

Tasmanian Secondary Assessment Board

BY826 Biology (825, 826)

Report on 1996 External Examination

Assessment Panel Membership

Chief Examiner: Perviz Marker
Setting Examiner: Robert Hopwood
Moderator: Anne Dean

Meetings

A team of 14 teachers from around the state were involved in marking the exam. They met to discuss the paper and answers provided. Groups of 2-3 teachers were then allocated to each criteria to mark. After marking about 200 papers the standards required for A, B, and C ratings for each criteria were checked.

The assessment panel met in early December to review the borderline cases.

General Comments

The paper was an excellent exam paper which was well received by teachers and students alike. The setting examiner and critics are to be congratulated for an excellent job. There was good coverage of all topics indicated in the syllabus, and a good spread of questions ranging from C to A standard within each section. Students were able to complete the paper in the given time and were able to show their potential in some of the open ended questions.

Section A

Question 1

- (a) Most students were able to identify the correct pathway. The best answers not only explained that aerobic respiration produced more energy than anaerobic respiration, but also why. A surprising number of students stated that aerobic respiration *requires* more energy than anaerobic respiration.
- (b) Few students gave good answers to this question. Students frequently failed to discuss the effects of both increased temperature and elevated levels of CO₂. Better answers stated the relevant biological principle (ie. effect of temperature on metabolism/enzymes; increasing the concentration of a reactant in a chemical reaction) and applied the principle to the given situation. One common error was that heat was the energy source for photosynthesis. Students need to understand that an increase in growth is due to an increased accumulation of organic matter which is produced by a higher photosynthetic rate, not by an increase in respiration.
- (c) A straightforward question which was correctly answered by most students.

Question 2

- (a) This question was often poorly answered or not attempted. Of those who attempted an answer, many did not give an example of a cell which *secreted* a protein. The majority of correct answers contained examples of digestive enzymes.

- (b) Adequate answers named four organelles involved in protein synthesis and gave a description of the function of each. Ribosomes were an essential inclusion, but any other three of the organelles mentioned in the sample answer were accepted.

Better answers developed the themes of co-ordination and co-operation between organelles showing links between the functions of the various organelles. A significant number of students described (often in some detail) transcription and translation but failed to discuss any of the processes involved in preparing the protein for export from the cell. Students should look for more meaningful ways of showing understanding than repeating phrases from their texts such as 'ribosomes are the workbenches of the cell on which proteins are made'.

Question 3

- (a) Correctly answered by most students.
- (b) A range of answers were accepted for this question, provided a clear link was made between the cells structure and its specialised function. This question was well answered by most students.

Question 4

- (a) This was generally well done. The most common error was to say that the process was transcription.
- (b) Well done.
- (c) Surprisingly few people got full marks. Most said the protein would be different and little else (for which they got 0.5 or 1 mark). Too many people didn't answer the question - instead of looking at the effect on the protein; they looked at the effect on the organism (this mutation may cause Downs Syndrome, a large nose etc)

Question 5

This question was well done by the good students, but very badly done by many students. The marks tended to be 5,6 or 7 or 0, 1 or 2 out of 7 with very little in between. The poor students simply did not recognise that this was an osmosis question and made comments like...

- 'Species Y did well in the new environment because it put on weight'.
- 'Species X lost weight because it exploded'.
- 'Species X preferred water with cyanide in it because it put on weight when placed in water containing cyanide'.

Question 6

- (a) This question was very well done although many of the weaker students had obviously just looked up enzyme in their text book and written down everything (Only some of this information actually answered the questions!).
- (b) Also well done and many students got full marks. Those that didn't failed to mention the purpose of the enzyme and merely said that the poison blocked the active site. A surprisingly common error was to say that the enzyme would be poisoned and die. Enzymes do not die! This question was marred by many spelling errors particularly: "protien, substate and active sight".

Section B

Question 7

- (a) Many students did not appreciate the meaning of the biological term *system* and used the word generally; hence answers such as “active/passive systems”, “open/closed systems”. The most frequent answer including “circulatory system” (0.5) but this was paired with other systems eg, digestive, respiratory, excretory, nervous, endocrine.
- (b) Many students did not appreciate that they need to refer to *both* systems when giving a difference eg. The circulatory system....., whereas the lymphatic system..... If a) was answered incorrectly, they could only score a maximum of 1 in b). The best answers in this section were given by students comparing the xylem and phloem as the differences tended to be precise.
- (c) (i) To get two marks students needed to show that they understood that gases are absorbed across the respiratory surfaces, that oxygen enters the blood and carbon dioxide leaves.

Common answers which scored 1 mark included:

“Inhaling oxygen and exhaling carbon dioxide”
 “Gas exchange”

- (ii) Almost all students were able to answer this adequately.

In general (a) and (b) were poorly done and (c) was well done.

Question 8

- (a) Many students did not read the introduction to the question or did not take in that the diagram was part of the *digestive* system, hence answers such as: kidney, cristae of mitochondria, lung.

