

Chemistry B

General Certificate of Secondary Education

Unit **B642/02**: Modules C4, C5, C6 (Higher Tier)

Mark Scheme for January 2012

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations

Annotation	Meaning
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject
	contradiction

Subject-specific Marking Instructions

- / = alternative and acceptable answers for the same marking point
- (1) = separates marking points
- allow = answers that can be accepted
- not = answers which are not worthy of credit
- reject = answers which are not worthy of credit
- ignore = statements which are irrelevant
- () = words which are not essential to gain credit
- = underlined words must be present in answer to score a mark (although not correctly spelt unless otherwise stated)
- ecf = error carried forward
- AW = alternative wording
- ora = or reverse argument

Question			Answer	Marks	Guidance
1	(a)		hydrochloric (acid) / HCl// sulfuric (acid) / H ₂ SO ₄ (1)	1	allow incorrect use of superscripts, subscripts or case allow ammonium nitrate / NH ₄ NO ₃
	(b)		sodium hydroxide and hydrochloric (acid) / NaOH and HCl (1)	1	allow mix of names and formulae allow incorrect use of superscripts, subscripts or case
	(c)		hydrochloric (acid) / HCl// sulfuric (acid) / H ₂ SO ₄ (1)	1	allow incorrect use of superscripts, subscripts or case
			Total	3	

Question			Answer	Marks	Guidance
2	(a)	(i)	149 (1)	1	
		(ii)	28.19 (%) (1)	1	allow any value between 28.2 and 28 allow ecf from wrong M_r from (a)(i)
	(b)		$\frac{17.5}{25} \times 100$ (1) but 70 (2)	2	allow $\frac{am}{pm} \times 100$ for one mark if answer incorrect allow full marks for 70(%) with no working out
	(c)		Level 0 (0 mark) No attempt has been made or the answer is not describing any aspect of eutrophication. Level 1 (1 mark) Idea that fertiliser, ammonium salts or phosphates increase the growth of water plants or an algal bloom or idea that organisms die because of lack of oxygen Level 2 (2 marks) Idea that algal bloom blocks out the sunlight so the water plants die Level 3 (3 marks) Idea that aerobic bacteria feed on the dead or decaying plants using up the oxygen	3	Use ticks in this question LEVEL OF RESPONSE MARK SCHEME Mark Scheme is hierarchical – level 1 is required before level 2 can be awarded and levels 1 and 2 are required before level 3 can be awarded ignore fertiliser poisons fish or other organisms at level 1 level 2 plants die because they cannot photosynthesise because of competition for sunlight allow microbes / microorganisms / decomposers instead of bacteria
			Total	7	

Question		Answer	Marks	Guidance
3	(a)	as carbon dioxide goes up the pH goes down (1)	1	allow as carbon dioxide increases the sea water gets less alkaline / as carbon dioxide increases the sea water gets more acidic allow ora
	(b)	universal indicator will be the same colour for all the pH values from 1970 (1)	1	allow there is no colour change (over this small pH range) allow does not have enough colours to measure the pH values allow universal can only really be used to measure the whole number pH values
	(c)	$\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$ (1)	1	allow any correct multiple allow = instead of \rightarrow not and or & instead of +
		Total	3	

Question		Answer	Marks	Guidance
4	(a)	<p>any one from can use a lower temperature (saving energy costs) / can use a lower pressure (saving energy costs) (1) idea of less wear on equipment (1) idea that labour costs are reduced (1)</p>	1	<p>allow so the energy costs are reduced</p> <p>allow can make more hydrogen peroxide in the same time</p>
	(b)	<p>any two from: automation / have machines can reduce costs because you can reduce labour costs / do not use people to do jobs to save salaries (1)</p> <p>recycle any unreacted starting materials so they are not wasted (1)</p> <p>availability of starting material the cheaper the raw material the lower the cost (1)</p> <p>use a lower pressure saves energy cost (1)</p> <p>use a lower temperature saves energy costs (1)</p>	2	<p>allow answers from part (a) if factor and explanation is given and not already credited in part (a)</p>
		Total	3	

