

GCE

Science

Unit **G642**: Science and Human Activity

Advanced Subsidiary GCE

Mark Scheme for June 2014

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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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Abbreviations, annotations and conventions used in the detailed Mark Scheme.

Annotation	Meaning of annotation
BP	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
/	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
—	underlined words must be present in answer to score a mark
ecf	error carried forward
AW	alternative wording
ora	or reverse argument

Highlighting is also available to highlight any particular points on the script.

The following questions should be annotated with ticks to show where marks have been awarded in the body of the text:
2(b), 4(c), 6(b), 7(b)(iii) and 12(a)

Question			Expected Answers	Marks	Additional Guidance
1	a	i	covalent bond labelled ; hydrogen bond labelled; lone pair labelled ;	2	3 correct = 2 marks 1 or 2 correct = 1 mark Any incorrect label is CON for that type of bond
		ii	104.5(°) ;	1	ACCEPT any value between 100 – 110 ACCEPT correct value on the diagram if answer line is blank
	b		<ul style="list-style-type: none"> hydrogen bonding between water molecules ORA (other molecules do not have hydrogen bonding); (boiling involves) breaking the hydrogen bonds / separating molecules / overcoming force between molecules; this requires more energy ; 	3	IGNORE mention of other forces Must clearly refer to intermolecular bonds AWARD 2 nd and 3 rd MP even if IMF are wrongly identified
	c	i	between 1600 -1700 cm ⁻¹ ;	1	
		ii	Increase in vibration / vibrational kinetic energy / vibrates more ;	1	ACCEPT more bond movement / motion NOT just “more kinetic energy”
	d		<p><i>(greenhouse effect) Any 4 from:</i></p> <ul style="list-style-type: none"> Radiation / light / uv from Sun ; absorbed by Earth / causes warming of Earth ; (re-)emitted by Earth as <u>infrared</u> (radiation) ; (some) molecules / gases / correct named substances absorb(IR) energy / radiation / heat (emitted by Earth); <i>(explains effect on global temperature)</i> preventing heat / energy / radiation from escaping (atmosphere) ; AW re-radiates IR <u>back to Earth</u> ; AW passes on energy by colliding with other molecules ; <p><i>(different contributions of gases) Any 2 from:</i></p> <ul style="list-style-type: none"> different amounts / concentrations / proportions of gases in atmosphere ; H₂O/ CO₂ absorb different frequencies / wavelengths (of IR) ; because they contain different bonds ; <p>QWC: for including description <u>and</u> explanation</p>	4	CON if radiation is identified as IR Must clearly be identified as originating from Earth Must clearly link to energy emitted by the Earth NOT just “trapped” NOT “ <u>light</u> cannot escape” (3 max if no valid comment about contributions of CO ₂ and H ₂ O)
					2
Total				14	

Question			Expected Answers	Marks	Additional Guidance
2	a	i	Sun's rays are (more) concentrated / directly above owtte (at A); ORA Sun's rays are less concentrated / spread out owtte at B ;	1	NOT "more intense" alone NOT "directly hitting" alone
		ii	air molecules have greater kinetic energy ; air molecules become more spaced out / further apart / take up more space; so air is less dense (and rises) ;	3	Must refer to <u>molecules / particles</u> in 1 st 2 MPs NOT <u>air</u> expands
		iii	volume increases / expands; volume <u>doubles</u> ; pressure caused by collision of molecules with a surface; the air molecules further apart means fewer collisions (per unit area of surface) ; pressure / force of gas = pressure / force exerted on gas; ANY four	4	ACCEPT "volume doubles" on its own for 2 marks Must imply that collision is with a surface / boundary of gas Reference to lower KE is CON, REJECT if implication that fewer collisions causes molecules to be further apart ACCEPT pressure of gas > pressure exerted if volume didn't increase
	b	i	<ul style="list-style-type: none"> Air is heated at the equator and rises; (rising air is associated with) low pressure at the equator ; (Air rises) until it reaches the tropopause / top of troposphere / height at which atmosphere stops cooling ; Spreads horizontally / N and S, cools and descends (at 30° N/S); High pressure at 30°N/S / where air descends; Pressure differences at surface owtte cause surface ;movement of air / air flows from high to low pressure ; <p style="text-align: right;"><i>Any 4</i></p>	4	Need all 3 for mark
		ii	<ul style="list-style-type: none"> ITCZ occurs at point of maximum intensity owtte of Sun's rays; This occurs at different positions / latitudes at different time of year AW intensity of Sun at the equator varies over the year; (because the) Earth is tilted (owtte) on its axis ; 	3	ACCEPT ITCZ will not be at equator if Sun is not directly above equator
Total				15	

