VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2008 Agricultural and Horticultural Studies GA 3: Written examination

GENERAL COMMENTS

Areas of strength and weakness

Students demonstrated an understanding of techniques for modifying climate, water, soil/growing media and topography. As in 2007, they found it difficult to compare and evaluate the advantages and disadvantages of alternative techniques.

Students demonstrated an adequate general knowledge of specific weeds, pests and diseases, with many students able to describe complete strategies using integrated management approaches.

A range of innovations similar to 2007 were described by students, although some could still only name and describe one innovation. Students are expected to be able to evaluate a range of innovations (new or emerging technologies) impacting on a specific business type. Some students are still using examples of technology that are not innovations and many described a general area of technology rather than a specific example.

The key characteristics of a natural ecosystem are poorly understood by students. Only a few students adequately discussed how biodiversity, biomass, efficient use of energy and cycling of matter related to agricultural and horticultural systems.

The case study presented on this examination allowed students to demonstrate their knowledge of the role of indicators in aiding resource management. The concept that an indicator is a measured quantity needs emphasis. If the correct quantitative measures are used, it is more likely that the potential for degradation can be identified before it occurs and becomes obvious via qualitative measures. Students showed an understanding of the management of environmental degradations affecting agriculture and horticulture, although many could not distinguish between short and long-term management actions. The physical processes leading to degradation also seemed to be poorly understood.

Students are expected to be able to evaluate the performance and outcomes of a small commercial agricultural or horticultural business in relation to its business plan. Simple tools used to do this were poorly understood. Students also had poor knowledge of risk, quality standards, and product marketing.

Choice of options to answer

Students needed to select an option from the provided lists of alternatives in Questions 2, 4 and 7.

Formula answers

When preparing students for the examination, teachers must refer to the current *VCE Agricultural and Horticultural Studies 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

Some questions addressed more than one of the examination criteria. 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 detailed 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.

For each question, an outline answer (or answers) is provided. In some cases the answer given is not the only answer that could have been awarded marks.

Question 1

Most students had no trouble answering Questions 1a. and 1b. However, Questions 1c. and 1d. proved difficult for many students. Students need to be aware that many options exist for managing the growing environment of plants and animals in both housed and field situations.

Question 1a.

Marks	0	1	2	3	4	Average
%	3	5	10	28	54	**3.3**

Any four of:

- increases air temperature
- increases humidity
- protection from pests
- protection from wind, rain, hail, etc.
- protection from frost
- allows variation in gas (CO_2 , O_2) concentrations
- may reduce available sunlight
- allows control of watering
- control of air circulation.

Question 1b.

Marks	0	1	2	3	Average
%	11	18	34	38	**2**

Any three of:

- cation exchange capacity
- physical support
- aeration – air filled porosity/drainage
- pH
- fertility, nutrient levels
- temperature
- number of pest and/or disease organisms
- organic matter
- soil structure.

Question 1c.

Marks	0	1	2	3	Average
%	16	38	33	14	**1.5**

Any three of:

- fan forced air, helicopter
- smoke
- overhead irrigation
- sacrifice excess vegetation
- aspect of plants (top of hill)
- heaters
- cover plants
- plant at a better time.

Question 1d.

Marks	0	1	2	3	Average
%	8	18	30	43	**2.1**

Any three of:

- shelter for shade and wind
- rotational grazing – control movement
- ensure good drainage
- control the number of animals in a herd/flock
- correct balance of roughage/nutrients available at appropriate times (species balance in pasture)

- cleanliness of the farm to reduce injury to animals
- ensure there is water available for drinking
- ensure it is pest and disease free.

Question 1e.

Marks	0	1	2	3	Average
%	11	62	22	4	**1.2**

Advantages

- improved soil structure and biological activity due to increased organic matter, leading to improved water holding capacity, porosity and nutrient availability
- used from within the boundary of property – lower cost
- natural nutrient source

Disadvantages

- may burn the roots
- may cause nitrogen binding
- weed increase
- may spread disease
- plants and animals use a higher amount of nutrients than what they produce, including manure, creating an imbalance
- smells – socially unacceptable
- slower response
- pH change

Full marks were awarded to answers that showed detailed consideration of the advantages and disadvantages of the two techniques. Two marks were given to answers that showed that the student clearly knew the main advantages and disadvantages of one technique compared with the other, and one mark was given for identifying isolated advantages and disadvantages of the practices being compared.

The answers to this question were too general. Many students answered along the lines of 'natural is better', without giving reasons. Most students missed the point that using manure adds organic matter to the soil.

Question 1f.

Marks	0	1	2	3	Average
%	31	55	13	1	**0.9**

Advantages

- sterile
- supplies exactly what the plant needs – nothing extra
- grows more in a smaller area
- growing media is lighter and easier to set up

Disadvantages

- cost of fertilizers
- if water supply fails then crops can fail sooner
- it is expensive to set up
- diseases may travel through the whole system once they are present

Full marks were awarded to answers that showed a detailed consideration of the advantages and disadvantages of the two techniques. Two marks were given to answers that showed that the student clearly knew the main advantages and disadvantages of one technique compared with the other, and one mark was given for identifying isolated advantages and disadvantages of the practices being compared.

This question was poorly answered as many students gave the advantages and disadvantages of a hothouse, greenhouse or glasshouse. Hydroponics as a method of production was poorly understood.

Question 2a.

Marks	0	1	Average
%	16	84	**0.9**

Disease or pest	Business type affected	Disease or pest	Business type affected
Red-legged earth mite	Grazing and cropping	Thrips	Vegetables, ornamentals, flower growers in both fields and glasshouses
Footrot	Sheep and goats	Ticks	Cattle, sheep, goats, horses – warm-blooded animals
Mastitis	Dairy cattle, sheep and goats	Rust	Ornamentals, horticultural crops, cereal crops and pastures
Black spot	Roses, ornamental plants, fruit trees and vines	Coccidiosis	Poultry
Botflies	Horses	Brown stomach worm	Sheep
Citrus gall wasp	Citrus trees	Soft brown scale	Plants, especially fruit trees, ornamental shrubs, succulents and cacti

Question 2b.

Marks	0	1	2	3	4	5	6	7	8	Average
%	11	13	16	18	14	11	9	5	3	**3.2**

Question 2bi.

Disease or pest	Symptoms (signs) that show the pest or disease is present and how the extent and stage of development of it is monitored
Red-legged earth mite	Typical mite damage appears as 'silvering' or 'whitening' of the attacked foliage. Mites use adapted mouthparts to lacerate the leaf tissue of plants and suck up the discharged sap. The resulting cell and cuticle damage promotes desiccation, retards photosynthesis and produces the characteristic silvering that is often mistaken as frost damage. Monitoring: Check host plants. Check for mite damage. Do a before and after assessment of mite numbers for any actions taken to assess effectiveness.
Footrot	• signs of footrot vary from mild reddening (inflammation) of the interdigital skin (the skin between the digits or toes), to complete separation of the horn of the hoof • infection commences when bacteria lodges on the interdigital skin causing inflammation; the skin-horn junction then begins to erode and the horn starts to lift • sheep become progressively more **lame** and exhibit the following signs in order: o inflamed, red and moist skin between the digits o grey pasty scum between the digits o lifting of skin-horn junction between digits o under-running or separation of horn around heel, sole, toe and outside hoof wall o loss of body weight, growth and wool production o infected feet may also have a characteristic foul smell • the Modified Egerton Scoring System has been developed to describe footrot at its various stages If footrot has been a problem once the pasture has dried off in summer, all sheep must be tipped up and individually examined, foot by foot, paring sufficiently to ensure an accurate diagnosis.

