.

Figure 1 represents industrial equipment used to separate crude oil into fractions.

Figure 1



Explain how crude oil is separated into fractions.

Use **Figure 1**.

[4 marks]

firstly, crude oil is heated until evaporated. Each fractions has different boiling points. The longer hydrocarbons reaches to the bottom fractions as they have very high boiling points, so the small hydrocarbons reaches the top fractions as they have low boiling points, so then at each fraction these condense.

This response gains the first two marking points in the first line. The student then describes the lengths of the hydrocarbons but the language used is very muddled, and is suggesting that the different heights in the column are the fractions. Because of this the mention of 'condense' is insufficient as it is linked to an incorrect interpretation of fraction. No further marks are gained.

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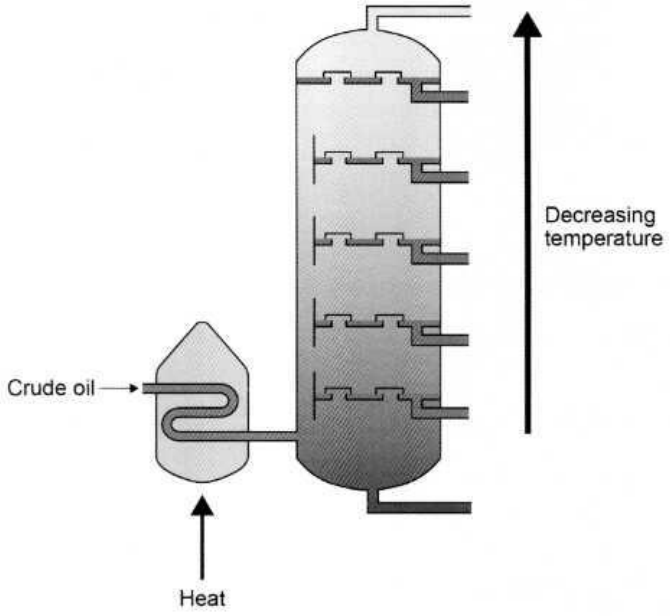
5.1.1.2 Mixtures

Answer 21 · Examiner comments June 2024 | 8464/C/2H | Original Q1

0 1 . 3 Crude oil is a mixture of hydrocarbons.

Figure 1 represents industrial equipment used to separate crude oil into fractions.

Figure 1



Explain how crude oil is separated into fractions.

Use **Figure 1**.

[4 marks]

Crude oil is a mixture of different hydrocarbons with different boiling points. First the crude oil is heated to a very high temperature to ~~extract~~ completely vaporise it, then its passed into a fractionating column which is hottest at the bottom, and coolest at the top. This means ~~hydrocarbons will continue~~ the gaseous hydrocarbons will rise until the temperature reaches the boiling point, causing them to ~~do~~ condense and collect in the trays. This means ~~crud~~ boiling point is used to seperate Crude oil into fractions

There is nothing creditworthy in the first sentence. Marking points 1 and 2 are gained in the second sentence. The student then goes on to describe the temperature gradient on line 5: '… hottest at the bottom, and coolest at the top' for marking point 3. The description of the gaseous hydrocarbons condensing their boiling points is sufficient for marking point 4.

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5.1.1.2 Mixtures

Answer 21 · Examiner comments June 2024 | 8464/C/2H | Original Q1

01.4 Most students correctly balanced the cracking equation.

01.5 Students find the recall of chemical tests challenging, with fewer than half of students gaining both marks on the test for an alkene.

01.6 Fewer than 20% of students applied their knowledge from paper 1 and the scaffolding provided to correctly identify the structure as a polymer, with the mark scheme also allowing hydrocarbon as an answer.

Answer 22 · Examiner comments June 2024 | 8464/C/2H | Original Q4

Question 4 (standard/high demand)

04.1 Although about 40% of students gained 1 or more marks it was rare to see the two marking points together; a tenth of students gained 2 marks. Many students simply repeated the question by stating the red ink did not move: the phrase 'with the solvent' was conspicuous by its absence. Insoluble was the most often seen correct answer. Incorrect explanations included 'too heavy', 'too strong', 'a pure colour', 'unreactive', 'least soluble' and 'not soluble enough'.

04.2 This question was well answered, with just over half of students gaining full marks. The most challenging step was the correct rearrangement of the equation.

04.3 Fewer than 1 in 5 students correctly answered this question. Very few students referred to the colours having the same R_f value. Several students answered in terms of primary colours; or of one of the inks being insoluble, when of course it had to be two of the inks, not just one. Many answers related simply to the diagram rather than showing an understanding of the principles of chromatography.

