TASMANIAN CERTIFICATE OF EDUCATION

Biology 5C

Subject Code: BIO5C

2005 External Examination Report

General Comments

The examination paper was generally well received and it allowed most candidates to complete it comfortably within the three hours. There was a consistency of standard throughout the paper, which was reflected in the fact that most sections had similar cut offs. Very few candidates indeed failed to get at least a PA result and again there was a substantial percentage of candidates achieving an EA or HA.

Generally there was a closer relationship this year between the internal and external ratings on the externally assessed criteria at least. Criterion seven proved the hardest on both the examination and in the internals. It is concerning however that in the criteria that are assessed only internally there is a continued upward creep in the number of candidates gaining an A or B, without being adequately based on the standards. It is hard to believe that over 60% of today's candidates reach the A standard (or nearly 90% getting at least a B) on criterion 3, on planning, organising work and meeting deadlines. This criterion may need to be more closely moderated in future years. Ratings for criteria one and two were almost as high.

Examination Marking Scheme and Comments

Suggested answers with mark allocations for each question are given in the following section along with comments on candidate's performance in the exam. Marking examiners have provided 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 specific details.

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.

Part 1 - Criterion 4

Question 1

(a) Hypothesis: The rate at which sucrase breaks down sucrose is dependent on temperature (3 marks). Other hypotheses were accepted, with 2 marks for including both independent and dependent variables in a clear cause and effect relationship and 1 mark for it being in expressed as a testable statement.

Deductions: - 1 or more if not a testable hypothesis, -1 mark if in the form of a question, -1 mark for unnecessary explanation, - $\frac{1}{2}$ mark if mention action of sucrase/enzyme not included.

(b) (i) Dependent variable: Time taken for sucrose to break down, or rate of breakdown of sucrose

(ii) Independent variable: Temperature

(c) Well designed experiments only have one independent variable so that any differences in the response of the dependent variable can be attributed (as much as possible) to the independent variable (2 marks). Alternatively if 2 variables were used then you would not know which was responsible (1 mark)

(d) Four factors that need to be kept constant can include: ($\frac{1}{2}$ mark for each)

- Amount/concentration of sucrose
- Amount/concentration of enzyme (sucrase)
- pH of the solution
- Size/type of test tube
- Amount of light or humidity
- Method of measuring variables such as temperature etc

(e) There is a greater range/variability of results at 60oC, especially when B (140 minutes) is compared with A and C (90 & 100 minutes respectively). $1\frac{1}{2}$ marks for relating to range/variability and the extra $\frac{1}{2}$ mark for including other relevant details such as comparison of figures. 1 mark for answers that suggest an underlying explanation such as variability in the extent of denaturing of the enzyme at this temperature, as is where you would expect it to start happening.

Comments

This question was straight forward, as it tested basic ideas of experimental design and reliability of results. Candidates gave very good answers, indicating that the fundamentals were quite well understood.

(a) Candidates should note that hypotheses are not long statements of explanation. It is important to extract the appropriate independent and dependent variables from the information given and link them clearly and precisely, avoiding lengthy explanations of results or details of what was tested.

Many candidates who lost marks did not use sucrase in the hypothesis and no indication was given why the sucrose was breaking down. Properly structured but generalised hypotheses about enzymes, gained pass marks, but not full marks; as did hypotheses that the experimenter was testing that enzymes worked best at body temperature. Hypotheses with two independent or dependent variables lost marks.

Part (b) was done well. The usual error was getting the independent and dependent variables confused, but this was not common.

Part (c) was worded in such a way that many controlled variables were accepted, but they still need to be relevant to the situation; for example, humidity was not accepted as the reaction was occurring in a solution.

Part (d) was also done well, with most candidates recognising that it was the range in values, but a full explanation should include some reference to the figures, either by giving them, or noting

the actual range. Candidates should note that the question made it clear that they should base their answers on the results given. Therefore, reference to denaturing of enzymes alone did not gain full marks. The large difference between these results and the previous test tube, or the long length of time gained some recognition, but not sufficient to pass.

Question 2

(a) Evaluation of the candidate's hypothesis - 1 mark was given for any of the following points.

- It includes an independent and dependent variable
- The hypothesis is too generalised in relating to bacteria as a whole
- It is impossible to test all bacteria in one experiment as there are numerous species

(b) Essential components of experimental design that are missing (1 mark for suitable component and 1 mark for explanation for each) for example

(i) Repetition/replication, to provide statistical validity and/or avoid chance error

(ii) Control: need to be able to compare results with what would happen if no antibiotic was used and/or need to be confident that result can be attributed to the antibiotic and not some other factor present.

(c) Conclusion is not valid (1 mark) with one mark for any of the following reasons

- No conclusion could be valid as there is no control group to compare the results with
- There is far too little data or lack of repetition to draw any conclusions one way or the other
- Conclusion can only be related to the 3 types of bacteria used in the experiment, which don't represent all bacteria
- Hypothesis can't be seen as being correct or incorrect in the same way one experiment cannot prove an hypothesis
- The results do lend it some limited support for two out of the three bacteria, but not enough to base any real conclusions on

Comments

Many candidates gained at least half marks for this question overall, but few were able to gain full marks for any given part, at least in part due to a lack of detailed understanding shown.

Of particular note was the response for part (b). While a majority of candidates realised that there was no control and that there was a lack of repetition, the explanation of why this was a flaw in the experiment was answered too generally. Comments such as 'the results wouldn't be accurate' rather than 'there wouldn't be statistical validity, or the 'effects of anomalies wouldn't be minimised' meant that only part marks were awarded. Many candidates mistakenly thought that having a large sample size would automatically *remove* any errors or anomalies. This may be a problem with expression.

