Biology 5C

Subject Code:BIO5C

2004 External Examination Report

General Comments

The feedback regarding the examination was positive and it was felt that it gave most candidates a chance to show what they knew and that it was particularly good for borderline candidates. The only concerns were whether it would allow the more capable candidates to stand out, a couple of questions that were difficult to relate to for the average candidate and a lack of longer answer questions.

The paper was fairly uniform in standard, with most sections having similar cut offs. The cut offs were generally higher than usual to take into account that marks were easier to gain than usual. It was felt that the cut offs reflected the standard of the answers and once again the experimental design section (Part 1on criterion 4), on the whole produced work of a very high standard.

The assessment panel was satisfied that the combination of exam and external marks separated the candidates well into the different awards, with the exception of the EA's. More EA's were given than normal, and this can be attributed to two factors. Firstly there were not enough appropriate A standard questions in the exam to distinguish the top candidates, so there were larger groups of candidates bunched together with high marks and so hard to separate. Secondly there continues to be a continuing trend of giving higher internal grades, so that a considerable percentage of candidates go into the exam with the potential to gain an EA. It is very concerning for the adherence to the given standards that only one candidate in the state was given a 't' for criterion 3.

Written Examination

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

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

Part 1 – Criterion 4

Question 1

(a) (i) The independent variable in the hypothesis is pH.

(ii) Dependent variable – rate of fermentation

Or - temperature (only $\frac{1}{2}$ mark).

(b) Flasks 1 and 4 would need to be compared ($\frac{1}{2}$ mark).

- These flasks have solutions of different pH (½ mark) but the temperature (1 mark) is the same for each.
- If incorrect flasks were listed and mention of different pH given (only _ mark).

(c) Using only one flask will make the sample size too small (½ mark). This does not allow for errors/anomalous results (½ mark) and hence the hypothesis cannot not be adequately tested. No valid conclusions can be made (1 mark).

If the alternate suggestion to one flask was given as two or a few more, then ½ mark was deducted since this did not emphasise the need for a large sample size.

(d) Factors kept constant were:

- Amount of glucose used (½ mark)
- Amount of yeast used (½ mark)
- Temperature was also accepted when referenced against part (b) in the question.

Reason:

It is essential to control all variables other than the experimental variables so the effect of altering the independent variable on the dependent variable can be seen (1 mark).

(e) Acceptable hypotheses are:

The higher the temperature, the more rapid the rate of fermentation of glucose by yeast cells.

Or

The rate of fermentation in yeast cells increases with temperature.

If IV and DV clearly identified (1 mark). If clear direction of experiment in hypothesis given (1 mark)

Comments

This question was very well done overall.

(a) This part was well done and only a few candidates confused the difference between the dependent/independent variables.

(b) This part was well answered.

(c) Many candidates gave answers as expected but others mentioned replicas and repeating experiments instead of focussing on the topic of sample size and the need for that to be very large.

(d) Most answers correctly identified the two fixed variables but some did not give a relevant reason.

(e) Hypotheses were generally well done.

Marks were deducted:

- if candidates only restated the pH and rate of fermentation relationship already given in the question.
- if the term 'rate' was not included.
- if the term 'yeast' was not included.
- if the term 'effect' was included instead of the causal 'increase.... to increase...'

Question 2

Select 70 hydrangeas (or hydrangea seeds) from a similar genetic stock (½). Using a standard soil mix and solutions of different pH produce seven soil types of different pH ranging from pH 4 to pH 10 (½). For each pH plant 10 hydrangeas in separate identical pots (½). Place all plants in an identical environment controlling the 'constant' factors listed in the question description (½). All other variables such as CO2 concentration and temperature must also be controlled as they might influence the independent variable (½). After the plants flower, compare the flower colour of each plant against a standard colour chart (½). Compare flower colour within each pH group and between groups to determine if the hypothesis should be accepted or rejected (½).

Results that would support the hypothesis – Flower colour did not vary significantly within each pH group (½) but did vary for each point on the pH scale between pH 4 and pH 10 (½).

Results that would negate the hypothesis – Flower colour did not vary for each point on the pH scale between pH 4 and pH 10 (½) OR at least two soils of different pH consistently produced flowers of the same colour (½).

Bonus marks were given if candidates provided extra information relevant to the experimental set up or indicated potential problems that could have influenced the outcomes of the experiment. For example:

- The benefits of using a large sample size and the problems of recording data if sample size is too large.
- The problems of using a number of people to classify flower colour without the use of a reference chart.
- No specific treatment needed to be used as a control group as each treatment acted as a control for previous and subsequent treatments.
- The need to repeat the experiment several times to validate the data.

Comments

Candidates generally coped well with this question and most candidates had a clear understanding of how the experiment needed to be designed. The few problems that were noted include:

- A lack of detail about sample size and replicates used. Some candidates used no replicates for each treatment and many did not state a suitable sample size or merely stated 'use a large number of plants'.
- Many candidates did not test each point on the pH scale from pH 4 to pH 10. Often these candidates only used three soil treatments (acidic, neutral and alkaline) preventing the data that was collected from being used to support or negate the stated hypothesis.
- Several candidates tested a pH range of pH 0 to pH 14 and used pH 0 as the control group for the entire experiment.
- Some candidates lost marks for failing to provide a method for flower colour comparison.
- A number of candidates did not mention specific results that would either support or negate the hypothesis. Some candidates only mentioned that they either expected the hypothesis to be supported or negated.
- A number of candidates simply stated that flower colour changed and failed to mention that for the hypothesis to be supported that flower colour needed to change for each point tested on the pH scale.
- Some candidates stated that for the hypothesis to be accepted there would be a gradual but noticeable change of flower colour from blue at pH 4 through to mauve, pink and red as pH increased up to pH 10. This was correct. However, they then stated that if the gradual but noticeable change was in the opposite direction (i.e. changing from red to blue as pH increased) that this would negate the hypothesis when actually it would also support the hypothesis.

