VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

# 2006 Agricultural and Horticultural Studies GA 3: Written examination

## GENERAL COMMENTS

**Areas of strength and weakness**

Students demonstrated a sound understanding of techniques for modifying climate, water, soil/growing media and topography. However, they found it more difficult to compare advantages and disadvantages of alternative techniques. Methods for evaluating these techniques also needs to receive more attention.

Students demonstrated an adequate general knowledge of specific weeds, pests and diseases; however, the recommended treatments and preventions described were often isolated actions rather than complete strategies. Students need to improve their knowledge of integrated pest/weed management approaches and the broad legal responsibilities of animal and plant managers with regard to pests and diseases.

Students must be able to evaluate the impact of innovations (new or emerging technologies), and a distinction must be made between how an innovation works and its advantages and disadvantages. They should also be able to evaluate the impact on specific business types with regard to sustainability, not just productivity/profit. A large percentage of students did not address this area adequately, and many provided examples of technology that were definitely not an innovation. A small percentage of students had obviously studied a number of innovations and were capable of explaining and evaluating them in detail.

The case studies presented in this examination seem to have been handled better than in previous years' papers. This may be indicative of an improvement in students' ability to evaluate resource management practices. Students were able to discuss the advantages and disadvantages of management options with regard to production issues only. Their considerations would be improved if they used all the areas of sustainability. Students demonstrated some knowledge of the role of indicators in aiding resource management, but often confused what was being measured and the interpretation or implication of the measure for management practices.

Whilst most students knew that soil acidification was a problem which could be treated by applying lime and prevented with adequate monitoring, they had very little understanding of what causes it. Students showed very little understanding of the processes leading to acidification, the full range of management strategies to treat and prevent it, or the ramifications of its occurrence. Soil acidification is a major form of environmental degradation. Students should have a sound understanding of causes, prevention and treatment of all major forms of environmental degradation affecting agriculture and horticulture.

Most students seemed to have an overview of sustainability as it relates to agricultural and horticultural business management. Despite this, when asked to evaluate the impact of alternative management options, they generally evaluated the financial aspects and ignored the impact on the biophysical environment and social and community interests.

Evaluation of innovations, alternative management strategies, alternative pest/disease and weed treatments, and land or water improvement alternatives should be done on a basis of sustainability. Students are also expected to be able to evaluate the performance and outcomes of a small commercial agricultural or horticultural business in relation to its business plan. Many students focused on production aspects only and had poor knowledge of quality control, quality standards, risk management and business monitoring. Their answers were generalised statements that did not adequately draw on the students' experience in planning, monitoring and evaluating their school-based small business project.

**Choice of options to answer**

Students had to select an option from the provided lists of alternatives in Questions 2, 3, and 4. In Question 3, students were also required to nominate two innovations to discuss in their answer. In Question 6 students had to select a case study from five options. In all questions, a diverse range of options was chosen.

**Formula answers**

When preparing students for the examination, teachers must refer to the current *Agricultural and Horticultural Studies VCE Study Design* and the examination criteria. Students need to be able to apply their understanding to a range of land, plant and animal management techniques in agricultural and horticultural businesses throughout Victoria.

  

**Marking policies**
A marking scheme was developed to guide assessors. Marks were allocated to specific elements of the correct answer or according to descriptive criteria.

Where lists or alternatives were provided, examination assessors had general guides for the answers as well as specific answers to the alternatives. The specific answers were provided to guide the assessors in judging the accuracy of students' responses.

Marks were not deducted if students provided answers that were not correct.

# SPECIFIC INFORMATION

**Note: Student responses reproduced herein have not been corrected for grammar, spelling or factual information.**
Some questions addressed more than one of the examination criteria. The allocation of marks was determined by comparing students' answers with the examination marking guide.

The answers to each question and any marking guidelines are given in the information below. These are followed by general comments about the students' responses to the questions. For Questions 3 and 4 a student response has been reproduced as an example of what was required.

This report should be read in conjunction with the 2006 examination, which can be found on the VCAA website.

**Question 1ai–viii.**

| Marks | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| % | 4 | 4 | 7 | 13 | 15 | 18 | 18 | 14 | 9 | **4.8** |

**1ai.**

- install a heater, turn on a heater
- close the vents
- reduce shading

**1aii.**

- do not overhead water
- plant further apart
- increase air flow by pruning
- water at start of day not night

**1aiii.**

- add dolomite or lime
- add lots of sand
- increase worm activity
- improve structure, perhaps with organic matter
- use raised beds, surface drains

**1aiv.**

- add water holding crystals, vermiculite, perlite
- add organic matter, improve structure

**1av.**

- install wind breaks
- dress them in jackets
- sheer in wind free season

**1avi.**

- add large particles
- increase soil aggregate size
- increase organic matter
- increase worm activity
- add dolomite or lime

**1avii.**

- add organic matter/mulch
- increase worm activity
- deep rip/cultivate compacted area
- stop whatever activity is causing it

**1aviii.**

- add lime

One mark was awarded for specifying one way each change to improve production could be made. Most students answered Question 1a. well, demonstrating that they had an understanding of techniques for modifying climate, water and soil/growing media.

**Question 1bi.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 24 | 36 | 31 | 9 | **1.3** |

- Nitrogen fertiliser is easily applied and gives a quicker response compared with establishing and growing lucerne/clover for a growing season.
- Nitrogen fertiliser is easily leached into waterways.
- Lucerne/clover can be turned into soil to improve structure.

Three marks were given for answers that showed a detailed consideration of the advantages/disadvantages of using nitrogen fertiliser instead of a clover/lucerne pasture crop to improve a soil's nitrogen availability. Two marks were given for answers that showed the student clearly knew the main advantages/disadvantages of one practice compared with the other; and one mark was given for identifying isolated advantages/disadvantages of the practices being compared.

**Question 1bii.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 9 | 40 | 38 | 13 | **1.6** |

- With plastic sheeting, rain does not easily get into the root zone, therefore increasing surface runoff.
- Decomposing wood chips provide nutrients and organic matter to the soil, but cause nitrogen drawdown.
- It is more difficult to irrigate plastic (must apply underneath), but it results in less evaporation loss.
- Aesthetic issues.
- Fewer weeds grow with plastic.
- Some wood chips are toxic.
- Wood chips can be blown around and scratched away by birds.

Three marks were given for answers that showed a detailed consideration of the advantages/disadvantages of mulching with wood chips instead of using plastic sheeting between ornamental plants to conserve moisture. Two marks were given for answers that showed the student clearly knew the main advantages/disadvantages of one practice compared with the other; and one mark was given for identifying isolated advantages/disadvantages of the practices being compared.

Students are expected to be able to evaluate the effectiveness of the techniques. Parts 1bi. and 1bii. provided an opportunity for them to do this by comparing two techniques for a given situation. About half the students were able to adequately compare the two practices.

**Question 2**

| Diseases | % student responses | Pests | % student responses |
|---|---|---|---|
| mosaic virus | 0.00 | lice | 10.29 |
| damping off | 1.18 | red-legged earth mite | 6.47 |
| downy mildew | 3.24 | rabbits | 32.94 |
| grass tetany | 3.53 | sheep blow fly | 20.00 |
| pulpy kidney | 0.88 | aphids | 16.18 |
| Newcastle disease | 0.29 | slugs | 3.24 |

**Question 2ai.**

| Marks | 0 | 1 | Average |
|---|---|---|---|
| % | 12 | 88 | **0.9** |

| Disease or pest | Agricultural or horticultural industry that the pest or disease affects |
|---|---|
| mosaic virus | • ornamental gardens<br>• horticultural crops<br>• cropping<br>• grazing |
| damping off | • horticultural nursery industry |
| downy mildew | • fruit<br>• vine |
| grass tetany | • beef/dairy cattle<br>• sheep |
| pulpy kidney | • sheep<br>• cattle |
| Newcastle disease | • intensive poultry production |
| lice | • sheep<br>• cattle |
| red-legged earth mite | • grazing industry<br>• cropping industry |
| rabbits | • any grazing, cropping or field growing business |
| sheep blow fly | • sheep grazing |
| aphids | • market garden<br>• ornamental gardens |
| slugs | • market garden<br>• wholesale nursery<br>• ornamental gardens<br>• pasture and cropping |

One mark was given for a correct answer.