For part (c), a majority of candidates could see that there was limited support for the conclusions but did not go on to give a full explanation.

It was pleasing go to see, however, that almost all candidates had some understanding of the concepts covered by this question and did not resort to 'rote learnt' responses but were able to relate their understanding to the question.

Question 3

(a) Ethical considerations of the relocation exercise include (1 mark each reasonable suggestion):

- Minimising stress levels on the animals being relocated and/or on those being left behind;
- Increase in the likely incidence of disease affecting any remaining healthy animals being left behind as a result of having a higher percentage of diseased animals forming groups and breeding pairs;
- Ensuring that the places that they are released are suitable to their needs;
- Ensuring that family groups/pairs are released together;
- Consideration of the impact on the natural environment and food webs/chains, (competitors, prey, etc), on Maria Island and/or on mainland Tasmania as a direct result of the removal of Tasmanian devils (e.g. increase in feral cat numbers);
- Consideration of the human impact on the environment from increased activities in the field from tagging, monitoring etc;
- Consideration of the size and viability of the gene pool of the population of Tasmanian Devils being relocated and/or of the population remaining on mainland Tasmania;
- Difficulty in ensuring that only disease-free animals are relocated to Maria Island;
- Appropriate qualifications and training of personnel involved in trapping and relocating animals;
- Appropriate support and clearance by Animal Ethics Committee;
- Consideration of the impact on indigenous cultural/spiritual beliefs or practices associated with the animal;
- Justification of cost, and whether the money spent could be used in better ways; and
- Whether we should be intervening or not in the first place or whether they should be left to survive the disease on their own.

(b) Either could be argued for with justification and acknowledgement of limitations 1 mark each for points that support your choice, including points that are a consideration of disadvantages.

Whole island advantages are:

- more natural/realistic situation;
- devils have greater range of choice in foods and/or greater range of environments;
- easier to determine the animal's preferred habitats on the island and likely impact on the island in the longer term; and
- able to observe normal animal behaviour in family groupings and establishment of breeding pairs.

Whole island disadvantages are:

- ethical problems, as anything that goes wrong can impact the whole island;
- difficult to observe;
- many variables that come into play; and

- more costly in locating and monitoring animals with an associated greater human impact on the local environment.

0.5 hectare enclosure advantages are:
- more readily controlled, less variables involved and/or can more reliably test changing one variable at a time;
- more easily observed;
- easier to determine preferred food types and quantities;
- restricts the animals impact on the local natural ecosystem; and
- easier to trap and remove animals if there is an outbreak of disease
- more repeatable/replicable.

0.5 hectare enclosure disadvantages are:
- not representative of the whole island;
- potentially a more intense level of impact that may disrupt or compromise particular food webs/food chains;
- reduces the number of animals that can be released and studied over time; and
- different variables that come into play
  e.g. animal numbers or fencing may alter animal behaviour, animals may become too accustomed to human contact through regular feeding.

Comments

Majority of candidates (73%) gained half or more of the allocated marks for this question but very few (< 3%) achieved full marks for the question. Parts A and B were equally effective in identifying the capable candidates. Candidates that chose not to answer both parts of the question invariably gained some marks for answers to part (b) and left part (a) unanswered. Half marks were given when candidates provided when only a superficial answer was written without discussion or further elaboration through example (e.g. 'animals may impact on the environment' only gained a half mark).

Question 4

(a) The thyroid and water test-tubes acted as a control (1 mark) and gives an idea of what happens to the thyroid hormone levels over time in natural conditions (1 mark) or a similar statement that clearly demonstrates the candidates accurate understanding of the purpose of a control.

(b) Reasons why simple extraction of cancer cells from biopsies is not preferred (up 2 marks each, depending on suitability and explanation):

- Lab cultures allow for cloning of one type with minimal variations (2 marks) allowing for more controlled investigations into effects of different treatments (bonus mark);
- Natural secretion of thyroid hormone in body may confound observations;
- Associated cost and insurance issues of using people as experimental subjects;
- Inherent problems in identifying types and variants of cancers;
- Potential problems associated with small sample sizes;
- Lab culturing allows for more reliable supply, rather than relying on the availability of donors;

- Ethical objections such as permission to use of individual's cells and privacy issues, or using an invasive procedure on people who are already suffering etc; and
- Risk of infection/contamination from other diseases present in biopsy sample.

Comments

Majority of candidates had no difficulty in achieving four or more marks out of a total of six for this question. Almost all candidates achieved full marks for part (a) and it was equally as easy for candidates to obtain at least half the total marks for part (b) of the question. In part (b) several candidates confused the meaning of 'biopsy' with 'autopsy', which often resulted in a loss of marks. Several candidates also did not suggest two different reasons but further elaborated on the initial reason given. Part marks were given when candidates answering part (a) identified that it was a 'control' but did not go on to explain its purpose. In part (b) part marks were most commonly awarded to candidates who did not provide two different reasons or who identified a reason but did not explain why it was not the preferred method.

Part 2 – Criterion 7

Question 5

(a) (i) Circle one group of three including pentagon (deoxyribose sugar), black circle (phosphate group), , and one altered rectangle (base) ($\frac{1}{2}$ mark)

(ii) Label pentagon as deoxyribose sugar ($\frac{1}{2}$ mark)

(b) (i) Transcription (1 mark)

(ii) Process needs to be accurate as the sequences represent coding that will be translated to form proteins/enzymes (1 mark). Any change through a point mutation ($\frac{1}{2}$ mark), in the sequence/codons could well result in a different amino acid sequence (1 mark) and/or may mean that the enzyme won't work the way it should (1 mark).

