RECOGNISING ACHIEVEMENT

2806/01 Unifying Concepts in Biology

June 2004

Mark Scheme

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   x = incorrect response (errors may also be underlined)
   ^ = omission mark
   bod = benefit of the doubt (where professional judgement has been used)
   ecf = error carried forward (in consequential marking)
   con = contradiction (in cases where candidates contradict themselves in the same response)
   sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Examiners will be expected to use their professional judgment in marking answers that contain more than the number required. Advice about specific cases will be given at the standardisation meeting.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

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
	R	=	reject
	( )	=	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
	A	=	accept
	ora	=	or reverse argument

Question			Expected Answers	Marks
1	(a)		(aerobic) respiration; (much) release energy / produce ATP; **R** energy produced needed for repeated contractions / AW; **A** heart works continuously / *idea that heart* has strong *or* vigorous contractions ref to no oxygen debt / AW;	**max 2**
	(b)	(i)	(neuro) transmitters; **R** hormones	**1**
		(ii)	diffusion; *treat active transport as neutral* correct ref to concentration gradient / AW; through pores / across (cell) membrane(s) / through endothelium; **A** carrier proteins (enter because) high(er) concentration near nerve ending, low(er) concentration in blood; (leave because) high(er) concentration in blood, low(er) concentration in, muscle / target tissue;	**max 2**
	(c)	(i)	*accept points from an annotated diagram* **1** resting potential is reduced *or* lowered / idea; **2** ref to threshold value in correct context; **3** ion channels / ion gates / (voltage-) gated proteins, open; **4** sodium (ions) enter; **A** calcium ions **5** by diffusion; **A** down a, concentration / electrochemical, gradient **6** interior of the cell becomes positively charged; **7** depolarisation; **8** (ion gate) proteins close; **9** potassium (ions) move out of the cell; **10** resting potential restored / potential returns to original value / repolarisation; **A** ref to local circuits **11** ref to action potential, spreading / lowering the resting potential, of neighbouring regions of membrane / neighbouring cells; **12** AVP; e.g. ref. to values of potential changes *or* to hyperpolarisation approx -70 mV to +40 mV *idea* refractory period prevents action potentials propagating in reverse direction	**max 5**
		(ii)	impulses / action potentials, pass between fibres; (excitation) spreads across, heart / wide area of muscle; *idea that* muscle contracts together; **A** avoids fibrillation myogenic / no nerves to muscle fibres;	**max 2**

(d) **1** *idea that* mechanism which maintains internal environment within narrow limits;
A constant

2 ref to norm / set point / optimum value / AW;
3 increase in, blood pressure / blood volume, is detected / is input;
4 heart / atria / muscle cells, are receptors / are detectors / monitor changes;
5 kidneys, effectors / carry out change;
6 excretion of, more / increased, water / more sodium ions;
7 corrective action / restores normal (blood volume / blood pressure);

look for these ideas in either a paragraph or on flow diagram **max 3**

[Total: 15]

Question			Expected Answers	Marks
2	(a)	(i)	both types of haemoglobin can be present in one (individual) sheep; if both sheep are Hb-I and Hb-II their offspring have all three phenotypes / AW; *see row three of Table 2.1* if not codominant only two phenotypes would be produced; shows that individuals with both haemoglobin types, are heterozygous / carry one of each type of allele / both alleles are expressed (in the heterozygotes);	**max 2**
		(ii)	Hb-II (only); **A** description of phenotype	**1**
	(b)		*either* less oxygen in the blood / AW; *or* more, oxyhaemoglobin would have dissociated / haemoglobin gives up oxygen; *because* (muscles) respire more / use up more oxygen; *or* stimulated by, high CO_2 / heat / low pH / lactate; **A** lactic acid *or* AVP; e.g. ref to Bohr effect	**max 2**
	(c)	(i)	Hb-I = 63 - 63.5 (%), Hb-II = 76 - 76.5 (%);	**1**
		(ii)	*accept ora for this question* oxygen concentration / pO_2, is lower in, hills / high altitudes; Hb-II has higher affinity for oxygen / AW; <u>adaptation</u> (to high altitude); comparative figures from graph; ref to selection / selection described; e.g. 'survive and breed'	**max 3**
		(iii)	carbon dioxide / pCO_2, influences the saturation of Hb with oxygen; **A** idea increase in CO_2 concentration causes, dissociation / unloading / Hb to give up O_2; *if awarding this point give marking point 2 as well* ref to Bohr effect; AVP; e.g. ref to validity / a variable that must be controlled	**max 2**
				[Total: 11]