Half a mark was given for “intestine” or “large intestine”. This part was poorly done, presumably because we no longer look at slides of prepared tissue or study histology in detail and illustrations of villi in text books tend to be more diagrammatic than this.

(b) and (c)

If answer to (a) was incorrect, a maximum of half marks could be scored in each of these. Both of these were reasonably well done.

- (d) This was a good discriminator. Only the better students appreciated why mechanical digestion occurs *earlier* than chemical.

Question 9

This question was generally well answered, however students lost marks where they failed to choose an excretory organ and to discuss its homeostatic role. Some common problems were:

- (a) Students chose any homeostatic mechanism and discussed it, regardless of whether an excretory organ had a major role.
- (b) Students merely copied feedback cycles from their texts, without endeavouring to apply knowledge from the diagram to the question in hand. Whereas it is acceptable to include such a diagram in the answer, that diagram should be qualified by suitable text.
- (c) Although many students adequately explained what homeostasis is, few endeavoured to explain its importance.

- (d) In some cases, too much information was given, for example, about the structure of the kidney or the nephron: although marks were not deducted for this, it takes up time which could be spent gaining marks on relevant details.
- (e) A proportion of students considered that the main homeostatic function of the kidney was in its functions of ultra filtration and reabsorption, overlooking the nervous and hormonal controls regulating these processes.
- (f) Students who chose the liver ignored the possibility of feedback loops in homeostasis.
- (g) Confusion re: the role of the Loop of Henle and its length (an adaptation) with the homeostatic function of the kidney.

Question 10

- (a) Students often choose II which could be either dominant or recessive and is not *clearly* one or the other.
- (b) Well done - mark given if symbols used eg Aa.
- (c) Well done - some students clearly guessed the answer
- (d) Poorly done - many students did not give genotypes at all - just meaningless drawings. Many students did not show X or Y chromosomes. Some students thought that female carriers had one allele on one chromosome but no allele on the other chromosome.

Question 11

- (a) Most students achieved at least one mark here but many thought that asexual reproduction meant there would be no mutations and therefore no variation.

Some interesting answers:

- “Maybe the women’s lib or lesbians got their way and had an all women society”.
- “The females would not get genes from the weaker sex”.
- “They would not pass on sexual diseases”.
- “Don’t require a partner and therefore no problems if no one likes you”.

Question 12

Students found this difficult and many left it out altogether.

Statements like “to keep the organism alive” and “because they are complex they need complex systems” were frequent.

Only the best students were successful at getting two marks on this question. Many students got one mark as they gave one almost correct idea.

Section C

Question 13

- (a) (i) Also accepted detritivore but not “degrader”. Also accepted consumer for honeyeater but not third order consumer nor “top storey niche”. Generally there was confusion with the use of terminology.

- (ii) Deduction of one mark if the arrows went the wrong way. Deduction of half mark for a non-Australian species: tiger, wolf, stoat, bear and half mark was deducted for including detritus as part of the food chain.

detritus_____ worm (not an organism).

- (b) Students only scored half marks for just saying decrease in number of birds ie, they had to say that they were eaten by or preyed upon by the cats.
- (c) Many students could see the environmental effect but only scored half mark for each if they didn't relate it to the soil organisms, eg. increased salinity could be mentioned and related to osmoregulation.
- (d) (i) Given the answer was climax it was inappropriate to accept "virgin", "untouched", isolated, traditional, primitive, historic, homeostatic, diverse, ye old time etc.
- (ii) Most students gave very confused answers for this part, they stated something like "the amount of photosynthesis was limited by the amount of CO₂ produced by the respirers".

Many of the answers were a bit too happy eg. "The plants need the animals and the animals need the plants etc", or "They have to be in equilibrium or balance because they've been around together for a long time". Many thought it was a homeostasis question and answered it accordingly. Common misconceptions were that "old trees don't grow" or some thought "plants photosynthesise and animals respire". Those that remembered that plants photosynthesise sometimes put that "they can't photosynthesise at night therefore they have to respire to get their energy".

Question 14

- (a) Only 50% got a mark for part (a). Lettuce was the commonest answer.
- (b) Many students did not label their arrows. Up to one mark was awarded for combinations of unlabelled arrows.
- (c) Well done, but a number of students did not relate their answer to the slugs/lettuce/greenhouse situation.

Question 15

Most students had ideas on factors influencing population growth rate etc but many overlooked the fact that they were being asked to discuss the statement given. Only three marks were awarded for a well reasoned discussion which did *not* refer to the "quotation".

Question 16

- (a) Well answered - most students had a solid grasp of natural selection.
- (b) While a few students confused and mixed Darwinian and Lamarkian ideas the majority could clearly differentiate.
- (c) Surprisingly poorly answered - interbreeding alone gained only half mark - it is possible to produce sterile cross species eg, mule, ass.

Section D

Question 17

- (a) This was fairly well done though many students did not achieve full marks as they just mentioned that treatment 1 was a control but needed to then indicate the purpose of the control in this experiment.
- (b) Well done.
- (c) Many students gave an interpretation of the graph rather than put forward a hypothesis to the experiment. Many hypotheses given failed to identify clearly either the independent or dependent variable.

