



## **2005 Agricultural and Horticultural Studies GA 3: Written examination**

### **GENERAL COMMENTS**

#### **Areas of strength and weakness**

Students performed well on the 2005 Agricultural and Horticultural Studies examination and demonstrated a general understanding of soil, plant, and whole-enterprise management practices.

The understanding of environmental degradation types and rectification techniques was adequate, although students did not use all the information presented to develop their answers fully. When asked to suggest causes and solutions to specific cases of environmental degradation, students often gave generalised answers rather than addressing the specifics of each case that was presented. In preparing for the examination, students must acquire the skills needed to collect and interpret environmental indicators that can be used to guide management techniques to achieve or maintain sustainability. Students should know what areas enterprise managers need to monitor in order to maintain financial, biophysical and social sustainability.

Students' ability to analyse agricultural and horticultural management problems in detail, using basic sustainability concepts, was generally limited to environmental aspects. Social and financial aspects of sustainability were only addressed in a general way. More specific detail is required when responding to questions in these areas.

Students showed a general knowledge of a range of common pests and diseases; however, few students were able to provide detailed treatment or control strategies.

Many students were able to describe the production practices, machinery and equipment of a commercial agricultural/horticultural business; however, their answers indicated that a large proportion of students were limited to their school-based enterprise experience. Students must be able to relate their schoolwork to commercial activities.

In Question 6, approximately 40 per cent of students used examples that were not recent technology, indicating that there is some confusion about what constitutes 'recent'. Students must be familiar with innovative, recent technology rather than technology that has been around for over 30 years.

#### **Choice of options to answer**

Students had to select an option from the provided lists of alternatives in Questions 2 and 5. This selection process was handled well. In both questions, a diverse range of options was chosen. In Question 6 students nominated a recent technology to discuss in their answer.

#### **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. Teachers should note that a new Study Design and examination criteria apply to the subject from 2006. Sample examination questions are available on the VCAA website ([www.vcaa.vic.edu.au](http://www.vcaa.vic.edu.au)). 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 examiners. 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**

Some questions addressed more than one of the examination criteria. The allocation of marks was determined by comparing students' answers with the marking scheme.

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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. This report should be read in conjunction with the 2005 examination, which can be found on the VCAA website.

## Question 1a.

Marks	0	1	2	3	Average
%	4	7	25	64	2.5

One mark (up to a total of three) was given for each of the following environmental factors:

- temperature
- humidity
- air flow
- sunlight
- daylight hours
- water application
- pest/disease numbers
- light intensity
- air constituents.

## Question 1b.

Marks	0	1	2	3	Average
%	11	17	34	38	2.0

One mark (up to a total of three) was given for each of the following characteristics:

- nutrient level
- pH
- drainage/aeration
- water holding capacity
- bulk density
- infiltration rate
- pest/disease numbers
- organic matter
- soil structure.

## Question 1ci.

Marks	0	1	2	Average
%	25	38	37	1.1

One mark (up to a total of two) was given for each of the following benefits:

- increases water holding capacity
- improves soil structure
- improves nutrient retention
- provides some nutrients when breaking down
- increases positive soil organisms.

## Question 1cii.

Marks	0	1	2	Average
%	38	44	18	0.8

One mark (up to a total of two) was given for each of the following problems:

- introduces weeds/seeds
- introduces pathogens/toxins
- holds too much water/water logging
- nitrogen drawdown.

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## Question 1d.

Marks	0	1	2	Average
%	32	42	26	1.0

One mark (up to a total of two) was given for each of the following ways shelterbelts change the nearby microclimate:

- reduce wind speed
- provide some shade
- cause fewer sunlight hours
- increase soil moisture level
- reduce evapotranspiration.

Question 1 tested students' knowledge of the relationship between plant growth and the environment. The questions only required students to list their answers, rather than describe or explain, so should have been easily answered. Many students still could not fully answer most of the questions.

## Question 2

Pest/disease	No. student responses	Pest/disease	No. student responses
mastitis	92	powdery mildew	46
liver fluke	31	cabbage moth	41
footrot	28	Marek's disease	2
rusts	22	ringworm	11
black spot	29	mosaic virus	0
botflies	24	aphids	49

## Question 2a.

Marks	0	1	2	3	Average
%	7	30	44	19	1.8

Three marks were given for providing complete information about how a manager would recognise that this pest or disease is present; two marks for an explanation that showed the student could reliably recognise the pest/disease; and one mark for providing some information, but not enough to recognise the pest or disease.

Pest/disease	Recognition
mastitis	<ul style="list-style-type: none"> <li>• an infection of the mammary (udder) tissue caused by a range of bacteria (over 1000 organisms)</li> <li>• inflammation of the mammary gland caused by microorganisms</li> <li>• reduced milk yield and altered milk composition</li> <li>• pus in milk samples</li> </ul>
liver fluke	<ul style="list-style-type: none"> <li>• sheep or cattle may:               <ul style="list-style-type: none"> <li>• lose condition</li> <li>• develop a soft fluid swelling under the jaw ('bottle jaw')</li> <li>• become weak and die</li> </ul> </li> <li>• closer examination will reveal pale eye linings and gums, caused by the loss of blood</li> </ul>
footrot	<ul style="list-style-type: none"> <li>• signs vary from mild reddening (inflammation) of the interdigital skin (skin between the digits or toes) to complete separation of the horn of the hoof</li> <li>• infection commences when bacteria lodge on the interdigital skin causing inflammation; the skin-horn junction then begins to erode and the horn starts to lift</li> <li>• sheep become progressively more lame and exhibit the following signs in order:               <ul style="list-style-type: none"> <li>• inflamed, red and moist skin between the digits</li> <li>• grey pasty scum between the digits</li> <li>• lifting of skin-horn junction between digits</li> <li>• under-running or separation of horn around heel, sole, toe and finally to the outside hoof wall</li> <li>• loss of body weight and growth and wool production</li> </ul> </li> <li>• infected feet may also have a characteristic foul smell</li> <li>• a scoring system, the Modified Egerton Scoring System, has been developed to describe footrot at its various stages</li> </ul>



rusts	<ul style="list-style-type: none"> <li>• small yellow or orange patches or spots which appear mainly on the upper surfaces of leaves</li> <li>• later, oval orange–brown pustules 0.5 to 1.0 mm occur on both leaf surfaces</li> <li>• on the underside, powdery, raised pustules appear under each spot</li> <li>• disease can cause leaf fall and seriously weaken plants</li> </ul>
black spot	<ul style="list-style-type: none"> <li>• lower leaves of susceptible plants become covered with brownish–black spots; eventually they yellow and drop off</li> <li>• diagnosed when small, circular, black spots with feathery margins develop on upper leaflet surfaces</li> <li>• spots are 2 to 12 mm in diameter</li> <li>• leaf tissue surrounding the spots turns yellow and this chlorosis spreads until the leaflet drops from the plant</li> <li>• a severe infestation can completely defoliate a plant over a period of weeks</li> </ul>
botflies	<ul style="list-style-type: none"> <li>• appearance of small yellowish dots on horse’s coat</li> <li>• licking and biting by the horse</li> <li>• symptoms include irritation of stomach membranes, ulceration of stomach, peritonitis, perforated ulcers, colic, mechanical blockage of stomach resulting in stomach rupture, oesophageal paralysis and squamal cell tumours</li> </ul>
powdery mildew	<ul style="list-style-type: none"> <li>• dormant shoots, which are heavily infected from the previous growing season, are covered with dense white mycelium, and the terminal bud is pinched and shrivelled</li> <li>• other shoots may look normal but the fungal mycelium may over-winter in otherwise healthy-looking fruit or leaf buds</li> <li>• leaves become narrow, brittle, curled and covered with a white powdery layer, while flowers may be stunted and fail to develop</li> <li>• secondary mildew may appear as a powdery mottling on either side of the leaves</li> <li>• early fruit infection causes a web-like russet on the skin that may be difficult to distinguish from early spray damage</li> <li>• less commonly, fruit may be distorted and partly covered with a white powdery coating</li> </ul>
cabbage moth	<ul style="list-style-type: none"> <li>• tunnels into the interior of cabbages, onions, lettuces, peas, etc.</li> <li>• evidence of the moth in the area</li> </ul>
Marek’s disease	<ul style="list-style-type: none"> <li>• the virus that causes Marek’s disease attacks the white blood cells of the bird and results in cancer. These cancers most commonly affect the nerves and cause paralysis</li> <li>• the legs are usually affected, but the tumours may also affect the nerves in the wings and neck</li> <li>• birds may also develop tumours in the body</li> <li>• a number of signs may be apparent as these tumours grow, including weight loss, diarrhoea, ill thrift, and difficulty breathing</li> </ul>
ringworm	<ul style="list-style-type: none"> <li>• ringed appearance of the infection</li> <li>• scalp ringworm usually appears 10 to 14 days after contact, and ringworm of the skin four to 10 days after contact</li> <li>• the time between exposure and symptoms is not known for the other types</li> </ul>
mosaic virus	<ul style="list-style-type: none"> <li>• mosaic pattern on the leaves</li> <li>• leaves are stunted</li> <li>• exaggerated rosette growth habit, with varying degrees of leaf distortion</li> <li>• suspect samples should be submitted to an accredited diagnostic laboratory for an accurate diagnosis</li> </ul>
aphids	<ul style="list-style-type: none"> <li>• appearance of aphids, which live in exposed situations on leaves, shoots, or buds</li> <li>• some species live hidden in unfolded leaves, at the base of the stem, or on roots and eat parts of the plant</li> <li>• 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</li> </ul>

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## Question 2b.

