



EXAMINERS' REPORT ON 2001 TERTIARY ENTRANCE EXAMINATION

SUBJECT: BIOLOGY

STATISTICS

Year	Number Who Sat	Non-Examination Candidates	Did Not Sit
2001	1815	88	111
2000	1965	116	146
1999	2037	96	156

The Examiners' Report is written by the Chief Examiner (or another examiner on their behalf) to comment on matters relating to the Tertiary Entrance Examination in their subject. The opinions and recommendations expressed in this report are those of the Chief Examiner and not necessarily representative of or endorsed by the Curriculum Council.

The Marking Guide provided at the end of this report was prepared for markers and substantially amplified by discussions held in the pre-marking meeting. It is not intended as a set of model answers, and is not exhaustive as regards alternative answers. Some of the answers are less than perfect, but represent a standard of response that the examiners deemed sufficient to earn full marks. Teachers who use this guide should do so with its original purpose in mind.

SUMMARY/ABSTRACT

This examination followed the format of the previous six years and attempted the usual balance of wide coverage of the syllabus, straightforward and more difficult questions, and a testing of knowledge and higher-level skills. It comprised multiple-choice, short-answer and extended-answer questions. Very few candidates gave the impression of not trying, with very few questions not attempted.

Most candidates appeared well prepared for the paper, with a higher frequency of excellent answers, especially in relation to the extended-answer questions, than we have seen for a few years. The paper seems to have discriminated well, attracting a broader range of marks than was allocated last year. The overall average of 55.39% is a slight increase on last year's 53.99%. The Chief Examiner has received no adverse comments about the paper.

GENERAL COMMENTS

The Examining Panel comprised three members, all of whom contributed to the preparation of the paper. The panel acknowledges the assistance and guidance of the independent reviewer, the final checker and the staff of the Curriculum Council. The structure of the paper followed the pattern of the previous six years. Most topics of the syllabus were tested, with a balanced coverage of each of the syllabus modules. Questions varied in complexity, with straightforward questions giving an opportunity for well-prepared candidates of average ability to achieve their best. Other, more demanding questions gave an opportunity for very able candidates to demonstrate higher levels of understanding.

Performance in the multiple-choice section was slightly better than last year's, probably indicating a slightly easier standard. This is reflected in a slightly improved mean mark for the whole paper.

Sections B and C revealed general improvements in legibility and presentation, along with a continuing need to read questions carefully and to avoid verbosity and digression.

In general, candidates need to pay closer attention to the wording of the question. The instruction to “explain” an observation carries a different requirement from the instruction to “describe” it. Candidates should also carefully consider the number of marks awarded for each question. Where 4 marks are awarded, for example, a few words will almost never score full marks. The space allowed for an answer is good guide to the length of answer required. Candidates should be encouraged to be concise enough not to require more space than is provided

Where a question in Section B or C asks for a list or number of items, these should be ranked in order of the candidate’s confidence in them.

COMMENTS ON EACH SECTION

Section A comprised 30 multiple-choice questions. The overall performance in this section was better than in recent years, possibly indicating an easier standard, but most questions appear to have discriminated reasonably well. Only five questions were answered correctly by fewer than 50% of candidates, whilst in question 18 one incorrect distracter was chosen by nearly 60% of candidates. This revealed the interesting misconception that a molecule of ATP contains more energy than a molecule of glucose. The reliability of the section (0.93) was high.

