TASMANIAN QUALIFICATIONS AUTHORITY

The feedback from the final examination paper was positive and seen as one that had a good range of questions and enough longer questions to give the better candidates a chance to show their abilities.

However, the candidates had more problems with the paper than anticipated. This was particularly apparent in part 3, which assesses criterion 6, where many candidates failed to attempt one or more questions. These questions were seen to cover some important concepts that could be expected to be well covered by teachers. As a result, there were a much higher proportion of candidates who failed to gain a C rating or better for this criterion on the exam.

Overall the standard of answers was down too. It was hard to determine whether this was due to a weaker cohort. Concern was also expressed by a number of markers regarding the handwriting of many candidates.

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 Criterion 2

Question 1

(a) (i) temperature (of yeast and glucose solution) (or water) (1)

(ii) rate of (anaerobic) respiration of yeast (1) (rate of bubbles of CO_2 production 1(mark) Number of bubbles (½)

(b) The concentration of glucose should be controlled, (1) as the rate of anaerobic respiration would increase as the concentration of glucose increased / glucose is the substrate for anaerobic respiration (1)
OR The concentration of glucose should be controlled (1) so that it is clear that the results are caused by the independent variable, the temperature. (1)
OR The concentration of glucose should be controlled (1) so that only 1 variable temperature is changed in the experiment. (1)
OR The concentration of yeast should be controlled -yeast provides the enzymes for the reaction
OR strain /age/batch of yeast – will influence the activity of the yeast.

OR apparatus -will affect the rate of collection of bubbles.

Other answers were acceptable if they related to the rate of respiration and/or the production of bubbles, with 1 mark given for a credible factor and up to one mark for the explanation, e.g. thickness of the layer of oil, secure seal on the bung etc.

(c) (i) *Either* Yes, as the results for each temperature can be compared (1) & thus act as controls for each other. (1)
And/Or No, (½) not in the classic sense, but as you cannot have a test tube with no temp as a control, then range of temp act as a control to one another, Alternate controls could have been set up without the presence of yeast for each temp, or
Could use optimum temp 40^{o}C as control or could use room temp as control (20^{0}C)

Credit was given to answers that indicated that there was no control in the conventional sense where one tube was set up with normal/optimal conditions that would also show that the yeast was behaving normally as a valid reference point. Just yes or no without explanation is insufficient.

For this question the important factor was the explanation showing some understanding.

(ii) Third count at 60^{0}C (30) (1)
Possibly the temperature of the water bath was nearer 70^{0}C rather than 60^{0}C due to experimental error. (1) Alternatively, there could have been an error in the concentration of yeast/glucose in the solution if the set-up was changed or it ran out of glucose.

(d) Repeat the experiment several more times (1) to get more readings to increase the confidence in the average result & reduce the effect of any atypical result (chance errors). (1)

OR Use a thermostatically controlled water bath (1) for more accurate temperature control. (1)
OR Collect gas in inverted measuring cylinder (1), which would be more accurate as bubbles vary in size. (1)
OR the beaker could be insulated (1) to ensure the temperature remained exactly as required.(1)
Some credit was given for other reasonable modifications.

1 mark for method and 1 mark for explanation

(e) The optimum temperature is 50^{0}C. (½)
EITHER Not very confident. (½) as insufficient replicates involved (½). Temperature only measured in 10^{0}C intervals. More results between 40^{0}C & 60^{0}C (½) need to be collected (½) to accurately establish the optimum temperature.

OR Reasonably confident because of consistency of the three counts at 50°C as a maximum of measured rate (½) but would need replicates (½) or more results between 40^{0}C & 60^{0}C (½) to be fully confident.

Examiners comments

Most parts of this question were attempted by all candidates, and overall were well answered.

(a) Few candidates confused the independent and dependent variable. Quite a few wrote the "amount" or "count" of bubbles without indicating a time factor to make clear the *rate* was to be measured.
(b) For full marks it was important to explain *how* lack of control could affect the rate of respiration or would mean more than one variable was changing.
(c) (i) A number of candidates stated that 80°C was a suitable control because of the zero count of bubbles at that temperature rather than suggesting that the range of temperatures be used as a control compared to each other or a lower temperature at which respiration was clearly occurring.
(ii) The third count at 60°C was the only clear anomalous result. Many candidates indicated the 80°C results or those above 50°C as anomalous because the bubble count dropped against the expectation of the hypothesis. However it was clear that this was not the result of experimental error, and credit was not given for this answer.
(d) A large number of answers suggested better ways of counting the bubbles (more than one person; video so as to count and re-count after, etc.) While this was given some credit it was not given the same marks as improvements such as measuring volume of carbon dioxide.
(e) A large percentage of candidates expressed confidence in 50°C as optimum, but *then* went on to give reasons for lack of confidence. Credit was given for good reasons, but a better answer was to be *less* confident and give reasons for that.

Question 2

(a) (1 mark each)

Hypothesis	Suitable (S) Unsuitable (U)	If unsuitable, explain why (use point form). Acceptable answers included:
A	U	• No dependent variable • Fails to link soil depth to plant growth/distribution • No causal relationship between IV and a DV • Half marks, if not explained further: statement, not hypothesis/observation only
B	U	• Three independent variables (wind, sun and salt spray). Good hypothesis only has 1: hard/impossible to know which of the 3 variables is affecting the DV/plants
C	U	• Question, not hypothesis. Should be a statement.
D	U	• No clear IV or DV • Hard to know exactly what the IV is (several linked factors given) • No DV – bird factors not clearly linked to plant distribution/growth/density • Overly complex, wordy – hypotheses should be clear, simple

(b) 3 marks for complete credible hypothesis linking independent and dependent variables, for example:

For Hypothesis A:

- The soil at B is deeper than at A, allowing this species of plant to grow better.
- Shallower soils at A inhibit growth of this plant species.
- This species of plant grows better in deeper soils.
- Seeds of this plant species germinate more successfully in deeper soils.
- This plant species grows more densely in deeper soils.

For Hypothesis B:

- Greater exposure to wind/sun/salt spray (**one** of only) at A inhibited growth of this plant species.
- B is protected/sheltered (choose **one**) from (sun/salt or wind – choose **only 1** factor), causing (better growth/better seed germination/denser growth - choose **one**) of this plant species.

For Hypothesis C:

- Protection from salt spray allows (better growth/better seed germination/denser growth - choose **one**) of this plant species.
- Protection from salt spray at B allows better growth of this plant species.
- Growth rates of this plant species are higher in areas in the lee of the island with less salt spray / lower salt concentrations.

For Hypothesis D:

- More seeds of this plant are deposited in bird droppings at point B, resulting in higher populations of the plant species at this location. (or reverse at A or suitable comparison)
- Birds sheltering in the lee of the island (B) increase the nutrient content of the soil resulting in a higher growth rate of plants.

Examiner's comments

Most candidates attempted this question, and most obtained over half the allocated marks. Full marks were not uncommon. However, some candidates skipped this question, suggesting that they had failed to grasp the nature of a biological hypothesis, a fundamental and important concept.

Key aspects of the wording of this question included: 'testable', 'suitable, properly formulated' and 'plausible'.