	Permanently brand all infected or suspect sheep. During this examination, sort sheep into clean and infected (infected or suspect) mobs. Culling all infected sheep will give better results. An infected mob kept for treatment is a high risk for breaking down and infecting clean mobs. Keep clean and cured mobs separated and isolated until after next spring. Keep the sheep under close surveillance for signs of lameness; any lameness must be checked to determine the cause. If footrot is detected, recommence the program.
Mastitis	• mastitis is an infection of the mammary (udder) tissue caused by a range of bacteria (over 1000 organisms) • inflammation of the mammary gland caused by micro-organisms • reduced milk yield and altered milk composition • pus in milk samples • mastitis is usually found in two forms. The first is obvious since clinical mastitis is easily recognised. Milk is abnormal, from the appearance of flakes or clots to garget and quarters may be swollen or sensitive. However, most mastitis is subclinical. The milk appears to be normal. Bacteria usually, but not always, can be isolated in milk. Milk yield is depressed, and composition may be altered. Subclinical mastitis may become clinical. There are 15–40 cases of subclinical mastitis for every clinical case. Herds with bulk tank somatic cell count (SCC) above 200,000 will have varying degrees of subclinical mastitis • dairy farmers should monitor the SCC of the herd and for each cow suspected of having a high SCC. They should pay attention to the herd's monthly average SSC score or weighted average and any changes that have occurred from month to month. A decreasing trend suggests that improvement has occurred. On the other hand, an increase in the herd average SCC score from one month to the next would indicate that a major breakdown has occurred in the herd's mastitis control program. Somatic cell counts from a day's milk are the best indicator of the extent to which the gland is involved in fighting a mastitis infection. The DHI program provides a monthly SCC which identifies cows with subclinical mastitis and whether a milk sample should be cultured. The DHI SCC is highly correlated to losses in milk yield. The DHI SCC program assists dairy farmers in monitoring herd subclinical mastitis status, progress in mastitis control programs such as milking practices or equipment, cow environment and dry cow therapy, and can be used in making decisions regarding cow segregation and culling
Black spot	• the lower leaves of susceptible plants become covered with brownish-black spots. Eventually they yellow and drop off • black spot is diagnosed when small, circular, black spots with feathery margins develop on upper leaflet surfaces • spots are 2–12 mm in diameter • the leaf tissue surrounding the spots turns yellow and this chlorosis spreads until the leaflet drops from the plant • a severe infestation can completely defoliate a plant over a period of weeks Black spot spreads quickly in wet or humid, warm weather. • expanding leaves between six and 14 days of age are most susceptible to infection • the optimal temperature for disease development is 24°C; check when these temperatures occur • rainy weather, or overhead watering that wets leaves and does not have enough time to dry, produces optimum conditions for the spread of the disease • for black spot to develop, an environmental temperature of 18–26°C needs to be maintained for at least seven hours
Botflies	• appearance of small yellowish dots on the horse's coat • licking and biting by the horse • symptoms include irritation of stomach membranes, ulceration of the stomach, peritonitis, perforated ulcers, colic, mechanical blockage of the stomach resulting in stomach rupture, oesophageal paralysis and squamal cell tumours Monitor for signs, symptoms and eggs regularly during fly season.
Thrip	• seeing large numbers of the thrips on and around plants, wilted soft tissues and young leaves, misshapen leaves and shoots, and curled leaves

	• the two most popular ways of monitoring for thrip are with **sticky traps and crop inspections** • sticky traps are a simple way to check for thrip numbers in a crop. It is important to hang traps just above the plant canopy as this will mean you will need to keep adjusting the height of the traps as your plants grow • sticky traps should be changed every 2–4 weeks. Check them weekly to ensure they are still hanging at the correct height and not covered in dirt or insects • the number of traps you hang on your property can vary. A suggested starting level is three traps per hectare outdoors or one trap per 200 square meters in a glasshouse • growers can also check for thrips by walking through the crop with a sticky trap or white container. tap the flowers and leaves over the trap or container and the thrips should fall out • to encourage thrips to come out of flowers, it sometimes helps to breathe gently into the flowers • while walking through the crop, be wary of signs of feeding damage infection
Ticks	In the answers that follow, not all details refer to all tick species. They present a different problem in different regions of Australia, for example, cattle tick is a major problem for Queensland and north New South Wales. Cattle tick is not found in Victoria. The main tick species in Australia include: • the indigenous tick: found in Western Australia, Tasmania, the southeast coastal region of New South Wales and central Victoria. It may cause paralysis • paralysis tick: found from northern Queensland to Bairnsdale in Victoria along the coastal regions. Causes paralysis • cattle tick: found in Queensland, northeastern New South Wales, Northern Territory and Western Australia. This tick is rare in dogs and carries parasites found in cattle blood • bush tick: also known as a scrub tick and the New Zealand cattle tick. It is found in the southeast coastal area of Queensland, along the New South Wales coastline and through northeastern Victoria along the Murray River • brown dog tick: found mainly in inland areas of Queensland, Western Australia, New South Wales and Victoria. It is most prevalent in the northern parts of Australia. The brown dog tick carries a wide range of infectious diseases including Babesia Canis which can occur in a symptomless carrier state or in disease form ranging in severity from mild to severe and occasionally causing death • other ticks found in Australia include the cat tick, possum tick, opossum tick and the wallaby tick. Symptoms (signs) that show that ticks are present on an animal may include: • scratching and irritation • anorexia • partial paralysis • depression • increased respiratory rate, particularly following exertion • muscle tremors and reluctance to move • abortions in early pregnancy • reduced quality of meat due to lack of movement • patchy or uneven coat. The bush tick is primarily a parasite of cattle, but readily infests many other warm-blooded animals. Adult ticks are usually dark brown in colour, and grow to about the size of a pea when fully engorged with blood from a host. The favoured sites of attachment are around the tail, on the udder, inside the legs, on the brisket, in the ears, and occasionally on the face and neck. On sheep, non-woolled areas are preferred. The Australian paralysis tick, found in southeastern coastal temperate climes from Queensland, New South Wales and Victoria, secretes a neurotoxin in its saliva that causes a progressive, and occasionally fatal, paralysis. In some cases a severe hypersensitivity reaction may occur. The tick often goes unnoticed until weakness or ataxia develop, and is only found during an extensive search of the body. On most properties, the pasture is relatively short and dry in the period when tick eggs are deposited and very few develop in this situation. Areas which could harbour ticks should be readily identified and would usually occupy only a small part of a farm. Talk to other farmers, the Department of Primary Industry and local vets to find out about how prevalent specific ticks are in your region.
Rusts	There are several different types of rust. Details that follow vary according to the specific rust and situation

	and they do not apply to all rusts. • Brown, yellow or red streak, circular or irregular patch pustules with darker spores in the centre, the affected part breaks or tears easily at the pustule margin. Spores rub off easily and darken as the plant matures; the plant is stunted. • Crops should be inspected for the presence of stripe rust at regular intervals throughout the growing season. • Cool wet weather conditions promote stripe rust so increased vigilance is desirable after such weather periods. Monitor water levels. Free water on the leaf surface for several hours enhances development of rusts and many other diseases.
Coccidiosis	Coccidiosis in chickens is caused by seven different species of coccidia (genus Eimeria), which are single-celled parasites that live in the gut wall of their host. It is characterised by droopiness, paleness of the comb, diarrhoea and occasionally blood in the droppings. The death rate may be quite high, both in chicks and in adults. Birds of almost any age may be affected, but problems are not common in chicks under three weeks of age because the parasites take time to build up in sufficient numbers to cause problems. Affected birds become depressed, lose condition and are very pale. The feathers are ruffled, the wings droop and the shanks become pale and dry. A slight whitish soiling may be present around the vent. Often, a large percentage of the chickens are sick. Birds may die suddenly before the above symptoms are obvious or the performance of birds may be affected without the disease causing obvious signs. Definite diagnosis can be confirmed only by laboratory examination. Regular monitoring of the birds for signs of the disease should be completed.
Citrus gall wasp	A native wasp (*Bruchophagus fellis*) is attracted to exotic citrus trees. Originally this wasp was native to coastal New South Wales and Queensland. It utilised the native finger lime (*Microcitrus australiasica*) for development. Now it has many other citrus to choose from. The female wasp lays her eggs inside the stem in spring. Usually stems that are only a few weeks old are chosen, but leaf midribs, petioles (leaf stems) and fruit stems can also be infested. Heavily flecked young twigs in spring can indicate that the wasp is laying a large number of eggs in the current spring growth. These twigs may die and be replaced by weaker growth. Usually galls develop and if the infestation is heavy enough the galling can weaken older trees and reduce fruiting, and dieback also occurs. **Gall formation** In response to the mechanical damage inflicted by the female wasp as she pierces the stem and inserts eggs, and the subsequent feeding of larvae, young plant tissue grows around and encloses the insects in 'tumor-like formations'. Inside the stem the larvae hatch and feed on the plant tissue. Inside any one gall, which can be as large as 25 cm long and 3 cm thick, there can be hundreds of larvae. The monitoring which should be done is twofold. Look carefully for the telltale sign of speckled young twigs which indicates that there are wasp eggs in it. Secondly look for the wasp itself. The use of insect traps such as the 'Insectrap' can assist. This is a non-toxic sticky trap that attracts the wasp, which is then stuck fast and dies.
Soft brown scale	Scales are small sap-sucking insects that often go unnoticed by the gardener, but they can do damage out of proportion to their size. Common scales include black scale, pink wax scale, cottony-cushion scale, San Jose scale, soft brown scale, red scale and white louse scale. Scales tend to have small, round shells and are often found along the veins of leaves and the stems of plants. They look like small bumps and can be mistaken for part of the plant, as adults do not move. Eggs are laid under the scale shell and immature 'crawlers' emerge. Crawlers can be moved around by wind, ants, or by hitching a ride on a bird's leg. Scale in large numbers cause leaf yellowing, leaf drop and dieback of twigs and limbs. In very large numbers scale can seriously damage or kill young trees. Some scales secrete large amounts of honeydew, for example, in a eucalyptus forest this can sometimes be seen as a gentle sticky rain. The honeydew causes problems by sticking to the lower leaves where it is fed on by a black fungus called 'sooty mould'. This interferes with photosynthesis. Honeydew also attracts ants, which feed on it.

