GENERAL COMMENTS

The feedback from the final examination paper was positive and seen as one that generally had a good range of questions to give the candidates a chance to show their abilities. However, there were a couple of questions that proved challenging for candidates. Part A was fairly well done though the main difficulty was the lack of understanding by candidates of what was required for field experiments in question 3. Whilst 20% of candidates scored 22 and above, no candidates scored above 29 in this section, 10% of candidates scored 11.5 or less. Part B proved to be a more straightforward section with candidates performing much better in this section, 30% of candidates scored 24 and above, whilst 10% of candidates scored 10 or less marks. Part C with 70% scoring 22.5 and above was also done well. Again about 10% of candidates scored 10 or less marks. Part D was the most challenging section for candidates with 30% scoring 19 and above. In particular question 16 proved to be a challenge. Approximately 20% of candidates were unable to gain enough marks for a C rating. Part E was a very straightforward section with 70% of candidates scoring 27 and above and less than 5% of candidates scored 12 or less marks. Candidates should read questions carefully and make sure their answers relate to the question being asked, especially when they are assisted by the information sheet. Many ‘A’ standard answers require detailed explanations to show understanding of the concepts and linking of ideas that are being asked in the question rather than a general overview.

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 may 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) concentration of ethanol, medium Daphnia mounted in, ethanol percentage (1) ethanol, alcohol, amount of ethanol (½)
   ii) heart rate of Daphnia, bpm of Daphnia(1) beats, bpm (½)

b) Control is the Daphnia in water (its normal habitat) with no added ethanol(1). Control is used as benchmark /data – basis for comparison (½) to determine the effect of ethanol on heart rate beat(½)
c) 
- Temperature,
- species of Daphnia,
- origin of the Daphnia,
- light intensity,
- volume of liquid,
- length of time on slide before counting begins,
- pH of water,
- concentration of dissolved oxygen / CO₂ in water,
- other sensible suggestions. (½ mark each)

ii) These factors must be kept constant so that they are eliminated as the cause of change in heart rate / the independent variable is isolated as the only cause of change in heart rate. (1)

d) The larger the sample size the less effect there is likely to be from chance variations/outliers (½) or natural variability inherent in any population (½). Variations in the heart rate of Daphnia and their response to ethanol exposure can lead to bias if the sample size is too small. (1) 20 specimens are a large enough sample size to be representative of the species as a whole (1). A mean/average heart rate can be calculated from 20 results (½) (needed to demonstrate the need for large sample size to reduce the impact of chance and variation)

Exam Comments

Overall this question was answered reasonably well with the vast majority of candidates able to identify the independent and dependant variable, and what the control in the experiment was. The majority of candidates were also able to name at least two variables that needed to be fixed (controlled) in the experiment. For a small but significant fraction of candidates there was confusion between the experimental ‘control’ and controlled variables. Another common mistake was candidates listing the manipulated variable (concentration of ethanol) as a controlled variable.

The last section of the question proved to be quite difficult for candidates to achieve full marks. Very few candidates mentioned that small sample sizes, or experiments with only one repeat, are prone to sampling bias or that they may not be representative of the larger population of Daphnia. Most candidates understood that it was better to have a larger sample size but appeared to lack the vocabulary or understanding to describe WHY this is the case. The word ‘accurate’ was often used incorrectly where the student appeared to mean ‘representative’ or ‘reliable’ or ‘valid’.

Question 2

Hypothesis samples:
- An increase in light intensity causes an increase in yield of peas.
- A decrease in water availability causes a decrease in yield of peas.
- An increase in density of planting causes a decrease in yield of peas.
- etc.

(No marks for factors which would be the same in both gardens)
(1 mark IV, I mark DV and 1 mark for clear testable link between the 2)
Exam Comments

Overall the question was well answered. Some candidates explained their hypothesis which was not required as the 3 marks could be scored from a succinct hypothesis as long as it had a clear IV,DV and a clear testable link between the two.

Question 3

a) **Procedure** (3 marks)
- Locate an area of woodland burnt in the bush fire. (½mark)
- Control = area of woodland in same which was not burnt. (½mark)
- Method of sampling leaf litter eg quadrats / standard weight of litter taken. (½mark)
- Sensible number of samples from each area (eg 10 quadrats) (½mark)
- Method of extracting organisms from litter. (½mark)
- Continue sampling burnt area for sensible time period until re-establishment occurs (eg once a month for a year) (½mark)

**Variables** (2 marks)
- Independent variable = areas burnt or unburnt (½mark)
- Dependent variable = number/abundance of Springtails (1/2 mark)
- Controlled/fixed variables = same locality (controls many environmental factors), same type of woodland (tree species), same volume / weight of leaf litter sampled (1 mark)

**Avoidance of bias** (1 mark)
- Selection of sample areas should be randomised(½mark)
- Suggested method of randomisation (eg dividing area into a grid, numbering squares and using random number generator) (½ mark)

b)

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Such an investigation can only be carried out after a bush fire therefore difficult to replicate</td>
<td></td>
</tr>
<tr>
<td>There are many different species of Springtails</td>
<td></td>
</tr>
<tr>
<td>Bush fires occur with different intensities</td>
<td></td>
</tr>
<tr>
<td>Other sensible ideas</td>
<td>(2 marks for well explained idea)</td>
</tr>
</tbody>
</table>

Exam Comments

a) To score full marks, candidates were required to address all 3 aspects i.e. procedure, variables and bias. The procedure of field experiments was not well answered by most candidates; especially the method of extracting very small invertebrates from litter. Most candidates did not demonstrate an understanding of the importance of having a control. No marks were given for answers suggesting setting fire to woodland or springtails to replicate a bushfire.

Some candidates suggested using placebos or double blind to avoid bias, showing a poor understanding of field experiments. Other candidates suggested replicating a bushfire under lab conditions but did not fully explain the shortcomings and challenges of conducting such an experiment in a lab.

Overall this part was not well answered.
b) To score full marks, candidates were required to mention one problem, not referred to in 3a. They did not need to provide a solution to the problem they identified. Most candidates said that counting the small springtails to determine the abundance was the main difficulty in the investigation and this answer was given ½ mark only, as this needed to be answered in the procedure in 3a. Tagging and marking the springtails was not given any marks – the scale provided on the diagram suggested they were too small to make this a feasible procedure. The answer, ‘it is not possible to determine whether the springtails had re-established after the bushfire because their pre bushfire numbers were not known and the area was burnt out and the springtails had perished’, scored 1 mark because the candidates did not understand that the data from the unburnt woodland (control) is used to determine the abundance before the bushfire.