Question 18

- (a) Students lost marks because answers were loose and lacked detail although there were some excellent answers reflecting a clear understanding of experimental design. Most students talked about the glue improving growth rate but did not latch on to the fact that the glue was only holding the growth product in place.
- (b) Many students did not give a range of possible results - this may have been helped by the question being more specific. There are still student using the term 'prove' and not many indicated there should be a significant difference between the growth rate of mussels with and without growth product.
- (c) Answers were very vague eg, change environmental conditions and change concentrations of glue.

Question 19

- (a) (i) Overall fairly well done. A significant number merely restated the observation about height and north facing without either looking for the biological reason behind the ripening or not putting it as a hypothesis with one dependent variable. Many students however did relate sunlight lends to ripening rates. A few gave over-elaborate explanations.
- (ii) Most students, correctly chose ripening rate as the dependent variable, but even some of those who had indicated light as responsible in (i) reverted to height and direction of branches. Students lost marks for having two independent variables.
- (b) The bulk of students came up with good answers for this part. However a number of students got sidetracked on things such as ethical problems, and some were confused as well... "It is not ethical to see how many offspring people can produce to justify science...How well is it being monitored?"

Question 20

Candidates did very well on the whole and showed a sound understanding of unwanted variables and how to minimise their effects.

Some candidates got side tracked discussing method details in part (i) and (ii), and a fair number majored on the possible side effects of vitamin B overdoses. Some were rather extreme in the controls - no food, no drink or sleep for anyone, and some had original ways of expressing things eg. "using (who would all have a similar problem and symptoms".

Section E

Question 21

- (a) Use of wrong terms proportional, inversely proportional (lost half mark). Some students repeated question: There is a relationship between VEIPD and LMT. (0 marks)
- (b) Some students misinterpreted physiological as psychological. “Soldiers ate warm food to feel good”. (0 marks). There was also some repetition of reasons. (1. Soldiers eat more food to maintain body temperature. 2. Soldiers eat food to warm up). (1 mark only).
- (c) Maximum of three marks given for weaknesses or strengths *only*. Most answers dwelled on controlled variables only (ie different race, background, size, interest, fitness, etc - if a reasonable answer was given a maximum of three marks was achieved). Few mentioned that a large sample size would reduce (average out) personal variation.

Question 22

- (a) Few (less than half) gave a *biological explanation*. (1 mark) was given for “the ease of data collection and comparison”, although it is easier to weigh a fish in a net than measure it. Also half mark given that fish could be released unharmed.
- (b) (i) Generally answered satisfactorily. Several students stated that the groups grew at the *same rate* - confusing this with *proportionality*. Several students also tried to explain *reasons* for the difference when the question did not ask for this. Many students did not bother to provide data extracted from the graph relating to the extent of the difference in growth (2x) or the years in which growth occurred/levelled off.
- (ii) Many students answered this question well, especially those choosing temperature and nutrient availability, though some of these failed to explain how these enabled higher growth rates and so lost marks.

Those choosing predation (including fishing) often either failed to mention natural selection or suggested that fishing/predation removed larger fish, decreasing average size, which was not a reasonable explanation for the difference in sizes at each age group (unless selection over time is put forward as a mechanism).

Question 23

- (a) Very few candidates obtained 2 marks for part (a) of this question. The question specifically asked candidates to give an *accurate* description of the relationship shown in the table. This implied that a reasonable interpretation of the data was required. However, most students (about 60%) simply stated “... as salt intake increases so does the mean systolic b.p” and neglected to describe the relationship more fully. Some students were given a little credit (half a mark) for calculating the total change in mean blood pressure (1.7 kPa) over the range of salt intakes and stating that this increase was very significant. A surprising number of students incorrectly stated that the relationship was one of direct proportionality or that an exponential increase in blood pressure was evident.
- (b) Most students had little difficulty in finding limitations, although some (perhaps in a rush) simply stated them without explaining how they limited the usefulness of the investigation. Better answers discussed the effects/significance of the limitations and were able to relate them better to their conclusions.

Several students said that it was unethical to give more salt to patients and that this limited the investigation, but since the investigation did not involve the giving of salt this was not given full credit.

For conclusions, many students correctly expressed doubt as to the significance or validity of the results, and the limitations as to their applicability. A small deduction was made if students failed to indicate that the results did, on the face of it, support the idea that salt intake may affect blood pressure levels.

Question 24

- (a) This part was answered very well with most students being able to find two significant flaws in/objections to the way the net was used.
- (b) This part was also answered very well. The majority of candidates saw this step (only 1 hour duration) as an improvement on ethical and ecological grounds. Only one mark was available so this part of the question did not discriminate well between very good and mediocre answers.
- (c) Very few candidates obtained full marks for this part of the question. The majority of candidates examined the correlation between New Moon (low light) and high recruitment rates and agreed with the student's conclusion (about the timing being association with the avoidance of predation). Very little credit was given to these students unless they indicated that the very good correlation may also be due to factors other than light intensity and predation.

