AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.3.5

Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**12**
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.

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 01 · Mark scheme June 2018 | 8462/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	solid (zinc chloride) does not conduct (electricity) **or** zinc chloride needs to be in solution **or** molten	allow liquid / aqueous	1	AO1 4.4.3.1
	(because) ions cannot move in the solid **or** (as) ions can (only) move in liquid / solution	do **not** accept references to movement of electrons in zinc chloride	1	
06.2		allow free electrons for delocalised electrons		AO1 4.2.3.2
	each carbon / atom forms 3 (covalent) bonds		1	
	one electron per carbon / atom is delocalised		1	
	(so) these electrons carry charge through the graphite **or** (so) these electrons move through the structure	ignore carry current / electricity	1	
		if no other mark scored, allow **1** mark for delocalised / free electrons		
06.3	use measuring cylinders (instead of test tubes)	allow use burettes allow use (gas) syringes allow Hoffmann voltameter	1	AO3 4.4.3.4
	(because) test tubes cannot measure volume **or** (because) test tubes have no graduations / scale	allow (so that) volume can be measured	1	

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 01 · Mark scheme

June 2018 | 8462/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	any **three** from: • the volume of hydrogen collected is directly proportional to the time • the rate of collection of hydrogen is 0.45 (cm^3/min) • up to 8 minutes chlorine is collected at an increasing rate • after 8 minutes the rate of collection of chlorine is the same as that of hydrogen **or** after 8 minutes the rate of collection of chlorine is 0.45 (cm^3/min)	allow the (volume of) hydrogen is collected at a constant / steady rate allow any value from 6 to 8 minutes allow initially chlorine is collected at an increasing rate allow any value from 6 to 8 minutes allow after 8 minutes the (volume of) chlorine is collected at a constant / steady rate if neither bullet point 3 nor bullet point 4 is awarded allow **1** mark for chlorine is collected slowly up to 8 minutes and then more quickly allow any value from 6 to 8 minutes	3	AO2 4.4.3.4
06.5	chlorine reacts with water **or** chlorine dissolves (in the solution)		1	AO3 4.3.5 4.4.3.4

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 01 · Mark scheme

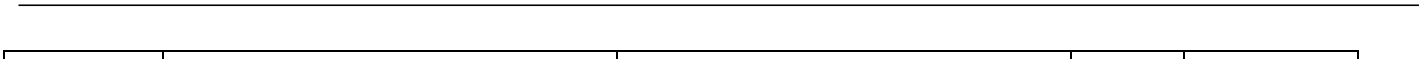
June 2018 | 8462/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6		an answer of 2.75×10^{-4} (mol) or 2.8×10^{-4} (mol) scores **3** marks an answer of 0.000275 / 0.00028 / 2.75×10^{-1} / 2.8×10^{-1} (mol) / scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.5
	(volume=) $\frac{6.6}{1000}$ (dm^3) **or** 0.0066 (dm^3)	allow 6.5 (cm^3) for 6.6 (cm^3)	1	
	(moles=) $\frac{0.0066}{24}$	allow use of incorrect volume from step 1	1	
	= 2.75×10^{-4} (mol)	allow 2.8×10^{-4} (mol) allow answer from incorrect calculation given in standard form alternative approach for marking points 1 and 2 24 dm^3 = 24 000 cm^3 (1) (moles =) $\frac{6.6}{24\,000}$ (1)	1	
Total			**14**	

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 01 · Mark scheme

June 2018 | 8462/1H | Original Q6



4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 02 · Mark scheme

June 2019 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	wood is renewable **or** (natural) gas is finite (burning) wood produces the same amount of carbon dioxide as the trees absorbed **or** (burning natural) gas increases the amount of carbon dioxide (in the atmosphere)	 allow wood is carbon-neutral allow wood does not add to global warming allow (burning natural) gas adds to global warming allow (burning natural) gas adds greenhouse gases (to the atmosphere) ignore references to energy / cost	1 1	AO3 4.9.2.2 4.10.1.1
05.2	not enough oxygen (so) incomplete combustion	allow not enough air do **not** accept no oxygen / air	1 1	AO1 4.9.3.1
05.3	$\mathbf{2}CH_4(g)+\mathbf{3}O_2(g)\rightarrow\mathbf{2}CO(g)+\mathbf{4}H_2O(g)$	allow correct multiples / fractions	1	AO2 4.9.3.1

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 02 · Mark scheme

June 2019 | 8462/2H | Original Q5

05.4	ratio of O_2 : CO_2 = 5 : 3 (oxygen needed = $\frac{3.60 \times 5}{3}$) = 6.0 (dm^3) (oxygen unreacted = 7.25 – 6.0) = 1.25 (dm^3) (oxygen unreacted = 1.25 × 1000) = 1250 (cm^3)	an answer of 1250 (cm^3 oxygen unreacted) scores **4** marks allow correct calculation using an incorrectly determined mole ratio allow correct subtraction of an incorrectly calculated volume of oxygen allow correct conversion to cm^3 anywhere in response **alternative approach for MP1 and MP2** moles CO_2 = 0.15 **and** moles O_2 = 0.25 (1) (0.25 x 24 =) 6.0 (dm^3 oxygen needed) (1)	1 1 1 1	AO2 4.3.5 4.7.1.3
Total			**9**	

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 03 · Mark scheme

November 2020 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	the activation energy should be from the reactants (line to the peak) the products (line) should be below the reactants (line) **or** the products should have less energy than the reactants	ignore description of where the activation energy is on the diagram allow the product (line) is above the reactants (line) allow the products have more energy than the reactants allow the profile shows an endothermic reaction ignore the arrow for the overall energy change should point downwards	1 1	AO3 4.5.1.2
07.2	any **two** from: (hydrogen fuel cells) • no toxic chemicals to dispose of at the end of the cell's life • take less time to refuel (than to recharge rechargeable cells) • travel further before refuelling (than before recharging rechargeable cells) • no loss of efficiency (over time)	allow converse arguments for a rechargeable cell allow has a greater range allow does not lose capacity / range in cold weather	2	AO1 4.5.2.2

