

**MARK SCHEME for the May/June 2012 question paper  
for the guidance of teachers**

**9790 BIOLOGY**

**9790/02**

Paper 2 (Structured), maximum raw mark 85

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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### Question 1

Q	Expected answers	Mark
(a)	<p>(i) ammonia ; methane ; hydrogen ;</p> <p>(ii) amino acids / named amino acid(s) / amide(s) ; fatty acids / organic acids ; <b>A</b> lipid(s) urea ; AVP ; <b>A</b> formaldehyde (methanal) / HCN / bases / purine / pyrimidine / named base(s) / monosaccharide / ribose / other named monosaccharide</p> <p>(iii) provide energy for, synthesis of molecules / ionisation ; to mimic lightning (in early atmosphere) ;</p> <p>(iv) <i>water present</i></p> <ol style="list-style-type: none"> <li>1 high latent heat of vapourisation ;</li> <li>2 liquid over wide range of temperatures ;</li> <li>3 high specific heat capacity ;</li> <li>4 so temperature does not fluctuate much ;</li> <li>5 (almost) universal solvent ;</li> <li>6 permits biochemical reactions to occur / is a reactant / AW ;</li> <li>7 allows, substances / organisms, to, move / be moved ;</li> <li>8 AVP ;</li> <li>9 AVP ;</li> </ol>	<p>3</p> <p>max 2</p> <p>max 1</p> <p>max 3</p>
(b)	<p>(i) shows that carbon has been fixed ; no, abiotic process / AW, can cause enrichment of rock with carbon-12 ;</p> <p>(ii) provides evidence for origin of prokaryotes ; similar to extant stromatolites that, contain cyanobacteria / fix carbon / carry out photosynthesis / release oxygen ;</p> <p>(iii) provides evidence for origin of eukaryotes ; steranes derived from cholesterol ; cholesterol, only in eukaryotic membranes / not prokaryotic ;</p>	<p>max 1</p> <p>max 1</p> <p>max 2</p>
(c)	<ol style="list-style-type: none"> <li>1 energy from inorganic compounds ;</li> <li>2 oxidation ;</li> <li>3 of electron donor / AW ;</li> <li>4 e.g. NH<sub>3</sub> / NO<sub>2</sub> / H<sub>2</sub>S / S / H<sub>2</sub> / Fe<sup>2+</sup> ;</li> <li>5 to fix carbon / use carbon dioxide ; <b>A</b> definition of chemoautotrophic</li> <li>6 detail of carbon fixing ;</li> </ol>	<p>max 3</p>

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## Question 2

Q	Expected answers	Mark
(a) 1	volume of urine, excreted / collected, peaks at $0.50 \text{ mol dm}^{-3}$ sodium chloride solution ;	
2	concentration of $\text{Na}^+$ in urine increases with increasing salt solution up to $0.75 \text{ mol dm}^{-3}$ ;	
3	little difference in concentration between $0.75$ and $1.00 \text{ mol dm}^{-3}$ ;	
4	comparative data quote for either volume or concentration ;	
5	decrease in intake of liquid at higher concentrations ;	
6	excess $\text{Na}^+$ is excreted in the urine ;	
7	less reabsorption of $\text{Na}^+$ in the kidney ;	
8	AVP ;	<b>max 5</b>
(b) 1	high medulla: cortex ratio / AW ;	
2	(relatively) long loops (of Henle) ;	
3	all loops are long (not a mixture of short and long loops as in humans) ;	
4	low, water / solute, potential produced in medulla ;	
5	high concentration of, sodium chloride / solutes, at base of medulla ;	
6	ref to counter current (multiplier) effect ;	
7	further detail of counter current ;	<b>max 3</b>
(c) 1	ADH is released from posterior pituitary gland ;	
2	released when there is a low blood, water potential / solute potential ;	
3	stimulates, DCT and/or collecting duct to become permeable to water ; <b>A</b> increase in reabsorption of water	
4	reabsorb urea ;	
5	detail of mechanism of water reabsorption ;	
6	in $1.0 \text{ mol dm}^{-3}$ release (from posterior pituitary) is greater than synthesis (in hypothalamus) ;	
7	stores of ADH (in posterior pituitary) were used up over 5 day period ;	
8	AVP ; e.g. vesicles with aquaporins	<b>max 4</b>
(d) 1	feed on plants with high water content ;	
2	(high) production of metabolic water ;	
3	store fat which gives metabolic water ;	
4	live in burrows ;	
5	burrows are, under / between, root of plants ;	
6	do not feed at, hottest / coldest, time of day ;	
7	crepuscular / nocturnal ;	
8	efficient absorption of water from gut ;	
9	produce very dry faeces ;	
10	hibernate / aestivate ;	
11	lick fur for heat loss ;	
12	no sweat glands / no sweating ;	
13	AVP ; e.g. hop / walk on two legs, to reduce contact with ground	<b>max 4</b>