Question 4

a) A supplement of folic acid tablets (1) taken by women in the early stages of pregnancy (1) reduced the risk of autism in children (1). (½) for increases the risk of autism in children

b) This investigation was carried out using questionnaires which rely on memory and honesty (1) This could mean that the numbers of mothers taking folic acid was not represented correctly which means the data collected is not accurate and affects the overall outcome (1) OR There is no control of all other variables that may affect the incidence of autism (½) such as the amount of folic acid in the diet (½) OR Lifestyle factors (½) OR family history (½) OR the amount of folic acid taken (½) that could affect the occurrence of autism, therefore there is no way of isolating the influence of folic acid supplements working. Needed to have a MAJOR factor for (1) mark (on THIS study); and describe its influence on the results (1) mark.

c) Humans have a wide range of individual variation (1) This can be genetic variation (½) or due to lifestyle factors (diet, smoking, drinking, exercise, medication etc) (½). A very large sample size would give a more valid average as outlying data becomes less significant making the result more reliable (1) OR A very large sample size minimises the effect of individual variation or chance. (1) Also accepted: The incidence of autism is quite low (rare) in the population so a large number of responses is needed to validate the data (1) Many candidates did say that the larger sample size was more “accurate”, but if this was used with the right context, was given ½ a mark.

d) i) The subjects taking the placebo would not know if they were taking the drug or the supplement making it the control (1). This ensures that the effect of any psychological factors which may arise from knowing that they are taking a drug can be accounted for (1)

ii) Offering mothers a placebo would be unethical (1) if folic acid lowers the incidence of autism, then pregnant mothers should not be deprived of this (1) OR It was not necessary to create a control group by using a placebo (1) as the group who did not take folic acid acts as the control (1) (in this retrospective study, providing a basis for comparison).
Exam comments

a) Generally all candidates did this very well

b) Candidates did poorly on this question. Over 50% cited that the difference in sample sizes was too large and needed to be the same for each group, making the percentages inaccurate. Other incorrect responses included that the study was not repeated or replicated.

c) This question was well attempted.

d) i) This question was done poorly, many candidates did not really understand what a placebo was and did tend to use the information sheet definition which is not really the right context for this question.

ii) On the whole this question was done very well by candidates. Those who explained that the placebo only affects the mother and therefore would not have any effect on the child ......the mother can’t “think” the child to have autism ... were correct but were not addressing the question being asked and therefore gained few marks.

PART 2 CRITERION 5

Question 5

<table>
<thead>
<tr>
<th>Statement</th>
<th>Biological compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>All enzymes are this type of compound.</td>
<td>Protein</td>
</tr>
<tr>
<td>This is a compound, generated by cellular respiration.</td>
<td>ATP</td>
</tr>
<tr>
<td>This compound is a polymer of nucleotides.</td>
<td>Nucleic acid</td>
</tr>
<tr>
<td>This compound can be broken down into fatty acids and glycerol.</td>
<td>Lipid</td>
</tr>
<tr>
<td>This compound contains cytosine.</td>
<td>Nucleic acid</td>
</tr>
<tr>
<td>Cell walls are composed of this type of compound.</td>
<td>Carbohydrate</td>
</tr>
</tbody>
</table>

(½ mark each)

Exam Comments

The majority of candidates did well. Some candidates interpreted the question incorrectly and tried to list up to three compounds for each statement.

Question 6

a)  

<table>
<thead>
<tr>
<th></th>
<th>Adenine</th>
<th>Thymine</th>
<th>Cytosine</th>
<th>Guanine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coding strand</td>
<td>60</td>
<td>21</td>
<td>44</td>
<td>32</td>
</tr>
<tr>
<td>Complementary strand</td>
<td>21</td>
<td>60</td>
<td>32</td>
<td>44</td>
</tr>
</tbody>
</table>

(½ mark each)
b) - RNA would contain Uracil instead of Thymine found in DNA
- RNA would contain ribose instead of deoxyribose sugar found in DNA
- RNA is single stranded whereas DNA is double stranded

c) - DNA molecule is unzipped (by the enzyme helicase). (1)
- Individual nucleotides pair with exposed bases along each strand according to complementary base pairing (½), adenine with thymine and cytosine with guanine. (½)
- This ensures that the 2 new DNA molecules are identical to the original molecule. (1)
- Describe how correct base pairing ensures the function of the cell, or describe how incorrect base pairing results in a mutation (½)

Exam Comments

a) Some candidates doubled, halved or made the number of the bases add up to a total of 100. Others had all of the answers correct but interpreted the complimentary strand to be a strand of mRNA, and so they recorded 0 for the number of Thymine bases. A large majority of the candidates recorded exactly the same number of bases in each strand (Adenine – coding strand 60, complementary strand 60).

b) The majority of candidates gave the correct answer but in only a few words and without identifying the molecule they were referring to, losing them the full mark.

c) A large proportion of candidates interpreted this question incorrectly and described the process of protein synthesis, or they outlined DNA replication but included elements of protein synthesis as well eg. “A DNA molecule replicates by first unzipping via helicase, once unravelled the mRNA then matches the base pairs. Using DNA ligase it then changes uracil to thymine”, “DNA replicates by protein synthesis”. Some candidates gave excellent answers clearly outlining the process, referring to the complimentary bases and stating how this results in identical molecules (for which they received full marks).

