T A S M A N I A N

S E C O N D A R Y

A S S E S S M E N T

B O A R D

BY826

Biology

2002 External Examination Report

General Comments

Most of the feedback regarding the examination was good and it was generally well received by teachers and students. The paper was recognised as having more graphs and data to interpret than usual, which was seen as a plus by some and a negative by others.

The first section of the paper proved to be the most difficult, with more questions than usual that challenged students. This showed up during the marking process with large groups of students who failed to really address a couple of the questions which was reflected in the significantly lower standards being obtained for this section. It was also noted that students are very well prepared for section on experimental design and hence the percentage of candidates who gained A's or B's on this section was significantly higher.

Once again there were significant differences between the state-wide results for externally assessed criteria and in the internal assessments for the same criteria. Also there continues to be higher grades given to non-externally assessed criteria on the whole. It was interesting to see the number of students who either performed much better in the exam than there internals and vice versa.

Written Examination

The following section specifically comments on candidate's performance in the exam. Marking examiners offer suggested answers to each question followed by specific comments on aspects such as how the question was assessed, where candidates gained and lost marks and where candidates misinterpreted questions. Comments on the open-ended questions may necessarily be limited to general comments rather than a suggested answer.

The suggested answers are by no means prescriptive and a number of them go into a greater detail than would be required to gain full marks. Candidates providing different but valid answers were rewarded accordingly.

Section A Criterion 3

Answer

(a) Any two of

(i) A (½ mark) cell wall (½ mark)
(ii) D (½ mark) large vacuole (½ mark)
(iii) E (½ mark) chloroplast (½ mark)

(b) Either E or chloroplast (½ mark) as the site of photosynthesis (1 mark). Any further relevant explanation of the chloroplast in terms of its role in photosynthesis (½ mark).

(c) The vacuole and cytoplasm of the plant cells would shrink (½ mark), but the rigid cell walls would maintain the size and shape of the cell (1 mark). The cells would lose turgor and the plant would become flaccid (1 mark) due to lack of hydrostatic pressure. Only in extreme cases of water deprivation would plasmolysis occur (½ mark).

(d) This is not a root cell (½ mark) because (any two of)

(i) it contains chloroplasts which would be useless in the lack of light underground. (1 ½ marks)
(ii) it has very few mitochondria, which are required for energy production for active uptake. (1 ½ marks)
(iii) there are not root hairs shown to increase the surface area for the uptake of minerals. (1 ½ marks)

Comments

About 60% of candidates had enough basic knowledge of cell structure to be able to achieve at least 5 marks out of 10 for the whole question. A common error in part (b) was to name the mitochondria as the organelle that **produces** glucose. (At least one student did not recognise the term 'organelle' and named the liver.) Some candidates gave only one reason for their answer in part (d). Either only one reason was known or the question was not read carefully.

Question 2

Answer

(a) As the concentration of the external solution increases, the concentration gradient (the difference between the internal and external concentrations) decreases (1 mark). This means that less water enters the cell (1 mark) by osmosis (½ mark). Therefore, less water needs to be removed from the *Paramecium* through beating of the contractile vacuole (½ mark).

(b) The *Paramecium* is now in a hypertonic solution and will lose water by osmosis (1 mark). This means the *Paramecium* will shrivel/lose weight/water (1 mark). The contractile vacuole will cease contracting.

Comments

(a) Poorly done by a large number of students. A common mistake was to assume that the concentration of the external solution had been increased to the point that it was more concentrated than the *Paramecium*, and that fewer contractions of the vacuole were therefore needed as the *Paramecium* was already losing water by osmosis.

(b) Generally well done, even by those who had little idea about (a). Many students, however, did not state that the *Paramecium* would shrivel as a result of water loss.

Question 3

Answer

In specialised cells, not all the genes are "switched on". Different cells will have different genes which are active (which depends on the positioning and environment of the cell) (2 marks). The active genes determine which proteins can be produced by that cell (1 mark) and so determine the structure and function of the cell during the process of differentiation.

Comments

A pleasing number of students were able to write coherently about the relationship between genes and protein synthesis, and students who made reasonable suggestions were given up to 2 marks for this question. However,

many students resorted to "information dumps" from texts, often of irrelevant information, or produced an answer which was a general re-expression of the question.

Question 4

Answer

(a) Two of a number of the following properties could be suggested:
— **ATP** contains a high energy bond
— The terminal **P** bond is easily broken
— **ATP** is involved in a reversible reaction which enables it to be regenerated
— Can move through the cell (between organelles)
(1 mark for each reasonable suggestion.)

(b) Four cellular processes of the following large number of possibilities including: Active transport, endocytosis (pinocytosis/phagocytosis), exocytosis, protein synthesis, movement of cilia/flagella, pumping of contractile vacuole, photosynthesis, respiration, cell reproduction (mitosis/meiosis), whole cell movement (contraction, amoeboid motion).
(½ mark for each valid suggestion.)

Comments

(a) Generally well done, although many students simply restated information given in the stem of the question.

(b) Very well done. Some students named processes which related to whole body functioning (e.g. homeostasis, production of body heat), rather than describing processes occurring on a cellular level.

