AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.5

Polymers

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**69**
Available paper years	**2007–2025**

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.

4.2.2.5 Polymers

Answer 01 · Mark scheme

Question 5

	answers	extra information	mark
(a)(i)	poly(ethene)	accept polythene	1
(ii)	cracking		1
(iii)	hydrogen		1
(b)(i)	bar labelled 9 bar drawn to correct height		1 1
(ii)	(boiling point) increases		1
(iii)	heat / evaporate (the crude oil) cool / condense (hydrocarbons at different temperatures)	accept separate by boiling point accept smaller molecules go to top / larger molecules stay at bottom accept fractional distillation for two marks **or** distillation / fractionation for **one** mark	1 1

Continued on next page

4.2.2.5 Polymers

Answer 01 · Mark scheme

	answers	extra information	mark
(c)	**yes** any **two** from: • because plastic does not biodegrade **or** running out of space for landfills **or** land cannot be used for a long time • it provides heat energy • which can be used to generate electricity / heat homes or greenhouses • any other advantage of burning • any other disadvantage of landfill **or** **no** • burning plastic produces carbon dioxide / carbon emissions / toxic gases • causes global warming / climate change / increase greenhouse effect / global dimming / acid rain • any other disadvantage of burning • any other advantage of landfill	accept landfill does not produce carbon dioxide / carbon emissions	2
total			10

4.2.2.5 Polymers

Answer 02 · Mark scheme March 2007 | CHY1B | Original Q1 | Legacy

One	**A**	alkanes	**2**
	B	fuels	**1**
	C	monomers	**4**
	D	polymers	**3**

Answer 03 · Mark scheme March 2007 | CHY1B | Original Q3 | Legacy

Three	**A**	ethanol	**2**
	B	ethene	**4**
	C	helium	**1**
	D	poly(propene)	**3**

Answer 04 · Mark scheme June 2007 | CHY1F | Original Q1 | Legacy

The full source mark scheme begins on page 83. Follow original question 1 in that document.

Answer 05 · Mark scheme November 2007 | CHY1B | Original Q2 | Legacy

Two	**A**	screwdriver	**3**
	B	disposable coffee cup	**4**
	C	bottle for soft drinks	**2**
	D	frying pan	**1**

Answer 06 · Mark scheme November 2007 | CHY1B | Original Q5 | Legacy

Five	**A**	alkene with the smallest molecules	**2**
	B	alkene with the largest molecules	**3**
	C	alkane	**1**
	D	polymer	**4**

4.2.2.5 Polymers

Answer 07 · Mark scheme

January 2008 | CHY1F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
(a)(i)	monomers		1
(a)(ii)	crude oil		1
(b)	any **three** from: • metal may not corrode away / remains • plastic remains / does not break down (decay) / not affected by microorganisms • should recycle / conserve resources / mend the kettle / burn (plastic) as a fuel • landfill sites are limited / filling up • water pollution	accept non-biodegradable accept it is a waste of materials / resources ignore harms wildlife / habitats **or** problems caused by burning the kettle	3
total			5

4.2.2.5 Polymers

Answer 07 · Mark scheme January 2008 | CHY1F | Original Q4 | Legacy

CHY1F

Answer 08 · Mark scheme March 2008 | CHY1BP | Original Q4 | Legacy

Four	**A**	alkanes	**2**
	B	alkenes	**1**
	C	catalysts	**4**
	D	polymers	**3**

Answer 09 · Mark scheme March 2008 | CHY1BP | Original Q5 | Legacy

Five	**A**	**3**
	B	**4**
	C	**1**
	D	**2**

Answer 10 · Mark scheme March 2008 | CHY1BP | Original Q6 | Legacy

Six	**A**	Molecule A	**1**
	B	Molecule B	**4**
	C	Molecule C	**2**
	D	Molecule D	**3**

	A	**B**	**C**	**D**

Answer 11 · Mark scheme June 2008 | CHY1BP | Original Q6 | Legacy

Six	**A**	catalysis	**2**
	B	polymerisation	**3**
	C	combustion	**4**
	D	thermal decomposition	**1**

	A	**B**	**C**	**D**

Answer 12 · Mark scheme June 2008 | CHY1BP | Original Q8 | Legacy

Eight	**1**	**1**	**4**	**1**

4.2.2.5 Polymers

Answer 13 · Mark scheme

June 2008 | CHY1F | Original Q5 | Legacy

question	answers	extra information	mark
5(a)(i)	hydrogen	must be name	1
5(a)(ii)	a line of four or more ethene molecules joined to the original two with single bonds	at least two other ethene molecules joined to the original two in a chain gains **1** mark	2
5(b)(i)	any **two** from: • non-biodegradable • landfill sites are filling up / limited • waste of a resource / could be recycled / reused	accept remains a long time accept land / space used up ignore references to tablets / animals	2
5(b)(ii)	any **one** from: • (two) different polymers / plastics / materials • need to be separated • limited collection points / many need to be collected • tablets may still be present		1
Total			**6**

4.2.2.5 Polymers

Answer 13 · Mark scheme June 2008 | CHY1F | Original Q5 | Legacy

COMPONENT NUMBER: CHY1F

COMPONENT NAME: Science B / Chemistry

STATUS: Final

DATE: June 2008

Answer 14 · Mark scheme March 2009 | CHY1BP | Original Q2 | Legacy

Two	**A**	Use **A**	**4**
	B	Use **B**	**1**
	C	Use **C**	**2**
	D	Use **D**	**3**

Answer 15 · Mark scheme March 2009 | CHY1BP | Original Q9 | Legacy

Nine	**3**	**3**	**4**	**2**

Answer 16 · Mark scheme June 2009 | CHY1BP | Original Q2 | Legacy

Two	**A**	PTFE	**2**
	B	Nylon	**3**
	C	Polystyrene	**1**
	D	PET	**4**

Answer 17 · Mark scheme June 2009 | CHY1BP | Original Q5 | Legacy

Five	**A**	Molecule **A**		**1**
	B	Molecule **B**		**4**
	C	Molecule **C**		**2**
	D	Molecule **D**		**3**
	A	**B**	**C**	**D**

Answer 18 · Mark scheme June 2009 | CHY1BP | Original Q6 | Legacy

Six	**2**	**1**	**2**	**2**

4.2.2.5 Polymers

Answer 19 · Mark scheme

November 2009 | CHY1BP | Original Q9 | Legacy

No matching mark scheme was available in the supplied archive for this question.

4.2.2.5 Polymers

Answer 20 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)(i)	any **one** from: • bond / join (together) • double bond opens	ignore polymerisation / heat	1
5(a)(ii)	any **one** from: • heat / energy • cost of fuels / the crude oil • construction of the factory / plant • wages / salaries	ignore many processes / distillation / cracking / polymerisation	1
5(a)(iii)	any **two** from: • non-biodegradable • landfill sites are filling up / limited • waste of a resource / could be recycled / reused	ignore gases released / burning / habitats accept remains a long time accept land / space used up accept crude oil is running out	2
5(b)	any **two** from: • renewable / sustainable • less fuel <u>burned</u> • biodegradable • <u>natural</u> resource • plants absorb carbon dioxide	ignore recycling ignore crude oil is running out accept less energy / heat needed	2
Total			**6**

4.2.2.5 Polymers

Answer 20 · Mark scheme January 2010 | CHY1F | Original Q5 | Legacy

CHY1F

Answer 21 · Mark scheme March 2010 | CHY1BP | Original Q4 | Legacy

Four	**A**	Kevlar	**3**
	B	Acrylic	**1**
	C	66 Nylon	**2**
	D	Polyester	**4**

Answer 22 · Mark scheme March 2010 | CHY1BP | Original Q6 | Legacy

Six	**2**	**2**	**2**	**4**

Answer 23 · Mark scheme June 2010 | CHY1BP | Original Q3 | Legacy

Three	**A**	Polymer **A**	**1**
	B	Polymer **B**	**4**
	C	Polymer **C**	**2**
	D	Polymer **D**	**3**

Answer 24 · Mark scheme June 2010 | CHY1BP | Original Q8 | Legacy

Eight	**2**	**3**	**1**	**2**

4.2.2.5 Polymers

Answer 25 · Mark scheme

June 2019 | CHY1F | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	A **and** 3 anomalous result	accept A **and** 39 independent mark accept not close to other two volumes **or** correct comparison using the results ignore does not fit the pattern	1 1
5(a)(ii)	any **one** from: • volume of water (used) • time (for water to run through) • temperature • mass / surface area of pad • same filter funnel	 allow amount of water (used) accept rate / speed (at which water runs through) accept amount / size / volume / thickness of pad ignore other equipment	1
5(a)(iii)	any **one** from: • incorrect / volume / amount of water added • reading / volume / amount of water collected • some water does not go through the pad • not enough time allowed for water to drain through • pads (from one company) not identical / faulty	ignore human error unqualified allow spillage / poorly placed pad accept rate / speed at which water is added	1

Question5 Continues on the next page

4.2.2.5 Polymers

CHY1F

Question 5 continued

question	answers	extra information	mark
5(b)(i)	any **two** from: • it was not the best (at absorbing the water) • (needed) to absorb more (water) • to improve their image / sales	accept correct descriptions of 'not the best' / third best **or** only better than B allow not absorbing enough (water) accept (needs) to absorb more (water) than A and C for **2** marks	2
5(b)(ii)	any **one** from: • cost (more) • use (more) resources • use (more) energy	must relate to the company	1
Total			**7**

4.2.2.5 Polymers

Answer 25 · Mark scheme

June 2010 | CHY1F | Original Q5 | Legacy

CHY1F

Answer 26 · Mark scheme

November 2010 | CHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	Crack	**2**
	B	Evaporate	**1**
	C	Polymerise	**4**
	D	Burn	**3**

Answer 27 · Mark scheme

November 2010 | CHY1BP | Original Q9 | Legacy

Nine	**3**	**2**	**4**	**3**

4.2.2.5 Polymers

Answer 28 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	carbon hydrogen	accept in either order ignore number eg 2 carbons 4 hydrogens	1 1
4(a)(ii)	(a carbon carbon) double (bond)		1
4(b)	poly(ethene)		1
4(c)	any **two** from: • made from crude oil • non–renewable resources • litter • not biodegradable • use energy to make • when burned or biodegraded carbon dioxide is released • encourage customers to reuse bags / use their own bags	ignore pollution / cost / global warming / harms environment / recycling accept resources are running out accept go to landfill accept reduces carbon emissions / footprint	2
Total			**6**

4.2.2.5 Polymers

Answer 28 · Mark scheme

January 2011 | CHY1F | Original Q4 | Legacy

CHY1F

4.2.2.5 Polymers

Answer 29 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)(i)	hydrogen		1
3(a)(ii)	partially		1
3(b)(i)	same size / mass / amount / length of magnesium (ribbon) **or** same concentration of acids	allow react for same time ignore repeats ignore volume / amount of acid	1
3(b)(ii)	bubbles / gas given off **or** magnesium disappears / dissolves / reacts slower with ethanoic acid **or** faster with hydrochloric acid		1 1
3(c)(i)	titration	allow titration identified in box if answer line blank	1
3(c)(ii)	burette		1
3(c)(iii)	(indicator) changed colour	allow solution changes colour but not vinegar ignore specific colours	1
Total			8

4.2.2.5 Polymers

Answer 29 · Mark scheme January 2011 | CHY3F | Original Q3 | Legacy

CHY3F

Answer 30 · Mark scheme March 2011 | CHY1BP | Original Q9 | Legacy

Nine	**3**	**2**	**3**	**2**

Answer 31 · Mark scheme June 2011 | CHY1BP | Original Q1 | Legacy

Question	Key		
One	**A**	polymer (dust cover)	**3**
	B	polymer (tray)	**2**
	C	polymer (coat and hat)	**4**
	D	polymer (cable cover)	**1**