(c) (i) The presence of uracil (U) instead of thymine (T) indicates RNA rather than DNA (1 mark).

(ii) In mRNA original was CGU, ∴original DNA was GCA, with mutation mRNA is UGU ∴ original DNA was ACA, so in the template strand of DNA glycine (G) was replaced by adenine (A) (1 mark). $\frac{1}{2}$ mark for saying that C has been substituted by U (i.e. in mRNA).

(iii) The normal sequence CGU would give the amino acid **arg**, whereas the mutant form UGU results in the amino acid **cys** (2 marks). Up to 1 mark was awarded for a general statement about the mutation resulting in one amino acid being substituted for another in the final amino acid sequence.

Comments

This question was answered very well overall by the majority of candidates.

(a) A large number of candidates confused nucleotides with nitrogenous bases. Because of the small number of marks available for this part, candidates were not penalised if they included the base pair (as opposed to a single base) in their nucleotide. Similarly, there was no penalty for simply circling the nucleotide and not labelling it.

(b) The most common error was to describe the process as DNA replication.

(i) Many candidates thought that part (ii) of this question related to part (i) and therefore repeated their answer to part (i). In part (iii) it was sufficient for candidates to use the abbreviated amino acid names (arg, cys) and there was no penalty if they devised incorrect names (e.g. argase, cysase).

Question 6

(a)

Prior incubation temp (ºC)	New incubation temp (ºC)	Expected result (g/min)	Reason
0	40	***1.0***	*Intact enzymes, put in close to optimum temp ∴max rate*
70	40	***0.0***	*High temp would denature enzyme, ∴min rate*

1 mark for each expected result correct or very close to ($\frac{1}{2}$ mark if bit out), 1 mark for reasonable explanation. It was not necessary for candidates to state that the enzyme was intact after incubation at 0°C, but they did need to explain why the expected result when the temperature was raised to 40°C was 1.0 g/min (as opposed to, say, 0.8 or 0.6 g/min) to gain the full mark for their reason.

(b) Increasing the concentration of substrate reduces the effect of the enzyme inhibitor because there is now a greater chance of the substrate coming in contact with an enzyme before the inhibitor can act on the enzyme (2 marks). This also increases the total number of molecules and decreases the chances of the inhibitor contacting/acting on the enzyme (1 mark). Up to 1 mark for any other relevant understanding of enzyme inhibition shown.

Comments

Most candidates had an excellent understanding of enzyme action. However, a number of candidates stated that the enzyme was "killed" at high temperatures (rather than denatured). Some candidates thought that part (b) was referring to an increase in the concentration of enzyme (rather than substrate).

Question 7

(a) Net gain of energy occurs between 7.5 – 24°C +/- 0.5 ° C, (this is where the rate of photosynthesis exceeds the rate of respiration), $\frac{1}{2}$ mark for one correct and the other not too far off.

(b) At 24°C the rate of photosynthesis is equal to the rate of respiration (1 mark) so there is no net production/growth to allow the plant to produce tubers (1 mark). Some credit given for connecting the rate of photosynthesis to storage in tubers.

(c) The rate of photosynthesis decreases above 21°C is most likely due to closing of stomata in the leaves (1 mark) in response to excess water loss through transpiration ($\frac{1}{2}$ mark), so there is less CO_2 entering the leaf ($\frac{1}{2}$ mark) which is needed for photosynthesis ($\frac{1}{2}$ mark). Alternatively up to $1\frac{1}{2}$ marks gained for saying that extra heat meant excess water loss so less photosynthesis as water was needed as input for it.

Comments

Overall the question was not very well done, and tended to sort out the better candidates from the rest. A sizeable group of candidates confused the idea of net gain in energy, taking it to mean that more energy was being released by respiration than was being captured by photosynthesis.

(a) This part was poorly done, with only the stronger candidates understanding how to interpret the question.

(b) Very varied answers, but a lot of the better candidates recognised that this was the compensation point between respiration and photosynthesis and at 24°C where all the sugars being produced by photosynthesis were being used in respiration.

(c) This part was a good discriminator and separated those who could only recognise that the plant was adapted to lower temperatures or there was a limiting factor from those who went into specific and relevant details. A surprisingly large number of candidates attributed the drop to the enzymes being temperature specific, which was given credit, but most of them then went on to say that the enzyme was being denatured at 24°C, a mistaken idea most likely from interpreting the photosynthesis rate curve as an enzyme activity curve.

Question 8

(a) (i) Aerobic (cellular) respiration (1 mark). No marks were given for suggesting the process was photosynthesis, but $\frac{1}{2}$ mark was given for any active process that would involve respiration.

(ii) Substances ($\frac{1}{2}$ mark each)

A: Glucose, (or pyruvate or organic molecules etc)

B: Carbon dioxide OR Water

C: Water OR Carbon dioxide

D: ATP

(b) Anaerobic respiration or glycolysis (1 mark), as it gives similar inputs and outputs in terms of input of glucose and output of ATP ($\frac{1}{2}$ mark). Aerobic respiration is much more efficient as it results in a more complete breakdown of glucose (1 mark), and as a result much more ATP is produced (1 mark), with 38 ATPs for aerobic compared to 2 ATP for anaerobic or 36 extra ATP ($\frac{1}{2}$ mark). Comparison of breakdown products CO_2 & H_2O vs lactic acid/alcohol $\frac{1}{2}$ mark or 1 mark if toxic or problem nature of these wastes mentioned.

Comments

This question was very straight forward and covered a fundamental topic so the vast majority of candidates gained 5 of 6 out of six, with six being the most common score. Some candidates who didn't distinguish between aerobic and an aerobic respiration put down photosynthesis for part b).