Item	Answer	n	%	r
1	A	1694	93.4	0.189
2	C	1272	70.1	0.257
3	D	705	38.9	0.191
4	A	1058	58.3	0.275
5	B	1444	79.6	0.236
6	C	1143	63.0	0.313
7	B	864	47.6	0.408
8	B	1369	75.5	0.358
9	C	1630	89.9	0.247
10	D	844	46.5	0.388
11	D	1362	75.1	0.404
12	C	1163	64.1	0.309
13	C	1134	62.5	0.217
14	C	1514	83.5	0.267
15	C	1639	90.4	0.279
16	D	1226	67.6	0.387
17	A	1279	70.5	0.393
18	B	669	36.9	0.263
19	D	1098	60.5	0.358
20	C	1298	60.5	0.370
21	A	1465	80.8	0.321
22	B	1442	79.5	0.193
23	C	1667	91.9	0.234
24	A	1255	69.2	0.303
25	D	936	51.6	0.297
26	B	851	46.9	0.248
27	D	950	52.4	0.285
28	A	911	50.2	0.333
29	B	1464	80.7	0.376
30	D	1043	57.5	0.321

Maximum score = 60 (30 correct items), mean score = 40.12 (66.9%), SD = 8.00, reliability = 0.93

Section B comprised five questions, each with five subsections carrying four marks, and each broadly testing one of the five modules of the syllabus. It is anticipated that this format will be continued in the future.

Question 31 Marks range 0-18, mean 9.3, SD 3.38

Many candidates coped well with this question, with the exception of (c). In (i), a surprising number of biomass pyramids were inverted, with the greatest mass allocated to the higher trophic levels. This is not a difficult concept and it was disappointing that it could be misrepresented so badly. In (ii), few explained that biomass decreases at

each level while the amount of insecticide does not. One-word 'biomagnification' answers were too common, with candidates ignoring the instruction to explain.

Question 32 Marks range 0-19, mean 10.64, SD 3.30

The graph was generally well done, although many candidates gave an inadequate title or no title at all. Part (c) was answered poorly, with many candidates *describing* the results rather than explaining them. In part (d), 'photosynthesis' was a common answer, despite the experiment being conducted in the dark! In part (e) many sketches did not have the axes labelled, making them useless.

Question 33 Marks range 0-20, mean 9.59, SD 4.77

Candidates generally answered this question either very well or very badly, as evidenced by the high standard deviation. A common fault was the belief that sex-linked characteristics could only occur in males. Furthermore, candidates frequently made inadequate use of the pedigree to support their answers. For example, in (e) it was often said correctly that IV 9 was the appropriate male to choose because he had a chance of being homozygous dominant. However, this needed to be supported with the comment that all other males in that line must be either heterozygous or homozygous recessive. Another case occurred in part (c), where a candidate short on knowledge but long on ingenuity wrote: 'I don't need to use the pedigree to show that this characteristic is recessive and sex-linked. The question has already said that it is recessive and autosomal, so it can't be sex-linked.'

Question 34 Marks range 0-19, mean 12.00, SD 3.76

A disappointing feature in the answers to this question was the number of candidates who could not identify the cytoplasm and the mitochondrion as the sites of respiration in the cell (d). A common error was to place one or other of these processes in the chloroplast. Perhaps this misunderstanding also confused candidates in part (c)(ii), where many stated incorrectly that the conclusion was true, probably because they failed to note the presence of cytoplasm and its potential for anaerobic respiration. Many candidates also failed to write an adequate equation for respiration in (d)(ii), in some cases writing the photosynthesis equation instead.

Question 35 Marks range 0-20, mean 10.62, SD 3.59

Many candidates had particular trouble with (c), either not attempting the question or drawing unworkable apparatus. A common problem with drawing was the omission of any equipment to measure time or the amount of water transpired. In (d) some very good answers were given, but a disappointing number of candidates were confused about the process of osmosis.

Section C required candidates to answer two of four choices in each of Questions 36 and 37. Choices in Question 36 emphasised knowledge of syllabus content, while those in Question 37 required application of knowledge.

On the whole, candidates appeared to be well instructed in some of the requirements for writing good answers to Section C questions, particularly legibility, clarity of thought, and the need to be exhaustive in presenting relevant knowledge on the topic. Notable areas needing improvement included the following:

- Excessive verbosity: markers look for specific points in awarding marks. The marking keys (see Appendix) are strictly adhered to and should be studied carefully. No marks are awarded for emphasis, embellishment or repetition.
- Preambles: these are almost invariably a waste of time and rarely attract any marks.
- Digressions: however interesting or impassioned, they cannot be awarded marks.

