



Examination

Section A – Criterion 4

Question 1

- (a) The independent variable was the spraying of spinosad at 10g/L but alternately the species of Eucalypt may have been identified by students so either was accepted.
- (b) The dependent variable is the mortality rate of the *C. bimaculata* beetle.
- (c) Spraying Eucalypts with spinosad will increase the mortality rate of the *C. bimaculata* beetle OR The use of Spinosad on *E. globulus* has a higher mortality rate of the *C. bimaculata* beetle than when used on *E. nitens*.
- (d) (i) The scientist should have had treatments which were sprayed with (i) surfactant and water, but not spinosad this acts as a control for to allow for comparison to see mortality due to spinosad not something else. (ii) Fixed variables – amount of spinosad, how sprayed any variable that could be controlled should have been controlled, in each forest type and the presence of beetles before and after treatment to ensure mortality rate is due to spray OR A thorough explanation of why controls are necessary. All answers needed to refer to the need to make results comparable and ensure results can be attributed to the independent variable.
- (e) Four factors could include: Volume/rate of spraying; type of sprayer in terms of nozzle size which would affect droplet size, plane speed, altitude during spraying, pattern of flight (spraying), wind, temperature, humidity, time of day, rainfall etc.
- (f) No the results do not enable you to confidently recommend the use of ‘Spinosad’ for reducing the number of leaf-eating beetles in *Eucalyptus* plantations as variability is too great 68 – 82% for *E. globulus* , 21 – 57% for *E. nitens*. Need more trials, the natural mortality rate of insect not known; weather conditions on days prior to the count; only two species of *Eucalyptus* used in the trial and the different locations without appropriate controls means mortality could be attributed to other factors than the spray.

Comments: (a), (b) and (c) were answered appropriately by most candidates, though many failed to score full marks due to listing two independent variables or constructing a hypothesis that did not include the independent variable they had listed but a different one. Example Independent variable listed Spinosad 10g/L and then hypothesis stated the tree type without mentioning Spinosad. (d) Also answered well though a number of candidates missed full marks by not explaining the significance of controlling variables.

Candidates needed to explain controlling variables are necessary for comparison, so changes in the dependent variable are attributable to the independent variable not something else. (e) Well answered by majority of candidates who obtained full marks. f) Many

candidates chose to recommend the spray based on the differences seen between E. globulus and E. nitans and suggested the higher mortality rate for E.globulus suggested its use for this type of plantation, some marks were awarded, but only a few student obtained full marks for recognizing the shortcomings with the trial and so suggesting hesitation to recommend the spray without further controlled trials.

Question 2

- (a) Two reasons why the experimental strips were separated in this way are: (i) Management reasons – easier access and mowing and (ii) Prevention of cross contamination of treatments.
- (b) Significance of Treatment 1 is to act as a control for comparison with other plots (grass growth normally without fertilizer/insecticide).
- (c) The soil must have had sufficient nutrients normally and so fertilizer made no significant difference between Strip 1 and 2 or 10 days was insufficient time for fertilizer to effect growth rate.
- (d) Must have been an insect presence that reduced growth rate on Strip 2 but these were not a factor on Strip 3 as insecticide applied.
- (e) Dry weight is used as a comparable measure of plant production, water on and in the plant can vary for many reasons and can change weights significantly. Dry weight eliminates this variability so results are comparable.
- (f) Insecticide was added with 10L of water and that the insecticide does not hamper grass growth or presence of insects is impacting on grass growth.

Comments: (a), (b), (c), (d) and (e) were overall well answered with most candidates obtaining close to full marks. (f) This question was poorly answered with many candidates summarizing the results for Strip 3 or indicating that insecticide actually weighed more than fertilizer or that insecticide just made grass grow better.

