The final examination paper was generally well received and seen as a well-balanced and fair one. The only real reservation was with the preponderance of questions that required candidates to read and interpret large amounts of information from graphs, tables or diagrams.

There were however still sufficiently challenging parts of questions to discriminate the best candidates from the rest.

Suggested 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 given credit for any points that addressed the criterion and relevant to the question.

PART 1

Question 1

1. a. Animal tissue contains higher levels of catalase than plant tissue (3)
   OR Liver contains more catalase than other/plant tissues (3)
   OR Different tissues contain different amounts of catalase (2)

Look for relevance to the question, and: clear IV (1 mark); Clear DV (1); Clear predicted result (1)

b. (i) Type of tissue (used as source of catalase) (1)
(ii) Amount/concentration of catalase
OR rate of hydrogen peroxide breakdown
OR rate/volume of oxygen produced (1).

c. Any two of the following (or other appropriate answers), ½ for the factor, ½ for the explanation.
- Temperature of the reactants (½). The rate of chemical reactions usually increases with a rise in temperature (½).
- The size/surface area of the tissue (½). The larger the piece of tissue and/or surface area the greater the amount of catalase available for reacting (½).
- The concentration of H_2O_2 (½). The more the substrate the greater the rate of reaction (½).
- The pH of the solutions (½). The pH has a marked effect on the rate of any enzyme-mediated reaction (½).

d. If there is more than one IV, it is not possible to tell which caused any observed changes in the DV or results (1). OR: One IV only is included so that the results / changes to the DV can be attributed solely to changes in that one variable.

e. Satisfactory answers may have begun with yes or no, thus marks are awarded for the explanation that followed rather than saying yes or no. Some answers included elements of both and were awarded marks accordingly.
'YES' - but not a specific control *group/set-up*.
Experimental results need to be compared to that of a control (½). In this experiment each set of results acts as a control for the others (the control is implicit in the comparison between experimental groups) (1½)
'**NO'** - No specific control *(group/set-up)* was included.
- Experimental results need to be compared to that of a control (½).
- No control group was included **with H_2O_2** but **without tissue** to provide a comparison / baseline data / measure the production of oxygen without the IV (tissue) present. (1½)
- Also gave 1½ marks for suggestions of reasonable controls that could have been used:
    - An identical set up with no tissue added
    - A control for each tissue type where the tissue is placed in H_2O instead of H_2O_2
    - A control for each tissue type where the tissue is subjected to heat treatment to denature the enzyme catalase before being placed in H_2O_2

Exam comments

a) Many candidates, including some that did well later in Q1, scored badly on this part. Many simply hypothesized that (tissues with) higher amounts of catalase would produce more oxygen when placed in H_2O_2 – when this was simply the known method used for measuring the relative concentration of catalase in tissues. This was despite the aim of the investigation being stated clearly in the first line of the question (to determine the relative catalase concentration of various tissues).

Many also lost marks failing to mention 'catalase' in their hypothesis and referring only to oxygen produced. ½ mark only (max) was given if there was no reference to tissues at all (only catalase, oxygen and H_2O_2) but the format of the hypothesis was appropriate.
Many hypotheses were written in a way that, standing alone and out of the context of the question, would make little sense to the reader and did not gain as many marks accordingly.

b) (i) An alarming number of candidates answered that the IV was the 'concentration of catalase in the (different) tissues', when the (relative) concentration of catalase was the **DV** (as measured by O_2 production). Most correctly answered

(ii) Generally many candidates identified how the DV was being measured -'oxygen produced' rather than what the DV was a measure of - 'catalase concentration'.

c) Many candidates were able to get 2 x ½ marks for finding 2 factors, but many also failed to get the other 2 x ½ marks on offer as they didn't provide *specific* explanations for the need to keep that factor constant (as asked by the question), giving only general reasons such as the 'need to keep factors constant so that the results could be attributed to the independent variable only' (which received little to no marks).

d) Again, quite a number of candidates received little to no marks through giving too general an answer ('because it makes the experiment easier to control', or 'so that the results are valid') instead of focussing on the logic that dictates having only one IV or not having more than one (see the solutions).

e) Most candidates made a moderately good attempt at this question, though an alarming minority stated that a control was not necessary in this case – hopefully meaning *'a specific control group'* was not necessary!
The importance of having to *compare* results of *experimental groups* with that of *control groups* did seem to be generally well-understood, but not always the notion that, as in this case, the experimental groups might act as controls for each other. In other words, some candidates' understanding of methods of experimental control was somewhat limited and appeared rote-learnt, inflexible and formulaic.

Question 2

a) The optimum temperature of sucrase is approximately 30°C (1), effective temperature range for sucrase 20 – 40°C (1). The activity of sucrase is temperature dependent (½)

b) (i) For group C the time taken for the sucrose to break down completely at each temperature was longer than for the other groups (1). Or no result obtained for O°C and 60°C (½)

(ii) Their solution of sucrose may have been made more concentrated than the other groups - hence more substrate (1).
OR They may have consistently added a lesser amount of the solution of sucrase than instructed (1).

OR Sucrase may have been exposed to conditions that reduced its effectiveness, e.g. higher temperatures or an unfavourable pH (1)

c) Because group C's results are significantly different, it would not be appropriate to include the groups results when calculating the average (1). Group C had no result for 0°C and 60°C so the average in the table is based on only two sets of data, while other values are based on three (1).
It would be more appropriate to use the average of Groups A and B (1).
(A variety of points regarding the use of averages, averaging a small number of results given credit).

d) **Error 1.** Failure to maintain constant water bath temperatures for the duration of the experiment. (1). Reaction rates vary as temperature varies - this would affect higher and lower temperatures more than temperatures near room temperature (1).