Marks	0	1	2	3	4	5	6	Average
%	10	15	21	22	20	10	2	2.7

Students were required to select three of the five options given. For each option, one mark was given for an incomplete description or only one listed item and two marks for a reasonably complete description, or two listed items.

Students' knowledge of pest and disease management was adequate, but could be improved by covering a broader range of aspects of control and prevention. Most pests and diseases have a variety of factors that need to be considered for their prevention and/or control. Teachers should consider structuring activities on pest and disease management within the headings presented in this question.

<b>Mastitis</b>	
Monitoring	<ul style="list-style-type: none"> <li>the somatic cell count (SCC) and white blood cell count of the milk will be elevated.</li> <li>bacteriological culturing of milk will detect bacteria in the milk</li> <li>an increase in blood components present in milk and a decrease in normal milk constituents</li> <li>monitor milk yield</li> </ul>
Hygiene practices	<ul style="list-style-type: none"> <li>sources of environmental pathogens include manure, bedding, feedstuffs, dust, dirt, mud and water</li> <li>housed cows are at greater risk of environmental mastitis than cows on pasture</li> <li>ensure bedding material is clean</li> <li>warmer temperatures require greater hygiene</li> <li>ensure that animals are not overcrowded</li> <li>ensure all equipment used is kept clean</li> </ul>
Environmental management	<p>Environmental conditions that can increase exposure include:</p> <ul style="list-style-type: none"> <li>overcrowding</li> <li>poor ventilation</li> <li>inadequate manure removal from the back of stalls, alleyways, feeding areas and exercise lots</li> <li>poorly maintained (hollowed out) free stalls</li> <li>access to farm ponds or muddy exercise lots</li> <li>dirty maternity stalls or calving areas</li> <li>general lack of farm cleanliness and sanitation.</li> </ul>
Timing	<ul style="list-style-type: none"> <li>more prevalent in warmer conditions</li> <li>ensure milking machines management occurs periodically – weekly, monthly, annually</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>control of environmental mastitis is achieved by decreasing teat end exposure to potential pathogens or increasing the cow's resistance to mastitis pathogens</li> <li>immunisation at the time may help</li> <li>antibiotics will help to control some</li> </ul>
Other	<ul style="list-style-type: none"> <li>genetically engineered cows with lower levels of mastitis</li> </ul>
<b>Liver Fluke</b>	
Monitoring	<ul style="list-style-type: none"> <li>use laboratory tests such as 'Fluketest', which detect fluke eggs in faecal samples</li> <li>monitor health of animals in susceptible conditions</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>snails prefer low-lying, wet, marshy areas; draining these areas reduces snail habitats and snail numbers</li> <li>irrigation areas often provide snails with ideal habitats, so: <ul style="list-style-type: none"> <li>keep drainage channels clear so water flows freely, discouraging the growth of vegetation to which fluke cysts can attach</li> <li>promptly repair seepages from drainage channels, which can provide ideal areas for snails</li> </ul> </li> <li>all stock in fluke areas should be vaccinated against black disease</li> <li>measures to reduce snail numbers and manage fluke-prone paddocks more effectively may reduce the number of drenches required, and reduce selection for resistance</li> <li>chemical control is not likely to be successful at eradicating snails because they reproduce quickly and can repopulate treated areas (and there are no chemicals registered in Australia for control of liver fluke snails)</li> </ul>



Timing	<ul style="list-style-type: none"> <li>• strategic use of drenches which kill different stages of the liver fluke, combined, where possible, with snail control</li> <li>• the structure of a drenching program will depend on the degree of infestation, rainfall pattern and the drench used</li> <li>• drench sheep in February and July and cattle in April/May and July</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>• vaccination against some species is possible</li> <li>• drenching</li> <li>• several drugs that remove flukes from animals are available</li> </ul>
Other	<ul style="list-style-type: none"> <li>• resistance is of serious concern as flukes can spread between properties and regions through the movement of infected snails or infected stock</li> <li>• future vaccines are being developed</li> </ul>
<b>Footrot</b>	
Monitoring	<ul style="list-style-type: none"> <li>• moist conditions are ideal for multiplication; will therefore spread most rapidly when it is warm and moist, as in spring and some autumns</li> <li>• the bacteria can only survive away from the foot for a maximum of seven days, even in ideal conditions; in less favourable dry conditions, the bacteria die rapidly</li> <li>• spread is primarily from foot to foot via pasture or mud</li> <li>• goats, cattle and possibly vehicles can act as carriers; however, moist pastures, laneways and muddy yards are the main areas where footrot is spread</li> <li>• during dry periods, the disease naturally regresses in a flock. Lameness will decrease accordingly, but infection will survive in many feet</li> <li>• spread is absent during dry times, therefore interdigital signs are minimal</li> </ul>
Hygiene practices	<ul style="list-style-type: none"> <li>• prevent through thorough examination, footbathing and movement control</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>• moist conditions are ideal for multiplication; in less favourable dry conditions, the bacteria die rapidly</li> <li>• in most cases, footrot is a preventable disease</li> <li>• virtually always carried into a property and flock by means of a carrier sheep or goat</li> <li>• to eradicate footrot from a property all the <i>D. nodosus</i> bacteria must be killed or the infected sheep removed. As the bacteria cannot be seen, must look for the signs of their presence, cull those sheep with signs and use chemicals and time to kill any bacteria on the remaining sheep and pasture</li> <li>• damage control is minimising the effect by isolating and checking all new sheep until removed, or the sheep go through spring with no sign of footrot</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>• short-term immunity can be achieved using vaccines</li> <li>• footbathing – walk through or stand in for five to 10 minutes: <ul style="list-style-type: none"> <li>• zinc sulphate 10 per cent – 1 kg to 9 litres water (safer and gentler on the sheep than formalin)</li> <li>• formalin (formaldehyde five per cent) – one part to 19 parts water</li> </ul> </li> <li>• ‘Radicat’ – 10 litre container mixed with 100 litres of water provides two weeks’ protection. Specific treatment instructions include: paring; followed by a 15 minute footbath (within four hours of paring); followed by 15 minutes on slats, grating or a dry concrete; and then one hour on a clean dry area</li> <li>• vaccine – 1 ml dose, two doses, minimum six weeks apart; booster every 10 to 12 weeks while spread conditions persist (protects clean sheep rather than curing those infected)</li> <li>• several antibiotic injections, as prescribed by a veterinarian (provides a good cure but is not ongoing protection against reinfection)</li> </ul>
<b>Rusts</b>	
Monitoring	<ul style="list-style-type: none"> <li>• monitor water levels: free water on the leaf surface for several hours enhances development of rusts and many other diseases</li> <li>• rainy weather, or overhead watering that wets leaves and doesn’t have enough time to dry, produce optimum conditions for rusts to spread</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>• fertilise to keep grass growing at a steady rate, about an inch a week, during summer or early autumn droughts; the growth of grass blades pushes the rust-infected leaves outward, where they can be mowed off and removed</li> <li>• do not over-fertilise, especially with a readily available high-nitrogen source</li> </ul>