04.4 Over 80% of students were not able to gain a mark for this question. There was a wide variety of suggestions for changes in the experiment: almost everything in the experiment other than the solvent. Often specificity of language stopped students gaining the mark, as 'stronger solvent' 'weaker solvent', 'more solvent' and 'less solvent' were common, none of which were creditworthy. The ink, the colour of paper, leave for longer and use longer paper were also common incorrect responses.

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Answer 23 · Examiner comments

Question 6 (standard/high & high demand)

06.1 About a quarter of students answered this question correctly. The most common incorrect responses included 'expensive' and 'time consuming'.

06.2 Methods for producing potable water from seawater were not well known.

Few students gave a creditworthy response in this question. By far the most common incorrect responses were a description of filtration or evaporation of the water followed by condensation, a repetition of the method given in question 06.1.

The few students who gave creditworthy responses clearly understood the process of reverse osmosis well and gained both marking points.

06.3 Very few students gained full credit in this question. A common misconception was that the question was asking why any chemical experiment should be repeated. The most common incorrect responses focused on reliability and repeating to find a mean.

Of the responses that did gain credit marking point 1 was achieved most often. Very few students appreciated the idea of heating to constant mass.

06.4 Students approached this question very well, using a variety of methods. Incorrect rounding was uncommon but was the main reason why marking point 2 was not gained following a correct calculation.

06.5 Many students recognised that electrolysis was a suitable method for extracting copper. However, further methods were not well known. Very few gained marking point 1. Those that did state displacement often gave an insufficient answer, not including that this process uses iron or giving an incorrect element such as carbon.

The most common incorrect responses were phytomining and bioleaching.

06.6 A large number of students had good knowledge of the process of phytomining, often gaining 2 of the 3 marks available in this question. Many students spent some time talking about the planting and absorption of the metal ions before getting to the creditworthy aspects of their response or in fact not getting to it at all and therefore not gaining the marks available.

'Burning' was the most common mark point gained. Many students forgot to include that the plants must first be harvested (marking point 1) and some missed marking point 3 by stating that the ashes contained the metal rather than the metal compound.

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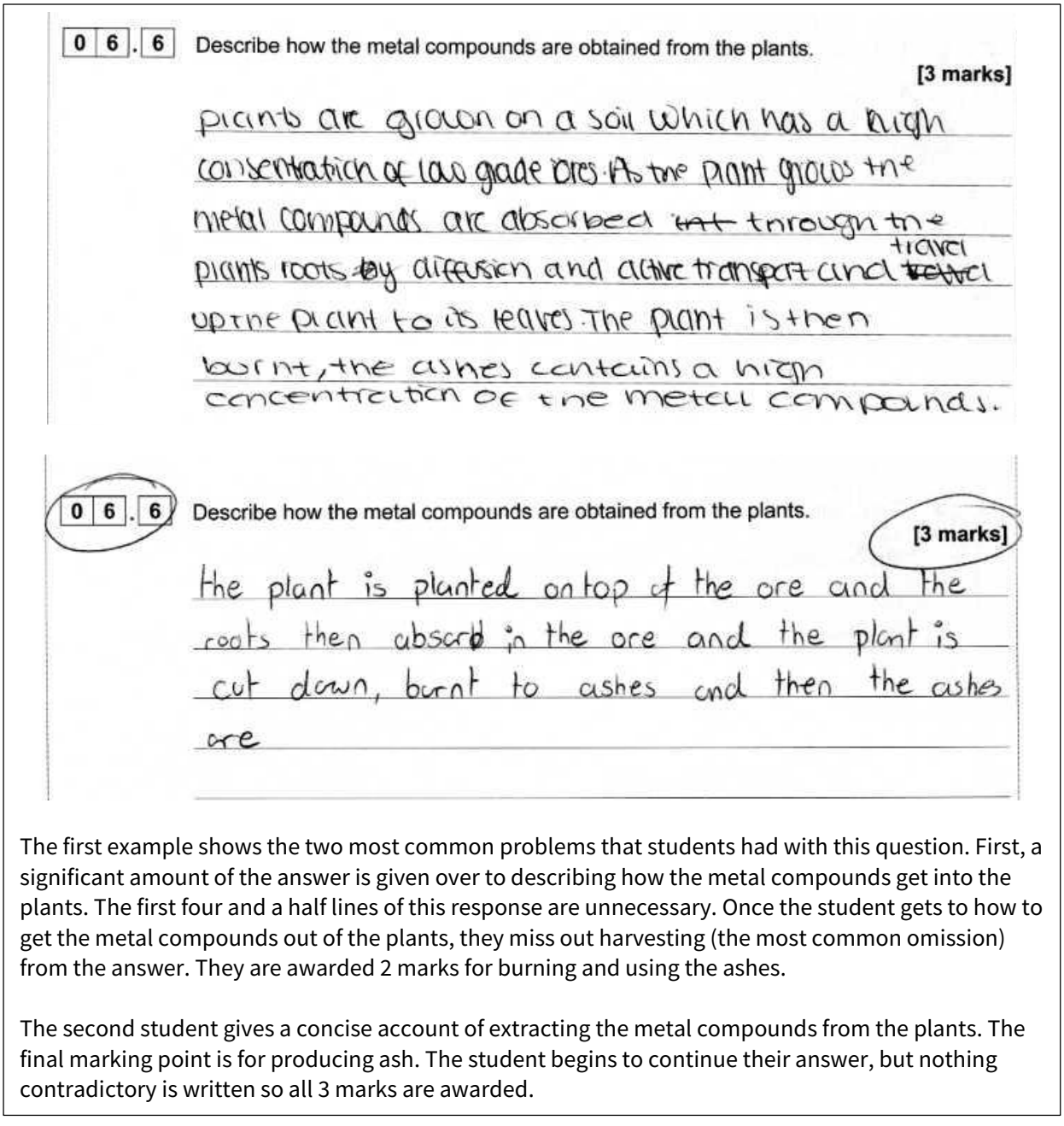
5.1.1.2 Mixtures