Error 2. The timing of the testing of the withdrawn samples needs to be consistent (1). If samples are not consistently tested as soon as they are taken, the time recorded will not accurately reflect the reaction time.(1)

Error 3 Failure to use same volume of sucrose throughout (1) will distort results as more sucrose will take longer to break down etc (1)

Error 4 Failure to use same volume of sucrase throughout (1) will distort results as more sucrase will increase the rate of break down etc (1)
Look for error identified clearly (1) and explanation (1)

Exam comments

a) This question was answered very well by most candidates. Little to no marks were given for answers such as 'increased temperature increases the action of the enzyme.'

b) (i) Most candidates recognised the difference between group C and the other groups.
(ii) Well answered (½) mark given for, 'different concentration of sucrose/sucrase' without specifying greater/lesser.

c) Although this question was worth 3 marks many candidates only made one point, i.e. 'it is not appropriate to include group C results in the average'. Some made broad general statements about the benefits of using averages in processing experimental data, but few if any marks were given for this, as it was not related to the data given, and not relevant here.

d) Some candidates included comments about the invalid use of averages here. These were given credit, if they were not repeating the answers given in c). The main problem was that explanations were not offered for the sources of error suggested, thus only 1 mark was obtained. Quite a few candidates repeated their answer from b(ii). Credit was given if further explanation was offered. Many candidates were concerned that periodically removing small samples would change the substrate/enzyme mix in the test tubes. Credit was given if a plausible explanation was offered e.g. inefficient mixing of solutions.

Question 3

a. The same or similar experiments, conducted independently, must yield similar results before gaining widespread acceptance (1). This helps rule out errors due to uncontrolled variables or errors in experimental technique (1).

b. The following should be taken into account when allocating women to the experimental or control group.
- ethnic background of women
- smoking history
- reproductive history (number of children/breastfeeding history/ age of onset of menopause/use of hormone replacement therapy)
- health/ activity/exercise level
- height/weight/body shape
- childhood history/nutrition/ illnesses
- other medication being used (may influence calcium uptake/metabolism)
- calcium content of food in 'normal' diet
- use of vitamins/dietary supplements
- the amount and type of tea drunk to be considered a 'tea drinker'
- use of calcium supplements
- age profiles of both groups must be the same
- coffee consumption (thought to affect calcium uptake/metabolism)
- family history of osteoporosis
- history of exposure to sunlight (vitamin D)

The women are elderly - how to deal with loss of participants through death or serious illness. (½ mark for each substantial point).

Exam comments

Candidates did not answer Part (a) well at all and generally lost marks because they only mentioned one of the main points. Some candidates answered this part of the question too narrowly and restricted their answer only to the specifics of the example provided thereby receiving only part marks.
Part (b) was generally answered well with the majority of candidates obtaining 4½ or more marks out of 6.

Question 4

Growth rates of the plants depends on many abiotic factors which could be expected to vary significantly over the given area, especially as distance from the sea increases (1). The following factors would vary over the area:
- Salinity would be greater closer to the beach (1).
- Because of the undulating sand dunes, some areas would be exposed to more wind than others, with associated drying effects also varying (1).

- The north facing aspects of the dunes would be more exposed to sunlight, which might cause greater photosynthetic rates, but also more desiccating effects (1).
- Shading and wind protection from other vegetation would increase as the dunes approached more permanent vegetation (1).
- Accumulated soil and plant debris would be greater in 'valleys' and also further from the beach - more nutrients/moisture available for growth (1).
- Activities of humans and/or animals might damage plants in certain areas (i.e. tracks) more than others (1).

Look for – factor (½ marks and explanation 1 ½ marks) Possibly 3 – 4 well explained factors

Exam comments

This question was poorly answered with a significant number not attempting it. Those that answered, but got less than half marks or half marks, gave no or little explanation of the factors they listed. Those that provided explanations received the marks.

PART 2

Question 5

a) Disaccharide
b) Polysaccharides
c) Cellulose
d) Starch
e) The initial mass of carbohydrates is relatively low, and it is used quickly because it is a short-term energy store (1). Fats reserves were initially high and steadily declined as they are responsible for long term supply of energy (1). Very little protein is broken down, suggesting that proteins are not normally used as energy storage molecules (1).

Key points: 1 reasonable suggestion for each of fat, protein and carbohydrate. Some extra credit given for consideration of time involved using information from the graph (½).

Exam comments

Candidates generally went well on this question with most obtaining at least 4 marks. Part (e) was the more difficult part of the question and required candidates to make the connection that the molecules shown on the graph were involved in the provision of energy for the starving person.

If candidates just gave an information dump from dictionary about role of fat, protein and carbohydrates without reference to the question and/or the graph, they were given little to no credit.

Many candidates gained full marks for recognizing that carbohydrates were the most readily available source of energy, they have limited stores and are therefore found in small amounts

that were used quickly. Many then scored well for listing that fats are broken down for energy in increasing quantities after the carbohydrates are used up.

Comparatively few made the observation that although protein was eventually broken down, this was only as a last resort as protein is important for many other functions in the body and is only used to provide energy under starvation conditions.