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	<ul style="list-style-type: none"> <li>• keep the phosphorus and potassium levels high</li> <li>• increase light penetration, air movement, and rapid drying of the grass surface by pruning or selectively removing dense trees and shrubs bordering the turf</li> <li>• space landscape plants properly to allow adequate air movement and to avoid excessive shade</li> </ul>
Timing	<ul style="list-style-type: none"> <li>• apply a fungicide soon after mowing and removal of the clipping</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>• orange rust, once considered a minor disease problem to the Australian sugar industry, devastated the crop in 2000, causing over AUD\$150 million in losses. The industry will be forced to rely on controlling the disease with fungicides until there is insufficient resistant planting material</li> <li>• follow suggested weed-control programs for the area and for the grasses grown</li> <li>• use the lower fungicide rates in a routine preventive program</li> <li>• use the higher rates for a curative program, after the appearance of numerous infections (light yellow flecks)</li> </ul>
Other	<ul style="list-style-type: none"> <li>• a preventative measure is to grow rust-resistant varieties of plants whenever possible</li> </ul>
<b>Black Spot</b>	
Monitoring	<ul style="list-style-type: none"> <li>• black spot spreads quickly in wet or humid, warm weather.</li> <li>• expanding leaves between six and 14 days of age are most susceptible to infection</li> <li>• optimal temperature for disease development is 24° C; check when these temperatures occur</li> <li>• rainy weather, or overhead watering that wets leaves and doesn't have enough time to dry, produce optimum conditions for the spread of the disease</li> <li>• for black spot to develop, an environmental temperature of 18 to 26 degrees centigrade needs to be maintained for at least seven hours</li> </ul>
Hygiene practices	<ul style="list-style-type: none"> <li>• sanitation is the first step: remove infected leaves and destroy</li> <li>• pick off all leaves at the end of the season to reduce the disease</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>• emerges on leaves that are stressed</li> <li>• avoid overhead watering</li> <li>• can be reduced by proper pruning to provide good air circulation</li> <li>• avoid wetting foliage</li> </ul>
Timing	<ul style="list-style-type: none"> <li>• expanding leaves between six and 14 days of age are most susceptible to infection</li> <li>• optimal temperature for disease development is 24° C; check when these temperatures occur</li> <li>• spray at approximately fortnightly intervals so that roses retain their healthy, glossy foliage</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>• protective fungicidal sprays and resistant cultivars are the best means of control</li> <li>• after organic practices have been used, chemical intervention is needed to keep the disease in check: spray a fungicide at the first sign of the disease</li> <li>• most effective control is achieved by rotating two or three chemicals</li> </ul>
Other	<ul style="list-style-type: none"> <li>• plant resistant cultivars is the best means of control</li> </ul>
<b>Botflies</b>	
Monitoring	<ul style="list-style-type: none"> <li>• significant control can be accomplished during the fly season by clipping hair to remove the eggs</li> </ul>
Hygiene practices	<ul style="list-style-type: none"> <li>• while washing, care should be taken to protect hands from insecticide and larvae with synthetic rubber gloves</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>• effective control of horse bots requires breaking the life cycle of the fly</li> </ul>
Timing	<ul style="list-style-type: none"> <li>• summer and early autumn</li> <li>• approximately two weeks after the first frost has killed all of the adults, apply warm water rinses</li> <li>• can control infestation by using a bot knife to remove the bot eggs from the horse's hair on a daily basis during the fly season</li> <li>• the most effective treatments should be applied one month after first sighting of eggs to control second stage larvae</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>• effective control requires breaking the life cycle of the fly</li> <li>• treatments should be applied weekly during peak oviposition periods</li> </ul>



	<ul style="list-style-type: none"> <li>control of horse bot flies is directed at the larvae in the stomach during the winter by using oral doses of an approved boticide</li> <li>modern de-wormers containing ivermectin are efficient at killing the larvae that reach the stomach</li> </ul>
Other	<ul style="list-style-type: none"> <li>grooming may aid in the removal of eggs but the effectiveness of control is questionable</li> <li>for internal treatment of horse bots, consult a veterinarian</li> </ul>
<b>Powdery Mildew</b>	
Monitoring	<ul style="list-style-type: none"> <li>monitor during winter and the growing season to assist with decisions about mildew control</li> <li>the level of mildewed terminals in winter can be used to help plan mildew control strategies for the coming spring</li> <li>shoots with infected terminal buds can be assessed immediately after flowering, using a minimum of 10 trees per block</li> <li>assess the same trees at intervals during the growing season; if mildew levels increase over time then control measures may need to be improved</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>powdery mildew quickly emerges on leaves that are stressed</li> <li>avoid overhead watering to reduce the amount of moisture on the foliage</li> </ul>
Timing	<ul style="list-style-type: none"> <li>no adequate substitute for a series of spring and summer sprays to prevent infection of fruit and leaf buds</li> <li>frequency of spraying is more important than the dosage of fungicide, and two weeks should be the maximum period between sprays for effective control in orchards where mildew has been a problem</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>no adequate substitute for a series of spring and summer sprays to prevent infection of fruit and leaf buds</li> <li>infection of fruit buds occurs before petal fall, and infection of terminal buds can occur until lateral extension is complete. Thus, frequent spraying from pink bud until the end of lateral extension is needed to protect fruit, leaf and terminal buds. The frequency of spraying is more important than the dosage of fungicide, and two weeks should be the maximum period between sprays for effective control in orchards where mildew has been a problem</li> <li>high volume sprays are recommended for mildew control, although recent work has shown that low-volume sprays can be equally effective</li> </ul>
<b>Cabbage Moth</b>	
Monitoring	<ul style="list-style-type: none"> <li>should either be ignored or hunted down manually, picked off and destroyed.</li> <li>control is most effective when caterpillars are young</li> <li>spray or dust as soon as leaf damage is evident and then every 10–14 days</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>should either be ignored, or hunted down manually, picked off and destroyed</li> </ul>
Timing	<ul style="list-style-type: none"> <li>control is most effective when caterpillars are young</li> <li>spray or dust as soon as leaf damage is evident and then every 10–14 days</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>control is most effective when caterpillars are young</li> <li>spray or dust as soon as leaf damage is evident and the every 10–14 days</li> <li>necessary to use pesticides for effective control: Chemspray Carbaryl, Garden King Carbaryl, Garden King Bug Kill, or Garden King Pyrethrum</li> </ul>
<b>Marek's Disease</b>	
Monitoring	<ul style="list-style-type: none"> <li>monitor most susceptible birds, especially between 10–24 weeks of age</li> <li>infected birds show signs of paralysis, depression, loss of appetite and weight, anaemia and dehydration</li> </ul>
Hygiene practices	<ul style="list-style-type: none"> <li>clean out and disinfect sheds and equipment between batches of chicks</li> <li>disinfectant must be effective against viruses, not just bacteria</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>exposure of sheds and runs to sunlight helps the disinfection process</li> </ul>
Timing	<ul style="list-style-type: none"> <li>a vaccine should be given to birds at one day of age</li> <li>all birds should be vaccinated, even though the vaccine is not as effective as it used to be (this is due to the virus that causes the disease mutating slightly over time)</li> <li>isolate vaccinated chicks to build immunity</li> </ul>





Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>• a vaccine should be given to birds at one day of age</li> <li>• all birds should be vaccinated, even though the vaccine is not as effective as it used to be (this is due to the virus that causes the disease mutating slightly over time)</li> </ul>
Other	<ul style="list-style-type: none"> <li>• good nutrition and freedom from other diseases and parasites helps ensure resistance to the disease</li> <li>• select genetically resistant strains of birds</li> </ul>
<b>Ringworm</b>	
Monitoring	<ul style="list-style-type: none"> <li>• watch new animals; often it is a new animal which introduces the condition to an establishment</li> </ul>
Hygiene practices	<ul style="list-style-type: none"> <li>• prevention can be achieved by careful handling of any animals with skin lesions, and good personal hygiene</li> <li>• disinfect area often</li> <li>• wash hands after handling animals</li> <li>• vigorously vacuum and steam clean carpets to remove spores (vacuum cleaner bags should be discarded)</li> <li>• very few products are effective at decontaminating the environment; however, bleach diluted 1:10 will kill 80 per cent of fungal spores with one application, so apply to any bleachable surface</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>• transmitted from animal to animal by direct contact between animals, tack, grooming equipment, clothing, contact with infested stables or trailers</li> <li>• the fungi are quite resistant to environmental factors and can remain on fence railings and timber structures for long periods</li> <li>• the fungi can remain on the skin for up to three weeks before clinical signs develop, so the disease can be spread before there are signs of infection</li> <li>• infected people may spread ringworm to their animals</li> <li>• burn any hair removed as this will be contaminated with fungus</li> <li>• destroy all bedding, blankets, brushes, combs, scratching poles and anything else that isn't essential</li> </ul>
Timing	<ul style="list-style-type: none"> <li>• take monthly cultures of the environment</li> <li>• oral antifungal tablets may be needed (such medications are prescription products and are available from veterinarian. These tablets may need to be used for three to four months to get rid of the infection)</li> <li>• important to disinfect the environment the animal lives in: the fungal spores will live on hair in the environment for over a year so sanitising the environment is vital or a recurrence is likely</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>• very few products are effective at decontaminating the environment; however, bleach diluted 1:10 will kill 80 per cent of fungal spores with one application, so apply to any bleachable surface</li> <li>• sometimes a cream, wash or medicated shampoo may be enough but usually a combination of several therapies is needed</li> <li>• antifungal creams are readily available and may be efficient for small lesions</li> <li>• oral antifungal tablets may be needed (such medications are prescription products and are available from veterinarian)</li> </ul>
<b>Mosaic Virus</b>	
Monitoring	<ul style="list-style-type: none"> <li>• usually most serious during late autumn and spring, following flushes of winged aphid activity</li> <li>• monitor pest lifecycles and prevent pest spreading (refer to aphids)</li> <li>• monitor crops to identify hot spots and avoid planting seedlings there</li> <li>• monitor insects in the glasshouse with sticky traps to minimise risk of virus spread</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>• re-plough in old crops as soon as possible</li> <li>• do not crop continuously</li> <li>• glasshouse should be screened to be as insect-free as possible</li> </ul>
Timing	<ul style="list-style-type: none"> <li>• virus diseases cannot be cured; an integrated program to manage the virus is the best approach</li> <li>• make sure seedlings planted in the field show no symptoms of virus infection</li> <li>• make sure fresh seedlings planted out into the field are not planted next to 'older' plants</li> </ul>