Question 7

a) A - substrate  
C - active site  
B - enzyme  
D - product  
(½mark each)

b) Enzymes (B) have active sites (C) (½) which contain a precise shape that fits the substrate (A). (½) Enzymes lower the activation energy that the reaction requires (½) so the breakdown of the substrate (A) (½) into its products (D) (½) by the enzyme takes place much faster as they are a biological catalyst. (½)

OR 3 points from below provided they give the complete process of enzymes catalysing reactions:

- Enzymes are 3 dimensional proteins with a precise shape including an active site (C).
- The substrate molecule fits (A) the shape of the active site similar to the way a key fits a lock. (to form an enzyme-substrate complex).
- While bound to the enzyme, chemical changes occur in the substrate, in this case the bond linking the two subunits of the substrate is broken.
- The product (D) is released and the enzyme can be reused.
c) 1 of the following points
   - The shape of the enzyme actually adjusts to accommodate the substrate / induced fit hypothesis.
   - Coenzymes or cofactors are required by some enzymes before they are able to catalyse a specific chemical reaction.
   - Inhibitors may attach to an enzyme and change their shape so they are unable to combine with the substrate.
   - Some enzymes catalyse synthesis reactions where 2 substrates are combined to produce a product.

d) | How temp affects enzyme (½ each) | Explanation (½ each) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. At low temps rate of reaction (breakdown of cell walls) will be slow</td>
<td>Enzyme (pectin) and substrate are moving slowly and combine less frequently</td>
</tr>
<tr>
<td>2. As temp increases, rate increases up to an optimum so juice extraction is at a maximum.</td>
<td>All enzymes have an optimum temp at which maximum rate occurs (this should be determined for pectinase)</td>
</tr>
<tr>
<td>3. At high temps enzyme cease to act so no juice extraction occurs</td>
<td>High temps denature the enzyme protein (pectin), destroying the active site</td>
</tr>
</tbody>
</table>

Candidates could have drawn a graph to show how temp affects enzymes but still needed to provide explanations.

For example:
The enzyme pectin will have an optimal temperature. Maintaining the juice extraction process at the optimum temperature would mean that the pectin works at maximum efficiency and so is the breakdown of the apple cell walls and therefore juice extraction (1). Below this, the molecules do not have enough energy and are moving too slowly to combine, so the reaction slows markedly. (1). Above the optimum, the enzyme denatures and will not act so no breakdown occurs and the extraction will be slowed or stopped. (1).

Exam Comments

a) Most candidates labelled at least 3 of the 4 correctly. A common mistake was to confuse A or D as an inhibitor.

b) Most candidates were able to gain at least half of the available marks quite easily given the different combinations of the parts of the answer. However to gain full marks, answers had to include obvious reference to the diagrams and not just the comment “as shown in the diagram”. Some candidates included further labels on the diagram and that obviously helped them write their response. Some wrote generalised comments about enzymes that had little to do with the process of how enzymes catalysed biological reaction as indicated in the diagram, but some credit was given for this. Full marks could not be given without describing the whole process as indicated in the diagram. Candidates should be aware that enzymes and substrates do not run around searching for each other.

c) Most candidates did this well.
d) A common problem made by candidates here was to write a generalised account of how enzymes are affected by temperature, without mentioning the effect on the rate of reaction and then the effect on the juice extraction. A maximum of 1½ marks out of 3 was given if these were not mentioned and 2 marks if reactions were mentioned but not pectin or juice extraction.

**Question 8**

a) Oxygen is produced by photosynthesis (1) which requires light (½) and so occurs during the day/daylight hours (½).

b) The plant only photosynthesises in the light but it is respiring all the time. Negative oxygen production occurs at night (½) when photosynthesis is not occurring (½). The plant is only respiring (½) which involves the use/consumption/uptake of oxygen (½) which is registered on the graph as negative oxygen production.

c) At 9 pm the rate of production of oxygen by photosynthesis is equal to the rate of uptake of oxygen by respiration (this is the compensation point) (1). Therefore, the glucose product by the plant by photosynthesis will be all used in respiration and there is no excess glucose available for the production of new tissue (growth) (1).

d) Plant roots will have limited access to oxygen and so will respire anaerobically (1). Anaerobic respiration produces less ATP than aerobic respiration (1). This means that there will be less energy available to the root cells for metabolic processes such as active transport of ions (1), eventually resulting in the death of the whole plant.

**OR**

Anaerobic respiration produces less ATP from each molecule of glucose than aerobic respiration (1). This results in a high use of the root’s stores of glucose, rapidly depleting them (1) at which point further respiration is not possible and the cells die.

**OR**

Anaerobic respiration produces alcohol/ethanol (1). The root cells can’t use or remove this toxic substance, so it accumulates and eventually kills the cells (1).

Credit was given to other feasible scenarios – e.g. waterlogging results in lower than normal concentrations of ions in the soil water, making it impossible for them to move into root cells by diffusion. The cells may resort to active transport to obtain these ions, thereby depleting glucose reserves more rapidly than they can be restored by photosynthesis.

Essentially: 1 mark for identifying the process. 1 mark for describing a feature of this process that limits survival time (lack of ATP/energy; production of alcohol). 1 mark for explaining how this feature results in plant death (preventing important metabolic processes, accumulation of toxins).
Exam Comments

a) This was straightforward and well answered by the majority of candidates. A small number of candidates didn’t link the availability of light to the rate of photosynthesis and instead focussed on the impact of higher daytime temperatures. These answers generally received 1 ½ marks.

b) Again, this was well done by most candidates. To gain full marks, candidates needed to identify the conditions under which negative oxygen production occurred – i.e. night/no light.

c) This part was more challenging, with a large number of candidates not recognising that at 9pm there is some light present. The rate of oxygen production is zero (not negative); therefore both photosynthesis and respiration are occurring. Of those who did recognise that at this point the rate of oxygen production (photosynthesis) is equal to the rate of oxygen uptake (respiration), many did not go on to explain how this related to the lack of plant growth.

d) By far the most common response (70-80 % of answers) was to concentrate on the impact osmosis would have of the plant cells, suggesting that turgor would somehow interfere with the functioning of the cells (healthy plant cells are always turgid!) or that the cells would burst (cell walls generally prevent this by forcing water out as fast as it enters). No marks were awarded for answers along these lines.

The candidates who correctly identified anaerobic respiration as the process almost always went to on to give a clear and adequate explanation of why the plants survived only for a short time. Candidates who suggested that the small amount of dissolved oxygen in the soil water would enable the root cells to respire aerobically for a short time and once depleted the plant would die, received 1 – 1½ marks.