Answer 32 · Mark scheme June 2011 | CHY1BP | Original Q4 | Legacy

Four	**A**	alkenes	**2**
	B	polymers	**3**
	C	monomers	**4**
	D	alkanes	**1**

4.2.2.5 Polymers

Answer 33 · Mark scheme

June 2011 | CHY1F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	heat / high temperature / hot / vaporise	if (fractional) distillation / hydrogenation mentioned as the method = max 1 allow thermal decomposition ignore evaporation do **not** accept 'burns' do **not** accept temperature < 100	1
	catalyst **or** silica / alumina / porous pot **or** steam	ignore other named catalyst allow heat (the vapour) to a very high temperature / >800°C for **2** marks	1
7(a)(ii)	C_2H_3Cl	ignore attempts to balance equation	1
7(a)(iii)	single bonds between C – H, C – Cl **and** C – C	do **not** accept symbols outside the bracket	1
7(b)(i)	so that the amount of plasticiser / (sample of) PVC is the independent / only variable that affects the bending / flexibility of the samples	allow because different sizes would give different results accept because size is a control variable ignore references to reliability / precision etc	1
7(b)(ii)	to improve the reliability (of the investigation)	accept to calculate a mean accept to check for anomalous results **or** to check the range of results ignore accuracy / precision etc	1

Question 7 continues on the next page

Question 7 continued

question	answers	extra information	mark
7(b)(iii)	23	correct answer with or without working = **2** marks if answer is incorrect allow $\frac{22+23+24}{3}$ **or** 21 for **1** mark	2
7(b)(iv)	(PVC) sample had been stretched / used / tested in first three tests	accept higher temperature allow worn **or** become weaker ignore (human) error ignore more flexible / softer ignore intermolecular forces	1
7(c)	does not bend (easily / much) **or** it is not flexible **or** it is rigid	ignore non-biodegradable / low maintenance ignore sturdy / stronger / harder	1
Total			**10**

The AQA UMS Conversion Calculator is available on the Results statistics page of the AQA Website

4.2.2.5 Polymers

Answer 34 · Mark scheme

June 2011 | CHY3F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	orange		1
4(a)(ii)	colourless		1
4(a)(iii)	a carbon carbon double bond		1
4(b)(i)	C		1
4(b)(ii)	B		1
4(b)(iii)	only produces water **or** does not produce carbon dioxide	do **not** accept CO^2	1
Total			**6**

4.2.2.5 Polymers

Answer 34 · Mark scheme

June 2011 | CHY3F | Original Q4 | Legacy

CHY3F

Answer 35 · Mark scheme

November 2011 | CHY1BP | Original Q2 | Legacy

Two	**A**	can withstand high temperatures and is non-stick	**2**
	B	can be stretched into fibres	**3**
	C	makes a very light, solid foam which is a good . . .	**1**
	D	strong, rigid and a good electrical insulator	**4**

Answer 36 · Mark scheme

November 2011 | CHY1BP | Original Q9 | Legacy

Nine	**1**	**3**	**1**	**3**

4.2.2.5 Polymers

Answer 37 · Mark scheme

June 2012 | CH1FP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	Aluminium has a low density Aluminium is resistant to corrosion		1 1
3(b)(i)	(an alloy) is a mixture of metals	accept (an alloy) can be a metal mixed with another metal **or** iron mixed with carbon / a non-metal	1
3(b)(ii)	pure metals are soft **or** alloys are hard	allow weak allow strong / keep their shape ignore rust / corrosion	1
3(c)(i)	crude oil		1
3(c)(ii)	hydrocarbons		1
3(c)(iii)	oxygen		1
3(d)(i)	hydrogen	allow H_2 or H	1
3(d)(ii)	only water is produced (from the fuel) **or** no carbon dioxide is produced (from the fuel)	 allow less carbon dioxide produced **or** less global warming allow carbon dioxide causes global warming	1
Total			**9**

4.2.2.5 Polymers

Answer 37 · Mark scheme

June 2012 | CH1FP | Original Q3 | Legacy

CH1FP

4.2.2.5 Polymers

Answer 38 · Mark scheme

June 2012 | CH1FP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)(i)	(1) 5 3 (6) 4 2	all numbers in the correct order gains both marks any two numbers in the correct position gains **1** mark	2
8(a)(ii)	water	ignore formula if correct name given accept hydrogen oxide allow H_2O	1
	carbon dioxide	allow CO_2 accept carbon monoxide / CO **or** carbon / C	1

Question 8 continues on the next page . . .

CH1FP

Question 8 cont'd

question	answers	extra information	mark
8(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. **Examiners should also refer to the information on page 2**, and apply a 'best-fit' approach to the marking.		6

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content.	There is a **basic** description of at least one advantage **or** one disadvantage caused by using plastic shopping bags made from poly(ethene).	There is a **clear** description of both an advantage **and** a disadvantage caused by using plastic shopping bags made from poly(ethene).	There is a **detailed** description of both advantages **and** disadvantages caused by using plastic shopping bags made from poly(ethene).

examples of the chemistry/social points made in the response:
ignore cost unqualified

Advantages:

- Simple properties eg strong / low density / water resistant
- Bags can be reused (for shopping) **or** another specified use eg bin liners
- Money charged for bags can go to good causes **or** encourage reuse
- Poly(ethene) bags can be recycled eg made into milk bottle crates
- Poly(ethene) bags can be burned to provide heat for buildings/generation of electricity
- New bags are now made that can biodegrade

Disadvantages:

- (Older) bags can take many years to biodegrade
- There is a shortage of landfill space
- Bags are made from (crude) oil which is a non-renewable resource/running out
- Large amounts of energy/fuel are used for the production of poly(ethene)
- Production of poly(ethene) releases carbon dioxide/causes global warming
- Specified issue caused by litter eg visual pollution or effect on wildlife
- Burning bags release carbon dioxide / causes global warming

Total			10

UMS Conversion Calculator www.aqa.org.uk/umsconversion

4.2.2.5 Polymers

Answer 39 · Mark scheme

June 2012 | CH2FP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	79 79		1 1
2(b)	hundred		1
2(c)(i)	electron(s)		1
2(c)(ii)	three		1
2(d)	changes rate of reaction **or** speeds up / slows down reaction	accept lowers activation energy accept reduces costs	1
2(e)(i)	melt		1
2(e)(ii)	crosslinking **or** (covalent) bonds between polymers / chains	allow answers on diagram allow bonds between layers do **not** allow intermolecular	1
Total			**8**

4.2.2.5 Polymers

Answer 39 · Mark scheme

June 2012 | CH2FP | Original Q2 | Legacy

CH2FP

4.2.2.5 Polymers

Answer 40 · Mark scheme

question	answers	extra information	mark
4(a)	would melt	accept they have a low melting point allow lose their shape ignore would soften when hot ignore boiling point	1
4(b)	to speed up the reaction	accept can use a lower temperature accept less energy needed	1
4(c)(i)	mass spectrometer	allow mass spectroscopy	1
4(c)(ii)	any **one** from: • accurate • sensitive • rapid / quicker • small amount of sample	ignore reliable ignore more precise	1
4(d)	any **two** from: • pressure • temperature • catalyst **or** initiator • solvent	allow concentration	2
Total			**6**

4.2.2.5 Polymers

Answer 40 · Mark scheme

January 2013

CH2FP

4.2.2.5 Polymers

Answer 41 · Mark scheme

January 2013 | CH2FP | Original Q8 | Legacy

question	answers	extra information	mark
8(a)(i)	because they are positively charged	accept they are positive / H^+ accept oppositely charged **or** opposites attract ignore they are attracted	1
8(a)(ii)	gains one / an electron	accept $H^+ + e^- \rightarrow H$ or multiples allow gains electrons	1
8(b)	3 bonding pairs 1 lone pair	 accept 2 non-bonding electrons on outer shell of nitrogen	1 1
8(c)(i)	hydroxide / OH^-	do **not** accept sodium hydroxide	1
8(c)(ii)	$H^+ + OH^- \rightarrow H_2O$	ignore state symbols ignore word equation	1

January 2013

CH2FP

question	answers	extra information	mark
8(d)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.		6

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content.	There are basic descriptions of advantages or disadvantages of the electrolysis cells.	There are clear descriptions of environmental or economic advantages or disadvantages of the electrolysis cells. Comparisons may be implied.	There are detailed descriptions of environmental and economic advantages and disadvantages, comparing the electrolysis cells.

examples of chemistry points made in the response:

Accept converse where appropriate.

- mercury cell is more expensive to construct
- mercury is recycled but membranes must be replaced
- mercury is toxic but membrane / polymer is not
- removing traces of mercury from waste is expensive
- mercury cell uses more electricity
- mercury cell produces chlorine that is purer
- mercury cell produces higher concentration / better quality of sodium hydroxide (solution)

Total			12

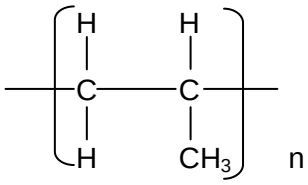
UMS conversion calculator www.aqa.org.uk/umsconversion

4.2.2.5 Polymers

Answer 42 · Mark scheme

June 2013 | CH1FP | Original Q5 | Legacy

Question 5

question	answers	extra information	Mark
5(a)(i)	ethene	allow C_2H_4	1
5(a)(ii)		accept line drawn from word 'Monomer' or from the monomer box to the correct 'Polymer' allow the correct 'Polymer' indicated by a tick, circled etc.	1
5(b)(i)	nickel	accept Ni	1
5(b)(ii)	75(%)		1
5(b)(iii)	(stainless steel) is hard /strong / durable (stainless steel) resistant to corrosion **or** unreactive	it = stainless steel accept (pure) iron is soft accept (pure) iron rusts / corrodes / reacts do **not** allow corrosive	1 1
5(c)	**Advantage**: Conserves resources of crude oil and ores **Disadvantage**: High cost of separating materials	do **not** allow more than one tick in the advantage column do **not** allow more than one tick in the disadvantage column	1 1
Total			**8**

4.2.2.5 Polymers

Answer 43 · Mark scheme

Question 2

question	answers	extra information	Mark
2(a)	11		1
2(b)(i)	nitric		1
2(b)(ii)	neutralisation		1
2(c)	fertiliser	accept helps plants grow accept provide nitrogen	1
2(d)(i)	nitrate iodide	must be in this order	1 1
2(d)(ii)	precipitate		1
2(d)(iii)	filtration/filtering		1
2(d)(iv)	crystallisation	allow evaporation / heat / cooling do **not** accept freezing ignore “leave it” if unqualified	1
Total			9

4.2.2.5 Polymers

Answer 44 · Mark scheme

June 2013 | CH2FP | Original Q5 | Legacy

Question 5

question	answers	extra information	Mark
5(a)	giant lattices		1
5(b)(i)	heat / warm / increase the temperature	allow reduce pressure do not accept melt	1
5(b)(ii)	(polymer) chains cannot slide because they have cross-links	 if no other mark awarded allow polymers do not melt for **1** mark	1 1
5(c)(i)	separates (substances)		1
5(c)(ii)	any **two** from: • quick / rapid • accurate • can detect small quantities / sensitive	ignore reliable / precise / efficient ignore references to cost	2
Total			**7**

4.2.2.5 Polymers

Answer 45 · Mark scheme

June 2014 | CH1FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
4(a)	hydrocarbons **or** hydrocarbon		1	1 / 1.4.1c	G
4(b)(i)	distillation		1	1 / 1.4.2b	G
4(b)(ii)	evaporation		1	2 / 1.4.2b	G
4(b)(iii)	condensation		1	2 / 1.4.2b	G
4(c)(i)	bond		1	1 / 1.4.2a	G
4(c)(ii)	$(C_6H)_{14}$		1	2 / 1.4.2a	G
4(c)(iii)	cracking		1	1 / 1.5.1a	G
4(d)(i)	poly(butene)	allow with or without brackets	1	1 / 1.5.2a	E
4(d)(ii)	Advantage=energy is released Disadvantage=carbon dioxide is produced	do **not** accept more than one tick in the advantage column do **not** accept more than one tick in the disadvantage column	1 1	3 / 1.5	G
Total			**10**		