Question 5

Answer

Uptake of sulphate ions by the root cells of barley plants is achieved by active transport and diffusion. Active transport requires the use of **ATP**/ energy by root cells. (2 marks)

Under aerobic conditions, the root cells can perform aerobic respiration that provides a maximum of available **ATP**/energy and enables a high rate of uptake of sulphate ions. (1 mark)

Under anaerobic conditions, the root cells can only carry out anaerobic respiration that provides far less **ATP**/energy for active transport so the rate of uptake of sulphate ions is considerably reduced. (1 mark)

Under aerobic conditions with a metabolic poison added, cellular respiration would be very much slowed or entirely prevented. There would be little or no **ATP**/energy available so the active uptake of sulphate ions is reduced even more. (1 mark)

The fact that there is still some uptake of sulphate ions indicates that some are absorbed by passive diffusion. (1 mark)

Comments

The majority of candidates answered this question poorly and a disappointingly large number did not attempt it at all.

Many answers were little more than a restatement of the data. Up to two marks were given to candidates who showed some understanding of the processes involved. Only the better candidates realised that diffusion was also involved in sulphate ion uptake.

Question 6

Answer

(a) Intermediate **A** would accumulate. (1 mark)

(b) Continuous production of isolucine will occur only if feedback inhibition is prevented. i.e.
Isolucine is converted by the cell to another substance. (1 mark)
Isolucine is removed/excreted/actively transported out of the cell. (1 mark)
Credit was also given for continuous availability of threonine, and of enzymes 1, 2 and 3 and for mentioning suitable pH and temperature etc.

Comments

The majority of candidates answered this question poorly and a disappointingly large number did not attempt it at all.

Any answer for part (a) which indicated that intermediate **A** would accumulate, not be used/processed or not be converted to intermediate **B** was given credit.

In part (b), some candidates suggested that if the rate of production of isolucine were very slow, it would not accumulate. This is only true in the short term but the answer received some credit. Many candidates suggested only that a continuous supply of substrate, enzymes and the optimum temperature, pH, etc. were needed to ensure continuous production of isolucine. This, however, ignores the feedback inhibition of enzyme 2 and, considered alone, is incorrect. However, because this answer indicates some understanding of metabolic pathways, it was awarded up to one mark.

Section B Criterion 4

Question 7

Answer

1 mark for each adaptation and 1 mark for discussing it.

(a) Many possible adaptations were accepted including:
- large ridged molars which crush the vegetation
- one or more regions in the digestive tract where microbial fermentation of cellulose takes place eg. fore-gut, caecum, proximal colon etc.
- ability to recycle droppings to extract more energy from the food
- multiple stomachs with the ability to regurgitate the food to extract extra energy.

(b) Many possible adaptations accepted including:
- modified mouthparts to pierce and suck the blood
- production of an anticoagulant to prevent the blood clotting
- no need for teeth for mechanical digestion as blood already a liquid
- produces proteases as blood primarily composed of proteins
- a short simple digestive system since mechanical digestion not required etc.

Comments

Most students did well on this question. Many looked up koalas and mosquitos and successfully answered the question from there. The most common errors were to think that blood meant meat or to think that the blood would go directly into the organism's circulatory system and so there would be a risk of AIDS etc.

Question 8

Answer

Two reasons clearly explained as to why frog lungs are less efficient than mammalian lungs were required for full 4 marks.

Variations on any 2 of the following:

- Frog lungs have a lower surface area due to their simple sac-like structure, lacking the alveoli of mammals. This reduces the rate at which gases can be exchanged by diffusion.

- In frogs capillaries are only in contact with the outer surface of the sac, while in mammals, there is a network of capillaries throughout the lungs, surrounding each alveolus. Thus mammals have a greater surface in contact with the blood and can carry away oxygen more rapidly.

- Frogs do not rely solely on lungs, having the ability to absorb oxygen, and remove carbon dioxide through their moist skin and the skin of their buccal cavity. Thus they do not require such an efficient set of lungs.

- Frogs have: lower activity levels/a lower metabolic rate due to their being ectotherms and not using energy to maintain their body temperature/ lie dormant in extreme conditions, thus they require less oxygen, and have no need for a more complex set of lungs.

- The circulatory system of frogs does not completely separate oxygenated blood from deoxygenated blood due to its having only 3 chambers rather than 4 as in the heart. As a result, the diffusion gradient between blood and air in the lungs can not remain as steep as that in mammals, reducing the rate at which oxygen is absorbed.

- The frog breathes by forcing air into its lungs with its mouth, which is not as efficient a means of ventilation as the diaphragm of mammals. This means the diffusion gradient is less, reducing the rate of diffusion.

Note: This last point did not always earn a full two marks if combined with the first as they are very similar. The clarity and detail in the answer influenced this.

One mark was also given for any of the following:
- Frogs lungs may not contain as much moisture, which is required for oxygen to dissolve in before it can be absorbed.

– Frog lungs may not expand and allow as much air in as mammalian lungs.
– Frogs develop lungs while metamorphosing from tadpole to adult and this may make it impossible to develop lungs as sophisticated as those of mammals.

*These answers were accepted because students were asked to suggest **possible** reasons.*

Comments

This question was quite well answered, with a vast majority of students mentioning the difference in surface area, though many did not go beyond this. About 80% of students scored at least two points, with about 20% scoring 3 and another 20% scoring 4 points.

It is perhaps a consequence of the reduction of frog numbers in recent years that a significant proportion of students lack basic knowledge of frog biology. Many believe that adult frogs either have gills to supplement their lungs, or that they use their lungs to breathe water.

Many students stated that frogs required less efficient lungs because they are smaller than mammals, and thus needed less energy. Since oxygen consumption per kilogram body mass is greater for smaller animals (ignoring differences due to homeothermy), this isn't an acceptable answer.