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	any **one** from: • $H_2 \rightarrow 2H^+ + 2e^-$ • $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ • $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ • $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$	allow multiples allow $H_2 - 2e^- \rightarrow 2H^+$ allow $H_2 + 2OH^- - 2e^- \rightarrow 2H_2O$	1	AO1 4.5.2.2
07.4	any **two** from: • hydrogen is not shown as H_2 / molecules • particles are shown as spheres • particles are shown as solid • does not show the (weak) forces (between particles) • does not show the movement / speed (of particles) • is only two-dimensional		2	AO1 4.2.2.1
07.5	any **one** from: • under (higher) pressure • cool • absorb / adsorb in a solid	allow increase concentration allow condense allow store as a liquid / solid allow develop more efficient engines	1	AO3 4.2.2.1 4.5.2.2

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(58 MJ =) 58 000 kJ **or** (290 kJ =) 0.290 MJ	allow (58 MJ =) 58 000 000 J **and** (290 kJ =) 290 000 J	1	AO2 4.3.2.1 4.3.5 4.5.2.2
	(moles = $\frac{58000}{290}$ **or** $\frac{58}{0.290}$ =) 200	allow correct use of an incorrectly converted or unconverted value of energy	1	
	(volume =) 200 × 24	allow correct use of an incorrectly calculated number of moles of hydrogen	1	
	= 4800 (dm^3)		1	
	alternative approach: (58 MJ =) 58 000 kJ (1) (energy released per dm^3 = $\frac{290}{24}$ =) 12.08333 (kJ/dm^3) (1) (volume =) $\frac{58000}{12.08333}$ (1) = 4800 (dm^3) (1)	allow correct use of an incorrectly converted or unconverted value of energy allow correct use of an incorrectly calculated energy released per dm^3		
Total			**12**	

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 04 · Mark scheme

November 2020 | 8462/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	all seven points plotted correctly line of best fit	allow a tolerance of ±½ small square allow **1** mark for five or six points plotted correctly	2 1	AO2 4.6.1.1
08.2	0.0038 **and** 0.0014 $\frac{0.0038 - 0.0014}{105 - 20}$ = 0.000028 **or** = 2.8 x 10^{-5} mol/s	 allow correct use of incorrectly determined mole value(s) allow moles per second	1 1 1 1	AO2 4.6.1.1
08.3	(for large lumps) a smaller number of moles of gas is collected in the same time **or** (for large lumps) more time is needed to collect the same number of moles of gas **or** the line (of best fit for large lumps) is less steep	allow converse statement for small lumps allow the line (of best fit for large lumps) takes more time to become horizontal	1	AO2 4.6.1.1

Question 8 (continued)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	(surface area = 6 x 0.5 x 0.5) = 1.5 (cm^2)		1	AO2 4.6.1.3
	(volume = 0.5 x 0.5 x 0.5) = 0.125 (cm^3)		1	
	(surface area : volume =) 12 : 1	allow correctly calculated ratio using incorrectly calculated values for surface area and/or volume	1	
08.5	decreases by a factor of 10	allow 10 times smaller allow one tenth allow 1/10 allow 1 : 10 (large cube to small cube)	1	AO2 4.2.4.1 4.6.1.3
Total			**12**	

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 05 · Mark scheme

November 2021 | 8462/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	potassium chloride	allow KCl	1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$H^+ + OH^- \rightarrow H_2O$	ignore state symbols	1	AO1 4.1.1.1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	copper carbonate and copper oxide only		1	AO1 4.4.1.2 4.4.2.2 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(Step 2) to speed up the reaction (Step 5) to make sure all the (hydrochloric) acid reacts (Step 6) to remove the excess magnesium oxide	 ignore to remove impurities	1 1 1	AO1 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	using a (boiling) water bath **or** using an electric heater		1	AO1 4.4.2.3 RPA1

Question 5 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(moles Fe = $\frac{14}{56}$ =) 0.25 (mol)		1	AO2 4.3.2.1 4.3.2.2 4.3.5
	(moles Cl_2 = $\frac{3}{2}$ × 0.25 =) 0.375 (mol)	allow correct use of an incorrectly calculated number of moles of Fe	1	
	(volume Cl_2 = 24 × 0.375) = 9.0 (dm^3)	allow correct use of an incorrectly calculated number of moles of Cl_2	1	

Total			**10**

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 06 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	silicon is less reactive than carbon	ignore references to hydrogen allow converse allow silicon is below carbon (in the reactivity series)	1	AO3 4.4.1.3
	(because) carbon displaces silicon (from silicon dioxide)	ignore (because) carbon reduces silicon dioxide	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	more energy is needed (to obtain aluminium)	ignore references to electricity	1	AO3 4.4.1.3 4.4.3.3
	(because) aluminium is obtained (from aluminium oxide) by electrolysis		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	both products are solid		1	AO3 4.4.1.3