4.2.2.5 Polymers

Answer 45 · Mark scheme

June 2014 | CH1FP | Original Q4 | Legacy



4.2.2.5 Polymers

Answer 46 · Mark scheme

June 2014 | CH1FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
5(a)(i)	economical		1	1 / 1.3.1a	A
5(a)(ii)	phytomining		1	1 / 1.3.1g	A
5(a)(iii)	carbon dioxide		1	1 / 1.3.1d/f	A
5(b)(i)	copper / Cu iron sulfate / $FeSO_4$		1 1	2 / 1.3.1h	E
5(b)(ii)	copper/ ions have a positive charge	it = copper ions allow copper ions have a different charge accept copper / ions are free to move accept to gain electrons accept copper / ions are attracted to the negative electrode **or** opposite charges attract	1	1 / 1.3.1h	E
5(c)	any **two** from: • copper ores are limited / running out • copper can be recycled • copper can be reused • copper is expensive • landfill sites are filling up • copper compounds are toxic	ignore not biodegradable or does not decay allow copper is running out allow copper is toxic	2	3 / 1.3.1j	E
Total			**8**		

4.2.2.5 Polymers

Answer 46 · Mark scheme

June 2014 | CH1FP | Original Q5 | Legacy



4.2.2.5 Polymers

Answer 47 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
2(a)	alloy		1	1 / 2.2.4d	A
2(b)	in mixture: *different sized / bigger atoms* *so there are no layers / rows / lines (to slide)*	accept converse	 1 1	1 / 2.2.4c / 2.1.1h	E
2(c)	any **two** from: • cost • toxicity • strength • *appearance of brace* • *unreactive **or** resistant to corrosion / saliva*	*ignore references to bend and mould* *allow rusting as alternative to corrosion*	2	3 / 2.2.4	E
2(d)	crosslinks	*allow lines / bonds between the rows / chains*	1	1 / 2.2.5b	E
Total			**6**		

4.2.2.5 Polymers

Answer 47 · Mark scheme

June 2014 | CH2FP | Original Q2 | Legacy



4.2.2.5 Polymers

Answer 48 · Mark scheme

June 2015 | CH1FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	the polymer is not biodegradable the polymer is waterproof		1 1	2 / 1.5.2b/c
4(a)(ii)	any **one** from: • made from a renewable/sustainable resource • is biodegradable	ignore releases less carbon dioxide allow decomposes	1	3 / 1.5.2c/d
4(b)(i)	crushing filtering	in the correct order	1 1	1 / 1.6.1a
4(b)(ii)	open the tap to allow only water to flow out **or** close the tap to leave the oil in the funnel	allow close tap then allow oil to flow out into a separate container	1 1	2 / 1.6.1a
4(c)(i)	They provide a lot of energy		1	1 / 1.6.1b
4(c)(ii)	because the vegetable/plant absorbs / uses carbon dioxide which is released when the biofuel burns	second marking point is dependent on first marking point allow a fossil fuel releases locked up carbon dioxide/carbon if no other mark awarded allow carbon neutral for **one** mark	1 1	1 / 1.5.2a
Total			**10**	

4.2.2.5 Polymers

Answer 48 · Mark scheme

June 2015 | CH1FP | Original Q4 | Legacy



4.2.2.5 Polymers

Answer 49 · Mark scheme

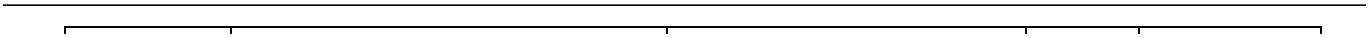
June 2016 | CH2FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
2(a)(i)	hard	ignore strong	1	AO2 2.2.3b
2(a)(ii)	hundred		1	AO1 2.2.6a
2(b)(i)	Covalent		1	AO1 2.2.3a
2(b)(ii)	3		1	AO1 2.2.3.c
2(b)(iii)	Soft and slippery		1	AO1 2.2.3a,c
2(c)(i)	cross-links	allow bonds ignore links do **not** accept intermolecular	1	AO1 2.2.5b
2(c)(ii)	melt		1	AO1 2.2.5b
2(c)(iii)	any **two** from: • temperature • pressure • catalyst	allow heat(ing)	2	AO1 / AO3 2.2.5a
2(d)(i)	CH_4		1	AO1 2.1.1g
2(d)(ii)	Small molecules		1	AO1 2.2.1a
Total			**11**	

4.2.2.5 Polymers

Answer 49 · Mark scheme

June 2016 | CH2FP | Original Q2 | Legacy



4.2.2.5 Polymers

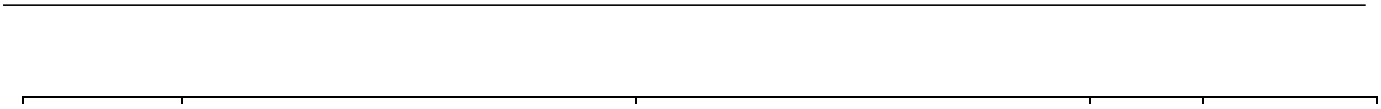
Answer 50 · Mark scheme June 2017 | CH1FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	hydrogen	allow H ignore numbers	1	AO2 1.1.2
2(b)	about 100		1	AO1 1.1.1a
2(c)	same number of electrons in the outer shell similar chemical reactions		1 1	AO1 1.1.2a
2(d)	noble transition	ignore inert	1 1	AO1 1.1.2b 1.3.3a
2(e)	ions molecules	in this order	1 1	AO2 1.1.3a
Total			8	

4.2.2.5 Polymers

Answer 50 · Mark scheme

June 2017 | CH1FP | Original Q2 | Legacy



4.2.2.5 Polymers

Answer 51 · Mark scheme

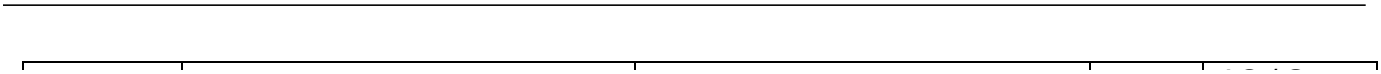
June 2017 | CH2FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	s		1	AO2 2.6.1a
2(a)(ii)	to speed up the reaction		1	AO2 2.6.1b
2(a)(iii)	tick (✓) by: 1		1	AO1 2.6.2d
2(a)(iv)	tick (✓) by: To make sure all the sulfuric acid has reacted		1	AO1 2.6.1b
2(b)(i)	funnel	accept filter funnel	1	AO1 2.6.1b
2(b)(ii)	heat / evaporate / boil	accept cool accept leave (to evaporate) do **not** accept heat until all water gone	1	AO1 2.6.1b
2(c)	tick (✓) by: The student left some copper sulfate crystals in the apparatus.		1	AO3 2.3.3d
2(d)(i)	white	accept grey	1	AO1 2.5.1d
2(d)(ii)	it goes blue	accept steam / water vapour ignore unspecified colour change	1	AO1 2.5.1d
2(e)(i)	polymers		1	AO1 2.2.5a
2(e)(ii)	as wealth decreases, ethene production decreases	accept converse	1	AO2 2.6; 3.7.12
2(e)(iii)	no relationship		1	AO2 2.6; 3.7.12
Total			12	

4.2.2.5 Polymers

Answer 51 · Mark scheme

June 2017 | CH2FP | Original Q2 | Legacy



Answer 52 · Mark scheme

June 2017 | CH2FP | Original Q6 | Legacy

The full source mark scheme begins on page 95. Follow original question 6 in that document.

Answer 53 · Mark scheme

June 2018 | 8462/1F | Original Q6

The full source mark scheme begins on page 109. Follow original question 6 in that document.

4.2.2.5 Polymers

Answer 54 · Mark scheme

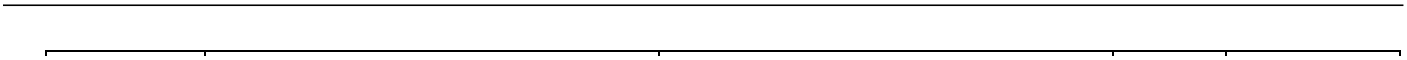
June 2018 | 8462/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	<table><tr><th>property</th><th>J</th><th>K</th></tr><tr><td>density in g/cm^3</td><td></td><td></td></tr><tr><td>melting point in °C</td><td></td><td>✓</td></tr><tr><td>flame resistance</td><td></td><td>✓</td></tr><tr><td>water absorption</td><td>✓</td><td></td></tr></table>	three correct = **2** marks one or two correct = **1** mark	2	AO3 4.10.1.1 4.10.3.3
03.2	$\frac{1.4 \times 6.0}{0.90}$ = 9.3 (kg)	an answer of 9.3(333…)(kg) scores **2** marks allow 9.3(333...)(kg)	1 1	AO2 4.10.1.1 4.10.3.3
03.3	polymer **L** will not melt		1	AO3 4.10.3.3
03.4	polymers are more hard-wearing		1	AO3 4.10.1.1
03.5	any **two** from: • (wool / sheep) renewable • (wool) will not run out • (crude oil) non-renewable • (crude oil) will run out	allow wool grows back, etc ignore (wool is) readily available allow finite ignore references to cost ignore properties from tables 1 and 2	2	AO2 4.10.1.1
Total			**8**	

4.2.2.5 Polymers

Answer 54 · Mark scheme

June 2018 | 8462/2F | Original Q3

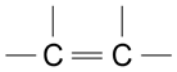


4.2.2.5 Polymers

Answer 55 · Mark scheme

June 2019 | 8462/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	covalent		1	AO1 4.2.1.4
05.2			1	AO1 4.7.2.1 4.7.2.2
05.3	composite		1	AO2 4.10.3.3
05.4	limestone sand	either order	1 1	AO1 4.10.3.3
05.5	any **two** from: (makes the board) • strong • hard • tough • waterproof • durable • aesthetic reasons • rigid • less friction • protection	ignore corrosion / erosion / rotting / rusting allow long lasting allow streamlined / smooth allow prevents damage	2	AO3 4.10.3.3
05.6	(advantages of addition polymers) low(er) cost low(er) density (disadvantages of addition polymers) weak(er) hard(er) to dispose of	 allow cheap(er) allow light(er) allow (more) likely to break ignore references to recycling or use as a fuel	 1 1 1 1	AO3 4.10.1.1 4.10.2.1

4.2.2.5 Polymers

Answer 55 · Mark scheme

June 2019 | 8462/2F | Original Q5

05.7	150 = $\frac{5.25}{\text{volume}}$ (volume =) $\frac{5.25}{150}$ (volume =) 0.035 (m^3)	an answer of 0.035 (m^3) scores **3** marks. allow **2** marks for an answer of 0.105 (m^3) (addition polymer)	1 1 1	AO2 4.10.1.1
Total			**14**	

Answer 56 · Mark scheme

November 2020 | 8462/1F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$C_6H_8O_7$		1	AO2 4.2.1.4
06.2	covalent		1	AO1 4.2.1.4
06.3	shows (single and) double bonds shows which atoms are which element		1 1	AO3 4.2.1.4
06.4	temperature decreases (during the reaction)	allow (the solution) gets colder	1	AO3 4.5.1.1 RPA 4
06.5	all six points plotted correctly line of best fit extrapolation to meet the printed line	allow a tolerance of ± ½ small square allow **1** mark for four / five points plotted correctly	2 1 1	AO2 4.5.1.1 RPA 4
06.6	22.6 – 20.2 = 2.4 (°C)	allow ecf from question **06.5** ignore sign if no other mark awarded allow **1** mark for 2.2 (°C)	1 1	AO2 4.5.1.1 RPA 4

4.2.2.5 Polymers

Question 6 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	temperature of solution		1	AO1 4.5.1.1 RPA 4
Total			**12**	