Candidates should be reminded that questions of this nature are always testing the candidates' ability to spot the essential features of a hypothesis:

- only one IV and DV;
- IV and DV linked in a clear statement of cause/effect;
- a hypothesis should not be stated as a question;
- the statement should be clear and direct with no additional explanation;
- a hypothesis must be testable;
- a 'direction' for the DV is usually required (e.g. 'increased', 'decreased' **not** simply 'affected');
- a hypothesis shouldn't involve more than one sentence of writing.

It is not necessary to begin a hypothesis with, 'It is hypothesised that', 'That' or to use an, 'If…then' format.

A common error in part (a) was to become entangled in considerations of whether the candidate thought the hypothesis would be supported, which was irrelevant to the question.

Some candidates thought viable seeds could not survive passage through a bird's gut. This is incorrect, and many plants depend on birds to spread their seeds in droppings, as suggested in hypothesis D. Some candidates thought D was not a testable hypothesis as it would be difficult to manipulate the birds and control their behaviour. This was irrelevant, as it would be reasonably straightforward to make counts of birds at A and B, and also to count droppings, take dropping samples, count seeds and plant these to check whether they germinate.

An alarming proportion of candidates expressed firm beliefs that soil depth cannot be measured or would have no effect on plant growth – this shows a major lack of understanding of the relationship between plants and the soil they grow in. Many candidates also failed to understand the transect diagram and thought it indicated equal soil depth at A and B. The transect shows the overall shape of the island, but, at any point, there may be bare rock, deep soil or shallow soil.

In part (b) the question asked that the chosen candidate hypothesis simply be **reworded** into a correct format. There was no need to introduce new topics or change the general intent of the candidate hypothesis examples provided. It was not necessary to explain why the reworded hypothesis was an improvement or to give further explanation, or to propose experimental methods to test the hypothesis.

It was easiest to gain the full 3 marks by rewording hypothesis C, since only a small change to the wording was needed. Hypothesis D was the most difficult (due to its complexity) and candidates who attempted to clarify hypothesis D often forgot to add the necessary DV.

As a general rule, succinct hypotheses were most likely to gain full marks, and the more rambling answers usually included errors which lost marks. Some hypothesis attempts were descriptions/explanations, not hypotheses at all. It was essential that the hypothesis related specifically to the plant in question, instead of referring to 'plants' in general (minus half a mark). Anthropomorphism should always be avoided ('the plant prefers/requires…' is not satisfactory as it is not measurable/quantifiable and thus loses marks). Also, a number of candidates misunderstood the word 'inhibit', thinking it had the opposite meaning.

Question 3

(a) (i) 8 mice (1)

(ii) 5 doses (1)

(iii) Sample size is 25 (the number per treatment) (½).
This is a large enough number to reduce the impact caused by chance events or atypical individual responses by mice to either the *Streptococcus pyogenes or* the penicillin (1). Results show that there were 0 survivors in the control group compared with 24 in the treatment group. A sample size of 25 was enough to show a clear trend/significant difference (1).
OR Sample size is only moderate, so this would make it harder to draw conclusions on the basis of smaller differences between treatments (1). Extra half a mark for specific details about reasons

(iv) More virulent (½). The only way to compare the virulence is to compare the death rates in the control groups (untreated mice) (½) as the experimental groups have different other variables/treatments that affect the outcome (½). Control groups can be validly compared as they have the same treatment/dosage levels (½). In Trial 1 no mice survived the first day (1), whereas in Trial 1 9 survived the first day and 4/25 survived after the 10 days, whereas in Trial 2 0/25 survived after the 10 days (1). However this may not be a significant difference because the sample size may be considered small and this may be due to random variation in mice (½).

To gain full marks candidates needed to refer to the relative survival data in the control groups.

(b) **Conclusion**: Penicillin is effective in treating *Staphylococcus aureus* infections in mice (1). In both trials more mice survived for longer in the treated groups than in the control groups after 10 days. (1) The higher dosage level of *Staphylococcus aureus* in Trial one is more lethal (1) as shown by the higher death rate in the first 2 days when both trials received the same treatment rates (1).
Max 2-3 marks for conclusions

Questions raised: When looking at the treated mice in both trials:
Was the increased survival rate in trial 2 (especially beyond day 2) influenced by the longer treatment times or the greater total dosage? (1)
How much of the differences in the trial results can be attributed to the different doses of bacteria as against the different penicillin treatments? (1)
Was the virulence for all batches of the bacterium the same and if not what effect did it have? (1)
Other questions
Are the surviving mice in trial 2 effectively cured? (1)
What were the time intervals between doses in trials 1 and 2? (½)
Max 2-3 marks

Future trials: Keep batch (virulence) and dose volume of infecting culture the same for each trial (1), run separate trials to study the effect of one variable only (½), such as: different time intervals before starting treatment (½); different amounts of penicillin in a single dose (½); length of total treatment (½); total amount of penicillin given (½). Extend Trial 2 by comparing different single doses over 4 days + different intervals of time of dosage (1). Extend observations to beyond 10 days to see if the mice remain healthy and are effectively cured (1).
Max 2-3 marks

Examiners comments

Overall, the question was reasonably well done and was attempted by all but a very few. It still produced a wide range of marks, with the earlier marks easier to get and part b) allowing the better candidates to show what they knew.

a) Parts i) and ii) were easy and most candidates scored both marks

In part iii) most candidates mentioned at least some of the considerations regarding the need for large sample sizes. However, few candidates balanced these considerations with the clear trend shown in the results. Answers that gave the sample size as 50 total for both groups, also got the ½ mark.

Part iv) was surprisingly well done, with a good proportion of the candidates drawing their conclusions on the basis of the control group data. There were still those who based their argument on the experimental groups and came up with the wrong answer and few if any marks, while others were in two minds and sometimes started very well only to spoil their answer by giving equal or greater weight to the data from the treated groups.

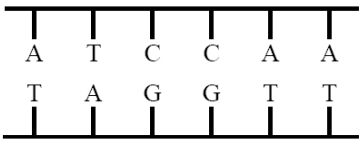
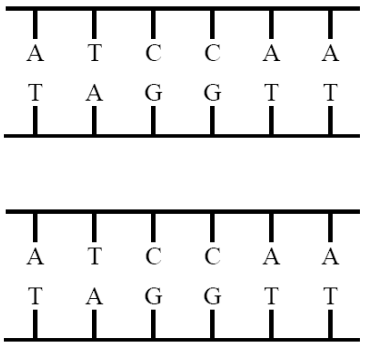
b) This part was challenging to get full marks, but most candidates attempted to cover the three considerations to some degree and so few actually scored badly. The main thing that was looked for was the level of understanding of the experimental data and its limitations.
There were some common problems:

- a lot of candidates tried to read too much into the results and received less marks if they didn't include reservations based on the multiple variables
- around one in five candidates misinterpreted the bacterial dosage level, by ignoring the decimal point and basing answers on the arguing that Trial 2 had twice the concentration
- many candidates treated the group size as a variable that needed to be strictly controlled, a lot making a big deal about the difference of one between groups and some insisted that the validity of the experiment was at stake because the numbers in the groups were not absolutely identical
- candidates often posed their questions in terms of simply "why did Florey" do this or that and so got less marks than looking at questions that were raised or remained unanswered by the experimental data in the table
- a lot of candidates simply restated the third dot point about the need for follow up trials

Part 2 – Criterion 5

Question 4

(a) (i) K - phosphate (½)
(ii) L -deoxyribose sugar (½)

Original DNA molecule	Replicated DNA
	

(1) (1)

(c) (i) A single base could be substituted e.g. ATC may mutant to ACC altering this and all following codons [any other reasonable mutation acceptable] (1) . This mutant triplet of bases would

possibly code for a different amino acid. The resulting protein would not be functional possibly causing malfunction or disease in the organism. (1)

(ii) A mutation in a body cell would affect only that cell, and unless it was a cancer causing mutation would not be significant (1).
Mutations in gametes affect all body cells of a resulting embryo and may cause significant, harmful consequences (1). Mutations in gametes also affect the gene line so can impact future generations too (½). It may be neutral or rarely a beneficial mutation in which case it may be selected for in the process of natural selection and lead to evolution of a new species even.