Question 3

(a) As a control ($\frac{1}{2}$) to compare the effect of using a liquid containing lactase to that of only distilled water (1). Therefore any differences in results can be attributed to the presence of lactase ($\frac{1}{2}$).

OR

As a placebo ($\frac{1}{2}$) to keep the milk volumes the same (1), preventing the treatment group from being identified by the participants ($\frac{1}{2}$).

OR

As a placebo or control (1) to compare the effects of lactase on the reduction of colic symptoms with distilled water ($\frac{1}{2}$). Distilled water was used as it has minimal effect on the human body ($\frac{1}{2}$).

(b) (i) Ethics

- All proposed human experimentation needs to pass before an ethics committee for approval before proceeding. If participants are likely to suffer in the experiment, approval might be difficult to obtain (2).

- Ethically it is wrong to harm humans or any animals during experimentation and the control group of babies in this experiment will continue to suffer from colic without receiving any treatment to reduce their symptoms (2).

- There might be significant problems in finding mothers willing to volunteer their babies for the experiment if the experiment is deemed unethical because of prolonged suffering from colic within the control group (2).

- All participants in the experiment would need to give their informed consent prior to participating. Babies are too young to understand the implications and possible undesirable consequences of being involved in such an experiment. Is it ethical for them to participate in an experiment that could be detrimental to their health without them giving their consent? (2)

(ii) Methodology

- Genetic variation, weight, age and sex of babies involved in the experiment will be variable and this could influence the rate of symptom reduction. A large sample size would be needed to accommodate these differences and may be difficult to obtain (2).

- Measuring colic symptoms is very subjective and babies with the same degree of colic may respond differently to the illness. This would make it difficult to assess the effects of the treatment accurately (2).

- Environmental variation (e.g. room temperature, humidity etc) as well as factors such as amount of sleep and other food intake can influence the results. These variables would be difficult to control for all participants (2).

- The large number of babies needed for a valid experiment would require a number of medical professionals to observe and record the data. Problems could be encountered through individual biases of different team members (2).

(c) A good follow up experiment would investigate the optimum levels of lactase for relief of colic. This could include varying the concentrations and/or time intervals. (2 marks)

Up to 2 marks was also given for other follow up suggestions including investigating:

- the actual cause of colic and/or the way that lactase acted to reduce its effects
- the duration of colic symptoms with breast feeding and/or levels of lactase in breast milk

Usually 1 mark was given for:

- suggesting investigation of the continuation or long term effects of colic
- repeating the experiment, with larger numbers or swapping group A & B

Comments

(a) Generally this question was well answered. The majority of candidates recognised that the distilled water group was the control group or was to be used as a placebo. For full marks candidates needed to mention that it was the control group and it was used to compare to the lactase treatment to make sure that the colic symptoms were being affected by the addition of lactase to the milk and not a change in solution volume.

If candidates failed to mention why it was compared to the lactase treatment, why volume needed to be controlled or why distilled water was used instead of more milk, they would possibly have lost half a mark depending on the quality of the remainder of their answer. Candidates were given partial credit for saying the addition of distilled water diluted the milk to a similar level as the treatment group. No credit was given for answers that stated the milk was diluted with distilled water to make it easier to digest.

(b) Again, this question was well answered by most candidates. Candidates needed to state only one significant difficulty for each of the ethics and methodology parts of the question. Some candidates described two significant difficulties for each part of the question. These candidates would have received full marks if each difficulty described was deemed to be significant. Candidates who mentioned more than two significant difficulties were given credit for the best one or two difficulties described.

If only a one or two word answer was provided or the answer was not particularly well reasoned then the candidates would have lost marks.

Many candidates lost marks if the significant difficulties faced by the researchers were unclear or if the difficulties could be easily fixed with a small change in methodology.

(c) Most candidates came up with a reasonable answer, although it was evident that a proportion of them did not understand the nature of colic as many suggested long term studies or trying the treatment on older age groups. Usually 1 mark was given for valid revisions of the old experiment, but candidates had to introduce a new element such as varying the dose rate to gain full marks.

Question 4

(a) (i) As the depth below the surface increases the net oxygen production decreases (1 mark).

(ii) Hypothesis:

Light penetration decreases with depth resulting in reduced photosynthesis by the algae in the Southern Ocean community. (3 marks) with $\frac{1}{2}$ mark given for including some of the specifics such as algae &/or Southern Ocean location. 1 mark minimum for an hypothesis relating net oxygen production to depth, more if they used light available &/or photosynthesis by the algae.

Alternative hypotheses (2-2 $\frac{1}{2}$ marks):

- Fewer algae in deeper water and therefore less photosynthesis/ net oxygen production.

- Greater respiration by community at increased depth resulting in lowered net oxygen production.

(b) Stronger validity: Data combines readings from many sites in various places around the world's oceans, combining the information from all depths, which gives a more valid picture of what is happening as the large sample size and range of sites compensates for individual/chance variation.