Question			Expected Answers	Marks
3	(a)	(i)	***R** ref to nitrogen fixation, to ash and to Nitrosomonas / Nitrobacter as decomposers* no / little / few, plants / vegetation, to take up, nitrate ions / ammonium ions; dead roots / vegetation / litter, decays / rots / putrifies / decomposes; (named) organic compounds converted to ammonia *or* ammonium ions / ammonia converted to nitrate; **A** ammonification / nitrification nitrifying bacteria; **A** *Nitrosomonas / Nitrobacter*	**max 2**
		(ii)	competition increases; *R competition for non-nutrient factors such as space* succession; **A** a description of succession *Nicotiana attenuata* is a pioneer species; return / increase, of primary consumers / herbivores; decrease in, nitrate (ions) / ammonium (ions); **A** nutrients / named nutrient leaching; chemicals that stimulate germination reduced *or* absent; AVP; e.g. decay is complete	**max 2**
	(b)		amino acids used for protein synthesis; amino acids / proteins needed, for, cell division / mitosis / meiosis; **A** for new cells to make enzymes; to make structural proteins; to make membranes; for seeds / gametes; AVP; e.g. ref. to rubisco	**max 3**
	(c)	**(i)**	*look for one of these ideas* all plants used in investigation are damaged; experiment investigates types of damage; leaf area is lost in both; less photosynthesis in both treatments ;	**max 1**
		(ii)	*description of data* more nicotine where recently burnt forest soil used / ora; more nicotine in punctured leaves / AW; more seeds in plants in recently burnt forest / AW; fewer seeds from plants with punctured leaves / AW; use of figures to make a comparison; *explanation of data* nicotine is produced to protect against, insects / feeding; less resources available for making seeds; more insects feeding, less seed production; less nitrogen for, growth / reproduction, in soil not recently burned; nicotine may inhibit, growth / flowering / seed production / enzymes ; AVP;	**max 3**

[Total: 11]

Question		Expected Answers	Marks
4	(a)	amino acids / side chains / R groups, may be both acidic and basic; **A** amphoteric carboxyl group, hydrogen donor; amine group, hydrogen acceptor; **A** chemical symbols ref to carboxyl and amine groups at ends of polypeptides; ref to buffers;	**max 2**
	(b)	more, carbon dioxide / carbonic acid; lactate / lactic acid, produced;	**max 1**
	(c)	**1** constant internal conditions / AW; **A** for a list of conditions **2** cells, surrounded by / exchange substances with, tissue fluid; **R** body fluid **3** (composition of) tissue fluid controlled by blood; **R** body fluid **4** needs to maintain constant conditions for efficient metabolism / AW; **5** pH affects enzymes; **6** temperature affects enzymes; **7** proteins / enzymes, may denature at extremes of, pH / temperature; **8** constant concentration of oxygen needed (in brain); **9** carbon dioxide must be removed, ref to decrease in pH / increase in acidity ; **10** cells swell / burst, if <u>water / solute potential</u>, increases / less negative; **11** <u>high water potential</u> of blood leads to oedema / AW; **12** cells shrink / shrivel / crenate, if <u>water / solute potential</u>, decreases / more negative; **13** nitrogenous waste / ammonia / urea, removed as can be toxic; **14** glucose concentration too high, named effect; **A** blood sugar *and in 15* **15** glucose concentration too low, named effect; e.g. coma **16** ion concentrations must be controlled, ref to ions as enzyme cofactors; **17** ref to K^+ / Na^+, action potentials; **A** Ca^{2+}, synaptic transmission **18** *idea that* hormone(s) must be controlled, so that target tissues respond optimally; **19** AVP; **20** AVP; e.g. each enzyme must work at a controlled rate ref to balance between metabolic processes ref to blood pressure	**max 7**
		QWC – legible text with accurate spelling, punctuation and grammar;	**1**
			[Total: 11]

Question			Expected Answers	Marks
5	(a)		*treat refs to yeast, ions and nutrients as neutral* temperature; pH; concentration / volume, of, substrate / sugar, solution; **A** mass of, substrate / sugar (to make solution) concentration / volume, of bacterial culture; *volume of solution = one mark* diameter / volume / size, of the test tube; oxygen (concentration); age of culture; AVP; e.g. same strain of *E. coli* **R** light intensity	**3**
	(b)		ref to results with no sugar *or* distilled water / control, *either* (no) some gas produced / respiration has occurred (using stored substances); *or* (yes) gas produced could be experimental error / AW;	**1**
	(c)	**(i)**	*look for description of results not explanation* glucose, fructose, maltose and sucrose, tubes full of gas within 2 hours; correct ref to, arabinose / lactose, at 2 hours; correct ref to lactose at 24 hours; after 24 hours arabinose still not full / AW;	**max 2**
		(ii)	glucose is used without, hydrolysis / breakdown; ora for lactose **R** ref to glucose hydrolysis because the membranes have, transport / carrier proteins, for glucose; ora for lactose **A** ref to facilitated diffusion enzymes needed to break down lactose must be, synthesised / induced; ref to production of, galactose permease / galactose isomerase / transport protein for galactose;	**max 2**
	(d)	**(i)**	cells have limited space for enzymes; **A** small size energy / resources / nitrogen, wasted if enzymes not needed; different quantities required at different times / AW; AVP; e.g. excess, tryptophan / product, may be, harmful / toxic	**max 2**
		(ii)	*similarity* repressor, protein / gene; operator (locus); promoter; regulate the binding / action of RNA polymerase; genes for tryptophan synthesis are together / AW; max 1 *difference* in the lac operon the repressor is inactivated by lactose / in the tryptophan operon tryptophan activates the repressor; more / different, (structural) genes in the tryp operon; max 1	**2**
				[Total: 12]