	<ul style="list-style-type: none"> <li>do not calendar spray with insecticides to control aphids, sprays should only be applied as needed</li> <li>do not plant seed crops near the celery crop</li> <li>monitor crops to identify hot spots and avoid planting seedlings there</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>petroleum spray oils show great promise at inhibiting the aphid from transmitting the virus; however, when used in conjunction with other chemical sprays phytotoxicity may be a problem</li> </ul>
Other	<ul style="list-style-type: none"> <li>continuous calendar spraying can increase virus spread; however, controlling colonising aphids in the crop may reduce secondary spread when aphids are in high numbers</li> </ul>
<b>Aphids</b>	
Monitoring	<ul style="list-style-type: none"> <li>aphids are seasonal pests and may occur in large numbers for a relatively short time, usually during spring and autumn</li> <li>aphids do not like hot, dry weather but the sheltered conditions in which many ornamentals are grown may allow the aphids to survive throughout the year</li> <li>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 (check underside of leaves)</li> <li>ants can be an indicator that aphids are present</li> </ul>
Hygiene practices	<ul style="list-style-type: none"> <li>in general, 'virus-free' plants should be grown in isolation, away from potential sources of infection</li> <li>growing conditions (including weed control) should discourage aphids</li> <li>infested plants should be rogued out</li> <li>strict hygiene should be enforced</li> </ul>
Environmental management	<ul style="list-style-type: none"> <li>before planting, check surrounding weeds and other plants and remove them if infected with aphids</li> <li>prune and dispose of infected, localised leaves or shoots on plants</li> <li>avoid overuse of nitrogen fertiliser as this attracts aphid reproduction</li> </ul>
Chemical/biological prevention and control	<ul style="list-style-type: none"> <li>after detection, spray with a suitable insecticide to prevent economic damage</li> <li>take care to avoid the use of insecticides that may be phytotoxic to the crop plants</li> <li>aphids are well known for developing resistance to pesticides</li> </ul>
Other	<ul style="list-style-type: none"> <li>birds, spiders, lacewings, predatory bugs, parasitic flies and wasps, predatory beetles and some caterpillars attack aphids, but growers aiming for 'pest-free' crops usually spray pesticides that result in the crops being 'insect-free' or, at worst, devoid of beneficial insects</li> </ul>

**Question 2c.**

Marks	0	1	2	Average
%	13	16	71	1.6

One mark, (up to a total of two) was given for each of the following safety considerations when handling and/or using chemical and herbicidal products:

- read the instructions
- follow the instructions
- use appropriate body protection
- use appropriate equipment, safely maintained
- wash, clean
- use correct dosage rate
- withholding period
- note likely spray drift or water run off.

A diverse range of answers for safety considerations was presented by students.

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## Question 3ai.

Marks	0	1	Average
%	63	37	<b>0.4</b>

The most likely type of environmental degradation could be any one of:

- excess water run off
- nutrient entering local waterways
- blue green algae.

## Question 3aii.

Marks	0	1	2	3	4	Average
%	42	21	25	9	3	<b>1.1</b>

Practices which could have caused the problem could be any two of:

- overhead irrigation – incorrect sprinklers/volume of delivery
- incorrect time of day/length of watering period
- incorrect spacing of plants
- no surface run off collection points or drains for recycling and treatment
- excessive use of fertilizer and/or not collecting and reusing surplus.

One mark (up to a total of two) was given for each point listed, or two marks (up to a total of four) if the point was adequately described.

## Question 3aiii.

Marks	0	1	2	3	Average
%	43	31	20	5	<b>0.9</b>

To fix the problem, Steve should:

- develop surface collection grids for wastewater
- treat and recycle on-site
- develop alternative, more accurate irrigation/fertigation techniques
- not water in the middle of the day
- water/fertilise according to need rather than according to a regular time pattern.

One mark was given for a limited answer; two marks for a fairly full but incomplete answer and three marks for a complete answer.

## Question 3bi.

Marks	0	1	Average
%	63	37	<b>0.4</b>

The most likely type of environmental degradation could be any one of:

- soil structure decline due to soil compaction
- water logging.

## Question 3bii.

Marks	0	1	2	3	4	Average
%	46	14	23	12	4	<b>1.2</b>

Practices which could have caused the problem could include any two of:

- excessive cultivation
- stock trampling, especially when soil overly wet
- vehicle traffic, especially when soil overly wet.

One mark (up to a total of two) was given for each point listed, or two marks (up to a total of four) if the point was adequately described.

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## Question 3biii.

Marks	0	1	2	3	Average
%	47	27	20	7	<b>0.9</b>

To fix the problem, Chris should:

- use minimum tillage practices
- carefully select rotations
- reduce traffic, especially when soil wet
- increase organic cycling/biological activity by maintaining dense ground cover and not overgrazing.
- deep rip seriously compacted areas.

One mark was given for a limited answer; two marks for a fairly full but incomplete answer and three marks for a complete answer.

## Question 3ci.

Marks	0	1	Average
%	34	66	<b>0.7</b>

The most likely type of environmental degradation could be any one of:

- rural dieback
- salinity.

Salinity was acceptable but not the best answer, as the information provided leant towards dieback by mentioning that the dying trees were in the lowest paddock.

## Question 3cii.

Marks	0	1	2	3	4	Average
%	43	22	17	13	5	<b>1.2</b>

The best answers acknowledged that dieback, or the death of trees, is a complex issue and discussed some of the possible causes. The primary cause of rural dieback is believed to be landscape clearance, and consequent ecosystem dysfunction. Rural dieback can have many causes (most arising from indiscriminate landscape clearance), including:

- water logging
- cinnamon fungus
- excessive insect attacks – beetles (especially Christmas Beetles), psyllids and phasmids are often involved
- nutrient enrichment – stock grazing and defecating near the trees as they seek shelter
- grazing of bark
- drought
- soil acidification
- airborne salt
- salinisation
- mistletoe
- loss of natural predators
- soil compaction.

One mark (up to a total of two) was given for each point listed, or two marks (up to a total of four) if the point was adequately described.

## Question 3ciii.

Marks	0	1	2	3	Average
%	38	27	25	10	<b>1.1</b>

To fix the problem, Kylie should:

- monitor the problem, which is vital to establishing the cause
- stop/reverse landscape clearance
- monitor and address the relevant issues listed above in 3cii.

One mark was given for a limited answer; two marks for a fairly full but incomplete answer and three marks for a complete answer.

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## Question 3di.

Marks	0	1	Average
%	37	63	0.6

The most likely type of environmental degradation is wind erosion – loss of topsoil.

## Question 3dii.

Marks	0	1	2	3	4	Average
%	28	26	22	16	7	1.5

Practices which could have caused the problem could include any two of:

- having soil bare or with little vegetative cover during critical times of hot and windy weather
- over-grazing
- over-cultivating
- working soil during windy periods.

One mark (up to a total of two) was given for each point listed, or two marks (up to a total of four) if the point was adequately described.

## Question 3diii.

Marks	0	1	2	3	Average
%	23	37	28	12	1.3

To fix the problem, Mitch should:

- avoid any of the causes listed above
- use minimum tillage practices
- plant shelterbelts effectively, near areas prone to wind erosion
- use stubble to protect and bind soil particles
- cross rip where appropriate.

One mark was given for a limited answer; two marks for a fairly full but incomplete answer and three marks for a complete answer.

Case studies continued to be a problem for many students. Those students who did very well in these questions used the information from the cases, rather than generalising about possible problems and solutions. The mini case studies presented in these questions contained hints and leads as to the required answers; however, few students used these adequately. Of those who did identify the problem accurately, most gave reasonable descriptions of the cause and solutions.

## Question 4a.

Marks	0	1	2	3	Average
%	7	51	34	8	1.5

Possible reasons why Tania would want to import a new plant variety could include:

- a marketing advantage over competitors and perhaps to obtain plant breeder's rights
- improved growth/production efficiency
- disease resistance.

Students needed to discuss three separate points in their explanation to receive full marks.

