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Mark Scheme (Results)
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GCE

GCE Chemistry (6242) Paper 1

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Registered Office: One90 High Holborn, London WC1V 7BH

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response

Using the mark scheme

1 / means that the responses are alternatives and either answer should receive full credit.
2 ( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
3 [ ] words inside square brackets are instructions or guidance for examiners.
4 Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
5 ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- show clarity of expression
- construct and present coherent arguments
- demonstrate an effective use of grammar, punctuation and spelling.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated "QWC" in the mark scheme BUT this does not preclude others.

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)	bauxite			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(b)	electrodes	Anode / cathode	A reducing agent Just "to form carbon dioxide"	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(c)(i)	$Al^{3+} + 3e^{(-)} \rightarrow Al$ Ignore state symbols unless (aq)	Multiples $Al^{3+} \rightarrow Al - 3e^{(-)}$	Equilibrium	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(c)(ii)	Oxidation **(1)** Stand alone loss of electrons (from O^{2-} ions) **(1)** Conditional on first mark	oxidisation	Oxidising / redox in terms of ox. no. Oxygen molecules or O_2 or wrong formula for ion	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(d)	900 (^{0}C)	800 - 1000 (^{0}C) any range or number within this range (inclusive) value in kelvin (1073 – 1273) provided unit given		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(e)	to dissolve the aluminium oxide/alumina/Al_2O_3 Or As a solvent		To dissolve bauxite. Just "lowers melting point (of aluminium oxide)". Any reference to catalysts scores 0.	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(f)	(Generation of) electricity/or electrical energy. Ignore any reference to heat.			1

Question Number	Correct Answer		Acceptable Answers	Reject	Mark
1.(g)	Any one correct use linked to appropriate property:				1
	<u>Use</u>	<u>Property</u>			
	Planes:	low density high strength to weight ratio(1)	(Superstructure of) ships	"light" if used instead of "low density" "Light and strong"	
	bicycle frames/parts	low density (1)	Light for its strength	"Light but strong"	
	car bodies/engines	low density /does not corrode/oxidise (1)	Protected by oxide layer	Rust if used instead of corrode	
	window/ greenhouse frame	does not corrode/ easily extruded (1)	protected by oxide layer		
	cans	do not corrode/ do not react with contents/ acids high strength to weight ratio.	Protected by oxide layer	Do not react with water Easy to recycle	
	pans	good **heat** conductor (1)			
	(cooking) foil	good **heat** conductor / good reflector (1)			
	power cables	high/good conductivity / low density (1)		Electric wiring	

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(a)	N/N_2 goes from 0 to –3 = reduction (1) H/H_2 goes from 0 to (+)1 = oxidation (1)	If "the oxidation number of N goes down hence reduced and the oxidation number of H goes up and hence oxidised" (**max 1**) If all O.N. correct but fails to state which is oxidation and which is reduction scores 1.	If all O.N. correct but both reactions misclassified, scores zero. Any answer not referring to nitrogen or hydrogen scores zero.	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(b)(i)	Calculation of bonds broken 463×3+944/ (=2252) (1) Calculation of bonds made 388×6/ (=2328) (1) ΔH = -76 (kJ mol^{-1}) (1) mark consequential on numerical values calculated above	Correct answer with some working scores 3 marks Correct answer alone scores 2 marks		3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(b)(ii)	Average / mean bond enthalpy used for **N-H bond / ammonia**		Just "average bond enthalpies used"	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(b)(iii)	<u>Thermodynamic:</u> energy level of products lower than that of reactants OR energy released in bond formation > energy used to break bonds (1) <u>kinetic:</u> **high** activation energy (1) because strong N≡N (1) [confusion between thermodynamic and kinetic loses first 2 marks].	ΔH negative / reaction exothermic because N≡N is 944/ total bond breaking energy is high/2252($kJmol^{-1}$)		3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)(i) **Q** **W** **C**	<u>One way</u> temperature increase therefore molecules have greater (average kinetic) energy (1) more molecules/collisions have E ≥E_{act} (1) Therefore a greater **proportion** of/ more **of the** collisions are successful (1) Ignore greater frequency of collision <u>Another way</u> addition of (iron) catalyst (1) provides alternative route of lower activation energy (1) EITHER: A greater proportion of /more of the molecules/collisions have E ≥ E_{cat}/a greater proportion of collisions are successful OR provides (active) sites (where reactant molecules can bond / be adsorbed) (1) Ignore any answers referring to pressure or concentration. Do not penalise just "more collisions are successful" more than once	moving faster E > E_{act} particles for molecules greater frequency of successful collisions/ more successful conditions per unit time platinum catalyst	just "more successful collisions" incorrect catalyst just "more successful collisions"	6

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)(ii) **Q** **W** **C**	Decrease temperature(1) because (forward) reaction exothermic (1) increase pressure (1) because more moles (of gas) on left (1)	Low temperature Δ*H* is negative High pressure Molecules for moles	Answer based on endothermic reaction scores 0	4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(d)(i)	(cool to) condense / liquefy OR cool to below **critical temperature**		Just "cool"	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(d)(ii)	Recycle (the unreacted gases) OWTTE			1