Question		Answer	Marks	Guidance
5	(a)	has weak (intermolecular) forces between the layers (1)	1	allow weak bonds between layers allow Van der Waals' forces between layers has weak intermolecular forces is not sufficient not weak covalent bonds
	(b)	(i)	1	no mobile electrons / electrons cannot move / no delocalised electrons not reference to ions
		(ii)	2	allow has a giant (covalent) structure strong bonds not sufficient not giant ionic or giant metallic / intermolecular forces allow lots of heat needed to break the bonds not lots of energy needed to break ionic or metallic bonds harder to break or more heat to break not sufficient
			Total	4

Question		Answer	Marks	Guidance												
6	(a)	120 (tonnes) (1)	1	unit not needed												
	(b)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">sentence</th> <th></th> </tr> </thead> <tbody> <tr> <td>At equilibrium the forward and backward reactions have stopped.</td> <td></td> </tr> <tr> <td>At equilibrium the rate of the forward reaction is greater than the backward reaction.</td> <td></td> </tr> <tr> <td>At equilibrium the rate of the forward reaction is the same as the backward reaction.</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>At equilibrium the concentrations of the reactants are the same as the concentrations of the products.</td> <td></td> </tr> <tr> <td>At equilibrium the concentrations of the reactants and of the products do not change</td> <td style="text-align: center;">✓</td> </tr> </tbody> </table> <p>one correct (1) but two correct (2)</p>	sentence		At equilibrium the forward and backward reactions have stopped.		At equilibrium the rate of the forward reaction is greater than the backward reaction.		At equilibrium the rate of the forward reaction is the same as the backward reaction.	✓	At equilibrium the concentrations of the reactants are the same as the concentrations of the products.		At equilibrium the concentrations of the reactants and of the products do not change	✓	2	if more than two ticks mark the incorrect answers first. <ul style="list-style-type: none"> • one incorrect answer max 1 mark • two or more incorrect will be 0
sentence																
At equilibrium the forward and backward reactions have stopped.																
At equilibrium the rate of the forward reaction is greater than the backward reaction.																
At equilibrium the rate of the forward reaction is the same as the backward reaction.	✓															
At equilibrium the concentrations of the reactants are the same as the concentrations of the products.																
At equilibrium the concentrations of the reactants and of the products do not change	✓															
	(c)	greater concentration of products / smaller concentration of reactants (1)	1	allow more products / more hydrogen / more carbon monoxide / less methane / less water / less reactants ignore rate for forward faster than rate of backward reaction												
Total			4													

Question		Answer	Marks	Guidance
7	(a)	Na_2SO_4 (1)	1	allow any order of atoms case and subscript must be correct
	(b)	1.2 (g) (1)	1	unit not needed
	(c)	0.535 (1)	1	allow 0.54 not 0.5 unit not needed
	(d)	$\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$ (1) correct formulae and balancing (1) correct state symbols (1)	2	case and subscript must be correct for formulae mark allow state symbol mark even if there are errors in case, superscript or subscript
	(e)	ions (1) can move / react at electrodes – dependant on marking point 1 being correct (1)	2	allow has charged particles (1) that can move (1) allow has free ions (2) allow has ions attracted to electrode (2) allow one mark for has particles that can move / electrons that can move
		Total	7	

Question		Answer	Marks	Guidance
8	(a)	mass = 0.44g and M_r of carbon dioxide is 44 (1) moles = 0.01 (1) volume = 0.24 (dm ³)	3	unit not needed allow ecf from mass and M_r unit not needed allow ecf from moles i.e. moles x 24 allow full marks with no working for 0.24 (dm ³)
	(b)	0.02 (1)	1	unit not needed
	(c) (i)	both have the same amount of acid / have the same number of moles (1)	1	allow (can eventually) have the same number of hydrogen ions ignore have the same volume and concentration
	(ii)	ethanoic acid has fewer hydrogen ions (1) there are fewer collisions / less collisions (1)	2	assume answer refer to ethanoic acid unless hydrochloric acid is specified in which case award ora allow higher level answers such as there are less collisions per second / lower collision frequency
Total			7	

