



General Certificate of Secondary Education

Chemistry 3421/F

Specification B

Mark Scheme

2005 examination – June series

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.

Chemistry (Specification B)
Foundation Tier 3421/F**3421/F Q1**

question	answers	extra information	mark
(a)	nucleus		1
	electron		1
(b)	correct number of electrons (12)	accept dots and circles	1
	2.8.2		1
total			4

3421/F Q2

question	answers	extra information	mark
(a)	F	accept indium / In	1
(b)	C	accept sodium / Na	1
(c)	A	accept hydrogen / H / H ₂	1
total			3

3421/F Q3

question	answers	extra information	mark
(a)(i)	water	accept H ₂ O accept correct ringed answer in box	1
(ii)	neutralisation	accept underlining or any indication, eg tick	1
(b)	sodium hydroxide	apply list principle	1
	sulphuric acid		1
total			4

3421/F Q4

question	answers	extra information	mark
	electrolysis		1
	positive electrode	accept anode	1
	negative electrode	accept cathode	1
	bottom of the tank		1
total			4

3421/F Q5

question	answers	extra information	mark
(a)(i)	test tube containing liquid (limewater)	accept any container do not accept wrongly named liquid	1
	tube extended to below level of liquid and connected to conical flask	must not be closed system, ie with bung or cork	1
(ii)	cloudy / chalky / milky	accept white (precipitate) do not accept foggy, misty	1
(b)(i)	any two from: <ul style="list-style-type: none"> • sugar • yeast • water 		2
(ii)	produces CO ₂ / gas / bubbles		1
	makes the dough / bread rise owtte	eg makes bread light and airy / expands / puts air in	1
total			7

3421/F Q6

question	answers	extra information	mark
(a)(i)	melting point increases as atomic number increases	accept 'increase' / higher / bigger / larger	1
(ii)	200 to 350°C		1
	exactly on $85 \pm \frac{1}{2}$ square	up to <u>their</u> value $\pm \frac{1}{2}$ square	1
(b)(i)	chlorine or fluorine	accept if both chlorine and fluorine ticked, otherwise list principle	1
(ii)	chlorine / fluorine are more reactive (than bromine)	accept chlorine / fluorine are higher (up group 7) accept a more reactive halogen will displace a less reactive halogen	1
(iii)	500 (litres)		1
total			6

3421/F Q7

question	answers	extra information	mark
(a)	sodium hydrogen phosphorus oxygen	2 marks for all 4 1 mark for 2 or 3 0 marks for 0 or 1 not symbols / formulae	2
(b)(i)	gives out	gets hot(ter) / temperature rises (1)	1
	heat / energy	independent mark	1
(ii)	Quality of written communication	for clearly expressed ideas	1
	take temperature of water at start	owtte	1
	take temperature after adding soup powder		1
	plus any one from: <ul style="list-style-type: none"> • using a thermometer • mix / stir / shake etc • in beaker / conical flask / test tube / plastic cup • temperature will rise (indicates an exothermic reaction) 		1
total			8

3421/F Q8

question	answers	extra information	mark
(a)(i)	water <u>vapour</u> given out from volcano	accept steam	1
	condensed	do not accept hydrogen and oxygen combining to form water accept rain / clouds formed just 'cools' is insufficient	1
(ii)	plants or dissolves in ocean / seas / water	accept photosynthesis	1
(b)	nitrogen (left) N_2	not N	1
	oxygen (right) O_2	not O	1
total			5

3421/F Q9

question	answers	extra information	mark
(a)	A ammonia	accept correctly indicated in the box	1
	B nitrogen monoxide		1
	C nitrogen dioxide		1
(b)	any two from: <ul style="list-style-type: none">• air / oxygen / O₂• ammonia / NH₃• water / H₂O• nitrogen / N₂		2
(c)(i)	speeds up reaction (owtte)		1
(ii)	platinum	accept indication, circles etc	1
total			7