Examiners comments

Parts (a) and (b) were straightforward and well answered by most candidates. Where deoxy ribose was identified as sugar a ½ mark was awarded. Some candidates confused replication with transcription for (b), no mark was awarded.

Part (c) (i) required candidates to show that they understood the relationship between the amino acid sequence in a protein and the sequences of bases on DNA by outlining the processes that link them. Many candidates provided information about the mutations in DNA base sequences and failed to refer to link them to processes of transcription and translation.

Part (c) (ii) was straightforward and well answered by most candidates.

Correct use of terminology was often an issue, with answers referring to 'transpiration' and 'translocation', 'condons' (instead of codons) and 'complimentary' (instead of' complementary') bases.

Question 5

(a) Any 4 of the following (½ mark each)
- removal of metabolic wastes
- homeostasis / thermoregulation – sweating and cooling
- solvent for metabolic reactions
- transport of materials in blood plasma
- respiratory surfaces need to be moist to function
- medium for movement of gametes and internal fertilisation
- hydrostatic pressure for ultra-filtration in kidneys etc
- or any other reasonable answer

(b) (i) *Human milk is comparatively low in protein (½); protein is used to grow new tissues (½)
OR protein (which is used for growth) is in much higher concentration in cow's milk than human milk

(ii) Rabbit milk is high in fat than monkey milk (½) (energy dense - good for longer term energy release while mother away) (½); monkey milk is higher in lactose (½) (ideal for quick, ongoing, short term energy release) (½).

(c) Seals live in cold water (½); fat is a good insulator (½). OR High energy content of fat allows for rapid weight gain (½) - larger size (lower SA/Vol) reduces heat loss (½). OR High energy content of fat allows for higher metabolic rate required to maintain homeothermy in such cold conditions

Examiners comments

This question was attempted by all but two candidates. In part b i) * candidates needed to made reference to the data/figures in the table relevant to the question. If the candidate did NOT reference the figures then only (½) mark was awarded. No marks were allocated if numbers were stated without any explanation or comparison. In part ii) it was essential that the candidate referenced the relevant data/figures in the table (½) AND commented on the lactose being only a short-term energy supply (½) to gain full marks together with any two of the statements given. Many candidates omitted consideration of the significance of the lactose levels and the frequency of feeding.

Question 6

(a) CO_2 uptake indirectly measures the difference between the rates of photosynthesis and respiration (1), which also provides a measure of growth (½ or 1 – with explanation). Answers that link the uptake of CO_2 to rate of photosynthesis can be given ½ to 1 mark depending on depth of understanding shown. CO_2 is a raw material for the synthesis of glucose by plants (1). It can also indicate the rate of output of O_2 (½).

(b) Species B lives in the shade (1). Indicated by:
- it reaches its maximum rate of CO_2 uptake at much lower light intensity than species A (1);
- its CO_2 uptake is lower in high light intensities (½), suggesting it is unable to make good use of increased light (½).
- compensation point (rate of photosynthesis = rate of respiration) is reached at much lower light intensity than in A
- at higher light intensities species B's rate of photosynthesis declines.

(c) (i) Species B (½). At light intensity of zero (½) (no photosynthesis) plant is giving out 0.05dm^3/m^2 CO_2 by respiration compared to 0.1 dm^3/m^2 in species A, (1)
OR species B produces less CO_2 than species A (½) - this CO_2 is produced by respiration (½).
Some credit was given for stating that the compensation point of B is lower than that of A so B's rate of respiration rate must be lower. This is not correct, however, as their rates of photosynthesis are not the same.

(ii) The amount by which total photosynthesis exceeds respiration determines the growth rate of a plant (1). Plant B is adapted to living in shady/low light conditions (½). Because of low light intensities in the shade, plant B would have a reduced rate of photosynthesis (1). A low rate of respiration would result in less glucose being broken down, thus more available for growth (1).
OR A low rate of respiration means that it reaches the compensation point more quickly. (1) At this light intensity the plant will be making as much glucose by photosynthesis as it is consuming in respiration. At higher light intensities photosynthesis will exceed respiration and the plant will grow. Hence a low compensation point is an advantage to a shade plant.

3 clear points -1 relating to the graph, 1 relating to the difference between P and R and 1 relating to the impact of this were looked for in the answer.

Examiners comments

(a) The vast majority of candidates scored 1.5/2 for this question with most writing that the CO_2 uptake indirectly measures the rate of photosynthesis and only a small number of candidates mentioning the rate of respiration.

(b) The majority of candidates did well on this question (scoring 2/3 to 3/3). The most common error was the suggestion that the decrease in CO_2 uptake by B at high light intensity was the result of adaptations to those conditions which allowed it to conserve water whereas A continued to photosynthesise uncontrollably. Therefore candidates thought that B was adapted for full sun instead of shade. Unfortunately, this was over-thinking the problem and seemed to revolve around the idea that increased light intensity would also result in increased temperature. Some candidates took the x-axis to represent the time of day. It is important to take the time to interpret the graphs correctly.

(c) Most candidates did not make the connection that the rates of respiration could be compared when the light intensity was zero. Instead, many felt that B's rate was lower because its graph did not go as high as A's and so they scored only ½/2.
Many candidates did not know what to write for the answer to the last part of the question. A significant number thought that the rates of photosynthesis and respiration are locked together – the CO_2 released by respiration is all that is used by photosynthesis – ignoring the fact that the plant is able to absorb CO_2 from the atmosphere.

Question 7

(a) A is glucose (½)
B is water (½).

(b) C is ADP (1). When respiration releases energy (½), ADP combines with phosphate (P) to form ATP, with energy stored in its bonds (1). This is the energy currency of all cells. (½)The ATP moves to the ribosomes and it is broken down to ADP and P (½) with the release of energy that is needed for protein synthesis (½).

Examiners comments

(a) This was straightforward and well answered by most candidates.

(b) Fewer candidates addressed the second dot point, and those that identified ADP as the energy carrying molecule, often did not elaborate on the way that ATP and ADP interact to store and release energy.
Very few candidates made any reference at all to the ATP moving to the ribosomes to release energy.

Question 8

* Enzymes (molecule A) have an active site (1). Substrate molecules (B) fit into this, facilitating the breakdown of the molecule into product molecules (C and D) (1).
  * The enzyme is unaltered by this reaction (1).
  * The enzyme can only catalyse one specific reaction because the shape of other potential substrate molecules (E) is not complementary to the shape of the active site (1). OR
  E could be solvent OR competitive inhibitor, **OR a solvent, another substrate, sugar etc**.
  * Some molecules (F) inhibit the action of the enzyme (1). One way in which this occurs is when the inhibitor binds to part of the enzyme and thus alters the shape of the active site (1).