Question 6

a. ..... = CO_2 (1).
b. Respiration (1).
c. When the light was on both photosynthesis and respiration would occur (1). Respiration produces CO_2 and photosynthesis uses CO_2 (1). The graph shows a decreasing concentration of CO_2, which shows that there is a net CO_2 uptake by the plant (1), indicating that the rate of photosynthesis is significantly greater than the rate of respiration (1). Uptake of CO_2 by photosynthesis creates a concentration gradient between the inside of the leaf and the outside causing CO_2 to diffuse in (1).

Look for 4 clear facts / explanations about the graph

Exam comments

Parts a) and b) were generally done well.

Part c) caused some problems for many candidates as they misinterpreted the graph and revealed a confused understanding of the process of photosynthesis. They assumed the light and dark sides of the graph referred to the reactions in the light dependent and light independent stages of photosynthesis (not actually required in the course). This resulted in them giving information dumps about these processes including complicated and unnecessary detail rather than answering the question that was asked.

Question 7

a) i. Transcription C G T T A C C A A (1)
ii. Translation C G U U A C C A A (1)
b) i. As G C A and G C U in mRNA both code for the amino acid alanine (ala) (1), there would be no change in the polypeptide produced (1).
ii. In mutation 2 G U U is altered to G C U, which results in valine being replaced by alanine (1), resulting in a change of one amino acid in the polypeptide produced (1).
c) In mutation 3 the insertion of the additional C base, would affect all codons from this point on (½), which will affect all amino acids (½). Original sequence coded for the amino acids ala, met & val, while mutated sequence codes for ala, asp & gly (1) this would result in a significant change in the shape of the protein molecule (1). Thus enzyme 1 is likely to have its active site altered (½), rendering it ineffective (½). This

enzyme catalyses the production of lilac pigment from white; no lilac (and hence no blue) would be produced (½), so the plant would have white flowers (½).

Exam Comments

Generally answered well by most candidates.

a) As this question was set out in the opposite way of convention, some candidates got confused and answered the DNA section on the tRNA and vice versa. If this was done ½ marks were awarded. Another common error was in the placement of the U, T and A. For example, when a T appeared on the mRNA then a U appeared on the DNA/tRNA.
b) Common error was that candidates did not fully answer the question. They gave the mutation in DNA, mRNA and amino acid form (only required in mRNA/amino acid form), but failed to comment on how this affected the polypeptide. Some candidates tried to use anti-codons to answer the question, therefore commenting that the amino acid required was not given in the table.
c) Many candidates struggled with this question. Some were not able to make the link that although the insertion caused the first amino acid to be the same as the original sequence (alanine), this affected the other amino acids downstream of the insertion making a completely new polypeptide. Thus candidates said that the mutation was silent and enzymes were produced as normal.
Some candidates did not comprehend the stepwise nature of the enzyme that if enzyme 1 was not able to function, neither could enzyme 2. Many failed to mention that since the enzyme was not produced correctly it lost its specificity for the substrate, losing its complementary shape.
Another comment that came up frequently was about alleles and that incomplete dominance was occurring (due to blue, white and lilac) although that would not be examined in this criteria.

Question 8

a) Protein synthesis (1) or active transport, or any other reasonable suggestion accepted; where they required energy, applied to the cell in question and were not shown in the diagram.

b) Photosynthesis converts light energy into chemical energy (glucose) (1). In mitochondria aerobic respiration releases the energy contained in the glucose (1). This energy fuels the reaction ADP + P →ATP, and the high energy bond formed makes the molecule a very effective energy carrying molecule (1). The ATP is transported to the ribosomes where ATP break down to ADP and P releases energy which is available to protein synthesis (or any other process named in part a) (1).

Exam comments

This question proved a lot harder than was expected, with a significant percentage either not attempting it or receiving no marks. Most candidates received less than half marks as a result of superficial efforts or answers that missed the point of the question.

Part b) was not particularly well done, with a lot of candidates referring to processes in the diagram or sub-processes of them or to processes not carried out by green plant cells such as transpiration or translocation. Suggestions that were vague, such as transport were given ½ a mark, especially where there was passive and active variations.

Likewise, energy consuming processes that occurred outside of the cell or not in a green plant cell as shown were also given ½ a mark. Answers such as transpiration or diffusion or those clearly labelled in the diagram received no marks.

Candidates struggled on the whole to come up with answers that related to how energy was available for the active process mentioned. However, a fair number did pick up on the use of light for photosynthesis to store chemical energy in molecules like glucose. Some mentioned that ATP was released in the process of photosynthesis, but often went little further.

However, the better answers did pick the further usage of glucose in respiration, with the energy used to produce ATP from ADP, which was then used to provide energy for the process specified. A fair number of candidates either missed this part of the question or just described the process they had listed in part a). Where incorrect answers to part a) could be linked to energy supply/usage, some marks were given. Full marks were given where for 4 clear pathway steps in the conversion of energy.

Question 9

Before the dive: the seal would be respiring aerobically (½) with breathing keeping oxygen levels constant. The very low, constant levels of lactate (½) show no significant anaerobic respiration occurs (½), [the little that occurs can be attributed to the seal being active and it is being broken down at the rate it is being formed (½)].

When diving: the concentration of oxygen show a steady drop as the seal could no longer breathe (½). Aerobic respiration would become increasingly unable to supply the necessary energy (½). The rising levels of lactate, indicating that anaerobic respiration becomes progressively more significant the longer the dive lasts as lactate is a bi-product of anaerobic respiration (1).