4.2.2.5 Polymers

Answer 57 · Mark scheme

November 2020 | 8462/1F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	poly(ethene)		1	AO2 4.2.1.4
	water		1	4.2.2.4 4.2.2.5

Question 8 continued

Question	Answers	Mark	AO/ Spec. Ref
08.2	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	4–6	AO1 4.2.1.2 4.2.1.3 4.2.1.4
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	
	Indicative content • (both) carbon dioxide and silicon dioxide are made up of atoms • (but) magnesium oxide is made up of ions • (both) silicon dioxide and magnesium oxide are giant structures • (but) carbon dioxide is small molecules • with weak intermolecular forces • all three compounds have strong bonds • (both) carbon dioxide and silicon dioxide are formed from two non-metals • (so) bonds formed are covalent • (so) electron (pairs) are shared (between atoms) • (but) magnesium oxide is formed from a metal and a non-metal • (so) bonds in magnesium oxide are ionic • (so) electrons are transferred • from magnesium to oxygen • two electrons are transferred • bonds in silicon dioxide are single bonds • (where) each silicon forms four bonds • (and) each oxygen forms two bonds • (but) in carbon dioxide the bonds are double bonds • (where) carbon forms two double bonds • (and) oxygen forms one double bond ignore properties e.g. melting point, electrical conductivity		

Total			8

4.2.2.5 Polymers

Answer 58 · Mark scheme

November 2020 | 8462/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	disposal at the end of useful life		1	AO3 4.10.2.1
06.2	heating in a furnace shaping wet clay		1 1	AO1 4.10.3.3
06.3	polymers propene	allow (a) monomer	1 1	AO1 AO2 4.7.3.1
06.4	cracking fractional distillation		1 1	AO2 4.7.1.2 4.7.1.4
06.5	covalent		1	AO1 4.2.2.5 4.7.3.1
06.6	thermosetting		1	AO3 4.10.3.3
06.7	polymer **A** has crosslinks (between polymer molecules) **or** polymer **B** has no crosslinks (between polymer molecules)		1	AO3 4.10.3.3
Total			**10**	

4.2.2.5 Polymers

Answer 59 · Mark scheme

November 2021 | 8462/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$\frac{54 + 50 + 55}{3}$ = 53 (°C)	if no other mark awarded allow **1** mark for $\frac{54 + 50 + 37 + 55}{4}$ = 49 (°C)	1 1	AO3 AO2 4.4.1.2 4.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(most reactive) magnesium zinc (least reactive) cobalt	allow ecf from question **04.1**	1	AO3 4.4.1.2 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(18 ±) 2 (°C)		1	AO2 4.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	control		1	AO1 4.4.1.2 4.5.1.1 RPA4

4.2.2.5 Polymers

Answer 59 · Mark scheme

November 2021 | 8462/1F | Original Q4

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	use the same mass of metal / powder		1	AO3 4.4.1.2 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(A) progress of reaction (B) activation energy (C) products		1 1 1	AO1 4.5.1.2

Total			9

4.2.2.5 Polymers

Answer 60 · Mark scheme

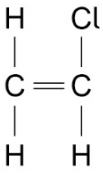
November 2021 | 8462/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	limestone sodium carbonate		1 1	AO1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(advantage) stronger (reason) less easily damaged		1 1	AO3 AO2 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(advantage) lower density (reason) lighter (to install)		1 1	AO3 AO2 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4			1	AO2 4.7.3.1

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

Question 3 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(polymers) last a long time (wood) renewable	ignore references to cost allow break down slowly allow trees can be replanted allow aesthetic reasons	 1 1	 AO3 AO1 4.10.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	(percentage of aluminium =) $\frac{5.94}{6.00} \times 100$ = 99 (%)		1 1	AO2 4.10.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	(alloy is) harder (than pure aluminium)	allow (alloy is) stronger (than pure aluminium) ignore references to cost	1	AO2 4.2.2.7 4.10.3.2

Total			14

4.2.2.5 Polymers

Answer 61 · Mark scheme

November 2021 | 8462/2F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	fuel		1	AO1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	propene		1	AO2 4.7.2.1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(percentage yield =) $\frac{380}{400} \times 100$ = 95 (%)		1 1	AO2 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	some ethanol changes back into ethene and steam some ethanol escapes from the apparatus		1 1	AO2 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	C_2H_5OH + **3** O_2 → 3 H_2O + 2 CO_2	allow multiples	1	AO2 4.1.1.1 4.3.1.1 4.7.2.3

4.2.2.5 Polymers

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(advantages) (fermentation) low energy usage (fermentation) uses renewable raw materials (disadvantages) (fermentation) produces impure ethanol (fermentation) slow rate of reaction		 1 1 1 1	AO3 4.7.2.2 4.7.2.3 4.10.1.1

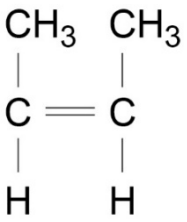
Total			**11**

4.2.2.5 Polymers

Answer 62 · Mark scheme

June 2022 | 8462/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	C=C bond		1	AO2 4.7.3.1
	2x C-H bonds **and** 2x C-CH_3 bonds	do **not** accept extra bonds	1	
		an answer of  scores **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	any **one** from: • (otherwise) the copper (produced) would be impure • (otherwise) the copper (produced) would be a mixture • (otherwise) the insulation would burn / melt (during recycling) • copper and poly(butene) are recycled by different methods	allow (otherwise) the copper (produced) would be contaminated allow (otherwise) poly(butene) could produce toxic fumes	1	AO3 4.10.2.2

4.2.2.5 Polymers

Answer 62 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(wire heated until) copper melts (re)cast / reformed (into pipes)	 allow (re)shaped / extruded / (re)moulded	1 1	AO1 4.10.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	 any **two** from: (recycling scrap copper) • uses less energy • conserves copper (ore) • (produces) less waste • specified environmental impact	allow converse statements for extracting copper from ores ignore references to cost allow less landfill required	 2	AO1 4.10.1.1 4.10.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	 sodium hydroxide (solution) blue precipitate	MP2 dependent on MP1 allow NaOH for sodium hydroxide allow blue solid	 1 1	AO1 4.8.3.2 RPA7

4.2.2.5 Polymers

Answer 62 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	(add acidified) barium chloride (solution)	MP2 dependent on MP1 allow $BaCl_2$ for barium chloride allow (add acidified) barium nitrate (solution) do **not** accept add sulfuric acid	1	AO1 4.8.3.5 RPA7
	white precipitate	allow white solid	1	

Total Question 8		11

4.2.2.5 Polymers

Answer 63 · Mark scheme

June 2022 | 8462/2F | Original Q10

Question 10

Question	Answers	Mark	AO / Spec. Ref
10.1	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3 4.10.1.1 4.10.2.1
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content **raw materials** • crude oil is finite • quarrying / mining pollute the environment • glass uses more energy to process raw materials **manufacturing** • glass uses more energy to make bottles • glass is heavier so takes more energy to transport **use and operation** • glass bottles are reusable • reuse of glass conserves (natural) resources • reuse of glass consumes energy during washing • reuse of glass consumes water during washing **disposal** • both glass and polymer bottles can be recycled • recycling polymer conserves finite resources • recycling glass and polymer uses less energy than making new glass and polymer • both methods reduce use of landfill **other points** • energy needed may be derived from fossil fuels • use of fossil fuels causes (specified) pollution • total energy for glass (bottle) (7500 kJ) is greater than total energy for polymer (bottle) (1800 kJ) **reasoned judgement**		

4.2.2.5 Polymers

Answer 63 · Mark scheme

June 2022 | 8462/2F | Original Q10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	mass = density × volume mass = 0.40 × 40 = 16 (g)		1 1 1	AO2 4.10.1.1 4.10.2.1

Total Question 10		**9**

4.2.2.5 Polymers

Answer 64 · Mark scheme

June 2023 | 8462/1F | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(independent variable) mass (of ammonium nitrate) (dependent variable) (lowest) temperature (reached by solution)	 allow change in temperature (of solution)	1 1	AO1 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	all 6 points plotted correctly line of best fit	allow a tolerance of ± ½ a small square allow **1** mark for 4 or 5 points plotted correctly	2 1	AO2 AO3 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	line extrapolated to *y*-axis (initial temperature) value for temperature where extrapolated line meets *y*-axis	 allow a tolerance of ± ½ a small square	1 1	AO3 AO2 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	temperature decreased	ignore correct references to energy transfer	1	AO1 4.5.1.1 RPA4

4.2.2.5 Polymers

Answer 64 · Mark scheme

June 2023 | 8462/1F | Original Q10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	(0.3 °C) is the uncertainty (because 0.3 °C) is the range about the mean value	 allow values are (a maximum of) 0.3 (°C) either side of the mean allow (because) 16.8 = 16.5 + 0.3 **and** 16.2 = 16.5 – 0.3	1 1	AO2 4.3.1.4 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.6	random error		1	AO3 4.5.1.1 RPA4

Total Question 10	**11**

4.2.2.5 Polymers

Answer 65 · Mark scheme

June 2023 | 8462/2F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(the poly(propene) beaker will begin to) melt (the poly(propene) beaker will) burn / ignite	allow poly(propene) has a low melting point allow poly(propene) is flammable	1 1	AO3 4.7.3.1

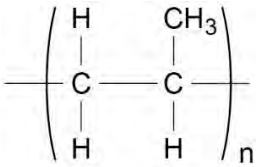
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(poly(propene) beakers are) less easily broken	allow (poly(propene) beakers are) less likely to shatter allow (poly(propene) beakers are) tougher allow (poly(propene) beakers have a) higher resistance to impact	1	AO3 4.7.3.1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	boron trioxide		1	AO1 4.10.3.3

Question	Answers	Mark	AO / Spec. Ref.
02.4	<table><tr><th>Symbol for element</th><th>Name of element</th><th>Number of atoms of element in one molecule of propene</th></tr><tr><td>C</td><td>carbon</td><td>3</td></tr><tr><td>H</td><td>hydrogen</td><td>6</td></tr></table> if no other mark awarded allow **1** mark for a correct column	1 1	AO1 AO2 4.1.1.1 4.7.2.1

4.2.2.5 Polymers

Answer 65 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5			1	AO2 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(**Stage 1** is) fractional distillation		1	AO1
	(**Stage 2** is) cracking		1	AO2
	(**Stage 3** is) polymerisation		1	AO2 4.7.1.2 4.7.1.4 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	alkene		1	AO2 4.7.2.1
	monomer		1	4.7.3.1

Total Question 2	12

4.2.2.5 Polymers

Answer 66 · Mark scheme

June 2024 | 8462/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	displacement		1	AO1 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(percentage =) $\frac{63.5}{159.5} \times 100$		1	AO2 4.3.1.2
	= 39.81191 (%)		1	
	= 39.8 %	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses both the values in the question	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	volume of copper sulfate solution		1	AO1 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	0.8(0) g		1	AO3 4.5.1.1 RPA4

4.2.2.5 Polymers

Answer 66 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(maximum temperature change) = 47 – 22 (°C) = 25 (°C)	 allow correct use of incorrectly determined value(s) from the graph	1 1	AO2 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(conversion 25 cm^3 =) 0.025 dm^3 (concentration =) $\frac{6.75}{0.025}$ (g/dm^3) = 270 (g/dm^3)	 allow correct use of an incorrectly determined or unconverted volume	1 1 1	AO2 4.3.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	line of best fit using the first five points line of best fit using the last four points	max **1** mark if the lines do not intersect	1 1	AO2 4.5.1.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	energy is **taken in from** the surroundings so the reaction is **endothermic**		1	AO3 4.5.1.1 RPA4

Total Question 3	14

4.2.2.5 Polymers

Answer 67 · Mark scheme

June 2024 | 8462/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	percentage of nitrogen increases until 2.3 billion years then remains constant	 allow a value in the range 2.1 to 2.4 billion years allow until 80% 	1 1 1	AO2 4.9.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the percentage of carbon dioxide decreased		1	AO1 4.9.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	light		1	AO1 4.9.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	algae plants		1 1	AO1 4.9.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	cellulose starch		1 1	AO1 4.7.3.4