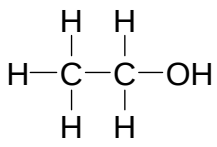
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(i)	2-bromobutane the "2" must be in front of "bromo" Ignore punctuation and capitals			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(ii)	$CH_3CHBrCH_2CH_3 + KOH \rightarrow CH_3CHOHCH_2CH_3 + KBr$ OR $CH_3CHBrCH_2CH_3 + OH^- \rightarrow CH_3CHOHCH_2CH_3 + Br^-$	C_2H_5 instead of CH_2CH_3 Allow K^+ as spectator ion	eqns with NaOH	1

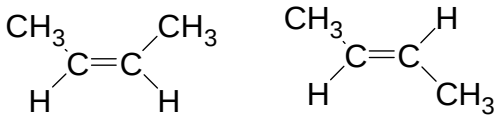
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(iii)	water / H_2O / aqueous ethanol	C_2H_5OH (aq) / aqueous alcohol/KOH(aq)/aqueous Do not penalise use of NaOH(aq) again	just "ethanol / ethanolic / alcoholic (KOH)"	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(iv)	nucleophilic substitution (both needed)	reasonable phonetic spelling		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(i)	$CH_3CHBrCH_2CH_3 + OH^- \rightarrow CH_3CH=CHCH_3 + H_2O + Br^-$ OR $CH_3CHBrCH_2CH_3 + OH^- \rightarrow CH_2=CHCH_2CH_3 + H_2O + Br^-$ Double bond need not be shown	 C_2H_5 instead of CH_2CH_3 Ignore spectator ions		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(ii)	Ethanol / C_2H_5OH / CH_3CH_2OH / 	Alcohol OR Ethanolic/alcoholic KOH/NaOH	C_2H_6O Any mention of water/aqueous	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(iii)	elimination ignore "nucleophilic"		electrophilic elimination	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(c)(i)		bond to H of CH_3 on left carbon structure with 90° bond angles		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(c)(ii)	no / restricted rotation around double bond / C=C /π - bond (1) has two different groups joined to **each** C (of double bond) OR each (carbon of C=C) has a CH_3 and a H (1)	limited rotation	on the carbon	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(d)(i)	nickel / Ni OR platinum / Pt OR palladium / Pd			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(d)(ii)	butane / $CH_3CH_2CH_2CH_3$	C_2H_5 for CH_3CH_2	JUST "C_4H_{10}"	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(e)(i)	$CH_3CHBrCH_2CH_3 + 2NH_3 \rightarrow CH_3CHNH_2CH_2CH_3 + NH_4Br$ OR $CH_3CHBrCH_2CH_3 + NH_3 \rightarrow CH_3CHNH_3^+CH_2CH_3 + Br^-$	$CH_3CHBrCH_2CH_3 + NH_3 \rightarrow CH_3CHNH_2CH_2CH_3 + HBr$		1

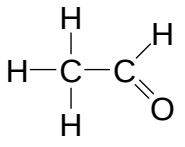
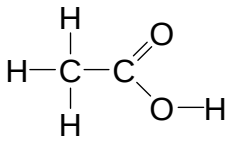
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(e)(ii)	excess / concentrated / ethanolic ammonia	heat in sealed tube	Just "heat" Just "sealed tube"	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(e)(iii)	$\frac{74.4}{12}$: $\frac{14.7}{1}$: $\frac{10.9}{14}$ (1)(= 6.2: 14.7: 0.779) $\frac{6.2}{0.779}$: $\frac{14.7}{0.779}$: $\frac{0.779}{0.779}$ = 8:19:1 so $C_8H_{19}N$ (1)	Correct answer alone scores (2)	dividing by atomic number scores zero	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(a)(i)	$\Sigma\Delta H_f$ (products) - $\Sigma\Delta H_f$ (reactants) / [(-394) + (2 x –242)] – (-75) (1) = -803 (kJ mol^{-1}) (1)	correct answer without working scores (2) -561 (kJ mol^{-1}) scores (1)	any positive value scores zero	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(a)(ii)	(under standard conditions) water condenses / is a liquid (more heat evolved)	Reverse argument **Water** is not in its standard state	Any answer in terms of average bond energies Just "conditions are not standard"	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(a)(iii) **Q** **W** **C**	Any 4 of: H_2 better because: cheaper per kJ (1) more energy per gram / less weight/mass to carry for same energy (1) no CO_2 /only H_2O produced (at point of use) (1) H_2 worse because: gas storage needs pressurised/large containers (1) which are heavy (1) needs to be cooled to very low temperature to be liquefied (1) Ignore problems with refuelling	converse argument	Just "cheaper" Just "more energy" Just "hard to store" Hydrogen is flammable/ dangerous/explosive	4

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(b)(i)	 (1)  (1)	-OH for –O — H		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(b)(ii)	structural formula of any tertiary alcohol (1) and its name (1) - must not contradict the formula and conditional on tertiary alcohol	2nd mark can be awarded if minor slip in formula or no formula given		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(c)	(concentrated) sulphuric acid / H_2SO_4 OR phosphoric acid / H_3PO_4 OR aluminium oxide/Al_2O_3	 pumice	Dilute H_2SO_4 Or H_2SO_4(aq) Or Dilute H_3PO_4 50% H_2SO_4	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(d)(i)	$-CH_2CH_2-$ (1)	$-(-CH_2 - CH_2 -)_n-$	$- CH_2 -$	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(d)(ii)	bags / bottles / packaging / (food) containers / buckets / bowls	Electrical insulation /cling film/water pipes	Clothing, light fittings, ropes	1