Weaker: The samples are taken in a wide range of locations, which would experience highly varied seasonal and weather conditions affecting light availability, water temperature, turbulence and gas concentrations that impact on photosynthesis and respiration. 1 mark was given for discussing that the graph was harder to draw meaningful conclusions from or for saying that as the data was combined for all the depths you could not be sure how depth affected the results.

Comments

(a) (i) A fair number of candidates misread the question and addressed the relationship between net oxygen production and oxygen production. Others included details of the data or descriptions of the type of relationship, but this was not required for 1 mark. Others wasted time trying to explain the relationship.

(ii) A large proportion did little more than restate the observations about the relationship between depth and net oxygen production. Candidates were given half marks if they stated that it was the algae that were responsible for the increase in net oxygen production at lesser depths. The better answers addressed probable underlying causes, notably the change in light and which affected the rate of photosynthesis by the algae.

(b) Most candidates made a reasonable attempt at this part of the question. However some got side tracked with insignificant differences between the graphs such as the units of measurement and that one measured respiration and photosynthesis and the other net oxygen production and oxygen production, when in reality they are very closely related.

Part 2 - Criterion 6

Question 5

(a) X:thymine
Y:cytosine
Marks:(1/2)mark for each correct base.

(b) (i) DNA replication

Marks: 1 mark. Half mark for muddled answers like 'DNA replication (transcription)'. No marks for 'Transcription (replication)'.

(ii) Both new DNA strands are identical to the original parent strand (1 mark).

This ensures that correct genetic instructions are passed on to each new cell formed as a result of cell division. (1 mark)

Other relevant statements given credit included:

'Original DNA strand acts as a template (or blueprint) from which new strands are copied (thus ensuring 100% accuracy)'.

'The original strand is a template which is preserved for future use, and never lost'.

'Reduces the risk of mutations occurring' or similar ideas.

(c) Base sequence codes for the sequence of amino acids in proteins synthesised by the cell. Three bases in a precise order on the DNA strand code for each amino acid. Thus the base sequence determines exactly which proteins can be produced.

Marks:(1/2) mark for each point in a sensible answer, up to a maximum of 2 marks.

Relevant points given credit also included the following:

Further details of the process by which the code is transcribed and translated (so long as these were clearly related to importance of base sequence).

This included ones which related the sequence of bases to:

- the role of the proteins created, e.g. for specific enzymes or structural proteins, and/or one gene, one enzyme/protein.
- determination of the characteristics of whole organism and variations in base sequence create variation between individuals in populations and between species.

Comments

(a) Was well answered, with most candidates getting the full mark. A number of candidates gave 'uracil' instead of 'thymine'. No marks were deducted for poor spelling, but candidates should make an effort to use the correct biological names.

(b) (i) Well answered, with most candidates able to identify the process correctly.

(ii) This was a good challenging question, and only the most capable candidates gained the full 2 marks. Many candidates were able to recognise that semi-conservative DNA replication produces two identical DNA molecules, and some could extend this concept by stating that mutations are minimised, but few could see the significance of this, as the newly synthesised DNA molecules are incorporated in the nucleus of each new cell, both present and future.

There were 3 common major errors. One was a failure to read the question &/or understand the word 'significance'. These candidates did not address the question at all, merely repeating the information in the question, with further details of exactly how DNA replication occurs.

The second common error was to launch into a description of protein synthesis, which was not part of the question. These answers also scored zero for 5 (b)(ii), but the knowledge and understanding shown here was given credit as part of the candidate's answer to (c).

The third common error was to confuse this process at the molecular level with various processes at the cellular, individual or population level (e.g. mitosis, meiosis, fertilisation, creation of variation, evolution). These answers showed major misunderstandings and attempted to introduce information relating to other criteria rather than criterion 7.

(c) This was well answered, with many candidates gaining the full 2 marks, and giving information beyond what was required. The question was correctly interpreted by virtually all candidates. Knowledge and understanding of the processes of protein synthesis were excellent.

Question 6

(a) (i) Answer:37-38˚C (1 mark). 36˚C and 39˚C received a half mark.

Wider variations were given no credit, as it was assumed that this was a very easy question, and that candidates would be familiar with normal human body temperature.

(ii) One mark for each factor. Any of the following were given credit:

- 'Enzyme subjected to temperature well outside optimal range.'
- 'Enzyme subjected to pH well outside optimal range.'
- 'Enzyme denatured (by excessive heat or extreme pH), such that substrate cannot enter the active site.'
- 'A non-competitive inhibitor has changed the shape of the enzyme such that the substrate cannot enter the active site'. (Examples of inhibitors and metabolic poisons, such as cyanide, nerve gases, organophosphate insecticides, arsenic, mercury, lead were also given credit).

(b) (i) Answer: Enzymes are substrate-specific, due to the precise shape of each enzyme's active site. Each molecule in the pathway has a different chemical structure, and hence a different enzyme is needed to catalyse each separate reaction in the pathway.

Marks: One mark given for the concept that enzymes are 'substrate-specific'. Half marks for the other points, up to 2 marks in total.

(ii) Answers needed to address the issue of why 'stepwise chemical pathways' are important. This could earn one or two marks, depending on the answer.

'A lot of important reactions are complex and involve making a number of discrete chemical changes resulting in a lot of intermediate compounds, which requires a series of enzymes to catalyse each sub-reaction.'

Credit was also given for any of the following points in relation to stepwise pathways:

- 'In a reaction such as respiration, many small steps allow energy to be released a little at a time rather than all at once.'

- 'If the energy of glucose was released all at once, much of this would be lost from the system, in the form of heat. Small steps allow the energy to be captured as ATP.' Or variations of this.

