The Chief Examiners met with the marking team during the week after the exams. With a team of 15 markers the standards required for A, B and C ratings were determined for the externally assessed criteria. The Assessment Panel met early December to review the results and reassess the borderline candidates on an individual basis.

General Comments

The final examination paper was generally seen as more difficult than in those of recent years, but did discriminate well on the whole. Some of the longer response questions helped achieve this along with the more challenging nature of a number of the questions. There is a continuing problem with the very high percentage of A's and B's in non-externally assessed criteria.

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) That increased temperature causes an increase in the rate of diffusion from beetroot cells/ vacuoles (3).

OR

That increased temperature causes an increase in the permeability of the membranes in beetroot cells/vacuoles.

OR

An increase in temperature increases the rate at which the colour comes out of the beetroot cells. (2)

Other answers given credit included variations on:
An increase in temperature causes an increase in the intensity of colour of water containing beetroot cells (1½)

(b) (i) Rate of diffusion (Permeability of membranes) (1)
Intensity of colour (½) but if mentioned or clearly inferred in the candidate's hypothesis: (1)
(ii) Temperature (1)

(c) A control must be included so the experimental results can be compared with the control results (1) in order to establish their validity (½) or to establish that change in the independent variable was responsible for change in the dependent variable (½).

Each of the temperatures used could be considered a control (1), or one of them suggested as the control for the others (1) but it would be preferable to use a low temperature within the range at which beetroot normally grows (10ºC – 20ºC) (1).

Also acceptable: control using water without beetroot, or a series of such controls at the four temperatures. (1)

Information about variables that should be controlled/fixed, rather than a true experimental control (½)

(d) Any of the following were accepted:
- Consideration whether all other variables were controlled/kept the same. (½)
- Abiotic e.g. humidity, length of time at each temperature, volume of liquid surrounding each beetroot sample. (1)
- Biotic e.g. size, shape/surface area of beetroot samples; were cells from the same beetroot/beetroot species for consistency – or more than 1 beetroot used (1 beetroot may have been atypical) Had beetroot been grown in identical conditions? (1)
- Was the sample size sufficiently large? (½)
- Were experiments replicated? (½)
- Need to identify a factor (½) and explain how this would improve accuracy and reliability, (1) unless very carefully explained as shown above.
- How subjective/objective was the method of determining intensity of colour? (½)
- Suggested way of making more objective/quantitative: (½ -1)

Comments

This question was reasonably well answered, but few candidates achieved full marks, most giving inadequate answers on at least one part.

(a) Many candidates did not mention cell membranes or diffusion through them in their hypothesis. A large number simply linked temperature with increased intensity of colour.

A number of candidates used the term osmosis rather than diffusion; others suggested that intensity of colour *within* beetroot cells was being measured.

(b) A considerable number of candidates confused the dependent and independent variable in this part of the question, even if they had written a clear hypothesis.

(c) Quite a few candidates suggested room temperature as the control, with or without specifying a temperature, and a large number suggested 0ºC, apparently unaware that the water at this point would be frozen.

A disappointingly high number of candidates wrote about a range of *variables that should be controlled/kept the same*, rather than an *experimental control*. This meant they gave information here that should have been included in their answers to (d).

(d) Most candidates were able to answer this part fairly well, but a number gave generalised information about variables to be controlled without linking it specifically to this experiment.

A number did not indicate clearly how the suggested information would aid with accuracy and reliability.

Question 2

Identify independent variable	The different species of trees	1 mark
Identify dependent variable	Rate of photosynthesis	1 mark
Identify Sample size	20 + leaves from each tree for each	1 mark
Identify key controlled variables: Trees Laboratory	Similar age, orientation on trees, remove one disc from the same place on each leaf. All leaves should be free of insect or damage. Discs same size. Trees grown in similar conditions.(rainfall, soil type) Ensure constant temperature, size of container, CO_2, volume of water, same light conditions.	2 marks 1 mark
Identify the control group	Identify one of the eucalypt trees as the control in order to allow photosynthetic rates to be compared to it. OR allow each tree to be the control for each other.	1 mark
Identify how the dependent variable will be measured	Keeping discs separate and remove air from them. Record time taken for leaves to float OR count number of floating in each container after 10, 20, 30 40 50 mins etc	2 marks

Identify difficulties of experiment set up Or what happens with results	Candidates may come up with some problems in their expt evaluation. Average results and analyse statistically to draw conclusions as to whether there is any difference in photosynthetic rates of each species.	2 marks

Sample answer:

Select 20 leaves of similar age, thickness, orientation on trees from each of the 5 *Eucalyptus* species and remove one disc from the same position of each leaf. All leaves should be free of insect or other damage. (The independent variable is the species of *Eucalyptus* leaves used). Keeping discs from each species separate, remove as much air as possible from the discs. Select the10 discs from each species which are the least buoyant after the air has been removed, and place each group of 10 discs in separate beakers. (Sample size = 10). Add equal quantities of the same solution containing CO_2 to each beaker. Keep all beakers at the same temperature and expose all beakers to the same light intensity. Record the time taken for each leaf disc to rise to the surface. The average for the 10 discs from each species will give a measure of photosynthetic rate (dependent variable). The results of each species would be compared, so each result acts as a control for the others. The experiment should be repeated several times to ensure that a consistent result is obtained. The species with the lowest the average time leaves take to rise would have the fastest photosynthetic rate.