Brown stomach worm	Sheep with heavy infections of brown stomach worm rapidly lose condition, develop profuse scours and may die. Most commonly, brown stomach worm causes production loss in the absence of obvious disease. Diseased sheep have reduced appetite and protein loss into the gut. The only accurate way to diagnose brown stomach worm infestations before productivity losses have occurred is to conduct a worm egg count and larval culture and identification. Conducting worm egg counts diagnoses infestations before they cause productivity losses and allows producers to plan treatment rather than react to a crisis. To accurately identify the worm species present, the sheep dung is sent to a laboratory, processed and put in an incubator to hatch the eggs. The resulting larvae are identified. By knowing the worm egg count and the species present, a producer can choose the best drench for the situation. A post mortem of animals with infections will reveal the numbers of worms and nodules in the fourth stomach. It is a small (10 mm) red-brown worm that is just visible on the lining of the fourth stomach (abomasum).

Two marks were given if the answer clearly showed that the student knew the symptoms/monitoring techniques for the pest or disease and one mark was given if the students' knowledge was in some way limited.

Question 2bii.

Disease or pest	**Controlling the source of the pest or disease and managing the host's environment so that it does not favour the pest or disease species**
Red-legged earth mite	Clean fallowing and the destruction of weeds around crop and pasture perimeters can reduce mite numbers. Control weeds, especially capeweed and thistles, as they are important breeding sites for the 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. Maintain a dense, vigorously growing pasture.
Footrot	• To eradicate footrot from a property all the D. nodosus bacteria must be killed or the infected sheep removed. Cull those sheep with symptoms and use chemicals to kill any bacteria on the remaining sheep and pasture. • Footrot is virtually always carried into a property and flock by means of a carrier sheep or goat. **Quarantine** new arrivals. Damage control is done by minimising the effect by **isolating** and checking all new sheep. • Goats, cattle and vehicles can act as carriers; however, moist pastures, laneways and muddy yards are the main areas where footrot is spread. • Spread is primarily from foot to foot via pasture or mud – therefore sheep movement should be controlled. Keep prone sheep in drier areas as moist conditions are ideal for multiplication. In less favourable dry conditions, the bacteria die rapidly.
Mastitis	• Regular testing and maintenance of milking machines is a key part of any herd's risk management strategy for mastitis control. Regular testing minimises the risk of teat damage and mastitis spread occurring – prevention is much better than cure. • Listed below are some of the areas that should be examined in herds with either increasing or high herd average SCC. o When was the milking system last serviced or checked? Is there a milking equipment problem, such as a loose belt on the vacuum pump, or a problem with a vacuum regulator or pulsator? Have the number of liner slips (squawking teatcups) increased? o Has there been a change in milking, either technique or people? Are the cows clean? Are teats dried thoroughly? Are individual towels used? Is teat dip used correctly? Are free stalls clean and dry? Do cows use them? Has there been a sudden change in the weather to cause muddy lots or frozen teats? Could there be a problem with dry cow management (environment or calving area)? o When the herd average SCC increases, is the problem caused by several cows or a greater number of cows with increased SCC? Look at the SCC for individual cows. Did very many cows have elevated SCC for the first time, which indicates a lot of new cases of mastitis? Especially pay attention to first lactation, which is the future of the herd.

Black spot	Sanitation is the first step; remove the infected leaves and destroy them. Pick off all leaves at the end of the season to reduce the disease. Avoid overhead watering. Ensure proper pruning is done to provide good air circulation. Avoid wetting foliage. Rainy weather, or overhead watering that wets leaves and does not have enough time to dry, produces optimum conditions for the spread of the disease.
Botflies	Significant control can be accomplished during the fly season by clipping hair to remove the eggs. Effective control of horse bots requires breaking the life cycle of the fly. Infestation can be controlled by using a bot knife to remove the bot eggs from the horse's hair on a daily basis during the fly season. Maintain hygiene practices.
Thrip	• Remove crop and weed trash from the greenhouse or field between crops as thrips can live and breed on this material until the new crop is planted. Waste should be removed and burnt, or ploughed in. If the waste is not destroyed, all the thrips, including the eggs in the plants, will survive and transfer into the next crop. • Control weeds within and around the crop. Weeds can be reservoirs for thrip. Thrips feed on and reproduce in weeds, especially when there are no crops being grown. When a new crop is planted the thrips move off the weeds and onto the new crop. Try to keep a weed-free area around the crop of 10 m. This can be bare ground, closely mown grass, concrete, stones or another hard surface. Try to avoid flowering weeds at all times as these are particularly attractive to thrip. If you use cover crops, use a species that is not a host of thrip. • Do not bring thrip infested plants onto your property. Inspect incoming plant material thoroughly. Thrip are small and may be hidden in buds or flowers. Eggs are laid in the plant tissue and are not easily visible. Pupae are hidden in the soil. If possible, hold plants in a monitored 'quarantine' area for up to two weeks to allow all eggs and pupae to hatch before introducing them into the greenhouse or field. • It is also a good idea to check with suppliers that they monitor for thrip and that the plants are free of thrip when sold. Do not leave transplants sitting next to weeds or other plants where they can become infested. • Never move plants from an infested field or greenhouse to a clean field or greenhouse. Thrip can easily be transported on tools and clothing. Greenhouse growers can use thrip-proof netting to help prevent an infestation. • Cover all vents and doorways with thrip-proof netting whenever possible. As screening reduces airflow in a greenhouse, extra venting may be required to compensate. Trials have indicated that the maximum hole size allowable for the exclusion of thrip is 0.192 mm. It is suggested that you sanitise all greenhouses between crops. It is important the greenhouse contains no plant material for this to work. • Use of resistant varieties will reduce numbers.
Ticks	Clearing scrub, and keeping potentially dangerous pastures grazed down over summer, also helps to control bush tick populations. Control measures include preventing susceptible stock (especially calves) from grazing paddocks suspected of harbouring large tick populations. Chemical control is then needed less frequently if tick burdens rise to significant levels. In some areas, this may only be in certain years, when weather conditions are especially favourable for tick survival. To reduce tick paralysis in cattle, it has been suggested that the calving time should be in winter rather than spring and cows should be put in 'clean' paddocks to calve.
Rusts	A preventative measure is to grow rust-resistant varieties of plants whenever possible. Use crop rotation. Rainy weather, or overhead watering that wets leaves and does not have enough time to dry, produces optimum conditions for rusts to spread. Increase light penetration, air movement, and rapid drying of the grass surface by pruning or selectively removing dense trees and shrubs bordering the turf.
Coccidiosis	• Knowing how coccidiosis is spread can suggest suitable management practices. • Spread coccidiosis is spread when a bird eats faecal material containing the infective stage of the coccidia (small egg-like bodies called oocysts) of an infected bird. The oocysts in the droppings need moisture and warmth to mature before they can infect other birds, but in the right conditions, they can do so very quickly (within 24 hours). Oocysts can remain alive in poultry sheds for more than a year and they are very resistant to most disinfectants.