Question 9.

a)

<table>
<thead>
<tr>
<th>Part</th>
<th>Normal person</th>
<th>Sickle cell anaemia sufferer</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>DNA base sequence</td>
<td>CTC</td>
</tr>
<tr>
<td>II</td>
<td>Messenger RNA base sequence</td>
<td>GAG</td>
</tr>
<tr>
<td>III</td>
<td>Amino acid coded for</td>
<td>Glutamic acid</td>
</tr>
</tbody>
</table>

(½ mark each)

b) i) ½ for any 4 of the following points

- transcription
- the genetic code carried on the section of containing Hb gene DNA is copied to the mRNA in the nucleus.
- mRNA is able to move from the nucleus
- moves to a ribosome in the cytoplasm.
- free nucleotides in nucleus line up with complementary bases on DNA strand
- RNA uses U instead of T
- Incorrect coding of GUG produced
ii) ½ for any 6 of the following points
- translation
- mRNA moves to ribosome/rRNA in cytoplasm
- each triplet of bases (=codon) of the mRNA codes for one amino acid
- transfer RNA molecules with the complementary code (= anti-codon) carry specific amino acids to ribosome
- and bind with the appropriate codons on the mRNA.
- This brings amino acids together in the correct sequence, dictated by mRNA sequence
- bind together (with peptide bonds) to form haemoglobin protein.
- Incorrect coding on mRNA means wrong amino acid is brought to the ribosome
- Amino acid sequence is important for protein structure/shape

c) The change in a single amino acid will affect the structure / shape and therefore the function of the haemoglobin protein. (1)

Exam Comments

a) Most candidates got full marks but a number of candidates struggled to read information off a table with 3 variables.

b) i) Many candidates did well in this question, but some confused the mRNA copy synthesis with DNA replication. Some candidates didn’t know the name of the process but only lost ½ mark. Other candidates concentrated too much on the fact that the DNA had the incorrect sequence rather than answering the question “outline the stage of the process”

ii) most candidates gained 1½ by stating translation of mRNA by ribosome produces the amino acid sequence or polypeptide. Additional marks were gained by adding the details.
If the student concentrated on the incorrect sequence on the mRNA they needed to put in details of what that incorrect sequence went through on its way to becoming part of the amino acid chain.
Candidates need to make sure that they show clearly that they understand where the amino acids come from. They are not produced/made in this process, just joined together.
Quite a few candidates stated that the amino acids are produced or formed when the tRNA codon attaches to the mRNA codon.

c) This question was not done well. Many candidates didn’t mention the protein/polypeptide and its possible structure/shape change. A common answer was rearranging the question as a statement.
PART 3 CRITERION 6

Question 10

a)  

<table>
<thead>
<tr>
<th>Cell</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>has a cell membrane</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>is a plant cell</td>
<td>X</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>has mitochondria</td>
<td>√</td>
<td>X</td>
<td>√</td>
</tr>
<tr>
<td>has a cell wall</td>
<td>X</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>has cytoplasm</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>has a single circular chromosome</td>
<td>X</td>
<td>√</td>
<td>X</td>
</tr>
</tbody>
</table>

(½mark for each correct row)

b)  Cell B is a prokaryote (1)

Reason: It has no visible membrane bound organelles (1) no membrane bound nucleus (½)

OR  it is very small (less than 1µm)

c)  Electron microscope (1)

Reason: Organelles are visible which would not be visible with a light microscope, such as mitochondria or Internal structure of chloroplasts visible. (1)

d)  50 µm = 0.05mm (1)

Exam Comments:

a)  Most candidates scored 1½ or 2 marks. The most common error was to not indicate that cell B, the prokaryote, has a cell wall.

b)  The vast majority of candidates identified cell B as a prokaryote. Not all of those candidates used the diagram to give a supporting reason. For example a single circular chromosome, which is found in prokaryotes, cannot be seen in this diagram. The absence of a nucleus supports the cell being a prokaryote but is not indicative as some eukaryote cells also lack a nucleus eg red blood cells. (½ mark given) Some candidates said the cell is very small (½ mark) but then estimated the size as 0.5µm, which is not accurate as that is the interval on the scale. They needed to estimate its size as 0.7 or 0.8µm to gain a full mark.

c)  The majority of candidates recognized cell C was viewed with an electron microscope. Supporting evidence needed to emphasise the higher level of detail that can be seen inside the cell organelles or that very small organelles not visible under a light microscope could be seen here. eg mitochondria. Inaccurate answers that stated cell walls, the nucleus, nucleolus, cell membranes and chloroplasts can’t be seen under a light microscope were only given ½ mark.

NB a number of candidates referred to organelles as organisms.
d) This question was poorly answered by most candidates. Very few measured the nucleus and even fewer knew how to use the scale shown and then convert µm to mm.

**Question 11**

a) In 5% salts the worms are in a hypertonic solution (½) which is a more concentrated solution. (½) Consequently water moves out of the worm’s cells (½) by a process called osmosis. (½) The loss of water has caused a decrease in their mass (½) of 50%. (½)

b) Water enters these worms by osmosis (½) as they are in a hypotonic solution (½), causing their cells to swell and eventually burst (½) as they only have cell membranes/no cell wall to contain the increased pressure (½).

c) Conc of salts is 3% (1)

**Exam Comments**

a) This question was explained and answered well. Candidates need to be careful when using the words hypertonic or hypotonic. These words are best used to describe the concentration of a solution compared to the concentration inside a cell or cells and not a concentration of water.

b) Again well answered by most candidates though many did not gain the last ½ mark as they neglected to mention worm cells only have cell membranes/no cell wall to contain the increased pressure.

c) Correctly answered by nearly all candidates. Important to include unit of measure. ie %.

**Question 12**

a) ii) Cell P Haploid
   iii) Cell Q Haploid
   iii) Cell R Diploid
   iv) Cell of embryo Diploid ½ mark each

b) Each cell possesses the **whole** genome / the **full** genetic code / **all** the genes / **all** the DNA for the whole organism. (1) must indicate “complete” or “all” with regard to the DNA/genetic code for full marks

   OR The embryo contains stem cells(½) which have not differentiated (½) at this stage. Many candidates also referred to the potency (e.g. totipotent, pluripotent) of the cells.

c) Any good example Structure /Function 1 mark /Adaptation 1 mark eg
   • Muscle cell: is long and thin with the capacity to contract along with other muscle cells, due to the myelin fibres that can contract under the direction of nerve impulses. It also (depending on the type) has a lot of myoglobin as an immediate oxygen reserve along with many mitochondria to supply it with the ATP needed for contraction.
Red Blood Cells (erythrocytes): Function was to carry oxygen around the body. Their biconcave shape and flexible membrane allowed them to fit through the very thin capillaries ensuring oxygen reached all areas, so that cellular respiration could occur.

OR Their biconcave shape increased their SA:V ratio which increased their ability to absorb / diffuse oxygen across the membrane ensuring enough oxygen reached all areas, so that cellular respiration could occur.

Note there was some confusion between increased surface area to volume ratio, and increased volume with the incorrect link. Eg Greater SA allowed them to carry more oxygen instead of more oxygen diffusing into the cell.