½ mark for labelling molecules
½ mark for explanation relating its role in the diagram shown

Examiners comments

If the candidates knew their theory, it was easy to get 4 or more marks.

The majority of candidates focused on the right-hand side of the reaction only and consequently many wrote their answers in terms of the reverse i.e. 'C' and 'D' were identified as the substrates for product 'B'. Candidates were not penalised for this as many stated that the enzyme reactions occur in both directions.

However many candidates identified 'F' as the substrate and consequently followed with 'B' and 'C' as competitive inhibitors or one being a co-factor for the other. No marks were awarded for this interpretation because 'F' was stated as binding with the enzyme's active site.

The presence of 'E' confused several candidates but overall the majority of candidates identified 'E' as either another substrate, inhibitor, cofactor, solvent or sugar molecule. A suitable explanation had to accompany the identified name and sugar was accepted if the candidate went on to say that this was a source of the ATP (energy) required for the reaction to proceed.

Most candidates who achieved 5 marks did not state that the enzyme 'A' remained unaltered by this reaction.

If candidates did not know what the various letters represented then many tried to write 12 lines on the difference between 'lock and key' and 'induced fit' and/or about the general conditions that can determine when enzymes operate e.g. pH, temperature, concentration of enzyme, substrate etc. Only a mark was given for demonstration of this knowledge if they could not relate the information to the diagram given in Q8, and much of this information was from their dictionary.

Part 3 – Criterion 6

Question 9

a) Meiosis (1 mark)
Halving number of chromosomes, from 64 to 32
Mark awarded for giving whole answer above, or in part- halve the chromosomes, or a reduction in chromosome number from 64 to 32. (1 mark)

b) 32 (I mark)

c) Mitosis (1 mark)

Examiners comments

Question generally not well answered.

(a)
- Candidates commonly confused mitosis and meiosis (often said mitosis and gave meiosis definition)
- Some confusion regarding the word spores, which led to discussions of asexual reproduction
- Explanation of meiosis often centred upon the formation of gametes, but lacked a discussion of how chromosomal numbers changed.

(b)
- Candidates often gave 16 as the answer (halving the 32) also many answered 23. Other random numbers offered between 0 – 64.

(c)
- Commonly answered meiosis, fertilization or named a stage of mitosis/ meiosis.
- Poor spelling of mitosis common (esp. meitosis)

Question 10

a) Contains DNA, ribosomes and cytoplasm (1 mark per answer, maximum of 2 marks)

b) 1 mark for each of the following:

- bacterial cell lacks a nucleus**, endoplasmic reticulum, chloroplasts and other membrane bound organelles
* genetic material not contained in a membrane bound nucleus in bacteria
- bacterial cell is much smaller than a plant mesophyll cell
- bacterial cell has a capsule around it, not present in plant mesophyll cell
- bacterial cell wall not made of cellulose, plant mesophyll cell wall is made of cellulose.

c) Prokaryotic (1)

Examiners comments

(a) Majority of candidates did not read the question and stated the differences between them, rather than similarities

(b) Candidates commonly listed all of the organelles as separate points, which could not be awarded full marks for this part

(c) Candidates answered this question correctly generally. Some mistakes showed that some candidates were unsure about what prokaryotic / eukaryotic meant.

Question 11

(a) (i) Endocytosis / phagocytosis (1) Active transport (1/2)
Cell membrane fluid and can change shape.(½) Invagination / engulfing of the cell membrane occurs at H, (½) the particles are then surrounded by the cell membrane (½) forming a vesicle/food vacuole at E. (1)

(ii) For substances to diffuse across the cell membrane they must be composed of very small particles.(1) In this case the white blood cell is ingesting a whole organism (bacteria) which are much too large to cross the cell membrane.(1)

OR The white blood cell uses endocytosis / phagocytosis to take in these particles rather than diffusion as the cell membrane is impermeable to them (1) because of their large size. (1)

(b) (i) Enzyme (1) Protein (1/2)

(ii) Digestion (1) Breakdown (1/2)

Credit was given for other sensible ideas where appropriate

Examiners comments

Candidates fell into 3 groups here in answering this question with 1) 20% of candidates not able to score more than 1 mark for this question. 2) Candidates being able to answer part a) and scoring 3 marks or 3) candidates knowing the answer and scoring 5 and above marks. A few candidates managed to score full marks in this question. Many candidates had very little idea about the process of phagocytosis. Careful reading of the question is encouraged too as candidates in many cases thought this cell was photosynthesising in G.

a) Was answered well in most cases.
b) Poorly answered as many candidates were discussing active transport based on concentration gradients.
c) Candidates either got this or they didn't. Many incorrect answers included cell replication, protein synthesis, mitosis,

Question 12

(a) (i) Diffusion (½) since it is not affected by the addition of a respiratory inhibitor i.e. the rate of absorption remains the same (1). Hence it must be a passive process/does not require energy from ATP.

(ii) Active transport (½) because when a respiratory inhibitor is added the rate of absorption decreases (½). It is a process that requires energy (½) to move substances against the concentration gradient (½).

(b) (i) Diffusion (1)

(ii) As the concentration gradient decreases rate of entry slows down (4-8hr) (½) and by 8hr diffusion ceases as the concentration inside the cell equals the concentration outside the cell (½).

OR

Initially the concentration in the cytoplasm of the cell is zero (½) thus substance B enters rapidly as the concentration gradient is large (0 - 4 hr) (½). As the concentration gradient decreases the rate of uptake decreases (4 - 8 hr) (½) until the concentration inside & outside are equal (8 - 10 hr). (½)

Data from graph (time) must be used in answer for full marks

(c) The graph would be less steep (½) as the molecules of substance B have less kinetic energy /move slower (½) so that diffusion will be slower. A maximum concentration of 12 $\mu g\ mL^{-1}$ will eventually be reached (½) but it will take more time for this happen (½).

Examiners comments

(a) Candidates who correctly interpreted the data in the table were easily able to gain close to full marks for this part. However, many candidates thought the numbers referred to concentration values (rather than rates of uptake/absorption). A large number of candidates identified the processes as aerobic and anaerobic respiration. Answers which correctly identified the key data in the table and which referred to the presence or absence of energy were able to gain part marks even when the actual process involved was not correctly identified.

(b) It was clear that many did not recognise that the vertical axis represented the concentration **inside** the cell. More than half the candidates identified the process as osmosis and suggested that the 0 mark on the graph represented a hypotonic (weak) solution external to the cell. Nevertheless, a majority of candidates were able to use the data correctly to suggest substance B was moving from a high concentration (outside the red blood cell) to a lower concentration (inside the red blood cell). Many also discussed the eventual equilibrium situation, but only strong candidates mentioned the decreasing rate of reaction between 4-8 hours due to diminishing concentration gradients.

(c) Candidates had little problem in recognising that diffusion would occur more slowly, but often did not indicate how this would be reflected in the shape of the graph. Quite a few candidates stated that because “diffusion is a passive process/does not require energy to happen” (true), it “would not be affected by a decrease in temperature” (not true).