**Question 2aii.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 11 | 44 | 32 | 12 | **1.5** |

| Disease or pest | Prevention |
|---|---|
| mosaic virus | • maintain vigorous plant growth using fertilisers and appropriate plant conditions<br>• eliminate vectors – insecticide for aphids<br>• control weed hosts of vectors<br>• plant resistant varieties – use certified free seed<br>• use diverse pasture species |
| damping off | • maintain good hygiene and optimum light and heat<br>• do not water excessively<br>• use a well-drained medium<br>• ensure proper growth conditions for plant and not for fungi<br>• seed and roots must be kept moist and warm until the roots have penetrated the soil and the seedlings have emerged. As the seedlings continue to grow, moisture at the soil surface can be decreased so the damping-off fungi will have less of an advantage. When watering, thoroughly saturate the soil and then apply no more water until the soil approaches the point at which plants wilt. This procedure will keep the surface soil dry for a maximum amount of time. Avoid frequent sprinkling because this generally keeps surface soil too moist and promotes fungal growth<br>• preventive measures are based on eliminating fungi (drenching media with 'Fongarid') that cause damping off or providing chemical barriers to prevent the fungi from growing in the planting medium<br>• soil for growing transplants in flats can be steam pasteurised |

| | |
|---|---|
| downy mildew | • create an environment that does not promote the fungus (need low humidity and good air flow)<br>• prune to produce an open canopy<br>• use hygienic practices<br>• plant resistant varieties<br>• monitor the crop carefully when climatic conditions threaten<br>• use drip irrigation rather than overhead sprinklers<br>• use copper spray (Bordeaux) |
| grass tetany | • protect from cold weather<br>• feed a high roughage diet<br>• give Mg supplements<br>• cull older, fat cows<br>• reduce stress/excitement levels<br>• monitor carefully, especially if it has occurred on other farms in the district |
| pulpy kidney | • maintain hygiene when marking, vaccinating, mulesing or carrying out similar operations. Carcases should be disposed of properly<br>• vaccinate to develop satisfactory immunity within the animal at risk<br>• avoid sudden feed changes<br>• exercise may help prevent the disease, and anything that speeds up movement of food through the gut |
| Newcastle disease | • maintain good hygiene<br>• vaccinate: all chickens in any commercial poultry flock in Victoria must be vaccinated in accordance with Newcastle Disease Vaccination Program Standard Operating Procedures<br>• quarantine: unvaccinated birds can be protected from infection by limiting their exposure to migrating waterfowl and wild birds that can carry these viruses. Prevent overseas visitors who may be inadvertently carrying the virus from accessing the birds and refuse to accept birds or eggs that may have been imported |
| lice | • maintain a clean herd<br>• quarantine imports to property and treat appropriately<br>• keep strays off property<br>• check regularly |
| red-legged earth mite | • in spring and autumn, spray omethoate on pasture at establishment<br>• sow seeds coated in an insecticide that prevents red-legged earth mite attack on seedlings<br>• maintain dense, vigorously growing pasture<br>• spring sprays: foliar sprays in the previous spring. Destroy mites in the spring prior to planting susceptible crops, and before the mites start laying over-summering (diapause) eggs. Spray-top pastures before the onset of seed set in the pasture species, usually before October. Early senescence of pastures will bring forward the time the red-legged earth mite lay their over-summering eggs, so it may be necessary to spray in September. If sprays are applied after mid spring, there is a risk that some diapause eggs will be produced and hatch in the following autumn<br>• autumn sprays: controlling first generation mites before they have a chance to lay eggs is the only effective way of avoiding the need for a second spray. Hence, insecticides used at or after crop planting should be applied within three weeks of the first appearance of mites, as adults will then begin laying eggs. Eggs are not susceptible to insecticides. Depending on the distribution of the mites, border sprays may be adequate<br>• bare earth sprays: bare earth insecticides, used just after sowing, will protect the germinating seedling at its most susceptible stage. Use rain-fast insecticides when available<br>• foliage sprays. Once the crop has emerged, these sprays are usually quite effective |
| rabbits | • install a rabbit proof fence<br>• cover the trunks of trees with aluminium-coated paper. Staple the paper around the tree, foil side out (plastic guards are also available commercially)<br>• install sound netting fencing to prevent pest animals<br>• poison (1080, pindone) in late summer<br>• myxomatosis<br>• rabbit calicivirus<br>• remove harbours and destroy warrens (plough, explosives) |

| | |
|---|---|
| | • fumigate<br>• chemical repellents |
| sheep blow fly | • correct tail docking, mulesing of sheep kept for wool, prevent scouring by a good worm control program, selection away from harsh-woolled, wrinkly sheep; pizzle dropping may also be of benefit<br>• destroy fly struck crutchings to kills many maggots that would otherwise survive<br>• monitor climatic conditions to predict blowfly activity<br>• monitor/reduce blowfly populations through trapping<br>• catch, clip and individually treat blowfly-struck sheep<br>• preventively jet or backline susceptible sheep (such as weaners and hoggets) at the start of the blowfly season<br>• jet specific areas on the sheep if a fly wave is expected (such as pizzle of wethers, breech of ewes, poll of horned rams)<br>• control internal parasites |
| aphids | Market garden<br>• use resistant varieties<br>• use only uninfected plants<br>• encourage beneficial insects<br>• use 'soft' insecticides (that kill only aphids) or broad spectrum insecticides (that kill beneficial insects too)<br>• control weed hosts<br>Ornamental garden<br>• grow 'virus-free' plants in isolation, away from potential sources of infection. Growing conditions (including weed control) should discourage aphids<br>• rogue out infested plants<br>• enforce strict hygiene<br>• regularly inspect plants that are not the hosts of aphid-borne diseases to allow the presence of aphids to be detected well before any damage occurs. Once aphids are detected, spray with a suitable insecticide to prevent economic damage |
| slugs | Market garden/wholesale nursery<br>• eliminate hiding places (so birds can get them)<br>• use textural, desiccating and toxic barriers<br>• physically remove pests<br>Ornamental garden<br>• eliminate hiding places (so birds can get them)<br>• use textural, desiccating and toxic barriers<br>Pasture and cropping<br>• use shelter traps (wet hessian bag) around margins of crop/pasture to detect presence<br>• encourage natural predators – plant shelter belts for birds and lizards<br>• have ideal plant growth conditions to out grow slugs |

Three marks were given for providing complete information about how a manager would prevent the pest or disease from occurring; two marks for an explanation that showed how the manager could reliably prevent the pest or disease from occurring; and one mark for providing some information, but not enough to prevent the pest or disease from occurring.