After a dive: while normal oxygen levels are being re-established (½) anaerobic respiration would still contribute to energy production (½) but decreasingly so, as O_2 levels rose allowing aerobic respiration to became re-established (½) etc. Or due to lactate diffusing out of muscles and building up in blood for a short time after the dive and seal returns to the surface.

Key points Before Comment on aerobic respiration 1 mark

During Comment on both O_2 curve and Lactate curve
After Comment on both O_2 curve and Lactate curve

One mark was reserved for answers that addressed the rise in lactate after the dive.

Exam comments

This question was exceptionally well done on the whole with most candidates getting 3½ marks or more out of 5, showing a good understanding of the topic. Most of them discussed the decrease of oxygen availability during the dive and the increased use of anaerobic respiration with the consequent increase in lactic acid and the return to aerobic respiration after the dive. A surprising number of candidates recognised that anaerobic respiration continued for a period after the dive until the oxygen could be resupplied to the muscles or referred to the idea of oxygen debt.

PART 3

Question 10

a) From top of diagram A, C, B then D.

b) Eukaryotic (1)
Presence of nucleus or nuclear membrane (1)
Presence of mitochondria (1) or any of: Golgi body, rough endoplasmic reticulum, ribosomes attached to endoplasmic reticulum, membrane bound organelles,
Larger than most prokaryotes (1)
No cell wall (indicating not a bacterial cell) (½)
(Max 2 marks for evidence)

c) A typical plant cell would have a cell wall, may have a large vacuole, chloroplasts, a more regular shape, larger in size. (Any 2 = ½ mark each)

d) Average length 400 μm (1)
Average width 200 μm (1)
(If length and width around the wrong way = 1½ marks)
(If correct numbers but incorrect powers of 10 = max ½ mark in total)
(If numbers within 20 μm of correct answer = ½ mark each)

Exam comments

(a) Was generally very well answered. The vast majority of candidates correctly labelled the cell parts with the functions. A small number of candidates did not see part (a) and hence lost 4 marks by not attempting to label the diagram. A small number of candidates labelled the diagram with the cell parts instead of the functions given. Also, a small number of candidates labelled the diagram with generalised organelle functions

instead of using the letters from the key (A, B, C and D) – one mark in total was max received for this.

(b) Was very well answered, with most candidates scoring full marks. Some candidates made the assumption that other organelles existed in diagram although they were not drawn (including centrioles and lysosomes) – and received few marks.

(c) Again was very well answered, with most candidates scoring full marks. Some candidates did not answer the question using the correct language – the question clearly asks for a description of how a **plant** cell differs from the pictured cell, whereas their answer described how the **pictured** cell differs from a plant cell. This scored few if any marks. Some stated incorrectly that a typical plant cell would contain a cell wall **instead** of a cell membrane – this received no marks.

(d) Was not well answered, with the majority of candidates scoring no marks. Many did not attempt to offer an answer. Many did not understand the relationship between micrometres and millimetres. Of those that did attempt an answer, many did not understand that length refers to the horizontal measurement across the field of view.

Question 11

a) i) mitosis (1)
ii) Chromosomes duplicate (replication) (1)
OR increase in volume of cytoplasm (1)
OR formation of spindle (1)
OR nuclear membrane breaks down (1)
OR DNA condenses (1)
iii) 1.2 units (1)

b) Shade 2 duplicated chromosomes on the diagram that are the same length (1)

c) (i) 3 (1)
(ii) Diagram of nuclear envelope containing the 3 chromosomes of different length in unduplicated state (2)

d) Haploid cells have half the diploid number of chromosomes (1) and are produced to counteract the doubling (½) that occurs during fertilisation. (½)
OR meiosis results in shuffling of genetic code in gametes (½). After fertilisation there will be greater variation in the species. (½)

Exam comments

a) (i) Very well done.
(ii) Poorly done. Too many candidates referred incorrectly to various other stages of mitosis.
(iii) About half of the candidates did not refer to the graph. If the graph was used many candidates misread it, indicating a poor understanding of the question.

b) Poorly done. Most candidates only shaded half of the pair of homologous chromosomes.

c) (i) Many candidates mistakenly answered with 6 or 23 instead of 3. (0 marks)
(ii) If the diagram consistently related to an incorrect answer to (i), then (1 mark) was given to avoid a double penalty.
If the diagram related to (b) then (½ mark) was given.

d) This question was well done.

Question 12

a) Osmosis has occurred (1). There has been a net (½) osmotic movement of water from the solution, a hypotonic environment (½), into the potato cells (½) [across a selectively permeable membrane (½)] as the osmotic concentration inside the potato cells is higher than in the solution (½). The potato cells expand/become turgid (½), thus increasing the length of the cylinder.

b) As a result of a net osmotic movement of water out of the potato cylinder (½) the concentration of the solution inside the cells has increased (½) and has reached equal concentration (i.e. is isotonic) with the external solution (1). There is no longer any net movement of water between the potato cells and the solution (1).

c) **i)** The **rate** of decrease in length of the cylinder in the 0.8 mol dm^{-3} is much faster (approx 4x) than in the 0.4 mol dm^{-3} (1).

ii) The diffusion or concentration gradient between the potato cells and the solution is much greater when the cylinder is in the 0.8 mol dm^{-3} (1) thus the rate of net diffusion movement of water out of the cylinder is much faster (1).