- 'Stepwise pathways can be controlled or regulated: as the concentration of certain products build up, the products inhibit the enzyme catalysing their production.'
- 'Precise regulation of stepwise pathways enables the production of individual chemicals by the cell to be varied in accordance with the changing needs of the organism.' Or variations relating to the regulation of chemicals at optimum concentrations.

In relation to enzymes, a maximum of ONE mark was given to answers that discussed the way enzymes work through lowering the activation energy of reactions, and enable reactions which would not otherwise occur or take place too slowly in living cells.

Comments

It was astonishing how many candidates had no idea of human body temperature. Suggestions ranged from 17˚C to 50˚C.

Well answered. Most candidates had a clear understanding of enzyme structure and sensitivity to damaging factors. Many showed good understanding of the action of inhibitors, including the difference between 'competitive' and 'non-competitive'. Many were able to give specific examples of these.

Well answered, showing good understanding of enzyme structure and function.
Most candidates showed good knowledge of the role of enzymes in catalysing reactions, but only the stronger candidates had a good grasp of the significance of stepwise pathways.

Question 7

(a) (i) Interval A Aerobic respiration ½ mark
Interval B Anaerobic respiration ½ mark

(ii) Lactic acid (or Pyruvic acid) 1 mark. (Not ethanol as CO2 levels do not increase in the graph.)

(iii) Process: Aerobic respiration 1 mark
Respiration ½ mark

Reason: During aerobic respiration, glucose is broken down to CO2 and water which contain no more energy accessible to the cell whereas the end product of anaerobic respiration – lactic acid still contains energy.

(b) (i) Protein synthesis, changing glucose to glycogen, urea synthesis, production of bile, detoxification of drugs or alcohol. Any 2 for ½ mark each.

(ii) Glucose has to be broken down to release energy whereas energy is liberated in a single reaction ATP → ADP + Pi + energy, and is immediately available.

Comments

This question was well answered with many candidates gaining full marks. Credit was given to other more suitable answers where appropriate.

Question 8

(a) (i) Oxygen is a product of photosynthesis 1 mark

(ii) Plants were kept in the dark, ½
therefore photosynthesis did not occur ½
Respiration continues at all times ½
This process consumes oxygen, therefore oxygen levels dropped. ½

(b) The plants are kept in a closed box ½
carbon dioxide supply is very limited ½
low levels of carbon dioxide act as a limiting factor on photosynthesis. ½
rate of photosynthesis limited by the amount of oxygen produced by respiration ½

Candidates who gave a good explanation of limiting factors on photosynthesis, including CO2 but did not tie this in to the plant being closed in the box, scored 1 mark. Those who talked about a limited capacity for photosynthesis based on various factors but did not mention carbon dioxide scored a ½ mark.

Comments

(a) (i) Most answered this well and many gave more detail than they could be given credit for. A few thought oxygen was produced in respiration.

(ii) Most answered this correctly, if not fully. Many stopped after stating that plants don't photosynthesise in the dark, without realising that they have to respire to cause oxygen levels to drop.

(b) Quite a few candidates made the connection between the closed box and the running out of carbon dioxide, and most of these answered well. Many misinterpreted the graph to represent changes in the rate of photosynthesis rather than actual amount of oxygen in the box. Most of these explained that there is a limit to the rate at which plants can photosynthesise due to various limiting factors, and that the graph would level off as the maximum photosynthetic rate was reached. Some who interpreted the graph correctly tried to explain the slowing of oxygen production as resulting from too much pressure in the box. Others stated that the lack of a diffusion gradient would not allow oxygen to escape from the plant once too much oxygen was in the box.

Question 9

(a) (i) Amino acids

(ii) Components are 3 fatty acids and one glycerol molecule (1 mark), (candidates who named the elements C, H, O were given ½ mark)

Polymers are made of many units of the same monomer, triglycerides always have only 3 fatty acids (1 mark)

OR Triglycerides are made up of two different units; polymers are made of the same type of unit. (1 mark) (Candidates who explained that triglycerides never join into polymers were given ½ mark)

(b) (i) All proteins contain Nitrogen (½ mark) other organic compounds do not contain nitrogen (½ mark)

This scored a full mark, even though nucleic acids also contain N, because there were no more marks available to discriminate.

Candidates who recognised that nucleic acids also contain nitrogen were given an additional ½ mark for this even if they didn't specifically state that other organic compounds don't.

(ii) Plant cells are surrounded by a cell wall ½
Made of cellulose ½
This has to be broken down by grinding, chewing ½
Protein makes up the cell contents within these walls, and cannot be easily extracted1
Mammals do not produce cellulase ½
Animal cells have only a thin easily digested membrane ½
Symbiotic micro-organisms are needed to break down cellulose ½
Much of the protein passes out in the faeces as it remains within the walls ½

Comments

(a) (i) Most candidates knew that amino acids are the monomers from which proteins are made. Quite a few gave the elements (no credit given). A few chose polypeptides. The rest gave a range of answers that included practically every common organic compound known to man, and more.

(ii) Many answered that there were three fatty acids and glycerol. Far fewer found it easy to explain why triglycerides are not polymers. Many thought the lack of double bounds made polymerisation between fatty acids impossible. Quite a few

did give a good explanation of this, with some showing a very thorough knowledge of organic chemistry. However this part was outside the scope of the syllabus.