Others stated that because frogs hold their breath much of the time while underwater their lungs do not need to be as efficient. This was not accepted unless related to breathing through the skin, which students rarely did.

Many students appeared envious of the idyllic life of frogs, who 'spend most of their time laying about and sunning themselves'. A lifestyle that no doubt has great appeal from the perspective of a student stressed out by exams!

Question 9

Answer

Correct Answer **B** (1 mark)

Organism **B** reproduces sexually (½ mark). This will result in the greatest genetic variation in offspring due to the production of haploid gametes by meiosis by each parent, independent assortment, crossovers, random fertilisation etc (½ mark). Organisms **A** and **C** reproduce asexually (½ mark) by budding and vegetative reproduction. With the exception of spontaneous mutation the offspring will be genetically identical to the parent. (½ mark)

Comments

Almost all students correctly identified **B** as the correct answer and consequently received at least 1 mark. The remaining marks were given based on the quality of their explanation. Simply stating which were sexual/ asexual was not enough to gain full marks. The students needed to expand on this more fully.

Question 10

Answer

This is an example of Autosomal recessive inheritance.

Cross 1 is a cross of two homozygous waltzer parents but we are unable to say from this whether the gene is dominant or recessive.
Cross 2 indicates that the waltzer gene is recessive to non-waltzer as no waltzer offspring were produced. The non- waltzer parent is almost certainly homozygous dominant considering the number of offspring involved, as a heterozygous parent would by chance give half waltzer offspring rather than the resulting 100% heterozygous dominant offspring.
Cross 3 is between heterozygous parents resulting in 3/4 non-waltzers and 1/4 waltzers. This is supported by the outcome of 124 and 47 respectively.

Let **W** represent the dominant Non-Waltzer Gene and **w** represent the Waltzer.

	Cross 1	**Cross 2**	**Cross 3**
Parents	Waltzer **ww**	Waltzer **ww** Non –Waltzer **WW**	Non-Waltzer **Ww**
Off spring	All Waltzer **ww**	All Non-Waltzer **Ww**	1/4 Non-Waltzer **WW** 1/2 Non-Waltzer **Ww** 1/4 Waltzer **ww**

Comments

There was a very even spread of marks allocated between 0 and 6. To achieve full marks, students needed to have read the stem of the question thoroughly and addressed the entire question. This required more than simply completing each of the crosses in some way. A statement of the pattern of inheritance and the genotypes of parents and offspring was required. Credit was given for recognition of the samples being large enough to overcome chance occurrences and referral to the experimental figures supporting the predicted.

Question 3

Answer

(a)

	Liver	**Intestines**	**Active Muscle**
Carbon dioxide	+	+	+
Glucose	-	+	-
Urea	+	0	0

Any three correct symbols were given a point. Any 2 extras a half point.

Comments

This question was interesting to mark because it was clear from the second part that students interpreted it in either of two ways:

- Comparing blood entering each organ with that leaving the organ, keeping in mind that the person had eaten two hours previously.
- Comparing blood two hours after eating with what the blood would contain in the same part of the body when food had not been recently consumed.

The second interpretation changes all glucose to +; students who emphasised the liver's role in regulating blood glucose often had a 0 for glucose under liver. Some went so far as to put '– 0 + depending on conditions', and to justify this. They were given credit for this where their reasons were clear.

This was further complicated by the fact that many students believed two hours was long enough for digestion to have been completed, and its 'after effects' to have passed.

Answer

(b)

Carbon dioxide would increase because the liver requires energy from aerobic respiration to carry out its functions, thus using up oxygen and producing carbon dioxide, which is released into the blood.

Glucose levels could be expected to fall because:

- The liver converts glucose to glycogen when it is present in large amounts in the blood, as it would be after a meal.
- The liver uses glucose as an energy source to product ATP for its metabolic activities.

The liver produces urea, by converting ammonia from deamination of amino acids, which would be present in larger amounts after a meal, so urea goes up.

Comments

One mark was given for a good explanation of changes for each of the three factors, with the fourth mark reserved to be given when an extra point was made under any of the three. Some credit was given where it was recognised that the liver controls blood glucose levels in response to insulin and glucagon secreted by the pancreas, thus maintaining steady levels in a healthy person.

It was particularly difficult to mark part (a) of the question because students who gave perfect answers to part (b) often had wrong answers in (a) and where they demonstrated valid understanding they were given marks accordingly.

Aside from these, this question discriminated well between students. Very few students scored 7 marks, and these clearly had a very sound understanding, as did those who scored 6 or 5. However the bulk of students scored between 2 and 4.

Understanding of liver function varied greatly, with some students giving detailed, in depth answers. Some even noted that the liver uses carbon dioxide to combine with ammonia to produce urea. Others though had showed very incomplete, inaccurate, or no understanding whatsoever of liver function.

Some common misconceptions include:

- Food enters the liver to be digested, and emulsified.
- The only function of the liver is either to produce bile or to control blood glucose. Some were very emphatic about this, appearing annoyed that the examiner was attempting to confuse the issue.
- Breakdown of red blood cells in the liver releases the carbon dioxide they contain.
- The liver removes carbon dioxide and urea from the blood.
- The liver stores glucose or starch.
- The liver secretes insulin.
- The liver has nothing to do with carbon dioxide or urea.
- Urea is produced from nitrogenous waste.
- Urea is identical to urine, and is not found in the liver, but in the bladder.