Exam comments

a) This part was extremely well answered overall, with most candidates showing an excellent understanding of osmosis. Answers that applied the terms 'hypertonic' and 'hypotonic' incorrectly were penalised ½ a mark. Candidates should note that as the term 'concentration' refers to the relative amount of solute in a solution, any reference to the relative amounts of solvent/water in a solution needs to be very explicit – e.g. 'concentration of water'.

b) Candidates generally understood that the cylinder and the solution eventually became isotonic, but often didn't go on to explain why this meant that there was no further decrease in length of the cylinder.

c) i) Answers that said that the 0.8 mol dm^{-3} cylinder decreased in length more than the other, without referring to the relative rates of decrease, were awarded ½ a mark.

ii) Many candidates simply stated that the 0.8 mol dm^{-3} solution was more concentrated than the 0.4 mol dm^{-3} solution, without referring to the difference in concentration between the cylinders and the solutions (i.e. the concentration

gradient). This was awarded ½ a mark. Answers that described the 0.8 mol dm^{-3} solution as being 'more hypertonic' to the cylinder were accepted. The explanation needed to relate concentration gradient to the speed/rate of diffusion. Many candidates wrote that there was 'more diffusion' happening in the 0.8 mol dm^{-3} solution.

Question 13

A unicellular organism is microscopic and thus has a very large surface area to volume ratio, (much greater than a human) (1). This means that diffusion happens very fast/effectively (1). Therefore it does not need complex structures to obtain nutrients such as glucose & remove wastes such as carbon dioxide (1). Also, as unicellular organisms are microscopic the diffusion distance for materials inside the cell is very small thus complex transport systems are unnecessary (1).

A digestive system is unnecessary as materials such as food particles can enter by endocytosis or phagocytosis & be digested inside an endocytic vesicle (food vacuole), which fuses with lysosomes, which contain digestive enzymes. (1)

Removal of wastes (CO_2, ammonia) occurs by diffusion (1).

Osmoregulation can occur by the use of a contractile vacuole thus a complex excretory system is unnecessary (1). Active transport would help maintain ionic balance (1).

Unicellular organisms are relatively unspecialised and can perform most essential factors whereas cells of multicellular organisms have usually lost certain other functions and are dependent on other cells, tissues etc (1)

Exam comments

It was only possible to gain full marks if at least 2 of the following areas were addressed in reasonable detail: importance of a large SA:Vol; homeostasis; and exchange of materials.

Up to 2 marks were awarded for a discussion of how SA:Vol affects exchange. Up to 3 marks were awarded for discussing methods of exchange, with an additional mark for giving examples of substances involved (e.g. CO_2, dissolved substances).

Up to 3 marks were awarded for explaining how a unicellular organism maintained homeostasis. Many candidates only addressed this aspect, most selecting osmoregulation and the role of, and necessity for, a contractile vacuole in freshwater environments.

Many candidates (wrongly) believed that contractile vacuoles 'sucked in' either nutrients, or water, or both.

This question was challenging and a wide range of points were awarded marks. For example, cytoplasmic streaming moving particles around the organism; endoplasmic reticulum as an internal transport system; aquatic environment providing the moist conditions that facilitates diffusion.

In tackling open-ended questions such as this one, candidates are advised to think widely and make as many different points/comments as possible, rather than focussing on a single aspect.

PART 4

Question 15

a) Speed decreased slowly (½) as the blood travelled from the aorta to the small arteries, and then rapidly as it travelled from the arterioles to the capillaries (½). This was because as the number of blood vessels increased the overall cross-sectional area increased (½) therefore reducing the pressure and speed of flow (½)
OR
This was because the vessels became increasingly permeable and so fluid was lost from the vessels (½) therefore reducing the pressure and the speed of flow (½)
OR
This was because the vessels became increasingly smaller in diameter (½) and along with increasing frictional forces, restricted the flow of blood and slowed it down (½)
OR
This was because as the vessels became smaller, they were much less muscular (½) and were unable to constrict and produce pressures as large as those experienced in the larger vessels, therefore slowing the blood down (½)

Candidates lost ½ a mark if they failed to mention why the pressure decreased or they gave a poor description of the trends shown on the graph.
Candidates received one mark if they only described the changes to the speed of flow without providing an explanation.

b) Pressure waves (waves of contraction) move along the muscular artery walls as blood is pumped into the arteries under high pressure (1). Veins are less muscular and contain blood under low pressure and its movement is dependent on skeletal muscle movement and valves. Any residual pulse generated by the arteries is usually lost by the time the blood reaches the veins (1).
Other accepted answers:
- Arteries are close to the heart (½)
- Arteries move high pressure blood away from the heart and veins carry low pressure blood back to the heart (1)
- The pulse can be felt in arteries because they contain high pressure blood pumped from the heart, whereas this pressure is reduced by the capillaries making it difficult to be felt in the veins (1½)

c) For full marks, three factors needed to be mentioned and well explained. Responses could include:

- Capillaries have very thin walls so diffusion distance is small; exchange of nutrients and wastes occurs very quickly (1).
- Capillaries have a small diameter thus red blood cells have maximum contact with the walls of the capillaries, maximising exchange (1).
- Capillaries have a very small diameter which slows red blood cells down, increasing the time for the exchange of materials (1).
- Capillaries are repeatedly branched which increases the surface area for diffusion and thus allows for a greater exchange of nutrients and wastes (1).
- The large number and small size of the capillaries means that they are able to be very close to most body cells, decreasing diffusion distances and thus increasing diffusion rates (1).
- Capillaries are very small and have a very large surface area to volume ratio enabling the very efficient exchange of materials (1).