Question 9

(a) $\frac{1}{2}$ mark for acceptable identification and $\frac{1}{2}$ mark for matching reason up to max of 4 marks total.

A: ATP because it is used up as this endergonic reaction proceeds and is decreasing at the same rate as ADP (B) is building up

B: ADP as it is building up as this endergonic reaction proceeds at same rate as ATP (A) is being consumed.

C: Maltase as it is an enzyme, which aren't consumed by the process and/or usually only present in low concentrations

D: Glucose as it starting at very high levels and being progressively reduced (till ATP runs out or an equilibrium is established); there is also an inverse relationship between the levels of polysaccharide and glucose.

Answers that got ATP and glucose the wrong way around but included sensible reasons scored 3 out of 4. Credit was given for recognising the relationship between ATP and ADP or between glucose and the polysaccharide even where the wrong letters were stated.

(b) (i) Key difference is that vitamins are organic whereas minerals are inorganic. 2 marks 1 mark for saying vitamins act as co-enzymes and minerals co-factors. Credit also given for saying minerals were metal ions.

(ii) Plants obtain their minerals from the soil and/or uptake through their roots (& leaves) (1 mark)

Comments

This answer produced a very wide spread of marks with the best candidates scoring full marks or close to it. Part (a) tended to sort the candidates out and gave a good chance for them to show their understanding of the processes involved. A number of candidates misread the question and assumed that the glucose was being used to provide energy and therefore it would be increasing and so would ATP, while ADP would be decreasing.

Part 3 – Criterion 8

Question 10

(a) Structure 1: Cell membrane & Structure 3 is cell wall / capsule (1 mark).
Differences in function: Cell membrane controls exchange of substances between the cell and its external environment (1 mark), whereas cell wall provides structural support and protection (which is enhanced by capsule especially) (1 mark).

(b) Cell B is prokaryotic ($\frac{1}{2}$ mark), Evidence: lacks membrane bound organelles (although this is hard to tell due to nature of diagrams), nuclear material not in a membrane bound nucleus, presence of capsule surrounding the bacterium (1 mark for each), Up to 1 mark for mentioning that bacteria are prokaryotic organisms while humans are not.

(c) Structures 2 & 4 involve/contain the DNA/genes/genetic material or chromosome(s) of the cell (1 mark for any point), determine/control cell structure and function (1 mark) contain nuclear material ($\frac{1}{2}$ mark).

(d) A light microscope has been used to photograph cell A (1 mark). Reasons: none of the ultrastructural detail is visible or smaller organelles are not visible/shown (1 mark for either)

Comments

(a) This question was answered very well by most candidates.

A small number described both structures 1 and 3 as either cell membranes or cell walls despite being asked to discuss the **difference** in their function. These candidates were given $1\frac{1}{2}$ marks (out of 3) provided they gave an adequate description of function.

(b) Nearly every candidate said cell B is prokaryotic ($\frac{1}{2}$ mark). The majority also supported this answer by saying that it did not have a membrane bound nucleus (1 mark). Candidates needed to state one more piece of evidence to obtain full marks.

(c) Most candidates recognised structures 2 and 4 as containing (or being) the genetic material for each cell.

(d) A surprisingly large number of candidates (about a third) said that an electron microscope had been used, despite the obvious lack of detail within cell A. A very small number of these candidates received a $\frac{1}{2}$ mark by stating that cilia are visible. The actual size of the cilia in this diagram may have confused some candidates.

Question 11

(a) Incorrect statement ($\frac{1}{2}$ mark). The three cells are from the same person so they will have the same DNA/genetic material (barring mutations) (1 mark) as they have all been derived from the same original zygote through mitosis (1 mark). They do operate in different ways to perform different functions as they have different genes switched on/off or cells have been differentiated for different structures/functions due to the activity of different sets of genes (1 mark).

(b) Any two structures (1 mark) with an explanation of how each structure is related to the cell's function in the immune system (1 mark). For example:

- Flexible membrane (and cytoplasmic streaming) ($\frac{1}{2}$ mark) enables cell to be highly motile, so it can move to sites of infection ($\frac{1}{2}$ mark);
- Flexible membrane ($\frac{1}{2}$ mark) enables cell to be phagocytic, so it can engulf bacteria ($\frac{1}{2}$ mark);
- Small and very flexible ($\frac{1}{2}$ mark) so it can move between cells ($\frac{1}{2}$ mark);
- Vacuoles/lysosomes) ($\frac{1}{2}$ mark) within the cell for digestion of engulfed bacteria ($\frac{1}{2}$ mark);
- Lobed nucleus ($\frac{1}{2}$ mark) allows cell to squeeze past other cells to get to infection sites ($\frac{1}{2}$ mark); and

- Large enough ($\frac{1}{2}$ mark) to (simultaneously) engulf many bacteria at different sites ($\frac{1}{2}$ mark).

Comments

(a) Only about half of the candidates said that the statement was incorrect and only a small number of these candidates were able to give a sufficient explanation to obtain full marks.

(b) Most candidates were able to discuss two functions of this white blood cell and obtained full marks. The majority of answers were based on the labelling of the Cell 2 diagram which actually stated 'engulfing bacteria' and 'highly mobile cell able to move between other cells'.

Question 12

(a) Cell division involved in growth of grape cuttings is mitosis (1 mark) Significance: the cuttings are all clones of the original (1 mark), this means that they will have the same "desirable characteristics" or produce very close to the same grapes (as close as the conditions will allow) (1 mark). They will also respond in the same way to the conditions and treatments. (1 mark)

(b) (i) Type of cell division occurring is meiosis

(ii) AB, Ab, aB, ab (after final division) ($\frac{1}{2}$ mark each), also accept AABb and aaBb, 1 mark each (after 1st division).