## Question 4b.

Marks	0	1	2	3	Average
%	14	40	39	6	1.4

Australian plant quarantine is vital to the horticultural and agricultural industry because it:

- provides protection for our plants and animals from the introduction of exotic pathogens
- helps maintain production
- maintains markets through the exclusion of pests and diseases that affect overseas competitors.

One mark was given for a limited answer, two marks for a fairly full but incomplete answer and three marks for a complete answer.

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## Question 4c.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>Average</b>
<b>%</b>	8	41	42	9	

Three problems that may occur as a result of illegal importation of plant material into Australia could include:

- introduction of a new pest or disease that could rapidly spread and devastate native flora or fauna or production crops, as there may be no natural predator
- loss of production/jobs
- economic effects
- introduced pathogens are unpredictable in our environment; they may adapt and spread rapidly
- may become an environmental/noxious weed.

## Question 4d.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>Average</b>
<b>%</b>	11	13	27	29	20	

Organisations that could help Tania manage for sustainability in various areas are:

- potting mix or soil problems: media supplier (for example, Debco), local DSE (Department of Sustainability and Environment) office, local nursery, other similar growers
- pests or disease problems: chemical company, a university, local suppliers' representatives
- water management: water boards, Melbourne Water, the local council, irrigation supply companies
- environmental management: EPA, agricultural consultant, Landcare.

One mark was given for each correctly named organisation. No mark was given if an organisation was used twice.

This question was well answered. Students' general knowledge of organisations and, in particular, AQIS appeared to be adequate.

## Question 5

<b>Business type</b>	<b>No. student responses</b>	<b>Average no. lines written</b>	<b>Business type</b>	<b>No. student responses</b>	<b>Average no. lines written</b>
growing a cereal crop	39	24.9	designing and constructing an ornamental garden	12	15.6
managing poultry for meat	9	25.8	maintaining an ornamental garden	6	11.5
managing poultry for eggs	25	19.3	growing flowering plants in a glasshouse	33	20.4
rearing cattle for the beef market	62	23.1	container growing of ornamental plants	7	23.0
rearing pigs for the meat market	5	28.8	field growing a vegetable, herb or flower crop	44	20.6
rearing sheep to produce wool/prime lambs	36	25.6	growing indigenous plants for revegetation use	9	17.9
producing milk for the whole milk market	28	23.3	hydroponic plant production	11	17.7
managing vines to produce a crop of grapes	9	19.2	managing trees to produce a crop of fruit	7	20.7
breeding fish or yabbies for food	16	21.1	managing horses for recreational purposes	11	17.2

## Question 5a.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>Average</b>
<b>%</b>	16	84	

Students had to specify the breed or species their chosen commercial business grows or manages. General statements such as 'cattle', 'sheep', 'poultry' or 'pigs' were not accepted – the breed had to be identified. 'Flowering plant', 'vegetable', 'wheat', 'pasture' and 'hay' were also not acceptable – the species and/or variety had to be identified.

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## Question 5bi.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>Average</b>
<b>%</b>	32	68	

Students had to nominate a relevant and specific target market. General answers were not acceptable.

## Question 5bii.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>Average</b>
<b>%</b>	36	38	19	7	

The explanation had to clearly link the needs of the identified target market to the strategies employed by the business with regard to product presentation, pricing, distribution and communication. If the key requirements of the target market were identified and discussed, three marks were given. If obvious gaps existed in the explanation, two marks were given. If only one aspect was considered, one mark was given.

Question 5b. related to target marketing. Students' answers indicated that they knew about marketing in general but had trouble relating it to the specific aspects of a business and a specific target market. When students review a business or establish their own school-based business, it is important that they identify the target market and the attributes of the market that they are focused on satisfying.

## Question 5ci.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>Average</b>
<b>%</b>	8	10	24	21	21	13	2	

The following descriptions were used to award marks for this question:

- six marks: all major production activities were listed in the correct sequential order
- three to five marks: some activities were missing but the listing was adequate to show a broad understanding of the business's production activities
- less than three marks: some isolated activities were listed.

See the table below for brief examples. The table provides a restricted list that was used to guide examiners – more detailed lists were expected of students.

## Question 5cii.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>Average</b>
<b>%</b>	9	8	14	23	17	16	10	3	1	

The following descriptions were used to award marks for this question:

- eight marks: demonstrated a clear understanding of what is involved in all the activities by describing fully how, why and when each is done
- four to seven marks: obviously understood most of the activities; the mark was dependent upon the degree of detail and the fullness and accuracy of the descriptions
- less than four marks: did not seem to understand what is involved with most of the activities; the activities were poorly described.

The number of activities described and the level of detail influenced the number of marks given.

See the table below for brief examples. The table provides a restricted list that was used to guide examiners – more detailed lists were expected of students.

## Question 5ciii.

<b>Marks</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Average</b>
<b>%</b>	8	16	24	29	20	3	

The following descriptions were used to award marks for this question:

- four marks. a fairly complete list of equipment/machinery required for each activity
- three marks: most of the main equipment/machinery listed
- two marks: a number of main items of equipment/machinery were left out
- one mark: more equipment/machinery left out than included

The last mark was awarded if the list of equipment/machinery required was related to a commercial business context.

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See the table below for brief examples. The table provides a restricted list that was used to guide examiners – more detailed lists were expected of students.

Questions 5c. allowed students to go into detail about all the production activities of a commercial business. The better answers demonstrated an accurate grasp of sequencing the activities and gave detailed descriptions of each activity and the machinery required. These questions were well answered, although many students still described their own school-based enterprise and hence details about commercial activities and commercial scale equipment were lacking.

Commercial business	Production activities listed in order	How, why and when each production activity is done	Machinery/equipment required
growing a cereal crop (wheat will be considered in this example, as it is the major cereal crop)	paddock selection and crop sequence	Careful consideration must be given to the paddocks to be used and the variety to be grown. The first crop after pasture is now often canola. This Brassica crop offers an efficient disease 'break' prior to growing wheat. Wheat yields after canola are often superior to wheat after pasture. Records need to have been kept and carefully consulted.	pasture records
	seedbed preparation	Two to three passes with a tillage implement are as effective for high-yielding crops as eight to 10 passes. This operation could be done March/April.	tillage implement
	disease control	Seed dressings to control fungal diseases should be applied to all wheat seed prior to sowing. Fungicide needs to be mixed with seed.	
	sowing	Seasonal variability always modifies a calendar decision but, whether the season breaks early or late, farmers need to be prepared. Every year there is a weather limit on the window of opportunity for sowing and the equipment needs to be ready. A season which breaks in March or April is ideal. Sowing/germination requires soil moisture. The depths of sowing and seeding rates need to be carefully set: 50 mm is a good average depth to use. Deep sowing may delay or stifle emergence, while shallow sown seeds are at risk of damage from herbicide uptake.	seeder
	crop nutrition	Soil tests are available to assist in the assessment of paddock nutrient status. Phosphorus and/or nitrogen may need to be applied to the paddock.	soil test kits for pH (measure of acidity/alkalinity), phosphorous/nitrogen spreader
	harvest	A combine harvester is used when the wheat is ripe. This could be late spring or summer, depending on variety sown.	combine harvester, auger, silo
designing and constructing an ornamental garden	establish client brief	Discuss the requirements with the client, including needs, function and budget.	recording stationery, etc.
	site analysis	Conduct an inspection to establish measurements. Survey soil type, drainage, aspect, locality and existing hard landscape features. Identify structures and plants to be retained if applicable.	survey equipment, measuring wheel/tape, soil testing kit, bore sampler
	draft a concept plan of site	Sketch up basic site boundaries and ideas for site. Re-establish client requirements.	drafting supplies, pens/paper, overlays, computer program (e.g. CAD), printer
	develop detail plans	Draw the hard landscape plan and planting plan overlay.	drafting supplies, pens/paper, overlays, computer program (e.g. CAD), printer, plant lists