Question 12

Answer

(a) A cold day means little need to sweat for cooling purposes so the water content of the blood remains high (1 mark). This is detected by the receptors in the brain and so the pituitary gland releases less A.D.H. (1 mark). The reduction in A.D.H. reduces permeability of the tubules so there is less reabsorption of water into the blood stream and so a greater volume of urine (1 mark).

(b) The diagram does and does not fit the homeostasis model. There is no negative feedback loop shown, neither is the stimulus of changed blood water concentration, the receptor cells in the hypothalamus nor the effectors in the kidneys. It does however show the message in the form of the hormone A.D.H. and the response in change of urine concentration.

1 mark was allocated for stating that there was no feedback and 3 more marks were allocated for any 3 correct points.

(c) Any 2 reasonable consequences were accepted including:

- dilute urine
- great thirst
- difficulty with temperature regulation due to lack of water for sweating
- dehydration
- salt imbalance etc.

(1 mark for each consequence.)

Comments

(a) Many students got 1 out of 3 for simply saying that less water was lost as sweat so more was lost as urine. Many also wasted time writing about both hot and cold days when the question was only about cold days.

(b) For full marks students needed to write about ways it both fitted and did not fit the model of homeostasis. Many students got 2 out of 4 for a beautiful written description of homeostatic control of water in the body but made no reference to the diagram given. Too many students made only one point in what was a 4 mark question. Another group of students were muddled about whether this question was about osmoregulation or thermoregulation.

(c) Well done by most students, although some simply looked up diabetes and wrote down the symptoms without referring to A.D.H.

Section C Criterion 5

Question 13

Answer

(a)
- Phytoplankton (½ mark)
- Either small fish or zooplankton (½ mark)
  - One of the following: sharks, small fish, large fish, dolphins, baleen whales, killer whales (½ mark)
- Small fish (½ mark)

(b) Killer whales (1), if students only said higher order consumers or an example of a higher order consumer (½ max). As DDT is non-biodegradable/persistent therefore it builds up in concentration along the food chain as higher order consumers need to eat more to obtain their energy requirements (1). This process is called biomagnification (1).

(c) No (½) inorganic compounds are recycled through the ecosystem (½)

Examples of inorganic are N, P, S compounds which are absorbed by the living part of the ecosystem (plants) and passed onto consumers (1) or they remain in the abiotic part of the ecosystem which can be recycled later (1).

Comments

(a) Well answered on the whole. Many students did not recognise the omnivore.

(b) Many did not mention that DDT is non-biodegradable and that is partially why it builds up along the food chain.

(c) Too many thought this was an energy question or got confused with organic compounds involved in the carbon cycle.

Some did not read the question and discussed how the decomposers broke down the inorganic compounds.

Question 14

Answer

Native animals (hawks, Tasmanian devil) prey on rabbits as a food source. If rabbit numbers suddenly decreased then native animal numbers would decrease due to a decrease in available food source. (2) Alternatively the native animals that previously fed on rabbits may choose to feed on other native animals (mice) therefore decreasing their numbers by increased competition. (1)

Other examples

– Native animals use rabbits homes as shelter therefore with less rabbits less shelters will be made hence some native animals may not be able to escape predators therefore decrease in numbers of native animals.
– Native animals may emigrate from area to find a new source of food hence numbers will decrease in the area.

(Any valid idea well explain for 2 marks.)

Comments

Many assumed that native animals do not eat introduced animals.

Too many thought foxes were native.

Some good examples of feeding relationships offered.

Many thought rabbits were carnivores.

Question 15

Answer

Gas **A**: CO_2 (1 mark) is released from decomposers and consumers (½ mark) through respiration. (½ mark)

Organism **X**: Plants (or cyanobacteria or other such autotrophs) (1 mark) use CO_2 and release O_2 (½ mark) through the process of photosynthesis (½ mark).

Comments

This question was very well done, most students being able to obtain full marks. Of those students who missed out on marks, many did not name the process (photosynthesis or respiration). Where students referred to the nitrogen cycle, they were given credit where gases such as methane or nitrogen were named and qualified, however many students wrongly cited nitrogen gas as a raw source for **X**.

Question 16

Answer

(a) (i) Two reasons why population **D** is reproductively isolate from the other populations.

- D could be geographically isolated e.g. on an island or by a mountain range or sea as a result of continental drift which separated it from the other species.
- It could be behaviourally isolated e.g. it doesn't recognise the others mating calls or courtship displays.
- It could be temporally isolated e.g. different breeding season or nocturnal vs diurnal.
- It could be structurally different such that it didn't recognise the others, it was bigger or smaller, it was incompatible during mating.
- It could be genetically different with incompatible gametes, the zygote doesn't develop or the offspring are infertile.
- It could even be a different species.

(1 mark was given for each reason.)

(ii) The population which would least likely survive if conditions in the environment change rapidly is **D**.

D is least likely to survive because it is likely to have the least genetic diversity and therefore is unlikely to have the range of traits which would enable to survive if the environment were to change. (This makes the assumption that **D** is most likely to be a small isolated population living in a homogeneous environment. It could just as easily be a large population, of the only frog species, living on an island, in a great range of habitats and therefore have great genetic diversity and survival capabilities.) (1 mark for each point.)

(b) Refers to a diagram about flies that was found in a student's notebook.

The process illustrated is an example of evolution by the process of natural selection. Those flies which survived already possessed a random mutation which made them resistant to the fly spray. These flies were able to reproduce and pass this gene onto their offspring. Over time the proportion of flies in the population, with the resistant, gene increases. (1 mark for each point.)