Statistical Summary

Award Summary	Outstanding Achievement (OA)	137
	High Achievement (HA)	266
	Satisfactory Achievement (SA)	235
	Failure (NN)	1
	Reassessed into neighbour	74
	Total	713
Gender Breakdown	Males	228
	Females	485

Summary of external ratings

	A	B	C	D
Criterion 3	152	193	269	87
Criterion 4	98	224	226	153
Criterion 5	83	206	321	91
Criterion 8	107	263	263	66
Criterion 9	164	275	220	41

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Solutions for the 1996 External Examination

SOLUTIONS

Section A

Question 1

a) Pathway A.

Aerobic respiration results in a complete breakdown of glucose, yielding more energy.

(b) Heating increases the rate of chemical reactions so photosynthetic rate will increase. Enriching the air with carbon dioxide (a reactant in photosynthesis) also increases the rate of photosynthesis and hence growth.

c) *Either water, or light or nutrient availability.*

Question 2

(a) Cells in the islets of Langerhans produce and secrete the protein insulin, which helps regulate blood sugar levels.

OR

Cells in the salivary glands produce and secrete the protein salivary amylase which breaks down starch to maltose.

(b) The DNA in the *nucleus* of a cell has the specific coding for proteins. This code is transcribed into mRNA which leaves the nucleus and moves to the *ribosomes* where the code is translated into the appropriate amino acid sequence. Each protein has a unique amino acid sequence. The ribosomes may be free in the cytoplasm or studded on the surface of the *rough endoplasmic reticulum*. The protein is then transported via the endoplasmic reticulum to the *Golgi complex* where it is modified ready for release from the cell. *Secretory vesicles* containing the protein bud from the Golgi complex and move to the cell membrane, fuse with it, thus releasing the protein to the outside of the cell in a process known as exocytosis. Energy for this process is supplied by respiration which takes place in the *mitochondria*.

Question 3

(a) The sperm cell (a) is haploid.

(b) Either;

Sperm cell

- acrosome in the head contains enzymes which aids penetration of the ovum
- concentration of mitochondria behind the head provides energy for movement.

Or;

Palisade mesophyll cell

- large number of chloroplasts maximise photosynthesis
- the cell shape permits many cells to be aligned to maximise light absorption and hence photosynthesis.

Or;

Kidney tubule cell

- folded cell membrane increases surface area which allows more efficient reabsorption
- large number of mitochondria supply ATP for active transport which is involved in reabsorption.

Question 4

- (a) DNA replication or Duplication.
- (b) Nucleus.
- (c) A change in the DNA sequence will change the mRNA which is produced and this may lead to a different amino acid being incorporated, so that the protein produced may not function effectively. (One mark for saying 'may lead to a different amino acid' and one for 'protein may not function').

Question 5

- (a) Moving the worms into an environment with a lower salt concentration caused a net flow of water into the worms by osmosis. (1 mark). This flow was caused by the difference in salt concentration from low in the environment to high in the worms. (1 mark)
- (b) Osmoregulation.
- (c) Cyanide inhibits respiration so that insufficient energy is available for osmoregulation to occur. (1 mark for linking respiration with energy and one mark for linking energy with active transport and osmoregulation).
- (d) Species X, (1 mark) because species X can osmoregulate (from expt 1 on the graph) and therefore survive in both fresh and sea water. (1 mark)

Question 6

- (a) Many different points were accepted including:
 - enzymes speed up metabolic reactions
 - enzymes lower the activation energy of these reactions
 - enzymes control reactions and ensure that they proceed in an orderly, stepwise fashion
 - examples such as enzymes in respiration, digestion etc etc.

(1 mark for each point but only 1 mark allocated an example)
- (b) The enzyme functions by having substrate molecule(s) fitting into its active site forming the enzyme - substrate complex. It then catalyses the reaction (be it synthesis or breakdown). The poison has blocked the active site of the enzyme which means the enzyme cannot function as a catalyst and the reaction will not proceed as quickly as it should.

Section B

Question 7

- (a) *Advanced plant*
 (i) xylem
 (ii) phloem

Human/Mammal

- (i) circulatory or blood
 (ii) lymphatic

Full marks were also given for:

Advanced plant

conduction/translocation
 transpiration/translocation

Human/Mammal

venous/arterial
 pulmonary/systemic

- (b) (i) eg. xylem transports water and dissolved minerals.
 Phloem transports dissolved organic compounds such as sugars
- (ii) Xylem cells are dead at maturity
 Phloem cells are living (Marks given for any reasonable differences)
- (c) (i) Provide a surface for the diffusion of oxygen from the air to the blood.
 Provide a surface for the diffusion of carbon dioxide from the blood to the air.
 Minimise water loss.
 Assist in temperature regulation (Any 2 points)
- (d) (ii) Greater surface area in mammals allows greater rate of diffusion

OR

respiratory surface of mammals is more efficient because mammals are endotherms and therefore have a higher demand for oxygen.