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 06 · Mark scheme

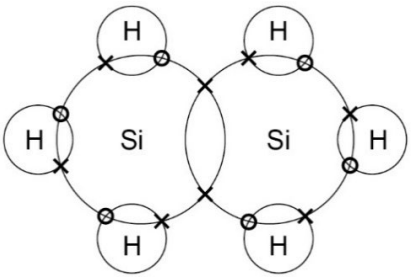
June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(M_r of SiO_2 = 28 + (2 × 16)) = 60		1	AO2 4.3.1.2 4.3.2.1 4.3.2.2
	(conversion 1.2 kg =) 1200 (g)		1	
	(number of moles of SiO_2 = $\frac{1200}{60}$) = 20	allow correct use of an incorrectly converted or unconverted mass of SiO_2 allow correct use of an incorrectly calculated M_r of SiO_2	1	
	(number of moles of Mg = 20 × 2) = 40	allow correct use of an incorrectly calculated number of moles of SiO_2	1	
	(mass of Mg = 40 × 24) = 960 (g)	allow correct use of an incorrectly calculated number of moles of Mg	1	
	alternative approach:			
	(M_r of SiO_2 = 28 + (2 × 16)) = 60 (1)			
	48 g Mg reacts with 60 g SiO_2 (1)	allow correct use of an incorrectly calculated M_r of SiO_2		
	(conversion 1.2 kg =) 1200 (g) (1)			
	48 × $\frac{1200}{60}$ (g Mg reacts with 1200 g SiO_2) (1)	allow correct use of an incorrectly calculated mass of Mg and / or incorrectly converted or unconverted mass of SiO_2		
	= 960 (g) (1)			

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 06 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5		allow any combination of x, •, o, $e^{(-)}$ for electrons	1	AO2 4.2.1.4

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 06 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(volume of oxygen for 30 cm^3 Si_2H_6 = 3.5 × 30) = 105 (cm^3)		1	AO2 4.3.2.4 4.3.5
	(volume of excess oxygen = 150 – 105) = 45 (cm^3)	allow correct use of an incorrectly calculated volume of oxygen for 30 cm^3 Si_2H_6	1	
	(volume of water (vapour) = 3 × 30) = 90 (cm^3)		1	
	(volume of gases = 45 + 90) = 135 (cm^3)	allow correct use of incorrectly calculated volumes of excess oxygen and / or water vapour	1	
	allowed alternative approach: (moles Si_2H_6 = $\frac{0.03}{24}$ =) 0.00125 (1)			
	(moles water vapour formed = 3 × 0.00125 =) 0.00375 **and** (moles oxygen used = 3.5 × 0.00125 =) 0.004375 (1)	allow correct use of an incorrectly calculated number of moles of Si_2H_6		
	(moles excess oxygen = $\frac{0.15}{24}$ - 0.004375 =) 0.001875 (1)	allow correct use of an incorrectly calculated number of moles of oxygen used		
	(volume of gases = 24 × (0.00375 + 0.001875) = 0.135 dm^3 =) 135 (cm^3) (1)	allow correct use of an incorrectly calculated number of moles of excess oxygen and / or moles of water vapour formed		

Total Question 7		15

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 07 · Mark scheme

June 2023 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	$Al^{3+} + 3e^- \rightarrow Al$	allow multiples	1	AO2 4.1.1.1 4.4.3.3 4.4.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	sodium is more reactive than aluminium		1	AO3 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3		allow hydroxide ions for OH^- throughout		AO1 4.4.3.4
	water (molecules) break down		1	
	(to) produce (H^+ and) OH^- (ions)		1	
	(OH^- (ions) are attracted / move to the positive electrode		1	
	(OH^- (ions) are discharged / oxidised to give oxygen (molecules)	allow (OH^- (ions) lose electrons to give oxygen (molecules)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4		allow (inverted) burettes for measuring cylinders allow gas syringes for measuring cylinders		AO3 4.4.3.4
	(change) use measuring cylinders (instead of test tubes)		1	
	(reason) because there is a scale (on the measuring cylinders)	allow measuring cylinder(s) measure volume	1	

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	10 cm^3		1	AO2 4.3.5

Total Question 7	**9**

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 08 · Mark scheme

June 2023 | 8462/1H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(nanoparticles) any **two** from: • have a higher surface area to volume ratio • less (material) needed (for the same effect) • more light gets through	allow converse arguments for fine particles allow a thinner coating is needed	2	AO3 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	(M_r TiO_2 =) 80		1	AO2 4.3.1.2
	(conversion 100 kg =) 100 000 (g)		1	4.3.2.1 4.3.2.2 4.3.5
	$\left(\text{moles } TiO_2 = \frac{100\,000}{80} =\right)$ 1250	allow correct use of an incorrectly determined M_r allow correct use of an incorrect / no conversion of mass	1	
	(moles Cl_2 = 1250 × 2 =) 2500	allow correct use of an incorrectly determined number of moles of TiO_2	1	
	(volume Cl_2 =) 2500 x 24	allow correct use of an incorrectly determined number of moles of Cl_2	1	
	= 60 000 (dm^3)		1	

Total Question 10	8

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 09 · Mark scheme

June 2024 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(thermal) energy is transferred by delocalised electrons	allow heat is transferred	1 1	AO1 4.2.1.5 4.2.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	 (the alloy / mixture has) different sized atoms (so the) layers are distorted (so the) layers cannot easily slide	allow (positive / metal) ions for atoms throughout allow (so the) atoms cannot slide over each other	 1 1 1	AO1 4.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$		1	AO2 4.3.1.1 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	1 Fe^{2+} : 2 Fe^{3+} : 4 O^{2-}		1	AO2 4.4.2.2