**Question 2aiii.**

| **Marks** | **0** | **1** | **2** | **3** | **Average** |
|---|---|---|---|---|---|
| **%** | 10 | 37 | 37 | 17 | **1.6** |

| **Disease or pest** | **Treatment** |
|---|---|
| mosaic virus | • destroy affected plants<br>• fertilise to encourage plant growth to outgrow infection<br>• maximise plant growth conditions to compensate for lost production<br>• utilise pasture growth available |
| damping off | • remove and destroy affected plants<br>• maintain hygienic conditions to prevent spread<br>• use alternate species/varieties |

| | |
|---|---|
| downy mildew | • Mancozeb and systemic fungicide Bayleton<br>• use hygienic practices to prevent spread<br>• dispose of infected plant material correctly |
| grass tetany | • injection of Mg by vet<br>• feed causmag or Epsom salts and hay |
| pulpy kidney | • not usually treated; general treatment usually not economical<br>• antitoxin, antibiotics and electrolytes may be given to high-value stock |
| Newcastle disease | • mass slaughter, culling, vaccination<br>• accepted international practice is to attempt to eradicate the disease by destroying all birds that may have been exposed to the virus and to dispose of any infected or exposed products. This is done in conjunction with strict quarantine and movement controls to contain the virus; decontamination to remove any remaining virus; tracing and surveillance to determine the extent of infection; and zoning to define at-risk and disease-free areas |
| lice | Cattle<br>• a range of products to treat cattle lice may be applied by high-volume spraying or by 'pouring-on' a concentrated formulation<br>• routine treatment is usually not warranted. Occasionally, individual animals become heavily infested and require treatment. When this occurs they should be checked for other problems, such as internal parasites, which may be contributing to lowered resistance<br>• looking for lice requires close examination of a sample of the herd. If individual animals have a heavy burden and the rest of the herd have few or no lice, treat only the heavily infested cattle<br>Sheep<br>• pour on insecticides in autumn, within 24 hours of shearing<br>• plunge or shower dips within two months of shearing. All parts of animal must be covered<br>• may be treated for lice in long wool if necessary for control, or after shearing to achieve eradication. To treat successfully, use an effective chemical at the prescribed dose and application |
| red-legged earth mite | • seed treatments: work best when mites are active at germination and when mite pressures are not high<br>• natural enemies (other predatory mites, small beetles, spiders and ants): major role in reducing earth mite populations in pastures. A predatory mite (Anystis wallacei) has been introduced as a means of biological control, but it is very slow to establish. Minimise insecticide impact on the natural enemies by choosing a spray that has least impact and minimise the number of applications<br>• cultural control: clean fallowing and destroying weeds around crop and pasture perimeters can reduce mite numbers. Control weeds, especially capeweed and thistles, as they are recognised breeding sites for red-legged earth mite. This is especially important around the periphery of the crop. Crop rotations involving cereals are likely to reduce the population build up in paddocks prior to planting highly susceptible crops like canola. Cultivation will significantly decrease the number of over-summering eggs. Hot stubble burns provide a similar effect. Close grazing of pastures by stock (in spring) can also reduce mite numbers |
| rabbits | • poison<br>• fumigate<br>• remove harbours<br>• destroy warrens<br>• shoot |
| sheep blow fly | • jet<br>• crutch |
| aphids | Market garden<br>• insecticide<br>• change varieties<br>Ornamental garden<br>• birds, spiders, lacewings, predatory bugs, parasitic flies and wasps, predatory beetles and some caterpillars attack aphids<br>• growers aiming for 'pest-free' crops usually spray pesticides that result in the crops being 'insect-free' or, at worst, devoid of beneficial insects |

| | |
|---|---|
| | • regular inspection of plants that are not hosts of aphid-borne diseases should allow the presence of aphids to be detected well before any damage occurs. Once aphids are detected, spray with a suitable insecticide |
| slugs | Market garden/wholesale nursery<br>• baits and traps<br>• molluscicide (methiocarb) or iron phosphate<br>Ornamental garden<br>• physically remove<br>• baits and traps<br>• molluscicide (methiocarb) or iron phosphate<br>Pasture and cropping<br>• encourage natural predators – plant shelter belts for birds and lizards<br>• ensure ideal plant growth conditions to out grow slugs |

Three marks were given for providing complete information about how a manager would treat this pest or disease when it does occur; two marks for an explanation that showed how the manager could reliably treat this pest or disease when it occurs; and one mark for providing some information, but not enough to treat this pest or disease when it occurs.

Students distinguished successfully between prevention and treatment and generally knew something about these for one of the listed pests or diseases. About half of the students successfully explained how to treat or prevent their chosen pest or disease. More attention should be given to complete strategies for prevention and treatment rather than isolated single measures.

**Question 2bi.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 5 | 33 | 42 | 21 | **1.8** |

One mark (up to three) was given for each of the following way weeds reduce production:

- competition with wanted plants for light, water and nutrients
- not as productive as wanted plants
- may be selectively avoided by grazing animals
- may damage the product (for example, burrs in wool, tainted milk, contaminated crops)
- may damage livestock – poisonous plants, storks bill seed penetrate skin
- harbour pests and diseases
- release chemicals that hinder crop growth (allelopathy)
- reduce saleability of container stock.

Responses needed to be clearly different from each other.

**Question 2bii.**

| Marks | 0 | 1 | Average |
|---|---|---|---|
| % | 29 | 71 | **0.7** |

Landholders are responsible for controlling the growth and spread of the weed on their land.

**Question 2biii.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 15 | 41 | 37 | 7 | **1.4** |

| Weed | % student responses |
|---|---|
| oxalis (*Oxalis spp.*) | 2.65 |
| blackberry (*Rubus fruticosus*) | 34.71 |
| Paterson's curse (*Echium plantagineum*) | 29.41 |
| Cape weed (*Arctotheca calendula*) | 12.06 |
| wild oats (*Avena fatua*) | 6.47 |
| serrated tussock (*Nassella trichotoma*) | 9.71 |
| no selection | 5.00 |

| Weed | Business type | Integrated Management Strategy |
|---|---|---|
| oxalis | Nursery | • use clean potting medium<br>• mechanically remove weeds from containers<br>• mechanical/pesticide (glyphosate) removal of plants in surrounding areas<br>• destroy weeded out plants<br>• keep surroundings weed free with mulch – organic or inorganic<br>• fertilise infested areas in summer to promote growth of wanted plants while oxalis is dormant |
| | Market garden<br>Ornamental garden | • mechanically remove weeds from rows<br>• mechanical/pesticide (glyphosate) removal of plants in surrounding areas<br>• destroy weeded out plants<br>• keep surroundings weed free with mulch – organic or inorganic<br>• have vigorously growing ground cover<br>• fertilise in summer while oxalis is dormant<br>• do not allow seed set |
| blackberry | All extensive agriculture and non-glasshouse horticulture | • maintain dense, vigorously growing plant cover<br>• be vigilant in watching for infestation and remove blackberry plants as soon as seen<br>• biologically control (blackberry rust)<br>• use herbicide<br>• slash<br>• grub out<br>• burn |
| Paterson's curse | All extensive agricultural businesses – grazing and cropping | • maintain vigorous pasture growth of desirable species<br>• monitor paddocks and identify Paterson's Curse and treat early, do not allow seed set<br>• biological control (Crown boring weevil)<br>• use windbreaks to prevent seed blowing in<br>• plough-crop-pasture improvement on arable land, mechanical and herbicide on grazing land<br>• purchase stock from weed free areas<br>• quarantine stock when brought on to property<br>• use certified pasture seed<br>• hygiene – ensure good machinery clean down protocols |
| Cape weed | Dairy | Prevention<br>• have no bare soil (do not overgraze or allow stock 'camps')<br>• maintain vigorously growing, dense ground cover<br>Treatment<br>• spray herbicide (spray-grazing, pasture topping) at low dose<br>• hard graze 'sweetened' weed<br>• do not allow seed set |
| | Market/ornamental garden | • have no bare ground – use ground cover plants or mulch<br>• mechanically remove any single plants that appear<br>• use herbicide on large infestations<br>• do not allow seed set |
| wild oats | Cropping | • use certified seed so weed is not introduced<br>• use a range of herbicides (chemical rotation) including knockdown and systemic herbicides<br>• alternate cropping with pasture phase<br>• use cultivation, the grazing animal, pasture-topping, stubble burning, etc., together with pasture and crop rotation<br>• strategic heavy grazing of pasture to prevent seed set in late spring<br>• cut hay or silage<br>• green manuring |