3421/F Q10

question	answers	extra information	mark
(a)	coal → solid and crude oil → liquid	both must be correct	1
(b)	carbon		1
(c)(i)	A	or correct indication	1
(ii)	oxygen		1
total			4

3421/F Q11

question	answers	extra information	mark
(a)(i)	ions		1
	silver		1
(ii)	decorative (owtte)	protective / stops rusting (owtte) / less expensive than solid silver do not accept more valuable	1
(b)	sodium hydroxide		1
	positive		1
	sulphuric acid		1
	oxygen		1
total			7

3421/F Q12

question	answers	extra information	mark
(a)	sulphur dioxide		1
	vanadium oxide		1
	oleum		1
	water		1
(b)	used as battery acid / in batteries or (used to make) fertilisers / detergents	do not accept as a battery	1
(c)	attack / destroy / damage / burns linked to tissues / skin / eyes or attacks metals (owtte)	owtte	1
(d)(i)	goes white / off-white / paler (blue)		1
(ii)	(crystals are) dehydrated or (crystals have) water removed or lose water of crystallisation	owtte do not accept loses water do not accept crystals are dried	1
total			8

3421/F Q13

question	answers	extra information	mark
(a)(i)	ions		1
(ii)	5		1
(iii)	orange		1
(iv)	fair test: same amount / mass / quantity / length of magnesium	owtte same volume of acid is neutral	1
	observation: fewer bubbles with lactic acid or more bubbles with HCl or Mg lasts longer with lactic acid or Mg disappears quicker with HCl	owtte	1
	rate / time comment: slower with lactic acid or faster with HCl	owtte	1
(b)	carbon dioxide		1
(c)	Brønsted and Lowry		1
total			8

3421/F Q14

question	answers	extra information	mark
(a)	6	accept 5.8 – 6	1
(b)	hydrochloric acid used up / reacted / combined / or fewer particles (of hydrochloric acid) or fewer hydrogen ions owtte fewer collisions owtte	accept reactants used up accept less calcium carbonate or smaller surface area of calcium carbonate accept lower concentration / less crowded do not accept atoms / molecules ignore references to energy do not accept references to atoms or molecules independent mark	1 1
(c)	steeper curve initially levels out at same volume	independent marks <ul style="list-style-type: none"> • must indicate levelling out • if line goes higher than 66 do not award this mark • diagonal line only = 0 marks • if steeper initially and then crosses the line and finishes correctly, then loses one 	1 1
total			5

3421/F Q15

question	answers	extra information	mark
(a)	(very) small percentage / amount (in the Earth's crust)	any indication that there is a small amount, eg not much (left) accept rare (elements) / rarer accept not commonly found ignore cannot find easily ignore hard to extract	1
(b)(i)	oxygen / O ₂ / O	do not accept O ²	1
(ii)	any one from: <ul style="list-style-type: none"> • potassium / K • sodium / Na • calcium / Ca • magnesium / Mg 	symbols must be correct write name and incorrect symbol, ignore symbol	1
(c)(i)	heating (with) or hot air blown into furnace	accept high temperatures or (very) hot	1
	carbon / carbon monoxide / coke / coking coal	do not accept coal / charcoal accept balanced equation only	1
	or: carbon reacts with O ₂ or carbon / coke burning (1)	accept balanced equation only CO / CO ₂	
	CO reacts with the ore (1)	for naming the reducing agent	
(ii)	cost of melting ore / electricity makes aluminium expensive (owtte) or (large amount of) electricity used or because you have to use electrolysis or aluminium is higher in the reactivity series or aluminium is harder to <u>reduce</u> or unable to reduce with carbon or the cost of purifying the bauxite	do not accept harder to extract / produce more energy is not enough	1
total			6