4.2.2.5 Polymers

Answer 67 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	1.4×10^{11}		1	AO2 4.3.1.2 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	70 000 000 000		1	AO2 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	helix		1	AO1 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.9	4		1	AO1 4.7.3.4

Total Question 4	**13**

4.2.2.5 Polymers

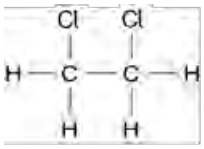
Answer 68 · Mark scheme

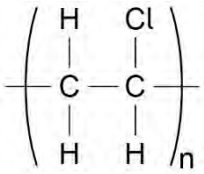
June 2024 | 8462/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	colourless	ignore clear	1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	damp litmus paper		1	AO1 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3			1	AO1 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4			1	AO2 4.7.3.1

4.2.2.5 Polymers

Answer 68 · Mark scheme

June 2024 | 8462/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	1.5 × 10 0.9 × 10		1	AO2 4.7.3.1
	(ratio =) 15 : 9		1	
	= 5 : 3	allow correct determination of the simplest whole number ratio from an attempt at a density ratio	1	
	alternative approach			
	(ratio =) $\frac{1.5}{0.9}$ $\frac{0.9}{0.9}$ (1)			
	1.666 : 1 (1)			
	= 5 **:** 3 (1)	allow correct determination of the simplest whole number ratio from an attempt at a density ratio		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	the pipes will melt **or** the polymers will melt	allow the melting point of both polymers is below 300°C	1	AO3 4.7.3.1 4.10.3.3

4.2.2.5 Polymers

Answer 68 · Mark scheme

June 2024 | 8462/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	oil is non-renewable **or** paper is obtained from a renewable source	allow oil is finite	1	AO2 4.10.1.1

Total Question 6	**9**

4.2.2.5 Polymers

Answer 69 · Mark scheme

June 2025 | 8462/1F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	CaS		1	AO2 4.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	calcium (atom) loses electrons		1	AO2 4.2.1.1 4.2.1.2
	sulfur (atom) gains electrons		1	
	reference to transfer of two electrons		1	
	calcium forms positive ions **and** sulfur forms negative ions	allow Ca^{2+} (ions) **and** S^{2-} (ions) are formed allow calcium ions **and** sulfide ions are formed	1	

4.2.2.5 Polymers

Answer 69 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
09.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.2.1.1 4.2.1.4 4.2.2.6 4.2.3.2
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	
	No relevant content	0	
	Indicative content • giant structure • layers • of hexagonal rings • each (carbon) atom forms three bonds • has no covalent bonds between layers • with delocalised electrons • one delocalised electron from each carbon atom • the bonds are covalent • with shared (pairs of) electrons • the (covalent) bonds are strong		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	the molecules do not have an (overall electric) charge	allow there are no ions allow there are no delocalised electrons	1	AO1 4.2.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	poly(ethene) has stronger intermolecular forces to overcome than methane		1	AO1 4.2.2.4 4.2.2.5

Total Question 9	11

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Chemistry 4421

CHY1F Unit Chemistry 1

Mark Scheme

2007 examination - June series

4.2.2.5 Polymers

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Dr Michael Cresswell, Director General.

4.2.2.5 Polymers

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.2.2.5 Polymers

CHY1F Question 1

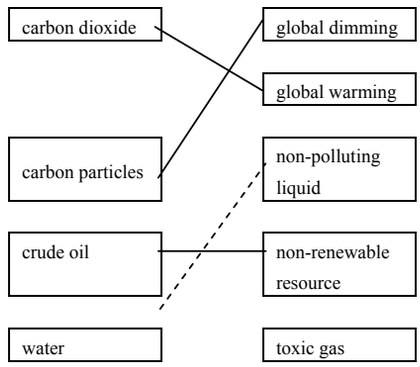
	answers	extra information	mark
(a)	low density unreactive		1 1
(b)	a polymer		1
(c)	any **one** from: • not broken down by (microorganisms) • does not decay (naturally)	ignore cannot recycle / degrade / disintegrate	1
total			4

CHY1F Question 2

	answers	extra information	mark
(a)(i)	additive		1
(b)	any **three** from: • colour 1 is made up of only one colour / dye • colour 2 is made up of only one colour / dye • colour 3 is made up of two colours / dyes **or** more colours (than colours 1 and 2) • colours 1, 2 and 3 are all different • colour 1 is less dark than colour 2	accept colour 3 is a mixture of colours 1 and 2 for **3** marks accept E-number or additive instead of colour ignore comments about height / level	3
total			4

4.2.2.5 Polymers

CHY1F Question 3

	answers	extra information	mark
(a)	hydrogen	ignore formulae	1
(b)	any **two** from: • different sized molecules / more or less (carbon) atoms (in molecules) • fuels have <u>different</u> boiling points • fuels condense at <u>different</u> temperatures	ignore different densities	2
(c)		all three correct = **3** marks two correct = **2** marks one correct = **1** mark	3
total			6

4.2.2.5 Polymers

CHY1F Question 4

	answers	extra information	mark
(a)(i)	any **one** from: • iron ore is a limited resource / non-renewable • iron is in high demand • provide jobs • economic advantage		1
(ii)	any **two** from: • would damage (wildlife) habitats / countryside / greenfield sites • extra traffic • visual (pollution) / eyesore • noise (pollution) / sound (pollution) • dust (pollution) • river (pollution) • carbon dioxide (from traffic) / adds to greenhouse effect / global warming • damage roads / buildings by <u>vibrations</u> / <u>shockwaves</u>		2
(b)(i)	carbon monoxide / carbon	accept formulae CO / C	1
(ii)	atoms are all the same (size) / type	accept (particles) are all the same (size) / type for one mark	1 1

Continued on next page

4.2.2.5 Polymers

Question 4 continued

	answers	extra information	mark
(iii)	any **two** from: • impurities / carbon / different (sized) atoms **or** elements **or** metals • changes the structure / disrupts the pattern or layers • prevents layers sliding over each other • it is an alloy		2
total			8

4.2.2.5 Polymers

CHY1F Question 5

	answers	extra information	mark
(a)	core	ignore outer or inner	1
	mantle		1
(b)(i)	carbon dioxide	accept formula CO_2	1
	oxygen	accept formulae O_2 / O	1
(ii)	4%		1
(iii)	carbon dioxide has <u>decreased</u> / from 95% to 0%		1
	oxygen has <u>increased</u> / from 0% to 21%		1
	any **one** from: (carbon dioxide decrease) • carbon dioxide used during photosynthesis / by plants • carbon dioxide dissolves in oceans • carbon dioxide is locked up in rocks / carbonates / fossil fuels (oxygen increase) • oxygen released during photosynthesis / by plants		1
total			8

4.2.2.5 Polymers

CHY1F Question 6

	answers	extra information	mark
(a)	any **two** from: • nitrogen • carbon dioxide • water (vapour) / steam	 accept formulae N / N_2 accept formula CO_2 ignore CO accept formula H_2O	2
(b)	any **three** from: <u>limestone</u> • abundant / local • natural material **or** no 'processing' needed • relatively easy to cut • appearance better <u>concrete</u> • <u>raw materials</u> are abundant • can be reinforced (by steel rods) / strong(er) / supported (by steel rods) • concrete mixture can be poured / moulded / constructed on site • less reactive with acid rain / weathering / erosion	no mark for 'limestone' or 'concrete' on first line – mark advantages only ignore ideas of speed of production or easier to use accept 'can build higher' ignore density / extraction / quarrying / pollution / cost	3
total			5

4.2.2.5 Polymers

CHY1F Question 7

	answers	extra information	mark
(a)(i)	$Cu_2S + 2O_2 \rightarrow 2CuO + SO_2$	accept fractions and multiples	1
(ii)	any **two** from: • sulfur dioxide • causes acid rain • consequence of acid rain eg kills fish / plants	 accept sulphur dioxide / sulphur oxide / SO_2 ignore other comments eg global warming / ozone / global dimming / greenhouse effect	2
(b)	any **two** from: • heat (copper oxide with carbon) • oxygen is removed by carbon **or** carbon monoxide / carbon dioxide is produced **or** carbon displaces copper • because carbon is more reactive than copper	 accept copper (oxide) loses oxygen **or** carbon gains oxygen accept carbon oxide accept a correct word or balanced symbol equation allow a correct comparison of reactivity	2
(c)(i)	electrolysis	accept electroplating	1
(ii)	(electrical) wiring / appliances / coins / pipes / cladding for buildings / jewellery / making alloys **or** named alloys		1

Continued on next page

4.2.2.5 Polymers

Question 7 continued

	answers	extra information	mark
(d)	any **three** explanations from: <u>for recycling</u> • less acid rain (pollution) • copper reserves last longer / conserved **or** do not run out • energy for extraction (saved) **or** less energy required • less mining / quarrying • less waste (copper) / electrical appliances dumped **or** less landfill <u>against recycling</u> • collection problems • transport problems • difficult to separate copper from appliances • energy used to melt the collected copper	ignore electrolysis / pollution ignore ideas about less machinery / plant ignore idea of cost	3
total			10

4.2.2.5 Polymers

GCSE

Additional Science / Chemistry

CH2FP
Final Mark scheme

4408 / 4402
June 2017

Version/Stage: v1.0

4.2.2.5 Polymers

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.2.2.5 Polymers

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.
At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.
In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Different terms in the mark scheme are shown by a / ; eg allow smooth/free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.
Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation 'ecf' in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept/allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore/Insufficient/Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.
Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4 Quality of Written Communication and levels marking

In Question 6 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail.
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information.
- Clear understanding.
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given.
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised.
- Detailed understanding, supported by relevant evidence and examples.
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.2.2.5 Polymers

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1 (a)(i)	the ink would run / smudge / smear	accept converse	1	**AO1** 2.3.2b
1 (a)(ii)	below		1	**AO1** 2.3.2b
1 (a)(iii)	any **two** from: • contains red • does not contain blue • contains two other colours • contains three colours in total	do **not** accept contains red and blue	2	**AO3** 2.3.2b
1(b)(i)	separated		1	**AO1** 2.3.2c
1(b)(ii)	6/six		1	**AO2** 2.3.2c
1(b)(iii)	any **one** from: • accurate • sensitive • rapid / fast • small sample.	do **not** accept more precise do **not** accept more reliable	1	**AO1** 2.3.2a
Total			**7**	

4.2.2.5 Polymers

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	s		1	AO2 2.6.1a
2(a)(ii)	to speed up the reaction		1	AO2 2.6.1b
2(a)(iii)	tick (✓) by: 1		1	AO1 2.6.2d
2(a)(iv)	tick (✓) by: To make sure all the sulfuric acid has reacted		1	AO1 2.6.1b
2(b)(i)	funnel	accept filter funnel	1	AO1 2.6.1b
2(b)(ii)	heat / evaporate / boil	accept cool accept leave (to evaporate) do **not** accept heat until all water gone	1	AO1 2.6.1b
2(c)	tick (✓) by: The student left some copper sulfate crystals in the apparatus.		1	AO3 2.3.3d
2(d)(i)	white	accept grey	1	AO1 2.5.1d
2(d)(ii)	it goes blue	accept steam / water vapour ignore unspecified colour change	1	AO1 2.5.1d
2(e)(i)	polymers		1	AO1 2.2.5a
2(e)(ii)	as wealth decreases, ethene production decreases	accept converse	1	AO2 2.6; 3.7.12
2(e)(iii)	no relationship		1	AO2 2.6; 3.7.12
Total			12	