Question 3

- (a) Students needed to devise an experiment that showed their understanding of good scientific experimental design, to obtain 10 marks students needed to include the following in their design.
- Testable Hypothesis that included both the **independent variable – species of lavender: *Lavandula angustifolia*** (currently used species) or *Lavandula stoeches* (the new NZ hybrid) and the **dependent variable** which would compare growth rate, quantity and quality of oil production.
 - Site selection: Trial held at Bridestowe to ensure results useful as where lavender is ultimately to be grown and will expose plants to same conditions that will need to grow in.
 - Sample size: Needs to be of sufficient size to be meaningful but not so large as to disrupt or reduce production at Bridestowe (a number of plots and replicas to cover the variability of the farm in terms of soil, topography, wind exposure etc.). By growing the same sized plots of each species under the same conditions they can act as controls for each other.
 - Other Variable: All other variables that can be controlled should be in terms of treatments the soils receive for preparation for planting, fertilizing, irrigation, pest management and harvesting of flowers throughout the trial should be the same for the various test sites. Also the age, health, size and density of the plants being grown etc. must also be the same. By being in close proximity the variables that cannot be controlled such as rainfall, wind soil type etc. should be the same for both species and so results obtained should be comparable.
 - Measurement: How the dependent variable is to be measured must be consistent and would probably need to measure plant heights, size and flower volume as a measure of plant growth and the collection of flowers and extraction of oil to determine quantity and quality. Whatever measurement is done it has to be reliable and done in the same way at predetermined intervals.
 - Duration of trial: As it takes 4 years for plants to reach maturity the trial would need to be carried out over at least five to six years. The quantity and quality of oil extracted after harvesting each year during this time should then be compared.
- (b) Cuttings will produce plants that are genetically alike and so can minimize variability while ensuring consistency for the producer. Also cuttings are quicker and more reliable to establish.

Comments: (a) Few candidates answered this comprehensively enough to obtain full marks, many candidates included aspects of good experimental design but few developed the ideas beyond a very superficial level, most lost marks because they omitted vital aspects of good experimental design. (b) Most candidates recognized the greater reliability of cuttings to establish, though some answers were confused and referred to oil production from cuttings.

Question 4

- (a) Candidates needed to identify three improvements and include an explanation as to why the suggested improvement would improve the reliability of the results.

Candidates needed to select three improvements from the following:

- Include a control, the oysters in the same condition but with no bacteria to determine the oysters survival rate in the particular conditions
- Use different concentrations of bacteria to determine if any level is safe
- Run the investigation over a longer time frame to see if longer exposure would have any effect
- Simulate natural conditions such as wave action, currents that may dilute bacteria concentrations
- Include trials that investigate the effect of the oil alone or the products formed as the bacteria metabolise the oil to determine if these may impact on the oysters' survival.
- Have trials involving more oysters
- All suggested improvements would mean the independent variable is more likely to be the cause of changes to the dependent variable.

- (b) In the field many variables cannot be controlled such as wave action, wind, currents, other organisms, water depth, temperature, rainfall etc. In the laboratory all variables can be controlled so the results obtained can be directly attributable to the independent variable. Also ethically and legally cannot intentionally introduce oil (pollutant) or bacteria into a natural ecosystem.

Comments: (a) This section was well answered and most candidates obtained close to full marks, candidates lost marks when they did not explain how it might help the reliability of the results. (b) Candidates answers were more variable and most candidates did not compare the difficulty of field tests with laboratory tests, also most did not think about the ethics or legalities related to intentionally contaminating the environment so were unable to obtain full marks.

Section B – Criterion 8**Question 5**

- (a) The irrigation system that a significantly higher yield of fruit is the double drip line with a total yield of 41.88.
- (b) Microjet = $0.15 + 1.84 + 8.6 = 10.59/34.17 \times 100 = 30.99\%$ or 31%
Double line drip = $0.63 + 5.59 + 16.90 = 23.12/ 41.88 \times 100 = 55.2\%$ or 55%
Single line drip = $0.05 + 0.70 + 6.38 = 7.13/ 33.91 \times 100 = 21\%$
- (c) Based on fruit diameter and the largest fruit size the irrigation system you would recommend to a farmer would be single drip line as this had the highest values of 1.06 and 3.24 for the largest fruit. It also uses the least water.
- (d) Microjet as it provides 40L/tree/hour and over a wider area desirable as sandy soils hold little water and the more water you can provide the better. The other systems provide a lower volume of water per tree/ per hour being 25L and 13L for the double and single drip lines respectively and also distribute water over a much smaller area.