A typical 'C' standard answer gained the following marks out of 6:

(a) 0.5 (b) 0.5 (c) (i) 1 (ii) 1
 C=3, B=4, A=5-6

Question 8

- (a) Small intestine/ileum.
- (b) (i) digestion.
 (ii) absorption (full mark also given for any two of osmosis/diffusion/active uptake).
- (c) To assist absorption:
- villi increase surface area for more rapid absorption
 - villi walls are only one cell thick
 - villi contain capillary network to remove products of digestion

- villi contain a branch of the lymphatic system for absorption of lipids
- villus contain large numbers of mitochondria to assist active uptake etc (Any 2 points)

(d) Mechanical digestion results in an increased surface area (1) on which enzymes can act (1) further down the digestive tract.

C=2-3, B=4, A=5-6

Question 9

- specify the excretory organ and its role in homeostasis; (1 mark)
- explain what homeostasis is; (2 marks)
- the importance of homeostasis. (1 mark)

For the chosen organ:

- hormonal/nervous role, including stimulus, receptor, response; (2 marks)
- display/explain a negative feedback loop. (1 mark)

Sample Answer

The kidney is an excretory organ whose function in homeostasis is to regulate the water content of the blood. (1m) Homeostasis is the process of maintaining a relatively constant internal environment (1m) despite changes in the internal or external environment. (1m). Metabolic processes take place within a small range of chemical and physical environments (eg, pH, temperature, salinity, ionic concentration, etc) thus homeostasis is important in maintaining that optimum environment. (1m).

In kidneys, regulation of water level is maintained by negative feedback established via water levels in the blood and the hormone anti-diuretic hormone. (ADH). If a decrease in water level is detected in the blood by the cells of the hypothalamus (receptor), it stimulates an increase in the release from the posterior pituitary of ADH. (1m). The resulting effect is an increased permeability in the kidney tubule so that more water is reabsorbed back into the blood stream, restoring its water content to an optimal level (1m) and thereby inhibiting further release of ADH. Water levels are also restored by stimulation of the thirst reflex. In this way, the response from the pituitary gland has altered the original stimulus. (1m)

Alternative Answers

Other organs of excretion are the *lungs*, the *liver* and the *skin*.

The role of the *lungs* in homeostasis:

removal of CO₂, regulation of blood gas levels. (1m). This is regulated through nervous transmissions from the efferent nerves in the respiratory centre of the brain (1m) to the intercostal muscles and diaphragm which effect a response. (1m). Thus if the CO₂ level in the blood elevates, the intercostal muscles and diaphragm respond to generate, deeper, more rapid breathing, which in turn results in a fall in blood CO₂ concentrations. (1m). This response has altered the original stimulus, an example of negative feedback. (1m).

The role of the *liver* in homeostasis:

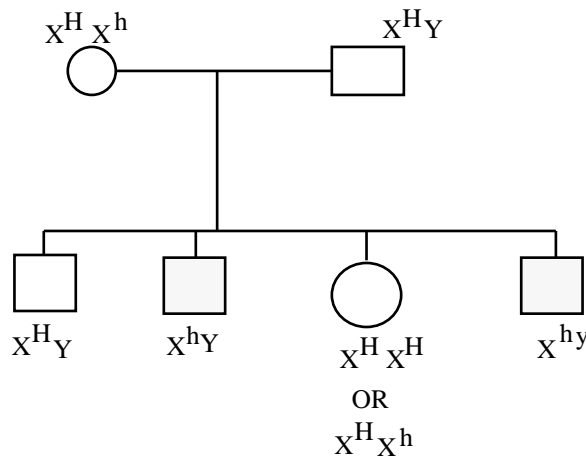
removal of bile, regulation of blood sugar levels. (1m) Involves hormonal regulation via glucagon and insulin secreted from the pancreas. (1m). An increase in blood sugar is detected by the pancreas which increases its output of insulin to convert excess glucose to glycogen in the liver, which, along with other metabolic responses, restores the blood sugar level (bsl) to normal. (1m). Thus the original stimulus of elevated bsl, has resulted in a reduced bsl through negative feedback. (1m).

The role of the *skin* in homeostasis:

excretion of sweat, regulation of body temperature. (1m). Lowering of body temperature is detected in the hypothalamus of the brain, which sends a nervous transmission effectors such as muscles, causing shivering. The results is that heat is generated, elevating the body temperature. (2m). Thus the initial stimulus has been altered by the response, an example of negative feedback. (1m).

Question 10

- (a) (i) III (1 mark)
- (ii) I or IV (1 mark)
- (b) (iii) heterozygous (1 mark)
- (c) 25% (accepted and 1:3) (1 mark)
- (d) Pedigree IV



(or 2 marks for any other correct pedigree. 1 mark given for knowing XX = female, XY = male).
 A = 5-7, B = 4, C = 3

Question 11

- (a)
 - Asexual reproduction leads to rapid increase in numbers
 - No need to spend time and energy finding a mate
 - Offspring are genetically similar to parent and therefore should be well adapted to the same environment.
 - Reproduction can occur more easily in isolated populations or where males are less frequent.