	• Management: it is important to provide clean water and feed. Prevent or minimise the birds contaminating either with their faeces. Buy birds only from trusted suppliers. Keep new birds separate from other birds as this minimises the risk. • Minimising the build up of oocysts using other management strategies will greatly assist the efficiency of a coccidiostat program since coccidiostats can be overwhelmed by heavy infections. • Low dose rates of coccidiostat may be used to slow down a major build up of coccidia, reducing the challenge to the bird, and thus preventing outbreaks while allowing immunity to develop. • Prevention – management aspects: as coccidia require moisture to become infective, the litter must be kept dry. Ventilation must be good and the birds should not be overcrowded. However, it is very risky to rely on hygiene alone to produce satisfactory control.
Citrus gall wasp	The key to controlling the source lies in knowing the life cycle. **Life cycle** The citrus gall wasp has complete metamorphosis: egg, larvae (four stages), pupa, adult. The adults emerge from the galls through tiny exit holes, which are clearly visible and can cover the gall. Immediately after they emerge they mate and the females lay eggs. About 100 eggs are laid. There is one generation per year and the adult wasps only live for about a week after emergence. In the home garden, **remove all infected stems** (cutting back to well behind the galls) by the end of August at the latest, before the adults emerge. The stems must be destroyed by burning, or wrapped in a plastic bag and put in the garbage.
Soft brown scale	The first step is always to control any ants, as without their protection the abundance of natural enemies in an organic garden will usually be able to keep scales under control. Keep ants out of trees by banding the trunks with sticky barriers or grease bands. Prune any low branches that are touching the ground and make sure tall stems of grass are not providing an alternative route for the ants. Enhancing the environment for the natural predators of scale is a long-term strategy with the benefits increasing over time Many beneficial insects that feed on garden pests need nectar and pollen for food during part of their life cycle. Growing a year-round supply of suitable flowers will maintain beneficial insect populations throughout the year. Small insect-eating birds are also helpful in controlling scale; attract them by providing safe nest sites and a constant supply of water. Try to keep any birds visiting the garden safe from cats.
Brown stomach worm	Adult female brown stomach worms lay 50–100 eggs per day. All larval stages (except stage 3 larvae or L3s) feed on bacteria in the dung pellet until they either die or escape from the dung pellet onto the pastures. As the pasture is warmed by sunlight and in the presence of moisture (dew/rain), the L3 migrate up the grass blades where they are most likely to be eaten. Keep worm-free sheep away from infected dung. Cell grazing and cross grazing with cattle and dung beetles can reduce the number of worm eggs in a paddock.

Two marks were given if the answer clearly showed that the student knew the control strategies for the pest or disease and one mark was given if their knowledge was in some way limited.

Question 2biii.

Disease or pest	**Chemical, mechanical and/or biological control methods to treat the pest or disease**
Red-legged earth mite	Foliage sprays. Once the crop has emerged, these sprays are usually quite effective. Natural enemies, such as other predatory mites, small beetles, spiders and ants, have a major role in reducing earth mite populations in pastures, although their efforts are seldom recognised. 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.
Footrot	• short-term immunity can be achieved using vaccines and footbathing • footbathing – walk through or stand in for five to 10 minutes: zinc sulphate 10 per cent – 1 kg to 9

	litres of water (this is safer and gentler on the sheep than formalin) • formalin (formaldehyde five per cent) – one part to 19 parts water • 'Radicate' – 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 • vaccine – 1 ml dose, two doses a minimum of six weeks apart, a booster every 10–12 weeks while spread conditions persist (this protects clean sheep rather than curing those infected) • several antibiotic injections as prescribed by a veterinarian. This provides a good cure but is not ongoing protection against reinfection • zinc sulphate 10 per cent – 1 kg to 9 litres water (safer and gentler on the sheep than formalin) To eradicate footrot from a property all the D. nodosus bacteria must be killed or the infected sheep removed. As the bacteria cannot be seen you 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.
Mastitis	• The introduction in 2003 of a teat sealant product onto the Australian market has changed the traditional method of choosing a treatment strategy. So there are now three basic drying off treatment strategies which are possible: o treat the whole herd with antibiotic Dry Cow Treatment (blanket strategy) o treat only infected cows with antibiotic Dry Cow Treatment (selective strategy) o treat infected cows with antibiotic Dry Cow Treatment and uninfected cows with teat sealant (combination strategy). • Post-milking teat disinfection (teat spraying) is one of the most effective cell count and mastitis control measures available if it is done thoroughly.
Black spot	Protective fungicidal sprays and resistant cultivars are the best means of control. After organic practices have been used, chemical intervention is needed to keep the disease in check. The most effective control is achieved by rotating two or three chemicals.
Botflies	Control of horse botflies is directed at the larvae in the stomach during the winter by using oral doses of an approved boticide. Modern dewormers containing ivermectin are efficient at killing the larvae that reach the stomach.
Thrip	• Remove crop and weed trash from the greenhouse or field between crops as thrips can live and breed on this material until the new crop is planted. Waste should be removed and burnt, or ploughed in. If the waste is not destroyed, all the thrips, including the eggs in the plants, will survive and transfer into the next crop. • Control weeds within and around the crop. Weeds can be reservoirs for thrip. Thrips feed on and reproduce in weeds, especially when there are no crops being grown. When a new crop is planted, the thrips move off the weeds and onto the new crop. Try to keep a weed-free area around the crop of 10 m. This can be bare ground, closely mown grass, concrete, stones or another hard surface. Try to avoid flowering weeds at all times as these are particularly attractive to thrip. If you use cover crops use a species that is not a host of thrip. • Do not bring thrip infested plants onto your property. Inspect incoming plant material thoroughly. Thrip are small and may be hidden in buds or flowers. Eggs are laid in the plant tissue and are not easily visible. Pupae are hidden in the soil. If possible, hold plants in a monitored 'quarantine' area for up to two weeks to allow all eggs and pupae to hatch before introducing them into the greenhouse or field. • It is also a good idea to check with suppliers that they monitor for thrip and that the plants are free of thrip when sold. Do not leave transplants sitting next to weeds or other plants where they can become infested. • Never move plants from an infested field or greenhouse to a clean field or greenhouse. Thrip can easily be transported on tools and clothes. Greenhouse growers can use thrip-proof netting to help prevent an infestation of thrip. • Cover all vents and doorways with thrip-proof netting whenever possible. As screening reduces airflow in a greenhouse, extra venting may be required to compensate. Trials have indicated that the maximum hole size allowable for the exclusion of thrip is 0.192mm. It is suggested that you sanitise all greenhouses between crops. It is important the greenhouse contains no plant material for this to