4.2.2.5 Polymers

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	tick (✓) by: covalent		 1	**AO1** 2.1.1g
3(a)(ii)	ticks (✓) by: oxygen consists of small molecules oxygen has a low boiling point		 1 1	**AO1** 2.1.1g
3(b)(i)	 magnesium (atom) loses (electrons) oxygen (atom) gains (electrons) two (electrons) ions formed	max 3 if reference to incorrect particle or incorrect bonding accept ionic bonding or full outer shells/noble gas structure is formed allow magnesium forms positive (ion) **or** oxygen forms negative (ion)	 1 1 1 1	**AO1** **AO2** 2.1.1a,b,c, d,e,f
3(b)(ii)	ticks (✓) by: nanoparticles contain a few hundred atoms nanoparticles have a high surface area to volume ratio		 1 1	**AO1** 2.2.6a
3(c)	giant covalent		1	**AO1** 2.2.3a
Total			**10**	

4.2.2.5 Polymers

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	58.5		1	**AO2** 2.5.1b
4(b)	water		1	**AO2** 2.3.3a
4(c)(i)	prevents loss of thermal energy	allow prevents heat loss	1	**AO1** 2.6.1
4(c)(ii)	13/thirteen		1	**AO3** 2.5.1
4(c)(iii)	temperature changes/results are all similar	accept no anomalous results allow they are all similar do **not** accept temperature	1	**AO2** 2.5.1
4(c)(iv)	exothermic	allow giving out energy	1	**AO3** 2.5.1
4(d)(i)	ions move	allow they move ignore free ions do not accept movement of electrons	1	**AO1** 2.7.1a 2.2.2b
4(d)(ii)	(chloride ions are) negative	accept opposites attract do **not** accept chlorine is negative	1	**AO1** 2.7.1c
4(d)(iii)	Tick (✓) by: soap		1	**AO1** 2.7.1i
4(d)(iv)	1 bonding pair of electrons 6 unbonded electrons on Cl	accept dot, cross, e or – or any combination	1 1	**AO2** 2.1

4.2.2.5 Polymers

4(d)(v)	Tick (✓) by: $\frac{1}{36.5}$ x 100		1	**AO2** 2.3.3a
Total			**12**	

4.2.2.5 Polymers

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	a smooth curve through or close to all points except (30,12)		1	**AO2** 2.4
5(a)(ii)	correct reading from the curve in 1(a)(i) (cm^3)	allow a tolerance of +/- 0.5 cm^3	1	**AO2** 2.4
5(a)(iii)	45-50 (seconds)		1	**AO3** 2.4
5(a)(iv)	line becomes less steep because gas is produced more slowly	ignore line levels out or plateaus allow examples with figures, eg 12 cm^3 gas from 0 to 20s but 1.5 cm^3 gas in last 20s ignore reaction has stopped or no more gas produced	1 1	**AO3** 2.4
5(a)(v)	0.6 (cm^3 per second)	allow 0.55 to 0.65	1	**AO2** 2.4
5(b)(i)	 temperature volume (of hydrogen peroxide)	concentration of hydrogen peroxide = max **1** ignore amount (of hydrogen peroxide)	 1 1	**AO3** 2.4
5(b)(ii)	 rate increases because more particles (in the same volume) so frequency of collisions increases	incorrect reference to energy = max **2** accept particles closer together allow greater chance of collisions ignore more collisions	 1 1 1	**AO1** 2.4.1e

4.2.2.5 Polymers

5(c)	(increasing the amount of catalyst) increases rate same final volume of gas	accept steeper graph or graph levels off earlier	1 1	**AO2** 2.4.1g
Total			**13**	

4.2.2.5 Polymers

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>6</td><td></td><td></td><td>6</td><td rowspan="6">AO1
2.1.1h
2.2.4b,c
2.2.5a,b</td></tr>
<tr><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td>0 marks</td><td>Level 1 (1–2 marks)</td><td>Level 2 (3–4 marks)</td><td>Level 3 (5–6 marks)</td></tr>
<tr><td>no relevant information given</td><td>a statement about the structure or a property of a metal
or
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer
and
at least one statement linking structure and property</td></tr>
<tr><td colspan="4">Statements shown as HT only are credited on both FT and HT.
However, HT only means that these statements are not expected in a FT answer.</td></tr>
<tr><td colspan="4">Examples of chemistry points made in response
Metal:
Properties
shiny
hardness
(tensile) strength
melting point/boiling point
density
malleable/flexible
ductile
conduct electricity or thermal energy</td></tr>
</table>

Structure • metals contain atoms /((positive) ions HT only) • (the atoms/(positive) ions/particles are) closely packed / in a regular pattern / in a giant structure/in layers / in a lattice • strong bonds/(electrostatic attractions HT only) • (metal has delocalised electrons HT only) **Polymer:** **Properties** • flexible • melting/boiling point • density • can be shaped/moulded • poor conductor of electricity or thermal energy **Structure** • polymer consists of chains • polymer chains may be tangled • polymer has no cross links. • (polymer has weak intermolecular forces HT only) **Level 3:** **Examples of linked statements:** • metal can be bent and shaped because the layers can slide • some metals are soft because layers can slide • some metals are hard because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice • metal has high melting/boiling point because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice • metal is strong because of strong bonds • some metals are dense because the atoms are closely packed • (metal can conduct thermal energy and electricity because metal has delocalised electrons HT only) • thermosoftening polymer melts when heated because it has no cross-links (or has weak intermolecular forces HT only) • thermosoftening polymer is flexible because the chains can move over each other	

Total			**6**

4.2.2.5 Polymers

AQA

GCSE
CHEMISTRY

8462/1F - PAPER 1 FOUNDATION TIER

Mark scheme

8462

June 2018

Version/Stage: 1.0 Final

4.2.2.5 Polymers

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do not accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

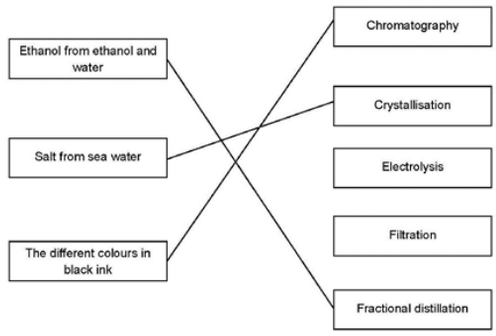
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1			1 1 1	AO1 4.1.1.2
01.2	include a (filter) funnel	allow funnel drawn on the diagram ignore clamp stand	1	AO3 4.1.1.2
01.3	evaporate condense	must be this order	1 1	AO1 4.1.1.2
01.4	$\frac{2}{20} \times 100$ = 10 (%)	an answer of 10 (%) scores **2** marks an answer of 11.1(%) **or** 90 (%) scores **1** mark	1 1	AO2 4.2.2.7
01.5	an alloy		1	AO1 4.2.2.7
01.6	the layers in the mixture are distorted		1	AO1 4.2.2.7

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	8000 nm^3		1	AO2 4.2.4.1
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	7		1	AO1 4.1.2.6
02.2	small molecule		1	AO2 4.1.2.6 4.2.2.4
02.3	F_2		1	AO1 4.1.1.1 4.1.2.6
02.4	the reactivity decreases (going down Group 7) (because) chlorine displaces bromine and iodine (and) bromine displaces iodine **or** iodine does not react	allow the reactivity decreases from chlorine to iodine allow (because) chlorine has two reactions allow (because) neither bromine nor iodine can displace chlorine allow (and) bromine has one reaction **or** iodine has no reactions allow (and) iodine cannot displace bromine	1 1 1	AO1 4.1.2.6 AO3 4.1.2.6 AO3 4.1.2.6
02.5	80		1	AO2 4.3.1.2

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(1.2 kg =) 1200 (g) **or** (900 g =) 0.9 (kg)	an answer of 75 (%) scores **2** marks	1	AO2 4.3.3.1
	$(\frac{900}{1200} \times 100) = 75(\%)$ **or** $(\frac{0.9}{1.2} \times 100) = 75(\%)$	allow an answer correctly calculated from: $(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100)$ **or** $(\frac{\text{incorrect attempt at conversion of 900}}{1.2} \times 100)$	1	
Total			**9**	

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nucleus neutron neutron electron proton	must be in this order	1 1 1 1 1	AO1 4.1.1.3 4.1.1.4 4.1.1.5
03.2	$(A_r)\ \frac{(63 \times 70) + (65 \times 30)}{100}$ = 63.6	an answer of 63.6 scores **2** marks	1 1	AO2 4.1.1.6
03.3	copper / Cu	allow ecf from answer to question **03.2**	1	AO2 4.1.1.1
03.4	$\frac{1.2 \times 10^{-10}}{10\,000}$ **or** $1.2 \times 10^{-10} \times 1 \times 10^{-4}$ $= 1.2 \times 10^{-14}$ (m)	an answer of 1.2×10^{-14} (m) scores **2** marks a correct answer not in standard form scores **1** mark	1 1	AO2 4.1.1.5
Total			**10**	

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	3.6 (cm^3)		1	AO2 4.4.3.4
04.2	hydrogen line only		1	AO3 4.4.3.4
04.3	both lines		1	AO3 4.4.3.4
04.4	graphite has delocalised electrons		1	AO1 4.2.3.2
04.5	**cathode** zinc (1) **anode** chlorine (1) hydrogen (1) bromine (1)	do **not** accept chloride allow **1** mark if chlorine and zinc the wrong way around do **not** accept bromide allow **1** mark if bromine and hydrogen the wrong way around	1+1 1+1	AO2 4.4.3.2 4.4.3.4
Total			**8**	

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	gas		1	AO1 4.2.2.2
05.2	the gas escapes	allow carbon dioxide escapes do **not** accept references to evaporation	1	AO1 4.3.1.3
05.3	5.12 (g)		1	AO2 4.3.1.3
05.4	4.00 (g) trial 1	allow 2.89 written in either space, or ringed in the table, unless contradicted by mass of copper carbonate or trial number	1	AO3 4.3.1.3
05.5	reheat (and reweigh) until constant mass	 an answer of heat to constant mass scores **2** marks if no other mark scored allow for **1** mark heat for longer **or** (heat at a) higher temperature **alternative approach**: (1) continue heating and pass gas through limewater (1) until the (lime)water stops bubbling **or** until the limewater no longer turns cloudy	1 1	AO3 4.3.1.3

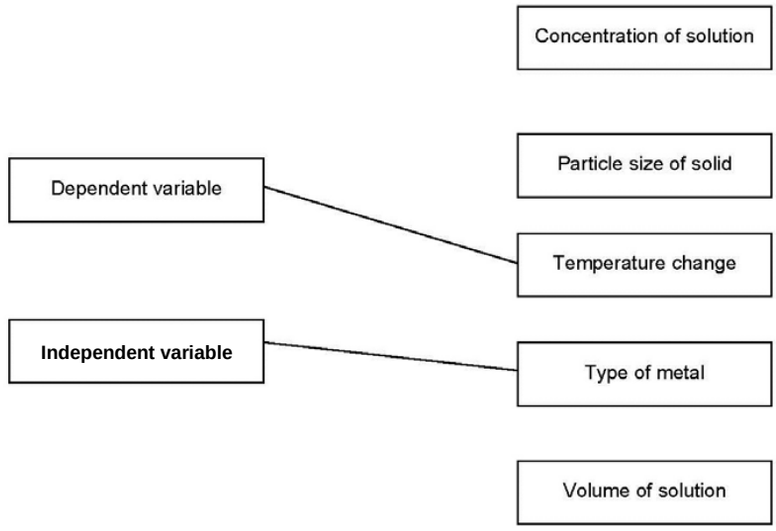
4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	straight line of best fit	must touch at least 5 of the 6 plots	1	AO2 4.3.1.3
05.7	correct value read from line of best fit in Figure 8	allow tolerance of ± ½ small square	1	AO2 4.3.1.3
05.8	(mass =) $168 \times \frac{\text{answer from question } \mathbf{05.7}}{8.4}$	a correctly calculated value from their answer to question **05.7** scores **2** marks allow (mass =) answer from question **05.7** × 20	1	AO2 4.3.1.3
	correctly calculated value (g)		1	
Total			**10**	

