

Science

Advanced GCE **A2 7885**

Advanced Subsidiary GCE **AS 3885**

Mark Schemes for the Units

June 2006

3885/7885/MS/R/06

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Advanced GCE Science (7885)

Advanced Subsidiary GCE Science (3885)

MARK SCHEMES FOR THE UNITS

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**Mark Scheme 2841
June 2006**

Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit () = words which are not essential to gain credit — = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument	
Question	Expected Answers	Marks
1 (a) (i)	trophic level;	1
	(ii) consumers;	1
(b)	by eating / feeding / consumption; description of sequence of feeding eg: organisms eat those in lower level / herbivores eat plants; energy is passed on as biomass / (dry) organic matter; stored as chemical energy / compounds / molecules / fats / lipids / carbohydrates / sugars / glucose / starch / glycogen / in bonds; released in respiration / from chemical reactions; some used to build up new biomass / organic matter / compounds; (3 points from above list)	3
(c) (i)	second; law of thermodynamics;	2
	(ii) entropy;	1
	(iii) heat / thermal energy;	1
(d) (i)	rate of / per unit time / per year (production of); mass of organic matter; dry; per unit area / in given area / per m ² / other example of area; (AW award first two marks for biomass) (3 points from above list)	3
	(ii) light intensity / temperature / salinity / efficiency of producer;	1
	(iii) changes from salt water to freshwater; as tide comes in and out / as sea level rises and falls; between spring and neap tides; with periods of heavy rain / drought; (2 points from above list)	2
Total: 15		

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Question	Expected Answers	Marks
2 (a)	same atomic number/ same proton number / <u>atoms</u> of same element ;	2
	NOT different forms of the same element	
(b)	different numbers of neutrons / nucleons / different mass number;	1
(c)	235 mass number / nucleon number;	
	splitting of a nucleus / atom;	3
	into two lighter nuclei / as a result of bombardment;	
(d) (i)	(in this case) 92 (protons) splits into 53 and 39;	
	correct height bars;	2
(ii)	correctly labelled	
(e)	30% / 29%;	2
	working to show total radioactivity = 2730 Bq;	
	it has the lowest boiling point;	2
	so vaporizes most easily;	
	substances are likely to have escaped from chimney;	
(f) (i)	(2 points from above list)	
	correctly plotted points;	2
(ii)	smooth curve through points;	
	<u>time</u> taken for (level of) radioactivity / (rate of) decay / mass / amount;	2
(iii)	to fall to <u>half</u> (of its original value);	2
	8 days;	1
(iv)	lines drawn on Fig. 2.5 to show time taken to halve level of radioactivity;	
	background level of radioactivity / safe or recommended exposure limit to iodine-131 / residence time of iodine in thyroid gland / distance of farm from reactor ;	
	Total: 19	

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Question	Expected Answers	Marks												
3 (a) (i)	red light has longer wavelength than blue light; ora	1												
(ii)	reflection; absorption;	2												
(iii)	white light consists of all the colours; red pigment absorbs all colours except red / absorbs complementary colours / blue pigment absorbs all colours except blue; (accept general explanation)	2												
(b) (i)	correct single sinusoidal waveform; wavelength labelled correctly; (separate electric and magnetic components not required)	2												
(ii)	they are able to paint / make use of colour coding on products / other sensible answer;	1												
(c) (i)	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">wavelength range</td> <td style="width: 25%;">healthyvegetation</td> <td style="width: 25%;">soil</td> <td style="width: 25%;">colour assigned</td> </tr> <tr> <td>red light</td> <td>low</td> <td>HIGH</td> <td>BLUE</td> </tr> <tr> <td>VNIR</td> <td>HIGH</td> <td>LOW</td> <td>RED</td> </tr> </table>	wavelength range	healthyvegetation	soil	colour assigned	red light	low	HIGH	BLUE	VNIR	HIGH	LOW	RED	
wavelength range	healthyvegetation	soil	colour assigned											
red light	low	HIGH	BLUE											
VNIR	HIGH	LOW	RED											
(ii)	correctly filled in healthy vegetation column; correctly filled in soil column; correctly filled in colour assigned column;	3												
(iii)	pixels;	1												
	travel round / orbit Earth from pole to pole / N to S (and S to N); at (relatively) high altitude; sense a band of Earth's surface; sense a different band on successive orbits; build up coverage of all Earth's surface; sequence repeats itself after several weeks; orbits are not geostationary / alternative correct description; (3 points from above list)	3												
	Total: 15													