	work. • Various pesticides have been developed to kill thrips. To break the thrip life cycle three sprays need to be applied over several days. Pesticides should only be applied when absolutely necessary because thrips quickly develop resistance to them. • Biological control is possible with predatory mites in many environments.
Ticks	Control measures for bush ticks are based on tickicide chemicals. The most effective products have a persistent effect, as individual bush ticks attach for only a few days, and hence protection against continual infestation is needed. These chemicals are available as dips, sprays, or pour on products. For the cattle tick the trend has recently moved towards strategic control programs to minimise problems associated with resistance to tickicides, chemical residues in cattle and environmental concerns over the continued use of insecticides. Tick control by acaracide dipping has been widely used in endemic areas. Acaracides used for this purpose include various synthetic pyrethroids, amitraz and some organophosphates. Dipping is compulsory in Queensland for cattle leaving defined tick areas, otherwise dipping is at the discretion of farmers. Dipping may be done as frequently as every four to six weeks in heavily infested areas. Ticks' increasing resistance to available acaricides has forced the development of integrated strategies for tick control.
Rusts	Foliar fungicide. Wheat varieties with a rating of five or less may need spraying with foliar fungicide during the season.
Coccidiosis	A wide selection of drugs (coccidiostats) is available for prevention and treatment. The choice of drug will depend on the type of flock, the type of coccidia and the aim of the medication program – prevention or contol of the disease. Coccidiostats can be provided in the feed, water or as a vaccine.
Citrus gall wasp	There are no practical chemical controls for home gardeners, although there are registered chemicals for commercial growers that are mostly highly toxic. The use of insect traps such as the 'Insectrap' can be a useful adjunct to cultural practices. Apart from their use in monitoring for the wasp, they can also be used to reduce their numbers. This is a non-toxic sticky trap that attracts the wasp, which is then stuck fast and dies. The citrus gall wasp has natural predators. Native wasps (*Megastigmus spp*.) parasitise the gall wasp larvae. These predatory wasps are known to lay eggs in over 90 per cent of gall wasp eggs, eventually resulting in smaller and fewer galls.
Soft brown scale	Insecticidal soap sprays such as Natrasoap work by blocking the breathing pores and dissolving the scales' outer covering so they dehydrate and die. Commercial soap sprays are based on potassium, will not harm beneficial insects and have a very low toxicity to people or pets. Oil sprays such as white oil and Pest Oil kill all stages of scale insects by suffocation. It has a low impact on beneficial insects. Oils kill all stages of scale insects by suffocation. Natural enemies of scale include ladybeetles, lacewings, spiders and tiny parasitoid wasps. On indoor plants small colonies of scale can be rubbed off by hand. Wear garden gloves and dip a toothbrush or a cotton bud in a soap solution. In the garden very heavily infested twigs can be pruned off, dropped into a bucket of soapy water, then composted or mulched.
Brown stomach worm	Various drenches can be used. Drench resistance in brown stomach worm is very common in all major sheep production areas of Australia. Often the worms are resistant to several drench groups. It is essential to have drench resistance test data in order to choose an effective drench, that is, one that will kill at least 95 per cent or more of the resident worms. Treatments for brown stomach worm are all broad spectrum or mid spectrum. Most are short acting. However, if effective, moxidectin gives not less than 14 days, injectable moxidectin gives up to 21

	days, long acting moxidectin injectible gives not less than 91 days and ivermectin or BZ slow release capsules give 100 days protection against incoming larvae. A number of combination drenches are also available. If there are any doubts about which drench is the best for the situation, professional advice should be sought.

Two marks were given if the answer clearly showed that the student knew the specific treatments for the pest or disease and one mark was given if their knowledge was limited to general treatments.

Question 2biv.

Disease or pest	Critical timing required for the treatments to efficiently manage the pest or disease
Red-legged earth mite	• Spring and autumn spray omethoate on the pasture at establishment, sow seeds coated in insecticide that prevents red-legged earth mite attacks on seedlings. • 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.
Footrot	Vaccines will not provide any significant benefit until after the second dose. It is therefore necessary to footbath sheep for 4–6 weeks until after the second dose is given. To maintain protection beyond 10–12 weeks a single booster dose is required, and should be repeated every 10–12 weeks while protection is necessary.
Mastitis	Research has shown that the two most common times when new infections of the udder occur are in the first few days after drying off, and also at and around calving. The period around calving (from two weeks before calving until two weeks after calving) is often the highest risk period for mastitis infections to occur.
Black spot	Spray a fungicide at the **first** sign of the disease.
Botflies	The most effective treatments should be applied one month after the first sighting of eggs to control second stage larvae.
Thrip	Spray applications are only effective when thrip are actively feeding as larvae or adults.
Ticks	Treatment may be needed every few weeks during summer when adult ticks are present in situations especially favourable to ticks.
Rusts	The earlier the development of rust epidemics, the greater the yield loss. Crops need to be monitored to detect rust early as timing is critical for the effective control of rust diseases with fungicides. Rust epidemics can be explosive and once out of control can be difficult to manage.
Coccidiosis	Birds can be given a low dosage rate of an appropriate coccidiostat in their feed or water when young to build immunity. Treatment with higher doses of coccidiostats should start immediately when coccidiosis has been diagnosed.
Citrus gall wasp	All of the actions have a critical time element to them if the plan is to be successful. The manager should have records from previous years. They should take weather conditions into account, start monitoring and take actions before wasp numbers build up. The wasp lays its eggs into new spring growth.
Soft brown scale	The best time to control scales is when the crawlers have recently emerged as they are more vulnerable to organic sprays than the adults with their thick shells. Correctly identifying the scale will help you to time this exactly but mid summer is common. Frenetic ant activity can indicate scale hatching periods. If you plan to spray, wait for settled weather with little wind and no rain. Spray in the early morning or late afternoon to avoid burning the leaves and to reduce the impact on beneficial insects.

Brown stomach worm	It takes around 21–28 days from when a sheep ingests the larvae to when worm eggs appear in dung samples. If the sheep are tested for worms using a worm egg count during the 21–28 day period, you may think that the sheep are free of worms when, in fact, they could have a considerable burden of larvae. If you think the sheep could be picking up worms after drenching, test at about 4–6 weeks when egg laying has commenced and you will have a much better idea of the rapidity and scale of the reinfection. Naturally, if a sustained action drench was used, the period from treatment to eggs in the dung is longer, being the length of action of the drench plus 21–28 days.

Two marks were given if the answer clearly showed the student knew the specific timing of treatment and control strategies for the pest or disease, and one mark was given if their knowledge was limited to general timing of control and treatment strategies.

Question 3a.

Marks	0	1	2	3	4	5	Average
%	8	7	7	15	27	35	**3.5**

Any five of:

- seed falls to the ground
- came in stock feed
- bought in on new stock, machinery, person/animal, including wild animals
- carried on the water
- carried in the wind
- explosive ejection
- rhizomes
- bulbs/corms
- stems/stolons/suckers
- roots.

This question was generally well answered.

Question 3b.

Marks	0	1	2	Average
%	37	44	19	**0.8**

Weeds and dispersal methods.

		Seed							Vegetative			
Common Name	**Scientific Name**	**S**	**stf**	**bq**	**ge**	**ho**	**wi**	**ee**	**rh**	**bu**	**st**	**ro**
African boxthorn	*Lycium ferocissimum*			x								x
African daisy	*Senecio pterophorus*					x	x					
African lovegrass	*Eragrostis curvula*			x								
Alligator weed	*Alternanthera philoxeroides*										x	
Bathurst burr	*Xanthium spinosum*			x		x						
Blackberry	*Rubus fruticosus* agg.			x							x	
Boneseed/Bitou bush	*Chrysanthemoides monilifera*	x		x		x						
Californian/Perennial thistle	*Cirsium arvense*						x					x
Cape broom (Montpellier)	*Genista monspessulana*			x								
Cape tulip	*Moraea flaccida*		x							x		
Cape weed	*Arctotheca calendula*			x		x						
English broom	*Cytisus scoparius*			x	x							
Fat hen	*Chenopodium album*			x								
Fennel	*Foeniculum vulgare*						x			x		
Flick weed (Hairy/common bittercress)	*Cardamine hirsuta*							x				
Gorse/Furze	*Ulex europaeus*			x				x				

Common Name	Scientific Name	S	stf	bq	ge	ho	wi	ee	rh	bu	st	ro
Hemlock	*Conium maculatum*		x	x		x						
Hoary cress	*Lepidium draba* or *Cardaria draba*)			x								x
Horehound	*Marrubium vulgare*			x		x						
Paterson's curse	*Echium plantagineum*	x	x									
Prairie ground cherry, Sticky Cape gooseberry	*Physalis viscosa*			x		x						x
Prickly pear (erect)	*Opuntia stricta*	x									x	
Oxalis	*Oxalis* sp.	x							x			
Ragwort	*Senecio jacobaea*			x		x	x					
Saffron thistle	*Carthamus lanatus*	x	x	x								
Serrated tussock	*Nassella trichotoma*		x	x		x	x					
Shepherd's purse	*Capsella bursa-pastoris*					x	x					
Soursob	*Oxalis pes-caprae*									x		
Spiny rush	*Juncus acutus*			x								
St John's wort	*Hypericum perforatum*	x							x			
Stinkwort	*Dittrichia graveolens*		x	x		x	x					
Sweet briar	*Rosa rubiginosa*			x		x						
Thorn apple	*Datura sp.*		x			x						
Tree of Heaven	*Ailanthus altissima*	x									x	
Tutsan	*Hypericum androsaemum*	x		x								
Wild garlic	*Allium vineale*									x		
Watsonia	*Watsonia meriana* var. *bulbillifera*									x		
Willow	*Salix* spp.					x					x	

S seed falls to the ground
stf came in stock feed
bq brought in on new stock, machinery, person/animal, including wild animals and birds
ge Garden escapee
ho Carried on the water
wi Carried in the wind
ee Explosive ejection
rh Rhizomes
bu Bulbs/corms
st Stems/stolons/suckers
ro Roots

The above table was derived from information found at <http://www.weeds.org.au/vicmap.htm> and weeds were mostly chosen for being classified noxious weeds across at least seven of the 11-catchment regions in Victoria.