(iii) Gives new combinations of alleles (1 mark) and results in greater genetic variation among the offspring (1 mark), and this greater variability gives the species more chance of survival if conditions change (1 mark).

Comments

(a) This question was generally well done although a surprising number of candidates gave an "information dump" about the process of mitosis which did not address the significance aspect of the question at all.

(b) (i) Well done although the number of different spellings of the word meiosis was dissappointing.

(ii) The most common errors were to only include two possibilities after the final division or to give four – Aa, Ba, Ab, Bb accompanied by a Punnett Square.

(iii) Many candidates simply said more variation/diversity and hence only got one mark.

Question 13

(a) Processes involved:

- Diffusion of magnesium ions (1 mark)
- The concentration of magnesium ions is greatest outside the root cell so the passive process of diffusion is sufficient to absorb them (1 mark).
- Active transport for potassium ions (1 mark)
- The concentration of potassium ions is greater inside the root cells than in the surrounding soil water, this means that they must be moved against a concentration gradient or from areas of low concentration outside the cell to areas of higher concentration inside it, this process requires energy so active transport is needed (1 mark),

(b) (i) Structure A is a contractile vacuole (1 mark) and its function is to expel excess water from the organism (1 mark).

(ii) Mild salt water is closer to the Amoeba's own concentration (more isotonic) (1 mark), or the concentration gradient is less (1 mark), so the rate of water moving into the organism by osmosis is slowed (1 mark), With less net water movement into the amoeba there is less work for the contractile vacuole so it pumps less (1mark).

Comments

(a) Many candidates got full marks but there was also a group of candidates who did not understand what this question was about. They gave detailed answers from the text book about the uses of potassium and magnesium in plants or the difference between xylem and phloem or translocation and transpiration.

(b) (i) Most candidates knew what this was. The most common errors were that it was just a vacuole not a contractile vacuole which gained half a mark. Some said that contractile vacuoles exploded or burst and one candidate even named the structure as the sun!. Many candidates wasted time by giving a text information "dump" on contractile vacuoles that did not answer the question. Identification as centrioles gained no marks

(ii) This was well done by many candidates. The question said that the contractile vacuole slowed down rather than stopped so half a mark was lost by candidates who thought that the Amoeba was now in a hypertonic solution rather than a less hypotonic solution.

Question 14

(a) The most likely reason for the difference in time to become blue throughout is the difference in surface area to volume ratio (1 mark), both have the same mass so would have similar volume (1 mark) but the potato has a more rounded/spherical shape than the carrot and therefore a lower surface area to volume ratio (1mark). The process involved is diffusion and the rate of diffusion into the vegetables is limited by the surface area to volume ratio (or the amount of surface area compared to the distance to diffuse, which in turn affects the concentration gradient), (1mark).

Other possible explanations worthy of credit include, carrot tissue is more porous and diffusion can take place faster (1- $1\frac{1}{2}$ marks), something in the potato reacted with the colouring or slowed its diffusion (1- $1\frac{1}{2}$ marks) or the concentration gradient was greater with the carrot than the potato (1- $1\frac{1}{2}$ marks).

Need to mention both surface area to volume ratio and its affect on the rate of diffusion to gain full marks.

Comments

Most candidates got 2 or 3 marks for this question with a pleasing number recognising that it was about surface area to volume ratio.

Part 4 – Criterion 9

Question 15

(a) $\frac{1}{2}$ mark for each correct main answer.

If M labelled xylem and W labelled phloem but rest of information right – only 1 mark lost.

Diagram letter	**M**	**W**
Name of tissue	phloem	xylem
Material transported	sugars (ions, water etc)	water (& ions)
Active or passive transport	active	passive

(b) (i) Transpiration (1 mark) (diffusion $\frac{1}{2}$ mark, evaporation $\frac{1}{2}$ mark)

(ii) Net change in mass of the plant at 8 am is – 0.5 g hr-1 or loss of 0.5 g hr-1 (loss not indicated - $\frac{1}{2}$ mark)

(iii) 16:00 hours ($\frac{1}{2}$ mark), as this is when maximum net loss of water occurs (1 mark) and also when there is the maximum cumulative effect of net water loss ($\frac{1}{2}$ mark) or $\frac{1}{2}$ mark for some other explanation either plant related (e.g. cells become less turgid, stomata close) or conditions related (e.g. the hottest part of the day).

Comments

The majority of candidates confused phloem and xylem but apart from this the question was well done.

Question 16

(a) 1 mark for each different reasonable symptom and one mark for an accompanying explanation, eg.

- Rapid/deeper/heavier breathing (or loss of breath) even with little exercise, as more air needs to be vented to get the same amount of gas exchange due to decreased surface area
- More rapid pulse, due to less efficient oxygenation etc of the blood and so more blood has to be circulated to supply the needs of the cells
- Reduced metabolic rate, body is harder to keep warm as oxygen supply to cells is restricted and hence less cellular respiration
- Physical weakness/reduced capacity for exercise, less oxygen absorption so less cellular respiration and less energy for exercise etc
- Other symptoms for similar reasons to above include easily fatigued, tired/lethargic, pale/bluish in skin tones as less oxygenated blood carried, slower growth rate etc

Also 1 mark given for the following symptoms/signs and explanation

- Build up of carbon dioxide causing increase rate of breathing
- Build up of carbon dioxide causing blood to become acidic effecting Ph balance of body

Credit was also given to the following

- Smaller thoracic cavity lowers lung volume means less air can be respired and less oxygen and carbon dioxide exchanged
- Increase in membrane thickness due to mucus which limits diffusion rate of carbon dioxide and oxygen
- Any other symptom and explanation that was reasonable but did not relate specifically to the diagram received one mark

(b) (i) Conversion of CO2 into bicarbonate ions means that the concentration gradient for CO2 is maintained at the highest possible level (1 mark), this means that the rate of diffusion of CO2 is maximised (1 mark), it also increased the amount of CO2 that can be carried in the blood (1 mark). Credit can also be given for an understanding of the equilibriums involved and how by changing the concentration of one it allows more movement in one direction or that CO2 is not sufficiently soluble in water/plasma for enough to be transported by that means alone (up to 1 mark). Credit also given for suggesting that this process enables the continual removal of CO2 without the use of active transport which would require energy (1 mark). $\frac{1}{2}$ mark given for stating that this makes CO2 removal more efficient or that the enzyme speeds up the process or that this is a reversible reaction.