**Mark Scheme 2842
June 2006**

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Question	Expected Answers	Marks
1 (a)	The Sun; AW heat from the Earth's surface	1
(b) (i)	Air is heated; Most intensely at equator; Causes expansion / reduces density Air converges;	2
(ii)	A: Low; B: High; C: High;	1
(iii)	Force = pressure x area; $2.06 \times 10^6 / 2060000$ ecf; N / Newtons ;	3
(c)	Dry; Hot / Warm; AW cooler than equator Sunny; Any two	2
		TOTAL: 9

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Question	Expected Answers	Marks
2 (a) (b) (c)	<p>Acid deposition includes acid snow / fog / dry deposition; AW there are alternative routes for acid to be transported</p> <p>Coal / fossil fuels (are burnt) (They contain) sulphur / impurities which <u>reacts/ combines</u> with oxygen AW impurities / S combusts ;</p> <p>e.g. Catalytic converters on cars; Convert NO_x / NO / nitrogen oxide to N; By reacting it with CO; Absorbers /scrubbers/ (<i>filters</i>) in chimneys AW flue gas desulphurisation (<i>scores 2</i>); Absorb / neutralize SO_x; / SO₂ / sulphur (di)oxide by exposing to water / limestone; Use low sulphur petrol / low sulphur coal / alternative fuels in cars / electric cars; Lime / add limestone to / lakes ; Limestone / calcium carbonate added to paint on walls Limestone / lime neutralizes / reacts with acid; Describes these processes as clean-up technology ; (other valid points possible)</p> <p>e.g. power can be generated using alternative energy sources (or gives example); Energy efficiency measures introduced (or gives example) NOT jus recycling without justification Hence less fossil fuels / coal burnt Describes these strategies as clean technology; NOT legislation Any 6 points QWC: Legibility and grammar 2 marks: A: Text is clearly legible and B: Spelling, punctuation and grammar are accurate (1-2 minor errors) throughout 1 mark:</p>	1 2 6 2

	A: Text is untidy but can be read without difficulty and B: Spelling, punctuation and grammar shows some mistakes 0 marks: A: text is difficult to read and B: spelling punctuation and grammar show a high proportion of mistakes	TOTAL: 11
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Question	Expected Answers	Marks
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3 (a)	Epidemiological / epidemiology; AW case study / cohort study / longitudinal study	1
(b) (i)	Sinusoidal shape and field reverses (ignore electric field); 1 cycle shown or clearly indicated;	2
(ii)	Rate; at which energy is converted / supplied / used up / work is done; AW energy divided by time (2 marks); NOT power = $V \times I$	2
(iii)	Rearranges equation current = power / voltage; Correctly calculates current as 0.277777./ 0.28;; AW calculates power; as 1.008 W / 1.0W (2 s.f.);	2
(c) (i)	$0.28 \times 50 = 14 \text{ C}$	1
(ii)	$0.67 \times 3600 = 2412 \text{ C}$	1
(iii)	$(14 / 2412) \times 100 = 0.58 \% / 0.6\% ; \text{ecf}$	1
(d) (i)	Power lines are higher voltage / higher current / are higher power; So field strength is higher; AW some people are closer to power lines; Some people are exposed for longer periods;	2
(ii)	We are closer to mobile phones; So field strength is higher; Frequency of radiowaves is higher / wavelength is shorter; We are exposed to them for longer periods; Any two points	2
		TOTAL: 14

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Question	Expected Answers	Marks
4 (a) (i)	H ₂ O ₂ (ignore 2 in front of formula);	1
(ii)	New mechanism has a lower activation energy; More molecules have enough energy to react / more successful collisions;	2
(b) (i)	<u>Shared</u> (pair of) electrons; Electrons <u>between</u> atoms; Negative charge attracts; <u>positive charge</u> / <u>nucleus</u> of atoms (on either side); any three points (could be gained by a diagram)	3
(ii)	Electron (pairs) repel each other; Get as far apart as possible / minimize repulsion; 4 <u>pairs</u> of electrons AW there are lone pairs / non-bonding pairs as well as bonds / bonding / shared pairs; take up tetrahedral arrangement; (extra repulsion of) lone pairs reduces bond angle (to less than 109°); any three points	3 TOTAL: 9 MARKS