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### Question 3

Q	Expected answers	Mark
(a)	<ol style="list-style-type: none"> <li>1 RNA polymerase binds to promoter region ;</li> <li>2 transcription factors also required ;</li> <li>3 starts transcription ;</li> <li>4 upstream of gene to be transcribed ;</li> <li>5 ref to at 5' end ;</li> </ol>	<b>max 3</b>
(b)	<ol style="list-style-type: none"> <li>1 transcription ;</li> <li>2 assembly of nucleotides ;</li> <li>3 nucleoside triphosphates ;</li> <li>4 RNA polymerase ;</li> <li>5 base pairing / e.g. (A – T / U – A / C – G / G – C) ;</li> <li>6 phosphodiester bonds ;</li> <li>7 pre-RNA cut to remove <u>introns</u> ;</li> <li>8 splicing <u>exons</u> together ;</li> <li>9 addition of, 'cap' / poly A ;</li> </ol>	<b>max 5</b>
(c)	<ol style="list-style-type: none"> <li>1 only exons are to be translated ;</li> <li>2 introns are non-coding ;</li> <li>3 if pre-RNA not cut in the right places, then incorrect sequence of bases ;</li> <li>4 equivalent to frame shift ;</li> <li>5 may be too short if reading frame gives a stop codon ;</li> <li>6 may be too long if reading does not include a stop codon ;</li> <li>7 gives incorrect sequence of amino acids ;</li> <li>8 an effect on structure of protein described ;</li> <li>9 small differences in protein primary structure can have significant effects ;</li> </ol>	<b>max 3</b>
(d)	<ol style="list-style-type: none"> <li>1 prevent breakdown of, mRNA / exons ;</li> <li>2 cap identifies 'start' of mRNA ;</li> <li>3 directs mRNA to ribosome / AW ;</li> <li>4 assembly point for small and large subunits of ribosomes ;</li> <li>5 AVP ; e.g. distinguished from viral RNA / identifies host RNA</li> </ol>	<b>max 2</b>
(e)	<ol style="list-style-type: none"> <li>1 CD proteins have different shapes ;</li> <li>2 monoclonal antibodies are all identical ;</li> <li>3 all with the same, binding site / variable region ;</li> <li>4 shape of antibody complementary to CD protein ;</li> <li>5 combine at antigen-binding site ;</li> <li>6 visualising monoclonals using, radiolabels / fluorescence / AW ;</li> </ol>	<b>max 4</b>
(f)	<ol style="list-style-type: none"> <li>1 B cells, do not produce antibody / need activating ;</li> <li>2 B cells differentiate into plasma cells that produce antibody ;</li> <li>3 but do not divide indefinitely / do not survive in tissue culture ; <b>A</b> ora</li> <li>4 fused with myeloma cells which do ;</li> </ol>	<b>max 2</b>