Some aspects of this experiment may be very difficult to control. It would be particularly difficult to eliminate all variables relating to disc selection. Once air is removed, the discs should be kept in the dark while other discs are prepared to eliminate photosynthesis occurring prior to the start of the experiment. Keeping light intensity constant for all 50 discs would be difficult, as discs could shade each other. Results could be graphed to show with the average times for each species and the differences analysed.

Additional Marking Information:

The above marking scheme was generally followed when candidates clearly identified they understood that they were being asked to design an experiment to investigate and compare the photosynthetic rates of five species of *Eucalyptus* trees.

One mark was also given to candidates who considered the effect different growth stages or types of leaves (including varying amounts of chlorophyll and number of stomata) may have on the photosynthetic rate.

One mark was also given if the candidate clearly stated an hypothesis that identified the correct independent and dependent variables.

Comments

Question 2 separated out the candidates in Part 1 of the exam. Overall most candidates passed the question and if the question was attempted marks were nearly always achieved. It was very disappointing to see the number of candidates who did not attempt the question at all.
Many candidates answered the question by designing an experiment that did not specifically compare five *Eucalyptus* trees. Instead several candidates designed experiments that investigated either the effect of varying the concentration of carbon dioxide or oxygen on the photosynthetic rate or varying the amount of air in the spongy mesophyll (pressure) or the effect of temperature on photosynthesis.

In these cases candidates did not receive full marks but could score 7 or 8 out of 10 if they designed experiments that supported their hypothesis and related this to the different species of Eucalypts.

Candidates who failed to demonstrate that they were being asked to consider five species of Eucalypt yet designed experiments that logically supported their hypothesis could obtain between 4 and 7 marks depending on how relevant their experiment (and independent/dependent variable) was to that asked for in the question.

Candidates who had really no understanding of the intention of the investigation but were able to demonstrate some knowledge of key aspects of experimental design were given some marks.

Question 3

(a) Any two of the following were accepted:

- Girls would have genetically determined variation in the timing of puberty (1 mark). Taking this into account when allocating girls to control and experimental groups would be a problem (1 mark).
- Girls vary in exposure to food prepared using female hormones (1 mark). This would be difficult to quantify, both currently and over the girls' lifetime (1 mark).
- Aspects of the diet other than the addition of hormones, such as naturally occurring hormone like substances, may play an important role in the onset of puberty (1 mark). This will be difficult to control when allocating experimental groups (1 mark).
- The length of time to perform an experiment (1 mark) will make the selection of participants, maintaining the participants in the investigation and control of the fixed variables difficult (1 mark).
- Girls cannot be exposed to any danger in experimental investigations (1 mark). This is an ethical issue (1 mark).

  There were other acceptable answers involving obtaining large samples, random allocation, participants' life history, how the groups were handled and differently expressed ethical issues.

(b) Any of the following were accepted:

- A longitudinal study of girls from 0 -15 years of age could be used (1 mark). Girls and their parents would be asked to complete regular questionnaires about their intake of food with female hormones, as well as family history regarding the onset of puberty (1 mark). Medical personnel could determine the onset of various indicators of puberty and conclusions made regarding the onset of puberty and the exposure to hormones (1 mark).
- Use animals, such as rats, as experimental subjects, bearing in mind that these must be handled in an ethical manner (1 mark). Take a large number of rats and divide into groups fed diets containing varying amounts of hormones added and a control group on the same diet with no hormones added (1 mark). Feed until oestrous commences and record the time to reach this stage. Compare the results between the experimental groups for the onset of puberty and the exposure to hormones (1 mark). A positive result would lead to further experiments.
- Questionnaires could be given to girls from areas which may have been eating different diets. These should include diets likely to high in added hormone intake and diets likely to be low in added hormone intake (1 mark). The questions should cover diet, age of reaching puberty and aspects of behavioural history (1 mark). From the answers allocate girls to categories and compare the age of reaching puberty and the exposure to hormones (1 mark)

  Variations on the three basic approaches of longitudinal studies, experiments using animals and questionnaires were accepted.

Comments

Question 3 was done well. Candidates were well-prepared. Marks were lost in 3a when the two significant problems were the same thing, or very similar things, expressed in different ways. In 3b candidates were asked to give 'a way' and where more than one way was given, the best was marked. Some multiple way answers formed a clear sequence and this was accepted.

Question 4

Any one of three approaches was acceptable:

- Sample the area appropriately before the pipe goes in and do studies over a period of time after its installation.
- Sample the area appropriately and do a control in an identical manner of a similar area in Bass Strait.
- Sample a large area in the vicinity of the pipe outlet and do repeat samples to assess changes over a period of time.

Sample answer:

Samples should be taken at the end of the pipe and at each of the major compass points, N, S, E and W every 500m from the end of the pipe up to 4km (1 mark). Currents might take the wastes in predominantly one direction and this will be detected with samples at different depths and repeat samples every three months until a trend becomes clear (1 mark). Samples should be taken in both directions along the shore every 500m to 10km to ensure that the beaches and inter-tidal zones are protected (1 mark).

Samples should include producers, first, second and third order consumers to assess bioaccumulation and biomagnification (1 mark). Water samples measure waste chemical movement (1 mark). Samples should be taken from the bottom to show accumulation of the sediment (1 mark).

Comments

Candidates answered this question very well. The sample answer is only one of the many possibilities of the three approaches given above.