One mark, up to a maximum of two, was awarded for each correct weed/spreading method identified.

Students commonly focused on weed spreading mechanisms caused by human activity rather than natural biological ones.

Question 4a.

Marks	0	1	2	3	4	5	6	Average
%	10	11	17	19	22	15	8	3.1

Question 4b.

Marks	0	1	2	3	4	5	6	Average
%	16	15	16	19	19	10	5	2.6

Question 4ai. and 4bi.
One mark was given for each nominated innovation that was clearly a new or emerging method or development that related to the business type chosen.

Although not as common as in previous years, a number of students still named examples that were clearly not new or emerging. Area of Study 2 of the study design requires students to have knowledge of new or emerging developments in five key management areas related to a specific business, so it should not have been difficult for students to name and describe two areas. Another common mistake students made was to name an area of technological change and not a specific example.

Below is a list of technologies named by students for each business type chosen. The example was either not a new or emerging technology (unless the description that accompanied it clearly showed a novel or new interpretation or use of the technology), or was too general and required the name and description of a specific example of the technology's application.

Beef cattle

- artificial insemination
- cloud seeding
- crossbreeding
- genetic engineering
- genetic manipulation
- genome mapping
- grain feeding
- growth food
- injections instead of drenching
- new feeding sheds
- pH in soil
- production rate
- selected breeding

Cereal cropping

- crossbreeding different plants
- direct drilling
- genetic engineering
- genetic modification of plants/crops
- genetically modified wheat
- GPS navigation
- modified crops
- new chemicals
- new croppers
- new harvester
- new spraying technology
- pest and disease resistant varieties

Dairy cows

- genome mapping
- GPS system
- irrigation
- milking room
- milking technology
- mobile phones
- producing hay quicker and faster
- rotary dairy
- rotary milking system
- shedding dairy cattle
- whole herd testing

Garden design/construction

- air pruning pots
- computer programs for garden ideas
- computers
- dripper system
- garden design
- glass house plants
- power tools

Field grown vegetables, herbs or flowers

- Bluetooth technology
- cloning
- computerised irrigation
- computerised watering system
- drip irrigation
- genetically modified plants
- GPS
- irrigation systems
- modern day tractor
- netting
- overhead sprinklers
- plant grafting
- precision agriculture
- sprinkler system
- water tanks
- water management
- water pump
- wind breaks

Fish or yabbies

- supplementary food for enhanced growth
- water containers

Production of fruit or nuts from trees

- spraying chemicals

Glasshouse plants

- automatic computer controlled glasshouse
- automatic irrigation
- automatic shade cloth
- automatic watering system
- climate control
- computer controlled technology
- computer operated windows in greenhouses
- drip irrigation
- glasshouse plants
- heat blanket
- heating mats
- overhead sprinklers
- temperature/humidity control
- temperature heating controls
- watering systems

Grapevines

- advanced water management
- grape picking machine
- growing rose bushes
- insects
- irrigation systems
- netting
- new and upcoming chemicals
- noise control

Horses for recreation

- artificial insemination
- bail feeder
- genetic engineering
- microchipping

Ornamental garden maintenance

- genetic modification

Sheep or goats

- artificial insemination
- electric shearer
- fodder sheds
- GPS
- milking system
- new drenches
- new improved presses
- new shearing techniques
- pour on drenches
- shearers
- shears
- ultrasound
- vaccinate

Question 4aii. and 4bii.
This answer did not need to contain highly technical detail, but it should have shown a broad understanding of the nature of the operation of the technology (how it works or how it is used), even if it is not an innovation. The answers had to focus on how it works, not what it does.

Two marks were given to answers providing accurate detail of the innovation's operation and one mark if the student only provided an overview of how the innovation works or is used.

Question 4aiii. and 4biii.
Key elements of the innovation's advantage over previously used technology had to be clearly presented, and all impacted areas of sustainability should have been included in the answer.

Three marks were awarded for a detailed discussion of improvements and their impact on sustainability of the business. Two marks were awarded if the main improvements were discussed and one mark if some, but not most improvements were presented.

These questions were generally answered competently. Students would have done better if they evaluated the impact of technologies on all the areas of sustainability.

Question 5a.

Marks	0	1	2	3	Average
%	14	51	27	8	**1.3**

Detachment: The bigger the drop the more impact on soil. When the raindrop hits the soil it loosens soil particles. Dislocated particles in surface flow dislodge other particles.

Transport: Flowing water takes particles away. The degree of slope increases speed of water and this increases the erosive power.

Deposition: Water follows path of least resistance and when it slows down particles are deposited at another site.

Three marks were given to answers that included all aspects of the answer, two marks for answers that had some concept of raindrops dislodging soil particles or particles in surface flow causing erosion, and one mark for answers that indicated that water washes soil away.

Very few students understood the detailed physical process of erosion. Having knowledge of the various causal factors of environmental degradation should make it easier for students to suggest a range of prevention strategies.

Question 5b.

Marks	0	1	2	3	Average
%	13	27	38	22	**1.7**

The things that happen as a result of erosion caused by water include:

- loss of physical material, perhaps causing a hazard
- reduced depth for plant roots
- less soil moisture stored for plant use, depletion of nutrients and organic material
- lowered plant growth and less organic cycling
- erosion products moving down the catchment and accumulating on lower lands, reducing stream health, and damaging public utilities such as roads, dams and ports
- turbidity in stored water
- reduction in land value.

One mark, up to a maximum of three, was awarded for each item mentioned. Students showed a sound knowledge of things that happen as a result of erosion caused by water.

Question 5c.

Marks	0	1	2	3	Average
%	22	36	33	10	**1.3**

The strategies land managers could use to stop erosion caused by water include:

- intercept with mulch, reduce immediate grazing pressure, maintain plant cover to reduce raindrops dislodging soil particles
- slow down the water movement over the slope – contour banks, physical barriers, hay/straw bales
- use cultivation sparingly – retain stubble
- control traffic flow to reduce runoff speed
- change irrigation practice to avoid splash erosion.

One mark, up to a maximum of three, was awarded for each correct strategy described.

Students had a general knowledge of strategies to stop erosion caused by water, but had difficulty distinguishing between those suited to maintaining economic production in the short or long term.

Question 5d.

Marks	0	1	2	3	Average
%	20	33	35	12	**1.4**

Strategies used to repair land affected by erosion could include:

- improvement of vegetation biodiversity to ensure ground cover in all seasons – a mixture but preferably grasses
- develop property management plan – realign fence lines to suit land use capabilities. Look at long-term grazing/cropping practice. Fence off areas with fast surface water flow, establish permanent plantings to reduce surface runoff speed
- whole catchment area planning with neighbours
- improve organic matter in soil to improve soil binding and increase water holding capacity aeration
- alter topography.

One mark, up to a maximum of three, was awarded for each correct strategy described.

Students had a general knowledge of strategies to repair land affected by erosion caused by water, but had difficulty distinguishing between those suited to maintaining economic production in the short or long term.

Question 6a.

Marks	0	1	2	3	4	Average
%	41	4	38	1	14	**1.5**

The indicators to assess suitability of a property for organic production include:

- pesticide residue in the soil – shows what has been done on the farm previously as residue will remain for a very long time. Residues must be below set tolerance levels
- prevailing winds – know where wind with potential sprays coming in are coming from
- number of pests/predators – must assess predators/pests abilities to produce without pesticides.

One mark each was given for correct identification of the indicator and for correctly explaining how the indicator would help decide suitability for organic business.

This question required students to understand and interpret information from the case presented in the question, and then select the two most relevant indicators that should be used to assess the suitability of the property for organic production from a provided list. Many students did not know the correct answer, implying a lack of knowledge of indicators, difficulty with the provided definition of organic production, or an inability to apply their knowledge to new situations. Knowledge of indicators and the selection and use of appropriate ones is essential for sound and timely agricultural and horticultural business management.