3421/F Q16

question	answers	extra information	mark
(a)	fractional distillation / fractionation	accept distillation accept refining do not accept cracking	1
(b)	<p>Quality of written communication</p> <p>any three from:</p> <ul style="list-style-type: none"> crude oil is heated to high temperature or heated to 340°C or above (most of the) oil is evaporated / turns into gas / vapour heavier molecules do not boil heavier molecules sink to the bottom or lighter molecules rise up (the tower) oil vapours / gases go up the tower vapours condense at different points (up the tower) separation depends on their boiling points oil separated into fractions which have similar numbers of carbon atoms or similar chain lengths or similar boiling points temperature gradient up the tower 	<p>for technical words correctly used two from: evaporat(ion) / condensat(ion) / boiling points / gas / vapour / molecules / fraction / vaporised QoWC mark can be awarded for cracking described</p> <p>accept oil is boiled</p> <p>accept converse accept particles instead of molecules</p> <p>accept particles instead of molecules</p> <p>accept heavier molecules condense first / at the bottom accept lighter molecules condense last / at the top</p> <p>vapours condense at different temperatures</p> <p>accept in terms of similar chains</p>	<p>1</p> <p>3</p>
total			5

3421/F Q17

question	answers	extra information	mark
(a)(i)	(actual value 2403°C)	accept values between 2100 and 2450	1
(ii)	(actual value is 5.9 g/cm ³)	accept values between 3.5 and 6.5	1
(b)(i)	<p>any two sensible ideas such as:</p> <ul style="list-style-type: none"> • (why) put in order of mass • he left gaps or table not complete • no evidence for undiscovered elements or they believed all the elements had been discovered • he changed the order of some elements or there were exceptions to the rule(s) • he put metals and non-metals together • he did not explain his ideas clearly (owtte) 	<p>accept other equally valid orders, eg alphabetical</p> <p>accept predictions could not be backed by evidence accept why change previous ideas</p> <p>accept they didn't like his groupings / groups</p> <p>do not accept modern explanations, eg proton number etc</p>	2
(ii)	(the properties of gallium) fitted the predictions (owtte) or predictions were correct or (properties) would make it fit in the gap or (properties) would make it fit in group 3	<p>do not accept gallium fitted his theory</p> <p>accept finding gallium proved there were new elements to be discovered</p>	1
total			5

3421/F Q18

question	answers	extra information	mark
(a)	harmful / noxious / nocif	accept <u>less</u> dangerous than a toxic substance do not accept irritant	1
(b)	gives oxygen needed for burning (must be linked to oxygen)	accept oxidising accept 'it oxidises' accept 'it contains oxygen' oxidising <u>agent</u> scores 2 marks oxidising agent because it is flammable = 1 mark flammable loses a mark when both marks awarded accept oxygen makes the flame burn stronger or oxygen helps combustion for 2 marks	1 1
(c)(i)	122.5 or 123	accept $39 + 35.5 + (3 \times 16)$ for 1 mark 122 with no working scores 1 mark	2
(ii)	39% (39.18.... or 39.02....)	allow ecf accept $48/122.5 \times 100$ for 1 mark	2
total			7

3421/F Q19

question	answers	extra information	mark
(a)	colour		1
(b)	Fe_2O_3 or $(\text{Fe}^{3+})_2(\text{O}^{2-})_3$	2 and 3 should be below halfway on Fe and O	1
(c)(i)	4 4	or correct multiples	1
(ii)	any two from: <ul style="list-style-type: none"> • high melting point • strong / tough • hard • not (very) reactive 	ignore references to malleable / ductile / conductivity / stiff / boiling point / density accept can withstand high temperatures accept <u>not</u> brittle do not accept flexible	2
total			5