Answer 23 · Examiner comments June 2024 | 8464/C/2H | Original Q6



0 6 . 6 Describe how the metal compounds are obtained from the plants. [3 marks]

plants are grown on a soil which has a high concentration of low grade ores. As the plant grows the metal compounds are absorbed ~~int~~ through the plants roots by diffusion and active transport and travel ~~travel~~ up the plant to its leaves. The plant is then burnt, the ashes contains a high concentration of the metal compounds.

0 6 . 6 Describe how the metal compounds are obtained from the plants. [3 marks]

the plant is planted on top of the ore and the roots then absorb in the ore and the plant is cut down, burnt to ashes and then the ashes are

The first example shows the two most common problems that students had with this question. First, a significant amount of the answer is given over to describing how the metal compounds get into the plants. The first four and a half lines of this response are unnecessary. Once the student gets to how to get the metal compounds out of the plants, they miss out harvesting (the most common omission) from the answer. They are awarded 2 marks for burning and using the ashes.

The second student gives a concise account of extracting the metal compounds from the plants. The final marking point is for producing ash. The student begins to continue their answer, but nothing contradictory is written so all 3 marks are awarded.

06.7 Students approached this question very well, with over three-quarters gaining full credit. Of those who incorrectly calculated the area, many were still able to gain marking point 3 by carrying out a correct conversion.

Many students did not achieve full marks due to rounding too soon in their calculation. Although rounding errors are not taken into account until the final answer, if a solution is rounded too soon the answer is incorrect, so full marks cannot be awarded. Students should be encouraged to keep values in calculators for multi-step calculations so unnecessarily missing out on marks can be avoided.

A number of different methods were seen during marking that were not on the mark scheme. However, a correct answer was given full credit.

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5.1.1.2 Mixtures

Answer 23 · Examiner comments June 2024 | 8464/C/2H | Original Q6

0 6 . 7 Nickel is produced by phytomining.

One hectare of plants produces 215 kg of nickel.

Determine the area required to produce 750 kg of nickel.

Give your answer in m^2.

One hectare = 10 000 m^2

[3 marks]

$750 \div 215 = 3.48$

$\times 10,000 = 34,800\ m^2$

Area required = 34,800 m^2

0 6 . 7 Nickel is produced by phytomining.

One hectare of plants produces 215 kg of nickel.

Determine the area required to produce 750 kg of nickel.

Give your answer in m^2.

One hectare = 10 000 m^2

[3 marks]

$10,000\ m^2 = 215\ kg$

$10\,000 / 215 = 46.51$

$46.51 \times 750 = 34,882.5$

Area required = 34,882.5 m^2

In the first example, the student has rounded incorrectly, so even though the method is correct, full marks cannot be awarded because the answer is incorrect.

The second example shows an alternative to the methods on the mark scheme. The student has calculated the area required to obtain 1 kg of nickel and used the answer to calculate the total area required for 750 kg of nickel. However, the student has rounded too early in the calculation, meaning that the final answer is incorrect: 2 marks were awarded in this case.