Part 2 – Criterion 7

Question 5

Class of Biological Compound	**Sub-units (Building blocks)**	**Function (List one only)**
Proteins	***Amino acids***	Enzymes
Carbohydrates	***Glucose or Monosaccharides***	***source of energy or building blocks for complex compounds***
Lipids	Fatty acids and glycerol	***energy store or Structural/cell components***

- ½ mark for each box
- ½ mark awarded for an energy function for lipids or carbohydrates without requiring more detail
- ½ mark awarded for a range of appropriate functions other than those listed above.

Comments

Well answered overall (as would be expected) and an easy two/ three marks for most candidates.

Candidates who gave more than one answer for each box with some of those answers being incorrect lost marks. E.g.: sub units for carbohydrates listed as monosaccharides, disaccharides, polysaccharides, starch.

Another error was to give a type/form of carbohydrate or lipid instead of a function.

Question 6

(a) (i) anaerobic respiration (1)
(ii) aerobic respiration (1)

(b) Aerobic respiration (occurs when O_2 present - PQ) results in the complete breakdown of glucose to CO_2 and H_2O. (1) This enables the maximum amount of stored energy in the glucose to be converted to ATP (≈ 38 molecules per glucose molecule). (1) Anaerobic respiration in yeast (MN) results in the incomplete breakdown of glucose to alcohol and CO_2 with the release of only 2 ATP molecules per glucose molecule. (1) Much of the chemical energy remains in the alcohol. (1)

Also gave ½ or 1 mark for just a general comment referring to which form of respiration was more efficient.

Comments

The question was well answered by a few candidates who obtained full marks.

A significant number of candidates failed to interpret the graph correctly at all and received zero marks.

Many candidates who correctly identified the processes in 6a failed to correctly read the question 6b and did not refer to efficiency of energy release in their answers but referred to carbon dioxide production and rates of reaction.

Note: graph may not be really expected to go up and then down with anaerobic respiration as the conditions would be stable in oxygen concentration (or lack of it), there should be a rapid increase in CO_2 levels once oxygen is introduced to well above the initial levels, which were anaerobic.

Question 7

(a) (i) Photosynthesis (1)
(ii) Radioactive labelling makes it possible to track the pathways of various elements during biochemical processes (1). The labelling in this reaction shows that all the

free oxygen given off by photosynthesis comes from the H_2O, with none coming from the CO_2 (1).

(b) (i) Any of the following was accepted:
- Organisms need glucose for respiration. This organism could not survive without CO_2 unless glucose was supplied, (1)
- Suggesting that it normally used CO_2 (hence photosynthesizing) to produce its own glucose (1).
- Increased light intensity would increase photosynthetic rate (1),
- hence making more energy available for functions such as reproduction (1).
- Half mark given for: $CO_2 + H_2O + \text{energy} \rightarrow \text{glucose} + O_2$

(ii) The hypothesis that the pigment is involved in photosynthesis would be supported if (any two marks from):
- as the concentration of the pigment increased (½), the rate of photosynthesis also increased (½);
- this could be measured by measuring uptake of CO_2, production of O_2, or glucose production (1);
- the organism reproduced faster (1);
- the organism increased in biomass (1);
- provided all other conditions (light intensity, CO_2 concentration, etc) were kept constant (1).

Comments

(a) Well answered in general. Gave a good spread.
Many candidates received 1 mark for part (ii) due to insufficient detail.
If candidates omitted the first part of the above answer to 7a(ii) but included either
'None of the oxygen from the original water is incorporated into the glucose or the new water formed'
Or 'The oxygen from the CO_2 is incorporated into the carbohydrate'
with the second part of the answer then they received two marks.

(b) (i) The majority of candidates suffered under either one or both of these misconceptions:
- chlorophyll is the only pigment that can be responsible for photosynthesis,
- all organisms must have O_2 for respiration, therefore this organism must use photosynthesis to supply its O_2 requirement.
- This resulted in only a fairly small proportion of the candidates gaining the four marks for this question. Many candidates stopped after stating and explaining one piece of evidence and so scored only two out of four marks.

(ii) Most candidates did quite well with this question although some were still maintaining that there was no chlorophyll so no photosynthesis was possible. Again, one mark out of two was fairly common as some candidates only stated one result instead of two.

Question 8

(a) The results from Laboratory 1 suggest that **A** (adenine) and **G** (guanine) occur in equal amounts, and hence pair, as do **T** (thymine) and **C** (cytosine) (1).

Our present model indicates the pairing to be **A – T** and **C – G** (1).

Some credit was given for:
- **T-C** and **A-G** are erroneous results (½)
- Stating that a mistake had been made by Lab 1 without giving details (½)
- Considering the results of only one sample is less accurate than repeating results (½)

(b) (i) Process 2 (½), translation (½)
(ii) N = messenger RNA (mRNA); P = transfer RNA (tRNA); (1)

The mRNA (N) carries the transcribed genetic code from the DNA in the nucleus to the ribosomes in the form of a sequence of bases (1). As it passes through the ribosome, anticodons (three bases) on the tRNA pair with complementary codons on the mRNA (1). Each tRNA carries a particular amino acid (corresponding to its anticodon) (1). Bonds form between adjacent amino acids to form a particular protein/polypeptide chain (1). Thus the sequence of bases on the mRNA acts as a template which determines the amino acid sequence in the protein being formed, while the tRNA carries the correct amino acid to the assembly point (1).

Comments

(a) The majority of candidates (but not all) noticed that for Lab 1, the percentages of A and T did not match each other and neither did the percentages of C and G.

Quite a few candidates found this to be an easy two marks because they simply had to state the predicted and accepted results.