Comments

(a) (i) This question was done reasonably well with most students getting full marks although some answers were better than others. Students only needed to state the type of isolation to gain their marks; they did not have to illustrate this with examples. The exception to this was physical isolation which was a rather ambiguous term which could mean geographically or morphologically and therefore a further explanation was required. Students who wrote a well constructed answer for geographical isolation including several examples were given an extra half mark.

No marks were given for restating the meaning of 'reproductively isolated'. Some students in an attempt to provide a second point only managed to repeat themselves. Although there was no mention of the size of the relative populations many students assumed that the population was smaller and already heading for extinction. There were many erroneous answers about the frogs producing a single sterile offspring or that **D** was the result of hybridisation and therefore it was a single individual "like a mule". It seemed students struggled with the concept of population more than they struggled with the concepts of evolution and speciation.

Any reasonable answer for a type of separation was accepted e.g. "The population may be in a captive breeding programme". Incompatibility of genitalia was a common answer and this was given marks, although technically frogs don't copulate, the idea was right and so marks were awarded. It wasn't expected that students were experts in frog biology, although no marks for were given for answers which mentioned that they reproduced asexually.

(ii) This question was also well done with many students writing quite concise and accurate answers. Those students who didn't do well in this question were most likely to have suffered from some incorrect assumption in the first part of the question. Examples included statements like "**D** was a small population and would easily die out anyway." or "**D** had no genetic diversity because it reproduced asexually."

A number of students answered the question from the point of view that **A**, **B** and **C** would have greater genetic diversity and therefore would be better equipped to survive any environmental change. Often these answers were better than the straight forward one. Some students used a good, simple way of expressing this point i.e. "If they were all genetically similar, then any environmental change that killed one individual would probably kill them all".

(b) Again this question was well done, although not all students identified the process as natural selection. Students were expected to say that it was evolution or natural selection to gain a mark. Alternatively marks were given for artificial selection but only half marks for a selective breeding programme, or adaptation. Many students viewed pesticide resistance as something the student in the question wanted to achieve.

Few students were able to adequately express the idea that the resistant gene became more frequent in the population. Students had incorrect notions that the individuals became more resistant. Again it appeared that students struggle with the concept of populations.

There was a textbook dump, or students had learned verbatim, that the flies had developed a resistance "due to a random mutation, meiosis, crossing over and sexual reproduction". It was important that the students made the point that the mutation was pre-existing. There were a lot of Lamarckian answers which erroneously stated that the pesticide caused the resistance.

Many students described what had occurred, rather than explaining it, with many students just quoting figures from the diagram. No marks were given for this, nor were marks given for developing immunity nor pesticide resistance without an answer framed in terms of evolutionary biology. Most of the students, who did concentrate on immunity or resistance, using everyday language, did manage to at least make one valid point in their answer.

Question 17

Answer

(a) (Graph **B**. (1m) Growth is small at first due to a small number of reproducing individuals. Then it increases exponentially as food, space and other factors are abundant. (1m) As the population reaches carrying capacity, there is a competition for those resources and growth slows down. (1m) With environmental resistance setting in, the birth rate decreases and the death rate increases and the population falls. Recovery of resources results in growth again and so the population oscillates in this way around the carrying capacity. (1m) (or 3 marks for any 3 major points)

(b) Graph **A**. (1m)

Reasons
- Introduction of a new predator
- Depleted resources (e.g. prey) through overpopulation
- Wastes or toxins have built up to the extent that the environment cannot support the population
- A natural disaster (flood, fire, volcano etc)
- The species has been out competed by another one.

Any two ideas, 1 mark each

Comments

(a) This question was fairly well done by all students who did more than merely describe the graph. Other students referred loosely to 'environmental resistance', receiving some credit. Students who chose Graph **D** were also given some credit where they explained how it represented the population after it has been established. A number of students misread the question and answered it in terms of survival of the fittest and adaptation.

(b) This question was better answered than part (a), most students gaining some marks here. Marks were lost where students merely listed factors which might cause a decline (as occurs around a carrying capacity) rather than factors which cause a crash. Thus answers such as 'food shortage' were not given full credit.

Section D Criterion 8

Question 18

Answer

(a) Removal of the predator (giant triton) in the region below the dotted line on the map has caused the sudden increase in the crown of thorns starfish.

Marking scheme:
2 marks for hypothesis
1 mark for writing it clearly and correctly (i.e. not too verbose)

The hypothesis needed to be:
- simply worded and testable
- include dependent and independent variables i.e. giant triton and crown of thorns starfish or x causes y or x occurs because of y

(b) The common garden snail often follows existing mucus trails because the mucus contains a chemical that they detect and follow.
or
The common garden snail often follows existing mucus trails because the mucus provides a lubricated path that is easier to move on.
1 mark for a clear statement.
1 mark for including independent and dependent variables.
1 mark for "accounting for" the observation.

Comments

(a) Students generally coped well with this question. The few problems that were noted included:
- Long winded hypothesis 5/6 lines or more.
- Only commenting on an aspect of the observation, i.e. " starfish numbers will keep increasing"
- Stating an incorrect hypothesis through not reading the question carefully i.e. "Giant triton numbers are increasing due to the fall in numbers of crown of thorns starfish"

(b) The question was done well with most candidates having a clear understanding of how to write hypotheses. Generally 2 or more marks were gained. There were other credible hypotheses that were given full marks if they were well constructed.
Marks were lost if:
- the statement was too wordy and as a result lost clarity.
- multiple independent and dependent variable links were included. While the ability to give many possible explanations is admirable, it is not appropriate where one hypothesis is required.
- the hypothesis was not testable, usually through lack of clarity in wording.
- the hypothesis was incomplete; containing only three of four words.
- either an independent variable or a dependent variable was not identifiable.
- the hypothesis was simply a restatement of the stem. "The migration of snails often follows existing mucus trails." The question clearly asked to "account for this observation" and a restatement is not sufficient.