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 09 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(M_r Fe_3O_4 =) 232		1	AO2 4.3.1.2
	(% Fe =) $\frac{3 \times 56}{232} \times 100$	allow $\frac{168}{232} \times 100$ allow correct use of an incorrectly determined M_r using the values of A_r given in the question	1	
	= 72.4 (%)	allow 72.41379 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6		a maximum of **4** marks can be awarded for a method which determines and uses the volume of iron oxide as a gas		AO2 4.3.2.1 4.3.2.2
	(40.0 kg =) 40 000 (g)		1	
	(moles Fe_2O_3 = $\frac{40\,000}{160}$ =) 250	allow correct use of an incorrectly converted or unconverted mass	1	
	(moles CO_2 = 250 × $\frac{3}{2}$ =) 375	allow correct use of an incorrectly determined number of moles of Fe_2O_3	1	
	(volume of CO_2 =) 375 × 24	allow correct use of an incorrectly determined number of moles of CO_2	1	
	= 9000 (dm^3)		1	

Total Question 7	15

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 10 · Mark scheme

June 2024 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	high temperatures (cause) nitrogen (from air) and oxygen (from air) to react	ignore pressure	1 1	AO1 4.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2		ignore references to water vapour		
	less climate change	allow less global warming allow an effect of climate change for climate change	1	AO1
	(because) no carbon dioxide (produced)		1	AO3 4.7.1.3 4.9.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	more oxides of nitrogen (produced)		1	AO1
	(so) more acid rain **or** (so) more respiratory problems	allow an effect of acid rain for acid rain allow a named respiratory problem for respiratory problems MP2 cannot be linked to an incorrect gas from MP1	1	AO3 4.7.1.3 4.9.3.2

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 10 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(volume of oxygen = $3.50 \times \frac{1}{2}$ =) 1.75 (dm^3)		1	AO2 4.3.5 4.9.1.1
	(volume of air =) $1.75 \times \frac{100}{20}$	allow correct use of an incorrectly determined volume of oxygen	1	
	= 8.75 (dm^3)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	there is a temperature gradient in the (fractionating) column	allow the (fractionating) column gets cooler going up	1	AO1
	(so) kerosene condenses	allow (so) the hydrocarbons / vapours condense	1	AO2
	at the level (in the column) corresponding to kerosene's boiling point (range)	allow at the level (in the column) corresponding to the boiling point of the hydrocarbons / vapours for the award of 2 marks for MP2 and MP3, a reference to kerosene must be made	1	AO1 4.7.1.2

Total Question 5	12

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 11 · Mark scheme

June 2024 | 8462/2H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(some) hydrogen / gas escapes (from the flask)		1	AO3 4.6.1.2 RPA5
	(because the reaction starts) before the stopper is put in	allow (because) stopper cannot be inserted instantly	1	
		allow for **1** mark some air (from the conical flask) is collected **or** allow some hydrogen remains in the conical flask **or** allow some hydrogen remains in the delivery tube		

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 11 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	(volume = 39 − 25 =) 14 (cm^3)		1	AO2 4.3.5
	(14 cm^3 =) 0.014 (dm^3)	allow correct use of an incorrectly determined volume	1	4.6.1.1 RPA5
	(moles of hydrogen =) $\frac{0.014}{24}$	allow correct use of an incorrectly determined volume allow correct use of an incorrect / no conversion of volume	1	
	= 5.8 x 10^{-4} (mol)	allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol)	1	
	alternative approach 1:			
	(24 dm^3 =) 24 000 (cm^3) (1)			
	(volume = 39 − 25 =) 14 (cm^3) (1)			
	(moles of hydrogen =) $\frac{14}{24000}$ (1)	allow correct use of an incorrectly determined volume allow correct use of an incorrect / no conversion of volume		
	= 5.8 x 10^{-4} (mol) (1)	allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol)		

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 11 · Mark scheme

June 2024 | 8462/2H | Original Q9

	alternative approach 2: (24 dm^3 =) 24 000 (cm^3) (1) (moles of hydrogen at 100 s = $\frac{39}{24000}$ =) 0.001625 **and** (moles of hydrogen at 40 s = $\frac{25}{24000}$ =) 0.00104 (1) (moles 100 s – moles 40 s =) 0.001625 – 0.00104 (1) = 5.8 x 10^{-4} (mol) (1) **alternative approach 3:** (39 cm^3 =) 0.039 (dm^3) **and** (25 cm^3 =) 0.025 (dm^3) (1) (moles of hydrogen at 100 s = $\frac{0.039}{24}$ =) 0.001625 **and** (moles of hydrogen at 40 s = $\frac{0.025}{24}$ =) 0.00104 (1) (moles 100 s – moles 40 s =) 0.001625 – 0.00104 (1) = 5.8 x 10^{-4} (mol) (1)	allow correct use of an incorrect / no conversion of volume allow correct use of an incorrectly determined number of moles allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol) allow correct use of an incorrect / no conversion of volume allow correct use of an incorrectly determined number of moles allow 5.833333 x 10^{-4} correctly rounded to at least 2 significant figures allow 0.00058 (mol)		

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 11 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	tangent drawn at 45 s		1	AO2 4.6.1.1 RPA5
	correct values for *y* step **and** *x* step from tangent	allow correct use of an incorrectly drawn tangent allow a tolerance of ± ½ a small square for each coordinate	1	
	(rate =) $\frac{\text{value for } y \text{ step}}{\text{value for } x \text{ step}}$	allow correct use of incorrectly determined value(s) from the tangent for *y* step and/or *x* step	1	
	correct calculation of rate (mol/s)		1	
	rate given in standard form (mol/s)	allow a correctly calculated answer in standard form from an incorrect attempt at rate determination	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	line starting at 0,0.000 and less steep than existing line		1	AO2 4.3.2.4 4.3.4 4.6.1.1 RPA5
	becomes level at 0.0084 mol	allow a tolerance of ± ½ a small square	1	

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 11 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	(increasing the temperature) increases the rate of reaction		1	AO1 4.6.1.2 4.6.1.3
	(because) particles have more energy	allow (because) particles move faster	1	
	(so) the frequency of collisions increases	allow (so) a greater proportion of collisions have enough energy to react ignore successful	1	