Sperm: function to fertilise the egg in sexual reproduction /to carry the DNA to the egg for fertilisation. Sperm has flagellum which aids the propulsion of the sperm through the uterus and fallopian tubes in order to reach the egg for fertilisation

OR Sperm head contains enzymes which enables the sperm to break though the cell membrane of the egg in order for its DNA to mix with the DNA of the egg to enable fertilisation.

Note the function must match the correctly named or identified cell. The adaptation must be correct for the named cell and linked to the function of the named/identified cell to gain full marks.

d) Meiosis (½): occurs in the forming of gametes (sex cells) (P&Q) (½) -produces daughter cells that are haploid (half the number) (½) of chromosomes which allows full diploid (½) number to be restored at fertilization or at R (½) Generates diversity in gametes and therefore in offspring (½)

Mitosis ( ½ ) : occurs when cell R / the zygote divides to form the embryo(½).Maintains the chromosome number (½) all cells of the embryo are genetically identical (½) all cells are diploid (½)

Use of labels from diagram or appropriate associated worded labels for full marks

Exam Comments

a) Answered predominantly well.

b) Most understood the significance of an undifferentiated cell or a cell containing all the DNA necessary and many made comments referring to the genes being switched on or off.

Some candidates did not link the structure / adaptation to the function. Other candidates described adaptation to a change in the cell occurring. Most answered with reference to the erythrocyte (red blood cell), sperm or muscle cell. Many answered with reference to the lining of the gut but did not identify the cell name directly. They were not penalised if their descriptive name identified the cell they were referring. Some used an inappropriate link between function and structure: eg Increased SA:V gave a greater volume to hold oxygen etc.

c) Answers were varied but predominantly answered with some understanding. Most were able to identify the two processes, and mention some of the significance. Many did not associate their answer with the diagram and some answered with referrals to asexual reproduction. Many candidates incorrectly identified the process of fertilisation as meiosis.
Question 13

a) Active transport (½)
Reason: all the ions enter the seaweed against the concentration gradient which requires energy. (1½)
OR
the data shows the internal concentrations being maintained at significantly higher levels to that of the external environment. To transport ions against a concentration takes energy, hence active transport. (1½)

Good answers used data from the table but credit was given if they just talked about the differences between the seaweed and the seawater without giving numbers from the table. Candidates could still get full marks without mentioning that the process required energy as long as they used data to back up their answer.

b) The concentration would decrease (½)
This is because active transport requires energy in the form of ATP
ATP is produced by (aerobic) respiration which requires oxygen (1½)

OR

The concentration of ions in the seaweed would remain the same. (½).
This is because the plant will be producing oxygen as a product of photosynthesis and will therefore be able to continue undergoing aerobic respiration and producing ATP for active transport. (1½)

OR

The concentration of ions will decrease in the plant. (½)
This is because there is not enough oxygen for aerobic respiration, active transport will not happen so the ions present in the seaweed diffuse out of the plant, down the concentration gradient, into the seawater. (1½)

Exam Comments

a) There was a lot of confusion about what sort of transport was involved. Many said that as particles were moving from low concentration to high concentration the transport mechanism must be osmosis. Several responses contained all forms of transport with each ion going a different way i.e diffusion, osmosis and active transport. Surprisingly, there were several responses that said active transport by endocytosis! Many candidates used the term facilitated diffusion and described this as active transport.

Many candidates scored 0 with more than ½ getting 2 or less.

b) This question lacked clarity in the wording and may have confused many candidates as it did not specify the location of the change in ion concentration they were being asked to comment on. When marking, any of the alternatives for the movement of ions was awarded marks as long as the candidates could back up their answer with an accurate explanation. Many candidates failed
to grasp the point of the question and gave detailed answers that were full of chemistry knowledge. “Metal ions bonding with oxygen, if oxygen removed there would be plenty of other ions so the concentration would be unchanged etc.”. Many answers were excellent, if the candidates “got it” they seemed to be able to demonstrate their understanding of the biological knowledge very well.

Many candidates used symbols in their answer instead of words. Candidates need to be clear when doing this as it can be misleading for the marking examiner.

Question 14

a) Any two advantages:
   - Cells can become specialised for specific functions therefore more efficient (1)
   - Organisms can grow larger (size limitations on unicells) therefore more competitive (1)
   - Larger organisms aren’t as subject to changes in environments as they have lower SA:Vol ratios as well as more strategies for homeostasis (1)
   - If one cell dies, the organism still survives (1)
   - Damaged cells can be replaced (1)
   - A complex structure is possible (1)
   - The multicellular organism is better equipped to respond to a changing environmental conditions (1)

b) One disadvantage:

   Multicellular organisms cannot rely on simple diffusion for transport (1) and therefore require specialised transport systems (1)

   OR

   Multicellular organisms are larger and therefore have a smaller surface area to volume ratio. (1) Absorption of oxygen therefore requires a specialised gas exchange surface (1) If cells become infected it could spread to the whole organism (1) The development of specialised cells to fight infection can alleviate this problem(1) Larger groups of cells have a combined increase in energy needs (½) therefore systems (digestive & respiratory) to provide oxygen and nutrients (1½)

Exam Comments

Many candidates found this question difficult and only received one mark as they failed to offer solutions to the problem they had suggested. Many just commented on larger energy needs without explaining that the organism as a whole has larger energy needs. Individual cells within the organism have similar needs to a single celled organism.
PART 4 CRITERION 7

Question 15

a) 1. An X-linked recessive condition would be expected to be more common in males than females, that is not the case in this pedigree. (1)
2. If it were X-linked recessive, the female in Gen I would have the genotype $X^dX^d$ (1)
   She would pass an affected X chromosome to her son who would have the genotype $X^dY$ and would have the disease (1).
   (½) mark withheld if none of the genotypes are mentioned or if mode of inheritance not described (e.g. female passed on affected X chromosome to her son)
Candidates must indicate to which individual(s) (in which generation) in the pedigree they are referring. Otherwise, no marks were awarded.
Also accepted:
   ▪ If it were X-linked recessive, the female in gen IV would have the genotype $X^dX^d$ (1). She would need to receive an affected X chromosome from her father who would have the genotype $X^dY$ and would have the disease (1).