Question 19

Answer

(a) Increase in temperature (> 35C) (1 mark)
Or Temp (1 mark)
tight undies (½ mark)

(b) Sperm quality (1 mark)
sperm (½ mark)
fertility (½ mark)
sperm count (½ mark)

(c) Any 4 of the following possible points include:

- Sperm quality is difficult to assess quantitatively (eg taking sperm samples and analysing would require experts).
- The sample size is too small.
- The experiment length is too short as spermatogenesis takes longer than one week (about 70 days).
- The experiment could be unethical as long term fertility could be affected.
- Fertility was not checked before the experiment and some males may already be infertile.
- Bias may result from using volunteers rather than a random sample i.e. more athletic males may choose to volunteer.
- Environmental factors that may affect sperm quality are not taken into account (e.g diet, drugs, exposure to pollutants etc).
- Variation in the human subjects is not considered i.e. fitness, size, lifestyle which may affect fertility.
- There is no control on what is "normal" or "tight" clothing. For some people "normal" may be tight.
- The results are supposed to represent normal adults and yet only one age group, college males was used.
- Wearing tight or normal clothing is not a valid experiment. For a valid comparison sperm quality in the same individual before and after wearing tight clothing needs to be assessed.

One mark was given for each valid limitation listed.

Comments

(a) & (b)
Generally students coped very well with these sections of the question. A few had problems identifying the dependent and independent variables sometimes getting them the wrong way around or not correct.

(c) The majority of students listed four limitations easily and many listed more than was required. Problems occurred for some students when they didn't give enough explanation with the limitation i.e. just writing sample size without saying that the sample size was too small.

Question 20

Answer

A. This is not very valid (½ mark). The size of the sample is a fairly representative sample of the eggs (½ mark), but the method of collecting results by only sampling the first egg to hatch is not good procedure (½ mark) because only taking the first egg does not allow for variation in the population (½ mark).

B. This is not a valid procedure (½ mark). A sample size of one egg is not representative of the whole population (½ mark), as it is too small (½ mark) to allow for variation within the population and results will vary significantly between individual eggs (½ mark).

C. This design will give the most valid results (½ mark). It is a fairly representative sample (½ mark) and the time for all eggs is included in the results (½ mark). Averaging the results takes into account individual variation (½ mark).

Comments

This question was done extremely well. Clearly most candidates read the stem and looked at the diagrams carefully. Their knowledge of handling variability in experimental design was good.

Many commented validly, particularly in part C, that seven eggs was not a large enough sample. Other comments included that 10°C steps were too great, that the different arrangements of the eggs in A may affect the results and that the wording below diagram B was different. These were taken into account, depending on how they were worded, but the essential points had to be included to gain full marks.

Marks were lost:

- in case A where students did not realise that only one egg was being measured. From the wording of answers this appeared to be a reading problem, rather than an understanding issue.
- where incomplete answers were given. For example in case B, "not valid, sample size too small" is not a sufficient answer for 2 marks in an easy question, as it lacks reasons.
- by some students who stated that case A was valid, but then they proceeded to explain why it was not valid. This lost them ½ mark.
- from only one section in some cases. It was interesting that some candidates could give excellent answers to cases A and C and receive no marks for case B, but this did happen.

Question 21

Answer

(a) There are a number of valid designs possible; the following table highlights the main points which were considered necessary and the marks awarded. To gain full marks any 10 of the possible 11.5 marks were necessary.

1 mark	Large sample size	100 of a species of insect that makes up sparrow chicks' diet during the first three days of their life.
2 marks	Describe treatment of groups	Place equal numbers of insects into two containers (½ mark). Pipe MTBE free air (½ mark) (similar to concentrations found in rural areas) into one of the containers. Pipe MTBE (½ mark) at typical concentrations found in large cities (½ mark) into the other container or various concentrations (from none to that found in large cities).
1 mark	Identify control group	The container with MTBE free air is the control group. The results from this group will be compared to the experimental group.
1 mark	Identify independent variable	The amount of MTBE or (presence or absence of MTBE).
2 marks	Identify the main controlled (fixed) variables	In order for the results to be valid, many variables that would affect the dependent variable need to be controlled. Size of containers, temperature, humidity, light intensity and insects' diet should be the same for all groups. (½ mark) for each controlled variable.
1 mark	Identify dependent variable	Survival rate of the insects.
1 mark	Describe how the dependent variable will be measured	Count the number of dead insects in each container every day for long enough to test the effect of the MTBE.
1 mark	Treatment of results	Record the results in a table and draw a bar graph for each group. Compare to see if there is a significant difference in the survival rate of the two groups.
½ mark	Replication	The experiment should be repeated using larvae and pupae as well as other species of insects eaten by sparrow chicks.
mark	Results that would support hypothesis	If the survival rate of insects treated with MTBE is significantly lower than insects not receiving MTBE.

NOTE: It is NOT recommended that candidates present their answer in table format, but rather as a written answer. This should include the information from the right hand column of the above table. Headings can be useful in helping to organise information.