Question		Expected Answers	Marks	Additional Guidance
3	a	11O_2 ; 7CO_2 and $8\text{H}_2\text{O}$;	2	ACCEPT multiples, halves etc
	b	i <i>Method</i> <ul style="list-style-type: none"> • mass (accept volume) of water measured; • initial temperature of water measured ; • spirit burner lit / heat water ; • final temperature recorded ; • (fine detail) waits until highest temperature reached ; • correct equation to calculate heat energy / use mass of water, shc and temp rise to calculate energy ; <p style="text-align: right;"><i>Any 5</i></p> <p><i>Precision mark</i> temperature recorded to nearest 0.5°C or better AW choose conditions so that temperature rise is as high as possible;</p> <p>OR volume of water measured to nearest 1cm^3 / mass of water measured to 1g or better;</p> <p><i>Reliability mark</i> experiment repeated with conditions same;</p> <p>QWC : correct sequencing for method</p>	5	IGNORE weighing of heptane “records highest temperature reached” alone = 2 marks Max 4 if not correctly sequenced and/or experiment would not work One mark for a precision comment 1 1 Or at least one condition listed <i>ANNOTATE lost QWC mark by using CON x at bottom of answer</i>
		ii calorimeter made from copper or aluminium ; material must be a good (thermal) conductor AW low thermal capacity owtte for aluminium ;	2	ACCEPT any suitable named metal NOT just light / low density.
Total			11	

Question		Expected Answers	Marks	Additional Guidance
4	a	C ;	1	ACCEPT C or whole structure of C indicated on diagram if answer line blank
	b	hydrogen bond(s) ; <i>And any one from:</i> between peptide groups / CONH groups; between δ - oxygen / δ - nitrogen and δ + hydrogen ;	1 1	 Between amino acid side groups is CON ACCEPT shown as annotations on diagram
	c	i <ul style="list-style-type: none"> • (only) substrate has a specific / particular / unique owtte (3D) shape AW no other molecule has the same shape ; • which is <u>complementary</u> to the enzyme AW fits / lines up with and bonds to AW fits and forms enzyme-substrate complex ; • (fits into) enzyme's <u>active site</u> ; 	3	REJECT lock and key alone without explanation
		ii Shape of graph: <ul style="list-style-type: none"> • (enzyme activity) gradually increases(with temperature) to a maximum / optimum; • (activity) <u>rapidly owtte</u> declines (after optimum); • Optimum / maximum is 45 AND activity drops to 0 at 55; explanation: (gradual increase with temperature) <ul style="list-style-type: none"> • due to increased rate of collisions / more effective collisions (above optimum) <ul style="list-style-type: none"> • enzyme / active site is denatured / changes shape ; • <u>active site</u> no longer complementary to / fits to substrate owtte; <i>Any 5</i>	5	ACCEPT 43-47 and 53-58 CON if answer refers to denaturing at temperatures below 45
		Total	11	

Question		Expected Answers	Marks	Additional Guidance																	
5	a		4	6 correct = 4 marks 4 or 5 correct = 3 marks 2 or 3 correct = 2 marks 1 correct = 1 mark Annotate with ticks and crosses in RH column																	
	b	<table border="1"> <tr> <td>DNA</td> <td>A</td> <td>G</td> <td>T</td> <td>T</td> <td>A</td> <td>C</td> <td>G</td> <td>C</td> </tr> <tr> <td>Messenger RNA</td> <td>U</td> <td>C</td> <td>A</td> <td>A</td> <td>U</td> <td>G</td> <td>C</td> <td>G</td> </tr> </table>	DNA	A	G	T	T	A	C	G	C	Messenger RNA	U	C	A	A	U	G	C	G	2
DNA	A	G	T	T	A	C	G	C													
Messenger RNA	U	C	A	A	U	G	C	G													
Total			6																		