(b) (i) Most candidates answered that proteins contain nitrogen, but fewer specified that most other organic compounds do not. A significant few noted that nucleic acids also contain nitrogen. There was a lot of confusion about nitrates and some about nitrogenous bases in proteins. Quite a few answered in connection with nitrogenous wastes being excreted.

(ii) There was a lot of confusion about this question. Candidates who correctly interpreted the formula, and registered the connection with the cell wall and digestibility mostly answered well, but because three points were allocated, they had to be quite thorough to score full marks.

Many misinterpreted the formula to mean that plants having a low digestibility co-efficient compared to animals meant that plant proteins were easier to digest, and found creative ways to justify this. A surprising number based their answer on 'Biomagnification of proteins' as they move up the trophic levels, which made animal protein easier to digest for some, harder for others, depending on how they had interpreted the formula.

In both question 8 and 9 a high proportion of wrong answers were based on misinterpretation of the stem of the question, that is the graph and the formula.

Part 3 – Criterion 8

Question 10

(a) (i) 1. Mitochondrion
2. Chloroplast
3. Cell wall
4. Vacuole [½ each]

ii) Respiratory enzymes: 1 (mitochondrion)
Genetic material: 5(nucleus) [½ each]

(b) 520 - 560 μm [1]

(c) 2: Chloroplasts are the site of photosynthesis [½] and animals are heterotrophic and do not photosynthesise. [½]

3: Cell walls provide rigidity/ support [½] and animal cells are not rigid/ have other means of support (e.g. skeleton)/must be flexible to move. [½]

Comments

(a) Most candidates were able to get full marks on (i).

In (ii) many candidates thought that respiratory enzymes were in chloroplasts Genetic material in mitochondrion or chloroplast was also given credit.

(b) Poorly done. Candidates need to remember a ruler for the exam. $\frac{1}{2}$ marks given for another +/- 20 μm or correct working shown but wrong answer or correct answer with missing units.

(c) This was well done provided candidates had the identified parts 2 and 3 correctly.

Question 11

Xylem vessel

The function of the xylem is to conduct water and dissolved minerals up plants.

Any 2 of the following specialisations: [2 marks each].

- Xylem vessels are cylindrical in shape with no end walls, placed end to end to allow a continuous column of water.
- They are dead cells with no protoplasm/ cell contents to interrupt the flow of water
- They are dead cells with no protoplasm as no energy is required for conduction of water
- Strengthening of cell walls with lignin keeps the vessel open even under tension/suction.
- Lignification of walls waterproofs xylem vessels allowing for the conduction of water
- Pits in cell walls are unlignified areas which allow lateral transport of water

Human nerve cell

The function of the nerve cell is to transmit nervous impulses.

Any 2 of the following specialisations: [2 marks each]

- Nerve fibre/axon is long so that impulses can be transmitted over long distances
- Nerve fibre/axon is long so there are fewer synapses and transmission is quicker
- Dendrites are branched so that impulses can be received from many different neurons
- Myelin sheath insulates nerve fibre for more rapid transmission of impulses
- Nodes in myelin sheath enable impulse to jump from node to node for more rapid transmission of impulses

Comments

The function of the cell had to be included somewhere in the answer or $\frac{1}{2}$ mark deducted.

Function alone gained $\frac{1}{2}$ mark. For full marks the specialisation had to link the structural feature to the precise way in which it contributed to the function. Most candidates were able to gain half marks on this. Many gave structural features without relating them to the function. A lot of confusion over xylem vessel cells and xylem tissue.

Question 12

(a) (i) Mitosis [1].
The amount of DNA in the cell remained the same after cell division [1].

(ii) The cell has divided with half the DNA going to each cell [1]
Genotypes: EBG, EBg, EbG, Ebg [½ each]
Frequency: 25% for each [1]

Comments

(a) Most candidates were able to deduce that this was mitosis. Not all of these could give a sound reason. No marks were given for saying only that DNA replicates as this happens in meiosis too. Most candidates who identified mitosis understood the decrease in DNA at R. Some credit was given for reasonable answers to part (ii) in cases where candidates thought this was meiosis.

(b) Very few candidates understood that the question asked them to find the genotypes of the possible gametes. Many spent a lot of time and paper trying to work out genotypes of possible offspring.

1 mark was given if candidates appreciated that there were only 3 alleles in each but gave lots of extra possibilities.

Question 13

(a) (i) The egg is gaining weight as there is a net flow of water (½) into it by osmosis (½). This is because it has been placed in a hypotonic solution (1).

(ii) The egg is losing weight as there is a net flow of water (½) out of it by osmosis (½). This is because it has been placed in a hypertonic solution (1).

(b) The egg is in a very slightly hypotonic solution (½). The sugar concentrations inside and outside the egg are very similar so there is very little net flow of water into the egg. This means that the line is nearly horizontal. (1 ½).

Comments

This question was well done by most candidates.

The most common errors were to talk about haemolysis and plasmolysis in parts (i) and (ii) or to discuss the diffusion of sugar in part (ii).

For full marks in part (ii) candidates had to recognise that it was not perfectly isotonic.

Question 14

(i) Amino acids are assembled into proteins on the ribosomes (½) of the rough E.R. (½) so radio activity levels are high to start with (½). The proteins are then transported to the Golgi body in the E.R. (1) and the radio activity levels fall (½).

(ii) The proteins from the E.R. appear at the Golgi body to be 'sorted and packed' (1) and the radio activity levels increase (½). They are then secreted from the cell in vesicles (1) and the radio activity levels fall. (½)

Comments

This question was well done although some candidates spent time describing the table rather than explaining the results. Some candidates described the function of the rough E.R. and Golgi body without linking it to the change in radio activity levels.