Question 13

Unicellular organisms, such as an Amoeba or Paramecium, are not specialised to carry out any particular function (½), & must carry out all the functions necessary for its survival (½). They are very small (½) and therefore have a large surface area to volume ratio (½). This means that they are able to gain O_2 and nutrients directly from the environment by diffusion (1).

In contrast, multi-cellular organisms (like a human) are large – diffusion alone cannot provide materials to all cells (1). Some cells are specialised to carry out specific functions (½) (e.g. transport of O_2) allowing division of labour. This means they no longer carry out other functions and therefore they rely on other cells - they are interdependent (½). The structure of a specialised cell reflects its function (½).

For example: (up to 4 marks for TWO examples that relate structure to function)

Red blood cell (½): function = O_2 transport (½). Has a biconcave disc shape (½) to increase SA (½) so this happens efficiently. (or – lacks nucleus so it can carry a maximum amount of haemoglobin (½))

Sperm Cell (½): Function = carry DNA to ovum (½). Has mitochondria for energy (½) and a flagellum for movement (½). Contain half the usual number of chromosomes (½)

Muscle Cell (½): Function = contract to enable movement (½). Have many mitochondria (½) to provide the energy required (½) to change the shape of the cell (and thus contract the muscle tissue).

White blood Cell (½): Function = destroy foreign invaders (½). Flexible shape and ability to move (½) enables them to squeeze out of capillaries to attack foreign particles in tissue fluid (½). (or – flexibility enables phagocytosis)

Many other examples of specialised cells could be used, including from plants (e.g. xylem, phloem, palisade cells).

In summary:
Up to 2 marks for describing how structure relates to function in each 2 different specialised cells (total of 4 marks overall).
Up to 2 marks for discussing how unicellular organisms differ in this regard,
Up to 1 mark for mention of the significance of the size/SA:Vol of the two types of organism, or to any other relevant point – eg. interdependence of cells in a multi-cellular organism.

Examiners comments

Although the question asked candidates to frame their answer around a **named** multi-cellular organism and a **named** unicellular organism, they were not penalised if they only named the organism fairly generically (e.g. bacteria) or if they discussed two cells from different multi-cellular organisms (e.g. a plant and an animal). However, it was critical that the discussion of the cells went beyond a simple catalogue of structural features and differences – it needed to relate these structures to the function/role of the cell (the "why" part of the question).

Many candidates selected "bacteria" as their unicellular organism, which was acceptable. However, sometimes this led to answers which simply discussed the difference between prokaryotic and eukaryotic

cells, which was not the focus of the question. Similarly, answers which concentrated on documenting the structural differences between plant and animal cells gained only a few marks.

The number of candidates who considered that "all unicellular organisms are prokaryotic" (they are not), or that "unicellular organisms can only do one thing" (not true) was of concern, as was the suggestion that Amoeba and other protists have eyes and mouths!

Overall, it would be fair to say that candidates found this question challenging, and, for this reason, and also because was at the end of a section perhaps, it was not attempted by around 10% of candidates. However, those candidates who did attempt it, and made even very minor relevant comments were generally rewarded with a mark. It always pays to "have a go"!

Part 4 – Criterion 7

Question 14

(a) Recessive (½) Penny has it & neither of her parents have it (1). They must be heterozygous for it (Ff) (½)
Autosomal (½) Penny has it & if it were sex linked the X chromosome which comes from her father Isaac would have to carry CF. (1) As he only has 1 X chromosome he would then have CF (½) & he doesn't. (1)

Other answers accepted were:

Dominant traits often show someone affected in every generation and this is not the case on this pedigree. (1)
Recessive traits often skip a generation. This can be seen on the pedigree. (1)
Both sexes affected make it is unlikely to be sex linked (1/2) (only accepted if given with other good information)

(b) Penny (½) ff (½)

(c) F = normal
f = CF

Gametes:

Gametes	F	f
F	FF	Ff
f	Ff	ff

(1 mark for showing gametes and working)

Genotype: $^1/_4$ FF + $^1/_2$ Ff + $^1/_4$ ff (½)

Phenotype: $^3/_4$ normal + $^1/_4$ cystic fibrous (½)

Probability of cystic fibrous = $^1/_4$ (1)

Marks were lost where:
- if X,Y was used
- correct probability given but with incorrect working out.

Examiners Comments

Many candidates did not score as well as they could have on part c) because they didn't put their working out down- phenotype was something consistently omitted.

A lot of candidates thought that only males can get a sex linked trait and if males and females showed the trait this meant that it couldn't be sex linked.

Many did not read the question and invented their own letters to represent alleles rather than using F and f as requested.

Overall this question was poorly done by many candidates, which was surprising as it was fairly straight forward.

Question 15

(a) Any 3 of the following.

- The villi provide a large surface area required for efficient absorption of nutrients by diffusion and active transport and for release of enzymes. (1)
- The single layer of cells minimizes the distance the substances have to travel by diffusion into the bloodstream. (1)
- The extensive network of capillaries efficiently transport products of digestion amino acids and monosaccharides around the body to where they are needed. (1)
- Long lacteals move fatty acids and glycerol into the lymph system where they are transported to where they are needed. (1)

½ mark for structure and ½ mark for function

(b) - Low growth rates (failure to thrive) & fatigue would result from flatter villi, which would reduce the surface area for the absorption of nutrients such as amino acids & monosaccharides. (1)
- Low growth rates (failure to thrive) & fatigue would also result from shorter lacteals would reduce absorption of fats & fat-soluble vitamins. (1)
- Low growth rates (failure to thrive) & fatigue would also result from fewer capillaries which would result in less nutrients being carried away thus less energy would be available for growth & activity. (1)
- Iron deficiency anaemia & fatigue would result from flatter villi, which would reduce the surface area for the absorption of iron. Thus less iron available to produce haemoglobin. (1)

Up to two marks were awarded for identifying two of the following with an explanation of the impact: stunted villi having less surface area, limited blood supply, thicker capillary walls and

greater diffusion distance all contributing to a limited absorption rate for nutrients into the bloodstream.

Up to three marks were awarded for answers that identified and explained the effect of a limited supply of the following nutrients: iron in relation to anaemia, glucose in relation to energy/fatigue and amino acids for proteins and growth. Maximum of 4 marks

Examiners comments

(a) The majority of candidates were able to identify at least two structures within the villi shown in the diagram and state what they do though many merely referred to diffusion. Better answers made reference to the diffusion of nutrients into the bloodstream. Many candidates relied heavily on their dictionary's definition of "villus" and consequently did not answer the question as required – they received less credit for their answer. A number of candidates incorrectly wrote about the villi being involved in gas exchange or used the words "exchange of nutrients" instead of "diffusion" or "absorption". The term "re-absorption" was also used inappropriately in some answers.

(b) A wide range of responses was presented for this question including a number of excellent answers. Most were able to write about the stunted villi having less surface area, limited blood supply, thicker capillary walls and greater diffusion distance all contributing to a limited absorption rate for nutrients into the bloodstream. The best answers went on to identify the nutrients as iron as it relates to anaemia, glucose as it relates to energy and amino acids for proteins and growth. Some candidates incorrectly discussed limited oxygen uptake from the villi with resultant fatigue and anaemia!