(Any two of above).

- (b) Because there is less variation between individuals natural selection is not quickly able to bring about the evolution of species well adapted to new conditions OR/lack of variation means that if conditions are unsuitable for a characteristic many individuals die.

Question 12

- (i) Multicellularity leads to larger organisms and therefore transport systems are necessary to carry requirements to the cells and remove the wastes from them.

- (ii) Multicellularity means that specialisation and division of labour can occur so that organs and tissues carry out (certain functions and this leads to an efficient functioning of the body.
- (iii) Large size means a small SA/volume ratio and therefore diffusion of substances into and out of an organism is too slow and inefficient and therefore transport systems are needed for food, O₂ etc.

(Any 2 correct answers).

Section C

Question 13

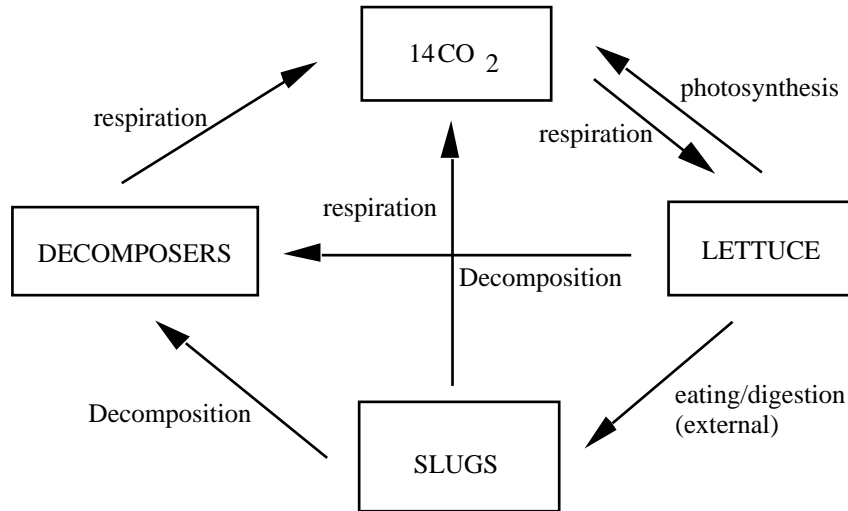
- (a) (i) Earthworm- Decomposer (recycling leaf litter and humus to enrich the soil). Honeyeater- First order consumer. (niche is the animal's "job" or occupation). Therefore accepted soil aerator and eats nectar and pollinates. First and second order consumer.
- (ii) eucalypt tree honeyeater hawk
 - or anything which makes sense. The trophic level indicates a position in a food chain.
- (b)
 - Predation on birds (especially the young) decreases the population of native birds.
 - Competition for prey decreases the population of smaller mammals. (didn't accept the food chain would become unbalanced)
 - Reduction in the population of competitor species eg, kookaburras.

OR

- increase in the number of insects that were eaten by the birds and lizards - also increase in feral cat numbers because they had no predators upon them.
- (c) Loss of leaf litter from the soil would mean loss of nutrients and a decrease in soil organisms and removal of the trees would reduce the stability of the soil and increase erosion causing the death of many soil organisms.
- (d) (i) Climax.
- (ii) The energy available to the community is determined by the amount of incident energy (sunlight) which is used in photosynthesis to convert CO₂ to glucose and then to other carbon compounds which are then passed through the food chain to consumer organisms. The amount of energy available is limited to the amount of energy liberated by respiration in all organisms. Therefore the amount/rate of respiration must be equal to the rate of photosynthesis, it can never be more. (It can be less where carbon compounds are accumulating eg, in coal production). If they were not equal we would expect some kind of change to be occurring in the community, ie, a build up of organic matter (if photosynthesis is greater) and consequently the community would not be a climax community.

Question 14

- (a) Glucose (but also accepted protein, starch, chlorophyll, sugars, carbohydrate etc). (1 mark).
 (b)



- (c) 1 mark each for this progression of points.

Photosynthesis uses $^{14}\text{CO}_2$ as a raw material and takes this from the atmosphere. It may be assimilated into the bodies of other organisms such as slugs and decomposers. At any of these stages it may be returned to the non-living environment through respiration and the cycle repeated. *There is a constant cycle of carbon* which can move from one location to another but cannot vary from the finite amount on the planet.

Light energy is also needed and is transformed into chemical energy *which is lost as heat at each link in a food web*. This heat is lost from the planet but is replaced by the constant flow of light energy entering the system. Slugs use energy in locomotion, chewing and daily respiration. Likewise bacteria, protozoa, fungi lose energy in the processes of life. Only about 10% of the energy available at a particular trophic level is assimilated at the next trophic level.

Question 15

Discuss factors influencing birth or death rates, such as

BIOTIC	ABIOTIC
Food	Water
Predators	Light
Disease	Nutrients
Competition for space	Temperature

Some of these factors are dependent on population density such as food supply, predator, disease and competition for other resources. Other factors relating to climate for instance are not dependent on population size/density.