(ii) In an environment with low concentrations of CO2 Chlorella produces increased amounts of carbonic anhydrase (1 mark), this converts more of the bicarbonate ions in solution to CO2 (1 mark) and this means it is able to increase its rate of photosynthesis (1 mark) credit was given to candidates who recognised this as an

example of negative feedback to maintain a constant concentration of CO2 in the alga (1 mark.)

Comments

(a) This question was answered quite well with most candidates scoring 3 or 4 out of a possible 4 marks. Candidates that failed to receive full marks either failed to address the question specifically in regards to the diagram and gave general symptoms relating to emphysema, or they were able to address the symptom part of the question but failed to give a reasonable explanation.

b) (i) This question was a good discriminator. Some candidates were able to recognise the concept of diffusion gradient, many looked up carbonic anhydrase and gave information dumps, others had little idea what the question was about and a considerable number left it blank. No credit was given for information which did not address the fact that the question asks about "the removal of carbon dioxide from body cells" (e.g. in maintaining stable pH, exhalation of CO_2 at the lungs)

(ii) Approximately 20% candidates did not attempt this question. There was a lot to read and those who were prepared to spend the time on it would have found that all the information was in the introduction and it was simply a matter of logic to put the answer together. Many candidates who tackled this question achieved 3 marks.

Candidates should avoid describing objects or other organisms in human terms (being anthropomorphic), for example there were too many examples of Chlorella or CO2 "wanting/trying to…" etc.

Question 17

(a) (i) XbXo x XoY

Female\Male games	X^o	Y
X^b	$X^b X^o$	$X^b Y$
X^o	$X^o X^o$	$X^o Y$

F1 generation	Genotypes:	Phenotypes
	25% X^bX^o	tortoiseshell female
	25% X^oX^o	orange female
	25% XbY	black male
	25% XoY	orange male

1 mark for diagram (can include branching method) _ mark each for each offspring in F1

(ii) Neither allele is dominant over the other, they are codominant (1 mark for either or both), as both can be expressed in the phenotype if present (1 mark). (While this is actually a case of X inactivation and in different parts of skin one X is active and the other X is not giving the tortoiseshell pattern, this was not expected as it is not covered in the syllabus).

(b) Albinism is recessive (1 mark), specific cross is individuals 9 & 10 or cross 5 & 6 (1 mark) where both don't show the trait but some of their offspring do (1 mark), or

alternatively the trait skips a generation (1mark) from 1 & 2 skips generation with 9 & 10 and reappears in next generation in individual 11 or similar using the other cross.(1 mark)

Comments

(a) This question was answered very well by most candidates, with many scoring full marks on this question. Candidates that failed to score full marks often failed to explicitly list the genotypes and phenotypes, particularly the phenotypes whether male or female and classed the orange phenotype as 50% rather than 25% male and 25% female.

(b) Once again this question was answered very well with most candidates being able to identify
the trait as being recessive, as well as providing a suitable argument that related specifically to particular crosses on the pedigree. Some candidates lost marks because while they could identify the trait as being recessive they were unable to specifically identify the evidence on the pedigree, many candidates in this case simply gave a run down of the rule i.e. "if the trait skips a generation it is recessive".

Question 18

(a) Advantage of parthenogenesis: (1 mark for any suitable advantage)
- don't have to be troubled in finding a mate or
- allows successful genes to be passed on (or similar) or
- a higher proportion of eggs develop into offspring (compared to where fertilisation is necessary).

Disadvantage of parthenogenesis: (1 mark for any reasonable disadvantage)

- don't have the genetic diversity/variation of normal sexual reproduction that allows natural selection to favour different characteristics in changing environments
- more likely to show deleterious recessive mutations or
- in small populations genetic drift may occur
- no pair bonding/cooperation involved ($\frac{1}{2}$ mark)

(b) The answer depends on whether parthenogenesis occurs in diploid adults by meiosis in the first instance or by mitosis in haploid individuals in following generations, as is most likely the case here. So either alternative was accepted as long as it was supported.

Yes ($\frac{1}{2}$ mark), as it is similar to asexual reproduction ($\frac{1}{2}$ mark), there is little to no genetic diversity of normal sexual reproduction because all the chromosomes come from the one individual (1mark) and/or as the offspring are haploid there is no chance of crossing over or random assortment (1 mark)

Also accepted No (1/2 mark), if the parthenogenesis resulted from a diploid parent through meiosis and produced haploid individuals (as happens in the honey bee) there would be some genetic diversity as the process of crossing over and random assortment would have occurred. (1 mark) but not as much variation as occurs with sexual reproduction as the genetic material is still only from one parent (1 mark) OR

No (1/2 mark), if the populations resulted from two different individuals that originated from sexual reproduction and were therefore different genetically (1 mark) in different areas and were then reproducing through parthenogenesis (1 mark)