Question 16

(a) Homeostasis (1) or thermoregulation (1)

(b) If the water content in the blood is low (no water consumed) then the rate of sweating would be reduced to conserve water his body. (1) Thus less sweat is evaporated (1) so less heat is lost evaporating sweat / body cannot cool (1) so his core temperature rose more than the other athlete.

Examiners comments

a) This was correctly answered by most candidates. The majority of candidates who did not score a mark on this question either wrote 'osmoregulation' as their answer or did not attempt it.

b) This was answered well by most candidates. Most achieved at least 3 marks out of 4. Half marks were lost if candidates did not mention evaporative loss as an explanation of how sweat cools the body or did not relate their answer to the athletic scenario. Even though most did well on this question it was concerning to note that a significant number wrote far too much for a three mark question, and used far more than the available writing space. In these cases candidates often went into detailed descriptions of how osmoregulation occurs in the kidney tubule as ADH is released. This was outside the scope of this

question and would have used up valuable writing time elsewhere on the exam.

Question 17

During the period of exercise (0-5min) the increase in heart rate pumps blood to the leg muscles faster & helps the muscle cells function at maximum capacity/efficiency (1). Maximum heart is reached at 126 beats per min (½). The muscles are respiring faster and are using more energy (1) thus more oxygen and glucose needs to be supplied to muscle cells (1). More oxygen needs to be supplied to muscle cells to prevent anaerobic respiration (1). Wastes such as carbon dioxide, lactic acid and heat need to be quickly removed (1). Increased oxygen needs to be supplied to muscles for the complete breakdown of glucose (1) for the production of ATP for energy (1). The metabolic heat generated needs to be transported by the blood from the muscles to the skin (1).

During recovery the heart rate decreases as respiration in the leg muscles slows down & less oxygen & glucose are required. (1). Over about 5mins (5-10mins) the heart rate returns to normal.
Credit given for any other reasonable explanations relating to changes in heart rate

Any 5 of the above – 1 mark for use of data in the answer – e.g. time / number of max heart beats

Examiners comments

This question was not answered strongly by a significant number of candidates and 4% of candidates did not attempt it. Most achieved around half marks. Where this happened the most common scenario was that candidates gave a comment but then did not expand upon that comment. For example a candidate who wrote “The heart beats faster to provide oxygen to muscles” would only have drawn half a mark if no statement about the need for oxygen in cellular respiration was then provided.

Many candidates were able to discuss how the need for oxygen is linked to increases in heart rate during exercise and then a decrease in heart rate during recovery, but then left it at that and did not discuss any other ways that heart rate changes are related to the muscular requirements. A number only discussed the exercise portion of the graph and did not mention the recovery phase.

A number of candidates wasted significant writing time discussing the various features of the aerobic and anaerobic energy systems rather than answering the question directly. Some also ignored the question description of the exercise being at a constant intensity and proceeded to discuss an incremental exercise scenario.

Those who achieved 4 marks or higher were able to discuss the roles of oxygen and waste products as related to heart rate during both exercise and recovery periods.

Question 18

(a) Transpiration /diffusion / evaporation (½); stomata (½).

(b) Three of: (½ mark for structure on diagram and ½ mark for well explained function)

- waxy cuticle which reflects light and heat or which reduces water loss by diffusion through epidermis or thick cuticle which reduces heat absorption/reduces water loss by diffusion through the epidermis
- stomata on the underside of the leaf to reduce transpiration as less exposure to sun/heat/ temp
- stomata in pits to increase water saturation, which decreases transpiration
- hairs in the stomatal region to hold moisture/ decrease concentration gradient for diffusion of water vapour, reduces transpiration rate
- stomatal guard cells can close stomates during periods of water stress.

(c)

- In summer there are more hours of sunlight and the temperature is higher, which contribute to more rapid water loss (1). Stomata are open much earlier in summer.
- Transpiration occurs mainly between the hours of 5 am - 10 am and 4 - 6 pm (½). This allows the plant to photosynthesise sufficiently (½), and also to conserve water (½) in the hottest part of the day (½), by closing its stomata between 10 am and 4 pm (½).
- In winter transpiration occurs from 7 am to 5 pm (½), making best use of the available sunlight hours for photosynthesis (½). Reaches a maximum between 12 noon and 3 pm (½). Increasing temperature increases rate of transpiration.
- Water conservation is not as important in wetter winter months (½), and without water loss being a priority the plant can make the most use of more limited light by maximizing the uptake of carbon dioxide for photosynthesis through the open stomata (1).

2 -2 ½ marks for summer, 1- 1½ marks for winter,1 mark for use of data from the graph.
Full marks cannot be achieved without use of data.

Examiners comments

(a) Very messy writing from a surprisingly large number of candidates made this question difficult to mark. Many could name the process but thought the structure was xylem.

(b) Where the answers were legible, they were usually good.

Large vacuoles to store water was not accepted

Many candidates thought that the small lines at the top of the diagram represented hairs on the upper surface of the plant. This was accepted if a good explanation of how this can reduce water loss was included.

A lot of candidates felt that the role of spongy mesophyll is to store water.

(c) Nearly all candidates attempted this question and presented a wide range of answers. A large number of candidates wrote answers that compared summer and winter regarding water loss in plants and consequently did not account for the variations through the daylight hours shown in the graph. Many candidates simply described the graph in relation to water loss without explanation or consideration of the data from the graphs. Better answers accounted for the function of stomata at different times of the day in winter and summer, but less than half the candidates were able to make links with the plants need to have stomata open for gas exchange in order to carry out photosynthesis.

Part 5 – Criterion 8

Question 19

(a) The scientific name is in two parts i) genus name ii) species name.
The shared name is the name of the species (½) and this give no indication of the relationship between the species (½). The animals are not closely enough related to be classified into the same genus (½), as their generic names are different (the first name) (½).
½ mark was given to candidates who explained that the common species name could indicate a shared feature such as spots.

(b) (i) Two (½). Different species are reproductively isolated from each other (½). IV is isolated from the rest, so is a single species (½). The diagrams show that there is potential gene flow between I, II and II so they are one species (½).

(ii) Three (½). Without population II there would be no interbreeding between I and III (1). Because they would be reproductively isolated they would be separate species (½).
OR
Two (½) - if populations I and III were brought closer together so that they could interbreed.

Examiners comments

Candidates found this question challenging, with half scoring 2 marks or less.

(a) A common error was identifying *maculatus* as genus, and the genus name as the species name. Many candidates said the animals were very closely related due to their shared species names; therefore they were all capable of interbreeding to produce fertile offspring.