The initial statement suggests that if birth rate is high the death rate will be high also, because an area has a certain carrying capacity and most populations are stable. To achieve this stability there is a negative feedback system operating to reduce the population again, if the birth rate is high, so that as resources become limiting in response to population increase, then factors such as disease, predation, starvation etc will begin to operate.

Question 16

- (a) (i) Variations exist in the populations
 (ii) Formations of islands produced geographic/reproductive isolation
 (iii) Different selective pressures on the different islands eg. agents of selection - predators, availability fo food etc.
 (iv) Different environmental factors on the islands selected for particular characteristics.
 (v) Selective inheritance of particular genes/genotypes.
- (b) (i) The use/lack of use of muscles led to increase/decrease of size of the snake during its lifetime.
 (ii) These acquired characteristics were passed on to subsequent (iii) generations of snakes.
- (c) Interbreed snakes - fertile offspring indicates they are from the same species.

Section D

Question 17

- (a) Treatment 1 is a control (1 mark) so that the differences observed in 2,3 and 4 can be attributed to raking, watering or a combination of both.(1 mark).
- (b) Variables that were controlled:
- orientation
 - environmental conditions
 - flat level- area size
 - soil type
- (c) Some examples of acceptable hypotheses:
- Heavy raking will enhance the effect heavy watering has in decreasing corby grub ppopulations.
 - Heavy watering will cause a decline in the burrow density per m² over the years because there is not a dense batch of leaves for the grubs to live in.
 - The removal of dense thatches of dead leaves through raking decreases the number of corby grubs present in the lawn.

Question 18

- a) Hypothesis: Growth product impregnated into ropes with water soluble glue will improve growth rate in mussels.

Three areas of a sheltered bay where the environmental conditions are similar for each area (salinity, temp, currents, predators) should be designated. In this way these variables are controlled. Three sets of identical ropes (4 in each) are prepared:

- (a) growth product and glue
 (b) glue only
 (c) no glue

Although the growth product is the independent variable the glue needs to be checked to make sure it is not the cause of any effect. Mussels from the same source (same age/size) are attached to the ropes (150/rope) - the average mass of the mussels in each group has been calculated. The ropes are attached to the rafts and left for a normal growing season. At weekly intervals a dozen mussels taken from each rope and the dependent variable calculated by measuring the average mass of the mussels from each condition. The rate can be calculated by finding average mass change / unit time. All results must be recorded and a graph of average mass against time can be drawn.

Total marks 7 (A 6-7, B 4.5-5.5, C 3-4.5)

C Basic outline in which the independent variable has been manipulated.

B Some of the requirements of an A answer included but not tight.

A Quantities included, variables identified, methods of measuring dependent variable included.

- (b) If the hypothesis was supported then a significant increase in growth rate should have been seen in the mussels given growth product. If there was no significant difference between the groups or those without growth product showed a greater growth rate then the hypothesis is negated. If those with glue only showed an increase in comparison with the others this also negates the hypothesis.

Total 3 marks

A-3 gave all possible results, used the terms significant and support or similar.

B-2 gave all possible results, used terminology accurately.

C-1 gave one possible result

- (c) Any two relevant changes clearly stated must include one relevant to conditions and one related to concentration of product.

eg. The concentrations of the growth product impregnated into the rope could have been changed so that trials using a range of concentrations were made.

The temperature of the water in which the ropes were could have been altered under laboratory conditions.

Question 19

- (a) (i) Best answers: Increased exposure to levels of sunlight causes accelerated growth rates and ripening

OR

Increased temperatures from more exposure to the sun causes more rapid metabolism maturing of apples.

Good answers: More sunlight means faster ripening. C - standard needed one half reasonable cause and effect.

- (ii) Independent variable -sunlight exposure or heat. Dependent variable - ripening or maturing of apple.

- (b) No. 3. Level of well being can't be scientifically measured. Lesser answers include 'too vague', 'How do you measure it' or pointing out hypothesis 4 is not specific enough as it doesn't say which disease.

Question 20

- (a) (i) Differences relating to vitamin B levels: peoples natural levels, absorption rates and food consumed. (1 - 1.5 marks)

Differences relating to effects - amount of sleep, before/during/after, alcohol, time differences, flight time. (Approx _ mark each). Subject variation - age, size, sex, genetic variation.

- (ii) • Measurement and jet lag symptoms (1 mark)
 • subjectiveness of 'tiredness and confusion'. (1 mark)
 • puzzle solving abilities varies between individuals. (1 mark)
 • people show differing degrees of symptoms of susceptibility to jet lag.

- (iii) egs. Test before and after flight with similar puzzles. Controlled variables such as described in i). Use of large numbers, test or regular levels.

(1 mark for each good suggestion).

Section E**Question 21**

- (a) An inverse relationship or negative linear relationship. The lower the temperature, the higher the voluntary energy intake per day.

- (b) Any two of: (1 mark each)
1. Shivering requires energy
 2. Increased physical activity to stay warm
 3. Maintenance of constant body temperature.