Total Question 9	16

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 12 · Mark scheme

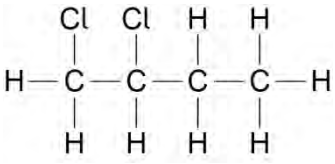
June 2025 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	– 6 (°C)	allow a value in the range (+)4 to –16 (°C)	1	AO2 4.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	ethanol	allow C_2H_5OH	1	AO2 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(test) damp litmus paper (result) litmus paper is bleached **or** litmus paper turns white	 ignore litmus paper turns red ignore litmus paper turns red	1 1	AO1 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4			1	AO2 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	propene		1	AO1 4.7.2.1

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(because of) incomplete combustion	ignore insufficient oxygen	1	AO1 4.7.2.2

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	(conversion 24 dm^3 =) 24 000 cm^3	allow conversion of volume anywhere in method	1	AO2 4.3.1.2 4.3.2.1 4.3.5
	(M_r = (3 × 12) + (6 × 1) =) 42		1	4.7.2.1
	(moles = $\frac{2.1}{42}$ =) 0.05	allow correct use of an incorrectly determined M_r	1	
	(volume =) 24 000 × 0.05	allow correct use of an incorrectly determined number of moles allow correct use of an incorrect / no conversion of volume	1	
	= 1200 (cm^3)		1	
	alternative approach			
	(conversion 24 dm^3 =) 24 000 cm^3 (1)	allow conversion of volume anywhere in method		
	(M_r = (3 × 12) + (6 × 1) =) 42 (1)			
	(ratio of mass = $\frac{42}{2.1}$ =) 20 (1)	allow correct use of an incorrectly determined M_r		
	(volume =) $\frac{24\,000}{20}$ (1)	allow correct use of an incorrect / no conversion of volume		
	= 1200 (cm^3) (1)			

Total Question 5	12

Question 6 (standard, standard / high and high demand)

06.1 Students found it difficult to score both marks on this question, although 77% of students scored one or more marks. Lower-attaining students simply stated that the electrolyte was a solid, without further explanation. Others incorrectly referred to the movement of delocalised electrons, rather than ions. Some refereed to zinc instead of zinc chloride.

06.2 Students struggled to put sufficient detail into their answers, although no more was required than what is directly stated in the specification. 9% of students achieved all three marks.

A lot of weakly expressed ideas were seen. Instead of stating that each atom forms three covalent bonds, many students stated that graphite has three covalent bonds, or that three out of four carbon atoms are bonded, both of which are untrue.

Very few said that each carbon atom has one delocalised electron: a statement directly from the specification. Those who did score the marks for the structure often didn't say that delocalised electrons move or carry charge **through** the structure. They often implied the delocalised electrons just moved around at random. Many students misunderstood the process of electrical conductivity completely, thinking that it is something to do with layers sliding over each other.

Some students referred to other properties such as softness, instead of confining their answer to the question posed.

06.3 58% of students did not achieve a mark for this question. The investigation was stated to be about the relationship between volume and time, but the diagram showed no means of measuring volume. The expected answer was to use inverted measuring cylinders so that volume (not 'amount') could be measured.

Although it would pose practical difficulties, the idea of using gas syringes was also accepted (on the grounds that it could be made to work if they were attached to funnels placed over the electrodes). Many suggested changing the electrodes as graphite is not inert, suggesting a lack of understanding of the required practical. Some students suggested that the apparatus is upside down.

Answer 01 · Examiner comments

06.4 Although 75% of students achieved one mark, usually for the trend in the hydrogen graph, just 7% achieved three marks.

In order to score the mark for proportionality of the hydrogen graph, both variables had to be stated, not just 'it is proportional'. Alternatively, a steady rate of collection would gain the mark. It had not been anticipated that students would calculate the rate of collection, but those who did were awarded credit. Some referred to proportionality correctly, but did not state which gas they were referring to.

The chlorine line posed more difficulty. Many described the chlorine line after 8 minutes as proportional. It is not as it shows a linear relationship, where the volume of chlorine increases at a steady rate.

Students are very unsure of how to describe trends in curved graphs; the idea of the chlorine being collected at an increasing rate (which could be expressed as faster and faster) being very rarely seen.

As in other questions, the language used by students created a barrier to attaining marks. 'It remains constant' could mean the gas volume no longer changes, rather than the rate of collection.

06.5 2% of students were able to answer this question. Many students either had not read or understood the statement that the number of moles of each gas produced is the same.

There were attempts to justify the difference in terms of reactivity, formula mass, size of molecules, pressure difference or the concentration of H^+ and Cl^- in solution. Some students referred to the length of time taken for the chlorine to react, rather than to be formed. Others suggested the molar volume was different for different gases, ignoring what they know from the part of the specification on gas volumes.

The formation of chlorine and hydrogen is part of the electrolysis required practical, so students should not be completely unfamiliar with the bubbles of chlorine taking longer to form. They should also be familiar with 'chlorine water' from their work on Group 7.

06.6 Students found this calculation on a new area of the specification quite difficult, with 26% of students providing a fully correct answer.

It was necessary to read off the correct volume from the graph and change the units from cm^3 to dm^3, or to change those of the gas molar volume to cm^3/mol, but many students didn't do this. Many students also struggled to express their answer in standard form.

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 03 · Examiner comments — November 2020 | 8462/1H | Original Q7

Question 7 (standard, standard / high and high demand)

07.1 Many students spotted that the curve was for an endothermic reaction rather than exothermic. Many also realised the activation energy was incorrect but could not always express correctly that activation energy should start at the energy of the reactants rather than the products.