Comments: (a) All candidates answered this question correctly. (b) Most candidates were able to complete these calculations but a number of candidates did not attempt the question, or did not read the question correctly and used only the 25mm value instead of those fruits with lesser diameters as well. (c) Most candidates answered this question well though some lost marks by not reading the table correctly and suggesting a different system. (d) Candidates answered well in most cases some marks were gained for suggesting double line drip as less water use than micro-jet but good yield. Many candidates did not obtain full marks by not discussing each system as instructed.

Question 6

- (a) The two animals you would expect to find in the high levels of pollution would be the rat-tailed maggot and sludge worm.
- (b) Candidates needed to list two problems associated with sampling of animals for such a study such as: Daily and seasonal variation in activity, migratory behavior or just moving through the area seeking resources up or down stream, habitats located in a range of places within the ecosystem so difficult to access to sample, presence of sampler (disturbance) can impact on animal presence and location, difficulty of taking samples in such locations.
- (c) The relationship between temperature and pollution and dissolved O₂ is:
- As temperature increases the level of dissolved O₂ decreases
 - As pollution level increases the level of dissolved O₂ decreases

- (d) Candidates needed to sketch the graph of volume of dissolved O₂ in water in parts per million (ppm) against increasing temperature to determine the volume of dissolved O₂ in water that is inhabited by trout at 10°C. Marks allocated to graph (for correct labels on axis including units and the actual plotted line) 1½ and ½ mark for the answer to the question which should be 7ppm.
- (e) The advice that would be given to a fish farmer who wanted to raise trout would be to have clean pollution free water as trout do not tolerate pollution and to keep the water cool to ensure it contained plenty of O₂ for the fish to be productive.

Comments: (a) Answered correctly by the majority of candidates. (b) Answered quite well for the most part but some candidates seemed a little confused and unsure what was required to answer this question. (c) Most candidates were able to simply establish this relationship but a number of candidates wrote long convoluted answers that were confused and ultimately did not express the relationship asked for. (d) Most candidates were able to draw the graph and find the correct value, some mislabeled the graph or did not attempt the question. (e) Answered well overall, though a number of candidates only obtained 1 mark as they only suggested one aspect minimize pollution or keep water cold but not both.

Question 7

- (a) For three marks candidates needed to list the factors from the table that would be classed as:
- Abiotic, not be related to living things, these are physical factors such as: Slope of land, soil type though no differences as both sites have the same soil, soil profile, depth of soil horizon and soil erodability. Each point needs some explanation of its relevance in site selection for growing *Eucalyptus globulus*.
 - Biotic factors are those factors attributable or related to living things such as Native plant type, leaf litter depth, Estimate of worms and beetle larvae/ha. Each point needs some explanation of its relevance in site selection for growing *Eucalyptus globulus*.
- (b) Candidates were asked to identify and explain which of the listed techniques (clear felling, aerial seeding by aircraft, variable retention, selective logging, controlled burning or contour ploughing) should be used in the management of each Site.

Site 1: Clear felling – to remove all tree competition and clear the site in preparation for even crop growth, so trees in the plantation are of equal age and size. Contour ploughing – should be undertaken in all grades of slope to channel sub soil moisture and surface run off and so minimize erosion. Controlled burning – could be used depending on size of wood waste but used less often due to CO₂ emissions.

Site 2: Clear felling – to remove all tree competition and clear the site in preparation for even crop growth, so trees in the plantation are of equal age and size. Contour ploughing – should be undertaken in all grades of slope to channel sub soil moisture and surface run off and so minimize erosion. Controlled burning – could be used depending on size of wood waste but used less often due to CO₂ emissions.

- (c) Candidates needed to explain why the land described in Table 2 would not be used for growing plantation timber facto - such as:

Native plant type – Dry Eucalypt forest so could indicate low water; Leaf litter - indicating low fertility or nutrient recycling; Sandy loam on granite – low water holding capacity; Soil profile – shallow horizons on bedrock would restrict root growth; Soil erodability – high within 10cm of the surface; Estimate of worms and beetle larvae/ ha – low number indicates poor soil fertility.

Comments: (a) (i) and (ii) Candidates were asked to identify the abiotic and biotic factors from the table that could be used to assist in site selection, candidates were also asked to explain why these would be useful. Many candidates lost marks by not explaining the significance of the factors or by mixing up the terms abiotic and biotic factors as well as mixing both factors together in the one answer. (b)

Section C – Criterion 7

Question 8

- (a) South Australia – mechanical pulping, using 1.6 million tons of timber sourced from private plantations (blue gums) producing 750,000 tons medium grade pulp per annum at a conversion ratio of 2:1, boosting South Australian economy by \$400 million per annum, closed loop system meaning no effluent leaves the site using an underground aquifer for water needs which are 2,600ML's a year, it is located 50km away from a city of 24,000 people.

