SCOTTISH QUALIFICATIONS AUTHORITY

2004 Biology

Advanced Higher

Finalised Marking Instructions

2004 Biology Advanced Higher

Marking scheme

Section A

1.	A	14.	A
2.	C	15.	B
3.	B	16.	A
4.	A	17.	B
5.	B	18.	D
6.	C	19.	C
7.	D	20.	D
8.	B	21.	D
9.	A	22.	D
10.	B	23.	D
11.	A	24.	C
12.	C	25.	B
13.	D		

Section B

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
	Bold entries are essential **ideas**; <u>underlined</u> entries are essential wording			
1 (a) (i)	kinase	1		With 2nd enzyme
(ii)	chloride is charged/hydrophilic/polar (1)		Chloride too large on its own Chloride is insoluble without specifying in lipid	
	membrane/phospholipid (bilayer) is hydrophobic/nonpolar **OR** chloride is not soluble in membrane/ lipid no double penalty for hydrophobic-hydrophilic confusion (1)			Reference to active transport negates the transport mark ie points 2 or 3
	protein channel/pore is opened to allow diffusion/chloride to leave the cell (1) *Any 2*	2		
(iii)	(maximises) concentration gradient across membrane **OR** clear explanation using the idea of **difference in concentration** (and hence outward diffusion)	1	Makes diffusion easier	
(b) (i)	isoprenaline can only open normal channels/channels with normal functioning **OR** isoprenaline cannot open channels in CF	1	Isoprenaline affecting normal **gene** Reference to thick mucus Isoprenaline entering cell	
	No/little/decreased movement of Cl /ions **OR** no ΔPD/voltage change	1		
(ii)	(first time) <u>error bars</u> do not overlap/touch/cross over (for the two groups)	1	Values do not overlap Error bar only implied	

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
1 (c)	aim is to introduce normal gene or equivalent (to over-ride faulty one) **OR** to treat the cause of the disorder/restore normal function	1	Get rid of mutated gene on its own Replace mutated gene on its own To treat the mutated gene Liposomes carry good copy of gene on its own	
(d) (i)	researchers <u>and</u> subjects are not aware of which treatment is being administered	1	Neither researcher nor subjects/nobody knows what is happening	
(ii)	removes any psychological factors/or equivalent **OR** removes/reduces researcher bias/influence	1	Fairer, more accurate, more valid, more reliable Explanation of placebo as control	
(iii)	**in both groups, pre-treatment** responses to isoprenaline procedure are about zero/the same/only differ slightly	1	Comparison of pre- and post-treatment values The pre-treatment lines of both graphs are slightly different (ie should stress **only differ slightly)**	
(e)	have to wait for gene expression/transcription/translation to occur/normal channel proteins to be constructed (before ion movement will be detectable)	1	Time to take effect/to work/for delivery Time for gene to replicate Time for gene to function (unless information on protein implied)	

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
1 (f)	ΔPD/movement of chloride/ions in CF group receiving active liposomes (Fig 2B) is about the same (10 mV) as non-CF individuals (in Fig 1).	**1**	Not enough to simply say the graph shapes match/are similar	
(g) (i)	-2 to +2 = net change of 4 4/16 x 100 = **25%**	**1**		
(ii)	error information/error bars for table values **OR** response of non-CF group to placebo liposomes **OR** comment referring to need to know the range of values for each mean	**1**	Initial ΔPD of non-CF group – the value given **is** the initial value	

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 (a) (i)	detritivores	1	detrivores decomposers	With decomposers
(ii)	nitrococcus/nitrosomonas ammonium ⟶ nitrite AND nitrobacter nitrite ⟶ nitrate both transformations 1 mark bacteria correctly allocated = 1 mark	 1 1		Additional transformations negate 1 mark for not knowing nitrification
(b) (i)	NPP is energy/biomass remaining **after** (energy consumed in) plant/producer respiration/maintenance **OR** NPP = GPP - respiration losses	 1	Energy passing on to next trophic level on its own Implication that growth is an energy loss	
(ii)	(above ground biomass) only measures shoot production **OR** does not include roots **OR** does not measure the whole of the plant **OR** below ground biomass not included	 1		
(c) (i)	**After** fertiliser was stopped diversity increased… plus quantification including values and one date, or duration of study: **eg** the number of species increased from 19 in 1984 to 28 in 1995 **OR** 19 to 27 over the 14 years **OR** correct % for data used (19 to 28 = 47% , 19 to 27 = 42% , 20 to 28 = 40% , 20 to 27 = 35%	1 1		
(ii)	Reference to nutrient availability eg reservoir of nutrients/fertiliser in soil, breakdown of existing biomass/roots, decomposition of humus in the soil	1		