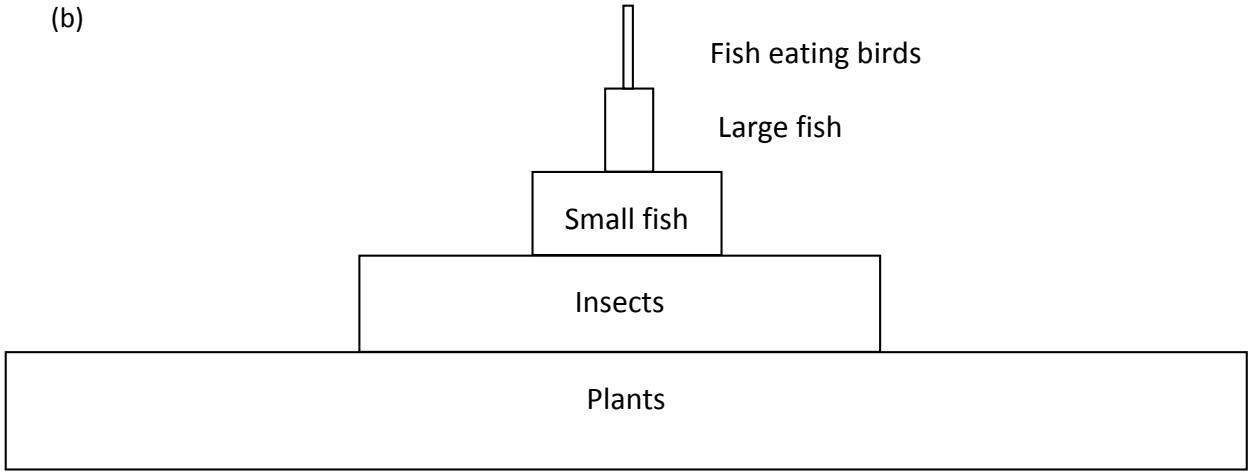
(b) (i) A large number of candidates counted 5 circles, incorrectly assumed 5 species and stated that 2 new hybrid species would be produced from the interbreeding of I and II, and II and.III. This gave a total of 7 species. Others counted 4 original populations which, when added to 2 hybrids, imagined produced 6 species.

(ii) Many arrived at the correct number of species, 3, following on from their flawed logic in part (i). Those who stated there would now be 3 separate species due to no interbreeding were awarded 1 mark.

Question 20

(a) DDT may have been use on farmland, and washed into the river by rain (1).

(b)



(2)

1 mark for shape and relative size of each layer / pyramid blocks preferable as each successive level should be shown as (well) under half the size of the one before ; 1 mark for labels (& order).

(b) Plants contain a low concentration of DDT which does not harm them (½) Organisms do not break down or excrete DDT and DDT is non biodegradable (1) so it builds up in the body / fat tissue over the life of the organism (½). Only about 10% of biomass is passed on to the next trophic level; the rest is used for energy or lost as wastes. (1). Hence, consumers eat many times their body weight during their life and accumulate DDT from the previous trophic level and so accumulate many times their levels of DDT concentration (1). So the DDT which enters the plants is passed on to the insects, and so on up the food chain (1). Thus all the DDT in the plants becomes concentrated into ever smaller biomass, thus increasing to dangerous levels in the top consumers like the birds (1). An example of Biomagnification (½)

Important points looked for

- *Builds up in fatty tissue –passage through food chain*
- *Why it does not break down*
- *10 % transfer through food chain*
- *Consequence of high levels of DDT*

Examiners comments

This question was answered well by most candidates, with 75% scoring 3 marks or higher.

(a) Many suggested run-off from nearby farms and gained the full mark.

(b) Most candidates had a pyramid of the correct shape, but many lost a ½ mark for not having successive levels well under half the size of the one before. Those who drew traditional 3-sided triangles scored 1 mark.

(c) Very few candidates (9) gained full marks on this part of the question, although it was generally done well. Many omitted to mention 10% energy transfer to higher trophic levels, and lost 1 mark.

Question 21

(a) Light coloured skin would reflect some of the heat from the sun (½) and aids cooling (½). OR Short hairs would allow for more efficient evaporation of sweat (½), thus increasing cooling (½) OR Short hair retains less body heat (½) by decreasing the levels of insulation (½) OR Light coloured skin blends with desert sand (½) for camouflage from predators (½).

(b) Oryx feed mainly at night enabling them to be inactive (perhaps in the shade) during the heat of the day (1).

(c) During the day the mechanisms designed to cool the body are not activating until a body temperature of 40^{o} is reached – a higher set point (1). Evaporation of sweat cools the skin, which cools the underlying blood, thus cooling the body (1). Between 37^{o} and 40^{o} the Oryx would not be sweating excessively thus helping it conserve water in the dry desert (1). Consequently, less energy is used in maintaining a lower temperature – this energy can be used for other purposes. (1)

Other answers given some credit:
Ability to tolerate high temperatures means less competition from other grazers who do not tolerate such temperatures during daylight hours spent feeding (1) OR less danger from predators. (1)

Temperatures in the desert are very cold at night; tolerating a high temperature allows the Oryx to remain warm throughout the night (1).

Higher temperatures increase the rate of metabolic reactions; therefore food can be digested more quickly by the Oryx. (1)

In other animals enzymes would begin to work less efficiently at such a high core temperature – Oryx enzymes must be adapted to this increase in temperature and will continue to work effectively. (1)

Examiners comments

The vast majority of candidates scored between 2 and 3 marks for this question. Most candidates had no difficulty reading the graph in the question, and could answer questions (a) and (b), however most did not understand the significance of water conservation in question (c). In question (b) many candidates did not give a behavioural adaptation, and simply restated the structural adaptations given in (a). Also in (b), some candidates noted that the Oryx eats only at dawn and dusk – no marks awarded, as the Oryx feeds during the night also. In question (c) many candidates simply restated the information in the question – that the Oryx can survive so well in the desert because it can allow its temperature to rise to 40°C – no marks were awarded for this.

Question 22

(a) A range of answers were accepted including:

- Yes, soil nutrient would be replenished by decomposition of the droppings of the sea birds (1). Decreased nesting would decrease bird dropping (guano) on the land leading to a decrease in soil nutrients (1).

- Yes, damaged vegetation means plants would need to take up more nutrients for growth and repair (1), resulting in decreased amounts of soil nutrients (1).
- Yes, damaged vegetation destabilises the soil (1) resulting in increased erosion and decreased amounts of soil nutrients (1).
- Yes, more browsing by introduced mammals results in more growth and nutrient uptake by the plants (1) lowering the nutrient content of the soils (1).
- Yes, more introduced mammals results in a greater amount of soil nutrients (1) as these animals excrete wastes and return nutrients to the soils (1).
- Yes, more introduced mammals results in a greater amount of soil nutrients (1) as these introduced animals die, decompose and return nutrients to the soils (1).
- Yes, as more vegetation is damaged it is broken down by decomposers and the nutrients are released back into the soil (1) raising soil nutrient levels (1).
- No, the reduced numbers of birds depositing guano and building soil nutrients (1) would be balanced by the increased amount of faeces being deposited by the introduced mammals (1).
- Yes, if the damaged vegetation included nitrogen-fixing legumes (1) then this would result in fewer nitrates in the soil and reduced soil nutrient levels (1).
- Yes, a reduction in bird numbers would result in less legume seeds being dispersed (1) and established, resulting in lower soil nitrate and nutrient levels (1).
- No, in the short term there would be fewer droppings supplying nutrients to the soil (1), but there would be more decomposing bird carcases adding to the nutrient levels (1).
- Yes, the introduced mammals would be adding different types of nutrients to the soil compared to the marine seabirds (1), therefore influencing the types and amounts of soil nutrients (1).