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5.1.1.2 Mixtures

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

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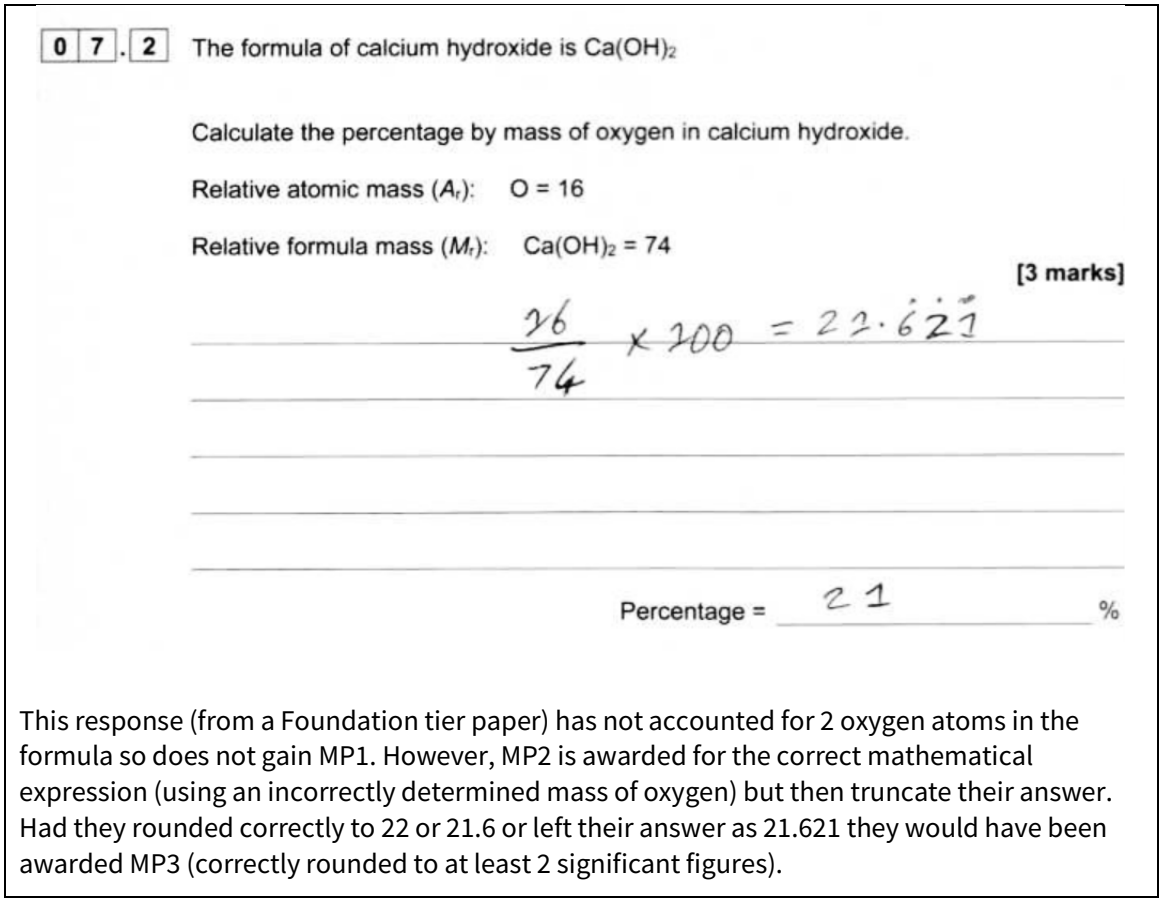
Answer 24 · Examiner comments

June 2025 | 8464/C/1H | Original Q2

Question 2 (Standard demand)

02.1 The specification definition for an 'exothermic' reaction was not well known as students rarely stated that energy or heat was released or transferred '*to the surroundings*'. However, more than three-quarters of students gained this mark. Answers were mostly general explanations, describing how energy or heat were 'given off' or 'released'. Common non-creditworthy responses referred to energy or heat being 'produced', the idea of heat or energy being 'lost' or references to an increase in temperature. Some answers stated that 'oxygen' or 'a gas' was given off by the reaction.

02.2 This question was well answered. The majority of students understood the use of brackets in a formula and used the subscript 2 correctly so evidence of 32 was common. There were some different variations on the use of 16 and 74 such as 74+16, 74-16 or 74÷16.



0 7 . 2 The formula of calcium hydroxide is $Ca(OH)_2$

Calculate the percentage by mass of oxygen in calcium hydroxide.

Relative atomic mass (A_r): O = 16

Relative formula mass (M_r): $Ca(OH)_2$ = 74

[3 marks]

$\frac{16}{74} \times 100 = 22.6\dot{2}\dot{1}$

Percentage = 21 %

This response (from a Foundation tier paper) has not accounted for 2 oxygen atoms in the formula so does not gain MP1. However, MP2 is awarded for the correct mathematical expression (using an incorrectly determined mass of oxygen) but then truncate their answer. Had they rounded correctly to 22 or 21.6 or left their answer as 21.621 they would have been awarded MP3 (correctly rounded to at least 2 significant figures).