Comments

Part (a) was done well by most candidates with the majority attempting it and getting full marks. Part (b) was less successfully answered with few candidates getting full marks most were allocated $1\frac{1}{2}$ marks. Credit was given to candidates who said populations would not be similar as long as they backed up their assertion with clear explanations. (see answers above)

Question 19

Feedback can be defined as where the response to the stimulus alters the stimulus in this case low body temperature (1 mark) and negative feedback is where the response to low body temperature causes the body temperature to rise and regain an equilibrium or maintain a more or less constant temperature (i.e. homeothermy) (1 mark). The change (Low body temperature) is detected by a receptor (skin or core body temp) (1 mark) and this is communicated to the pituitary gland by nerves (via the temperature regulatory control centre in the brain- extra mark), the hormonal message (TSH) then stimulates the thyroid gland to produce another hormone, thyroxine (1 mark for covering messages), which stimulates the body's effectors that increase the body temperature (1 mark) by increasing the metabolic rate and therefore heat output of the body's cells ($\frac{1}{2}$ mark); this counter change in temperature ($\frac{1}{2}$ mark) is detected by the sensor which reduces the response through negative feedback (1 mark if not already mentioned earlier). This question has a lot of scope for different approaches, marks awarded on relevant points, but to gain full marks there needs to be an explanation of the main ideas of negative feedback, and homeostatic control of body temperature with reference to the diagram.

Stimulus	The change in body temperature (decrease)
Receptor	Skin or core body temperature/pituitary gland in the hypothalamus
Transmission of message	The production of hormone TSH which circulates in the blood
EffeEffector	Stimulates thyroid gland to produce thyroxine which circulates to all body cells, increasing metabolic rate and more heat energy is released by cells
Response	Heat energy released by cells increases body temperature.

Comments

This question was a discriminator with quite a spread of answers. Many candidates simply wrote out the diagram in words. Some credit was given for this but in order to gain full marks candidates needed to identify the stimulus, receptor, effector, response and messages. Also many candidates failed to define negative feedback and therefore failed to address the question fully.

Many others commented on homeostasis in relation to other examples of negative feedback such as water balance etc and therefore failed to answer the question. Some credit was given if their answers were accurate and if they defined negative feedback.

Several candidates drew their own diagrams and in many cases these were obviously copied off their information sheet. Very few did this correctly with arrows going in the wrong direction and incorrect labelling. Many candidates crammed their answer onto the lined space (including diagrams) not realising that they could simply label the existing diagram in the question.

Part 5 – Criterion 10

Question 20

(a) The bionomial name for organism A is *Hexaminius popeiana*. (1 mark) $\frac{1}{2}$ mark for binomial name that includes either of the parts.

(b) Organism E is most closely related ($\frac{1}{2}$ mark) as it belongs to the same genus (*Hexaminius*) (1 mark), other $\frac{1}{2}$ mark for saying that C belongs to a different genus or relating closeness of relationship to classification grouping.

Comments

This question was generally very well done by candidates. Surprisingly there were some candidates who did not attempt this question or had no understanding of how a species was identified. Most candidates received 2 $\frac{1}{2}$ or 3 marks.

Question 21

(a) (i) One mark for any reasonable such as:

- Limited amount of light absorbed is converted to chemical energy by photosynthesis
- Most energy is lost as heat
- Energy conversions are never 100% efficient
- The light may not be captured by the chloroplasts
- Not enough raw materials such as CO_2 and/or H_2O

$\frac{1}{2}$ mark for any reason that relates to the processes after conversion to organic molecules, e.g. heat loss in respiration etc.

(ii) 2920 (kJm^{-1} -units provided) (1 mark) i.e. 44090 – (20,000 + 15,330 + 55840)

(iii) The majority of the energy is lost between one level and the next (1 mark) usually only about 10% or less is passed on ($\frac{1}{2}$ mark), this is due to respiration/heat mostly (1 mark) and other losses such as remains and wastes not consumed by consumers but passed on to decomposers or lost to the system (1 mark +/-), so there is such a tiny fraction of the energy from the producers left by the time it gets to the fourth or

fifth trophic level there is not enough energy/biomass to support a viable population (1 mark).

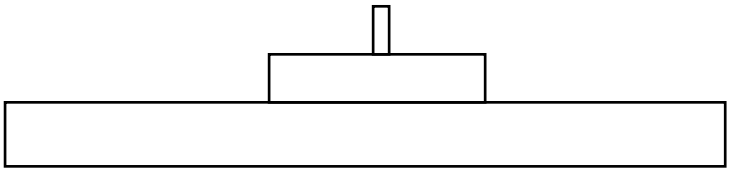
(b) (i) Any one suitable reason (1 mark), such as

- Producers nearly always have a higher biomass than herbivores or carnivores that they support.
- They need to be near the surface to be able to receive sufficient light for photosynthesis.

(ii) One mark each for any reasonable point including

- Decomposers do receive their input from all other trophic levels (1 mark) (but this would not normally make their biomass greater than the producers unless there is another input of organic matter into the system extra $\frac{1}{2}$ -1 mark)
- This is most likely due to the fact that there is other organic matter finding its way into the lake, (otherwise you would not normally find the biomass of the decomposers being greater than the plants, unless the plants had a very high turnover extra $\frac{1}{2}$ -1 mark).

(iii)



$\frac{1}{2}$ mark only if levels are misnamed or not named or if one level is more than $\frac{1}{2}$ size of the one below it.

Comments

(a) (i) Many candidates did not read this part of the question well and thought it referred to the transfer of energy loss from one level to the next whereas in fact the question was referring to the 1% transfer to organic molecules after the light had been captured by the plant.

(ii) This was done well by candidates who were able to do the calculation.