Many candidates, however, did not consider that the results may have been the result of human error at the lab. Instead, many felt that Lab 1 had investigated a different type of DNA in which A and G were actually paired as were T and C. These candidates often scored only one mark.

Candidates who had not noticed the incorrect percentages generally made a comment about conclusions being less reliable if only one set of results are considered. For this they were given half a mark.

(b) (i) Well done, though there were a few candidates who wrote either transcription or translocation.

(ii) Many candidates did not identify and name the two structures before describing the process. Descriptions of translation were often very muddled particularly with regard to the roles of tRNA and mRNA.

P and M are not two different forms of the same molecule if you look carefully at what the arrow points to. Saying they were was a very common error.

Question 9

(a) (i) Drawing should show lower activation energy with enzyme – ie significantly lower peak

(ii) Complex changes cannot be made in one step as there are many transitional chemicals involved, each involving a change at a time (1). Many steps are required so that energy can be released or added in small, manageable amounts as packaged in ATP molecules (1). Some of the intermediate products formed during a reaction may be used in different chemical reactions in the cell (1). Enzyme with their active sites only work on one specific reaction involving one aspect a chemical reactant, so each enzyme controlled reaction only makes incremental chemical changes (1). Any 2 points.

(b) During chemical reactions substrate molecules fit into the active site of the appropriate enzyme, the two complementary shapes fitting like a lock and key. This facilitates the chemical reaction (1). This diagram shows a poison molecule which has a similar shape to the substrate occupying the active site (1), in competition, thus inhibiting this particular step in respiration (1). If one step of the reaction is inhibited, the whole reaction cannot proceed (1).

Comments

(a) (i) This was poorly done by many candidates. The most common errors were lowering the whole graph including the energy levels for reactants and products, having no activation energy at all or moving the whole graph to the left.

(ii) Many candidates simply rewrote the question rather than answering it.

(b) This question was well done though it would be nice if candidates could spell site (not sight) and substrate (not substraight). There was some confusion between cellular respiration and breathing. There was also a number of candidates who did an information ‘dump’ from their dictionary or sheet which did not refer to the diagrams and therefore did not score full marks.

Part 3 – Criterion 8

Question 10

(a) Reason: the absence of a cell wall, or no cell wall, or no large vacuole or rounded cell shape (1) lack of chloroplasts (½)

(b) Stomach wall, or pancreas - Cell producing enzymes for digestion (1). There are a number of ribosomes shown which would be the site of protein (enzyme) synthesis (1). This process requires a lot of energy which would be provided by the large number of mitochondria present (1).

OR human muscle tissue (1) requiring energy for movement (or 'exercise', 'contraction', 'work'), (1) cell has high number of mitochondria to provide this energy (1)
OR kidney tissue (1) since cell has large number of mitochondria to provide energy (1) supporting active reabsorption of molecules from filtrate (1).
OR any other reasonable suggestion that fits the cell illustrated, provided structure is clearly related to function.

(c) Ribosomes are shown (½); light microscopes do not have the resolving power to show ribosomes (½). Also acceptable: ER or details of mitochondria (cristae, internal membranes) or of nuclear membrane (pores).

Comments

(a) Most candidates noted either the lack of cell wall, large vacuole, or regular shape some the lack of a chloroplast. A small minority pointed erroneously to the large number of mitochondria or ER.

(b) A complete answer here required nomination of a logical tissue type, the identification of either the many mitochondria as supporting an energy-dependent cell function, or the ER supporting an enzyme production function. Many chose muscle tissue, successfully identifying contraction, movement, exercise or 'work' as the energy dependent function. Others successfully claimed nephron cells and active transport, or for secretion, stomach cells. Liver cells were a popular choice, although some had difficulty in identifying their metabolic activities.

A significant minority nominated lung tissues, but erroneously claimed that this was the major site for aerobic respiration in the body since oxygen is immediately available. Some candidates appear to believe that mitochondria move actively around the cell, delivering energy where it is required.

(c) Candidates were given full credit for identifying either the ribosomes on the ER, nuclear pores, nucleolus, or internal detail of mitochondria as evidence of the use of the electron microscope. Partial credit was awarded for mentioning 'details of organelles'

or for detail in general, provided it was also made clear that the electron microscope was significantly more powerful. It was not sufficient to simply say that it was 'a clear drawing showing all the organelles'.

Question 11

(a) **I** shows xylem cells (½) and **II** shows phloem cells (½). Xylem carries water and minerals from the roots to the rest of the plant. (½) It contains no cytoplasm and consists of tubes of dead cells when mature, and the process is a passive one.(½) Phloem, by contrast carries nutrients (mainly sugars) from the leaves to the rest of the plant,(½) is living and contains cytoplasm, uses active transport.(½). It consists of sieve tubes, with a little cytoplasm and perforated end plates joining adjacent cells, as well as companion cells (½). These have a nucleus and control the cytoplasm in the sieve tube (½).

A further 1 mark was available for answers which clearly contrasted the two tissues, either by the language used, or by juxtaposition of contrasting properties in a table or two lists. Credit was also given to correct explanation of the terms transpiration (xylem) and translocation (phloem), and to mention of strengthening fibres and the support role of xylem, or the role of xylem side-wall pits in transmission of water to adjacent cells.

(b) The function of this cell is to absorb minerals and water from the soil. (1) The projection from the cell (root hair) increases the surface area in contact with the soil for more efficient absorption (1). The thin projection is able to force its way between the grains of the soil to absorb the water and minerals found there (1). Absorbed water passes into the large vacuole which occupies most of the cell (1).