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Question	Expected Answers	Marks
5 (a)	Points plotted correctly; Suitable attempt to join points including curved section;	2
(b) (i)	0.47-0.53 ecf from (a)	1
(ii)	0.95-1.05 ecf from (a)	1
(iii)	Rate is proportional to concentration; AW Rate doubles when concentration doubles	1
(iv)	(Molecules / particles) collide; More <u>frequently</u> ; AW greater chance (of collision);	2
(v)	<u>Increase</u> temperature / <u>increase</u> amount or concentration of enzyme / add catalyst; AW heat it	1
(c) (i)	Rate equation; AW first order equation / linear equation	1
(ii)	Rate constant;	1
(d) (i)	Rate remains constant / does not increase / reaches maximum; levels off / reaches optimum	1
(ii)	Hydrogen peroxide is in excess; Active sites are full; So collisions have no effect; AW high concentration of hydrogen peroxide act as an inhibitor;	2
(e) (i)	Production of cheese / beer / bread etc (+ other possibilities).; Describes reaction (e.g. sugar becomes alcohol and/or CO ₂); Explains importance of reaction (e.g. provides the alcohol for beer, bread rises); Names enzyme (NOT microorganism / yeast);	3
(ii)	Washing powders / desizing / biostoning / stone washing /extraction of metals etc. Accept descriptions of these processes	1
		TOTAL: 17

**Mark Scheme 2843/01
June 2006**

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Question	Expected Answers	Marks
1 (a)	3 °C;	1
(b)	inverted bell shape; peak drawn at 3 °C;	2
(c)	the bell curve is skewed/has a long tail at the higher end;	1
(d)	tail extending to 10 °C, labelled as Murphy's graph; tail extending to 12 °C, labelled as Stainforth's graph;	2
(e)	clouds;	1
		Total: 7

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2	(a)	(i)	that warming/greenhouse effect; caused by increase in greenhouse gases/carbon dioxide alone / without effects of feedbacks;	2
		(ii)	solar radiation is transmitted/ passes through/is unaffected by greenhouse gases; radiation from the earth is <u>absorbed</u> by greenhouse gases;	2
	(b)	(i)	pale coloured/white snow/ice/glaciers; reflect solar radiation; but when these melt the surface becomes darker; and more radiation is absorbed; (3 points from above list)	3
		(ii)	the Earth is responding to warming by changing; in such a way as to increase warming further; OR description in terms of specific example	2
		(iii)	water vapour;	1
	(c)		(For every doubling in atmospheric CO ₂) the direct greenhouse effect (produces warming of 1 °C); melting of ice (produces warming of 1 °C); and evaporation/water vapour (produces warming of 1 °C);	3
	(d)	(i)	clouds <u>reflect</u> solar radiation (away from the Earth);	1
		(ii)	warming and cooling effects cancel one another;	1
			Total: 15	

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Question	Expected Answers	Marks
3 (a)	inter-tropical convergence zone;	1
(b)	diagram should show that warm, moist air is rising more rapidly; faster formation of storm clouds which rain out more quickly; edges of diagram should show that skies are clearer than twenty years ago / rest of tropics drier;	3
(c) (i)	air may be rising more quickly; because it is warmer; OR argument based on the fact that changes have taken place over the last 20 years;	2
(ii)	Weilicki is unsure/cautious as to (whether clearer tropical skies are due to global warming);	1
(d)	clouds are very variable; the ways in which they may affect climate are not clearly understood; clouds may have a more significant effect on global temperatures/warming than previously thought;	3 Total: 10