Questions in this section sometimes effectively ask for lists of characteristics, adaptations, strategies, conditions etc. Candidates should bear in mind that the marking panel will decide on a particular number of these to award marks to (eg 5 adaptations, 10 variables). If a candidate exceeds this number, the practice in recent years has been to mark only the first, say, 5 or 10 items on the candidate's list, and to ignore the rest. The purpose of this is to avoid rewarding candidates who make large numbers of "guesses" in the hope of being lucky enough to score good marks. The consequence of this policy is that candidates should carefully plan answers so as to present items in order of their confidence in them. "Guesses" should appear at the bottom of the list. Planning of this nature should also be applied to answers in Section B.

Question 36(a) Attempted by 41.2% of candidates; marks range 0-10; mean mark 6.49; SD 2.79

This straightforward question scored the best marks in Section C, with better candidates finding it easy to obtain full marks. Homeostasis is an area in which candidates appear well instructed. Where weakness was evident it was in

reasons not being made specific to the condition regulated, eg. “pH must be regulated to maintain optimal conditions in the cell”.

Question 36(b) Attempted by 56.7% of candidates; marks range 0-10; mean mark 4.92; SD 1.90

Good definitions of the terms “autotrophs”, “heterotrophs” and “decomposers” were generally given, but detail was often lacking in explanations of their roles in ecosystems and in the nature of matter and energy flow in ecosystems. A common misconception was that energy and matter are both recycled.

Question 36(c) Attempted by 34.8% of candidates; marks range 0-10; mean mark 3.48; SD 2.06

15 marks were available in the marking key for this question, but only 3-4 marks were scored on average. Candidates were not required to discuss the Lamarckian model of wombat evolution but many wasted time by doing so. A careful reading of the question would have led good candidates to simply write an account of the requirements and outcomes of natural selection in wombats. This question also seemed to attract lengthy preambles which rarely contained any points for which marks could be awarded.

Question 36(d) Attempted by 63.5% of candidates; marks range 0-10; mean mark 4.70; SD 1.70

Most candidates indicated an understanding of the natures of diffusion and osmosis, recognising that the latter is a special case of the former, but missed out on marks by being imprecise. For example, a common statement was that in osmosis, water moves from a region of low to high concentration. (“Solute” concentration needed to be specified.) The second part of the question was poorly answered, with most candidates giving only one or two instances of the importance of osmosis.

Question 37(a) Attempted by 65.7% of candidates; marks range 0-10; mean mark 4.39; SD 1.96

Questions such as this seem to attract candidates with axes to grind and many wrote lengthy diatribes against clear-felling. Candidates are advised to remain focussed on the question and not to dwell at length on a single aspect (such as soil salinity) in an answer which is expected to cover a wider range of issues. The second part of the question was badly answered because candidates seemed to feel confined to the issue of the clearing of vegetation, even though the question was much broader in scope.

Question 37(b) Attempted by 67.7% of candidates; marks range 0-10; mean mark 5.93; SD 2.19

This popular question attracted some excellent answers, particularly in respect of environmental adaptations. Marks were often lost because candidates regarded the higher surface: volume ratio of the mouse as a sufficient reason for its higher metabolic rate. Further explanation is clearly required in an extended-answer question of this type.

Question 37(c) Attempted by 36.1% of candidates; marks range 0-9; mean mark 2.86; SD 1.50

A difficult question which seemed to attract poorer candidates who gave brief answers. A good answer required an understanding of both natural selection and the nature of genetic change, and few candidates successfully linked the two.