Question 6b.

Marks	0	1	2	Average
%	47	41	12	**0.7**

Indicators that could be used to assess whether runoff could become a problem include:

- surface flow of water
- water quality
- faecal content
- nutrient levels
- turbidity.

One mark, up to a maximum of two, was given for each correct indicator.

As in Question 6a., a large percentage of students did not know the correct answer, implying a lack of knowledge of indicators, difficulty with the concept of 'runoff', or an inability to apply their knowledge to new situations. Knowledge of indicators and the selection and use of appropriate ones is essential for sound and timely agricultural and horticultural business management. Their teaching should be integrated into most aspects of the study, rather than as an isolated part of it.

Question 6c.

Marks	0	1	2	3	Average
%	39	34	14	12	**1**

Steps to establish a whole property management plan include:

- get a large map/plan (aerial photo) of the property
- overlay the map/plan/photo with existing structures, services, access points, land classes, drainage lines, soil/surface types, existing plantings, weeds, salting, other problems, etc.
- confirm business objectives as suitable for the property
- on a second overlay indicate proposed improvements and alterations
- on a third overlay show existing improvements (and add improvements as they are completed)
- separately document priorities, a proposed time line and a budget including a cash flow statement, consistent with business objectives.

Three marks were given for answers that showed an understanding of the process and contained most of the required detail. Two marks were given if the answer provided an overview of the process but lacked some detail, and one mark was awarded to answers that were limited to having some concept of mapping resources, or objective setting, but little idea of what to do next.

This question, or a question similar to this, has appeared regularly on past examinations. Student results were disappointing. The process of property management planning should be practised regularly, step-by-step, so that all students can apply it to a range of agricultural and horticultural situations.

Question 6d.

Marks	0	1	2	3	4	5	Average
%	23	20	21	21	12	4	**1.9**

Management of the property to minimise the change of water degradation include:

- build up riparian zones, fencing, reduce/control grazing/cropping, slow down surface flow of water and improve soil infiltration in riparian zone. Maintain a diversity of plants in riparian zone
- carefully managing type and level of manures used to ensure runoff and subsurface flows are not high in nutrients and undesirable organisms
- managing grazing, cropping and machinery traffic to ensure water erosion does not become a problem due to lack of plant soil cover, or compaction allowing increased surface water speed
- continued monitoring of water quality
- implement physical changes to slow down flow of runoff to dam/stream.

Marks were awarded according to the table below.

Management issues considered	No explanation of strategy	Limited explanation of strategy	Rational, clear explanation of strategy
1	1	2	3
2	2	3	4
3	3	4	5

Many students made a sound start to answering this question, but commonly did not consider the total range of activities involved in property management. Have the students ever been asked to consider the number of areas of property management that impact on the health of the property? For example, animal feeding and control, pasture/crop health and nutrition, biodiversity maintenance, soil management, water management, degradation reduction. The provided case study also contained many clues that pointed at the areas requiring action. Students must be encouraged to think broadly with regard to achieving desired environmental outcomes when managing properties.

Question 6e.

Marks	0	1	2	3	4	5	Average
%	42	21	16	13	6	2	1.3

Organic production is more likely to increase biodiversity by allowing growth of a diversity of indigenous trees, shrubs and grasses to encourage a wide range of invertebrates and vertebrates.

Minimise the import of matter/energy in the form of fertilizers. Waste product from the property such as manure is used on the property so you are attempting to approximate a closed system.

Organic farming minimises the use of pesticides and herbicides, vaccines and drenches so as to more closely approximate a self-regulating and balanced environment.

Marks were awarded according to the following table.

Points considered	No explanation of strategy	Limited explanation of strategy	Rational, clear Explanation of strategy
1	1	2	3
2	2	3	4
3	3	4	5

The concepts of biodiversity, biomass, efficient use of energy and cycling of matter were poorly understood by students. This area of the study design requires more emphasis when planning the teaching program, and probably needs to be related closely to the student's small businesses so that they may get a more concrete example of each concept.

Question 6f.

Marks	0	1	2	3	4	5	Average
%	48	22	14	10	4	2	1.1

Increasing the number and type of plant and animal organisms will result in an increase in biodiversity. This will allow improved checks and balances on the property, resulting in reduced dependence on pesticides and herbicides. This benefits the environment by reducing the probable contamination and the development of resistance in pest organisms. Undesirable chemicals are not introduced into food chain.

A reduction in the use of pesticides and herbicides could result in an improved economic situation by reducing the need to purchase expensive chemicals, but may also result in a drop in income.

Organic farming will result in a reduced use of chemicals resulting in the community not ingesting unwanted chemicals. A possible reduction in allergies and chemically ingested residues.

Minimising the export of matter/energy in the form of waste product from the property will result in less dependence on inputs such as fertilizers that are costly.

Recycling of effluent back onto the property will minimise loss of organic matter and result in improved soil structure.

Organic farming is often more labour intensive, hence there will be more employment for local people.

Marks were awarded according to the table below.

Areas considered	No explanation of impacts	Limited explanation of impact	Rational, clear explanation of impact strategy
1	1	2	3
2	2	3	4
3	3	4	5

Few students were able to fully analyse the organic production approach using sustainability principles. Those that attempted to answer the question commonly limited their response to only one area of sustainability.

Question 7a.

Marks	0	1	Average
%	8	92	**0.9**

Examples of end products/services of various industries
cereal cropping grain
poultry for meat poultry meat
poultry for eggs eggs
beef cattle meat
Pigs meat
sheep or goats meat, wool, milk
dairy cows milk/cream
grape vines fresh or dried grapes, wine
fish or yabbies fish or yabby meat
turf production turf
garden design/construction Plans for a garden/designing and making a garden
ornamental garden maintenance a maintained garden
glasshouse plants (container) (ornamental) plants
container-growing ornamentals pot plants
field grow vegetables, herbs or flowers vegetable, herb, or flower products
production of indigenous plants indigenous plants
hydroponic production plants grown without soil
production of fruit/nuts from trees fruit or nuts

horses for recreation horses for riding
rearing rabbits for pet or meat market pet rabbits or rabbit meat

The answer must have been an end product/service of the business.

One mark was given if the end product was correctly stated, even if in a general form or as part of a list.

Many students were not specific when answering this question. They either gave a very general product category or listed many end products.

Question 7b.

Marks	0	1	2	3	Average
%	29	34	27	10	**1.2**

The quality standard should have been industry-based.

Industry End product	**How the industry the business belongs to measures the quality of this end product**
cereal cropping grain	Receival standards: criteria applied at point of grower delivery to handling/marketing system – variety, protein, moisture, screenings, defective grains, residual herbicides/pesticides, contaminants such as weed seeds, insects and non-millable material. Quality standards are crop specific and differ for various quality grades.
poultry for meat poultry meat	Harvested at night – calm, no bruising or skin damage, disease free, weight standards exist. Organic, free range, chemical free standards exist.
poultry for eggs eggs	Shell quality, cleanliness, container type and cleanliness, storage temperature (below 20ºC), minimum handling. All eggs should comply with the minimum quality standard for eggs.
beef cattle meat	Size, fat thickness, breed, Organic/free range, disease free. Cattle must be prepared properly prior to sale. The CATTLECARE system is an on-farm quality assurance program for producers raising cattle. CATTLECARE places particular importance on: • minimising the risk of chemical contamination through the safe, responsible use of chemicals • minimising bruising and hide damage • more effective management and herd improvement through better record keeping • participation in the program is voluntary.