| | | |
|---|---|---|
| | | • mow<br>• grow a forage break crop between the pasture and crop phases |
| serrated tussock | Grazing businesses (cattle and sheep) | • maintain vigorous pasture growth of desirable species<br>• monitor paddocks and identify serrated tussock and treat early<br>• do not allow seed set<br>• biologically control when available<br>• create windbreaks to prevent seed blowing in<br>• plough-crop-pasture improvement on arable land, mechanical and herbicide on grazing land<br>• purchase stock from weed free areas<br>• quarantine stock when brought on to property<br>• use certified pasture seed<br>• hygiene – ensure good machinery clean down protocols |

One mark was awarded for limited relevant information; two marks for information that showed some knowledge of integrated management strategies for the weed; and three marks for a more detailed answer that mentioned some aspect of monitoring the extent of the weed problem and basing decisions upon the economic, environmental or community (including legal) impact of the weed.

About two thirds of the students showed that they knew of the different ways that weeds impact on productivity and that landholders have legal responsibilities with regard to controlling specific weeds. About half of the students successfully described how to manage their chosen weed. Understanding of integrated weed management needs to be improved.

**Question 3**

| Practice | % student responses |
|---|---|
| modifying climate | 12.79 |
| modifying soil/growing media | 2.94 |
| modifying topography | 4.71 |
| water management | 11.47 |
| soil management | 6.03 |
| controlling weeds, pests and diseases | 11.62 |
| decision making | 10.44 |
| managing animals and their products | 26.76 |
| managing plants and their products | 7.50 |
| no selection | 5.74 |

**Question 3ai.**

| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|---|
| % | 21 | 17 | 24 | 22 | 14 | **1.9** |

**Question 3aii.**

| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|---|
| % | 27 | 20 | 23 | 18 | 12 | **1.7** |

For each part, one mark was given for naming an innovation that was clearly a **new or emerging** method or development.

A further mark was given if only limited information was presented and it was not clear that the student understood how the innovation worked; two marks were given for adequate relevant information that showed the student had an overview of how the innovation works or is done; three marks were given for a detailed answer that provided relevant information about the innovation's operation.

Listing of innovations described (where the listing was the title of the 'practice' chosen it has not been recorded).

- advanced chemical spraying devices
- advanced soil testing
- aerial photography
- Ag Cam
- aglime
- Agronomist
- air vents
- animal paddock plan
- aquaponics
- Artificial Insemination breeding

- artificial selection
- astronaut milking machine
- auto calf feeder
- auto calf feeder, lely
- auto channel stops
- auto dairy
- auto grain monitoring system
- auto irrigation
- auto irrigation gates
- auto milking machines
- auto milking system
- auto planting machine
- auto potting machine
- auto seeding system
- auto shearing
- auto steer on boom spray
- auto steer
- auto teat cup removers
- auto temperature control
- auto vents for green house
- auto weigh stations
- auto weighing of animals
- Ball Australia
- bio diesel
- bio fuel
- bioclip
- biological control
- bionic net
- blocks
- boom irrigation
- boom spraying
- broccoli harvester
- BT cotton
- cages
- CALP act
- capillary matting
- cat tracks
- catchment areas
- cattle electric ear tags
- cattle feeder
- cell grazing
- centre pivot irrigator
- chemical shearing
- chemicals
- cherry picker
- climate control
- cloning
- cloning embryo splitting
- compressed air benches
- computer aided farm planning
- computer controlled greenhouse
- computer milk analysis
- computer programs
- computerised dairy
- computerised dairy system
- computerised ear tag
- computerised farm mapping
- computerised greenhouse
- computerised heating systems
- computerised management software
- computerised watering system
- contour ploughing, laser
- controlled temp room
- conveyor belt race
- cultivating
- cultivating and planting
- direct drilling
- double skin greenhouse
- double skin poly house
- DPI
- drip irrigation
- driver assist on tractors
- e sheep drafter
- e sheep ear tags
- e sheep tags
- e tag system
- easy dairy
- easy dairy program
- easy shear
- effluent pits
- effluent ponds
- effluent water supply
- electronic ear tags
- electric fence
- electronic calf feeders
- electronic collars
- electronic ear tag
- electronic milking
- electronic shutters
- electronic tagging
- electronic water cleaners
- embryo transfer
- fans
- farm plan
- farm planning software
- farm simulation soft ware
- feed
- feed lotting
- feeding machine
- fertilisers/chemicals
- frost fans
- frost tolerant cereals
- fumigating
- Gantry System
- genetic modification
- genetic modification of canola
- genetic modification of cotton
- genetic modification of crops
- genome mapping
- geotextile plastic sheeting
- gis whole farm planning
- glasshouse
- GM cotton
- GM wheat
- GMO
- GMO plants
- GPS
- GPS and auto steer
- GPS boom section
- GPS controlled tractor
- GPS controlled traffic
- GPS cropping
- GPS eartags
- GPS guidance systems
- GPS in boom sprays
- GPS in tractors
- GPS laser levelling
- GPS mapping
- GPS navigation
- GPS satellite mapping
- GPS system
- GPS systems in tractors
- GPS tractor control
- grafting
- grazing simulation – grass grow
- greenhouse
- greenhouse with sensors
- heat blanket
- heat mats
- heated environment
- heater blankets
- heaters
- heaters with a thermostat
- heating/cooling systems in glasshouses
- herbicide improved
- herd testing dairy
- hothouse
- hydroponic vegetable production
- hydroponics
- ICT and ear tagging in dairy
- ICT sensor
- infrared grape photo analysis
- integrated computer technology
- integrated control system
- intensive pig lots
- Internet
- IPM
- IPM pheromones
- irrigation
- jet engines
- land plane
- laser grading