Question 15

Species A has a greater surface area to volume ratio than species B. (1). This means that A is more efficient in gaining nutrients etc. such as glucose, oxygen (1) and in excreting wastes such as carbon dioxide (1).

The fourth mark was awarded for one other statement relating to why A might out compete B e.g. chemical communication is slower in larger organisms; the greater the diffusion distance, the slower the rate of diffusion; A will have an increased overall metabolic rate or A will be able to increase in numbers more quickly to take advantage of the resources available.

Comments

This question discriminated between candidates with many candidates only able to get two marks. The most common errors were candidates saying that being smaller meant a smaller surface area to volume ratio or that being smaller meant that you had a larger surface area.

Part 4 – Criterion 9

Question 16

(a) 1 = liver/spleen 2 = pancreas 3 = ileum/small intestine 4 = colon/large intestine ½ mark for each correct answer.

(b) A variety of answers were accepted, but they needed to relate to the internal lining of the small intestine e.g.

- villi/microvilli provide a large SA: Vol for the absorption of digested foods;
- lining only one cell thick to minimise distance products of digestion have to travel to get to the blood stream.

- good blood supply ensuring that absorbed components are removed from villi quickly, thereby maintaining concentration gradient and so increasing rate of absorption.
- cells contain mitochondria for the active uptake of some digested materials
- folded intestinal lining slowed down passage of food and increased time available for absorption.

Any 2 of the above, well explained, gained 2 marks each.

Comments

This question was straightforward and very well done by a majority of candidates. In (b), many candidates provided answers which did not apply to the particular area of the small intestine involved (ileum) – e.g. secretion of enzymes to facilitate digestion. Many also made suggestions relating to whole small intestine rather than specifically to the inner lining – e.g. muscle contractions/peristalsis in moving material along the gut, the total length of the small intestine. These answers attracted _ - 1 marks, depending on their clarity/depth.

Question 17

(a)

Tissue Function	Tissue Name	Source of transported material
Water transport	xylem	absorbed from soil by osmosis
Transport of	phloem	made by photosynthesis, or organic materials from leaves, or from green parts of plant
	(½ mark each)	(1 mark each)

(b) Transpiration is the loss of water from the leaves (1 mark). The sun is the source of energy and water moves passively from the xylem to replace the loss because of the adhesive attraction between the water molecules and the cellulose in the cell walls (1 mark). This produces a pulling effect (tension) on the water in the xylem. This tissue contains cell walls and no cytoplasm. The cohesive attraction between the water molecules and the adhesive attraction between the water and the cellulose maintain the column. (1 mark).

Comments

(a) This part was done very well. There were similar acceptable answers, but the understandings that water entered the roots by osmosis from the soil and that the transported organic materials were produced by photosynthesis were essential.

(b) Many did not have a clear understanding of transpiration, but the most common problem was the answer that water is pushed up the stem. While the endodermis does function in this way, the question asks for 'the process of transpiration … in maintaining the function of the xylem tissue.' Some credit was given for the endodermis information, but on its own was insufficient for a pass to the question asked. Full marks were difficult to obtain in this question which was taken into account in determining the cut off standards for this section.

Question 18

(a) (Two possible answers were acceptable,) A ½ mark was allocated for each genotype.
If autosomal

Assume alleles are: a – normal A – affected
1. aa
2. Aa
3. aa
4. Aa

If sex-linked
XaY
XAXa
XaXa
XAY

(b) If autosomal:
Parents Aa x aa
Gametes _ A _ a all a

Children

	A	a
a	½ Aa	½ aa

The children will have the genotypes ½ Aa and ½ aa
Their phenotypes will be ½ affected and ½ normal
If sex-linked
Parents XAY x XAXa
Gametes ½ XA ½ Y all Xa

Children

	XA	Y
Xa	½ XAXa	½ XaY

The children will have the genotypes ½ XAXa and ½ XaY
The girls will all be affected the boys will be normal.

(c) This conclusion is not valid (½ mark). One individual (4) is insufficient evidence to make this conclusion (½ mark). If we let the affected allele be A and the normal allele be a, then the parents are (1) aa and (2) Aa. The boy (4) is Aa and his two brothers are aa. The third generation working left to right are Aa, Aa, aa, aa and aa, using this pattern (1 mark).

(There were other acceptable answers, but this is the simplest complete answer.)

Comments

Candidate marks tended to be high or low and these marks were certainly not normally distributed. This reflected either an understanding of genetics or lack thereof. Many did very well.

Part (a) was quite well done. Either of the autosomal or sex-linked answers was acceptable. The most common error was ignoring the first line of the stem and using the assumption that affected individuals were of the recessive genotype.

Part (b) was also done well. If candidates had incorrect alleles for individual (4) in part a) and carried this error into part (b) they were not penalised again and if the working was correct could get the full three marks for their answer. Where this occurred, they needed to have reasonable alleles for individual (5), That is, she had to bear some correspondence with (3).

Part (c) was the hard part. If a candidate stated that the conclusion was not valid with no supporting evidence, then $\frac{1}{2}$ mark was given. Some worked through fully the sex-linked possibility and the autosomal possibility, which gained full marks. Comments such as, the expectation of more males than females affected were given some credit, depending on earlier misinterpretations of dominance and recessiveness. The most frequent error was the assumption that (1) and (2) had more than three boys.