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	construction planning	Develop a list of materials to be used for hard landscape, including construction techniques, and a plant species list for the planting plan.	trade catalogues and references
	supply a written quote if applicable/get approval	Cost all aspects of the design and present to client for approval before implementation.	trade catalogues and references
	site clearing	Clear site of unwanted material. Protect services and plants being kept.	bob-cat, truck, dump bin, spades, etc.
	site layout	Establish levels and mark out the plan.	survey equipment, lime powder, string lines, levels
	earth works	Create levels as per plan.	bob-cat, spades, rakes
	plumbing/electrical	Install drainage, irrigation and lighting.	equipment used by plumber/electrician
	hard surfacing	Install all hard surfaces.	muscles, levels, cutting equipment, cement mixer, trowels, etc.
	soil amelioration	Ensure that all soil is suitable for plants.	rotary hoe, fertilisers, spades, rakes.
	planting	Place and plant all plants. Water in.	spades, fertiliser, hose, etc.
	mulching	Protect soil surface with mulch.	wheelbarrow, shovel, rake
managing poultry for meat	identify type	Extensive (free range), semi-intensive or intensive production systems.	
	daily inspection	Daily inspection of pullets and facilities in broiler shed. Feed, water, and otherwise care for poultry. Prepare poultry for operations or inoculations. Collect fertilised eggs, candles, and store eggs in coolers.	
	cleaning	Clean poultry houses/sheds, pens, feeders, water receptacles, boiler rooms, and sheds. Wash and disinfect all poultry caging and equipment. Sterilise hatchery equipment.	steam/spray cleaners
	record keeping	Keep and check records on mortality of poultry, feeding of poultry, and other information on poultry.	computer and software
	maintenance	Repair and paint sheds, barns, and fences. Load and unload feed. Maintain proper lighting and heating for poultry sheds, pens and incubators. Put shavings in hens' nests.	various tools, wheelbarrows, rakes
	producing new stock	Set up, monitor and sanitise incubators. Have a separate pen/area where rooster has access to hens. Check that the rooster is active. Collect enough fertilised eggs to run the incubator. Manage incubator temperature settings. Activate auto-turning facility. Turn off auto turn for the last day(s) (follow manufacturer's recommendations). Eggs hatch after 21 days incubation. Move day-old chicks to brooder.	incubator
	brooding	Follow manufacturer's recommendations on ventilation and temperature regime. Remove to broiler sheds when feathered.	brooders
	slaughter and preparation for market	slaughter, pluck and clean, package, chill and freeze.	plucking and packaging equipment, delivery vans, refrigeration on farm and in van

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Maintaining an ornamental garden	site inspection	Divide site into management sections, if applicable, dependent upon use/function or maintenance needs (that is, high, medium, low). Examine and establish soil type, plant species and microclimate.	pH kit, references, paper and pens, computer and database
	develop a maintenance schedule	Identify plant species and needs. Develop a schedule. Divide jobs into short and long term (weekly/seasonally, etc).	references, database
	undertake soil amelioration (as needed)	Aerate, hoe and turn soil. Add manures, composts, gypsum, lime, etc. as required.	a range of garden tools (see below)
	prune, water, fertilise, mulch, weed, lift bulbs, mow, edge lawns, top dress and rake paths, etc. as required by maintenance schedule	Physically carry out tasks. All tasks should be completed according to locality, season and plant species; that is, prune hardwoods in winter, cut back perennials after flowering, lift bulbs when leaves have completely died back, mow lawn according to required height (this would be more frequent in summer).	secateurs, pruning saw, hedge trimmers, knapsack sprayer, brush cutter, lawnmower, hand tools, spade, shovel, trowel, rake, wheelbarrow, mulcher, chainsaw, rotary hoe, blower, etc.
	monitor and control pest and diseases	Regular observation and action as needed.	magnifying glass, references
	replant as needed or plant seasonal displays	Prepare annual beds, plant and weed.	hand tools, spade, shovel, etc.
Managing poultry for fresh eggs	select production type	Identify extensive (free range), semi-intensive and intensive production systems (caged layers).	
	daily inspection	Daily inspection of layers and facilities. Feed, water and otherwise care for poultry. Prepare poultry for operations or inoculations.	
	cleaning	Clean poultry houses/sheds, pens, feeders, water receptacles, boiler rooms, and sheds. Wash and disinfect all poultry caging and equipment. Sterilise hatchery equipment.	steam/spray cleaners
	record keeping	Keep and check records on mortality, feeding and other information about poultry.	computer software
	maintenance	Repair and paint sheds, barns and fences. Load and unload feed. Maintain proper lighting and heating for poultry sheds, pens and incubators. Put shavings in hens' nests.	various tools, wheelbarrows, rakes
	obtain new hens/produce new stock	Buy or brood, incubate and sex new hens.	
	collect eggs/store eggs	Collect and wash eggs. Candle. Store eggs in coolers.	coolers
Growing flowering plants in a glasshouse	prevention and control of diseases	Inoculation program. Monitor for diseases. Cull very sick hens. Remove dead birds.	
	develop a production schedule	Look at available space and resources. Given the time of year, decide which market should be targeted, then work back to develop when each activity will be done and how much space, etc. will be required.	



	plant selection/ obtain plant material	Select/obtain/purchase parent plant material. Import plant material if required. Purchase tube stock if required. Propagate plants if required (that is, seed sowing, cuttings, bulb offsets, micro-propagation, grafting, etc.).	
	select growing container, media and system	Match to plant and level of mechanisation.	
	prepare media	Sterilise/pasteurise, adjust pH, fertilise, etc.	pH kit
	treat plant material	Use fungicide dips, hormone dips, and cold treatment for bulbs.	coolroom/cabinet
	plant	Use hand or machine.	
	control growing environment	Monitor and control as necessary (lighting, temperature, humidity, irrigation, ventilation). Implement support structures. Monitor and control pest disease.	glasshouse, heater/cooler, watering system, spray system
	harvest flowers	At the optimal stage (that is, when the bud is partially coloured).	secateurs, boxes, buckets
	Apply post-harvest treatments	Use dips to maximise flower life. Grade and sort, bunch and package.	sprays, tubs
	store and distribute	Place in best environment to prolong shelf-life for storage and distribution.	coolroom
Rearing cattle for the beef market	feeding	Manage grazing to maintain correct stocking rate, hand feed during winter and autumn or late pregnancy and lactation. Ensure water access.	fencing, water and feed troughs, hay-making equipment, mustering equipment
	breeding/calving/ marking/weaning	Joining (mating): average pregnancy 282 days. Join in June/July for autumn calving. Join in December for September calving. Leave bull in for six to nine weeks or hand-mate. Pregnancy: a vet can test for pregnancy after six weeks. Mid-pregnancy: maintain moderate condition. In last two months ensure good nutrition. Calving: Inspect twice daily and assist if needed. Call a vet if calf not delivered within two hours of commencement or if difficulties arise. Have 3 in 1 (calcium, magnesium and dextrose) milk fever treatment on hand and inject if symptoms appear. Provide a paddock close to cattle yards. Marking: when calving is completed, or any time from one day to three months old. Castrate males with ring or knife if not for future breeding. Ear tag or ear mark. Vaccinate with 5 in 1 and repeat in six weeks. Weaning: when calves are ready for sale, or about eight weeks before next calving.	Rings, tool for rings, marking and/or tagging equipment



	disease control/prevention	<p>Vaccination – use (5 in 1) clostridial vaccine: adults annually; calves at marking, again in four to six weeks, then annually.</p> <p>Worms – all cattle: treat in February with a benzimidazole or ivermectin product, if indicated by diarrhoea, wasting and high worm-egg count; bulls: before joining; calves: at four months and weaning; weaners and young cattle: at weaning and in May, August and November.</p> <p>Fluke: Only in liver fluke areas (where swamps, springs or irrigation exist). Drench April and August with a product effective against mature and immature fluke.</p> <p>Lice: De-lousing is not essential. If done, should be in August and February. Use a pour-on, spray or injection.</p> <p>Grass tetany: May occur in cows with calves at foot, from May to September. Avoid stress and grass dominant pasture, feed clover hay, and provide magnesium supplement to herds at risk.</p> <p>Bloat: When grazing lush clover or lucerne. Strip graze or use a preventative treatment. Supervise closely and treat early if affected.</p> <p>Pink eye: eye infection, opaque, red, blind. Treat with patches, vet or spray/ointments.</p> <p>Other diseases: vaccinate as recommended if a disease risk exists; for example, leptospirosis, calf scours. Prevent or diagnose and treat other diseases. Use registered treatments or get professional advice.</p>	5 in 1 vaccine and vaccinator, broad-spectrum worming product (oral, injectable or pour-on products), flukicide, lice killer, magnesium supplements, electric fence for strip grazing, gun for humane destruction, yards and cattle crush
	culling	Cull out cattle that are unfit or too old to survive and be productive annually at weaning. Cull cows that do not conceive on time.	cattle yards
	selling/buying	<p>Options: direct to abattoir at \$ per kg, dressed; in the paddock to butcher or farmer; Saleyard auction (must use an agent, \$ per kg live weight or \$ per head); CALM sold by description.</p> <p>Property Identification Tags: the law requires that all cattle must have an approved tag that identifies the property of origin attached before they leave the property for sale or slaughter. Tags are obtained from the Department of Primary Industries.</p> <p>National Vendor Declaration (NVD): it is advisable to complete an NVD prior to sale. An NVD declares to the purchaser any chemicals to which the cattle have been exposed or treated with.</p>	tags
	record keeping	Keep records of pastures, individual animals and treatments given to both. Financial records, stock movements.	computer and software
Container growing of ornamental plants	develop production schedules	Establish the target market. Timeline specifics will depend on growing structures, plant species and target market. Allow two to six weeks for propagation, four to nine weeks for tube stock, and 10–20 weeks for 150–200 mm containers.	
	buy seed, tube stock, media, containers, etc.	Import plant material if required. Purchase tube stock if required. Propagate plants from stock material if required (seed sowing, cuttings, bulb offsets, micropropagation).	seed trays, hormone gels, dibbers, secateurs, heatbeds, misting systems