02.3 This was an 'extended response' style of question. Such questions are marked holistically. There are overall generic descriptions for the three levels of response at the top of the mark scheme, giving a hierarchy of response. Within each level there are 2 marks.

Students were asked to plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction when calcium oxide is added to water. The indicative content includes 5 key steps and the control variable, along with some additional information.

At Level 1, students needed to identify some relevant steps. To enter Level 2, three key steps, or two with the control variable, were required. To achieve marks in Level 3, all 5 key steps and the control variable were needed. Only a minority of students were able to obtain 6 marks.

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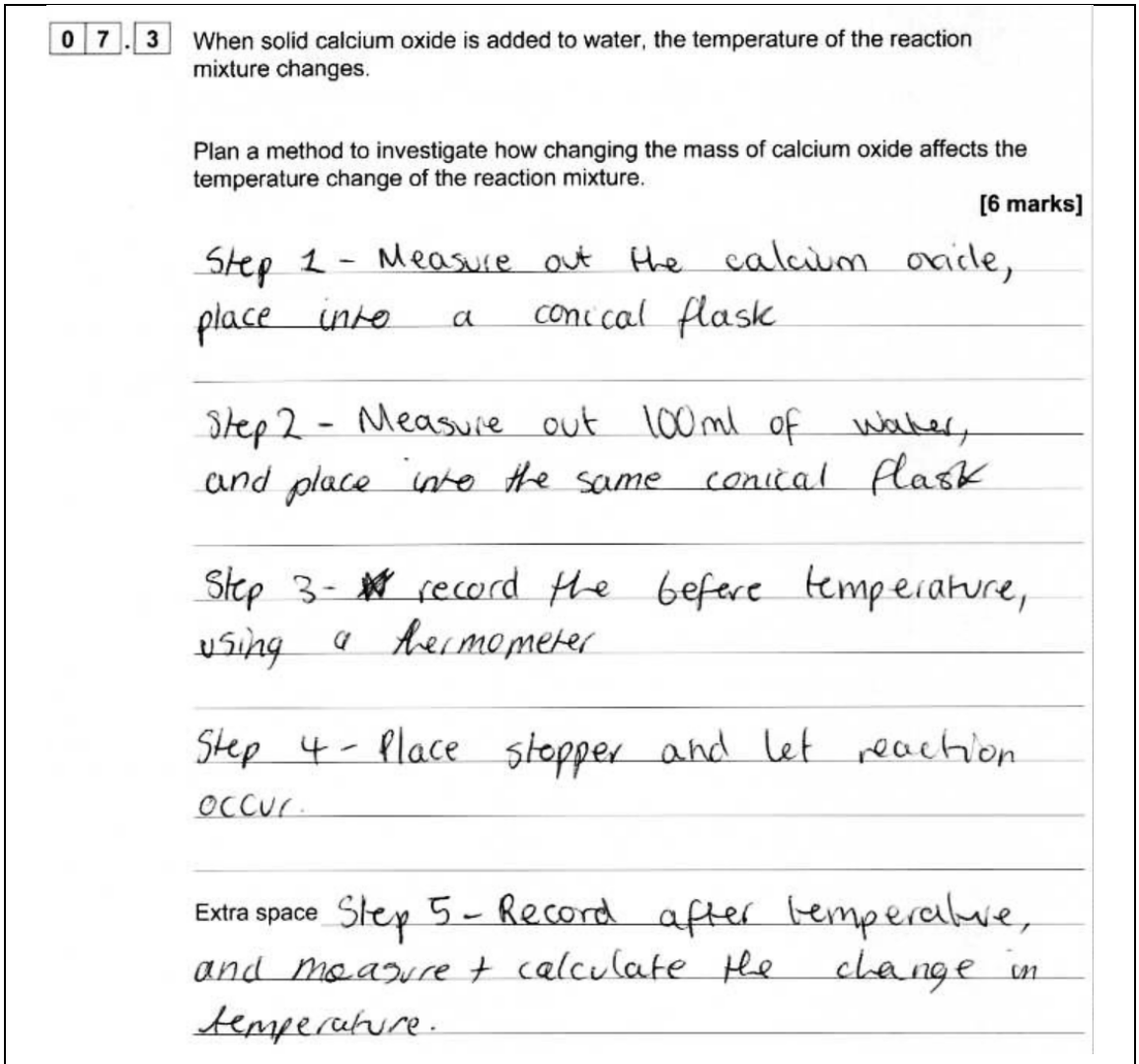
5.1.1.2 Mixtures