- laser levelling
- lining irrigation channels
- liquid fertiliser
- live video monitoring systems
- machinery
- micro chipping
- micro chips
- minimal tillage
- minimum tillage
- misting
- misting fan
- mobile watering station
- moisture probe
- Moliserler
- monitored watering systems
- mulesing clip
- mushroom picker
- NLIS
- NLIS ear tags
- NLIS tag readers
- no till
- no tillage
- olive picking machine
- overhead sprinklers
- packet instructions
- paddock action management software
- paddock action manager
- pastures from space
- pest monitoring – pheromones
- pesticides
- pests and disease chemicals
- pH scale
- pH testing
- pH tests
- pheromones
- pipeline
- ploughing machine
- poly house
- poly house heater cooler
- portable poultry shedding
- practices
- precision farming
- precision farming cropping
- precision milking
- pregnancy testing
- previa super computer
- prickle chain
- priva computer controlled greenhouse/weather station
- priva computer system
- privet super computer
- program software
- property management plan
- property management software
- protein mapping
- quarantine
- rain man
- raised beds
- raised seed beds
- record keeping herd tests
- recycle
- recycling
- recycling water
- remote electronic monitoring systems
- remote sensing
- retractable greenhouses
- retractable roof greenhouse
- retractable roofing
- ridging
- ripper
- robotic dairy
- robotic milker, lely astronaut
- robotic milking
- robotic sprayers
- roller tables
- rolling benches
- rolling machine with sprinklers
- rotary dairy
- rotary robotic dairy
- roto wiper
- roundup
- rumen bolus technology
- rust resistance in wheat
- satellite remote sensing
- satellite cropping
- satellite fertilising
- satellite imaging
- satellite mapping
- satellite navigation
- satellite navigation in tractors
- seed drilling
- seed sowing machine
- seedling sowing machine
- selling cattle
- semen sorting
- sex selection
- sexed semen for cows
- shear easy
- sheering sheep electric
- sheers sheep
- silo bag grain storage system
- silo bags
- slow drip sprinkler systems
- software
- soil moisture probe
- soil pH
- soil potting machine
- solar power
- solar powered hot houses
- spray booms
- St John's Wart mite
- sterilisation
- stock book
- stopping potato leaf roll with GM
- stubble retention
- summer cool greenhouse
- thermal blanket
- tiger poo
- training
- tram line farming
- tram line traffic
- tram tracking
- trapping rabbits
- travelling irrigator
- trolley rail and gantry system
- turbidity probe
- twin skin poly house
- ultra sound
- universal hay trailer feeder
- unmanned aerial vehicle
- updated seed sowing machine
- vacuum sealed packaging
- vacuum pollinator
- virtual fencing
- waste water management
- water beds/mats
- water blaster
- water recycling
- water tank
- water troughs
- weather station computer modification
- whole farm planning
- Wimmera Mallee pipeline
- wind break
- wind farm
- worm egg counts
- yard blaster
- yield mapping
- yield prophet
- zero tillage

Approximately one quarter of the students could not name an innovation. Many of these students chose examples that were clearly not 'new or emerging', or discussed the chosen practice in general terms. Students must be aware of a range of new and emerging technologies, as stated in the study design.

Following is an example of a high-scoring student response.

*Innovation Name: Bioclip*

*Description: Protein injection given to sheep which result in the wool 'breaking off' after several weeks. The wool is caught by the net wrapped around the animal and can be peeled off – which takes all the wool. It prevents second cuts from shearers – reducing cheesy gland and produces higher quality wool.*

*Innovation Name: Unmanned Arial Vehicle (UAV)*

*Description: It is essentially a remote controlled plane. In vast areas up north, they lack numbers of workers, but still need to check on cattle and bores. This UAV allows the manager to check they are in order – through the camera on the underside. It saves time and money.*

**Question 3b.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 18 | 37 | 32 | 13 | **1.4** |

One mark was given if the answer gave limited advantages/disadvantages of the innovation compared to previously used technologies; two marks were given if the main advantages/disadvantages of the innovation compared to previously used technologies were considered; three marks were given for a detailed consideration of advantages and disadvantages of the innovation compared to previously used technologies.

Of the students who named appropriate innovations, about two thirds were able to adequately describe how the innovation worked and its advantages and disadvantages.

Following is an example of a high-scoring student response.

*Bioclip has the advantage in that it prevents the need of second cuts, which will result in less pests and disease such as cheesy gland. The wool taken from the sheep is of higher quality (no second cuts) and gets a higher price. A disadvantage is that it costs about $4 a head compared with $2 a head shearing.*

**Question 3c.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 38 | 47 | 14 | 1 | **0.8** |

Students were expected to consider the effect of the innovation on a business in terms of the major areas of sustainability – economic viability, biophysical environment and social impact.

Marks were awarded according to the following table, where the 'No. of areas' refers to the major areas of sustainability – economic viability, biophysical environment and social impact – included in the answer.

| No. of areas | No explanation | Limited explanation | Rational, detailed explanation |
|---|---|---|---|
| 1 | 0 | 1 | 2 |
| 2 | 1 | 2 | 2 |
| 3 | 2 | 2 | 3 |

Some students were able to explain the effect the innovation would have on businesses that use it; however, students generally considered only the financial or productivity effects of the innovation. The focus of VCE Agricultural and Horticultural Studies is on sustainable businesses and thus students need to consider all areas of sustainability when answering questions such as this.

The following response only considered one area (economic viability), but gave a rational clear explanation and was therefore awarded two marks.

*Bioclip should result in less emphasis on pests and disease control or prevention. This can increase the productivity of the animals, and as well a higher price for the wool – it may increase a businesses revenue. The extra cost may mean the business may need to use funds from elsewhere initially – but in time, they should earn the money back. Bioclip increases efficiency and allows managers to spend more time elsewhere on more productive area.*

**Question 4**

| Business type | % student responses | Business type | % student responses |
|---|---|---|---|
| cereal cropping | 9.41 | design/construct a garden | 4.12 |
| poultry for meat | 2.94 | maintain an ornamental garden | 1.47 |
| poultry for eggs | 7.06 | plants in glasshouse | 8.82 |
| beef cattle | 10.88 | container-growing ornamentals | 1.18 |
| pigs | 2.94 | field growing vegetables etc | 11.76 |
| sheep | 12.06 | production of indigenous plants | 2.06 |
| dairy cows | 10.88 | hydroponic production | 2.35 |
| grape vines | 2.65 | fruit tree management | 2.06 |
| fish or yabbies | 2.65 | horses for recreation | 3.24 |

**Question 4a.**

| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|---|
| % | 3 | 23 | 38 | 25 | 11 | **2.2** |

One mark (up to four) was given for each of the following aspects that need to be considered when developing a business plan:

- background to business, available resources, history
- resource inventory/analysis
- production plan, time lines
- financial plan, cash flow plan, budgets
- marketing plan
- objectives, aims, goals, purpose
- safety plan
- risk analysis and planning.

Following is an example of a high-scoring student response.

*What type of trees to grow?*

*Do you have the skills and resources (equipment – glasshouses, and processes) to carry out the enterprise – is it possible?*

*Do you have a market to sell your production, if so how will you sell the product – do you have marketability?*

*Do you have the finances or access to finances to carry out your business – pay for production costs – financially viable? Will you generate an income, will this sustain your costs?*

*Will you degrade soil, water or air quality or use excessive non-renewable resources? Business must be sustainable long term, must not degrade other enterprises.*

**Question 4b.**

| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|---|
| % | 4 | 47 | 33 | 14 | 2 | **1.6** |

One mark (up to four) was given for each of the following aspects:

- time line of development/production
- cash flow
- critical expenditure and income compared with plans
- production schedule
- production efficiency/quality control
    - animal growth/health
    - crop growth/health
- markets, demand, changing patterns
- health and safety records.

Following is an example of a high-scoring student response.

*Quality – Are you maintaining a high quality product? Eg. Vegetable matter – low micron etc.*

*Quantity – were lambing percentages as you anticipated, do you have as much produce as you anticipated in the business plan? Was artificial insemination successful?*

*Expenses – Are you spending more or less than you planned?*

*Current market prices/fluctuations – is the market for your product increasing/decreasing?*

**Question 4c.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 31 | 54 | 14 | 1 | **0.9** |

Answers needed to relate to the specific business type to get full marks.

- Are established quality standards being met?
- Are market expectations being met?
- Have processes been audited for efficiency?
- Have processes been evaluated for health and safety implications?
- What is the impact of production on the environment and community?

One mark was given for limited, relevant but isolated information; two marks were given when the answer showed some concept of meeting production standards and monitoring processes but was missing some major elements; and three marks were given for a detailed explanation that made some reference to all the key elements of quality control and related to the specific business type.

Following is an example of a high-scoring student response.