Comments

(a) Most candidates were able to achieve 3 ½ marks, in some cases by using the dictionary effectively. Few were able to properly contrast the two tissues as the question required. A small minority simply had no idea what was depicted, guessing at a eukaryote-prokaryote comparison or simply plant cells, nerve cells, and talking about cell walls and photosynthesis.

(b) The question asked candidates to relate the unique structure of the cell to its specialist function. To achieve full marks candidates needed to clearly state the cells specialist function. Less credit was given where candidates listed structures, such as the nucleus, and related them to general cell function. With regard to high surface area, half (½) a mark only was awarded if it was mentioned but not related to shape or the projection from the cell. The majority of candidates who referred to surface area mentioned it in terms of the high surface area to volume ratio conferred by the cells unique shape.

It was evident from a small number of candidate's answers that they did not recognise the location or orientation of the cell and some candidates listed vitamins with water and minerals as taken up by the roots.

Question 12

(a) In each case osmosis has occurred (½) which is the movement of water from a dilute solution to a stronger solution through a semi permeable membrane (1).The potato strips in concentrations 0.0 and 0.2 - treatments **A** and **B** - are evidently hypotonic solutions (½)) having absorbed water and increased in length (1).The potato strips in concentrations 0.4 and 0.4 - treatments **C** and **D** - are evidently hypertonic solutions (½)) as they have lost water and shrunk (1).The greater concentration gradient in treatments **A** and **D** caused an greater rate of water gain or loss than has occurred with in treatments **B** and **C** hence a greater change in length (1).

(b) 0.3 units

Comments

(a) Most candidates correctly explained the effect of the treatments in terms of osmosis. A majority correctly explained the lengthening of the potato strips in treatments A and B and the shrinking in treatments C and D. Many did not explain the differences in increased length between treatments A and B and shrinkage between treatments C and D. Where explanation was limited to pointing out that one was more or less concentrated than the other, half (½) a mark was awarded. A number of candidates gave simplistic explanations of osmosis such as 'water moves to compensate for high salt concentrations' and 'cells wish to be isotonic with their environment'. Some incorrectly interpreted the information as an example of osmoregulation. Others referred to the solution, rather than water, moving into or out of the cell. Some pointed out that salt would tend to diffuse in the opposite direction to the movement of water. A small number of candidates suggested that the movement of salt was responsible for the changing length of the strips.

(b) A large majority of candidates correctly estimated the natural internal salt concentrations of the potato cells.

Question 13

(a) (i) **B** is an endocytotic vesicle (or food vacuole) (1). Food is being digested (½) using enzymes from lysosomes (½) and nutrients being absorbed into cell (½).

(ii) The process is exocytosis or egestion (1). Undigested material is being removed from the cell (1).

(b) Structures **A** and **C** are both contractile vacuoles (1). Because the cell lives in fresh water (hypertonic environment), water constantly enters the cell by osmosis (1). In order to maintain constant water balance with its environment the cell must osmoregulate (½), that is, pump water out at the same rate as it is entering or pump out excess water (1), which prevents the organism bursting (½). This is achieved by the contractile vacuole filing with water (which involves active transport (½)) then expelling its contents outside the cell when it is full (shown at **C**) (1).

Comments

(a) (i) Generally well answered. Many candidates proposed that the structure was a lysosome, which contained enzymes involved with the digestion of the food particles and gained up to 1 mark.
(ii) Also well answered, with many candidates getting full marks. Credit was given for saying the cell was excreting leftover wastes (½), or writing about phagocytosis (up to 1 mark).

(b) This part was very well done on the whole with most candidates gaining at least 3 marks. The mode for the whole question was 7 marks out of 8. However there were a small but significant number of candidates who argued that the contractile vacuoles job was to keep the cell as isotonic as possible.

Question 14

In multicellular plants and animals mitosis is involved in asexual reproduction (½) and produces cells with the same number of chromosomes as the parent cell (½). It is responsible for growth and repair (½), both processes not requiring any change in chromosome number (½). In multicellular plants, growth (hence mitosis) takes place in specialized regions, called meristems (½), such as those found near growing tips and roots (½). Growth in animals occurs in a whole range of tissues throughout the body (as most cells are being renewed on a regular basis) (1). Mitosis enables damage or worn out cells to be replaced (½), such as occurs at the site of a wound, the lining of the gut or bone marrow replacing blood cells (½). Mitosis is ideal and cell replacement as it produces cells with the same DNA and so is best suited to do the same job as the cell it replaces or a similar job in the case of cell growth (1+). Meiosis, in which the chromosome number is halved prior to fertilization (haploid (½), produces gametes (½) for sexual reproduction in both plants and animals (½). This only occurs in the gonads (testes and ovaries) of animals, and in the anthers and ovaries of plants (flowers also accepted) (1). The full diploid chromosome number is restored after fertilisation takes place (½).

Comments

This question separated the candidates well, and most managed to get 3½ marks or more. This was in part due to the sheer volume of information written by many candidates. Credit was also given where candidates compared the advantages and disadvantages of sexual

versus asexual reproduction, even though this was not strictly covered under the criterion. However there was a lot of restating the information in the question without really explaining the significance of what was taking place. The best answers addressed both the reasons why each type of division was suited to its purpose as well as the specialised regions involved. Little to no credit was given for simply listing the stages of mitosis and/or meiosis or including a diagram that didn't really address the question or show any understanding. Some candidates were misled into thinking that mitosis occurred in all cells.