Answer 24 · Examiner comments June 2025 | 8464/C/1H | Original Q2

Most students added calcium oxide to water but many omitted either volume (of water) or mass (of solid) although 'amount' was creditworthy for both here. Numerous students then took the 'initial' temperature (but this was often after they had added solid to water). Many were less clear on when and how the subsequent temperature or temperatures were to be taken. Too frequently it was stated that the 'temperature change' was to be measured which is not creditworthy, as this requires a calculation. The need for a control variable, whilst rarely stated as such, was often found in a Level 2 response due to the students realising that the volume of water needed to be fixed along with the experiment being repeated in some way. An indication of how the temperature change was to be determined was rarely seen.



0 7 . 3 When solid calcium oxide is added to water, the temperature of the reaction mixture changes.

Plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction mixture.

[6 marks]

Step 1 - Measure out the calcium oxide, place into a conical flask

Step 2 - Measure out 100ml of water, and place into the same conical flask

Step 3 - record the before temperature, using a thermometer

Step 4 - Place stopper and let reaction occur.

Extra space Step 5 - Record after temperature, and measure + calculate the change in temperature.

In this response (from a Foundation tier paper) the student has stated a valid volume of water but omitted 'mass' of calcium oxide. In step 3 they record the 'before' temperature but this is after both reactants have been added to the conical flask so is not credited with taking the initial temperature. They have not stated when the subsequent temperature is measured nor described how the temperature change is determined. Had the student 'repeated the experiment with different masses of calcium oxide' they would have been credited with the control variable as this would imply fixing the volume stated. The student uses a thermometer which is a valid point in the mark scheme.

Only one key step is stated with some additional information (correct use of a thermometer) so this is a Level 1 response and is awarded 1 mark.

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5.1.1.2 Mixtures

Answer 24 · Examiner comments June 2025 | 8464/C/1H | Original Q2

0 7 . 3 When solid calcium oxide is added to water, the temperature of the reaction mixture changes.

Plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction mixture.

[6 marks]

- Place water in a polystegrene cup with a thermometer and lid
- ~~Add in~~ measure out different masses of calcium oxide
- add smallest mass to cup, place lid on top and measure maximum temperature and temperature change
- repeat with increasing masses of calcium oxide
- repeat previous steps to make sure investigation is accurate
- ~~measure~~ find the mean temperature of each reaction of increasing calcium oxide mass and water.

Extra space

In this response (from a Foundation tier paper) the student has omitted volume of water but stated mass of calcium oxide. The initial temperature is not recorded but the maximum temperature is. They repeat for accuracy and then repeat with different masses of calcium oxide. They have not stated how the temperature change is determined nor that they need to use the same volume of water when repeating. The student uses a suitable container (an insulated cup) and a thermometer which are valid ideas from the mark scheme.

There are three key steps with some additional information (thermometer and insulated cup) so this is a Level 2 response and is awarded 3 marks.

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5.1.1.2 Mixtures

Answer 24 · Examiner comments June 2025 | 8464/C/1H | Original Q2

0 2 . 3 When solid calcium oxide is added to water, the temperature of the reaction mixture changes.

Plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction mixture.

[6 marks]

1. Measure 25cm^3 of water using a measuring cylinder and pour into a polystyrene cup.
2. Place the cup into a beaker and measure initial temperature using a thermometer
3. Measure 4g of calcium oxide using a balance
4. Add the calcium oxide and put on a lid
5. Once the temperature has come to a stable point take final temperature reading using a thermometer
6. calculate temperature change by doing final temp - initial temp
7. Repeat steps 1-6 with different masses of calcium oxide e.g 6g, 8g. and compare results.

(for more accurate results use cotton wool in the beaker as an insulator and use a digital thermometer)

In this response, the student has stated a valid volume of water and mass of calcium oxide. The initial temperature (before the solid is added) and final temperature are recorded. They repeat with different masses of calcium oxide and are using the same volume of water so are credited with having a control variable. They have shown how the temperature change is determined. The student uses a measuring cylinder, suitable container (an insulated cup), balance and a thermometer which are additional valid points in the mark scheme.

There are all five key steps, a control variable, how the temperature change is determined with lots of additional information, so this is a Level 3 response and is awarded 6 marks.

Answer 25 · Examiner comments

June 2025 | 8464/C/1H | Original Q4

Question 4 (Standard, Standard/High and High demand)

04.1 Many correctly stated iron can be extracted by reduction with carbon because iron is less reactive than carbon. The converse statement was the most common incorrect response.