Tasmania – chemical pulping, using 4 million tons of timber sourced from public forest and private plantation (soft and hardwood) producing 1 million tons top- grade white pulp per annum at a conversion ratio of 4:1 boosting Tasmanian economy by \$413 million per annum, releasing 64,000 tons of effluent a day into Bass Strait using local Hydro dam for water needs of 26,000ML's a year, it is located only 26km from a city of 100,000 people.

Considering the environmental impacts the South Australian mill uses only plantation timber, no Native forest, uses one tenth of the water Bell Bay will use and considering the drought conditions this is significant. It is a closed loop system so does not release the huge quantities of effluent that Bell Bay will and is located well away from any

major city unlike Bell Bay which is in close proximity to Tasmania's second largest city. The Penola Mill is recommended as it has fewer environmental impacts, better conversion rate and will cost 0.2 million less to construct but will return a similar return of \$400 million rather than \$413 million at Bell Bay per annum.

- (b) Candidates needed to choose two management issues and discuss how they can be overcome. Some possible issues – sourcing sufficient water or timber and getting it to the Mill, road infrastructure to cope with increased heavy vehicle traffic while ensuring public safety, piping water from Trevallyn dam through public and private land, accessing sufficient timber from sources other than Public Forest to avoid public protest, monitoring potential pollution such as water quality in the Tamar river, Bass Strait, air quality in the Tamar Valley due to burning chips for power source, sound pollution in the local area. Sourcing workers and housing for workers during construction phase, finding specialist workers to operate the Mill when it goes into production. Finding markets that will buy high grade white pulp in current economic downturn.
- (c) Other ways that value can be added to Forests (apart from pulp) to improve the Tasmanian economy are using the timber for building materials worth substantially more per ton than as pulp. Can be converted to furniture or arts or crafts worth even more per ton. Native forest can boost tourism if maintained in pristine, wild condition for eco-tourism. When carbon trading comes more into play can count as carbon credits and may be worth substantial amounts.
- (d) Candidates needed to cover this question from the four areas: management, economic, environmental and social issues. Each of the four areas needed to include a positive and negative impact to gain the available 3 marks per area. Answers will vary depending on the chosen natural resource. Possible natural resources could be water; wild life; native forest; land usage; agricultural production, fisheries, energy production.

Comments: a) Many candidates were able to obtain almost full marks by comparing the economic returns compared to the environmental impacts. A number of candidates lost marks by not answering the question, they were asked to recommend one mill or the other, others lost marks by only covering a few of the environmental impacts mentioned in the tables. (b) Most candidates were able to list two management issues however, a number of candidates lost marks by identifying the issue but not discussing ways to overcome it. (c) Most candidates were able to mention at least one value adding opportunity but it needed to be different from pulp, so paper production relied on pulp and so missed the point as an example. (d) Many candidates did not relate the issues to another natural resource directly and papers were marked accordingly as it appeared candidates did not fully understand what was being requested of them. Candidates were also asked to discuss both a positive and negative impact but many candidates did not do this and focused on either the positives or more commonly the negatives, few candidates obtained full marks.

Research Investigation

The examiners were generally very pleased with the standard of this year's investigations. Students demonstrated an ability to plan ahead and carefully develop a range of interesting science experiments. Hypotheses were sound, Independent, Dependent Variables and control treatments were correctly identified and control of other variables was recognized. Most students had clearly worked hard to obtain considerable amounts of data to support their findings. Presentation of data tables and graphs were generally of a high standard. Background research to support the science behind the investigated topic was sound as was the discussion of results. Most students were able to make clear links between their data, research and impacts relevant to the resource and its development.

Resource Research

The folios this year were very similar in standard to previous years; overall a good standard. It was interesting to read some new resources that had not been attempted in the past eg. Savage River Iron and Huon Pine. Students were very disciplined to write these folios under the prescribed criteria. Some resources have limited references and students must avoid using some references exclusively without addressing the specific criteria.

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