

Chemistry B

General Certificate of Secondary Education

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

Mark Scheme for June 2011

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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.

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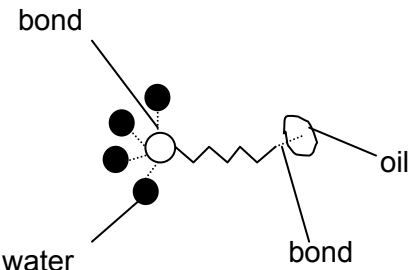
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The **Abbreviations, annotations and conventions** used in the detailed Mark Scheme are:

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

Question		Expected Answers	Marks	Additional Guidance
1	a	saves energy / can wash delicate clothes / colour does not become paler (1)	1	<p>allow reduces the carbon footprint / less greenhouse gases / less global warming / aw</p> <p>allow clothes will not lose colour / clothes will not shrink / clothes will not be damaged</p> <p>allow enzymes are not denatured</p> <p>ignore reference to cost</p> <p>ignore reference to environmentally friendly</p>
	b	i	1	<p>allow polar head and non-polar tail</p> <p>hydrophobic  hydrophilic</p>
		ii	2	<p>if no other marks awarded</p> <p>allow tail is surrounded by oil molecules and the head by water molecules</p> <p>allow as alternative to bonds sticks to, attached, joined the hydrophobic end sticks into oil is not sufficient</p> <p>all marks can be awarded from a labelled diagram but to get two marks must clearly show bonding to rather than surrounded by</p> <p></p>
	c	does not use water (1)	1	ignore it does not get wet
		Total	5	

Question		Expected Answers	Marks	Additional Guidance	
2	a	Na ₂ SO ₄ (1)	1	allow any order of atomic symbols	
	b	it contains chloride (ions) / reaction with chloride (ions) / formation of silver chloride (1)	1	allow sea water contains sodium chloride not reaction with chlorine (ions)	
	c	potassium chloride + barium sulfate (1)	1	allow KC/ + BaSO ₄ allow mix of name and correct formula allow products in any order both required for the mark	
	d	i	needs lots of energy (to boil the water) / aw (1)	1	allow the cost of energy is high allow needs lots of heat it needs a high temperature is not sufficient
		ii	(prevents death) from water borne diseases / aw (1)	1	allow named disease such as cholera and dysentery allow can die from disease (in water) / dirty water contains harmful bacteria / dirty water contains pathogens allow clean water reduces infections or diseases ignore to survive / prevents illness / might die / to stay healthy
		Total	5		

Question			Expected Answers	Marks	Additional Guidance
3	a	i	reaction is faster / can make more in a shorter time / have to pay for other costs for less time (1)	1	
		ii	can be automated / employing fewer workers / aw (1)	1	allow it is much easier to recycle materials / aw allow reaction does not have to be started and stopped / less downtime / no cleaning to be done between processes ignore there are less waste products
		iii	no need to pay for pollution control / higher percentage yield (1)	1	allow raw materials easier to get hold of / no waste products ignore references to cost
	b		any two from: plant is crushed / plant is ground down (1) use of a solvent / use of named solvent (1) distillation (1) chromatography (1)	2	allow cut the plant / squeeze the plant allow dissolve in water / steam (with water) / boil with water
			Total	5	

Question		Expected Answers	Marks	Additional Guidance
4	a	35 (%) (1)	1	
	b	<p>any two from: provides nitrogen / replaces nitrogen used up in soil (1) (nitrogen) gets used by plant to make plant proteins (1) plant proteins needed for growth (1)</p>	2	<p>not contains potassium or phosphorus</p> <p>not provides protein</p> <p>allow nitrogen used to make amino acids / nitrogen used to make polypeptides allow amino acids or polypeptides needed for growth</p>
	c	ammonia / ammonium hydroxide and phosphoric (acid) (1)	1	<p>both needed allow ammonium carbonate / $(\text{NH}_4)_2\text{CO}_3$ allow NH_3 / NH_4OH and H_3PO_4 allow acid-ammonia and alkali-phosphoric <u>acid</u> not phosphorus (acid) not ammonium / ammonia hydroxide</p>
	d	60 (1)	1	
		Total	5	

Question		Expected Answers	Marks	Additional Guidance	
5	a	CH ₃ COOK (1)	1	allow other ways of indicating correct response eg ringing or ticking the correct answer	
	b	i	3.7 (1)	1	allow any value between 3.6 and 3.8
		ii	24 (cm ³) (1)	1	
	c	methyl orange changes colour while it is still acid / methyl orange will not change colour at neutralisation / aw (1) phenolphthalein will change colour at the neutralisation point / aw (1)	2	allow methyl orange will not change colour at pH 7 allow methyl orange changes colour somewhere between pH 1.1 and pH 3.9 (allow a specific pH value within this range) allow phenolphthalein changes colour somewhere between pH 7.1 and pH 9.9 (allow a specific pH value within this range)	
Total			5		


Question		Expected Answers	Marks	Additional Guidance
6	a	C ₂ H ₂ O ₄ (1)	1	allow any order of atomic symbols not C ₂ H ₂ O ₄ / C ² H ² O ⁴
	b	H ⁺ (1)	1	allow other ways of indicating correct response e.g. ringing or ticking the correct answer
	c	will react with metal / will react with the element / corrodes the kettle (1)	1	allow strong(er) acid / it is strong(er) / it has too low a pH the kettle, metal or element is damaged is not sufficient ignore it is toxic / erode
Total			3	