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Question	Expected Answers	Marks
4 (a)	the effects of change can be delayed by several decades / good records only available from last 50 years;	1
(b)	changes in incoming solar radiation; volcanic eruptions;	2
(c) (i)	soot / carbon / ash / products of incomplete combustion	1
(ii)	burningtrees/crop waste/fossil fuels produces carbon dioxide, which is a greenhouse gas; the aerosols/soot particles are polluting/toxic/irritant; (any one point)	1
(iii)	less scattering/absorption of in solar radiation; so more incoming radiation reaches the Earth; and global temperatures may rise; description of 'parasol effect'; (3 points from above list)	3
(iv)	Crutzen estimates a 2°C increase on current predictions; therefore he predicts warming of 5°C; Crutzen's result not the same as Murphy's as quoted by author; Murphy's results show highest probability at about 5°C which does agree with Crutzen's estimate; author asserts that both scientists predict a rise of 7°C to 10°C, which Murphy predicts only at a low probability; Crutzen's and Murphy's predictions take into account different factors; however, aerosols do have an indirect effect on clouds which Murphy includes in his model; sensible reference to Murphy's & Crutzen's work rather than statement of candidate's opinion; any other valid point / argument; (5 points from above list)	5
		Total: 13

**Mark Scheme 2844
June 2006**

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Question 1	Expected Answers	Marks
(a)	Faeces / urine from animals in fields / Manure applied to fields; Artificial fertilisers; Allow sewage/industrial pollution/decomposition for one of the marks.	2
(b)	When stream flow is high nitrate is high; Both are higher in winter months; Spring and autumn farmers put fertiliser on soil; Less uptake of nitrates by plants in winter months; More rain in winter months/ less in summer ; Rain washes nitrate from land into stream; 3 from above	3
(c)	Don't use artificial fertilisers / manure; Use only the exact amounts; Apply fertilisers only when crops are fast growing; Don't put animals in fields near stream; Barrier between fields and stream/ example of barrier ; 2 from above	2
(d)	Sample several locations in the stream; But same locations each time; Same depth/distance from bank ; Same sampling method ; same times of day / day of week; Before and after rainfall/ same weather conditions ; Repeat samples; 3 from above	3
(e)	Nutrients for the algae; Allow "food for algae" ;	1
(e) (ii)	Fish die; Eutrophication ; Because as algae/ plants die; decomposed by bacteria; Uses up the oxygen;	3
		Total: 14

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Question 2	Expected Answers	Marks
(a)	(Cell with) 1 copy / 1n chromosomes / 1 set of chromosomes ; (do not allow references to half the number of chromosomes as parent cell or body cells)	1
(b)	Chromosomes duplicate; To form 2 chromatids; Chromosomes condense; Nuclear membrane breaks down; Chromosomes / chromatid pairs line up in middle of cell; Chromatids move to opposite ends of cell; New nuclear membrane forms; Cytoplasm splits; All cells identical; 5 from above	5
(c)(i)	Sexual reproduction / meiosis causes variation; Due to independent assortment / crossing over; Asexual reproduction /mitosis no variation; All daughter cells are exact copies;	4
(ii)	(Cell with) 2n chromosomes / 2 sets /paired / double chromosomes;	1
(d)	Variation means some cells carry genes that make them better able to survive; Changes in environment;	2
		Total 13

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Question 3	Expected Answers	Marks
(a)	Sugar phosphate backbone Bases attached to sugars Bases paired with each other Correct AT, GC pairing	4
(b)	Hydrogen / H bonds	1
(c)	Triplet code; 20 different amino acids; can code for 64 / more than 20 different amino acids / some amino acids have more than 1 codon;	3
(d)(i)	RNA single stranded; RNA has U instead of T	2
(d ii)	mRNA transcribes / makes a complimentary copy of DNA/gene; mRNA passes from nucleus to ribosome; mRNA has codon; codon pairs with anticodon on tRNA; tRNA brings amino acids to mRNA; There is a specific transfer RNA for each amino acid; protein assembled at ribosome 4 from above	4
(e)	different amino acid inserted in protein / stop codon can cause termination of chain; Protein folding / tertiary structure may be affected; Function dependant on structure / or example given ; 	3
		Total: 17

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Question 4	Expected Answers	Marks
(a)	Bigger yield; Delayed ripening; Disease resistance; Better flavour; Drought resistance; 2 from above or other good suggestion.	2
(b)	Restriction enzyme cuts DNA; at a specific sequence of bases;	2
(c)(ii)	Vector DNA cut with <u>same</u> restriction enzyme as passenger DNA; Sticky ends produced; DNA ligase used to join up sticky ends	2
(ii)	Bacterial plasmid/ virus	1
(d)(i)	Include a gene for antibiotic resistance in the vector; Bacterial cells can be grown on plates with antibiotic; Those that contain recombinant DNA will grow; Or same argument for fluorescent gene;	3
(ii)	Micro injection; Small quantity of DNA injected into plant <u>embryo</u> ; Or Bombardment; Tiny spheres of gold or tungsten coated with DNA fired into cells; Or Electroporation; Using plant protoplasts subjected to electric shock;	2
(e)(i)	Genes for pest/ herbicide resistance or good growth may spread from crops to weeds; Weeds may then grow much faster; Or May be unknown health problems; That we have not discovered yet;	2
(ii)	Grow GM crops far away from other crops; Cautious approach / continuing research;	1
		Total: 15