Question		Answer	Marks	Guidance
9	(a)	simplest (whole number) ratio of each type of atom in a formula (1)	1	allow simplest ratio of moles of each element in a compound not shortened form of formula
	(b)	1/12 th the mass of a carbon-12 (atom) (1)	1	
Total			2	

Question		Answer	Marks	Guidance
10	(a)	<p>any two from</p> <p>idea of depletion of ozone layer (1)</p> <p>allows more UV to reach Earth's surface (1)</p> <p>increases the risk of skin cancer, cataracts or crop damage (1)</p> <p>CFCs make chlorine atoms / CFCs make (free) radicals (1)</p> <p>CFCs only slowly removed from atmosphere (1)</p> <p>they are greenhouse gases (1)</p> <p>global warming (1)</p>	2	<p>allow makes holes in the ozone layer</p> <p>allow lets more UV through</p> <p>allow slow to degrade / inert</p>
	(b)	shared pair of electrons split one to each chlorine atom (1)	1	
		Total	3	

Question			Answer	Marks	Guidance
11	(a)	(i)	(temporary) hardness is removed by boiling (1) table shows all hardness removed by boiling (1)	2	allow on boiling result goes to same as control value 1cm ³
		(ii)	idea of a control (1)	1	e.g. so can compare other samples to it allow to give a baseline ignore distilled water contains very little hardness
	(b)		CaCO ₃ + H ₂ O + CO ₂ → Ca(HCO ₃) ₂ formulae on LHS (1) formula on RHS and equation balanced (1)	2	allow any correct multiple eg 2CaCO ₃ + 2H ₂ O + 2CO ₂ → 2Ca(HCO ₃) ₂ allow CaCO ₃ + H ₂ CO ₃ → Ca(HCO ₃) ₂ allow = for arrow not 'and' or '&' for + allow one mark for correct equation with incorrect use of upper and lower case formulae eg CaCO ₃ + H ₂ O + CO ₂ → Ca(HCO ₃) ₂
			Total	5	

Question			Answer	Marks	Guidance
12	(a)	(i)	answer in the range 15 to 17 (1)	1	
		(ii)	answer in the range 42 to 44°C (1)	1	
	(b)		<p>any three from</p> <p>little or no heating required for fermentation / large energy requirement for hydration (1)</p> <p>lower pressure used in fermentation / ora (1)</p> <p>fermentation is sustainable / ora i.e. hydration is not sustainable (1)</p> <p>need to distil to get ethanol / ora i.e. no distillation required for hydration (1)</p> <p>fermentation is slower / ora (1)</p> <p>fermentation needs enzymes or yeast / hydration needs (added) catalyst (cost) (1)</p> <p>fermentation is batch process / hydration is a continuous process (1)</p> <p>raw materials for fermentation may be limited (in the UK) / raw materials for hydration available from crude oil / ora</p> <p>fermentation produces a waste product / fermentation has a lower atom economy / ora (1)</p>	3	<p>ignore costs</p> <p>allow fermentation may involve deforestation to get raw materials / aw</p>
			Total	5	

Question		Answer	Marks	Guidance
13	(a)	$C_9H_8O_4$ (1)	1	allow any order not $C^9H^8O^4$
	(b)	similarities both contain ring of 6 carbon atoms / both contain carbon / both contain hydrogen / both contain oxygen / both contain C=O (1) differences aspirin contains fewer atoms / paracetamol contains nitrogen / ora (1)	2	allow contain a double bond
Total			3	

Question		Answer	Marks	Guidance
14	(a)	idea of barrier / stop water, oxygen or air reaching iron (1)	1	protects the iron is not sufficient
	(b)	magnesium more reactive than iron / magnesium loses electrons in preference to iron / magnesium reacts first (1)	1	allow sacrificial protection
	(c)	iron + water + oxygen → hydrated iron(III) oxide LHS (1) RHS (1)	2	
Total			4	

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