b) This disease is due to an autosomal recessive allele. (1)
   This is because the only way for the parents in gen III to produce two diseased children in gen IV is if they are both carriers / heterozygous and therefore the disease is recessive (1)
   Also accepted:
   ▪ Both parents do not have the disease (½)
   ▪ It skips two generations (½)
   ▪ If it were dominant, then it would appear in every generation (½)
   ▪ If it were dominant, then the disease would be inherited from one of the parents (1) in generation III

![Pedigree Diagram]

- (1) mark per generation
- In generation II, 2 min. correct for (½) mark
- H or X marking accepted
d) Mutation / change in DNA (1)
Also accepted:
- someone who marries into the family (1)
- a recessive trait (½) and it has skipped a generation (½)
- heterozygous/ carriers (½) in the family
- inbreeding (½)
Not accepted:
- incomplete dominance
- contracted from an animal/ organism
- contracted from diet

Exam Comments
Candidates did this section fairly well but would improve by reading the questions carefully. In d), for example, the Question states “Researchers may have data for families over many generations and occasionally they find this disease suddenly occurs, even though previous members of the family are disease-free. Explain what could be causing this sudden appearance of the disease in a family.” Particular attention must be paid to the word ‘sudden’ as this would rule out heterozygous family members. Also, contracting a disease via the diet and animal/ organism infection would not be a disease that would be passed on genetically.
In a): Candidates must indicate to which individual(s) (in which generation) in the pedigree they are referring. Otherwise, no marks were awarded.

Question 16

a) Carbon dioxide, containing $^{14}$C is absorbed through the stomates (½) of the leaf by diffusion. (½). In the leaf the $^{14}$CO$_2$ is used in photosynthesis (½) which produces glucose, (½) now containing the $^{14}$C.

b) Transport of carbon containing compounds is bidirectional / up and down the plant (via the phloem) (1). ½ mark given for comment that carbon was carried up or down.

c) Roots cannot photosynthesise (½) and must be provided with glucose (containing $^{14}$C) by the photosynthesising leaves such as Leaf X. (½). Transported / translocated (½) by phloem from leaves to roots (½). Excess glucose (½) produced by the plant is converted to starch (containing $^{14}$C) (½) for storage. (½)

d) | Transport of water | Transport of carbon compounds |
<table>
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<tr>
<td>Occurs in xylem</td>
<td>Occurs in phloem</td>
</tr>
<tr>
<td>Xylem is dead (process passive)</td>
<td>Phloem is living (active process)</td>
</tr>
<tr>
<td>Water moves upwards only</td>
<td>Carbon compounds transported up and downwards</td>
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Any two comparisons (½ mark each)
Exam Comments

A challenging question for many candidates.

Common misconceptions
- Plants take in CO₂ to get oxygen for respiration. They take of the O₂ & use it, leaving the radioactive C behind.
- CO₂ uptake by the roots
- Phloem only moves things downwards only
- Assumed that as water was moved by a passive process, that process had to be osmosis
- Water moves by osmosis and carbon moves by diffusion - I think this comes from them thinking about how these substances enter the plant rather than how they move within the plant
- Use of terms 'energy' and 'glucose' interchangeably
- Photosynthesis is a mode of transport

Other points
- Very few candidates got full marks on part (a). Most missed CO₂ moved in by diffusion and/or through the stomata
- Many candidates answered in way too much detail, particularly for part (a) where they gave detail that belonged in part (c).
- Few candidates made direct reference to the diagram in part (b)
- Quite a number of candidates said in part (b) that carbon only moved in 1 direction in the phloem in part (b) (for which they only received ½ mark) but were able to correctly state in part (d) that phloem transports materials in both directions.
- A significant number of candidates made no mention of direction of carbon movement in their answer to part (b), despite the fact that the question specifically asks for this.
- Part (d) quite a few said how water was transported but did not compare how carbon compounds were transported.
- Source-sink concept applied to Carbon was widely used in part (c)

Question 17

a) Nitrogenous waste products are formed from excess (½) amino acids (½)/excess (½) proteins (½)/breakdown (½) of proteins (½).

b) Plant are autotrophs (½), synthesising their own amino acids (½). They synthesise exactly what is required (½) therefore there are no excess amino acids in plants (½).

c) i) Tadpoles produce ammonia which is very soluble (½) and very toxic (½). However, because they live in freshwater there is plenty of available water (½) to flush out this toxic waste product. On land there is less available water (½) and so adult frogs convert ammonia to urea which is less soluble and less toxic (½) therefore it can accumulate before being flushed out (½).

ii) Uric acid is insoluble and non-toxic (½) so it can accumulate and be excreted as a paste, conserving water (½).
Exam Comments

a) Many candidates interpreted source as location, and provided answers such as liver, kidneys and blood. No credit was given for these answers, as a dietary source was required.

b) Relatively few correct answers were given here, many candidates stating that plants have no requirement for proteins, since they produce energy from photosynthesis.

c) (i) Many candidates focused on the energy requirements for the production of the nitrogenous wastes and failed to mention water availability as the important determining factor. These candidates stated that tadpoles were very small and lacked sufficient energy to produce urea, whereas the larger frogs have more energy. Those candidates who mentioned toxicity, solubility and water availability scored well.

(ii) Many candidates noted the least toxic nature of uric acid, or the water conserving benefits, but relatively few mentioned both.

Question 18

a) Asexual reproduction (½). All the spores are produced by mitosis (½) would be genetically identical / a clone (1).

b) If a mycelium is well adapted to a particular environment, eg food type, then all organisms developing from the spores of the mycelium would also be well adapted (1). Asexual reproduction does not require the presence of another organism for fertilisation (½) so it allows for a rapid increase in population numbers (½).

c) Sexual reproduction (½) involving fusion of gametes produced by meiosis (½) which generates variation among offspring (½). A genetically varied population is more likely to have individuals which can survive and evolve in the long term if the environmental conditions change (½).

Exam Comments

a) This question was answered very well, with many candidates scoring 1½ marks out of 2. The half mark was lost for not mentioning mitosis.

b) Most candidates who answered this question referred to the relative speed of asexual reproduction when compared to sexual reproduction. Very few mentioned inherited suitability to the environment.

c) Again this was answered well. Most candidates recognised this process as sexual reproduction that generates variation in the offspring. Many also mentioned the ability to adapt to the environment, but not all mentioned changing conditions. The most common score was 1½ marks out of 2, with half a mark being lost for failing to mention meiosis/ fusion of gametes.