(iii) It was expected that candidates would answer this question in a fair amount of detail as this question was worth 3 marks. Many candidates just gave a standard answer about energy loss being lost from one level to the next without explaining where it went or how it was used.

(b) (i) Candidates answered this section well.

(ii) Most candidates achieved 1 mark for this question by stating that decomposers received their input from all other levels above but failed to give any further detail for the other $\frac{1}{2}$ - 1 mark.

(iii) Most candidates were able to draw and identify the trophic levels in this pyramid.

Question 22

(a) (i) Feature 3- higher O_2 consumption rate indicates a higher metabolic rate (1 mark) which would release more heat and so help keep the seal warm/ maintain constant body temperature (1 mark). Up to 1 mark for saying things along the line of higher O_2 consumption rate indicates storing of O_2 before diving for extended underwater hunting (1 mark).

(ii) Feature 4- The seal has more than twice the % of body fat and when under the skin this is the best form of insulation (1 mark) (as hair/fur is not effective as an insulator underwater $\frac{1}{2}$ mark), which prevent heat loss and helps balance the heat equation/maintain constant body temperature (1 mark). Higher fat content is also an energy store for when food is scarce (1 mark)

(iii) Blood will mainly flow through capillary X when conditions are cold (or seal needs to minimise heat loss) 1 mark. This ensures that the blood is insulated effectively by the layer of fat on the outside and so heat loss is minimised. (1 mark) or this modified blood flow helps seal avoid overheating when basking in the sun.

(b) (i) The advantage of the stoma being located on the upper surface is that it allows gas exchange to take place with the air, which has much higher concentrations of gases such as CO_2 than the water that contacts the lower surface (1 mark). ($\frac{1}{2}$ mark for any secondary reasons such as the leaf would be more likely to sink etc). Also greater transpiration rate to draw more minerals into the plant, as loss of water is not an issue.

(ii) Any suitable suggestion (1 mark) such as

- Increased air circulation within the leaf that enhances the exchange of gases
- Provides floatation/buoyancy for the leaf

(i) Any suitable suggestion (1 mark) such as

- Minimises water loss through the epidermis or any variation on this idea

Comments

In general candidates scored well on this question.

A few common errors were

- Not linking increased metabolic rate to increased heat production to overcome the very high heat loss

- Considering that it is the rapid pumping of blood that causes the heat production
- Not linking the very thick layer of insulation to the very high temperature gradient.
- Using *diffuse* to describe heat transfer
- Confusing insulin with insulate
- Using the word *osmosis* to describe the water loss from a cell to air situation

Question 23

(a) The role of decomposers in the carbon cycle is to breakdown the organic remains and wastes of plants and animals (1 mark) and to return the inorganic nutrients (like minerals and ions as well as gases such as CO_2 $\frac{1}{2}$ for e.g.) to the environment (1 mark).

(b) The reduction in the amount of ploughing would lead to more carbon being stored in the soil because it (1 mark for any reasonable point such as)

- Reduces the aeration of the soil (1 mark) which slows the oxidation of organic compounds to form carbon dioxide (1 mark)
- Organic matter would have a chance to build up in the soil at a faster rate than it is being oxidised/broken down, hence there is a net increased in the amount of carbon locked up. (1-1$\frac{1}{2}$ marks)

Some credit can be given to answers that relate to the reduction of the breakdown of carbon, such as organic material stays cooler therefore its breakdown is slower or there is less mixing of decomposers in soil, or compaction of the soil restricts conditions needed for decomposers etc.

Comments

Part (a) was done well by almost all candidates

Part (b) was poorly done by many candidates as they didn't link decomposers into the answer. Common errors in part (b) were

- Not linking decomposer respiration rate to amount of oxygen in the soil
- Not recognising that the carbon being discussed was contained in organic molecules of dead animals and plants or their wastes
- Stating that pockets of CO_2 gas would accumulate in the ground if it were not ploughed

Question 24

Process of speciation: main points 1 mark each, (unless otherwise stated) up to total of 4

- Establishment of original population, either when connected to Tasmania (or other mechanism). Initial population may have had some variations. (founding effect - extra $\frac{1}{2}$ mark)
- Geographic isolation from Tasmania by rise in sea level preventing interbreeding/allopatric speciation

- Different environmental and selection pressures leading to natural selection for different adaptations
- Change in the gene frequency through natural selection over many generations
- Changes result in reproductive isolation, e.g. by different courtship/mating behaviours/structures etc (extra $\frac{1}{2}$ marks)
- New species formed as can no longer interbreed to produce fertile offspring

Some recognition given for discussion of loss of species from mainland Tasmania.

Comments

There were many excellent answers. Some candidates lost time by rewriting the question and only adding one or two points. Some candidates did not include four different points although most points made were valid.

Question 25

(a) (i) Exponential growth or J curve (1 mark) or S curve (log growth) ($\frac{1}{2}$ mark)

(ii) Natural selection (1 mark) plus

- where there is a selection for those organisms that are resistant to pyrethrum (1 mark) or
- the insect population has evolved a resistance to it (1 mark)

(b) Any suitable reason (1 mark) such as

- Running out of environmental resources or approaching the carrying capacity of the environment or at equilibrium
- Shortage of food
- Adverse weather conditions
- Increase in predators, parasites or disease etc.

Comments

Most incorrect answers were due to not reading the question correctly.
In (a) (ii) - some candidates did not recognise that an explanation of the change in **month 5** was actually needed. Also, two points were needed to gain full marks i.e. reference to how the resistant gene was transferred to offspring in the next generation was required to gain full marks.

In (b) most candidates gained the full mark by mentioning - approaching the carrying capacity of the environment.

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