Note: As candidates are not expected to know about alternation of generations answers to the last part need only be expressed in general terms.

Part 4 – Criterion 9

Question 15

(a) The cell in **B** is one of the epithelial cells (1) OR **B** is one of a single layer of cells (1) on the surface of the villus (1) shown in A. OR on the lining of the small intestine (½), which increases its surface area (½) An arrow with a box placing **B** appropriately onto **A** was given 1 mark, but no further marks were given if the worded description simply described the same relationship without giving any further information.

(b) **A** ½ mark was allocated for each (small) point as listed below. Up to 4 marks could be earned by referring to structures on a tissue/organ level. At least 2 marks had to be earned by referring to cellular organelles or characteristics of cells.

The villi and microvilli (½) provide a large surface area (½) required for absorbtion of nutrients by diffusion (½) and active transport (½) and for release of enzymes (½). The single layer of cells minimizes the distance the substances have to travel (½) by diffusion into the bloodstream (½). The extensive network of capillaries (½) and the lacteal (½) remove the products of digestion (½) maintaining a concentration gradient (½) which makes diffusion more efficient (½). Amino acids and monosaccharides (½) move into the capillaries (½) and are transported around the body to where they are needed (½). Fatty acids and glycerol (½) move into the lacteal (½) and are carried through the lymph system (½). Microvilli (½) further increase the surface area for absorbtion (½). The numerous mitochondria (½) provide energy (½) in the form of ATP (½) via cellular respiration (½) for active transport (½) of substances against the concentration gradient (½) once the concentration in the lumen has dropped below that in the cell (½).

Comments

(a) Most candidates answered quite well. A few did not recognize B as a cell. Some thought the question was entirely about surface area to volume ratio and wrote a lengthy, often repetitive answer elaborating on this. They were unable to score more

than 3 marks, usually less. A few thought the diagram was of a nephron. These were given some marks for parts of their answer that referred to surface area to volume and the movement of substances, or to the thin layer of cells and diffusion. Marks were not given for points relating to other parts of the digestive system (ie chewing to increase surface area). To get full marks, the candidate had to indicate that B was a cell otherwise not more than 1½ marks were allocated.

Exceptions were made if the candidate gave a full answer, and clearly indicated in part (b) that B was a cell. A number of candidates were not aware of this - some even thought B was a diagram of the entire digestive system.

(b) This question separated the candidates but was not done as well as expected. Very few candidates earned full marks and a very significant number scored 3 marks or less with many candidates repeating themselves.

Question 16

The form of nitrogenous waste excreted and the concentration of urine depends on the water balancing needs of the organism (1). In the freshwater fish, water constantly enters by osmosis and needs to be removed by the production of dilute urine (1). This volume of urine enables freshwater fish to dilute the (very soluble) toxic ammonia to safe levels (1). In the marine fish, water tends to leave the body by osmosis, so marine fish need to conserve water by producing concentrated urine (1). They also avoid the toxic effects of ammonia by converting ammonia to the soluble but less toxic urea (1). The terrestrial mammal also needs to produce concentrated urine because its only water intake is by drinking (1). As with marine fish, terrestrial mammals also have to avoid the toxic effects of ammonia by converting their nitrogenous waste to urea (1).

Comments

Candidates were asked to explain the difference in urine concentration for the three types of organisms given in the table. This required discussion of the water balancing needs for each organism (1 mark) plus the reason for the type of nitrogenous waste being produced by each organism (1 mark). This is reflected in the marking scheme (with two marks per organism). Some credit was also given to candidates who included discussion of hypotonic (freshwater) and hypertonic (marine) environments; the necessity for the input of energy to convert ammonia to urea; the role played by the gills of fish (for diffusion and active transport); differences in water and protein intake in the diet; plus differences in kidney nephron structure and function for the three organisms.

Question 17

The size of an animal affects its surface area to volume ratio (1). Generally, a small mammal (with a low body mass) will have a significantly higher surface area to volume ratio than a larger mammal (1). Since heat is mostly lost to the environment through radiation from the outer body surface, a small mammal such as a mouse (which has a very high surface area to volume ratio) will have a much faster rate of heat loss per kilogram of body mass than a larger mammal (1). All mammals need to maintain a constant body temperature, which is usually higher than that of the environment, and they usually do so by (predominantly) endothermic means (1). Hence all of the mammals listed in the table have to use metabolic activity to replace lost heat (at the rate at which it is being lost) (1). Being the smallest mammal, the mouse has the greatest heat loss (per kg of body mass) so it must also have the highest metabolic rate (1).

Comments

Most candidates mentioned that the mouse has the largest surface area to volume ratio. However, not many candidates were able to clearly articulate the effect that this has on the rate of heat loss and subsequently articulate the link between the higher rate of heat loss (per kg of body mass) and a higher metabolic rate. Some credit was given for mentioning that differences in body shape and the amount of insulation also affects the rate of heat loss and that a significant amount of heat is generated in endothermic organisms by cellular respiration (which requires oxygen). The majority of candidates were able to demonstrate some understanding of the main concept (the effect of surface area to volume ratio on heat loss) and more that 65% of candidates gained at least 2 marks (out of a possible 4 marks) for this question.

Question 18

(a) If the allele for white is sex linked recessive,
III 1 must be homozygous white (½)
One of her alleles for white would have to come via an X chromosome from **II 2** (1)
Being male, he would only have one X chromosome (1)
Hence he would be white (½). This contradicts the given data.