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 (d)	The question is looking for **general** commentary on the effect of raising the water table, so must compare with the control, the untreated dry compartment. In the 'wet compartment' • overall/total nitrification **less** • peak, **later** in year (June – August period) • occurs over **shorter** period/none in winter (Dec- Apr) • nitrification always **lower** than ammonification **unlike** in the dry compartment **OR** any 3 of above points without quantification **OR** any 2 of the above points plus quantified (3 marks) **OR** any 2 generalisations without quantification **OR** any 1 general point and quantification (2 marks) **OR** any one generalisation without quantification **OR** repetitive (2+) quantification/comparison with no general point being made (1 mark)	**3**	Quantification without units (must use correct units – kgN ha^{-1} wk^{-1} – at least once)	
(e)	species diversity increases **AND** • less nitrate available /less nitrification (Fig 3) • lower nutrient status/productivity associated with increased species diversity (equivalent to stopping fertiliser) (Fig 2) (Accept decrease in biomass as cause of increase in diversity.) Accept reasoning even if conclusion about diversity is wrong.	**1** **1** **1**		

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 (f)	raising water level/water logging reduces O_2 content/ causes anaerobic conditions denitrifiers are **anaerobic**/denitrification is **anaerobic** *both points*	**1**		

Section C

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
1 A (i)	**Composition and functions** 1. present in all eukaryotic cells 2. extends throughout the cytoplasm/cell 3. network of filaments/fibres 4. composed of protein /microtubules 5. named other components viz. intermediate and microfilaments **OR** keratin and actin 6. microtubules are made of tubulin 7. cytoskeleton gives (mechanical) support to cell 8. contributes to/creates/maintains the shape of the cell **OR** acts as scaffolding 9. governs the location of organelles **OR** microtubules involved in movement of cellular components within the cell/cyclosis/streaming 10. named membrane-bound organelle 11. movement of (whole) cells/pseudopodia/flagella 12. reference to dynamic nature of cytoskeleton	**8**	Not rigidity Not ribosome	
(ii)	**Relationship with the plasma membrane** 13. Attached/anchored to (inside of) plasma membrane/diagram 14. via membrane proteins/diagram 15. (which then) attach to extracellular matrix	**2**		
(iii)	**Movement of chromosomes** 16. (role of microtubules) in cell division/mitosis/meiosis/named stage 17. spindle fibres made of microtubules 18. attach to chromosomes/chromatids/ centromeres/kinetochores 19. radiate from the centrosome/ microtubule organising centre/ MTOC/centrioles 20. separate chromatids/chromosomes/ make two sets of genetic information 21. centrosome/centriole is site of microtubule synthesis 22. MTOC located near nucleus	**5**		

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
1 B (i)	**Sodium and potassium** 1. transport/carrier/pump/protein + embedded in plasma membrane/transmembrane 2. pumps sodium ions out of cell and potassium ions into cell (ignore numbers) 3. active transport/against concentration gradient 4. uses/hydrolyses ATP/requires energy 5. phosphate (from ATP) phosphorylates/attaches to pump/protein 6. (phosphorylation) results in a conformation/configuration/shape change **OR** description of shape change in relation to ion movements **OR** as diagrams 7. different conformations have different affinities for sodium and potassium ions	**5**	chemical change	
(ii)	**A named peptide hormone** 8. eg insulin/glucagon/ADH 9. hydrophilic/water soluble/not lipid soluble 10. molecules cannot diffuse across membrane 11. bind to receptors/proteins in plasma membrane/on cell surface 12. only target cells have receptors 13. activated receptors produce intracellular signals/initiate cell response/alter cell behaviour/act as transducers 14. eg. Cell response (G protein/cyclicAMP/enzyme link)	**5**	*need idea of response, so not* 'change in intracellular environment'	incorrect name of hormone
(iii)	**A named steroid hormone** 15. eg testosterone 16. hydrophobic/lipid soluble 17. crosses membrane by diffusion 18. activate gene regulatory proteins 19. regulation of transcription of (specific) genes 20. receptors in nucleus/cytosol/cytoplasm	**5**		incorrect name of hormone