(b) In cities the concentration of MTBE would be higher than in rural areas (½ mark) because there is more traffic (½ mark). Thus small insects are more likely to die (½ mark) hence less food for sparrow chicks (½ mark) resulting in fewer sparrows in cities.

Comments

(a) Generally well done. However, many students discussed the effect of MTBE on sparrows rather than insects. The hypothesis stated that MTBE is an **insecticide** not a 'sparrowicide'. These answers were given credit for their understanding of experimental design. A million insects were considered excessive.

(b) Many students were able to link high concentrations of MTBE to the large amount of traffic in cities. Unfortunately they then failed to link this to dead insects and thus less food for sparrow chicks.

Section E Criterion 9

Question 22

Answer

(a) *Homo erectus* (1 mark).
Lived for 1.3 million years. (1.25-1.4 million years accepted) (1 mark)

(b) *Australopithecus robustus, Homo habilis* and *Homo erectus*. (All three correct for 1 mark)

Comments

Over half of the examined students received 3 marks out of 3 for this question.

Common errors were:

- reading each line as 1 million years rather than ½ million years and
- failing to include the species of *Australopithecus* on part b. (Marks were not deducted in this instance as long as both other names were correct)

Question 23

Answer

(a) Spinifex ($2.2m^2$) (1mark)

(b) Mulga Grass ($5m^2$) (1mark)

(c) Spinifex (2x4=8 plants) Mulga is only (1.5x5=7.5) (1mark)

Comments

The name only is required for the mark in each section. If students had the incorrect name for part c, but showed working that indicated some understanding of the process, then ½ mark was awarded. A number of students had the correct name even though they had read the graph incorrectly. The mark was still awarded in this instance as no working was requested. Over half of the examined students received 3 marks out of 3 for this question.

Question 24

Answer

Species **Y** (1 mark)

Each reasonable point based on the information in the table and justifying the above was awarded with 1 mark.

Each species is suited to a particular set of conditions (**X** at high temp with high humidity and **Y** with low temp with low humidity or simply at low humidity). (1 mark)

Comparing at other conditions:

- At high temperature but low humidity **Y** out competes **X** (90:10)(Culture 2)
- At low temperature and high humidity **Y** out competes **X** (60:40)(Culture 5)
- At medium temp and high humidity **X** out competes **Y** (75:25) (Culture 3)
- At medium temp and low humidity **Y** out competes **X** (85:15) (Culture 4)

(1 mark)

Y has a higher survival rate than **X** in 4 out of the 6 conditions and therefore could be said to survive the widest range of environmental conditions. (This could be expressed as a percentage but extra marks were not awarded for stating the same information in different ways) (1 mark)

Y is able to survive at relatively high rates outside of its 'preferred' conditions as compared to **X** which drops off to 10%. The range of survival outside of 'preferred' conditions is 25%-90% for **Y** but only 10% to 75% for **X**. (1 mark)

This experiment was undertaken in a closed system and as such could not be applied to the natural environment. (1 mark)

If students identified **X** as the answer they were awarded marks for the reasons given (if reasonable and supported by part of the table) but not for writing **X** as this could not be justified by the total information.

Figures from the table should be used to support statements for full marks.

Comments

Most student were awarded at least 3 marks out of 5 for this question but only a small percentage were awarded 5 out of 5.

On the whole students were able to understand the data from the format in which it was presented and were able to come up with the general idea but at times were limited by the way that the answer was put together. Students with clear expression and points that flowed on from one another were marked more highly than those whose answers were disjointed or didn't clearly explain the connection.

A few students answered with a culture such as 'culture 5' rather than species **X** or **Y**.

A few students appeared to think that the 6 cultures corresponded to the 6 months and that the results were being recorded at the end of each month, thus they stated that by the end of the 6th month species **Y** had increased to 100%.

There was a very broad range of responses provided overall so an attempt was made to award marks for answers which indicated understanding of the information provided.

Question 25

Part (a) answer

Students were required to comment on the similarities and differences shown by the results of this experiment. (4 marks)

For full marks (4 marks) students were expected to identify two similarities and two differences; one mark being awarded to each. Possible answers for one mark each included:

Similarities
- Algal cultures increased in number/density over time;
- Both curves followed a similar growth pattern;
- Both cultures displayed a similar increase between 0 and day 1;
- Growth rate of cultures decreased over time;
- Both cultures appeared to plateau at the same time.

Differences
- Culture with silica increased in number at a faster rate between days 1 to 7;
- Culture with silica had approximately double the population number by day 10;
- Culture with silica had approximately double the population number by day 7;
- Culture without silica increased in number at a faster rate between days 7 to 10;
- Culture without silica declines in growth rate after day one.

Part (a) comments

Most students could interpret the graph accurately and many students scored at least 3 of the four marks.

Students did not receive marks for stating that both cultures started on Day 0 with 400 000 cells per millilitre as this was explicitly stated in the question's introduction.

Students who stated that both curves were of a similar shape received half a mark.

The majority of students had no trouble in identifying at least two similarities however fewer students were able to identify two differences. Students, who presented the same comment in different ways, received one mark only for that particular comment.

The few students who had trouble interpreting the results graphically read the graduations along the x-axis between the even whole numbers as representing half days.

Those students, who identified three similarities and one difference or vice versa, received part marks for the additional comment.

Part (b) answer

Students were required to give *two ways* the reliability of the data in work such as this could be increased and justify their choice. (4 marks)

One mark was allocated to methodology and one mark for the accompanying, appropriate justification.