04.2 Very few students were able to achieve both marks on this question as the idea that the melting point of the mixture is lower, was rarely seen. Many responses incorrectly stated that it is the melting point of the aluminium oxide or aluminium that is lowered. A large majority of students gained marking point 2 by stating that less energy is used. However, those who qualified this by saying that less energy is needed for the 'reaction' were not awarded the mark. Many students thought that cryolite was a catalyst.

0 4 . 2 Explain why a mixture of aluminium oxide and cryolite is used as the electrolyte instead of only aluminium oxide.

[2 marks]

Aluminium oxide has a very high melting point. Cryolite is added to reduce the melting point. This makes it cheaper and means less energy is needed.

This response gained 1 mark. MP1 was not awarded as it is the melting point of the mixture is lower not the melting point of the aluminium oxide. MP2 was credited.

04.3 Students found writing the half equation at the positive electrode to show the oxidation of oxide ions very challenging. Many students could not give the formula for the oxide ion (O_2^- was common), oxygen or electron (e either with a + charge or no charge was common). One mark was infrequently scored, since identifying the correct reactants and not the balancing appeared to be the problem.

04.4 Few students identified the species being reduced. Chromium, a product of the reaction, was a common incorrect answer.

04.5 This AO3 question required students to use data to give a reason for the difference in the cost of extracting aluminium and iron. Most provided a comparative, which was good, but many chose to compare reactivity or to state what the extraction methods of the metals were rather than comment on the energy implication.

04.6 Another AO3 question looking for a difference in the cost of extracting aluminium and chromium. Few students answered this correctly. Common answers referred to the rarity or difficulty of extracting chromium ores from Earth.

04.7 Just under half of students gained 1 or more marks. Students should know that pure metals are soft so are mixed with other metals to make alloys, which are harder. Those who gained one mark usually referred to the difference in the sizes of the atoms and the second most common mark was for layers not being able to slide. Layers are distorted was less frequently given. Many students gave good descriptions why metals are soft but their answers for alloys were less accurate. Many referred incorrectly to intermolecular forces.

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5.1.1.2 Mixtures

Answer 26 · Examiner comments

Question 4 (Standard, Standard/High and High demand)

04.1 Although well attempted, only a third of students were able to accurately describe a formulation. Several students knew that it was a mixture but did not expand on this any further to give the reason for the mixture. Several knew that you needed to add a number of substances together for a purpose but did not know that this would then be a mixture.

04.2 Well over half of students were able to select the correct response of 91 kJ/mol.

04.3 Half of all students could identify Le Chatelier as the scientist, although there were a variety of spellings offered.

04.4 Half of all students were able to select the correct response of 'the proportion of methanol decreases'. The most common incorrect answer was the opposite, being the proportion of methanol increases.

04.5 Again, half of all students were able to select the correct response of the proportion of methanol stays the same. A significant number however selected the proportion of methanol increases.

04.6 Students found equilibrium difficult. A large number of students related the increase in pressure to an increase in energy and number of collisions and hence an increase in the rate of reaction, but did not make any link to the effect on equilibrium.
A common misconception appeared to be that the proportion of methanol in the mixture was equivalent to the yield of methanol. Only a quarter of students gained 1 mark, with very few scoring 2 or 3.

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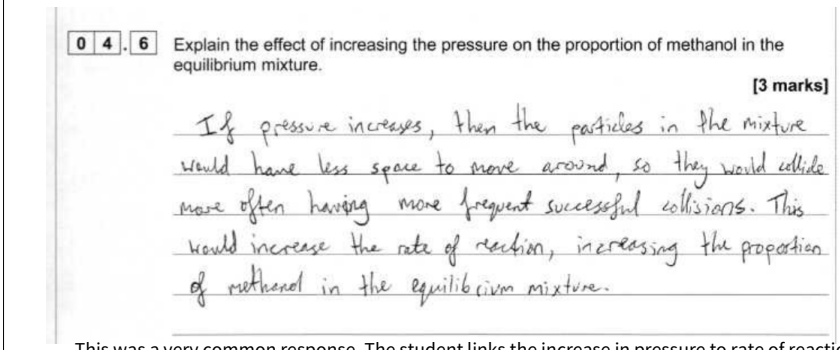
5.1.1.2 Mixtures

Answer 26 · Examiner comments June 2025 | 8464/C/2H | Original Q4



0 4 . 6 Explain the effect of increasing the pressure on the proportion of methanol in the equilibrium mixture.

[3 marks]

If pressure increases, then the particles in the mixture would have less space to move around, so they would collide more often having more frequent successful collisions. This would increase the rate of reaction, increasing the proportion of methanol in the equilibrium mixture.