Overall this question was answered very well. Candidates were able to recognise asexual versus sexual reproduction and were able to explain the advantages conferred on populations using these methods to increase.
Question 19

- The stimulus (½) was increase concentration of CO\(_2\) in the blood or a decrease in pH of the blood (½) or exercise (½).
- This change is registered by receptors (½) in aorta or carotid arteries (½).
- Communication or message or nervous impulse (½) between receptors and effector is by means of nerves.
- The effector (½) is the pacemaker (sino-atrial node) in the heart or the heart (½).
- An increase in CO\(_2\) in blood as registered by the receptors results in more nervous impulses from the medulla causing the pacemaker of the heart to [increase the heart rate. (½)]
- The increase in the heart rate is the response (½) and when blood is pumped more quickly to the (lungs, CO\(_2\) will be expelled more quickly or CO\(_2\) will diffuse from the alveoli (½))

Because the response removes the original stimulus the control centre decreases nervous stimulation (½) of the cardiac pacemaker, this is an example of homeostasis by negative feedback (½).

Exam Comments

This question was answered very well by a large number of candidates. Many candidates were unaware that positive feedback is not involved in homeostasis and were hedging their bets by mentioning both. Some candidates thought that homeostasis was controlled by positive feedback. The word stimulus was seldom mentioned.

The processes of respiration and ventilation were used interchangeably by many candidates. Candidates suggesting that, “increasing rates of respiration would reduce carbon dioxide concentrations.” Many candidates used the key words, but incorrectly. Many candidates appeared to have not connected the question to the diagram on the previous page and wrote about other examples of homeostasis. Some of these were awarded part marks however many of these candidates did not know much about the examples they were using, failing to describe the process of homeostasis. Quite a number of near perfect answers did not describe this as a process regulated by negative feedback. This question was easy to respond to as the diagram provided a high percentage of the marks derived.

PART 5 CRITERION 8

Question 20

a)  i) Abiotic factors:
   - Range of temperatures it can survive
   - Salinity
   - pH
   - tidal range,
   - turbidity,
   - current flow,
   - dissolved oxygen
   - depth/pressure
   etc (any two ½ mark each) as long as factor was directly related to jellyfish ecology, not an indirect factor acting through an intermediary.
ii) The food it consumes. The species will only be present in a habitat where adequate food can be found.

OR What predators it has. The presence of predators will affect the abundance of the species.

OR Interspecific competition: other organisms will be competing with the jellyfish for resources.

Accepted interspecific competition. For last ½ mark with food, predators or competition candidates needed to indicate that these factors would have an effect on population size (increase/decrease) of C. medeopolis.

b) i) Scientific names are a universal system used throughout the world to avoid the confusion which arises from using many different common names.

Large proportion of candidates used information from b(ii) and ‘back-filled’, suggesting scientific name showed phylogenetic relationships or some characteristic of the species – this only earned ½ mark unless full explanation was given and/or explanation above was also given. Similarly, only ½ mark if they said ‘more accurate’ or ‘specific’ without explanation.

ii) Species 3 and 5 are most closely related (1) because they are both members of the same genus – Carybdea(1)

Exam Comments

Overall, this question was relatively straightforward and easy

Question 21

a) Species A is the desert species (½) because it has smaller leaves/ needle shaped leaves (½) or reduced surface area on leaves (½) which reduces water loss (½) by transpiration unlike species B which has a larger surface area on leaves (1/2) or this is an adaptation for a dry environment (½)

OR Species A, (½) reduced leaves to spines (½) reduces surface area for water transpiration (½) and this is an adaptation I would expect to find in a desert species which must conserve water (½)

b) Adaptation (½) reason (½)

Examples:
- Extensive root system to obtain as much water as possible
- Thick waxy cuticle to reduce water loss
- Sunken stomata to create a more humid environment to reduce water loss
- Stomata on the underside of the leaf to reduce sunlight hitting the surface and reduce water loss
- Shorter plant due to lack of water in the desert

Exam comments

a) Well answered, some candidates talked about water evaporating from the leaves.
b) Well answered, candidates did not get full marks if they gave a physiological adaptation, an adaptation shown in or contrary to the picture (eg big leaves) or a structure that all plants have eg just saying leaves would have stomata with guard cells.

**Question 22**

a)

```
   R   R   D   D
   P   C   C

Carbon in plants  Carbon dioxide in water  Carbon in snails
```

Arrows must show a complete cycle for full marks.

Four correct arrows required for full marks (no marks deducted for mistakes beyond this) and four correct processes. Synonyms for processes accepted e.g. decay. Excretion for respiration not accepted. Where process correct but arrow wrong or vice versa, one ½ mark given.

b) excretion of waste by snails/microorganisms (½), broken down by bacteria/decomposers (½) to give nitrates (½) taken up by plants which are in turn eaten by snails (½).

**Exam Comments**

Again, question was relatively easy. Commonest misconception was to use information sheet to provide ‘information dump’ about nitrogen cycle (e.g. lightning, nitrogen fixing organisms) without considering aquarium at all e.g. N-fixing bacteria in root nodules/gravel.

**Question 23**

a) Food Chain

```
Grass  Grasshopper  Flower Spider  Bandicoot  Brown Goshawk
```

OR

```
Grass  Grasshopper  Flower Spider  Bandicoot  Spotted Quoll
```

OR

```
Grass  Grasshopper  Bandicoot  Spotted Quoll  Brown Goshawk
```

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<td>OR</td>
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```
Marks were not taken off if candidates started with Grass and only included 3 other organisms, as there was some confusion in the wording of the question as to whether it was 4 organisms in total or grass plus 4 other organism.

Marks allocated: 1 for food chain and 1 for trophic level.

b) Energy flows one way through the food chain (%). The initial energy from the sun (%) enters the food chain by autotrophs (%) which convert light energy to chemical energy through photosynthesis (%). At each trophic level 90% of the energy is lost as heat (%) or wastes (%) and only 10% (%) is converted to biomass to be passed to the next level (%). Therefore the energy decreases as you move along the food chain (%) and this limits the length of food chains (%) to usually no more than 4-5 trophic levels.

Basically marks were allocated along the points about energy entering the system, moving in one direction, 10% being passed along to the new level, and 90% being lost as heat or wastes.

c) PCB’s are not biodegradable and so accumulate in the tissues of the organism (%). (Bioaccumulation). Native hens are herbivores eating only grass (%) and would therefore have low levels of PCBs bioaccumulating in their bodies (%). As the poison moves up the trophic levels all of the PCB is passed up to the next trophic level. This is an example of Biomagnification (%). The Brown Goshawk eats small birds and mammals making the Brown Goshawk is a higher trophic level than the native hen (%). It would therefore have higher levels of PCBs (%).