Possible answers included:

- Repeat experiment with specified amounts of silica to obtain more detailed information on how silica effects the algal population e.g. identification of threshold levels;
- Repeat experiment with same amount of silica under controlled conditions of light, temperature, media etc to be confident of measuring the effect of silica on the algal population;
- Conduct an experiment under controlled conditions comparing different species of algae to investigate whether the affect of silica on algae is species specific;
- Repeat experiment for a longer period of time to ascertain whether the observed algal population growth trend continues or changes significantly in relation to control population;
- Repeat experiment and increase observation by undertaking population counts more frequently than every other day (eg every day) so as to obtain more accurate growth curves for comparative analysis;
- Repeat or replicate the experiment many times to increase the robustness/reliability or statistical validity of the data.

Part (b) comments

Most students answered this part very well receiving full marks. The most frequent answers given were combinations of the following:

- Repeat experiment for a longer period of time to ascertain whether the observed algal population growth trend continues or changes significantly in relation to control population;
- Repeat experiment and increase observation by undertaking population counts more frequently than every third day (eg every day) so as to obtain more accurate growth curves for comparative analysis;
- Repeat or replicate the experiment many times to increase the robustness/reliability or statistical validity of the data.

Some students failed to read the question carefully and wrote more than two ways the reliability of the data could be improved.

Students received half marks where insufficient information/reasoning was given for an appropriate justification.

Part (c) answer

The question was based on a student looking at these results who concluded that adding more silica increases the growth of single celled algae. Students were asked what additional information they would like to have before accepting or rejecting this conclusion.

The method used for allocating marks was sometimes influenced on how well the student had answered Parts a and b because of Part c's interrelationship with the preceding parts. Given the nature of the question a student got full marks if the following answer was given:

- The experiment should be repeated over a longer time period under controlled conditions and with varying amounts of silica in order to identify the optimum concentration of silica and if there is a concentration that either inhibits population growth or is lethal to the algal species (2 marks);
- Undertake an experiment as outlined above with different species of algae in order to ascertain the validity of the statement that adding more silica increases the growth of single celled algae (2 marks).

One mark each if reasoning not adequate. Other answers like those given in Part B were marked in a similar way.

Half marks were given if the student only wrote one or two words without any attempt to indicate why. For example the following answer would attract two marks

- Amount of silica;
- Nutrient levels;

- Temperature;
- Oxygen/Carbon dioxide concentrations.

Other 'one word' possibilities included
- Humidity;
- Light intensity;
- Longer period of experimentation/study;
- Seasonal considerations/environmental conditions.

Answers that were a repeat of those given in Part B were not given full marks as Part C did ask for additional information and all parts are interrelated and integral to the one question. Answers representing a combination of the above and included statements about the necessity for replication, adequate sampling regimes were marked on this basis of the above taking into account how well the student understood the question as a whole based on his/her answers to Parts A and B.

Comments

This was the most difficult section to mark because of the 'open-endedness' of the question and the expectation of what was required for four marks given what had been asked of the students for the same number of marks in Parts (a) and (b).

Students did not answer Part (c) well. This part separated the A and B students from the rest. Many failed to think beyond increasing the sample size and replication.

Question 26

Answer

(a) Generally the metabolic rate of the lizards decreases at a decreasing rate as their body mass increases.

1 mark for answers that related body mass increasing with decreasing metabolic rates,

1 ½ marks if they related metabolic rate decreasing as the lizards body mass increased and/or mention of it being a general trend. The extra half mark was reserved for those that recognised that it was not a linear relationship.

(b) (i) Metabolic rate is a measure of sum of the body's cellular respiration and water is produced by respiration and water loss is relatively easy to measure. However it is not a reliable indication of metabolic rate as water loss is affected by several other factors such as the water intake, environmental conditions and the body's water regulation mechanisms.

(ii) Carbon dioxide is an effective way of measuring of respiration and hence metabolism. It is as effective as oxygen as it is not affected by much else in normal conditions. It has no real weakness, apart from the fact that it is a bit harder to measure.

One mark was given for each valid reason.

(c) No, it is not valid for several reasons:

(i) There is no data for temperatures above 30° C and the trend of the graph suggests that higher temperatures will produce higher metabolic rates.

(ii) The highest metabolic rate does not necessarily mean the optimum temperature; in fact the higher temperatures may increase water loss and other stresses, as well as an increased rate of food consumption.

(iii) The experiment had a sample size of only one and was not replicated which is not enough to draw any firm conclusions.

½ mark for saying no. 1mark for each reason with an extra ½ mark for a good explanation with it.

Comments

Overall the question was fairly well done with most candidates scoring between 4 and 7 inclusive. Very few candidates failed to attempt the question or scored less than 3.

(a) This part was fairly well answered by nearly all candidates; however while many made identified the general trend or the increase of metabolic rate with the last lizard, only a small minority noted that the general trend was nonlinear.

(b) Part b of this question tended to be the greatest discriminator, with a small but significant percentage of candidates not attempting it. It highlighted a lack of understanding of the concept of metabolism and its relationship with respiration and also that is was being measured at rest, as many talked at length about the affect that activity levels especially on carbon dioxide levels. Many had some basic ideas right about water being lost through other means but went on to include sweat as one of the lizards' cooling mechanisms; more than a few included transpiration as another cause of water loss!

(c) Most students managed to score 1 ½ to 2 marks out of 3 on this question, by covering one reason fairly well. However not many candidates covered two reasons well and the vast majority failed to mention lack of numbers or replication. This helps to account for the fact that very few students obtained full marks.

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