Question 19

Meiosis produces the haploid gametes needed for sexual reproduction. (1 $\frac{1}{2}$ marks). Sexual reproduction produces variation in offspring and therefore increases the chances of survival of the species as whole in a changing environment (1 mark).

Mitosis produces cells that are identical to the original one, thereby ensuring that each cell carries the same genetic code (1 mark). In this case, mitosis occurs in the zygote ($\frac{1}{2}$ mark) and allows growth of the embryo ($\frac{1}{2}$ mark) and is also involved in repairing/replacing cells later in life ($\frac{1}{2}$ mark).

Comments

Many candidates misinterpreted the intent of this question. Some wrote of the relative advantages/disadvantages of sexual and asexual reproduction and so did not address mitosis in the context of growth. In some cases, candidates thought that the two types of cell division mentioned in the question were referring to the two stages within a meiotic division. There were a large number of misconceptions about meiosis, such as 'meiosis is sexual reproduction'; 'in fertilisation the process of meiosis is taking place'; 'gametes come together by meiosis' and 'eggs and sperm undergo meiosis'.

Question 20

An increase/decrease in water concentration in the blood occurs (stimulus) [1 mark]. This is detected by osmoreceptors in the brain (receptors) [1 mark], and as a consequence there is a change in the amount of ADH released (transmission) from the pituitary gland [1 mark]. ADH is a hormone that alters the permeability of the collecting duct (effector) [1 mark], so that more/less water is reabsorbed from the filtrate into the blood (response) [1 mark].The resulting change in the water concentration of the blood serves to alter the original stimulus (negative feedback) [1 mark].

(Note:A similar response is possible using the hormone aldosterone).

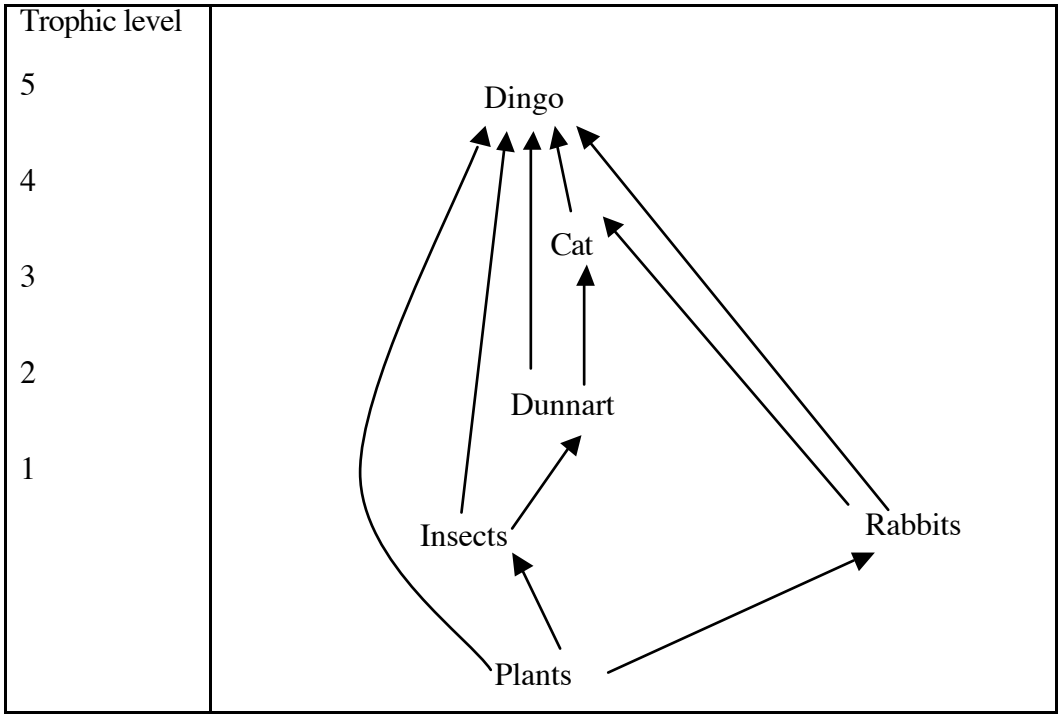
Comments

Candidates generally performed well on this question, with many producing a feedback diagram as their response. It was not expected that candidates address the role of both hormones (ADH and aldosterone). Whilst better candidates explicitly named key steps (stimulus, receptor etc.), it was possible to gain full marks by simply providing an accurate description of each step. The most common error was to concentrate on the details of the formation of urine without mention of the maintenance of water balance.

Part 5 – Criterion 10

Question 21

(a)



1 mark for arrows pointing in correct direction
1 ½ for organisms placed in correct trophic level
1 ½ for correct arrow connections

(b) 1st trophic level: producer/autotroph
3rd trophic level: 1st order carnivore/ 2nd order consumer ½ mark for each

(c) Decomposers (½ mark) breakdown the organic wastes and dead remains into inorganic ions (½ mark), recycle the nutrients (½ mark) making them available for producer uptake (½ mark).

Comments

(a) Some candidates put rabbits in trophic level 3 and lost ½ mark. Some candidates did not recognise plants as trophic level 1.

(b) Many candidates did not mention ion availability to plants and lost ½ mark. Some also confused the roles of decomposers with detritivores and some confused energy flow with cycling of matter.

Question 22

Elanus axillaris is the black-shouldered kite (1 mark).

Dieldrin is a fat soluble insecticide that is persistent in the environment (not easily biodegradable), which accumulates in fatty tissues and as it is not excreted or metabolised. It builds up in concentration in individual organisms as they feed on other organisms that have residues in them. (1 ½ marks).