(b) If the allele for white is sex linked dominant,
I 1's single X chromosome would carry the dominant allele for white (1)
This X chromosome would be passed on to **II 1** (1)
II 1 should be white also (1). This contradicts the given data.

(c) Yes – it is possible to distinguish. White must be autosomal recessive (½).
Evidence: cross between two normal tigers **(II 1 and II 2)** results in a white tiger (1)
trait skips a generation (1)
This is only possible if the allele for white is recessive and **II 1 and II 2** are heterozygous (or carriers) (½)

Comments

This question proved to be very challenging for candidates with many scoring 0. Some candidates did not understand which symbols represented male and female. A few read the pedigree from bottom up. In general candidates are advised to ensure that genetics answers include full explanations and if they choose to show working, such as Punnet squares, then these should be large enough for the examiner to read and credit. Also it was important to refer to the pedigree in the answers.

(a) Quite a lot of candidates scored 2 on this question but few were explicit in stating that the male only has one X chromosome

(b) This question was better answered because it can be proved that the allele is not dominant even if candidates did not really understand sex linkage.

(c) Many candidates explained why the trait was not sex linked, many could gain 1 or 1½ but few explained fully that **II 1** and **II 2** must be heterozygous. Some credit was given for just saying 'skips a generation.'

Question 19

V*ariable*:	blood glucose level, (½).
Sensor:	pancreas is sensitive to this rise (1) If blood glucose levels rise (½) pancreas responds by releasing insulin (½)
Effectors:	which respond to the insulin are cells in the liver and muscles (1). They respond by absorbing more glucose from the blood and the liver converts excess glucose to glycogen for storage (1)
Response:	blood sugar levels drop resulting in *negative feedback* as the response has reversed the change in variable (1)

If blood glucose level falls, pancreatic cells release glucagon (½) which causes stored glycogen to be broken down into glucose, thus reversing the change (1). (Note: 7 possible marks)

Comments

Candidates fell into two groups in relation to this question. A significant number scored very poorly because either they had no idea what the question was about or because they rewrote the diagram in words with no reference to the control of blood glucose levels. The other group answered it well with many scoring 5 and 6 marks. Information or diagrams obviously copied exactly from cheat sheets with no application to the question received fewer marks.

Part 5 – Criterion 10

Question 20

(i) (i) reduce water loss (1)
(ii) **I** Vertically hanging leaves reduce exposure to direct heat from the midday sun (1) and therefore reduces evaporation from the leaves.
II Hairs on leaf trap a layer of moist air close to the surface of the leaf (1) whilst reducing evaporation / transpiration rate.
III Reduced leaves have a smaller total surface area through which water can evaporate. (1)

(a) ___ Species B (½)
----- Species A (½)

Mangrove species A would be covered by seawater regularly during high tides (½) and the receding seawater would leave salt deposits on the leaves as the water evaporated. (1) OR the plant would need to actively remove excess salt which would enter it and the leaves would be involved in this. (1)

Mangrove species B has less access to water being closer to land and needs to reduce water loss. The waxy cuticle reduces evaporation from the leaf surface (1½)

Comments

(a) (i) Other answers included: osmoregulation (1), reduce transpiration (1), survival (½), water conservation (1). Some candidates wrote a dictionary response of what adaptations in general achieve. These candidates were given half marks.
(ii) **I** Other answers included – less exposure (½), the leaves are sheltered from the sun by the branches (½). Quite a number of candidates wrote that the benefit was that the rain would drip off the leaves and fall down to the roots of the plants. (0 marks).
II Good answers mentioned the humidity surrounding the leaves would increase and how the concentration gradient of the water is reduced. Other answers given credit included helps reduce the amount of air moving over the leaf reducing the amount of evaporation (1), increases the amount of light being reflected and so reduces the heat the plant is exposed to. (½)
III Other answers mentioned that smaller leaves reduced the SA:Vol ratio which reduced evaporation and hence water loss (1), decreased SA (½). Some candidates thought that reduced leaves increased the SA:Vol ratio and hence evaporation. (0)

(b) This question was not well answered, and responses were not detailed enough. Answers that merely said, because they are near the sea, or because they are close to land did not receive any credit. Some candidates interpreted the low water mark and high water

mark as meaning availability of water and did not notice the sea and land on the axis. However, some credit was given here if the explanations were provided as above. Many suggested that the species near the sea actively covered itself with salt crystals to control water balance, and no marks were given. Some marks were given for well explained responses suggesting the value of the waxy cuticle to prevent water loss for the species existing between high and low tide.

Question 21

(a) Autotrophic organisms (plants and some bacteria) convert inorganic molecules such as CO_2 and H_2O into organic molecules (sugar) through photosynthesis (1). Autotrophs are the producers in an ecosystem and all other organisms depend directly or indirectly on them as a source of food (1). The location of the autotrophs for the ecosystem described would be the plants outside the caves that the insects feed on (the bats' food) (1).

Other Accepted Answers:
Autotrophs are self feeders (½)
Producers can photosynthesise (½)
There are no autotrophs in the cave ecosystem described (½), autotrophs need light so that they can photosynthesise (½)

(b) Bacteria and fungi are acting as primary consumers in this ecosystem (½) and they provide food for other consumer organisms (½). Usually bacteria and fungi act as decomposers (½) and return inorganic nutrients back to the soil for use by producers (½).

Other Accepted Answers:
In this ecosystem and in other ecosystems, bacteria and fungi act as decomposers, breaking down organic matter into inorganic nutrients (1).
The niche of the bacteria and fungi is to provide food for consumers in the dark, moist environment of the cave (1).
Bacteria and fungi are consumers; usually they are decomposers (1).