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Question 5	Expected Answers	Marks
(a)	Top spot is original Pesticide; Other spots are breakdown products;	2
(b)	After 2 months all the original pesticide has broken down; More spots; No top spot; Only the break down products / lower spots are seen.	2
(c) (i)	Grains in coating on the plate are polar / carry electric charge; Some components are polar / carry charge, these will bind to plate; Other components non polar so do not bind / stay in solvent.	3
(c)(ii)	Solvent moves up plate; Compounds that dissolve well in solvent move faster/further (ora); Compounds which bind strongly to grains held back; These move slower / less far(ora); Fraction of time spent bound to grains determines how far/fast compounds travel; This is specific for different compounds 4 points from above.	4
d	Turn plate 90°; Run with different solvent;	1
e	GLC has gas for mobile phase; Column instead of plate; Other valid difference;	2
		Total 14

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Question6	Expected Answers	Marks
(a)	Dissolving involves breaking of bonds between ions; And breaking of bonds between water molecules; Breaking bonds requires energy input / is endothermic; Temp drops in surroundings; Water molecules form bonds to ions in solution / hydration; Hydration is exothermic / energy given out; Cause temp rise in surroundings When no temp (NaCl) change energy to break bonds is same as energy in bonds reformed; When temp rise seen (CaCl₂), more energy is released from bonds reformed than is taken in; If temp decrease (NH₄Cl), more energy required to break bonds than is released when bonds reformed; Overall temp difference is difference between energy taken in to break bonds and energy released when bonds reform; Credit for answers involving entropy 6 from above	7

	<p>QWC</p> <p>organization & vocabulary</p> <p>2 marks A answer is clearly and coherently organized throughout and B appropriate specialist vocabulary is used extensively;</p> <p>1 mark A answer shows a degree of organization and B some appropriate use of specialist vocabulary is made;</p> <p>0 mark A answer is not organized and B appropriate specialist vocabulary is not used;</p> <p>legibility & grammar</p> <p>2 marks A text is clearly legible and B spelling, punctuation, grammar are accurate throughout;</p> <p>1 mark A text is untidy but can be read without difficulty and B spelling, punctuation, grammar show some mistakes;</p> <p>0 mark A text is difficult to read; and B spelling, punctuation, grammar show extensive mistakes;</p> <p>(Candidates must satisfy both strands A and B to gain the marks at a particular level. Otherwise the marks for a lower level should be awarded.)</p>	4
(b)	<p>Hydration of ions with water; Water is held closer to ions than to other water molecules; Results in decrease in volume;</p>	2
(c)	<p>Mention of delta S surroundings and delta S system; Delta S system always positive; Because of increase in disorder of particles; Entropy change in surroundings may increase or decrease; overall entropy change always positive / change in system greater;</p>	4
		Total 17

**Mark Scheme 2845
June 2006**

Question	Expected Answers	Marks
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1 (a) (i)	micro / 10^{-6} / millionth ;	1
(ii)	2; $\times 10^{-5}$; (award 1 mark if value given in correct style)	2
(b) (i)	% sand = 20 % silt = 30 % clay = 50;	1
(ii)	correct size segments; correct labels; ecf from (i)	2
(c)	correctly labeled point; ecf from (b)(i)	1
(d) (i)	bottom three horizontal zones shaded except for far left and far right bottom triangles;	1
(ii)	clay particles are small and water is held in spaces inbetween ; sand particles are large and water runs out of spaces inbetween;	2
[Total: 10]		