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 A	1. population density as number per unit space 2. density-dependent defined/explained as factor whose impact intensity increases as density increases 3. density-independent defined/explained as factor whose impact is not affected by the size of a population (in an area) 4. relate density-dependent to biotic/relate density-independent to abiotic 5. density-dependent involved in ecological homeostasis/regulatory effect 6. 2 egs density-dependent (predation, disease, competition) 7. 2 egs density-independent (natural disasters, temp, rainfall etc) 8. niche is an organism's role/position in ecosystem and reference to behaviour/adaptations/resources/interactions 9. fundamental niche is set of resources organism is capable of using 10. realised niche is set of resources actually used (in the presence of competition) 11. competition arises when resources are in short supply 12. distinction between intra and interspecific 13. comment on severity of intra on basis of identical needs of individuals **OR** converse for inter 14. eg intra (named organism and resource) 15. eg inter (named species and resource) 16. exploitation competition is when use of resource reduces supply to others 17. eg vultures feeding, rosette leaf form 18. interference competition is behaviour preventing access to resource 19. eg territorial behaviour of robins, allelopathies, etc 20. negative effects of competition/ minus-minus interaction/eg. reduced fertility or growth 21. resource partitioning reduces competition 22. competitive exclusion/species displaced 23. eg impact of exotic species	**max 5 (1-7)** **max 10 (8-23)**	weather, climate where it lives and what it eats	

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 B (i)	**Use of fossil fuels** 1. growing demand for energy from increased population/affluence/standard of living 2. (obtaining energy) from **burning** fossil fuels/coal/gas/oil 3. results in increasing air pollution/emission of gases 4. 2 egs from SO_2, NOx, CO_2, CO 5. effect of acidic gases (from burning fossil fuels)	**4**	*No transfer of marks (i) to (ii)*	CFC or methane negate point 4
(ii)	**The greenhouse effect** 6. description of greenhouse effect as allowing incoming radiation but restriction of outgoing radiation/heat **OR** diagrams 7. by normal carbon dioxide **and** water in air 8. maintains temperature of atmosphere/insulates/ retains heat 9. **enhancement** of greenhouse effect by increasing addition of pollutants 10. (water and) carbon dioxide increased by burning/deforestation 11. greenhouse gases from other sources 12. eg methane/biogas and source (cows, paddy fields) 13. eg CFC and source (aerosol propellants, refrigerants) 14. (Increased temperature) causes **global warming**	**7**		
	Continued			

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 B (cont) (iii)	**Abundance and distribution of species** 15. global warming changes climate/weather 16. leads to habitat destruction/desert formation/fires, etc 17. (relationship between) zooxanthellae and coral 18. (effect of) increasing sea temperature (from global warming) 19. destroys relationship between the two/'coral bleaching'/death of coral 20. exemplification of how change in environmental conditions could result in change in distribution of species 21. susceptible species idea where some species will die out in new conditions/acid rain effects 22. tolerant species/favoured species/indicator species idea	**4**		

