

Mark Scheme for June 2013

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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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Annotations

Annotation	Meaning
/	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
e cf	error carried forward
AW	alternative wording
ora	or reverse argument
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject

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		Answer	Marks	Guidance
1	(a)	5 ; H ₂ O ;	2	NOT H ² O etc ALLOW correct multiples
	(b)	Suitable e.g. HF, H ₂ O, NH ₃ ; Difference in <u>electronegativity</u> between atoms ; More electronegative element is negative / has δ- symbol AW causes electrons to be shared unevenly / causes one side of molecule to be negative etc ;	3	IGNORE minor errors on diagram Comparative electronegativities need to be correct Third mark can be awarded from correct dipole on diagram. ECF from incorrect electronegativities above
	(c) (i)	4 ;	1	
	(ii)	Molecule is linear (in a straight line) ; Dipoles cancel out AW centre of positive charge is in same place as centre of negative charge ;	2	ACCEPT completely symmetrical
	(d) (i)	Between 0.125 and 0.135 ;	1	IGNORE unit
	(ii)	CO ₂ in air increases ; As ocean (water) warms CO ₂ becomes less soluble (in water) / less is dissolved ;	2	ALLOW CO ₂ released into atmosphere owtte IGNORE any mention of water vapour / evaporation
	(e) (i)	H ⁺ ion or H ₃ O ⁺ ;	1	Any other particle is CON
	(ii)	Only partially (slightly) ionised / dissociated ;	1	ALLOW “does not donate H ⁺ ions easily”
	(iii)	H ⁺ ; HCO ₃ ⁻ ;	2	ALLOW 2H ⁺ + CO ₃ ²⁻ (but must balance) ALLOW CO ₃ ⁻² Must show correct charge
		Total	15	

Question		Answer	Marks	Guidance	
2	(a)	Same atomic number / same no. of protons ; Different mass number / different number of neutrons ;	2	ALLOW same element IGNORE reference to electrons	
	(b)	(i)	Time on X axis, radioactivity on Y with labels and units ; At least half of graph used in each direction ; All points plotted correctly ; All points connected with line of best fit ;	4	IGNORE omission of arbitrary units If ruler used for any part of graph award 0, curve should be approximately exponential
		(ii)	8 days ;	1	ALLOW ECF from graph (construction lines need to be shown)
		(iii)	54 ;	1	
	(c)	(Splitting) breaking apart of a(n) (atomic) <u>nucleus</u> (to produce smaller nuclei) ; Releasing energy / heat / neutrons absorbed and/or released ;	2	NOT decay (this CONS 1 st mark)	
		Total	10		

Question			Answer	Marks	Guidance
3	(a)	(i)	<u>Alpha helix</u> ;	1	Not just helix
		(ii)	Overall / large-scale / complex ; 3D structure of the protein ; Produced when the sequence / 2ndary structures has folded ; <i>Any 2 from 3</i>	2	ALLOW as determined by primary structure AW for 3 rd marking point
		(iii)	Cysteine forms sulfur-sulfur links ; Links between cysteine's maintain tertiary structure of protein ; Mutation means that cysteine not present / unable to form S-S bonds ;	3	Needs to be linked to inability to form link between cysteine
	(b)		A. (idea that) activity from graph increases to a peak at <u>6</u> ; B. then decreases at pHs above this ; <i>2 marks</i> C. presence of acids / alkalis / H ⁺ / OH ⁻ affects amino acids / protein / enzyme (causes changes to structure / charges etc.) ; D. new ionic interactions / altered charges on side groups may result ; E. alters the tertiary / 3-D structure / shape of enzyme AW denatured ; F. change of shape to <u>active site</u> ; G. prevent enzyme binding to substrate / enzyme-substrate fit ; <i>3 out 5 for explanation</i>	5	AW A. optimum at pH 6 B. activity declines above and below this <i>1 mark max</i> if optimum pH not stated Need to link presence of acid with some change to enzyme structure ALLOW 1 mark for any reference to protonation or deprotonation of amino acids IGNORE "active site denatured"
			Total	11	