3421/F Q20

question	answers	extra information	mark
(a)	all electrons correct (inner shell need not be shown)	three bond pairs and two electrons anywhere else can use dots, crosses or e's in any combination	1
(b)	covalent	accept phonetic spelling do not accept convalent	1
(c)	reversible or any indication that reaction can go in either way	accept can go either / both ways accept equilibrium accept can be reversed accept ammonia can be turned into nitrogen and hydrogen	1
(d)(i)	increase yield (owtte) or helps plants to grow	accept answers in terms of fast / <u>better</u> growth accept nitrogen needed for making amino acids / protein / enzymes accept replace / add nitrogen / nutrients in the soil ignore make ground more fertile or plants more healthy	1
(ii)	any one from: <ul style="list-style-type: none"> • jobs • money • exports • increased <u>yield</u> or more coffee 	accept increased business accept land used over again	1
(iii)	washed by rain / permeated / soaked down / passed through soil / rocks etc	accept leached or dissolved / soluble in water ignore absorbed / picks up nitrate	1
(iv)	harmful / risk to health or because it is drinking water or main supply of water or blue baby syndrome etc.	accept references to eutrophication / weed growth do not accept kills people / animals unqualified	1

cont...

3421/F Q20 cont...

(v)	use less	ignore do not use / stop using	1
	especially at end of growing season	do not use at end of growing season = 2 marks	1
	or use natural/ slow release fertilisers (1) release nitrogen less quickly (1)	for alternative (nitrogen) fertiliser	
	or grow leguminous crops (1) nitrates not needed (1)	accept nitrogen obtained from air	
	or treat the water (1) to remove nitrates (1)	do not accept denitrifying bacteria	
		allow marks for mixing different routes	
total			9

3421/F Q21

question	answers	extra information	mark
(a)	sodium carbonate / sodium hydrogencarbonate / sodium bicarbonate	Na_2CO_3 / NaHCO_3 ie sodium / sodium ions (1 mark) carbonate / carbonate ions (1 mark) incorrect formula including Na and CO_3 = 1 mark	2
(b)	calcium chloride	CaCl_2 ie calcium / calcium ions (1 mark) chloride / chloride ions (1 mark) incorrect formula including Ca and Cl = 1 mark	2
(c)	iron or iron(II) ions	Fe^{2+} ferrous ions ignore anions ignore nickel / chromium do not accept iron(III) or ferric ions	1
total			5

3421/F Q22

question	answers	extra information	mark
	<p>Quality of written communication:</p> <p>any three from:</p> <ul style="list-style-type: none"> • B is least energy efficient in terms of cost (kJ per p), so A = C = D in terms of cost or B is the most expensive in terms of energy efficiency owtte • D is 1st, since gives only water as product or gives no harmful products / gases or there are no pollutants owtte • A is 2nd best, since produces CO₂ owtte • C is 3rd, since gives SO₂ owtte 	<p>for correct sequencing or linking of two ideas or two points annotate Q ✓ or Q ×</p> <p>ignore superfluous statements</p> <p>accept B is poor value for money / B is most expensive one is insufficient for mark</p> <p>if no other marks, then D A C B – based on energy per kJ per 100g only = 1 mark and Q mark if 2 ideas are linked</p>	<p>1</p> <p>3</p>
total			4

3421/F Q23

question	answers	extra information	mark
(a)(i)	to make sure all sulphuric acid reacts or to neutralise the acid or unreacted sulphuric acid difficult to remove owtte	ignore ‘to maximise the product’ accept otherwise (sulphuric) acid left	1
(ii)	filter(ing) / filtration or described owtte	accept use filter paper accept centrifuge and decant do not accept sieve / strain filter funnel is insufficient	1
(iii)	no more solid / solute can dissolve or maximum amount of solid owtte at that temperature	accept any link to temperature or any specified temperature	1 1
(iv)	<u>solubility</u> decreases (as temperature falls) owtte	accept <u>less soluble</u> in cold water answer must be linked to solubility ignore the extra cannot dissolve	1
(v)	otherwise get anhydrous CuSO ₄	accept otherwise get white CuSO ₄ accept do not get hydrated CuSO ₄ accept could get CuO or thermal decomposition / decomposes allow SO ₃ / SO ₂ produced allow dehydration accept removes the water of crystallisation not just remove water from the crystals or just steam	1
(b)(i)	56		1
(ii)	answer = 36	correct answer = 2 marks (ecf) (working seen for their 56– 20 for 1 mark)	2
total			9