- (c) *Strengths* - Any two of: (2 marks)
1. Sample size reasonable
 2. Same sex and age bracket
 3. Same occupation and level of physical activity
 4. Range of temperature studied.

- Weaknesses* - Any three of: (3 marks)
1. No hypothesis stated
 2. No obvious control to compare intake
 3. Controlled variables not stated including:
 - (a) genetic variability between soldiers (size, BMR, etc)
 - (b) food composition (protein/fat/carbohydrate/different menus)
 - (c) different preparation of food.
 4. Experimental values unclear (how many soldiers involved)
 5. How data gathered unclear and averaged.
- Or a good well balanced discussion gained full marks.

Question 22

- (a) *Biological explanation*
 Weight fluctuates due to various factors. (Spawning, recent food consumption, low body fat) but length is stable and most proportional to age (1 mark)

Non-biological explanation.
 "Easy" to measure without harming fish. (1 mark)

- (b) (i)
- length of both groups of trout increases with age
 - growth in both groups declines markedly after three years.
 - growth rate of reservoir fish is approximately twice that of Mt Lake fish throughout.
 - growth of trout in the two groups was roughly proportional.
 - growth of reservoir fish in first three years is linear whereas Mt Lake fish is exponential (doubles, steady).
 - reservoir fish grow to twice the size of Mt Lake fish by four years.
- (ii) *Temperature*
- Mt Lake probably colder than reservoir lake.
 - metabolic rate lower in colder conditions (fish are ectotherms) therefore rate of growth slower

Nutrients

- Mt Lake: cold weather/harsh conditions decreases growth of producers, therefore less biomass in the food web and a lower food supply for trout inhibiting rapid growth.
- Reservoir
 - (a) Higher temperatures therefore increased productivity/biomass and increased food supply for trout (eg insects) allowing high growth rates.
 - (b) Nutrient rich run off from rich agricultural lands (possibly including fertiliser) increases general productivity and food supply for trout in contrast to barren mountain run-off.

Other possible answers included:

Inhibition of growth of Mt Lake trout through:

- chemicals, pH in small mountain lakes
- competition for trout for meagre food supply, and with other species that may not exist in reservoir.
- presence of predators, in mountain lakes may have made small size a selective advantage.

Question 23

(a) The mean systolic pressure increases as salt intake increases (1 mark)

The increase is *not* uniform or proportional. (1 mark)

The greatest increase occurs between 1.5 and 3.5. (1 mark)

(b) Limitations include:

- sample was from hospital patients therefore may not be valid for non-hospital patients (health may influence results, medication may have affected results).
- age of sample was over 39 therefore may not be valid for those under 39.
- sample may also be biased in terms of sex, race, body weight, lifestyle previously etc).
- salt intake was in fact unknown
- how much salt was added was not measured
- salt content of food was not taken into account
- not known if data related to salt added at home or only in hospital, where food may be bland/low in salt.
- Number of samples in each category is unknown - may be statistically unreliable.
- No hypothesis stated.
- Diet of patients may have differed, therefore other variables that may influence blood pressure were not controlled.

Conclusions

1. Results appear to support the hypothesis that blood pressure increases with increased sodium intake.
2. But, although the high sample size lends support to this hypothesis, there can be little confidence in these results in view of the above limitations and a more controlled investigation is necessary for more significant results.

Question 24

(a) Objections to using *net* in this way:

- only one channel sampled (inadequate - may cause bias); (1 mark)
- alternative channels may be utilised if net seen (as in full moon); (1 mark)
- the channel is not completely blocked (fish can swim around or under a 50 m x 1 m deep net - especially at high tide); (1 mark)
- netting may not give an adequate indication of recruitment rate and other monitoring procedures may be more appropriate and far less intrusive (eg. underwater video cameras); (1 mark)
- unethical to leave net overnight as other non-target animals may be caught (eg. mammals, birds and other fish); (1 mark)
- ethically unsound to catch thousands of fish for a scientific experiment based solely on curiosity; (1 mark)
- may impact ecologically in food web and/or have an adverse effect on a rare or endangered species; and (1 mark)
- a small mesh net (suitable for catching fry) may be easily plundered by larger fish (especially in full moon).

(b) Improvements: (1 mark for any of the following)

- less ecological impact (fewer species affected);
- more ethical as smaller number of fish caught;
- less chance of predation by larger fish;
- time controlled and 'rate' (number per hour) measured; and
- still possible to make a comparison of rates of recruitment.

(c) This conclusion cannot be drawn from the data. (half a mark)

The experiment was only testing recruitment rates and there was no data or evidence relating to predation (1 mark). Experimental results do not '*prove*' anything, they merely '*support*' (or negate) the hypothesis (1 mark) provided the experiment was designed correctly and there were many flaws in this experimental design as indicated in part (a) above (1 mark). There is very good correlation between recruitment rates and bright moonlight but this could also be due to (any one of the following): tidal differences; tidal effect on water temperatures or reef currents; hatching times; and behaviour (eg. fry may swim individually or in schools, at the surface or near the bottom) (1 mark).