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	pot on plants	Pot on plants into a container size suitable for species and stage of growth.	potting machine/benches, nursery trolleys, media, pots
	place into growing structures/growing on area	Water, fertilise, weed, stake, prune, etc.	glasshouse, igloo, shadehouse, irrigated growing area, irrigation system, hand hoses, fertiliser applicators, hand tools, chemicals
	monitor and control pests and diseases	Observe and act regularly as needed.	sprays, measuring cups, protective clothing
	clean up and label for dispatch	Clean pots, remove weeds, pests, moss and lichen. Label appropriately. Package according to customer requirements.	pictorial/botanical labels
Rearing pigs for the meat market	clean the pens	Should be done daily. Use an appropriate system for handling effluent. A large-scale pig house will have a slurry channel or solid floor that can be cleaned with a tractor and scraper.	pig house effluent system, tractor scraper
	provide feed and water	If they are not grazing, make sure the correct amount of nutritionally balanced feed is provided. Different feeds are required for young, boars, dry and suckling sows. Clean water is also required.	feed troughs, silo, auger, scales
	ringing	A nose ring can be inserted on young pigs to prevent/minimise them rooting up the ground if they are out in paddocks.	rings and specialised fitting tool
	drench	Drench pigs to kill internal parasites.	drench gun, pens/race to organise pigs
	denail, trim teeth, iron injection	Teeth trimming is done to lessen the damage that might be done to other pigs and/or the handler.	teeth trimming tools
	marking/ear tagging	Needed so that feeding/weight gain/productivity records can be kept. Identifies any animal that has a problem.	
	castrate	Castrate young boars (don't want young males mating).	castration rings, fitting tool
	farrowing	Sow pregnancy is four months. Prepare quarters for sow in advance. Supply bedding – bracken, straw or shavings. Bring the sow into her farrowing quarters about one week before she is due. De-worm her about a week before bringing her in so that her effluent when in the shed is free of worms.	drenching gun, farrowing crate
	weaning	Five week and eight week weaning times are common. It is important to check on the piglets and sows daily during this time. After this, the piglets could be moved to a weaner house, maybe with slatted floors, controlled heat and ventilation. They should stay there until they are around 25 kg. Conduct daily checks that all automated environments are working.	weaner house, scales
Field growing a vegetable, herb or flower crop	develop a production timeline	Establish a target market and the species to be grown. Ensure resources are available for the crop. Timelines will depend upon the crop.	
	soil amelioration	Cultivate. Apply appropriate soil additives. Form beds.	tractor, cultivation equipment, rotary hoe, hand tools

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	seedling production	Purchase or propagate seedlings.	seedling trays and benches, propagation misters
	plant out seedlings	Plant mechanically or by hand.	
	manage growth	Apply water and fertiliser, and weed, stake, prune, etc.	irrigation equipment, hand tools
	pest and disease management	Monitor and control pests and diseases.	spray units, pest traps
	harvest	Grade, package and dip as required.	knapsack, tractor, harvester, hand tools, bins, coolroom.
	store and dispatch		coolstore
Rearing sheep to produce wool/prime lambs	lambing	Sheep pregnancy is five months. Joining needs to be timed to avoid severe weather for lambing (end of winter or early spring, depending on location).	sheds
	marking/tail docking	At four to six weeks lambs need to be marked, have their tails docked and ears tagged. Young rams should be castrated (apply rings).	knives, rings, applicator, tagging punch
	crutching/mulesing	Cut away wool from crutch to prevent faeces and urine collecting there and leading to fly-strike. (Mulesing is the removal of skin from the sheep's breech, done around October. The practice is being reviewed.)	shears
	drenching	Kills internal parasites.	drench gun, pens/race
	weaning	Collect lambs and remove from mothers/ewes. Stubble grazing: move sheep to paddock to graze on stubble of crop (provides additional feed).	
	shearing and fleece management	Shear sheep in summer, to provide wool.	shearing shed, shearing combs, sorting table, wool press
	wool marketing	Send bales to market.	
	drenching	In February or March, drench for a second time (part of overall disease management program).	drench gun, pens/race
	dipping	In February or March. Removes external pathogens. After dipping, joining is organised.	dipping bath, pens/race
	joining	In February or March. Ram runs with ewes. Maybe use AI if flock improvement is desired. Need to organise into paddocks.	
	sale of old sheep	Inspect overall condition of sheep, especially teeth. Old, poor sheep should be marked for sale.	
	pasture improvement and maintenance	Cultivate pasture. Spread super, normally in springtime. Organise irrigation equipment if any of the pastures are to be irrigated	cultivator, harrows, pump, irrigator
Growing indigenous plants for revegetation use	production schedule	Establish species of plants to be produced, according to available resources.	
	collect propagation material	Identify appropriate remnant species and collect seed (post flowering). Harvest material for cutting propagation. Treat seeds and cutting material with heat or chemicals	nets, bags, gun, secateurs
	sow seed or cutting	Prepare seed bed and labels.	propagation equipment, water
	manage seedlings	Water and protect from elements, pests and diseases.	
	transplant in tubes	Fill tube with appropriate media. Place seedling into appropriate depth.	media, tube, boxes
	grow on	Water, prune, cull and weed as required.	irrigation equipment

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	prepare soil at site	Remove weeds, prepare planting holes	tractors, spray equipment
	transplant to site	Use tree guards, mulch, water etc.	tree guards
	manage during establishment	Control weeds.	Hoes, spades, spray units
Producing milk for the whole milk market	milking	The major task is to milk the herd twice a day. It's a good opportunity to monitor the health of the cows as they come into the dairy. The dairy has to be washed down at the end of milking. A record of each cow's milking needs to be kept. Sell poor producers. Breed from high producers.	dairy, feed bags, wash down equipment, refrigerated milk vat, fencing, dogs, motor-bikes, utes, tractors
	joining	The bull needs to be in a separate paddock. The average gestation period for cows is 280 days (nine months). The cows are normally run with the bull two at a time. The cow needs to be watched for further heat periods. This would indicate that the cow is not in calf. Records need to be kept. AI is an alternative.	
	calving	No set time, varies with district/producer. It's better to move calving cows into a separate calving paddock near shedding. Provide succulent feed. Dehorn, drench, mark/ear tag each calf. Castrate male calves. Sell unwanted calves.	calf feeding equipment, elastrator, dehorner, rings
	pasture maintenance	Cultivate pasture. Spread super, normally in spring. Organise irrigation equipment if any of the pastures are to be irrigated.	cultivator, harrows, pump, irrigator
Hydroponic plant production	production schedule	Establish the target market and species to be grown. Check available resources. Develop a production timeline (timeline specifics will depend on growing structures; that is, field systems or igloos and plant species)	
	test water quality	Establish pH, nutrients, particulate and biological status of incoming water. Treat and adjust as necessary (for example, use a filtration system).	test kits, filtration systems, chemical additives
	prepare hydroponic system and plant structures	Check structures, media (growool, nutrients, etc.), pumps, plumbing, flow rates, timers, etc.	hydroponic/irrigation system, growing tubes/boxes, pumps, filters
	plant plants	Support plants in the nutrient. Ensure they are stable.	igloo (if applicable)
	adjust nutrient and water systems and monitor	Continually monitor the flow rate of nutrients and water quality.	nutrients, nutrient/water/pH test kits, growing media, mixing equipment
	maintain pest/disease control	Observe and act as required.	spray equipment
	maintain growing environment	Monitor temperature, humidity and light levels. Act as required.	heating/cooling equipment, watering equipment
	harvest, package and store		boxes, trolleys, secateurs
	distribution		vehicles
Managing vines to produce a crop of grapes	establish vines	Assume that species selection and vine establishment has been done previously.	