Question	Expected Answers	Marks
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2 (a) (i)	correct squaring of 6400, ie 4.1×10^7 / 4.096×10^7 / 40960000 ; (can be implied)	
	correct answer, ie 5.1×10^8 / 5.14×10^8 / 514457600; (answers need not be in standard form nor to correct sig. figs. for this part)	2
(ii)	3.1; $\times 10^9$; (ie volume of atmosphere = $3.1 \times 10^9 \text{ km}^3$; ecf from (i)	2
(iii)	8.6×10^{21} ; ecf from (ii)	1
(b)	9.0×10^{21} ;	1
(c) (i)	answers to (a) and (b) are equal / the same (value); there are enough molecules to provide one per breathful; ecf from (a) and (b)	2
(ii)	molecules move randomly / diffuse; they have become thoroughly mixed with others / spread out in the atmosphere; molecules have not escaped from the atmosphere; matter is not destroyed; (2 points from above list)	2
[Total:10]		

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Question	Expected Answers	Marks
3	<p>labels - 1 mark for each of three points cations / ions; electrons; field lines;</p> <p>summary - to include 7 points from the list below</p> <p>(cations have) positive charge / identified as <u>cations</u> ; in lattice / array / regular arrangement; (electrons have) negative charge; in 'sea' / delocalized / not attached to atoms / not attached to cations;</p> <p>(power supply creates) e.m.f. / potential difference / p.d. / voltage; (causes) electrons to move through metal / conductor; arrow shows direction of current / current flows anti-clockwise; arrows show direction of flow of positive charge; electrons move in opposite direction to current flow / from -ve to +ve;</p> <p>(on field lines) arrows show direction of movement / direction; of north pole / of B-field; caused by force; closeness shows field strength</p> <p style="text-align: right;">[Total: 10]</p>	<p style="text-align: center;">3</p> <p style="text-align: center;">7</p>

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Question	Expected Answers	Marks
4	<p>science of food chains</p> <p>trophic levels; level 1 is plants / producers; level 2 is herbivores / primary consumers; level 3 is carnivores / secondary consumers; description to show that organisms in level above feed on those in level below; only a fraction of biomass/energy is passed on from one level to another; decomposers / detritivores remove dead material / excreta; there is no food chain / no other trophic levels for bracken; there may be no level 3 organisms for the moth;</p> <p>science of population growth</p> <p>a number of organisms of the same species is a population; typical population growth curve drawn or described; exponential / logarithmic phase / stage identified; stationary / stable phase / steady state / carrying capacity identified; population size depends on births and deaths; predators eat / feed on / kill other animals; absence of predators leads to more births than deaths; stationary phase isn't reached.</p> <p>other points action might destroy another species / affect another food chain; there are ethical issues about introduction of 'foreign' species by humans;</p> <p>10 points max from the above list</p> <p style="text-align: right;">[Total: 10]</p>	10

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Question	Expected Answers	Marks
5	<p>science of climate zones climate zones arise from pattern of atmospheric circulation; climate includes temperature and rainfall; Earth is hottest at low latitudes / near equator; solar radiation is most intense; sun is overhead / maximum solar energy per unit area; warm air at low latitude / near equator rises; warm water evaporates; (both factors make) air less dense / low pressure region; air mass expands as it rises; cools; producing precipitation / rain; leading to a hot, wet climate zone;</p> <p>air masses stop rising at tropopause; travel outwards to higher latitudes / to N & S; descend around 30° / between 20° & 40° / near tropics; air is compressed / pressure increases; air heats up; leading to a hot, dry climate zone;</p> <p>(some) air masses then travel to higher latitude; over Earth's surface; pick up water vapour / become moister; leading to a warm, wet climate zone; identification of this as temperate zone;</p> <p>some air travels to higher latitude at high altitude; descends near poles; leading to a cold, dry climate zone;</p> <p>climate is also affected by ocean currents;</p> <p>science of temperature change global temperature is result of balance / steady state; between incoming and outgoing radiation; reduction in outgoing radiation leads to global temperature increase; 'greenhouse effect'; thermal infrared radiation; is absorbed / trapped by gases; in troposphere; eg, carbon dioxide / methane;</p>	