At each trophic level there is an increase in concentration that is proportional to the reduction in biomass; as the insecticide present in one level is largely passed on to the next and each consumer eats many times its own body mass accumulating the Dieldrin from its food. (This results in up to a 10x's increase between trophic levels.) The top carnivore will as a result have the highest concentration of Dieldrin. (1 ½ marks).

Comments

Most candidates lost marks because they did not mention why Dieldrin accumulates during the life of the organism, but other aspects of the question were well done.

Question 23

(a) From 0 – 3 months (immediately after the fire), the death rate was high due to injury and the birth rate was low due to the small number of reproducing individuals.

From 3 - 9 months the birth rate was greater than the death rate as shown by the exponential population growth.

From 9 – 30 months the birth rate was approximately equal to the death rate (apart from slight fluctuations) due to environmental pressures and a state of equilibrium was reached.

1 mark for each point given.

(b) Immediately after the fire intraspecific competition would have been high due to the lack of food and mates.

From 3 - 7 months competition would have been low due to low population numbers and an increasing amount of resources, hence exponential population growth occurred.

At approximately 7 – 8 months, the population reaches carrying capacity. Intraspecific competition is at its maximum due to a limited amount of resources and this results in negative feedback.

1 mark for each point given.

(c) Immediately after the fire, resource availability (food and shelter) was low, as the habitat has been destroyed.

From 3 – 7/8 months (up to carrying capacity), resource availability (per individual) was at a maximum due to regeneration of the ecosystem.

After 7/8 months as the population had reached carrying capacity, the availability of resources would not meet the demand of the population, which resulted in a decrease in the population to approximately 4000, where the amount of resources fluctuated.

1 mark for each point given.

Comments

If candidates only mentioned 1 part of the graphs, they were only able to achieve half marks at the most. Also, full marks were not achievable if candidates did not refer to the particular population of marsupials and just talked about populations in general.

(a) This question was fairly well answered however some candidates misunderstood the birth rate as the population increase and the death rate as the population decrease. They did not recognise that births and deaths occurred all along the graph. Also some candidates did not mention birth or death rates and only commented on the actual population number.

(b) This question was not as well answered as (a) and (b). Some candidates confused intraspecific competition with interspecific competition or simply defined what intraspecific competition was.

(c) This question was quite well answered.

Question 24

(a) (i) one mark allocated to any two of the following:

- Nitrogen removed when crops harvested;
- Nitrogen lost when field originally burnt;
- Crop plants not nitrogen fixers;
- Nitrates lost through leaching/runoff after burning; or
- Low numbers of soil microbes due to burning of organic matter.

(ii) one mark allocated to each of the five components below:

- field colonised by plants followed by grazing animals that introduce organic matter for decomposition;
- legumes such as wattles bring with them nitrogen-fixing bacteria;
- waste products from plants and animals – excreta;
- action of nitrifying bacteria as decomposers;
- action of lightning on atmospheric nitrogen.

(iii) one mark allocated for any four of the following:

- Areas of old growth provide a reservoir of plant/animal species for recolonisation;
- Corridors allow movement of animals for refuge/sanctuary;
- Biodiversity maintained;
- Destruction of habitat minimised;
- Removal of mature trees allows others to grow and mature due to access to light;
- Management strategy allows for minimal soil erosion, germination of seed etc;
- Minimises water runoff and fire hazards;
- Minimises leaching of soils, nutrient loss thereby maintaining effective carbon, nitrogen, phosphate cycling etc.

Comments

(a) (i) Candidates found it easy to get half marks but not many candidates got full marks. In the main the answers were protection of habitat/species and strategy allowed for recolonisation of selectively logged areas. Some candidates did not understand what was being asked.

Candidates generally knew enough to get 3 marks but only a couple of candidates got 5 marks. Not well done and too many candidates wrote about denitrifying bacteria. They got a mark if they were able to show how this might indirectly result in a build up of nitrates within the nitrogen cycle, but in the main they wrote about the denitrifying bacteria as being responsible for nitrates instead of the nitrifying bacteria.

Nearly all candidates mentioned decomposition and nitrogen fixing bacteria but a lesser percentage wrote more than that. Disappointing!

(b) Candidates found it easy to get half marks but not many candidates got full marks. In the main the answers were protection, of habitat/species and strategy allowed for recolonisation of selectively logged areas.

Many candidates interpreted the question as to referring to a management timeframe of 9 x 35 years. Overall most candidates got between 3 and 6 out of 11 marks.

Question 25

One mark allocated for each of the following points:

- Genetic variation in original population contains resistant genes, so a percentage of the initial population will be resistant to pesticide – due to random mutation;
- After first spray surviving population able to breed and transfer resistant genes to next generation – increasing % of resistant individuals;
- Following repeated spray there is a significant increase in the population of resistant flies;
- Pesticide is providing the selection pressure;
- Frequency of resistant genes is increasing significantly as a result of the selection pressure – actively being selected for..;
- End result is a population of insects in which a significant number carry the resistant gene – which will significantly lessen the impact of further sprays.

Comments

Most candidates answered the question reasonably well with about 80% getting between 3 and 5 marks.60 candidates got full marks. Full marks were not given unless selection pressure of pesticide and gene frequency were specifically mentioned. For the rest of the points the way they were expressed varied enormously as many interwove their answers with reference to 'natural selection' theory.

Candidates only got a maximum of three marks if they just described what they saw in the boxes with at least reference to resistance and genetics.

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