This was a very common response. The student links the increase in pressure to rate of reaction and hence to increased proportion of methanol. One mark is awarded for the increase in proportion of methanol.

04.7 Most students were able to state that a catalyst will increase the rate of a reaction. Less were able to explain that this is due to a lowered activation energy, and even fewer could link this to an alternative reaction pathway.
There was a common misconception that catalysts increase the rate of a reaction due to there being more frequent collisions, as this is a common explanation for how changing other factors affects the rate of reaction. Some students also incorrectly stated that catalysts cause the particles to gain energy.

04.8 Only half of all students answered this question well. Most of these identified that less energy used would be cheaper, but very few linked the idea of less fuels burning and the reduced contribution to global warming.
Some students gave ideas around the speed of the reaction decreasing at a lower temperature so the reaction could be controlled/monitored/more accurate results, lower temperatures being safer to work with, or lower temperatures resulting in less evaporation of methanol.

04.9 Just under a third of students gained both marks.
A large number of students did not know the formula for hydrogen and 6H was commonly used instead of $3H_2$
A small number of students could not gain marks due to errors in the size of the letter used eg Co_2 rather than CO_2 and $H2o$ rather than H_2O.
Students are expected to use subscript, superscript and size of letters appropriately.

5.1.1.2 Mixtures

Answer 27 · Examiner comments

June 2025 | 8464/C/2H | Original Q5

Question 5 (Standard, Standard/High and High demand)

05.1 This question was answered well by half of all students. The most common incorrect link to time taken was 'time taken for reaction to go cloudy'.

05.2 Although a significant number of students recognised that sulfur was formed and is a solid, they often then linked sulfur dioxide bubbling through the solution as a contributory factor causing the cross to become obscured thus not accessing full marks. Another common error was mistaking S for sodium rather than sulfur.

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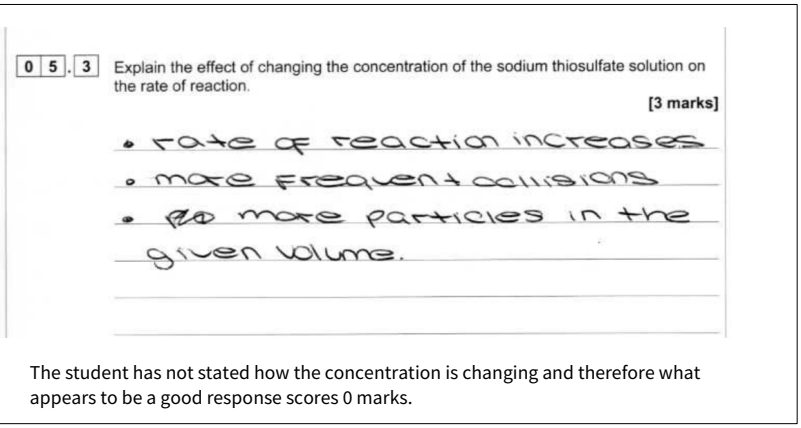
5.1.1.2 Mixtures

Answer 27 · Examiner comments June 2025 | 8464/C/2H | Original Q5

05.3 Several students misinterpreted this question and simply stated 'changing the concentration' without clarifying whether they meant 'increasing' or 'decreasing'. This resulted in them not having access to any of the marks.
Those who did achieve credit mainly did so by correctly linking the directional change in concentration to a directional change in rate of reaction and then linking this to an appropriate description of frequency of collisions. Descriptions of 'more particles per unit volume/ in the same volume' were rarely seen, with many students simply stating 'more particles'.


0 5 . 3 Explain the effect of changing the concentration of the sodium thiosulfate solution on the rate of reaction.

[3 marks]

- rate of reaction increases
- more frequent collisions
- more particles in the given volume.

The student has not stated how the concentration is changing and therefore what appears to be a good response scores 0 marks.

05.4 The majority of students did not recognise that the reaction would start immediately and that some gas would inevitably escape from the conical flask. They therefore answered in terms of an absolute such as 'to stop gas escaping' or 'to prevent the gas escaping' rather than expressing the fact that the insertion of the bung would 'minimise' or 'reduce' the volume of gas lost. Consequently, very few students gained this mark.

05.5 Over half of students answered this question well, however there was a significant number who mixed up the standard tests for hydrogen and oxygen giving perfect answers but for the wrong gas.

05.6 More students attempted this question than in previous years. Where a tangent was drawn further marks were nearly always achieved.
Common errors included misreading the scales to calculate the *x*-step or *y*-step, using these figures incorrectly (change in *x*/change in *y*), or simply trying to calculate the gradient from a single point (often 56,75).