Question		Answer	Marks	Guidance
4	(a)	A. ozone (methane) has different bonds ; B. different bond lengths / strengths / masses of atoms ; C. (peaks in) IR spectrum shows frequencies of vibrations (of bonds / molecules) ; D. <u>different bonds</u> vibrate / absorb at different frequencies ; <i>Any 3</i>	3	Gives examples e.g. double / single / C-H / O=O etc Credit any reference to spectrum e.g. ozone has peak at 1000cm^{-1} methane unlikely to have same peak (in context of different bonds) etc.
	(b)	(i) Correct selection and rearrangement / $\lambda = c/f$; $\lambda = 3.0 \times 10^8 \text{ m/s} / 1.27 \times 10^{15} \text{ Hz}$; $236 \text{ nm} / 2.36 \times 10^2 \text{ nm} / 2.36 \times 10^{-7} \text{ m}$;	3	Scores 2 if correct, IGNORE use of 10^{-9} Unit must be consistent with value for 3 rd mark
		(ii) $E = hf (1.27 \times 10^{15}) \times 6.63 \times 10^{-34} = 8.42 \times 10^{-19}$; Joules (J) ;	2	
		(iii) An atom (molecule/species) with an <u>unpaired</u> electron(s) ;	1	Must refer to the species which contains the unpaired electron(s)
		(iv) Radicals are very reactive species / can cause bonds to break (or form) / react with atoms (in DNA) ;	1	IGNORE ionise ALLOW break up / split DNA etc. IGNORE reference to DNA nucleus etc.
		Total	10	

Question		Answer	Marks	Guidance
5	(a)	Accept between 50-58 dm ³ ;	1	
	(b)	(i) Gas <u>molecules</u> gain (kinetic) energy ; Gas molecules do work on the atmosphere / push atmosphere outwards AW volume or surface area of gas must increase to keep pressure constant ; Distance between molecules increases / molecules more spread out ; <i>Any 2</i>	2	Accept move around faster Reference to density increasing is CON
		(ii) Work done / AW energy used when gas is compressed; Work done = energy transformed owtte ; Greater <u>kinetic</u> energy of molecules ;	2	Only award 2 nd mark if some reference to work done on gas
	(c)	(i) <u>Hydrogen bonds</u> form between molecules ; Bond formation releases heat ;	2	Must mention hydrogen bonding for this mark.
		Total	7	

Question			Answer	Marks	Guidance
6	(a)	(i)	Glycine ;	1	
		(ii)	TACCGA ;	1	
	(b)	(i)	Matches codon with anticodon (on mRNA) ; Brings amino acid to ribosome AW attaches to a (specific) amino acid ;	2	Correct statements relating to parts b(i) and (ii) can gain credit in either answer
		(ii)	Contains (binding) site for mRNA / AW binds to mRNA ; Moves along mRNA strand ; ✓ Site for translation / protein synthesis / joins amino acids ; <i>Any 2</i>	2	
	(c)	(i)	H bonds between bases (easily) broken ; New hydrogen bonds form / form between DNA strand and free nucleotides ; Bases must be complementary / A bonds to T and G to C ;	3	Needs to be in the context of replication i.e. that strands have become separated. Mention of (m)RNA is CON
		(ii)	A. hydrogen bonds between (atoms in) <u>amino acids</u> ; B. hydrogen bonds stabilise secondary ; structures / α helix / β pleated sheet ; C. by forming bonds between peptide groups ; D. ensure specific 3D / tertiary) structure ; E. by forming bonds between side groups ; <i>Any 3</i>	3	Reference to nucleotides is CON Mention of primary structure CON for marking point B or D IGNORE reference to other intramolecular forces
			Total	12	