1 mark for knowing how the PCB moves up the food chain, 1 mark for knowing the trophic levels of the Native Hen and the Brown Goshawk and 1 mark for knowing that the Brown Goshawk would therefore have higher levels of the PCB.

Exam Comments

a) Candidates needed to be specific not just insect, bird, mammal. Trophic levels were not accepted as herbivore, carnivore. Food chains should start with a producer. Producers are a trophic level. The question asked for a food chain not a food web. Overall, this question was often the one where candidates lost marks.

b) A number of candidates got their 10 and 90% back to front but gained marks for knowing energy was lost / passed on. A number of candidates had decomposers returning energy to the soil. Some candidates did not discuss energy in their answer and just focussed on whom eats what in the food chain from part (a). Overall, it was well answered.

c) This question was answered very well. Often if candidates only got 4 ½ out of 9 for example, the three marks came from the PCB question. A few candidates said that because they were both birds they would be the same, some thought that the native hen would have more and related the PCB’s to energy movement, but most fully got this concept. Candidates needed to mention both birds for full marks. Some randomly spoke about the spotted quoll and the grasshopper for example and didn’t mention the birds. A few drew very good diagrams to illustrate their explanation. A number related the amount of PCB to the 10% rule. “The Brown Goshawk would have 100 times as much PCB as the hen as it eats hens and mammals”.

Question 24

a) i) The population was growing rapidly (exponentially/linearly) (½) because of unlimited food supply (½) (and as yet no effect from the intraspecific competition).

ii) The population growth was slowing (½) because of (intraspecific) competition the food resources (½). Candidates could also say... because the population was reaching carrying capacity (½) or that the population had encountered some form of environmental resistance (½).

b) The population of both species was less in the mixed culture (½) because of (interspecific) competition (1). The *P.aurelia* outcompetes the *P. caudatum* (½) (and may eventually cause its extinction).

c) The population would crash (½) because food supplies would become exhausted (½) (or waste products would build up). Alternatively if the culture was fed more yeast then the population of paramecium would stabilise (or oscillate) around carrying capacity.

Exam Comments

a) i) Many candidates stated what would happen to the population but did not specify a reason. No marks were given for phrases like “unlimited resources” or “nothing limits it yet”. These were seen as too non-descript. Many candidates said that the paramecium were thriving or flourishing. The question asks what is happening to the population and so no credit was given for any answer that seemed to refer to the health of the individuals like “they are growing well” or “growing bigger”. It was not sufficient to say that the population was growing because birth rate exceeded death rate. This is a consequence of the biology not a reason behind it.

ii) No marks were given for phrases like “reaches maximum capacity” or “they reach their limit”. Lots of candidates said that the “paramecium run out of space”. In fact many candidates seemed very unfamiliar with *Paramecium sp.* and referred to them as bacteria or plants (that would outgrow their container).

b) It was not required for the candidates to mention interspecific and intraspecific competition but candidates did need to mention the effect of the competition on *P.caudatum* to get the last half mark. This is where most candidates lost marks. It seemed a common misconception that when the two cultures were mixed there was only interspecific competition and some candidates said things like “the competition changed from intraspecific to interspecific”. A lot of candidates believed that the more successful species was in fact a predator on the other, which is unlikely.

Many candidates considered this question from the aspect of niche concept despite the fact that the Paramecium were cultured. Unfortunately these candidates did not answer the question very well. Often the candidates tended to drop terms like “realised and virtual niches” which were not really relevant to this question since it is a culture not a natural habitat.

Quite a number of candidates considered this to be an evolution question and mistakenly stated that the reason why the population declined in the mixed culture was because “they were unable to reproduce and give rise to fertile offspring”.

c) No marks were given for one-word answers like “crash”.

Unfortunately the question did not mention whether or not the Paramecium were fed. This meant that there were in fact two acceptable answers; that the population would stabilise or it would crash. Lots of candidates thought that this part of the question referred to mixed cultures and they repeated the answer that P.aurelia would outcompete P. caudatum. It was disappointing that no student wrote the scientific names for P.aurelia and P. caudatum correctly.

Question 25

The different Nothofagus species were all descended from a common ancestor (1) that existed across the supercontinent of Gondwana. These populations contained genetic variations (1) because of pre-existing random mutations. Due to geographical isolation (1) various populations became separated (on different continents by continental drift or in different states by the rising sea level cutting off a land bridge to Tasmania). Gradually, due to further random mutations within these populations (1) the trees continued to evolve (½). The trees became adapted to the differing conditions (soil, temperature, rainfall) in their different environments (1) by natural selection (½). “Survival of the fittest” (½) occurred when favourable alleles were passed on to the next generation” (1). Eventually the trees in various locations became so different that they could be considered a different species (1). If these trees were re-introduced to the other trees they would not be able to reproduce and would be considered a different species (1).

Exam Comments

This question was done well. Most candidates understood about geographical isolation but did not have much of an idea of geography. Lot of candidates parroted answers about “geographical barriers like rivers and mountains”. Some talked about land bridges to South America. The relevant phrase “mutation, natural selection and genetic drift operate independently in each population” received one mark where it was inserted appropriately.

Reassuringly at least half the candidates realised that continental drift was important. Some focussed on the distribution across the continents and other candidates concentrated on the distribution across the Australian states. These answers were treated equally. In fact most good answers did not need to specifically mention one or the other.

The best answers were the most eloquent, where candidates were able to link the big ideas in a logical argument, through successive sentences, where they scored a mark per good big point. Many candidates however stumbled through an answer just picking up half marks along the way.

Some candidates had been taught a handy formula for understanding speciation: Variation, Isolation, Mutation, Adaptation and Speciation. Expanding on this was still only makes five points. It was preferred that candidates also included the fact that the species arose from a common ancestor and there were random mutations within that original population.

Quite a number of candidates considered the evolution of these trees to have occurred in a manner such as the textbook speciation on the Galapagos Is, for example. This led to quite a number of answers about different dispersal mechanisms such as spread by seeds in bird droppings, or even human
intervention. These were not considered relevant to the question because *Nothofagus* sp was widespread over Gondwana before its break up.

Although it was unusual, it was possible to achieve full marks without mentioning the word mutation. In fact there were so many points that could be made in this question that quite a large number of candidates gained full marks.
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