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#### Question 4

Q	Expected answers	Mark
(a)	<p>1 allows efficient energy transfer ;</p> <p>2 small / water soluble, easily moved around cell ;</p> <p>3 is used by (many), enzymes / proteins ;</p> <p>4 <i>idea that</i> adenine + ribose = recognition site ;</p> <p>5 terminal phosphate removed easily ;</p> <p>6 releasing, useful / AW, amount of energy when hydrolysed ;</p> <p>7 <i>idea that</i> easily recycled ;</p> <p>8 three phosphate groups are negatively charged and unstable ;</p> <p>9 charged so does not pass through membranes (and lost to cell) ;</p> <p>10 AVP ;</p>	max 3
(b)	<p>(i) <b>A</b> – crista of mitochondrion / inner mitochondrial membrane ;</p> <p><b>B</b> – thylakoid (of chloroplast) ;</p> <p><b>C</b> – cell (surface) membrane of, bacterium / prokaryote ;</p> <p>(ii) <b>A</b> – matrix to inter membrane space, (ignore leakage from organelle)</p> <p><b>B</b> – into thylakoid,</p> <p><b>C</b> – outwards towards cell wall ;</p> <p><b>R</b> if goes through synthase</p> <p>(iii) 1 energised electrons ;</p> <p>2 (<b>A</b>) from oxidation of, food / named substrate(s) ;</p> <p>3 from oxidation of reduced, hydrogen carriers / named ;</p> <p>4 ref redox potential of reduced, NAD ; <b>A</b> ref FAD</p> <p>5 (<b>B</b>) from absorption of light by pigments ;</p> <p>6 electron transport chain ;</p> <p>7 protein complexes with decreasing redox potential / AW ;</p> <p>8 final acceptor for, electrons / hydrogen ;</p> <p>(iv) 1 proton gradient / AW ;</p> <p>2 facilitated diffusion ;</p> <p>3 kinetic energy ;</p> <p>4 phosphate added to ADP ;</p> <p>5 detail of structure of ATP synthase ;</p> <p>6 detail of function of ATP synthase ;</p>	<p>3</p> <p>1</p> <p>max 3</p> <p>max 3</p>

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### Question 5

Q	Expected answers	Mark
(a)	ensures that pollination occurs ; reduces wastage / saves energy ; if no pollinators / AW ; (limited variation) so next generation is likely to be adapted to local conditions ;	<b>max 2</b>
(b)	(i) saves energy ; saves materials to make, nectar / reward ;	1
	(ii) <i>increases chances that</i> insects visit the flowers to collect pollen ; next flower they visit is the same species ;	2
	(iii) <i>idea that</i> relies on one species that may, migrate / present in small numbers / become rare or extinct ;	1
(c)	1 direct observation of visits paid to flowers by, pollinators / insects ; 2 use dummy flowers ; 3 stain pollen / use stained flour / AW ; <i>actually stained pollinia are used</i> 4 use microtags ; 5 observe / identify, pollen grains on stigmas ; 6 observe / identify, pollen grains on, pollinators / insects ; 7 number / proportion, of flowers that, set seed / AW ; 8 number / proportion of, fertilised ovules / seeds ; 9 AVP ; any experimental detail / another suitable method 10 AVP ; any experimental detail / another suitable method	<b>max 4</b>

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### Question 6

Q	Expected answers	Mark
(a)	(i) medulla (oblongata) ; <b>A</b> brain stem <b>R</b> hind brain	1
	(ii) <b>J</b> – cerebral hemisphere(s) / cerebrum ; <b>K</b> – cerebellum ;	2
(b)	<i>reject 'signals' and 'messages' in the answers for MP3 and MP5</i>	
	1 cardiac centre receives information about, blood pressure / oxygen or carbon dioxide concentration / stretch of right atrium ;	
	2 also receives information from, hypothalamus / cerebral hemispheres ;	
	3 impulses in ( <b>Y</b> ) cardiac accelerator nerve(s) / sympathetic nerve(s) , increase activity of, sinoatrial node / SAN ; <b>A</b> increase heart rate	
	4 (post-ganglionic) neurones release, noradrenaline / norepinephrine ;	
	5 impulses in ( <b>X</b> ) cardiac decelerator nerve(s) / parasympathetic nerves / vagus nerves , decrease activity of, sinoatrial node / SAN ; <b>A</b> decrease heart rate	
	6 (post-ganglionic) neurones release, acetylcholine ;	<b>max 4</b>
(c)	1 voltage-gated (calcium) ion channels open ; 2 calcium ions diffuse into the, (presynaptic) neurone / synaptic bulb ; 3 vesicles containing neurotransmitter move to presynaptic membrane ; 4 vesicles fuse with membrane / exocytosis ; 5 neurotransmitter diffuses across, synapse / gap ; 6 binds to receptor ; 7 activates G protein ; 8 adenylyl cyclase catalyses formation of cyclic AMP ; 9 from ATP ;	<b>max 4</b> <b>[Total: 11]</b>