Question		Expected Answers	Marks	Additional Guidance
7	a	greater concentration of product (than reactant) / ora (1)	1	allow more product than reactant / ora not more products made (than reactants)
	b	800 °C position of equilibrium moves to the left (1) 100 °C reaction is too slow (1)	2	allow the higher the temperature the lower the yield / as the temperature increases the position of equilibrium moves to the left / ora allow the lower the temperature the slower the reaction / ora allow 450 °C is the optimum temperature / because it gives a reasonable rate of reaction without shifting position of equilibrium to the left for one mark if no other mark has been awarded
	c	vanadium(V) oxide (1)	1	allow other ways of indicating correct response eg ringing or ticking the correct answer
	d	sulfur + oxygen → sulfur dioxide (1)	1	allow S + O ₂ → SO ₂ even if it is not balanced
		Total	5	

Question		Expected Answers	Marks	Additional Guidance
8	a	$4\text{OH}^- - 4\text{e}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O}$ correct reactants and products including electrons (1) balancing – dependent on correct formulae (1)	2	allow $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ allow one mark for correctly balanced equation with minor errors with case eg $4\text{OH}^- - 4\text{e}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O}$ n.b. this equation scores 0 marks $4\text{OH}^- + 4\text{e}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O}$
	b	i	1	not as time increases oxygen is produced faster
		ii	1	ignore as current increases oxygen is produced faster
	c	3000 (1)	1	
	d	Moles of $\text{KO}_2 = 1$ and moles of $\text{O}_2 = 0.75$ / 284 g of KO_2 make 96 g of O_2 (1) mass of $\text{O}_2 = 24$ (g)	2	allow full marks for 24 with no working out mark answer line first and ignore incorrect working out
		Total	7	

Question		Expected Answers	Marks	Additional Guidance
9	a	<p>any two from:</p> <p>zinc reacts instead of iron (1)</p> <p>zinc is more reactive (than iron) / ora (1)</p> <p>zinc loses electrons more easily (than iron) / ora (1)</p>	2	<p>allow zinc oxidises instead of iron</p> <p>allow zinc is a better reducing agent</p>
	b	<p>$\text{Fe} \rightarrow \text{Fe}^{2+} + 2\text{e}^- / \text{Fe} - 2\text{e}^- \rightarrow \text{Fe}^{2+}$</p> <p>correct symbols (1)</p> <p>correct balancing (1)</p>	2	<p>allow any correct multiple</p> <p>allow 1 mark for correctly balanced equation with minor errors of case or subscripts e.g. $\text{Fe} \rightarrow \text{FE}^{2+} + 2\text{e}^-$</p> <p>allow = instead of arrow</p> <p>ignore state symbols</p> <p>not and for +</p> <p>n.b. these equations score 0 marks</p> <p>$\text{Fe} \rightarrow \text{Fe}^{2+} - 2\text{e}^- / \text{Fe} + 2\text{e}^- \rightarrow \text{Fe}^{2+}$</p>
	c	<p>zinc + copper sulfate \rightarrow copper + zinc sulfate (1)</p>	1	<p>allow = instead of \rightarrow but not and / &</p> <p>allow correct formulae but ignore balancing / $\text{Zn} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{ZnSO}_4$</p> <p>allow mix of correct formulae and words</p>
		Total	5	

Question		Expected Answers	Marks	Additional Guidance
10	a	ethanol is $\begin{array}{c} \text{H} & \text{H} \\ & \\ \text{H}-\text{C} & -\text{C}-\text{O}-\text{H} \\ & \\ \text{H} & \text{H} \end{array}$ (1)	1	allow displayed formula with no bond shown between O and H
	b	C ₄ H ₉ OH (1)	1	allow C ₄ H ₁₀ O
	c	any two from: (much cheaper because) it is a continuous process (1) atom economy is 100% / no waste product (1) obtain pure ethanol / ethanol needs to be separated from reaction mixture in fermentation (1) in UK crude oil is easily available (1) hydration is a fast process / hydration takes a short time (1)	2	allow does not need lots of land / does not need a hot climate / United Kingdom does not grow sugar cane / sugar cane would need to be imported for one mark allow ethene is easily available
	d	C ₂ H ₄ + H ₂ O → C ₂ H ₅ OH	1	allow C ₂ H ₄ + H ₂ O → C ₂ H ₆ O allow any correct multiple allow symbol for reversible reaction or = instead of arrow ignore state symbols not and for +
		Total	5	

Question			Expected Answers	Marks	Additional Guidance
11	a	i	(compound B) has a (carbon-carbon) double bond	1	
		ii	bromine (water) (1) goes red-brown to colourless / yellow to colourless / decolourised (1)	2	allow 2 marks for bromine water is decolourised ignore goes clear allow any shade of brown allow goes colourless not goes discoloured
	b		saponification (1)	1	allow correct answer ticked, circled or underlined in list if answer line blank.
	c		In box  small circles / droplets labelled water rest of space labelled oil (1)	1	allow any number of water droplets
Total				5	

Question		Expected Answers	Marks	Additional Guidance
12	a	exothermic (1)	1	allow correct answer ticked, circled or underlined in list if answer line blank.
	b	reactants / $H_2 + O_2$ / hydrogen + oxygen (1)	1	not H and O
	c	at electrode A electrons are lost so it is oxidation and at electrode B electrons are gained so it is reduction (1)	1	both electrodes must be referred to for 1 mark electrode A may be referred to as the hydrogen electrode and electrode B may be referred to as the oxygen electrode
	d	any two from: fuel cells are more efficient (1) fuel cells are lighter than batteries (1) fuel cells can be used continually / fuel cells do not need to be charged (1) fuel cells use the same fuel that propels the rocket (1) fuel cells produce water that can be used to drink (1)	2	allow ora if batteries are specified ignore more energy is produced allow fuel cells do not run out / fuel cells last longer / fuel cells do not need to be replaced not reference to pollution
		Total	5	

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