*A manager could ensure quality control by setting quality standards on the business in the plan. This could ensure the sheep are a certain weight at a certain time of the year. This means the business sets benchmarks to live up to. This could be comparison to sheep in the same district of a similar age. This would be monitored regularly.*

**Question 4di.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 22 | 26 | 27 | 25 | **1.6** |

One mark (up to three) was given for each **relevant** factor listed. Answers should have related to the sustainability of the specific business type and included things the manager cannot control from the following areas:

- unusual weather/climate variations
- abnormal market variation
- unpredictable price rises of inputs
- development of new processes or technology that gives competitors an advantage
- outbreak of new pest/disease types/variations.

Following is an example of a high-scoring student response.

*The economic viability of the business could be affected by market and price drops.*

*There could be a flood or fire that eradicates the heard and feed*

*There could be a drought meaning no feed for the stock.*

**Question 4dii.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 42 | 33 | 19 | 6 | **0.9** |

Information that could be presented included:

- insurance – the cover will replace income from lost production or replacement of lost assets
- diversification – so that the failure of one market will not ruin the whole business
- contracts – setting income and costs with buyers and suppliers
- regularly monitoring industry developments to give warning of changes needed in time to alter production
- maintaining cash reserves/access to finance to allow recapitalisation as necessary
- ensuring strict hygiene and quarantine standards.

One mark was given for listed pieces of information without explanation; two marks were given if the answer showed the student had some understanding of how to reduce the impact of the risk, but explained it poorly or incompletely; and

three marks were given for a clear accurate explanation of how the risk to the sustainability of the business would be minimised.

Following is an example of a high-scoring student response.

*For market and price drops you could minimise risk by forward selling of the sheep. This would mean you could take out a forward contract to ensure you get the price you need to remain viable and sustainable.*

**Question 4e.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 38 | 36 | 19 | 8 | **1.0** |

Marks were awarded according to the following table, where the 'No. of Areas' refers to how many of the following areas were included in the answer and related to the chosen business type:

- financially viable indefinitely
- should not degrade its natural resources
- should not infringe on other people's rights
- should not impact negatively on community and heritage resources.

| No. of areas | No explanation | Limited explanation | Rational, clear explanation |
|---|---|---|---|
| 1 | 0 | 1 | 2 |
| 2 | 1 | 2 | 2 |
| 3 | 2 | 2 | 3 |
| 4 | 2 | 3 | 3 |

Following is an example of a high-scoring student response.

*Am I returning an income and profit for long term sustainability – look at accounts, receipts, cash flow.*

*Am I damaging soil, water or air quality – test all these then treat where necessary eg fertilise.*

*Am I using excessive non-renewable energy e.g. fuel. No I'm not, but I could decrease use of electricity.*

*Am I decreasing biodiversity – no, increasing with variety of trees.*

*Could the business keep going long term – financially, environmentally.*

Question 4 provided an opportunity for the students to use their small business project experience; however, most students ignored the specifics of their chosen business and answered all parts of the question in a very general manner. Answers tended to concentrate on the product/production aspects of running the business. Financial and sustainability issues were superficially covered, if at all.

Quality standards, quality control and risk management were only understood by about one quarter of the students, and most of these answers focused heavily on production aspects. Sustainability was largely related to 'profitability'. Other areas of sustainability were only considered by a small percentage of students.

**Question 5ai–ii.**

| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|---|
| % | 48 | 24 | 17 | 6 | 6 | **1.0** |

Land management practices that could have been discussed included the following.

- Product removal: When grain, pasture and animal products are removed from the paddock, the soil is left more acidic. Hay removal is particularly acidifying.
- Unbalanced nitrogen cycling: Soil acidification is often the result of nitrate leaching. Nitrogen is added to the soil:
    - by nitrogen fixed by legume-based pastures
    - as ammonium-based nitrogen fertilisers (in excess of plant requirements)
    - from the breakdown of organic matter.
- Dung and urine excretion by stock.
- Excess rainfall/water washes the nitrogen into the soil where it is converted into nitrate by the action of soil microorganisms. If the nitrate ions are not taken up by plant roots, they leach down below the root zone, contributing to acidification.

One mark was given for each part for answers that provided a listed response; two marks were given if the response contained an accurate, brief description.

**Question 5bi–ii.**

| Marks | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Average |
|---|---|---|---|---|---|---|---|---|
| % | 27 | 24 | 24 | 13 | 7 | 3 | 2 | **1.7** |

Examples of the way the sustainability of a business is reduced by soil acidification included:

- increased nitrate contamination of groundwater and reduced water quality
- reduced agricultural yields, farm income and domestic/export earnings
- reduced options for agriculture (as only acid-tolerant plants can grow well in these conditions)
- reduced vegetative cover, leading to accelerated run-off and erosion
- irreversible clay structure damage (or hard setting)
- declining pH of streams
- increased infrastructure costs
- decreased land values.

One mark was given for a listed answer with no explanation; two marks were given for answers that provided a limited link to sustainability; and three marks were given for answers that clearly explained how sustainability is reduced by acidification.

**Question 5ci–ii.**

| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|---|
| % | 36 | 20 | 21 | 16 | 7 | **1.4** |

**5ci.**

Appropriate treatments for soil acidification included:

- apply lime, hence raising the pH
- retain and sow deep-rooted perennial grasses (such as phalaris, cocksfoot) to reduce nitrate leaching
- apply maintenance dressing of lime after the first remedial rate has been applied, especially after hay cutting
- match fertiliser inputs to plant needs (to avoid excessive leaching)
- use strategic grazing practices
- use acid-tolerant species (subterranean clover, perennial ryegrass, cocksfoot and native grasses).

**5cii.**

Appropriate preventions of soil acidification included:

- monitor the pH status of paddocks (conduct soil testing)
- use forms of nitrogen fertilisers with a lower acidifying effect (ammonium sulphate, MAP and DAP have a high acidifying potential)
- feed out hay and silage on acidic paddocks
- use better grazing and irrigation management
- avoid irrigating when soil nitrate levels are highest (that is, straight after grazing)
- grow deep-rooted perennial species that take up nitrogen from greater depth.

For each part, one mark was given to answers that simply listed a method; two marks were given for accurate, brief descriptions of the method.

Question 5 showed that only about one quarter of students understood soil acidification. Students generally knew that it was a problem and could be treated by applying lime and prevented with the aid of monitoring; however, they showed very little understanding of the processes leading to acidification, the full range of management strategies to treat and prevent it, or the ramifications of its occurrence.

**Question 6**

| Case study | % students responses |
|---|---|
| Field- or container-grown plants | 31 |
| Organic or non-organic crop management | 8 |
| Shed-fed or open-grazed animal production | 31 |
| Free-range or shed production | 16 |
| Pasture management alternatives | 12 |
| No selection | 2 |

**Question 6a.**

| Marks | 0 | 1 | 2 | 3 | 4 | 5 | Average |
|---|---|---|---|---|---|---|---|
| % | 9 | 19 | 27 | 26 | 13 | 7 | **2.4** |

One mark (up to five) was given for each different item stated.

Answers to this question showed that students were able to competently compare management options, although many did not thoroughly consider the issues involved.

See below for appropriate answers for each case study.

**Question 6b.**

| Marks | 0 | 1 | Average |
|---|---|---|---|
| % | 35 | 65 | **0.7** |

Reuse the water (collect the water going into the drain and recycle it in some manner).

**Question 6ci.**

| Marks | 0 | 1 | Average |
|---|---|---|---|
| % | 39 | 61 | **0.6** |

Mud (Colloidal clay) is being washed from the slope into the dam.