Question 37(d) Attempted by 23.3% of candidates; marks range 0-9; mean mark 5.15; SD 2.12

Candidates with a good knowledge of DNA structure and function could score well in this question, but it was the least popular question in Section C. Most of those who attempted it gave good answers, but many wasted time giving a detailed account of mitosis when only one or two mitotic events have relevance.

POINTS FOR CONSIDERATION BY THE SYLLABUS COMMITTEE

Nil

Alan Needham
December 2001

2001 Examining Panel

Chief Examiner: Dr Alan Needham
Deputy: Mr John Mariotti
Third Member: Dr Michael Calver

Chief Marker: Dr Michael Calver

BIOLOGY TEE 2001 MARKING GUIDE

The following is the marking guide developed at the markers' meetings. This was prepared solely for the purpose of giving guidance to and ensuring consistency among markers. Trial markings were used to amplify and clarify the content and interpretation of the guide. The guide is reproduced here simply to afford the reader greater insight into the marking process. It is not in any sense a set of model answers and should not be used as such.

SECTION B

- 31 (a) (i) Fertilisers (domestic or rural),
Sewage,
Insecticide/pesticides,
Detergent
Litter,
Road run-off
Drainage (must be linked to a factor above). (1 each, max 2)

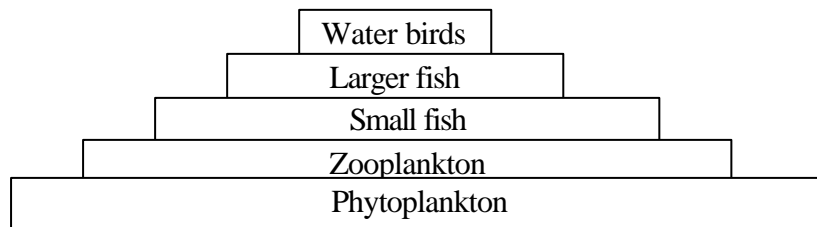
No marks for the same point twice (e.g., domestic fertilisers plus industrial fertilisers = 1 mark only)

- Algae/Bacteria/Micro-organisms,
Boat activity,
Human recreation
Canal construction
Livestock activity
Runnelling
Runoff/Erosion (1 each, max 2)

- (b) (i) Low light levels (1)
reduce photosynthesis/productivity (1)

These feed/depend on macroalgae/phytoplankton (1)
so would experience reduced resources of food/shelter and die or migrate. (1)

- (c) (i)



One mark for the pyramid and one mark for showing a food chain of at least three steps taken from the food web. Mosquitoes cannot be used in the food chain. Note: any shape OK (e.g., triangle, stepped pyramid). Can show trophic levels (e.g., first order consumer), but must show a named organism at each level. Must include producers or lose a mark. (2 marks)

- (ii) At each trophic level biomass is lost (by respiration), (1)
but there is no loss of insecticide, which is stored in organisms. Hence the concentration of pesticides rises in higher trophic levels. (1)
- Also accept:
One consumer eats many organisms below it and hence accumulates the pesticides from all those organisms (1)
Therefore insecticide is transferred and concentrated (1)
- (d) Kills species of insects which are normal parts of food chains.
Adds potential nutrients to the system causing overgrowth of producers.
Leads to development of resistance to the insecticide and loss of insecticide effectiveness.

BIOLOGY TEE 2001 MARKING GUIDE

One mark is for the reason and one mark for the explanation

(any two, 2 marks each)

- (e) Allows flushing of salt marshes and washing out of larvae.
Increases water depth, decreasing temp, so not so conducive to breeding.
Salinity levels may fluctuate, causing osmotic problems for larvae.
Allows access to larger predators, avoiding bottlenecks in food chains.

(any two, 2 marks each)

32. (a) 4 marks. Freehand drawing or ruled lines OK. Subtract 1 mark each for:

Inaccurate plotting/line of graph/column graph.

Absence of key.

Extrapolation.

Absence of descriptive title mentioning both variables in linked statement/two treatments/two flasks.

Absent/incorrect axis label(s). Must show label and unit.