Exam comments

Part a) was answered reasonably well by most candidates; however, common mistakes included candidates merely describing, but not explaining, the speed changes as the blood moved through the different vessels; candidates talking about the changes in pressure but failing to relate these changes to speed; and a number of candidates failed to say why the pressure would decrease.

In part b) of the question, very few candidates knew of the contribution that arterial peristalsis makes to the pulse; most thought that it was entirely due to the contractions of the heart. A number of candidates mentioned why arteries were suitable for detecting a pulse but failed to discuss why veins were unsuitable. Some candidates suggested that the reason was because arteries contained oxygenated blood and veins contained deoxygenated blood – they received no marks. Ideally, candidates needed to link the structure of arteries and veins with their ability to pulse to receive full marks.

In part c) of the question the majority of candidates managed to list a number of features of the capillaries, but a number of candidates then failed to explain how the structures mentioned enabled the capillaries to function. Three structural features of the capillaries and how these features assisted the capillaries to function needed to be stated to receive full marks. A number of candidates answered this question by using an ‘information dump’ from their dictionaries – these candidates rarely received more that half marks.

Question 16

a) There is very little water lost from 6 pm to 6am (½). During the day, water loss increased markedly until 3 pm and then dropped significantly (½).
OR
Substantially more water was lost through the daylight hours than during evening or early morning (1).

b) From 6 am to 3 pm in the presence of light the stomata opened (½) or the temperature increased (½) the stomata opened. As a result, there was an increase in water loss (½) due to transpiration (½) and through use by photosynthesis (½) which resulted in an increased water uptake due to the transpirational pull generated in the xylem (½) as water is drawn up the stem to replace the water that was lost (½).
From 3 pm to 6 pm the decrease of light levels or the lower temperatures caused the stomata to close (½), reducing water losses through transpiration (½). However, greater amounts of water were absorbed through the roots (½) to restore turgidity and replace the water that was lost through the day (½).

Exam comments

a) The majority of candidates received an easy mark by simply describing the changes to water loss. A number of candidates described the net loss or net gain and often didn't clearly indicate how the water loss changed as the day progressed.

b) To receive close to full marks, candidates needed to link the changes in absorption to the changes in water loss. Some discussion of transpirational pull and its effect on water uptake was needed. A major problem for a number of candidates was that they described the changes but failed to provide any explanation for them.

c) These candidates received little to no marks. A number of candidates wasted time discussing water losses for the entire day and not just for the stated period. Whereas, other candidates focussed purely on the transpirational losses, and failed to explain the differences in absorption levels.

Question 17

a)

Penny	tt	(1)
Jim	Tt	(1)
Kevin	Tt	(1)

b) T roller, t non-roller

	Geoff		Anne	
	tt	x	Tt	(½)
Gametes	$^1/_1$ t		$^1/_2$ T $^1/_2$ t	(½)
Genotype	$^1/_2$ Tt	+	$^1/_2$ tt	(½)
Phenotype	$^1/_2$ roller	+	$^1/_2$ non-roller	(½)
Chance child roller = $^1/_2$				(1)

OR candidates can show punnet working (2)

	t	t
T	Tt	Tt
t	tt	tt

2 marks for correct use of punnet square showing correct gametes and genotypes, plus evidence in answers of correct interpretation of phenotypes.
½ mark lost for incorrect genotype of parents
½ mark lost for incorrect genotype of offspring
½ mark lost for incorrect matching of genotype and phenotype.
Chance probability (1)

Exam comments

This question had a wide spread of marks. It confused many candidates but also allowed many other candidates to obtain full marks.

(a) Errors occurred with matching the correct genotypes to the phenotypes.
A common mistake was to give two alternatives for a genotype (Tt or TT) when further examination of the pedigree would indicate only one form was possible.
Some candidates incorrectly identified the characteristic as being sex-linked.
(b) The majority of candidates used a punnet square to answer this question and most arrived at the correct chance value. Some credit (½ mark) was given for correct use of punnet square even if there were errors with gametes and genotypes used.
(c) Errors were made in failing to recognise homozygous recessive as pure breeding.

Question 18

The simple gut, with no caecum and a much reduced colon indicates that Animal B is a carnivore (1). Its diet is mostly protein (½), which is quickly digested in the stomach and small intestine (½) by enzymes produced by the animal (½). The products of digestion are mostly absorbed in the small intestine (½); the only role of the reduced colon is water absorption (½); and there is no need for a caecum (½).

(Max three marks)

The long length of the colon and the presence of a large caecum indicates that Animal A (or Animal D) is a herbivore (1). Plant food contains large amounts of cellulose (½) and mammals lack the enzymes needed for its digestion (½), relying instead on enzymes from microbes (fermentation) somewhere in the gut (½). In Animal A food can be diverted into the caecum - a blind sac - (½) and/or move slowly through an elongated large intestine (½) allowing time for the slower digestion of cellulose to occur (½).
(Max three marks)

Some credit, up to 2 marks, if candidates use animal C as an example of a carnivore and refer to simple short system with caecum that is smaller than either A or D.

Exam comments

This question was reasonably well answered by the majority of candidates but few scored highly (5 or more marks/6) due to insufficient detail in answers.

Main errors involved simply describing the different systems without sufficiently accounting for the differences between them related to diet and digestive processes.

Some candidates incorrectly identified the carnivore as having the larger, more complex system and related this incorrectly to the more complex diet of meat being harder to digest. They did not recognise the presence of a caecum and large colon as indicating the system of an herbivore.