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	pruning, tying	During winter, prune to lead buds and tie to ensure growth along trellis. Remove prunings.	mechanical/manual pruning equipment, trellis, safety equipment
	fertilising, irrigation	Monitor soil moisture and nutrient levels and supply as necessary (especially during spring and summer).	drippers, pumps, poly pipe
	pollination assistance	Move beehives around vineyard to assist pollination during flowering (summer/autumn).	bees
	weed control	Cultivate or spray between vines. Mulch.	tractor, cultivator/sprayer
	pest/disease monitoring and control	Observe and act as required. Control birds and use netting as required.	spray equipment
	harvest and package		harvest and store equipment
Managing trees to produce a crop of fruit	plant trees	If new trees/varieties are required, plant during winter.	spade, mechanical digger
	pruning	Also done during the dormant period. Keeps the tree to a manageable size and encourages fruiting.	secateurs, loppers, chainsaw
	install/check watering system	Run black poly, set above the ground, to each tree. Needs to be designed so that each tree is getting approximately the same amount of water. Check the pump and system are operating properly with no blockages and equal pressures. Trees will need water during late spring and summer.	black poly, pump, filter
	fertilise	Done in spring. May be done using fertigation or spreading granulated fertiliser or manure. Calculate the amount required. Maybe do a soil test for macro and trace nutrients.	inline fertigation equipment, fertiliser spreader, testing kit
	weed control	Spray weeds around trees in early spring when the weeds are small. Slash the grass between rows of trees	OH&S gear, slasher
	beehives for fruit set and cross-pollination	Monitor for pests and disease. Check records of previous problems and when they have occurred. Get ready to spray or begin Integrated Pest Management.	beehives
	harvest	Pick fruit. Grade, package, store. For sale through the wholesale fruit and vegetable market, all produce needs the grower's ID.	fruit-picking bags, bins, grading machine, moveable elevated platform for picking
Breeding fish or yabbies for food	establish production schedule	Establish target market. Select species to breed. Review available resources.	
	obtain stock	Purchase adult breeders to stock dams/tanks (berried females may be used). The ratio of male to female depends on the species and production program. Collect/hatch eggs or buy juveniles to grow on.	portable storage tanks
	prepare tanks, dams, spawning substrate	Establish water turnover rates, dissolved gas levels and feed levels.	tanks, dams, filters, aerators
	test and maintain water quality and temperature	Sample regularly and observe	water test kits, thermometers, aerators
	maintain environment	Monitor environmental conditions and adjust if applicable, including pests and diseases.	
	feed	Feed as required by the species.	feed bins, scales, measuring containers
	pests and diseases	Monitor and act as necessary.	



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	harvest and dispatch	Clean and prepare for packaging and storage. Cold storage.	fridges, freezers, vacuum packer
Managing horses for recreational purposes	provide feed and water	If the horse is at grass, check that there is enough feed in the paddock. Supply additional feed if necessary. Check that water is available. Provide different types of horse feeds. Use food supplements/additives including tonics, tempters and salts. Establish feeding programs for horses, for different purposes.	water trough
	exercise/training	This task could be done daily to maintain the horse's condition and educate it (depends on the type of horse).	arena, tack
	monitor horse's health and condition		
	groom/wash	This could be done daily. It keeps the horse looking good and helps keep it healthy.	brush
	clean stable/stall	Wash down stable. Remove bedding and manure, daily or every couple of days. Provides a hygienic environment to lower the risk of disease.	rake, hose
	clean/prepare tack/equipment	Develop procedures to manage tack in a specified horse enterprise, including storage, use, repair/replacement and cleaning.	
	maintain facilities	Fix the different types of fencing used for horses, including barbed wire, timber post and rail and electric.	fencing materials

## Question 6a.

Marks	0	1	Average
%	42	58	0.6

The recent agricultural or horticultural technological development had to be one that is not already widely used by the industry. The list below shows the examples that were given by students – 'robotic milking system' and 'GPS' were the most popular examples by far, with over 20 students writing on each of these.

The second list (in italics) shows examples that were not necessarily recent (new and emerging). For these to be accepted, a sound supporting case, which demonstrated the newness or emerging nature of the technology, had to be presented. 'Automatic calf feeder' and 'artificial insemination' were the most popular examples from this list – these had to be supported with sufficient evidence in part b. in order for marks to be awarded.

- air pruning pots
- animal DNA transfer
- automatic seed sowing machine
- automatic teat cup removers
- bio diesel
- bio filter water treatment
- bio-clip or bio-sheer
- biotechnology genetic engineering
- BT cotton
- central pivot irrigator
- chemical shearing
- cloning
- computer software – Crop Tech
- computerised ear tags
- computerised tractors – GPS
- cyber cowboys (GPS related)
- dairy comp 305 cow production data recorder
- double skinned poly houses
- electronic ear tag
- embryo transfer
- embryo transfer in cattle
- embryo transfer in sheep
- 'free' milking
- genetic manipulation
- genetic manipulation – insecticide
- genetically modified canola
- GM
- GM cotton
- GM crops
- GM wheat
- GPS
- GPS automatic steering
- GPS computerised tractor
- GPS ear tags
- GPS in headers
- GPS in tractors
- irradiation of fruits and vegetables
- netting and chemical shearing
- remote sensing
- robotic milking system
- satellite imaging and monitoring
- satellite watering control on golf courses
- shearwell sheep
- solar powered electric fencing
- solar powered pumps
- tubulator (auger replacement)
- ultra sound for sheep
- ultra sound scanner
- virtual fencing
- wool nets on sheep

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- adjustable sheep loading race
- aeroponics
- air compressed post drivers
- air seeders
- artificial insemination
- auto Steer
- auto steer on tractors
- automated milking system
- automated watering computers
- automatic calf feeder
- automatic draughting in dairy
- automatic drip irrigation system
- automatic gate opener
- automatic irrigation system
- automatic milk metres
- automatic potting machines
- automatic sprinklers
- automatic timers for sprinklers
- automatic waterer
- biological control
- biological control for caterpillars
- button drippers
- cell grazing
- circulation fans
- climate control
- combine harvester
- computer aided micron testing of wool
- computer sensed rotary dairies
- computerised climate controlled glasshouses
- computerised equipment
- computerised glasshouse
- computerised shade roof
- controlled ovulation in cattle
- controlled traffic farming
- crop rotation
- dairy industry
- direct drilling
- disc seeders
- drip irrigation
- dripper system with sensors
- elastrator rings
- electric fence
- electro magnetic surveying
- electronic cow feeder and milker
- electronic dairy cow milking
- electronic overhead watering system
- electronic shearing
- electronic weighing
- electronic wool classing
- equine treadmill
- estimated breeding values
- frost fans
- fruit picking machine
- fully automatic cow milkers
- harvester
- heat bed
- heat beds in polyhouses
- heat blankets
- heat blankets in glasshouses
- heated solar banks
- herring milking/rotary wheel
- hydraulic lifting goat cradle
- hydroponics
- improved cattle crush
- incubator
- infrared spray rig system
- Internet
- irrigation gates
- irrigation system
- laser levelling
- liftable fence
- machinery in poly houses
- manure spreader
- mechanical harvester
- milk bottles (plastic)
- milking machine
- minimum tillage
- moisture probe
- moisture sensors
- National Livestock Identification Scheme ear tags
- new designer filter
- new grape harvesters
- new harvester
- new shearing shed design
- new tractors
- overhead sprinklers
- pig feeding system
- pig scales
- plastic water troughs
- post hole rammer
- potting conveyor belt
- potting machine
- prickle chain
- raised bed cropping
- raised bed cultivator
- raised benches
- reproduction manipulation
- reproduction manipulation in cattle
- rock rake
- rolling benches
- rotary
- rotary dairies
- rotary drum seeders
- round sheep shed
- round up
- seed sowing machine
- self-timed irrigation systems
- self-planter for horticulture
- sensor controlled irrigation systems
- sensor probes
- shade screens for hot houses
- shear express mobile shearing truck
- silage wrapper on balers
- soil sample transmitter
- spike spray irrigation system
- SSP tractor
- stem cell research gene manipulation
- stimulated ovulation
- stubble star seeders
- sunvale wheat
- sustainability
- synchronised oestrus cycle
- synchronised ovulation
- technological development
- temperature controller
- tissue culture
- travelling irrigation systems
- tray inspection systems
- water timers
- weighing bails of wool
- wild dog baits (Dogone)
- yard blaster washing system

## Question 6b.

Marks	0	1	2	3	Average
%	41	20	28	11	1.1

The following descriptions were used to award marks for this question:

- three marks: the student provided a detailed answer that showed knowledge of the recent technology and how it is applied, including what practices it replaced

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- two marks: the student knew about the recent technology but the description lacked detail or was vague about some areas or how it is applied, including what practices it replaced
- one mark: isolated facts or very limited information about the recent technology was given.

No marks were given if the example was not recent technology.

## Question 6c.

Marks	0	1	2	3	4	Average
%	32	33	22	11	3	1.2

The following descriptions were used to award marks for this question:

- four marks: the student explained four correct points or discussed two issues, and the two areas of sustainability were covered
- three marks: the student explained three correct points
- two marks: the student explained two correct points
- one mark: the student explained one correct point.

Marks were given for Question 6c. even if the answer in Question 6a. was not considered to be new technology, so long as the answer was correct for what the student had discussed in 6a.

Although knowledge of the technology was sound, few students were able to adequately evaluate the sustainability of new technology.