07.2 Most students did not score well on this question. There were many vague references to 'better for the environment' without any justification for that statement. Many students referenced the fact that water is the only product, failing to realise that rechargeable cells produce no waste products at all. Others failed to realise that the infrastructure for recharging cells is actually better than that for refuelling with hydrogen. Some students

Answer 03 · Examiner comments — November 2020 | 8462/1H | Original Q7

were effectively giving advantages of hydrogen fuel cells over petrol engines, instead of answering the question. Others failed to express themselves clearly; saying that hydrogen fuels cells take less time to charge which did not gain credit, as the cells are refuelled, not recharged.

07.3 Many students did not realise that either hydrogen or oxygen had to be a reactant. Many impossible species such as e^{2-} or O_2^+ were seen.

07.4 Many students were able to score at least one mark but only one in six scored both. Many noted that the movement of the particles was not shown; many also noted that the particles are not shown as diatomic, or that the forces between them are not shown.

07.5 This was quite well answered, with most students favouring compressing the gas rather than cooling to condense the gas. A number of students incorrectly stated that hydrogen can be taken in from the atmosphere.

07.6 A third of students were able to score full marks. It was not possible to give partial credit for working when the students did not explain what they were doing; too often there was a jumble of numbers with various operators between them, with no words or units. No credit was given for multiplying a value by 24 unless that value was identified as a number of moles.

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 04 · Examiner comments November 2020 | 8462/2H | Original Q8

Question 8 (standard and standard / high demand)

08.1 The point that was most frequently plotted incorrectly was the final one (180, 0.0040). A number of students failed to plot (0,0). There were some examples of rulers being used to to complete lines of best fit, with a number of straight lines seen. Some students produced excessively thick or 'feathered' lines. However, the majority of students were able to score at least two marks.

08.2 If either of the mole values were incorrectly determined from the graph, it was still possible to gain credit for using these values correctly. Some attempted to determine the instantaneous rate at a particular time by drawing a tangent to the curve. Units were sometimes written imprecisely e.g. moles per s, and some wrote 'm/s'. Many students were able to score at least two marks.

08.3 This part was quite well answered by many. Most students preferred to answer in terms of line steepness rather than time and moles collected.

08.4 This item was quite well answered by many students. The most common error was to fail to multiply the area of one face by six.

08.5 Only a very few students scored here, with many just responding 'smaller' rather than stating by what factor it was smaller. A few assumed that because the cube was larger, so too was the surface area : volume ratio. Only a tiny number of students gained a mark here.

Answer 05 · Examiner comments November 2021 | 8462/1H | Original Q5

Question 5 (standard, standard / high and high demand)

05.2 This equation, which is given in the specification, was not well known.

05.4 Students found this question difficult. Most students do not know why the acid is heated, and many incorrectly referred to helping the magnesium oxide dissolve. Very few appeared to understand that excess magnesium oxide is needed to ensure that all of the acid reacts. Most students knew that filtration separates solids from liquids or solutions, but many did not refer specifically to removing the excess magnesium oxide.

05.5 Very few students knew that a water bath or an electric heater should be used, despite this being stated in the specification.

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 05 · Examiner comments November 2021 | 8462/1H | Original Q5

05.6 Those who followed the method provided in the question were often successful in scoring at least one mark. It was common to see the number of moles of iron calculated by dividing the mass by 112 instead of 56. Those who calculated the number of moles of chlorine often insisted on converting this to a mass and then back again to calculate the volume of chlorine.

Answer 06 · Examiner comments June 2022 | 8462/1H | Original Q7

Question 7 (Standard, standard/high and high demand)

07.1 This was well answered, with more than half of students scoring both marks. There was, however, some ambiguous use of the word 'it' such as 'it shows that it is below carbon because it displaces it'. If it was not clear what 'it' referred to, credit was not given.

07.2 Only 10% of students were awarded both marks, although nearly 60% scored at least one mark. Many students realised that aluminium is extracted by electrolysis, although some stated that aluminium would be extracted by the use of a more reactive metal. Although many mentioned the high energy cost of electrolysis, few compared electrolysis to the lower energy cost of heating coal to obtain carbon. Other students did state that extracting aluminium requires more energy than forming carbon, but did not explain why.

07.3 Many students realised that the products both being solids would make their physical separation difficult. Some appeared to misunderstandd what 'separate' means, and described the difficulty of decomposing magnesium oxide; this did not gain credit. Another common incorrect approach was to say that magnesium is high in the reactivity series. Whilst true, this was not relevant to the question set.

07.4 Those students who adopted a systematic approach, either using moles or reacting masses by proportion, had little difficulty in scoring most or all of the marks. In a multi-step calculation it is essential that each step is shown in the working so that marks for working can be awarded. The most common error was to use 48, instead of 24, for the M_r of Mg, giving an answer that was twice the correct value. Nearly all students carried out the unit conversion correctly. Some students calculated the correct final answer (960 g) but used an incorrect method. Such responses did not score full marks.

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 06 · Examiner comments June 2022 | 8462/1H | Original Q7

07.5 This was well answered. However, there were many blank responses.

07.6 This was a high demand calculation, and students found it difficult to analyse the correct approach to take. The gas molar volume was not provided, because it was not needed. Indeed, with the water being formed as a gas, a value of 24 dm^3/mol was not correct. Even so, those students who adopted the approach of converting gas volumes to moles were given full credit if they succeeded. Few did, as a four-step calculation with simple numbers was turned into a seven-step calculation with a unit conversion by electing to follow this approach.