Some answers measured the size of organs such as the stomach from the scales given and compared these rather than comparing the relative size of organs to the whole system.
Some answers contained a lot of repetition.

PART 5

Question 19

a)

Density dependent	Density independent
Any two of A, B, D, F	C, E

b) Graph A shows a population, which is oscillating about the carrying capacity (½), the maximum sustainable population (½). This represents a relatively stable, well established population (½), in which negative feedback (½), due to density dependent factors (½) results in small fluctuations of the population about sustainable levels (½). (max = 2 marks)

Graph B represents a population recently introduced to a new environment (½). It is growing exponentially and dramatically overshooting its carrying capacity (½). This could represents an initially small population which is not subject to the normal environmental factors which limit growth (½); it would have an abundant food supply (½), few if any predators (½), little disease (½) and abundant 'nesting sites' (½) [max = 2 marks] .

Exam comments

This question was well done by most candidates and most candidates scored highly, although not too many got full marks. The fact that each point was worth only ½ mark meant that the candidates had to make 8 points and thus the question really discriminated the very good candidates.

Candidates could get more than the 2 marks for Graph A or B if they mentioned food supply or predators in the first part in addition to all the other factors that were required. A few candidates mentioned the relationship between birth rates and death rates in each graph and were given marks for this, although mentioning immigration and emigration rates was not relevant, since the candidates had already made their point with the birth and death rates.
Candidates who just mentioned a list of factors that might be different e.g. food supply and predators, did not score so many points, generally a maximum of 2 marks. Temperature was not considered a factor because they are both mammals and so they are warm-blooded. Explanations were needed with their identified factors.

Despite the fact that the question mentioned they were both small mammals, any answers that mentioned the colonising species was a weed, an algal bloom, yeast in the laboratory or something similar were not penalised as long as the answers made biological sense.

Quite a few people seemed to think of Graph B as an extreme case of A like a magnification of some part of it. They were given some marks if their argument made sense. A few answers incorrectly considered positive feedback to be a good thing and negative feedback to be a bad thing. Those who could mention positive and negative feedback in context correctly were given a ½ mark.

Question 20

(a) Kangaroo rats would lose water via body wastes (1), or urine (½), faeces (½), evaporation (sweat) from body surfaces (skin) (½), from the lungs (exhaled air) (½), and lactation (½).

(b) (i) Living in burrows (1) (Other reasonable answers accepted).

(ii) Temperatures in burrows would be cooler during the hot part of the day (½), resulting in a reduction in evaporative cooling (½).
OR
The air in burrows would be more humid (½), reducing evaporation from skin and lungs (½).
(Other reasonable answers accepted).

(c) (i) Longer loop of Henle (1) / Greater amount of active transport (1) in the kangaroo rat.
(Other reasonable answers accepted).

(ii) The longer the loop of Henle, the more water re absorption can take place (½) producing a concentrated urine (½), thus reducing water loss (via urine) in an arid environment (½).

(d) A high protein diet results large amounts of nitrogenous waste (urea) being produced (½).
Urea can exert a harmful osmotic effect if it accumulates and must be removed (½).
Urea is soluble so water is lost from the body to produce urine (1).
The significant loss of body mass of group B would be due to water loss for this reason (1).
Continuous loss of water in urine results in dehydration if there is no drinking water (½).

The breakdown products of a predominantly carbohydrate diet are CO_2 and water (1).
That is, the metabolism of carbohydrates results in the formation of metabolic water (1).
Furthermore, a diet of dry seeds provides adequate nutrition with little urea production (½).
The group C graph shows that changes in body mass almost matched the water loss caused by the environment (as shown in group A graph) (1).

Exam comments

a) Most candidates were able to list two or three ways in which a desert mammal would lose water. However, many candidates struggled to list four ways to get full marks.
b) Most candidates were able to give a feasible behavioural adaptation for desert mammals (in addition to being nocturnal). These included: living in burrows or underground (the most common answer); seeking shade (& 'stretching out'); plus reduction in activity.
Furthermore, many candidates were able to gain full marks for their explanation (part ii) as they included the idea that the adaptive behaviour reduced the need for evaporative cooling (i.e. water loss). There was some confusion between the kangaroo rat (a North America placental) and the spinifex hopping mouse, *Notomys alexis* (an Australian marsupial), with some candidates stating that the kangaroo rat puts its tail over its nose while it is resting. This answer was given credit as the question asked for behavioural adaptations (generally) in desert dwelling mammals (and not specifically for the kangaroo rat).
c) About half the candidates answering this question were able to state that the kangaroo rat would have a longer loop of Henle, and this was commendable. The justification for this question being in this section is that it is assessing knowledge of physiological

adaptations (for conserving water loss) found in mammals living in an arid environment.

d) This question was a very good discriminator as it involved considerable analysis and comprehension in order to interpret the graphs. In addition, this question also required a good knowledge and understanding of the metabolism of both carbohydrates and proteins. Overall, this question was answered very poorly with only a small proportion of candidates getting more than 2 marks.
This was mainly because the more capable candidates focused on either the role played by carbohydrates (to offset dehydration) or the role played by proteins (in causing dehydration). Only a small number of these 'more capable' candidates fully understood the question and focused on both aspects.
Very few candidates made any reference to graphs A, B or C. Many focused solely on the hydrolysis of carbohydrates and proteins and the energy gained from their complete decomposition.
A surprisingly large number of candidates stated or implied (incorrectly) that carbohydrates give a lot more energy than proteins. Furthermore, many answers were given that tried to somehow equate more energy with less dehydration.