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Question	Expected Answers	Marks
6	<p>scientific aspects of molecular structure & solubility</p> <p>compound - combination of elements; molecule - (group of) atoms bonded together; covalently; share electron pair; uncharged overall; CO₂ has one carbon atom and two oxygen atoms; double bonds; linear shape / 180° bond angle; dipole - fractional charges; separated on molecule / imbalanced; CO₂ is non-dipolar because of shape / charges cancel out; relevance of electronegativity mentioned; explanation of electronegativity; polar bonds result from differences in electronegativity; solution - particles randomly arranged among solute particles; moving around / translating; water has hydrogen bonding; intermolecular bonding; is (relatively) strong; water bonds electrostatically to solute particles; solution of dipolar solute in water has permanent dipole bonding; induced dipole bonding present between carbon dioxide and water;</p> <p>scientific aspects of ocean deep water circulation system</p> <p>system driven by density (differences); caused by salinity (differences); seawater sinks; in Norwegian Sea; saline water cools; from Gulf Stream / N. Atlantic Drift / Caribbean; and Weddell Sea / Antarctica; where ice freezes out; water flows deep under Atlantic Ocean from N to S; then E to W under Southern Ocean / around Antarctic; water rises in Pacific Ocean; and Indian Ocean; and flows back on surface; brings nutrients to surface; also surface circulation system; driven by winds; direction affected by land / Earth's rotation / Coriolis' force;</p>	

<p>6 cont</p>	<p>scientific aspects of reversibility</p> <p>reversible process can occur in either direction / forwards or backwards; shown by symbol; reaches a position of equilibrium; Le Chatelier's Principle (states that); when conditions change (for a system at equilibrium); the system changes in the direction that opposes the change / re-establishes the conditions; solubility increases as pressure increases to reduce gas pressure / oppose squashing together of molecules; solubility decreases as temperature increases because dissolving is exothermic; correct equation to summarize this reversible process;</p> <p>(18 points from the above list)</p> <p>for quality of written communication organization & vocabulary (α) 2 marks A answer is clearly and coherently organized throughout and B appropriate specialist vocabulary is used extensively;</p> <p>1 mark A answer shows a degree of organization and B some appropriate use of specialist vocabulary is made;</p> <p>0 mark A answer is not organized and B appropriate specialist vocabulary is not used;</p> <p>legibility & grammar (β) 2 marks A text is clearly legible and B spelling, punctuation, grammar are accurate throughout;</p> <p>1 mark A text is untidy but can be read without difficulty and B spelling, punctuation, grammar show some mistakes;</p> <p>0 mark A text is difficult to read; and B sp, punct, gram show a high proportion of mistakes;</p> <p>(Candidates must satisfy both strands A and B to gain the marks at a particular level. Otherwise the marks for a lower level should be awarded.)</p> <p>[Total: 22]</p>	<p>18</p> <p>4</p>
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**Mark Scheme 2846/01
June 2006**

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Question	Expected Answers	Marks
1 (a) (i)	2.02 x 10 ⁷ ; (allow all correct expressions in powers of 10, eg 20.2 x 10 ⁶)	1
(ii)	use of $v = s \div t$; rearrangement to $t = s \div v$ or correct rearrangement of values; 6.73 x 10 ⁻² s (need not be in standard form) ; ecf from (a)(i) and (a)(ii) point 1	3
(b) (i)	6 ;	1
(ii)	transverse up and down displacement; at right angles to the direction of travel / propagation; electromagnetic refers to related electric and magnetic phenomena; fields / waves / disturbances at right angles to one another ; (3 points from above list)	3
(c) (i)	signal travels from space / vacuum; passes into atmosphere; density of atmosphere changes; increases with decreasing altitude ; (2 points from above list)	2
(ii)	ray shown bent towards normal ;	1
(iii)	refraction ; ecf from (ii)	1
(d)	radiation / waves transmitted ; and received by co-located sensor on platform ; reflection ; shows presence of object / gives rise to signal ; greater reflection gives stronger signal; distance of object calculated from timing; shorter round trip means closer range; (4 points from above list)	4
Total: 16		

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Question	Expected Answers	Marks
2 (a) (i)	correct s.h.m. shape ; +50 to -50 scale for displacement / orequivalent amplitude ; 12.5 hour period ;	3
(ii)	point marked where graph is rising and at zero displacement ;	1
(iii)	greater accuracy in / surveying / civil engineering projects / building bridges / building tunnels ;	1
(iv)	day length / tide height / tidal range variation / sea level / waves / phases of moon / seasonal temperatures / tilt of Earth's axis ;	1
(b) (i)	outer layer / above asthenosphere / mantle;	1
(ii)	core / mantle / mesosphere / asthenosphere ; (NOT crust)	1
(iii)	seismometry / study of seismic waves / P & S waves / earthquakes / nuclear explosions; (measuring) time taken to travel through Earth; presence of shadow zones / non-transmission through liquid layer; refraction of waves; (2 points from above list)	
	or paleomagnetism / sea floor spreading; how this provides evidence of layers in plate tectonic model;	
	or vulcanology; magma under crust;	2
	Total: 10	