Students needed to use the equation to realise that the SiO_2 formed is a solid, not a gas. They were also told that the oxygen is in excess; that means that the Si_2H_6 is the limiting reactant, and that the gases after reaction would therefore be the water vapour and the remaining oxygen. All that was therefore necessary was to multiply the volume of Si_2H_6 by 3 to find the volume of water vapour formed, and by 7/2 to find the volume of oxygen used. Subtracting that volume from 150 cm^3 would then give the volume of excess oxygen, and adding the volumes of the two appropriate gases together gave the final answer. Only one sixth of students scored at least one mark, which was usually for calculating the volume of water vapour produced.

Answer 07 · Examiner comments June 2023 | 8462/1H | Original Q7

Question 7 (standard, standard/high and high demand)

07.1 Nearly all students could balance the ionic equation correctly.

07.2 About a fifth of students answered this high demand question correctly. Some students compared the reactivity of sodium with hydrogen instead of with aluminium. Imprecise language was sometimes a problem; it is elemental sodium which is more reactive, not sodium ions. Aluminium is released at the electrode, not discharged (it is the ion which is discharged, ie loses its charge). There is no displacement occurring.

07.3 The question discriminated well, but very few fully correct answers were seen, with just over a third of students scoring at least one mark. Students were asked to explain <u>how</u> oxygen is produced from water, not <u>why</u> oxygen is produced. Few students described the initial step outlined in the specification; that water molecules break down to form H^+ ions and OH^- ions. Many seem to think that oxide or 'oxygen' ions are responsible, rather than hydroxide ions. The attraction of the hydroxide ions to the positive electrode was reasonably well known, but few students then correctly described the oxidation or discharge of the hydroxide ions to form oxygen. As in the previous question, the term 'discharged' is widely misunderstood – the word means 'loses its charge', so to say that oxygen is discharged is not correct.

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 07 · Examiner comments June 2023 | 8462/1H | Original Q7

07.4 Nearly two thirds of students scored at least one mark, but just over half of these also scored the second mark. The easiest change to the apparatus is to change the test tubes to measuring cylinders or inverted burettes. Many students suggested gas syringes; this was allowed, although it would be difficult to set up the apparatus in such a way that this would work. However, a 'gas cylinder' is not a measuring device. One popular misconception is that gas would escape from the apparatus so a lid should be used.

Most students realised that the reason was so that the gas volume could be measured rather than estimated, or that test tubes have no scale; any equivalent way of expressing this idea was allowed. Some students used imprecise language such as 'so the gas could be measured' without referring to volume or a scale.

07.5 The great majority of students gave the correct response, with 20 cm^3 being the most common incorrect choice.

Question 10 (standard/high and high demand)

10.1 About a third of students scored one mark, but far fewer scored a second mark. Many students did not give comparative answers. Many referred to nanoparticles having a larger surface area, but failed to realise that this depends on the amount used. A higher surface area to volume ratio, or a higher surface area for the same mass of material was creditworthy and was the most common correct answer. This leads on to other creditworthy answers, such as a thinner coating being needed, and hence, more light getting through the window, but these answers were rarely seen. References to cost were ignored.

10.2 This question discriminated well. The great majority of students scored at least one mark, with nearly a half scoring five or six marks. The most common error was not converting 100 kilograms to grams in order to calculate the moles, or converting incorrectly. Another common error was to calculate a spurious volume of TiO_2. Some converted the number of moles of chlorine to a mass first, before converting to a volume; whilst unnecessary, this did give the correct answer and gained full credit. Students who gained one or two marks usually calculated the relative formula mass of TiO_2 and/or converted 100 kilograms to grams. A few seemed to be concerned by the large value of the answer and introduced a division by 1000 into what would have been a correct answer.

Students sometimes tried more than one method and did not cross out the one they did not want to be marked. This led to confusion and contradictions, sometimes meaning that marks could not be awarded. Students should always cross out discarded methods; examiners will not make the choice for the student.

4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Mark Ranges and Award of Grades

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

Answer 09 · Examiner comments

June 2024 | 8462/1H | Original Q7

Question 7 (standard, standard/high and high demand)

07.1 Only a quarter of students gained both marks, and a third did not score. Many students described how solids in general conduct thermal energy, rather than answering the question which is specifically about conduction in a metal. Many students realised that the process has something to do with delocalised electrons. However, many described how electricity is conducted, rather than thermal energy. The idea of the delocalised electrons transferring thermal energy through the metal was not at all well known. As the question asked how thermal energy is conducted, repetition of the word 'conduct' did not help to explain the meaning of that word.

07.2 This question discriminated well, with over a half of students scoring 2 or 3 marks. There were many well-expressed, complete answers. Common errors often involved an attempt to describe some sort of stronger bonding (sometimes covalent or ionic) in the alloy. Some lost credit because of poor use of language; it is not 'metals' which are different sizes, but their atoms (or positive ions). A common error was to refer to different shapes of atoms. 'Particles' is also insufficient as it could refer to other types of particle than atoms. 'Intermolecular forces' were often referred to, although they are not present in either a pure metal or an alloy.

07.3 Just over a half of students identified the correct equation, spotting that the mole ratio of Fe:Cl_2 was 2:3. The most popular distractor was Fe + Cl_2 → $FeCl_2$, where the student had ignored the information provided about the reacting number of moles.

07.4 Only two fifths of students identified the correct response by working out the total charge of the various combinations and choosing the one with a net zero charge. $3Fe^{2+}$:$4O^{2-}$ was a very popular distractor, with $3Fe^{3+}$:$4O^{2-}$ not far behind.

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Answer 09 · Examiner comments

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07.5 Over three quarters of students obtained full marks on this question. For those who did not, it was sometimes difficult to award any credit because the M_r had not been evaluated. Common errors were $56/M_r$ x 100 or $64/M_r$ x 100. Some students attempted to bring in the 0.12 and 0.18 from question **07.3**, which was about a different compound.