Inappropriate scale(s).

Axis inversion.

Squashing graph into a small area on the grid.

- (b) Independent variable: Chemical X (1)

Dependent variable: No of cells / mm³ (1)
(unit not required)
Cell density acceptable

Controlled variables: Temperature,
glucose conc.,
density of cells at start,
type of plant cell,
time period,
light intensity,
fluid volume
others at marker discretion

(any two, 1 mark each)

- (c) (i) Nutrients were depleted/exhausted (oxygen accepted as a nutrient), waste accumulation (1)
preventing further cell division/growth (1)

Chemical X prevents cell division. (1)

Its removal allowed cell density to increase. (1)

- (d) (i) Protein/enzyme synthesis,
DNA replication,
Respiration/ATP synthesis (any 2, 1 mark each)

- (ii) Protein synthesis: lack of an enzyme needed for DNA replication/cell growth or division/respiration.

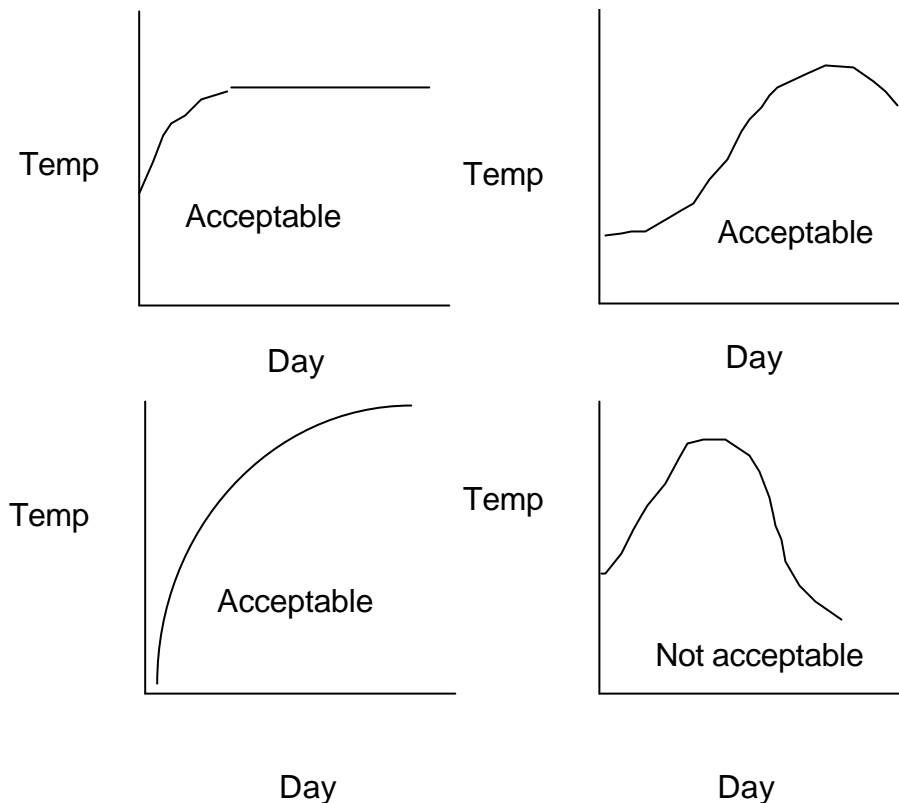
Active transport – critical substance not entering or leaving the cell

DNA replication: an essential part of mitosis.

Respiration: provision of energy for all cell processes, including division.

(2 marks for good explanation)

(e) (i)



2 marks. Slight drop off at end of curve is acceptable. Subtract 1 mark each for:

- Incorrect curve.
- Absent/incorrect axis label(s).
- Axis inversion.

Subtract two marks for no axis labels

(ii) Cellular respiration is exothermic/generates heat.

Metabolic activity increases as cells are dividing and becoming denser but then plateaus as resources become limiting.