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	 allow **one** mark if answers are reversed		1 1	AO1 4.5.1.1
06.2	polystyrene is a better insulator		1	AO3 4.5.1.1
06.3	both bars labelled both bars correctly plotted	 allow tolerance of ± ½ small square ignore width and spacing of bars if no other mark scored, allow **1** mark for any one bar correctly plotted and labelled	1 1	AO2 4.5.1.1

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	temperature increases **or** temperature does not decrease	ignore because it is exothermic allow (because) energy / 'heat' is transferred to the surroundings energy / 'heat' is not taken in from the surroundings allow the energy of the products is less than the energy of the reactants	1	AO3 4.5.1.1
06.5	(most reactive) magnesium (zinc) nickel	this order only	1	AO3 4.5.1.1 4.4.1.2
06.6	suitable method described the observations / measurements required to place in order an indication of how results would be used to place the unknown metal in the reactivity series **approaches that could be used:** **approach 1:** add the unknown metal to copper sulfate solution (1) measure temperature change (1) place the metals in order of temperature change (1)		1 1 1	AO3 4.4.1.2 4.5.1.1

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6 cont.	**approach 2:** add the metal to salt solutions of the other metals **or** heat the metal with oxides of the other metals (1) measure temperature change (only if salt solutions used) **or** observe whether a chemical change occurs (1) compare temperature change or whether there is a reaction to place in correct order (1) **approach 3:** add all of the metals to an acid (1) measure temperature change or means of comparing rate of reaction (1) place the metals in order of temperature change or rate of reaction (1) **approach 4:** set up electrochemical cells with the unknown metal as one electrode and each of the other metals as the other electrode (1) measure the voltage of the cell (1) place the metals in order of voltage (1)			
06.7	D		1	AO1 4.5.1.2
06.8	C		1	AO1 4.5.1.2
Total			**12**	

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	sodium oxide	allow Na_2O	1	AO2 4.1.1.1 4.1.2.5 4.4.1.1
07.2	oxidation		1	AO1 4.4.1.1
07.3	13		1	AO1 4.4.2.4
07.4	sodium hydroxide		1	AO2 4.1.1.1
07.5	OH^-		1	AO1 4.4.2.4
07.6	(volume =) $\frac{250}{1000}$ or ¼ or 0.25 (dm^3) **or** (mass per cm^3 =) $\frac{40}{1000}$ (g) or 0.04 (g) ($\frac{250}{1000}$ × 40 =) 10 (g)	an answer of 10 (g) scores **2** marks	1 1	AO2 4.3.2.5

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	all points correct	allow a tolerance of ± ½ a small square allow **1** mark for 3 points correct ignore any attempt at a line of best fit	2	AO2 4.1.2.5
07.8	39 (°C)	allow any value from 34 to 46 (°C)	1	AO2 4.1.2.5
Total			**10**	

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	any **one** from: • metal • (metal) hydroxide • (metal) carbonate • alkali	allow named example allow correct formula ignore base allow ammonium hydroxide allow ammonium carbonate allow soluble base allow ammonia	1	AO1 4.4.2.1 4.4.2.2 4.4.2.3
08.2	$Ca(NO_3)_2$	allow $Ca^{2+}(NO_3^-)_2$	1	AO2 4.4.2.2

PMT

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Mark	AO / Spec. Ref.
01.3	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.4.2.3
	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 • use magnesium oxide and sulfuric acid • add sulfuric acid to a beaker • warm sulfuric acid • add magnesium oxide • stir • continue adding until magnesium oxide is in excess • filter • using a filter paper and funnel • to remove excess magnesium oxide • heat solution in an evaporating basin • to crystallisation point • leave to crystallise • pat dry with filter paper credit may be given for diagrams		
Total			**8**

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	FeS_2	do **not** accept equations	1	AO2 4.2.1.3
09.2	 26 30 26	must be this order	 1 1 1	AO2 4.1.1.4 4.1.1.5
09.3	 any **two** from: • iron has a high(er) melting / boiling point • iron is dense(r) • iron is hard(er) • iron is strong(er) • iron is less reactive • iron has ions with different charges • iron forms coloured compounds • iron can be a catalyst	allow the converse statements for sodium allow transition metal for iron allow Group 1 metal for sodium ignore references to atomic structure ignore iron rusts allow iron is less malleable / ductile allow specific reactions showing difference in reactivity allow iron is magnetic	 2	AO1 4.1.2.5 4.1.3.1 4.1.3.2

4.2.2.5 Polymers

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	carbon is more reactive (than nickel)	allow converse	1	AO1 4.4.1.2 4.4.1.3
	(so) carbon will displace / replace nickel (from nickel oxide) **or** (so) carbon will remove oxygen (from nickel oxide)	allow (so) nickel ions gain electrons allow (so) carbon transfers electrons to nickel (ions)	1	
09.5		an answer of 67.8 (%) scores **3** marks an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.3.2
	(total M_r of reactants =) 87		1	
	(percentage atom economy) $= \frac{59}{87} \times 100$	allow (percentage atom economy) $= \frac{59}{\text{incorrectly calculated } M_r} \times 100$	1	
	= 67.8 (%)	allow an answer from an incorrect calculation to 3 sig figs	1	
Total			**11**	

4.2.2.5 Polymers

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	copper, zinc, sodium chloride solution		1	AO2 4.5.2.1
10.2	a reactant is used up	allow the reaction stops allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant	1	AO1 4.5.2.1
10.3	the reaction is not reversible		1	AO1 4.5.2.1
10.4	$2H_2 + O_2 \rightarrow 2H_2O$	allow fractions / multiples allow **1** mark for O_2	2	AO1 AO2 4.1.1.1 4.5.2.2

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td rowspan="5">10.5</td><td>Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.</td><td>5–6</td><td rowspan="5">AO3

AO3

AO2

4.4.3.4
4.5.2.1
4.5.2.2</td></tr>
<tr><td>Level 2: Some logically linked reasons are given. There may also be a simple judgement.</td><td>3–4</td></tr>
<tr><td>Level 1: Relevant points are made. This is not logically linked.</td><td>1–2</td></tr>
<tr><td>No relevant content</td><td>0</td></tr>
<tr><td colspan="2">Indicative content

reasons why fuel cells could be judged as better

<table><tr><th>from the table</th><th>from other knowledge</th></tr><tr><td>• time for refuelling a fuel cell is faster than recharging
or
a fuel cell does not need to be recharged
• a fuel cell has a greater range</td><td>• hydrogen can be renewable if made by electrolysis using renewable energy
• lithium-ion batteries can catch fire
• produces only water
or
no pollutants produced
• lithium-ion batteries may release toxic chemicals on disposal
• lithium-ion batteries (eventually cannot be recharged so) have a finite life</td></tr></table>
reasons why the lithium-ion battery could be judged as better

<table><tr><th>from the table</th><th>from other knowledge</th></tr><tr><td>• lithium-ion uses energy more efficiently
• cost of lithium-ion car much less
• cost of recharging much less than refuelling with hydrogen</td><td>• hydrogen is often made from fossil fuels so is not renewable
• charging points are more widely available than hydrogen filling stations
• hydrogen takes up a lot of space
or
is difficult to store
• hydrogen can be highly flammable / explosive
• no emissions produced
• (catalyst in the hydrogen fuel-cell eventually becomes poisoned so) have a finite life</td></tr></table></td><td></td><td></td></tr>
<tr><td>Total</td><td colspan="2"></td><td>11</td></tr>
</table>

4.2.2.5 Polymers

Answer 53 · Examiner comments

June 2018 | 8462/1F | Original Q6

Question 6 (low and standard demand)

06.1 25% of students could identify both variables, with 41% identifying one. This was usually the independent variable.

Many thought that the concentration of the solution was the dependent variable. A compensatory mark was awarded to those who identified the two correct variables but had them the wrong way round.

06.2 86% of students understood the reason for using a polystyrene cup in this required practical activity.

06.3 This question was very well done, with 83% of students able to draw a bar chart correctly. Of those who achieved a single mark, forgetting to label the bars was more common than mis-use of the scale.

06.4 50% of students answered correctly. Of the unsuccessful attempts, many failed to express their ideas coherently. Some confused endothermic with exothermic, eg saying the temperature decreased, ignoring the evidence in front of them.

There was confusion between heat and temperature: heat is not increasing, and temperature is not given out. Some students thought ‘taking in heat’ means the temperature would rise. This shows a common misunderstanding of endothermic reactions: students think that heat energy is moving, rather than being converted from heat energy to chemical energy.

06.5 81% of students were able to give the correct order of reactivity.

4.2.2.5 Polymers

Answer 53 · Examiner comments

June 2018 | 8462/1F | Original Q6

06.6 Students found this question difficult to answer. 19% of students achieved all three marks, although47% achieved at least one mark. 14% of students did not attempt the question.

Students answer in terms of repeating the experiment using the unknown metal, and reorder the four elements according to the temperature change. However, many decided to use a different method, with varying degrees of success.

Alternative approaches that were accepted were:

- reacting all four metals with an acid and assessing the rate of reaction or temperature change
- carrying out a series of displacement reactions, either by adding the unknown metal to salt solutions of the other three metals, or by heating the unknown metal with oxides of the others
- using the unknown as the test electrode in a series of electrochemical cells and measuring the voltage.

Approaches that were not accepted included:

- trying to react the metal with the other metals
- measuring melting or boiling point
- looking at the periodic table.

06.7 53% of students could identify line D as the correct answer. A decent number of students confused products with reactants.

06.8 This was well done, with 75% of students able to identify the activation energy on the reaction profile.

4.2.2.5 Polymers

Answer 54 · Examiner comments

June 2018 | 8462/2F | Original Q3

Question 3 (low demand)

03.1 67% of students achieved both marks. The most common error was to place the last tick under Polymer K, thinking that water absorption was an advantage.

03.2 A straightforward calculation in which 80% of students recognised selected the correct values from the table provided and inserted them into the given formula. A few students either inverted the values or, despite showing the correct working, multiplied the two densities instead of dividing.

03.3 80% of students correctly identified not melting as an advantage of firefighter's uniforms.

03.4 78% of students correctly identified being hard-wearing as an advantage of using polymers for firefighter's uniforms.

03.5 Many answers focussed on the fact that wool was readily available rather than picking up on the keyword in the question: 'sustainable'. Those who realised that wool was renewable often didn't go on to say that it would not run out, or the reverse argument for crude oil. Many answers simply referred to the properties given earlier in the table, missing the aim of the question.

Answer 62 · Examiner comments

June 2022 | 8462/2F | Original Q8

Question 8 (Standard demand)

08.1 This was well answered by a small minority of students with around 10% of students scoring both marks. The most common errors were to omit the double bond, to add additional bonds or atoms to the carbon atoms. Brackets and/or the inclusion of the letter n were ignored.

08.2 The better responses correctly referred to the insulation being burned or melted or the lack of purity or 'contamination' of the copper produced. Uncreditworthy responses often made comments such as 'so you only get copper'. Around 40% of the students scored this mark.

08.3 This was reasonably well answered as responses such as the copper melting and being reformed/moulded into new pipes were seen. Responses referring to 'heating the wire' were insufficient to gain credit. Around 40% of the students scored both marks.

08.4 The most common correct responses referred to the conservation of copper and the use of less energy in this process. Relatively few answers identified specified environmental impacts.

Weaker responses referred to 'pollution' alone which was too vague to gain credit. Some referred to cost without making a link to the amount of energy needed. Less than 10% of students were able to identify two advantages of recycling, though just over 40% could identify one.

08.5 The test for copper(II) ions was not well known.

A variety of tests were chosen, with the most common incorrect response being the use of flame tests. The addition of acids, especially hydrochloric acid, was also often suggested.

Acceptable results included shades of blue precipitate, e.g. pale/light blue, but answers giving two colours such as green/blue were not credited. Around 1% of students scored both the marks.