07.6 Those students who understand moles had little difficulty with this question; almost a half scored at least 4 marks. The most common error was a failure to convert the mass of Fe_2O_3 to grams. Some students attempted to calculate a volume of Fe_2O_3, not appreciating that it is a solid as shown by the state symbols in the equation. Some students unnecessarily calculated the mass of carbon dioxide before converting this to a volume. The mole ratio was sometimes applied incorrectly to the mass of Fe_2O_3. Despite being given the M_r of Fe_2O_3 as 160, many students used 320 instead. Whilst this sometimes led mathematically to the 'correct' answer, it is incorrect chemistry and full credit was therefore not awarded.

Answer 10 · Examiner comments

June 2024 | 8462/2H | Original Q5

Question 5 (standard and standard / high demand)

05.1 This was not well understood. Some students knew that nitrogen and oxygen were reacting together. However, some thought that nitrogen came from the fuel and some that oxygen is a product of combustion. Only a minority mentioned high temperature although many said, 'very hot'. About 15% scored both marks.

05.2 Some students stated that no carbon dioxide is produced when hydrogen burns. However, many simply described what carbon dioxide does to the environment, rather than stating that burning hydrogen instead of methane **reduces** the rate of climate change. Many referred to the greenhouse effect without referencing the effect on the environment, ie climate change. Around 40% scored both marks.

05.3 Most realised that increased levels of nitrogen oxides would be produced. Although there were some good descriptions of what nitrogen oxides do to the environment, very few said that those effects would be increased by burning hydrogen instead of methane, ie **more** acid rain etc. Many thought that nitrogen oxides are greenhouse gases rather than a precursor of acid rain. Some suggested more nitrogen was released to the atmosphere, rather than oxides of nitrogen. Less than 10% of students scored both marks, although more than half scored one.

05.4 Over one-third of students gained all three marks. However, some students appeared to believe that the other 80% of the air was hydrogen. Some tried to involve the relative atomic masses, even though these were not provided. A few unnecessarily converted the volume of hydrogen to moles and then the moles of oxygen to volume, not realising that the mole ratio is the volume ratio for gases. This did score full marks if correct.

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Answer 10 · Examiner comments

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05.5 Most scored the mark for kerosene, or the vapours condensing, and many also described the temperature gradient correctly. Far fewer scored the mark for linking the height in the column to the boiling point and the condensation of kerosene. Most did not mention the height or level in the column, while others seem to think that a vapour only condenses at a temperature below, rather than at, its boiling point. A few students thought that kerosene was either a product of cracking, or a polymer. Just over 10% scored all the marks.

Question 9 (standard, standard / high and high demand)

09.1 The idea that gas is lost was well understood but the reason why was less well known. Incorrect responses referred to the solubility of hydrogen in water and faulty apparatus. Around 15% of students gained both marks.

09.2 This question was awarded all four marks to around 20% of the students but a significant number of students did not recognise that the volume of the gas should be converted into dm^3. A small number of students believed that 1 cm^3 = 1000 dm^3 resulting in an answer 10^6 times too large.

09.3 Most students were able to construct a tangent at 45 s. The scale on the *y*-axis posed a problem for a significant number of the students. The calculation of the rate was well done, and most were able to convert their answer into standard form. A small number calculated the mean rate between 0 s and 45 s by drawing a single pair of construction lines which met the curve. Such students were only able to gain a mark for an answer correctly expressed in standard form. Just over half of the students scored five marks.

09.4 The vast majority of the students recognised that the curve started at 0,0 and rose less steeply than the curve shown, but only a minority were able to show that the curve levelled off at 0.0084 mol. Some students lost the first mark by shadowing the existing line for a significant time before becoming less steep. While around 20% of students scored both marks, more than four-fifths scored one.

09.5 This question was quite well done by a large proportion of the students, with nearly half of the students gaining all three marks. The idea that an increase in temperature increased the energy of the particles and therefore increased the rate of reaction was well understood by most students but the increase in collision frequency was less well known. A significant proportion of the students simply stated that there is an increase in the number of collisions with no reference

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4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only)

Answer 11 · Examiner comments June 2024 | 8462/2H | Original Q9

to time. A 'successful' collision was considered insufficient to describe particles whose energy of collision exceeded the activation energy.

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Mark Ranges and Award of Grades

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

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Answer 12 · Examiner comments

June 2025 | 8462/2H | Original Q5

Question 5

05.1 Over four fifths of students correctly estimated the boiling point. Those that did not gain the mark were often giving values that were just outside of the range given in the mark scheme.

05.2 Fewer than half of the students correctly identified ethanol as the product of the reaction between ethene and steam. Many of those who did not gain this mark gave the product as alcohol, which was insufficient.

05.3 Over half of students gained both marks on this item. Where students gained one mark, about 20%, it was because 'damp' was omitted from the test and only litmus paper was given.

05.4 The product of the chlorination of butene was well known by over 90% of students.

05.5 Around three quarters of students correctly identified propene. The most common incorrect response was butene. Very few students did not identify an alkene.

05.6 Around two fifths of students knew that alkenes burn with a smoky flame due to incomplete combustion. Many of the incorrect answers seen referred to there being a double bond present, or that there was insufficient oxygen.

05.7 This multi-step calculation was well answered by over 40% of students who gained all five marks. The most common error was the omission of the volume conversion from dm^3 to cm^3. Some students divided by the volume, rather than multiplying. Equally, a number multiplied by the M_r to calculate the number of moles. In both instances, marks were awarded where clear working was shown for correct

Answer 12 · Examiner comments

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additional steps. when one mark alone was awarded, it was for the correct determination of the M_r.