**Question 6cii.**

| Marks | 0 | 1 | Average |
|---|---|---|---|
| % | 90 | 10 | **0.1** |

Use alum to settle the colloids. This ideally should be done in a separate tank. The pH may need adjusting to between 6.8 and 7.5 to increase the alum's effectiveness. Lime may also be effective.

One mark was awarded for providing a valid method of settling the colloids.

**Question 6ciii.**

| Marks | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Average |
|---|---|---|---|---|---|---|---|---|
| % | 23 | 18 | 20 | 15 | 12 | 8 | 4 | **2.2** |

One mark was given for each listed solution; two marks were given for a limited explanation of a practice to prevent the problem; and three marks were given for a fully explained practice to prevent the problem.

Question 6c. related to water quality and management. Few students knew how to treat the water problem; however, many were able to apply soil management/erosion knowledge to suggest adequate prevention methods.

See below for appropriate answers for each case study.

**Question 6di.**

| Marks | 0 | 1 | 2 | Average |
|---|---|---|---|---|
| % | 42 | 36 | 22 | **0.8** |

One mark (up to two) was given for each different item raised. The indicators had to be relevant to the particular enterprise being monitored.

See below for appropriate answers for each case study.

**Question 6dii.**

| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|---|
| % | 62 | 14 | 17 | 4 | 3 | **0.8** |

For each of the two indicators, one mark was given for a partial description or where some doubt existed about the student's understanding of the indicator; two marks were given for a brief but accurate description.

In question 6d. many students listed indicators that were unrelated to the case study they had chosen. Only one quarter of the students correctly stated what the indicators measure. Often there was no distinction between what is measured and the interpretation/implication of the measurement.

See below for appropriate answers for each case study.

**Question 6ei.**

| Marks | 0 | 1 | Average |
|---|---|---|---|
| % | 72 | 28 | **0.3** |

One mark was given for naming an appropriate regulation (Act) for the case study.

See below for appropriate answers for each case study.

**Question 6eii.**

| Marks | 0 | 1 | 2 | 3 | Average |
|---|---|---|---|---|---|
| % | 66 | 21 | 9 | 4 | **0.5** |

One mark was given for answers that showed limited understanding of the regulation; two marks were given if the student showed a reasonable understanding of the regulation's significance; and three marks were given if the answer showed an awareness of the broad effect the regulation has on the business.

Question 6e. tested students' knowledge of government regulations (Acts) relevant to their selected case study. Approximately one third of students were able to name an appropriate regulation and offer some description of its relevance to the business being discussed.

See below for appropriate answers for each case study.

**Case study 1 – Field- or container-grown plants**
**6a.**
Advantages and disadvantages include:

- the controlled root environment in containers allows for optimum growth rates
- better nutrient and soil born pest/disease control in containers
- containers use space more efficiently and can be moved about easily
- containers have marketing advantages
- containers may cost more
- containers use more water, irrigation control is more difficult
- need to pot up plants as they grow
- wind blows containers over
- containers can be soil free to negate quarantine restrictions on soil movement between states
- field crop is more robust to extremes of weather
- harvesting field crops is difficult and dirty.

**6b.**
See above, or

- change from gravel to a hard surface so all runoff could be collected.

**6ci.**
see above

**6cii.**
see above

**6ciii.**
Management practices include:

- maintain better control over sprinklers to reduce runoff and splash damage; use lower pressure/finer sprays; change from sprinkler irrigation to something that does not cause splash erosion. The practice needed to be suitable for the crop/land use being considered
- plant better grass; filter the area around the dam to slow down the water flow and filter it; align rows across the slope to slow down water flow after rain
- do not allow stock to drink from dam or graze at its edges; fence the dam off and provide stock troughs away from the dam
- divert runoff to settling tanks/ponds before reaching dam
- reduce the amount of bare ground in the paddock/crop.

**6di–ii.**
Environmental indicators and what they measure include:

- pH of soil – how alkaline or acidic the soil is, which influences the availability of soluble nutrients
- levels of soil organic matter – the nature and amount of organic matter
- soil fertility – nutrients in the soil that are able to be absorbed by plants
- soil salinity – the concentration of salts in the soil
- water holding capacity: how much water the soil can hold, which influences irrigation frequency
- air filled porosity: the drainage capability of the soil, which affects the rate of irrigation and the soil's ability to handle higher rainfall before surface runoff occurs
- pH of water supply – how acidic/alkaline the water is, which affects the nutrient uptake of plants
- nutrients in water supply – the amount of nutrients/salts leached/washed from the soil. Fertility or toxicity depends upon this concentration
- pest/disease/weed seed in water supply.

**6ei–ii.**
Acts and their effects include:

- *Catchment and Land Protection Act 1994* – sets out the responsibilities of private and public land managers, stating that they must take all reasonable steps to avoid causing or contributing to land degradation which causes or may cause damage to land of another owner. The Act aims to conserve soil, protect water resources, eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds and prevent the spread of and (as far as possible) eradicate established pest animals
- *Wildlife Act 1975* – states that people cannot shoot or poison birds or other native animals that may damage their crops. Managers need to use other methods, such as netting, scarers, etc.

**Case study 2 – Organic or non-organic crop management**
**6a.**
Advantages and disadvantages include:

- there would be no costs for pesticides, herbicides, fertilisers, etc.
- organic crops are worth more per unit, but there is likely to be lower yields, or damage/wastage due to pests/disease
- enhanced environmental sustainability, natural predators fostered and healthy soil conditions encouraged.
- organic is likely to be more labour intensive
- a different and less-well-researched body of knowledge is required to succeed at organics
- investment of time/loss of production while converting to organic
- organic has more control over costs of inputs/there is less influence from outside organisations
- organic requires meeting strict codes of practice to obtain and maintain status.

**6b.**
see above

**6ci.**
see above

**6cii.**
see above

**6ciii.**
Management practices include:

- maintain better control over sprinklers to reduce runoff and splash damage; use lower pressure/finer sprays; change from sprinkler irrigation to something that does not cause splash erosion. The practice needed to be suitable for the crop/land use being considered
- plant better grass; filter the area around the dam to slow down the water flow and filter it; align rows across the slope to slow down water flow after rain
- do not allow stock to drink from dam or graze at its edges; fence the dam off and provide stock troughs away from the dam
- divert runoff to settling tanks/ponds before reaching dam
- reduce the amount of bare ground in the paddock/crop. Mulch between vine rows.

**6di–ii.**
Environmental indicators and what they measure include:

- pH of soil – how alkaline or acidic the soil is, which influences the availability of soluble nutrients
- levels of soil organic matter – the nature and amount of organic matter
- soil fertility – nutrients in the soil that are able to be absorbed by plants
- soil salinity – the concentration of salts in the soil
- water holding capacity: how much water the soil can hold, which influences irrigation frequency
- air filled porosity: drainage capability of the soil, which affects the rate of irrigation and the soil's ability to handle higher rainfall before surface runoff occurs
- pH of water supply – how acidic/alkaline the water is, which affects the nutrient uptake of plants
- nutrients in water supply – the amount of nutrients/salts leached/washed from the soil. Fertility or toxicity depends upon this concentration
- pest/disease/weed seed in water supply.

**6ei–ii.**
Acts and their effects include:

- *Catchment and Land Protection Act 1994* – sets out the responsibilities of private and public land managers, stating that they must take all reasonable steps to avoid causing or contributing to land degradation which causes or may cause damage to land of another owner. The Act aims to conserve soil, protect water resources, eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds and prevent the spread of and (as far as possible) eradicate established pest animals

**Case study 3 – Shed-fed or open-grazed animal production**
**6a.**
Advantages and disadvantages included:

- paddock feeding is easier to manage
- partial shedding involves moving the cattle around more
- shedding has increased cleaning and waste management implications
- shedding allows waste to be collected and evenly distributed to fertilise paddocks (after treatment)
- paddock feeding will result in higher fertilisation and irrigation costs
- there is an increased soil acidification risk with paddock grazing
- there is increased soil compaction with paddock grazing
- shedding reduces damage to pastures
- shedding allows for better control of feeding of the cattle – can use supplements to best advantage
- shedding allows for more cattle per hectare
- feed prices are out of the control of the manager.