08.6 The use of barium chloride or barium nitrate as the reagent for the test was generally followed by the correct result.

The test was often incorrect, with the result, therefore, not able to be awarded a mark. The most common incorrect reponses were the use of a flame test or an incorrect reagent(s). Again, around 1% of students scored both the marks.

4.2.2.5 Polymers

Answer 63 · Examiner comments

June 2022 | 8462/2F | Original Q10

Question 10 (Standard demand)

10.1 In this extended response question, the command word was 'evaluate'. This command word demands a reasoned judgement to be given for a fully complete answer and therefore for access to a Level 3 mark. Isolated comments such as 'I think polymer is a better material than glass' are not reasoned judgments. The vast majority of students did not go further than this and were therefore capped at four marks. Very few students gained 5 or 6 marks.

Most students scored a Level 1 mark (merely by comparing the values given in the table) or a Level 2 mark (by introducing one or two pieces of 'added value' information about the impacts of the data provided). Nearly 30% of students gained a Level 2 mark, whilst a further 15% or so did not attempt the question.

10.2 This straightforward calculation presented no difficulties for the majority of students. Well over 70% of the students gained all three marks.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of 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.

4.2.2.5 Polymers

Answer 64 · Examiner comments — June 2023 | 8462/1F | Original Q10

Question 10 (standard demand)

10.1 Nearly half of students scored at least one mark. Many realised that the two required variables were those in the table headings or in the description of the investigation. However, some had these the wrong way round. ‘Amount’ is not synonymous with ‘mass’ and is not an acceptable alternative. Some just mentioned the name of the substance rather than its mass.

10.2 This question discriminated well, with a third of students scoring all three marks and two thirds scoring at least one. Many excellent graphs were seen, with correctly plotted points and a straight line of best fit, with an even scatter of points about the line. Some students had difficulty in handling the different scales on the two axes, and some drew a ‘point to point’ line instead of a line of best fit. A line of best fit where the points do not all lie on the line should have an even scatter of points about the line. This was often not the case, with a line skimming the bottom of some points and most of the others above it.

Students should use a pencil for plotting points as well as for drawing the line. It is very difficult to ‘cross out’ points or lines drawn in ink if the student changes their mind. Where two points are given, the examiner will not choose which one to mark for the student.

10.3 Fewer than a half of students extended their line to the axis and read off the intercept value correctly. Many did extend their line to the axis, but then gave a value that was merely to the nearest major gridline, or was the temperature of the highest or lowest data point.

10.4 Nearly a half of students gave an acceptable answer. Many gave a definition of an endothermic change in terms of energy transfer, rather than referring to the results as required. Reference to the temperature decrease was all that was needed. Some contradicted a correct reference to temperature decrease with an incorrect reference to heat being released.

Answer 64 · Examiner comments — June 2023 | 8462/1F | Original Q10

10.5 This was very poorly answered. Only a handful of students scored both marks, with just over one in ten scoring one. Students are unfamiliar with the idea of uncertainty as the range about the mean, as stated in the specification. There were some good descriptions of the highest value being 0.3 °C above the mean and the lowest being 0.3 °C below the mean, but very few used the word uncertainty.

10.6 This question did not discriminate well, with roughly equal numbers of students choosing each response. The correct answer, random error, was the least popular.

4.2.2.5 Polymers

Answer 65 · Examiner comments

June 2023 | 8462/2F | Original Q2

Question 2 (Low demand)

02.1 More than two thirds of students were able to use the information provided in the table to provide two correct reasons as to why poly(propene) beakers should not be used to heat liquids. More students suggested that poly(propene) would burn rather than melt. Common incorrect responses did not refer to the effect of heat on poly(propene) instead referring to the effect of the liquid being heated on the polymer.

02.2 More than half of students used the information in the table to suggest a reason why using poly(propene) beakers could save money. The most common incorrect responses did not include a comparison to the glass beakers so that the unqualified 'because they are tough' added no value to the data in the table. Some students used the wrong column and said the poly(propene) does shatter (on impact) even though this then made no sense in the context of saving money.

02.3 More than half of students successfully identified boron trioxide as a raw material for making borosilicate glass.

02.4 More that 90% of students obtained at least one mark on this question (usually for completing the 'name' column correctly) with just over 50% achieving both marks. The most common incorrect response was to incorrectly identify the number of carbon atoms. A minority of students failed to identify the number of atoms but instead calculated the mass of each element.

02.5 This question was very well answered with over 80% of students correctly identifying the repeating unit of poly(propene). The distractors attracted roughly equal support.

02.6 Students struggled to recognise and correctly identify the stages needed to produce poly(propene) from the descriptions provided in the question. Quite often, correct processes were identified but sequenced incorrectly. Less than one-third of students obtained all three marks and less than half achieved 2 marks.

02.7 Just over one third of students achieved 2 marks to identify both of the words that described a hexene molecule during a polymerisation reaction. About half of students achieved 1 mark by identifying hexene as an alkene or by identifying it as a monomer.

4.2.2.5 Polymers

Answer 66 · Examiner comments

June 2024 | 8462/1F | Original Q3

Question 3 (low and standard demand)

03.1 Two thirds of students recognised this as a displacement reaction. Combustion proved surprisingly popular.

03.2 Nearly a half of students scored 2 or 3 marks on this calculation. A common error was to give the answer to three decimal places instead of three significant figures. A few students thought that 39.81 should be rounded up to 39.9, and some left a recurring dot on the $\dot{8}$ of 39.$\dot{8}$ (so an infinite number of significant figures). Many students operated on the data provided seemingly at random, with addition, subtraction and multiplication seen as well as the division the wrong way round. It was common to leave the ' × 100' out of the expression, so that marking point 1 could not be awarded if the answer was incorrect.

03.3 Two thirds of students identified the volume of copper sulfate solution as the control variable.

03.4 Two thirds of students gave the correct answer. Some students gave the minimum or maximum temperature as their answer, rather than reading the mass at the turning point of the graph.

03.5 Most students realised that they needed to subtract the minimum temperature from the maximum, and three fifths of students scored at least one mark. Some, however, misread those values from the graph, with 45.4 – 20.4 being frequently seen. Although this gave the correct answer, it was as the result of incorrect working so did not score both marks. A minority of students were unable to start the calculation, and various multiplications of random values were seen.

03.6 Over a half of students gave a fully correct answer. Many students could not convert their volume to dm^3 even given the conversion factor, with many trying to do a calculation involving the mass of copper sulfate. However, partial credit was then awarded for those who substituted their value of volume into the given equation and calculated the results correctly. Many students do not seem to understand the terms volume and concentration, and that they mean different things.

03.7 Just over a half of students were able to draw two sharp straight lines, with a ruler, which passed through all the points. Some did not use a ruler, and a few drew an extra line joining the first and last points, meaning that full marks could not be awarded.

03.8 Students struggled with this standard demand question, with only a quarter gaining a mark. More than a half of students selected the second distractor, in which both parts of the statement are the opposite of the correct version. When temperature decreases, heat energy is being taken in from the surroundings and converted to chemical energy, so the reaction is endothermic. It is this reduction in heat energy that causes the temperature decrease. A misconception for many students is thinking that when heat energy is taken in from the surroundings it remains as heat energy in the system, causing the confusion with the direction of temperature change.

4.2.2.5 Polymers

Answer 67 · Examiner comments June 2024 | 8462/2F | Original Q4

Question 4 (low and standard demand)

04.1 One in four students obtained all three marks in this question with two out of five obtaining two marks. The most frequently seen reason for not obtaining full marks was to incorrectly determine the date in billions of years at which the percentage of nitrogen in the atmosphere became constant. Students need to be exposed to as many examples as possible of explaining trends as some struggled to express the percentage of nitrogen becoming constant, describing the line as becoming, steady, calm, stable, stopping or going at a constant speed or using vague statements about 'it.'

04.2 Almost 80% of students correctly identified that the percentage of carbon dioxide decreased.

04.3 Well over 80% of students correctly identified light as being the energy source for photosynthesis.

04.4 Nearly 80% of students identified the two organisms that produce oxygen. A further 15% correctly identified one organism, usually plants.

04.5 Less than 30% of students could correctly identify the two natural polymers produced from glucose. It is important that students read the question carefully as there was a significant number of students who ticked only one box rather than the two requested.

04.6 Well over 75% of students correctly expressed the relative formula mass of DNA in standard form.

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Answer 67 · Examiner comments June 2024 | 8462/2F | Original Q4

04.7 Only one in two students were able to correctly calculate the relative formula mass of each polymer chain in DNA. The most popular incorrect distractor was 140 000 000 000 where the student had failed to realise that the DNA molecule was comprised of two chains.

04.8 Just under 75% of students correctly described the shape of a DNA molecule as a double helix. The most common incorrect response was double bond.

04.9 Less than 35% of students were able to correctly identify the number of different nucleotides present in a molecule of DNA.

Answer 68 · Examiner comments June 2024 | 8462/2F | Original Q6

Question 6 (low and standard demand)

06.1 The test for unsaturation is not well known by students. The question includes that bromine water is orange but only one in five students were able to correctly identify the colour change

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4.2.2.5 Polymers

Answer 68 · Examiner comments June 2024 | 8462/2F | Original Q6

when bromine water is added to ethene. The most common incorrect responses were brown, black, and clear.

06.2 Just over 60% of students correctly identified the test for chlorine.

06.3 Around half of the students were able to correctly identify the displayed structural formula of the compound produced when chlorine reacts with ethene.

06.4 Around two thirds of students were able to correctly identify the structure of poly(chloroethene).

06.5 Over half the students successfully processed the density values and correctly evaluated them for two marks. Only two out of five of these students then went on to determine the simplest whole number ratio and achieve all three marks. Incorrect responses included the use of temperature values rather than density or simply rounding the density values to the nearest whole number.

06.6 Three out of five students were able to correctly identify why neither polymer was suitable to carry steam at 300 °C. Incorrect responses included those that just quoted values from the table or stated low melting temperatures without including any consequence of the high temperature to either the pipe or the polymer. An incorrect unit for temperature was frequently seen in responses.

06.7 'Sustainable' is a poorly understood term with only one third of students correctly answering this question. Incorrect responses included reference to different stages in a life cycle assessment including comparisons in terms of the environmental consequences of different disposal methods for each material. Some students struggled to express that paper was made from a renewable resource, suggesting that paper is renewable or that paper can be regrown.

Answer 69 · Examiner comments

June 2025 | 8462/1F | Original Q9

Question 9 (standard demand)

09.1 Students found this very difficult, with only one in ten scoring the mark. Of those who knew they needed to count the ions of each element, few could then appreciate that the ratio was 1:1 so the formula was therefore CaS. Many just wrote the number of Ca atoms and of S atoms from the diagram.

09.2 Two fifths of students were able to score at least one mark, and one in eight scored all four. Many described electrons transferring from calcium to sulfur, and of those, most realised that 2 electrons would be transferred. Students were less able to gain the final marking point for a correct description of the ions formed. Some students contradicted an answer in terms of electron transfer by also referring to sharing electrons.

09.3 Students were unable to recall many details about the structure and bonding of graphite, even with the diagram as a prompt. Many did describe layers of carbon atoms, but few mentioned the giant structure or covalent bonding. Many focussed on the use of graphite in pencils, which was not relevant in the context of the question. Most responses did not mention the number of bonds per atom, or the delocalised electrons, or the lack of bonds between layers. The hexagonal rings, if mentioned at all, were not described well, with whole layers or even individual atoms being described as hexagonal. Fewer than a quarter of students scored a single mark and very few scored all four.

09.4 Only one in six students scored the mark, despite the clear statement in the specification that the molecules do not have an overall electrical charge. Those who did gain credit usually mentioned there being no delocalised electrons. 'Free' is not the same as delocalised in this context and did not gain credit. Popular incorrect responses were that the molecules are too small or that the molecules cannot move.

09.5 Only a third of students gave the correct reason, with stronger or more covalent bonds to break both being almost as popular.