Section D

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
1 (i)	**Silage production** 1. silage is fermented grass 2. provides good quality winter feed/nutritional qualities (of grass) preserved 3. (fermentation) carried out in 'silos'/black polythene bags 4. enzymes/bacteria added 5. *Enterococcus* and *Lactobacillus* present/in inoculum 6. pectinases and cellulases present 7. these break down plant cell walls to release nutrients 8. nutrients used by bacteria 9. (bacteria) make conditions anaerobic/use up oxygen 10. (bacteria) produce lactic acid/reduce pH 11. low pH inhibits spoilage (bacteria)/*Clostridium*/ *Listeria*	**7**		
(ii)	**Enhancing nitrogen fixation** 12. nitrogen fixation is the conversion of nitrogen gas to ammonia 13. by nitrogenase enzyme 14. nitrogen fixation in *Rhizobium* 15. nif gene codes for nitrogenase 16. nif gene in plasmid (of *Rhizobium*) 17. *Rhizobium* specific to legume 18. some (rhizobia) more efficient than others 19. most efficient fixation transferred to *Rhizobium* of interest 20. by transferring plasmids 21. improved strains have better gene expression/nif gene switched on constantly 22. nitrogenase is inhibited by oxygen 23. leghaemoglobin made by plant to create anaerobic conditions round nitrogenase	**8**		

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 (i)	**Isolation of a pure culture as a source of inoculum** 1. pure culture has to come from single organism/colony 2. isolation techniques named: any two from streak, spread or poured plates 3. eg 4. description of one method 5. transfer sample from single colony to growth medium 6. need for aseptic technique to prevent contamination 7. description of aseptic technique - any two features	**5**		
(ii)	**Determining growth conditions in laboratory culture** 8. suitable culture conditions need to be worked out 9. eg suitable media, pH, need for oxygen, temperature, shaking - any two 10. eg 11. growth has to be monitored 12. methods of monitoring - any two from cell counting, turbidity, growth rate determination 13. once optimum conditions worked out, maintain lab culture/sub-culturing	**5**		
	Continued			

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
2 (cont) (iii)	**Industrial production and product recovery** 14. volume is scaled up from flask to fermenter 15. factors considered eg volume of inoculum, size of fermenter 16. conditions monitored using probes 17. regulation of conditions to maintain optimum 18. purity of culture checked at each scale up 19. product formation checked in relation to stage of growth 20. types of product generated eg cell/enzyme/secretion/ hormone etc 21. product recovery - isolation from culture/purification of product. 22. eg of downstream processing eg gel filtration, crystallisation	**5**		

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
3 (i)	**Social hierarchy** 1. many primates exist in groups **and** eg baboons/chimps/vervet monkeys 2. (type of social hierarchy is) dominance hierarchy/one based on dominance/system of social ranking 3. initial establishment often due to fighting 4. threat of physical violence/aggressive displays used to **maintain** social/dominance hierarchy 5. advantage is that disputes/violence are minor/rare 6. rank determines access to food/shelter/mates 7. hierarchies generally linear/description of eg alpha, beta males 8. hierarchies not always straightforward/formation of alliances 9. rank changes with time as animals mature/grow old/ have young, etc 10. communication between members of groups eg movements, gestures, calls 11. grooming reinforces dominance 12. grooming also reinforces close relationship/bonding/lower arousal 13. sexual presentation as appeasement gesture towards dominant animal 14. dominant individuals lead/guide whole group **and** eg hunting, defence 15. contribute more to forming the next generation **Continued**	**10**	monkeys	

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
3 (cont) (ii)	**Avoidance of inbreeding** 16. inbreeding results from mating with close relatives 17. increases homozygosity in individuals 18. increases expression of disadvantageous/lethal recessive alleles 'genes'/inbreeding depression 19. natal dispersal/dispersal from home/territory before breeding 20. in mammals, males tend to be dispersing sex 21. dispersing individuals also reduce competition for resources/females 22. example described, eg. male female mobility differences in lions	**5**	increased risk of mutation	

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
4	**Foraging behaviour** 1. idea that animals behave optimally when foraging/ feeding 2. to maximise energy gain with minimum expenditure 3. example of social or individual foraging behaviour should stress **how** it optimises energy *Significant aspects* 4. encounter rate of the prey (by the predator) 5. energy content of prey 6. handling time of the prey (by the predator) *Example to illustrate:* 7. eg optimum mussel size for a foraging crab 8. can be predicted from energy intake of different sizes of mussels 9. set against energy needed to crack open shells (handling time) **OR** 7. eg optimal territory size in robin/humming bird 8. more resources within larger territory 9. set against increased costs of defence **Observation and Recording** *max five from 10 - 17* 10. name/define behaviours to be recorded 11. record must be objective/unbiased/not influenced by observer's evaluation/not anthropomorphic 12. latency - time from event/stimulus to behaviour 13. frequency - number of times behaviour occurs **in unit time** 14. duration - length of time behaviour lasts 15. intensity - relative/ordinal scale 16. time sampling/focal/instantaneous scan and appropriate eg of application (focal = one animal followed) 17. check-lists/ethograms for scoring frequency of specific behaviours **Continued**	**5**		