(b) A range of answers were accepted including:

- Increase in seabird numbers – due to reduced predation by cats (1)
- Increase in rats and mice (½), - which may have increased their predation of eggs and, possibly, young birds (½).
- Increased native fauna due to less competition for food from cats /less predation from cats (1)
- Rabbit numbers increased significantly (½) which would cause increased damage to native flora (½).
- Rabbit numbers increased significantly (½) and caused damage to native flora (½) and resulting in erosion reducing possible nesting sites for the marine birds reducing their numbers (1).
- Increased rabbit numbers would result in more competition for food and shelter for the native herbivores, decreasing their numbers (1).
- Overall the cat eradication would have had a negative effect on flora and fauna (½).
- Increase in birds – more guano / more mineral / more native plant growth (1) resulting in an increase in native herbivores (1).
- With the removal of a large predator such as the cat, environmental resistance would be less which would enable the native bird population to grow exponentially (1). Eventually, another form of environmental resistance would be encountered (competition for native flora/fauna, lack of shelter/nesting sites, or increased egg predation by rats) (1) and the populations of native birds would remain relatively stable and oscillate around the carrying capacity of the island (1).

(c) Without predation by cats the rabbit population would rapidly rise (½) when environmental resistance (cats as predators) is reduced. This could not continue indefinitely (½) due to high competition for food, burrow sites, water etc. Eventually the rabbit population would be expected to decrease (½) due either to shortage of food / environmental degradation (½) or spread of

disease (½). Eventually the population would stabilise at a reduced level reflecting the carrying capacity for the island (1).
OR Disease and food/shelter shortage could have a significant impact on the rabbit population as they overshot the carrying capacity which may result in a huge reduction of numbers from which the population might never recover (1).

3 good well explained consequences including the use of carrying capacity term

Examiners comments

In general, most candidates found it difficult to gain full marks on this question. The modal score was five marks out of a possible nine. Ten candidates did not attempt the question and only two candidates received full marks.

(a) Most candidates answered part (a) well. However candidates lost partial marks due to incomplete reasoning and explanations. A number of candidates indicated that there would be fewer nutrients due to increased digging by the introduced mammals. However, they did not explain how the digging influenced soil nutrient levels. Other candidates indicated that there would be more droppings and subsequently nutrient levels would increase, but they did not make it clear where these droppings were coming from.

Many candidates agreed that there would be an impact on soil nutrient levels because bird droppings contain nutrients, but didn't explain that the increased predation/ damaged nests would lead to fewer droppings being produced. A significant number of candidates suggested that soil fertility would decrease because there were fewer birds to spread seeds. As such, without any real explanation (e.g. relating to legumes) very few marks were awarded.

Similarly, they could have reasoned that more seeds meant more plant growth and as a result more nutrients would be removed from the soil. No marks were awarded for simply stating that 'Yes, there would be an impact on soil nutrients' or 'No, there would be no impact on soil nutrients'.

(b) The majority of candidates failed to get full marks for their responses to this part of the question. Many candidates focused solely on the impacts on the introduced species (rats, mice and rabbits) and failed to mention the native flora and fauna. Also, many candidates confused flora with fauna and explained how an increase in the rabbit population would result in more of the native fauna being eaten. The better responses stated at least four possible impacts on the native plants and animals once the cats were removed and their responses contained specific detail – i.e. 'with the removal of cats, marine bird populations would increase due to there being less predation or due to there being less disturbance to their nesting sites' NOT simply'with the removal of cats bird populations increase'.

Many candidates tried to be specific and talked about the impacts on the native mammal population when the stem of the question clearly stated that there were no native terrestrial mammals on Macquarie Island. Candidates could have received full marks if they discussed the exponential growth of the fauna in the absence of the predator until the carrying capacity was overshot and environmental resistance was encountered. However, they needed to be specific and mention the impacts on both native flora and fauna. The majority of candidates who took this path

usually focussed solely on the growth of the rabbit population. Some candidates didn't look at the long term impacts and suggested that if the cats were eradicated there would be plenty of dead cat meat lying around for native fauna to feed upon.

(c) Candidates needed to explain why the rabbit population would initially increase exponentially, slow and decrease as environmental resistance was encountered and the carrying capacity exceeded, and then why it would stabilise. Some candidates suggested that the rabbit population may eventually exceed the carrying capacity to such an extent that it would be decimated by the lack of food or the presence of disease, from which the population might never recover – this was an equally valid point. Many candidates focussed only on the short term exponential growth that the rabbits could experience in the absence of the cats and did not consider if the population would eventually stabilise or not.

A significant number of candidates discussed how the rabbit population would increase and then described how this would impact on the other organisms. Suggesting potential impacts of rabbit population growth on the other organisms received no marks as credit had already been given for this in part (b). Again, candidates were often quite general with their responses and failed to give specific examples of the types of environmental resistance that the rabbits may have encountered or the reasons why the population would eventually stabilise. A significant number of candidates drew graphs representing the rabbit population, but often there wasn't an appropriate explanation accompanying the graph.

Question 23

(a) Yes, the 2 separate gene pools would vary (½), as these two populations are breeding in isolation/no gene flow (½). Plus two of the following: In each population different random mutations would occur (1); In each population natural selection occurs so that the birds become adapted to local conditions(1); In each population genetic drift randomly changes allele frequencies (1); The founding birds for each island may have had significantly different genetic make-ups (1).

Or

The habitats on the two islets would vary in food availability, vegetation, predators etc; leading to selection of those genes which best suited each population to its environment (1). Before birds were extinct on Floreana there may have been gene flow between the three populations, which limited the differences in genetic make-up (1). Once isolated the two remaining populations would have diverged genetically from each other. (1). This would also be influenced by the differences in populations between the islands and the mainland prior to Darwin's time (1) and whether they had been totally reproductively isolated from each other over the recent times (½). Birds became adapted to local conditions.

3 well explained points

(b) The long term survival of a species depends on having broad genetic diversity, so it is more likely to have variations which enable it to survive changing conditions (1). Using birds from both islets would give the broadest possible genetic base (1). Some of the genes important for survival on Floreana may have been lost from one, but not the other population, so using both would improve the survival chances of the re-established population (1). Another consideration is the possible

negative effect of removing stock from the Champion island population that is probably at a critically low level (1).
Credit also given for: Gardner is a much larger island, and genetic drift occurs more slowly on larger islands as opposed to smaller islands, therefore use Gardner population, as more likely to still suit Floreana conditions (1).

3 well explained points.

Examiners comments

This question was answered quite well – 3% of candidates did not attempt this question at all. Most candidates were able to gain at least two marks in (a), but (b) proved to be more challenging. In (a), many candidates wrongly stated that there would be no difference in the gene pools, as birds from Gardner and Champion continued to interbreed, however the question clearly states that the two sub-populations are isolated. Similarly, in (b) many candidates also believed that the Gardner and Champion populations had already diverged to form two separate species, hence re-introducing them both onto Floreana would be pointless as they could no longer interbreed, and this would create competition with only one species surviving. Many candidates also believed that the Champion population was obviously not well-adapted and 'unhealthy' due its small numbers, and didn't take into account that because the area of Champion is much smaller it would have a smaller carrying capacity than Gardner. Of those candidates who stated that birds from both populations should be re-introduced to Floreana, most understood that increasing the genetic diversity gives a species a better chance of survival, however many could not state why it is beneficial. Only a very small number of candidates (6) received full marks for this question.

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