(any 2, 1 mark each)

33. (a) aa (1)
 Aa (1)
 Aa (1)
 AA or Aa (1)

Must be exactly as given (ie no other symbols acceptable)

- (b) Individuals III7 and III8 are phenotypically normal (1)
 but have an affected offspring. (1)

If the disorder were dominant, at least one parent would have expressed it. (Can say 'skipped generation' but must name individuals from the pedigree). (2)

Punnet square or diagrammatic answers OK, with explanation.

- (c) Individual III4 is an affected female. (1)

BIOLOGY TEE 2001 MARKING GUIDE

- So would be homozygous if the disorder were sex-linked. (1)
She would pass on an X chromosome to her son (IV5). (1)
Who would express the disorder, but does not. (1)
- (d) (i) 0.25 / 25% / 1 in 4. (2 marks. Subtract 1 for no working)
- If the punnet square is correct but no allowance is made for gender, then only 1 mark
- (ii) 0.25, 25%, 1 in 4 (2 marks. Subtract 1 for no working.
Can say 'Same working as above')
- If the punnet square is correct but no allowance is made for gender, then only 1 mark
- (e) IV9 (1)
because he has a 1/3 chance of being homozygous dominant. (1)
Male IV8 is homozygous for the disorder (1)
And the other males are both heterozygous (1)
34. (a) (i) Nucleus or chromosome (1)
(ii) Meiosis/spermatogenesis (1)
(iii) They contain half the full complement of chromosomes for the species. (2)
(Also accept 1/2 diploid, 1/2 somatic, has 23 (1/2 of 46), but not 23 only)
- (b) (i) They have a high energy requirement / need energy for swimming. (1)
(ii) Inputs: Fructose/glucose/sugar, pyruvate, ADP and O₂ (Any two) (1)
Outputs: CO₂, H₂O, heat, ATP, (Any two) (1)
(iii) To supply energy / For cellular respiration (1)
- (c) (i) False (1)
All structures in both cells are found in plants / cell II contains a chloroplast / cell II has a cell wall. (1)
- (ii) False (1)
Mitochondria could be present / anaerobic respiration would occur in the cytoplasm / all cells require energy. (1)
(contradictory reasons = no mark)
- (d) (i) Cytoplasm: anaerobic (1)
Mitochondrion: aerobic (1)
- (ii) Glucose + oxygen ? carbon dioxide + water (2)
or C₆H₁₂O₆ + 6O₂ ? 6CO₂ + 6H₂O
(Equations need not be balanced, can mix symbols and words, but NOT "food" or "sugar")
- (e) Sperm cells are both smaller and more cylindrical in shape than ova.
Sperm are more active, so diffusion distances for fructose, oxygen and CO₂ need to be short
Diffusion efficiency (must mention inputs/outputs and examples)
Heat generated during respiration in sperm can be quickly removed. (any two, 2 marks each)
35. (a) Stomata (1)
Epidermis (1)
Transpiration/Evapotranspiration (1)
Vacuoles (1)

BIOLOGY TEE 2001 MARKING GUIDE

- (b) Xerophytes (1)
because leaves are cylindrical, (but NOT narrow)
large vacuole for water storage,
stoma is sunken,
cuticle is thick,
epidermis is thick. (any three, 1 each)
- (c) Correctly labelled diagram of a potometer or other appropriate apparatus. (1)
timer (1)
apparatus (if it works) (1)
shoot (1)
labels (1)
- (d) (i) Solution 6 (1)

(ii) It showed the lowest or smallest weight change / lowest net water movement. (1)
(iii) Concentration of solutes was higher in the bathing solution than in the potato (1)
(iv) Water moved by osmosis out of the potato / into the bathing solution (1)
- (e) Temperature
volume of bathing solutions,
time spent in solutions,
method of drying.
shape of potato cylinders
freshness of potato cylinders (any four: 1 each)

SECTION C

36 (a)

- Temperature: to provide optimal conditions for enzyme systems and metabolic processes
- pH: ditto
- O₂ levels: to enable (aerobic) respiration to provide energy
- CO₂ levels: to enable regulation of pH/[HCO₃⁻]/[H₂CO₃]/[H⁺]
- Glucose levels: to ensure energy availability for metabolic processes
- Waste substance levels: must be kept to a minimum to prevent disruption/poisoning of normal functions.
- Electrolyte/Water/Ion balance: ion concentrations can affect osmotic gradients/water balance/nerve and muscle function.