Question			Expected Answers	Marks	Additional Guidance
6	a	i	239 ; 94;	2	
		ii	93 ;	1	
		iii	(indication of) 4 half lives ; 0.05 (mg) ;	2	ACCEPT 0.05 mg on its own for 2 marks ecf from incorrect deduction of number of half-lives
	b		<p><i>Hazards of source: 3 ma from:</i></p> <ul style="list-style-type: none"> • alpha radiation is (highly) ionising (over short distances) ; • (has a long half life so) it will remain radioactive for a long time ; • potentially cancer inducing / damaging to cells if <u>ingested / if inhaled / if injected</u> owtte; • as alpha has a low penetrating power ; <p><i>method of containment:</i></p> <ul style="list-style-type: none"> • in sealed container owtte <p>explanation (2 max)</p> <ul style="list-style-type: none"> • stop risk of leaking owtte (linked to risk of ingestion / contamination / no risk from low penetrating alpha radiation etc); • must not corrode / damaged by earthquakes etc (owtte) so lasts a long time (linked to remaining radioactive for a long time) ; 	5	<p>Needs to have indication that source must enter body to cause harm ACCEPT cannot pass through material etc</p> <p>Must imply sealed in some way NOT storage underground alone NOT container alone</p> <p>Explanation(s) needs to link clearly to a valid property of the source</p>
Total				10	

Question		Expected Answers	Marks	Additional Guidance
7	a	the energy is continuously being replenished / energy is input from sun etc ;	1	
	b	<p><i>Give credit for any specific comment about a named energy source in each the following 4 criteria</i></p> <p>Technical requirements wind turbines required ; solar panels required ; tidal barrage; wave energy device in sea; OVP</p> <p>Reliability: Need sufficient wind / constant wind / large numbers of wind turbines / large area needed ; Need high intensity of sunlight / only works during day / large area exposed to sun / south facing; School would need to be next to estuary / needs large tidal range; School would need to be on coast / next to sea Awn needs constant high waves; OVP</p> <p>Environmental issues Wind turbines are noisy / eyesore AW kill birds flying in to them Solar panels (on roof) have little environment impact Tidal barrage affects migrating fish / wading birds etc Wave energy device attached to sea bed so impact on wildlife in sea bed; OVP</p> <p>Cost / planning issues Wind turbines / solar panels cheaper to install AW easier to maintain than tidal / wave power; Consideration of return period on investment / comparison of set up costs to amount of electricity generated; Allowed to install wind turbines on roof; Solar panels grants available / allowed to install on roof; Tidal barrage:school don't own the estuary; Wave power: school don't own the seabed; OVP</p>	8	<p>OVP must clearly link to one of these 4 criteria in the context of a school 4 max for each criteria</p> <p>ALLOW answer in general terms</p>
		Total	9	

Question			Expected Answers	Marks	Additional Guidance
8	a	i	Joule = Watt x second AW energy = power x time ; 850 MW = 8.5×10^8 W ; $30 \times (8.5 \times 10^8) = 2.55 \times 10^{10}$ J / 2.6×10^{10} J ;	3	ACCEPT 850 x 30 or 25500 as idea of equation re-arrangement ACCEPT 25,500 MJ / 25.5GJ (3 marks) 1 or 2.6 / 2.55 or 2.6×10^x scores 2 2.5×10^{10} scores 2 (RE) Correct answer gets all 3 (answer must be consistent with units)
		ii	voltage increased ; current decreased ; in order to minimise (energy loss through) <u>heat loss</u> ; power loss = (current) ² x resistance; ANY 3	3	
		iii	<u>50</u> (complete) cycles every second / current changes direction 100 times a second ; alternating current / current changes <u>direction</u> ;	2	
	b		$I = W / V$; current = power / voltage; $I = 2500 / 230 (= 10.87)$; 10.9 (3s.f.) AW any number from a calculation using the data to 3 s.f. ; Amps (A) ;	3 1	11, 10.87, 10.8657 etc without any working = 2 marks, 10, 10.8 without working scores zero ACCEPT W/V, WV^{-1} or other valid unit Correct answer to 3.s.f and units gets all 4 marks
			Total	12	

Question		Expected Answers	Marks	Additional Guidance
9	a	(Less) ozone to filter out / absorbs owtte <u>UV</u> radiation ; (less UV filtered) so DNA / genes / cell division may be damaged AW mutations / cancer caused AW sunburn / cataracts caused ;	2	NOT just "more UV reaches surface etc" Mention of global warming etc is CON
	b	increases and decreases scores 1 ; increases in 1 st reaction decreases in 2 nd reaction AND change is 2 in each case scores 2 AW (+)2 to (+)4 in 1 st reaction AND (+)4 to (+)2 in 2nd reaction scores 2	2	Must identify reaction in which increase and decrease occurs
	c	i	1	ACCEPT proton donor NOT just has H+ ions
		ii	2	Either order If no charges shown on ions = 0 marks
		iii	5	ACCEPT marking points on labelled diagrams All MPs must refer to ions Can award last two MPs even if other details of ions are incorrect Needs to be linked to description of release or leaching of correct ions
			Total	12

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