**6b.**
see above

**6ci.**
see above

**6cii.**
see above

**6ciii.**
Management practices included:

- maintain better control over sprinklers to reduce runoff and splash damage; use lower pressure/finer sprays; change from sprinkler irrigation to something that does not cause splash erosion. The practice needed to be suitable for the crop/land use being considered
- plant better grass; filter the area around the dam to slow down the water flow and filter it; align rows across the slope to slow down water flow after rain
- do not allow stock to drink from dam or graze at its edges; fence the dam off and provide stock troughs away from the dam
- divert runoff to settling tanks/ponds before reaching dam
- reduce the amount of bare ground in the paddock/crop – grazing pressure management.

**6di–ii.**
Environmental indicators and what they measure included:

- pH of soil – how alkaline or acidic the soil is, which influences the availability of soluble nutrients
- levels of soil organic matter – the nature and amount of organic matter
- soil fertility – nutrients in the soil that are able to be absorbed by plants
- soil salinity – the concentration of salts in the soil
- water holding capacity: how much water the soil can hold, which influences irrigation frequency
- air filled porosity: the drainage capability of the soil, which affects the rate of irrigation and the soil's ability to handle higher rainfall before surface runoff occurs
- pH of water supply – how acidic/alkaline the water is, which affects the nutrient uptake of plants
- nutrients in water supply – the amount of nutrients/salts leached/washed from the soil. Fertility or toxicity depends upon this concentration
- ground cover quality and quantity
- faecal content of water supply
- amount and spread of cow dung in paddock.

**6ei–ii.**
Acts and their effects include:

- *Catchment and Land Protection Act 1994* – sets out the responsibilities of private and public land managers, stating that they must take all reasonable steps to avoid causing or contributing to land degradation which causes or may cause damage to land of another owner. The Act aims to conserve soil, protect water resources, eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds and prevent the spread of and (as far as possible) eradicate established pest animals.

**Case study 4 – Free-range or shed production**
**6a.**
Advantages and disadvantages include:

- free-range hens are able to find some of their own 'natural' food, possibly improving yolk colour
- free range results in reduced cost of pellet food, but the cost of land needs to be allowed for
- free-range eggs are more difficult to collect and have a higher loss percentage
- cleaning and waste disposal are more of an issue for battery hens, although if the stocking rate is too high for free-range it would probably be worse for it
- disease and pest control are more of a problem with free range. Wild birds may introduce these
- fencing costs for free ranges – fox/dog exclusion
- sheds more expensive for battery, there is less capital but more labour involved in free range
- free-range has a market advantage
- the quality is more consistent and easily managed for battery eggs
- free range provides a better community image
- there are fewer animal welfare issues for free range.

**6b.**
see above

**6ci.**
see above

**6cii.**
see above

**6ciii.**
Management practices include:

- maintain better control over sprinklers to reduce runoff and splash damage; use lower pressure/finer sprays; change from sprinkler irrigation to something that does not cause splash erosion. The practice needed to be suitable for the crop/land use being considered
- plant better grass; filter the area around the dam to slow down the water flow and filter it; align rows across the slope to slow down water flow after rain
- do not allow stock to drink from dam or graze at its edges; fence the dam off and provide stock troughs away from the dam
- divert runoff to settling tanks/ponds before reaching dam
- reduce the amount of bare ground in the paddock/crop.

**6di–ii.**
Environmental indicators and what they measure include:

- pH of soil – how alkaline or acidic the soil is, which influences the availability of soluble nutrients
- levels of soil organic matter – the nature and amount of organic matter
- soil fertility – nutrients in the soil that are able to be absorbed by plants
- soil salinity – the concentration of salts in the soil
- water holding capacity: how much water the soil can hold, which influences irrigation frequency
- air filled porosity: the drainage capability of the soil, which affects the rate of irrigation and the soil's ability to handle higher rainfall before surface runoff occurs
- pH of water supply – how acidic/alkaline the water is, which affects the nutrient uptake of plants
- nutrients in water supply – the amount of nutrients/salts leached/washed from the soil. Fertility or toxicity depends upon this concentration
- faecal content of water
- signs of predators
- ground cover quality and quantity
- pest/disease/weed species in water.

**6ei–ii.**
Acts and their effects include:

- *Catchment and Land Protection Act 1994* – sets out the responsibilities of private and public land managers, stating that they must take all reasonable steps to avoid causing or contributing to land degradation which causes or may cause damage to land of another owner. The Act aims to conserve soil, protect water resources, eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds and prevent the spread of and (as far as possible) eradicate established pest animals
- *Prevention of Cruelty to Animals Act 1986* – states that animals must be cared for and managed according to published ethical standards (note, the Prevention of Cruelty to Animals (Domestic Fowl) Regulations 2006 also apply)
- *Environmental Protection Act 1970* – owners must maintain and control noise and smell from businesses so that neighbours are not affected.

**Case study 5 – Pasture management alternatives**
**6a.**
Advantages and disadvantages include:

- using fertiliser/herbicide gives a quick response and more control over the balance of pasture
- fertiliser/herbicide needs to be applied regularly, and, combined with horse urine, will lead to acidity problems
- sheep/cattle require more management skills, equipment and time
- fencing/yards for sheep and cattle may be required
- sheep and cattle give more income, but require a capital outlay
- there would be less acidity with a sheep/cattle combination.

**6b.**
see above

**6ci.**
see above

**6cii.**
see above

**6ciii.**
Management practices include:

- maintain better control over sprinklers to reduce runoff and splash damage; use lower pressure/finer sprays; change from sprinkler irrigation to something that does not cause splash erosion. The practice needed to be suitable for the crop/land use being considered
- plant better grass; filter the area around the dam to slow down the water flow and filter it; align rows across the slope to slow down water flow after rain
- do not allow stock to drink from dam or graze at its edges; fence the dam off and provide stock troughs away from the dam
- divert runoff to settling tanks/ponds before reaching dam
- reduce the amount of bare ground in the paddock/crop.

**6di–ii.**
Environmental indicators and what they measure include:

- pH of soil – how alkaline or acidic the soil is, which influences the availability of soluble nutrients
- levels of soil organic matter – the nature and amount of organic matter
- soil fertility – nutrients in the soil that are able to be absorbed by plants
- soil salinity – the concentration of salts in the soil
- water holding capacity: how much water the soil can hold, which influences irrigation frequency
- air filled porosity: the drainage capability of the soil, which affects the rate of irrigation and the soil's ability to handle higher rainfall before surface runoff occurs
- pH of water supply – how acidic/alkaline the water is, which affects the nutrient uptake of plants
- nutrients in water supply – the amount of nutrients/salts leached/washed from the soil. Fertility or toxicity depends upon this concentration
- faecal content of water
- faeces quantity and spread in paddock
- ground cover quality and quantity.

**6ei–ii.**
Acts and their effects included:

- *Catchment and Land Protection Act 1994* – sets out the responsibilities of private and public land managers, stating that they must take all reasonable steps to avoid causing or contributing to land degradation which causes or may cause damage to land of another owner. The Act aims to conserve soil, protect water resources, eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds and prevent the spread of and (as far as possible) eradicate established pest animals.