Question 21

a) Each species has a unique scientific name which is used internationally, so each organism's name is very specific and cannot be misinterpreted. (1)
Some organisms do not have a common name, so can only be referred to by their scientific name. (1)
As scientific names are in Greek/Latin, their meaning is not going to change over time, as will common names in other languages. (1)
Common names can cause confusion as several species have the same common name that may vary from region to region, or include unrelated species. (1)
Scientific names can convey information on features or distribution, or related organisms within the various groups with which it is classified. (1)

b) *Limnodynastes tasmaniensis* (A) and *Limnodynastes dumerili* (C) (1) as their name indicates they are from the same genus. (1)

c) The common ancestor of the frogs was once widely distributed across Southern Australia. Changing sea levels and the drying of Central Australia geographically isolated the populations from each other (1), which prevented gene flow between the populations, isolating four different gene pools with their own variations (1).
The environments differed from each other, creating different selection pressures (1) and natural selection favoured the evolution of characteristics, which adapted each population to its particular environment and altered gene frequencies from the initial population (1).
Over time, the differences became sufficiently great to make Interbreeding impossible; the populations were reproductively isolated and speciation occurred, creating four new species from one (1).

Exam Comments

a) Any two well explained points, one for an advantage of scientific names, one for why they were preferable over common names.
Answers such as 'it makes you sound smarter using the scientific names' were given no marks as were responses that 'knowing the scientific name means you will know what its requirements are', akin to information on a plastic plant nursery label, as also were irrelevant information 'dumps' on binomial nomenclature in general.
This question was generally well-answered by candidates. Most were able to provide two clear reasons as to why it was advantageous to use scientific names rather than common names.
Some candidates focused on the 'gardening show' aspect of marketing and plant sales in the introduction to the question rather than providing evidence of their knowledge of classification.

b) This question was generally well answered by candidates. A concerning number, however, wrote frogs 'A' and 'B' (*Limnodynastes tasmaniensis* and *Crinia tasmaniensis*) were more closely related than 'A' and 'C' as they were the 'same species', disregarding this was not possible as they were not of the same genus. Some candidates wrote frogs 'A' and 'C' were in the same 'family' rather than genus, which was incorrect. Some candidates also wrote that 'B' and 'D' were most closely related as they were both Tasmanian froglets.

c) This question was generally well answered by most candidates, however, some candidates tried to explain the distribution of the frogs and the mechanisms by which this may have occurred (deliberate introductions, posting live frogs, rail, early settlers) rather than explaining how the evolution of four new species from the original one species.
A concerning number of candidates listed many isolating mechanisms in an attempt to gain marks and many wrote *geological* instead of *geographical* isolation. Also of concern was the fixation candidates had particularly with *mutation*, crossing over and random assortment causing changes in the population and neglecting the role of natural selection in producing variation within the population resulting in differing allele frequencies and phenotypes.

Question 22

a) Most of the 383 $kJm^{-2}year^{-1}$ is energy used in respiration (316 kJm^{-2} $year^{-1}$) (1), and (46 kJm^{-2} $year^{-1}$) is lost as faeces, skin, hair etc. (1) leaving very little (21 kJm^{-2} $year^{-1}$) available for transfer to the tertiary consumers (1).
Alternatively answers can consider that only around 10% of energy is passed on from one level to the next (½), with most energy being lost as heat (½), and also through decay, and material not eaten or not assimilated (1).

b) All energy which enters an ecosystem (C) is lost from the ecosystem as heat (A + B) (1). C represents the energy entering the ecosystem via photosynthesis (½), which then passes through the trophic levels (½). Respiration converts chemical energy into other useful forms of energy, which is ultimately converted to heat (B) (½); respiration in

decomposers acting on dead bodies, faeces etc also converts chemical energy to heat (A) (½).
Other possible answers include consideration of the law of conservation of energy (½), and that in a mature stable ecosystem total rate of photosynthesis is equal to the total rate of respiration (1) (aside from net import or export of organic material).

Exam comments

a) This question was not done so well. Most candidates did not relate it to the figures on the diagram and this limited them to 2 marks. Most candidates approached the question from the point of the 10% of energy which is generally passed on up the food chain. If they just mentioned that less energy (not the 10%) then they only scored ½ a mark.
Some of the candidates who referred to the figures in the diagram did not relate the figure to the biology and they did not gain full marks either. To gain full marks candidates needed to mention that it was the energy available to the tertiary consumers which determines their numbers.
Some answers mentioned the fact that the tertiary consumers were larger but not very abundant. Misconceptions here though, were that tertiary consumers have to eat more to survive. They don't necessarily eat more; they are just fewer in number as they have less food available to them.
Some candidates tried to make a point that there was more energy available if consumers eat lower down the food chain but sometimes this was poorly expressed. Also a few candidates saw this as a biomagnification question.

b) This part of the question was much harder and consequently not done well. Candidates could not gain full marks unless they made some discussion that it was the **sum** of the energy losses meaning that the loss due to respiration and decay occurred at all trophic levels.
Most candidates attempted this question by considering the Law of Conservation of Energy. Few of the candidates realised the distinction between **energy passing through a food chain and matter being recycled within**. Consequently there were a lot of answers, which incorrectly mentioned energy cycles.
Misconceptions in this question included statements where the candidates approached this question in a back to front manner eg CO_2, which was given out from respiration, provides the energy for the producers.

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