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
4 (cont)	*Examples of problems and how they are overcome* *Max 5 marks for problems* *Problems and solutions should correspond* 18. long sequence of complex behaviour difficult to record/recording without breaks in observation 19. photography/video etc useful in catalogue/analysis of behaviour/tally counters 20. individual animals may need to be distinguished/ recognised 21. marking/ringing/photos etc 22. limitations in human senses eg 23. specialised equipment used eg ultrasonic detectors/sound spectrograms/ chemical analysis of scents/infra-red cameras for night vision 24. animals must not be influenced by presence of observer	**10**		

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
5	**Effects of exercise** 1. **resting** heart rate decreases (ie Long term effect) 2. potential maximum heart rate during exercise is increased 3. stroke volume increases 4. stroke volume is the volume of blood pushed out in one heart beat/cycle 5. together these create a higher possible cardiac output 6. heart/cardiac muscle mass increases **OR** cardiac hypertrophy/size increase 7. individual fibres become thicker/have more contractile elements in fibres 8. increase in number of capillaries supplying heart muscle/increased cardiac blood flow 9. oxygen delivery becomes more effective/better to all tissues/heart 10. oxygen essential for aerobic respiration 11. recovery time decreases 12. improved blood lipid profile/more HDL, less LDL **Principles of exercise testing** 13. testing can be maximal or sub-maximal *Maximal tests* 14. VO_2 max measures maximum O_2 used 15. exercise to point of exhaustion 16. requires carefully controlled conditions/dangerous 17. only recommended for trained athletes/not for the unfit *Sub-maximal tests* 18. measure O_2 uptake/heart rate 19. under increasing load intensity 20. use of 220 minus age to estimate maximum heart rate 21. heart rate correlation with VO_2 can be used to estimate VO_2 max 22. 2 examples of submaximal tests: exercise stress testing/step/beep test/treadmills/bicycle ergometers 24. less accurate/reliable **OR** more appropriate for people with CVD	**8** **7**	*Focus of essay is on effects of exercise training and not on protective effects* increased number of fibres	

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
6 (i)	**Obesity** 1. definition – clinically obesity is BMI over 30/severe excess of body fat 2. individuals can be overweight because of large muscle or bone mass rather than fat 3. exercise increases energy expenditure/improves energy balance 4. increases muscle/lean to fat ratio 5. increases BMR 6. Energy expenditure/output is affected by two of: frequency, intensity, duration, type of exercise 7. from 6, one mark each	**5**		
(ii)	**Osteoporosis** 8. definition – bones becoming more porous/brittle 9. post-menopausal women susceptible 10. exercise (most effective) during adolescence gives greater mineral reservoir/more resistance to osteoporosis 11. (exercise) increases bone density/mass/strength calcium deposition OR physically fit people have greater bone density 12. type of exercise - weight bearing/resistance + eg 13. exercise can delay progress of osteoporosis (post-menopause) 14. however excessive exercise in young females can provoke (irreversible) osteoporosis	**5**	swimming	
	Continued			

Question	Acceptable Answer	Mark	Unacceptable Answer	Negates
6 (cont) (iii)	**Diabetes mellitus** 15. loss of control of blood glucose/sugar level 16. exercise only relevant in regulation of NIDDM/ Type2/late onset diabetes 17. (in NIDDM) less sensitivity to insulin/insulin resistance 18. exercise improves uptake of glucose in NIDDM 19. increase in sensitivity of insulin receptors/increase in number of insulin receptors 20. link between obesity and diabetes/high proportion of type 2 diabetics are obese 21. increased activity/regular exercise can reduce obesity and therefore the risk of NIDDM (also scores point 20) 22. exercise needs to be regular to sustain the benefits	**5**		

[END OF MARKING INSTRUCTIONS]