Any 5 of the above. 1 mark for the condition regulated and 1 mark for a reason.

36 (b)

- Autotrophs are organisms that generate organic compounds from inorganic molecules (1)
- by photosynthesis. (1)
- Heterotrophs are organisms that obtain organic compounds (1)
- from other living organisms. (1)
- Decomposers are organisms that recycle (1)
- the elements contained in organic compounds. (1)
- Energy flows from the sun through autotrophs and heterotrophs to decomposers (1)
- Most energy is lost as heat/ Energy is not recycled (1)
- Matter flows through autotrophs and heterotrophs to decomposers (1)
- and is recycled (1).
- Most matter is lost as wastes or excreta at each trophic level (1)

Maximum 10 marks

BIOLOGY TEE 2001 MARKING GUIDE

36 (c)

- There is natural variation in the wombat population (1)
- in respect of the strengths of muscles, teeth and claws. (1)
- These characteristics are genetically determined. (1)
- Variation arises from mutations, (1)
- recombination (1)
- random mating/sexual reproduction (1)
- and independent assortment (1)
- Wombats produce more offspring than survive to maturity. (1)
- There is selection pressure/competition in the population (1)
- Selection pressures favour those individuals with stronger muscles, teeth and claws (1)
- because they are able to obtain better food and shelter. (1)
- Those wombats with better burrowing skills survive better (1)
- and produce more offspring (1)
- These offspring carry the desirable genetic traits (1)
- and increase their frequency in the next generation. (1)

Maximum 10 marks

36 (d)

- Diffusion is the passive movement of substances/anything (1)
- along their concentration gradients/until equilibrium is achieved (1)
- where there is no barrier to movement (1)
- Osmosis is the movement of water (1)
- through a semipermeable/cell/plasma membrane (1)
- where a substance dissolved in the water is unable to cross the membrane (1)
- Osmosis results in the movement of water into/out of a compartment/cell (1)
- in which there is a higher concentration of solutes/lower concentration of water. (1)
- Osmosis allows cells to regulate their water balance/allows osmoregulation (1)
- in order to maintain cell shape/internal fluid pressure. (1)
- These are important in maintaining organism structure/turgidity/turgor pressure (1)
- and allowing normal function. (1)
- Osmosis can cause animal cells to burst/lyse/understanding of plasmolysis (1)
- Osmosis allows uptake of water by plants from the soil
- Osmosis is important in stomatal opening/closing

Maximum 10 marks

37 (a)

Ecological impact (maximum 5 marks)

- Clearing of land deprives native organisms of suitable habitat. (1)
- Clearing small pockets of the environment has had the effect of removing entire ecosystems. (1)
- Clearing results in wind/water erosion/loss of topsoil. (1)
- Adverse effect on waterways (1)
- Ecosystem fragmentation/edge effects (1)
- Transpiration is reduced/deep-rooted plants removed (1)
- resulting in raised water tables/salinity/waterlogging (1)
- Adverse effect of salt on vegetation (1)
- Nutrient depletion of the soil / leaching of nutrients/loss of fertility. (1)
- Reduction of area of arable land by desertification/fragility of ecosystems with poor soils and low rainfall (1)
- Decreased water absorption by the soil / increased run-off (1)
- Adverse effect on local climate (1)
- Reduction of genetic diversity/biodiversity (1)