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Question	Expected Answers	Marks
3 (a)	land masses; rotation of the Earth;	2
(b) (i)	it occurs in the S. hemisphere / in the S. Pacific ; pressure and/or currents swap over (then back again) ;	2
(ii)	becomes warmer; and wetter / more / high rainfall; windier; (2 points from above list)	2
(c) (i)	quantity of energy; needed to raise the temperature by 1 K / 1 °C / unit temperature; of 1 g / 1 kg / specific mass / unit mass of substance / 1 cm ³ water;	3
(ii)	water keeps its temperature; conditions in coastal regions determined by sea rather than by continental areas / example of this;	2
(iii)	two molecules involved; a hydrogen atom (in a molecule) accepts; a (share in a) lone pair of electrons; from an atom of N / O / F /from a highly electronegative atom; (3 points from above list) (allow use of diagram)	3
(iv)	hydrogen bonds are involved; strong / stronger / harder to overcome ; therefore more energy needed to get molecules moving; temperature is a measure of molecular speed; an increase in temperature means molecules move faster; (4 points from above list)	4
Total: 18		

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Question	Expected Answers	Marks
4 (a)	labeled diagram should show clearly vertical shaft in cliff and horizontal tunnel only open to sea and shaft; turbine in air in shaft; internal water surface shown in base of tunnel; sea level above top of tunnel;	4
(b) (i)	3.14 m ² ;	1
(ii)	(3.14 m ² x 50 m) = 157 m ³ ; ecf from (i)	1
(iii)	(157 m ³ x 28.8 kg m ⁻³) = 4520/4522/4521.6 kg ; ecf from (ii)	1
(c) (i)	Allow all numbers of sig. figs. from 3 upwards	1
(ii)	E = $\frac{1}{2} mv^2$;	1
(iii)	($\frac{1}{2} \times 4520 \text{ kg} \times (50 \text{ m s}^{-1})^2$) = 5.65 x 10 ⁶ J ; ecf from (i) Allow all numbers of sig. figs. from 3 upwards	2
(d)	correct replacement of 10 ⁶ factor by M ; correct value of 40% of value in (ii);	2
(e)	wave power project will be less noisy; unobtrusive; likely to be more days when waves are useable than when wind is; don't have to turn off wave power turbine in gales; wave power project will not disturb flying birds; (2 points from above list)	2
	percentages / fractions rather than absolute values compared; both types of country rely equally on fossil fuels / LEDCs rely a little more on fossil fuels; 95 % in MEDCs and 96 % in LEDCs; main difference is that LEDCs hardly use any nuclear power; (3 points from above list)	3
	Total: 16	

**Advanced GCE Science 3885/7885
June 2006 Assessment Series**

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2841	Raw	60	46	41	36	31	27	0
	UMS	90	72	63	54	45	36	0
2842	Raw	60	40	35	30	26	22	0
	UMS	90	72	63	54	45	36	0
2843A	Raw	120	83	73	63	54	45	0
	UMS	120	96	84	72	60	48	0
2843B	Raw	120	83	73	63	54	45	0
	UMS	120	96	84	72	60	48	0
2844	Raw	90	64	56	48	40	33	0
	UMS	90	72	63	54	45	36	0
2845	Raw	90	49	43	37	31	25	0
	UMS	90	72	63	54	45	36	0
2846A	Raw	120	88	79	70	62	54	0
	UMS	120	96	84	72	60	48	0
2846B	Raw	120	88	79	70	62	54	0
	UMS	120	96	84	72	60	48	0

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3885	300	240	210	180	150	120	0
7885	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
3885	10.2	20.5	39.3	59.4	79.0	100.0	466
7885	7.2	19.2	33.6	56.8	89.6	100.0	128

For a description of how UMS marks are calculated see;
www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp
 Statistics are correct at the time of publication

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