(c) As energy flows through an ecosystem the majority is lost as heat, used up for movement and digestion etc, or made unavailable to consumers as faeces, bone, hair etc (1). As a result, less energy is available at successive trophic levels to sustain large populations (½). Springtails/millipedes/blind cave beetles have relatively high population numbers because they are primary consumers and the energy available at this trophic level is relatively high. Tertiary consumers such as the cave spiders cannot maintain high population numbers because very little energy is available at this upper trophic level ($1^1/_2$).

Other Accepted Answers:
As you move up the trophic levels, organisms generally become larger. Larger animals, such as the Cave Spiders, do not have the energy available to them to maintain large populations. Whereas smaller organisms, such as the blind cave beetles – which are at a lower trophic level, don't have the same energy demands as larger organisms and therefore can maintain higher populations (2).

Comments

This question proved challenging, but also helped to discriminate well between candidates. There was a lot of confusion between whether the question was referring to the written description of the ecosystem or the diagram of the food web. This confusion flowed into part (b) with many candidates continuing to think that the fungi/bacteria were the autotrophs.

(a) Common Mistakes:
- 'Guano is the producer in this ecosystem'.
- 'The producers would be located just above the guano'.
- 'Bacteria and fungi are autotrophs'.
- Many candidates failed to recognise that organic matter was brought into the cave from producers living outside it.

(b) Common Mistakes:
- 'In this ecosystem the bacteria and fungi are producers.'
- 'The bacteria and fungi prefer light environments so that they can photosynthesise.'

(c) Common Mistakes:
- describing the numbers of organisms without giving any reasons or explanation
- many candidates explained how energy was lost but didn't relate it to the data and only received half marks

Question 22

(a) (i) At 10˚C, answers between 4.2 and 4.8 days were given 1 mark.
Answers between 4 and 4.1 days **OR** 4.9 and 5 days were given ½ marks.
(ii) At 30˚C, answers between 0.75 and 0.79 days were given 1 mark.
Answers of 0.74 **OR** 0.80 days were given ½ marks.

(b) 2.2 – 26 days (1) **OR** stated as a single figure - 23.8 days (1)

(c) Different species may develop at different rates (1). Different temperatures may affect different species differently (1). Eggs of different species may take different times to hatch (1).

Temperature may have varied since the rabbit died (1 mark). Eggs may have been laid some time after the rabbit died (i.e. not at time of death) (1 mark). There may have been larger larvae that have pupated/left/been eaten (1). Should have measured a number of larvae, as the one selected that might not be representative (1). There is no curve for an 8 mm maggot, so the estimate is not reliable (1). Any other reasonable suggestions gained appropriate marks.

Comments

(a) & (b) Candidates didn't interpret the graph accurately. They were too general with their ranges and the majority of the candidates did not state the units (days).

Common Mistakes:
2 – 25 days was a very common answer despite the 17mm graph starting well above the 2 day mark.

(c) (i) Most candidates gained at least one mark, but many found it difficult to find two reasons.
(ii) Well answered overall.

Question 23

(a) Speciation, the development of new species (1), is less likely to occur if the environment of the new population is as close as possible to that of the original population (1). Island **M** is more like the mainland because it is not covered by rocky outcrops and it does have trees. These would be significant in providing similar protection from predators and nest sites (1). Therefore, similar selection pressures should operate (1). The lack of birds on island **M** would reduce competition, which would be another selective pressure (1). Island **M** is larger so more birds could be used to establish a larger colony (1). This would help ensure that the genetic variability of the new population is more likely to match that of the original population (1). However the gene pools of the two populations may diverge due to the reproductive isolation and differences in environment, even when these differences appear to be small. Hence populations established on either island might show some changes in characteristics from the mainland population which may ultimately lead to speciation (1). Any other credible reason that relates to the situation described (1) – up to a total of 6 marks.

(b) The leaf litter in the forest provides a dark environment in which dark brown spiders have a selective advantage (1), meaning that they are less likely to be eaten by predators (1). Similarly, the light grey spiders would be better camouflaged in bright light, against dry grass (1).

Comments

(a) A large number of candidates did not discuss enough points, or provide enough detail, to gain good marks in this question.

1 mark was awarded to candidates who recognised that the fact that M is further from the mainland may increase the likelihood of speciation, as there is less chance of gene flow between M and the original population.

Common errors/misconceptions included:

- 'being in a different environment will **cause** mutations' (mutations are random, spontaneous, or induced by mutagens)
- 'interbreeding with other birds (of same or different species) will cause speciation'
- 'there are **no** selection pressures operating if the environment is the same as the mainland' (There are always selection pressures operating. If the environment is the same, you would expect the same types of pressures – i.e. the same phenotypes being selected for/against – to exist)

(b) The most common error was to confuse 'cause' and 'effect', mistakenly saying things like 'the dark spiders chose to live inside the forest because they are camouflaged there'. Rather, the fact that they are camouflaged in the forest means that they are more likely to survive in that environment. Some candidates didn't explain the distribution of the two populations but simply described it. A large number of candidates confused 'predators' and 'prey' ('so they will not be eaten by their prey').

All correspondence should be addressed to:
Tasmanian Qualifications Authority
PO Box 147, Sandy Bay 7006
Ph: (03) 6233 6364 Fax: (03) 6224 0175
Email: reception@tqa.tas.gov.au
Internet: http://www.tqa.tas.gov.au