BIOLOGY TEE 2001 MARKING GUIDE

Features of a good policy (maximum 5 marks)

- Conservation of large areas of various types of ecosystems/reduction of land clearing/maintenance of biodiversity (1)
- Provision of corridors between conservation areas. (1)
- Conduct of surveys of intact ecosystems which are threatened by clearing. (1)
- Reduction in human consumption levels/use of alternative (building) materials (1)
- Increased reuse/recycling of materials (1)
- Reduction of numbers of introduced species (1)
- Rehabilitation/replanting of native vegetation (1)
- Funding/Financial incentives (1)
- Community education (1)
- Research programmes (1)
- Captive breeding programmes (1)

37 (b)

Reasons for higher metabolic rate (maximum 4 marks)

- The mouse is smaller (1)
- and has a higher surface area: volume ratio than the fox (1)
- This will cause it to lose heat to its environment more quickly (1)
- and so must generate heat to replace the loss. (1)
- Body temperature must be maintained / the mouse is an endotherm. (1)
- Metabolic heat/cellular respiration maintains body temperature (1)

Adaptations to environment

1 mark for two correct adaptations + 1 mark for each discussion. (Max 3 marks for each animal)

- Mouse adaptations:
 - Burrowing to avoid the heat
 - High carbohydrate diet to maximise metabolic water production
 - Nocturnal activity to avoid the heat
 - Production of concentrated urine to reduce water loss
 - Hopping for energetic efficiency
 - Large ears/exposed extremities/vasoregulation for heat loss
 - Huddling to conserve heat
 - Drinking urine of young
- Fox adaptations:
 - Dense fur to trap body heat near the skin/reduce heat loss/piloerection
 - Countercurrent heat exchange/vasoconstriction/vasodilatation/vasoregulation to adjust limb temperature.
 - Burrowing to avoid the cold/wind
 - Hibernation/torpor to reduce food requirements
 - Light coloured fur for camouflage
 - Fat for insulation/food storage
 - Shivering/muscular activity for heat generation
 - Huddling behaviour to conserve heat

37 (c)

Similarities: (Maximum 5 marks)

- Selection pressures operate in both populations (1)
- Both result in changes in gene frequencies (1)
- Directional phenotypic changes occur (1)
- Changing/introducing genes is similar to mutation (1)
- providing increased variation (1)
- Both result in “fitter” populations (1)
- Both involve changes to the genetic code/nucleotide sequences (1)
- Both reduce genetic variation (1)

BIOLOGY TEE 2001 MARKING GUIDE

Differences: (Maximum 5 marks)

- Genetic changes are not random (1)
- Selection is artificial/environmental change has less effect (1)
- Evolutionary fitness is not usually increased – just usefulness to humans (1)
- Insertion of/changes to a gene may affect expression of other genes (1)
- Gene manipulation reduces variation more than does natural selection (1)
- Artificial selection produces faster change than natural selection (1)
- May involve introduction of genes from different species (1)

37 (d)

Location (2 marks)

- Information is stored in DNA (1)
- Which is located in the nucleus of the cell (1)

Structure (Maximum 4 marks)

- DNA is a double-stranded helix of polynucleotides. (1)
- Complementary bases are paired across the strands. (1)
- Adenine pairs with thymine and cytosine with guanine. (1)
- Nucleotide base sequences carry genetic information/are arranged in triplet codons (1)
- A nucleotide consists of a sugar, a phosphate and a nitrogenous base (1)

Single Cell to Complete Organism (Maximum 4 marks)

- All the information required for the construction of an organism is contained in the DNA of a single cell. (1)
- Because of base pairings on complementary strands (1)
- DNA is accurately replicated when cells divide (1)
- This information is used for the production of proteins/enzymes (1)
- And determines the structure and function of the cell (1)
- Accurate description of DNA replication (1)
- Mitosis is the process giving rise to identical cells (1)
- Segregation of chromosomes ensures genetically identical daughter cells (1)