Question		Answer	Marks	Guidance
7	(a)	Coal ; Crude oil (oil) ; Natural gas / methane ;	1	Must have 2 for 1 mark
	(b)	Breaking (covalent) bonds is endothermic (requires energy) ; Formation of new (covalent) bonds is exothermic (releases energy) ; <i>If only intermolecular bonds mentioned, 1 max</i> Exothermic process has greater magnitude than endothermic (then net (overall) energy change is exothermic) ;	3	AW (covalent) bonds broken and formed; Bond breaking = exothermic, bond forming = endothermic; Can be ecf from above if net result is exothermic
	(c)	(i) <i>Compares biobutanol and bioethanol</i> For: A. less plant material needed (because twice the yield) ; B. biobutanol can be made from greater range of plant material / feedstocks / AW wood / bio waste / material grown on marginal land etc ; C. biobutanol has a higher energy output per kilogram / energy density / has a higher energy efficiency ; D. biobutanol produces less NO _x and CO / pollutants / acid rain / toxic products (owtte) ; Against: E. if genetically modified organisms released into environment impact could be unknown / needs expensive or lengthy testing ; F. tampering with nature owtte ; G. 4% is still a small yield (compared to e.g. fermentation processes) ; <i>Any 6</i> <i>Sequencing: needs to make it clear that biobutanol is being compared with bioethanol. Max 5 marks if this is not clear</i>	6	Mark first of all as a comparison of biobutanol and bioethanol and then compare mark with what would be obtained by comparing biobutanol and fossil fuels. Award highest mark NOT higher yield alone NOT just from cellulose alone without justification NOT just more energy from biobutanol ALLOW NO _x as an example of greenhouse gas not reference to global warming without justification

Question	Answer	Marks	Guidance
	<p><i>If compares biobutanol with non-renewable fuels: Max 3</i></p> <p>For:</p> <p>A. carbon dioxide emitted is equal to carbon dioxide absorbed (owtte) ;</p> <p>B. makes use of waste plant material so reduces landfill ;</p> <p>C. less reliance on (non-renewable fossil fuels) ;</p> <p>Against:</p> <p>D. fertiliser use / transport for feedstock production emits CO₂ ;</p> <p>E. if genetically modified organisms released into environment impact could be unknown ;</p> <p>F. tampering with nature owtte ;</p> <p>G. technology for fossil fuel production is well-established ;</p> <p>H. Land use for biobutanol reduces use for crop plants ;</p> <p>I. Yield of biobutanol is small ;</p> <p><i>Sequencing: needs to make it clear that biobutanol is being compared with non-renewable fossil fuels. Max 2 marks if this is not clear</i></p>		
	Total	10	

Question		Answer	Marks	Guidance
8	(a)	Temperature ; Salinity ; Density ;	1	Any 1
	(b)	A. temperature is very low (in Antarctic) / AW in winter ; B. as a result water freezes / ice forms ; C. ice does not contain salt ; D. the resultant (sea) water has high salinity ; E. which is dense ; <i>Any 4</i>	4	Any 4 Reference to fresh water etc with low salinity is CON
	(c)	(i)	$Q = mc\Delta T$, $Q = 80 \times 4.2 \times 5 = 1680$; kJ ;	2 AW 1680000 J
		(ii)	A. warm water (at sea surface) loses heat / energy to atmosphere ; B. water (at sea surface) evaporates / water vapour formed ; C. (water's high s.h.c causes) large amount of heat to be transferred to atm owtte ; D. gas expands / become less dense and causes decrease in pressure ; E. (expanded air mass) rises and cools ; F. water vapour condenses as rain ; <i>Max 5</i>	5
		Total	12	

Question		Answer	Marks	Guidance
9	(a)	Coulomb ; Electrons ; Low ; Transformer ; High ; Heat ;	6	
	(b) (i)	Power is joules (energy) per second / rate of transfer of energy / rate of doing work ;	1	Allow $W = J/s$
	(ii)	$W = J/s$, $s = J/W$; $S = 10,500/15.0 = 700$ seconds AW 11.7 mins ; Answer to 2 s.f. ;	3	700s = 3 marks; 700 = 2 AW 11.7 or 12 = 3 ACCEPT 11.7 or 12 mins. Award 2 s.f. mark if answer is consistent with some valid working
	(iii)	$W = V \times I$, $I = W/V$; $I = 15/240 = 0.0625$; Amps (A) ;	3	$15/240 = 1$ mark ACCEPT 0.06, 0.063 etc.
		Total	13	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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