Industry End product	**How the industry the business belongs to measures the quality of this end product.**
pigs meat	Size, fat thickness, breed, organic/free range, disease free Pigs must be prepared properly prior to sale. APIQ standards 2004 include: Q1 Transport and loading arrangements avoid sunburn, temperature stress and exposure Q2 Pigs that are significantly different in weight are separated from each other during transport Q3 Stocking rates for transport meet industry standards Q4 The trip to the abattoir is by the most appropriate route Q5 Electric prodders are not used for loading or moving pigs, except in necessary cases by trained operators Q6 Dogs used in loading and moving pigs are properly supervised to minimise stress and carcass damage Q7 The loading facility is managed to minimise stress
sheep or goats meat, wool, milk	**Wool** • accurate product description (diameter, yield, strength, etc.) • no contamination (either in bale or pack) • accurate product identification and associated documentation • timeliness of delivery • appropriate packaging • produced and supplied through a robust and highly creditable quality system (from the paddock to the processor) • meets customer order specifications • the ability to handle and trace back customer complaints and to correct mistakes so they do not occur again **Lamb** Size, fat thickness, breed, organic/free range, disease free, must be prepared properly prior to sale The Flockcare system is an on-farm quality assurance program for producers raising lambs and sheep. It addresses: • food safety, chemicals and residues • animal health, husbandry and welfare • preparation, presentation and transport. **Mohair** Kemp levels Micron and length, properly sheared and classed goats where possible should be shorn in age groups, starting with kids so as not to contaminate the finer lines with coarse hair. Fleeces must be skirted properly, removing coarse necks, britches, legs, stain, short pieces and second cuts (locks). **Cashmere** Cover: The ideal cashmere should have full body coverage. Down Length: Staple length is an important factor, contributing to Total Down Weight (TDW) and it must be a strong consideration for superior selection. The minimum length for cashmere shearing is 45 mm, to give a shorn absolute minimum fibre length of 35 mm. Density: A dense fleece will exhibit compactness and feel thicker ('wool like'). Density also contributes to TDW. Density, combined with good staple length, is a highly desirable characteristic. Fineness: There are three grades, premium fibre below 16 um, 16 to 16.6 um and 16.7 to

	18.5 um. Evenness: It is desirable to have a fleece with an even diameter from neck to breech. Handle: Cashmere is warm and extremely soft to touch. Combined with warmth and lightness, handle is the 'selling point' for Cashmere garments. Guard Hair Length: Animals may have long, medium or short guard hair. Yield: Yield also greatly affects TDW and should preferably be medium to high. Low yielding fleeces will incur greater costs in de-hairing and therefore return less to the producer per kilogram of de-haired cashmere. Colour: there are both white and coloured Cashmere goats. White Cashmere usually commands the highest price. White cashmere goats may only display a few scattered coloured guard hairs at most. Coloured cashmeres may have any colour guard hair. Their cashmere colour may range from light (non-pigmented down), to brown down. Fibre Type – Cashgora: Cashgora is a cross-bred fibre and is not acceptable. Cashgora is, broadly speaking, fleece with three fibre components, coarse guard hair, a fine (crinkled) down or 'cash' portion and the longer shiny and straighter 'intermediate' fibre or 'gora' component. There must be a down component.

Industry End product	**How the industry the business belongs to measures the quality of this end product.**
grape vines fresh or dried grapes, wine	**Wine** pH, total acidity, colour, sugar and tannins in grapes can be reliably measured, but the challenge exists to also measure agrochemical residues, fungal contaminants, flavour compounds and precursors and other precursors for colour and mouth feel. **Table Grapes** Variety, ripeness (sugar content), bunch size, damage, disease, packaging, organic or not, vine to shelf process and time. **Dried Grapes** Variety, moisture content, sugar content, bunch size, damage, disease, packaging, organic or not, vine to shelf process and time.
fish or yabbies fish or yabby meat	HACCP standard by AQIS Appropriate production/harvesting protocols, transport, wet storage, post harvest handling storage and labelling.
turf production turf	Species blend, density, height, colour, root depth, soil medium type, chemicals/fertilisers used, packaging/delivery method, water requirements.
garden design/construction Plans for a garden/design and make a garden	• brief developed with client • brief followed and achieved • laws and council regulations obeyed • industry minimum standards met • OH&S standards followed
ornamental garden maintenance a maintained garden	• brief developed with client • brief followed and achieved • laws and council regulations obeyed • industry minimum standards met • OH&S standards followed
glasshouse plants (container) (ornamental) plants	Market demand satisfied for particular species. For example, the number of flower buds, flowering stage, packaging type, media type, disease free, weed free, information and labelling.
container-growing ornamentals pot plants	Market demand satisfied for particular species. For example, the number of flower buds, flowering stage size and shape, packaging type, media type, disease free, weed free, information and labelling.
field grow vegetables, herbs or flowers vegetable, herb, or flower products	Market demand satisfied for particular species. For example, the number of flower buds, flowering stage, packaging type, media type, disease free, bruise and damage free, weed free, information and labelling.
production of indigenous plants indigenous plants	Market demand satisfied for particular species and seed source. For example, the growth stage, packaging type, media type, disease free, weed free, appropriate quantity, information and labelling.
hydroponic production plants grown without soil	Market demand satisfied for particular species. For example, the number of flower buds, flowering stage, packaging type, media type, disease free, weed free, information and labelling.
production of fruit/nuts from trees fruit or nuts	Market demand satisfied for particular species. Appropriate size, harvesting type, no damage, packaging type, labelling, disease and pest free.
horses for recreation horses for riding	• readily accessible food and water to maintain health and vigour • freedom of movement to stand, stretch and lie down • regular exercise • social contact with other horses or people • accommodation that neither harms nor causes undue strain, and provides adequate

	protection • protection from disease, and regular inspections to assess the need for attention to feet, teeth and parasite control • rapid identification and treatment of lice, injury and disease • adherence to various State codes
rearing rabbits for pet or meat market pet rabbits or rabbit meat	Meat similar to poultry for meat and sheep for meat. Size, fat thickness, breed, Organic/free range, disease free, must be prepared properly prior to sale Address: • food safety, chemicals and residues • animal health, husbandry and welfare • preparation, presentation and transport. Pet: Breed, age, sex, health, inoculations, disposition, training

Three marks were given for a detailed description of the industries quality standard, two marks if a number of aspects were considered but with little detail or important information missed and one mark if only one aspect of quality was considered.

Approximately one third of the students had a reasonable knowledge of industry quality standards. This is a pleasing improvement on previous years, however considering all students are supposed to have investigated quality standards as part of their small business project, it is disappointing.

Question 7c.

Marks	0	1	2	3	Average
%	35	38	22	5	1

Following are the steps in getting a product/service to the end consumer.

cereal cropping Harvest to truck, deliver to grain elevator depot, rail, processing, packaging, transport, processing, packaging, transport, retailer, delivery, use	**garden design/construction** Discuss brief, agree, preliminary plans, client agreement, permits, assemble materials at site, construct, inspections, sign off, use
poultry for meat, (Transport) Slaughter, plucking, gutting, cleaning, grading, packaging, refrigerating (freezing), delivery, retailer, use	**ornamental garden maintenance** Discuss brief, agree, assemble equipment and resources at site, maintain, cyclical frequency, client review, use
poultry for eggs Harvest, (packaging, transporting) candling, grading, cleaning, packaging, refrigerating, transporting, retailing, delivery, use	**glasshouse plants** Weed, clean, label, pack, transport to market /wholesaler/landscaper/retailer, display maintain, sale, use
beef cattle Muster, transport, auction/sales, abattoirs (slaughter, grading, cutting, packaging, transport, butchers/retailer, packaging sale and delivery, use	**container-growing ornamentals** Weed, clean, label, pack, transport to market /wholesaler/landscaper/retailer, display maintain, sale, use
Pigs Load on trucks, transport, auction/sales, abattoirs, slaughter, grading, cutting, packaging, transport, butchers/retailer, packaging sale and delivery, use (could also be contracted to supermarket chain or smallgoods manufacturer)	**field grow vegetables, herbs or flowers** Harvest/dig, chill, grade and clean, pack, label, transport to wholesale market, retailer, display, maintain, sale, use
sheep or goats Meat: muster, transport, auction/sales, abattoirs, slaughter, grading, cutting, packaging, transport, butchers/retailer, packaging sale and delivery, use	**production of indigenous plants** Weed, clean, label, pack, transport to contract buyer/market /wholesaler/landscaper/retailer, display maintain, sale, use

Wool: shear, grade, bale, transport, warehouse, auction, washing, scouring, etc., spinning, weaving, use	
dairy cows chilling, vat, transport, dairy/cheese factory, processing, packaging, transport, retailing	**hydroponic production** Harvest, chill, grade and clean, pack, label, transport to contract buyer/wholesale market, retailer, display, maintain, sale, use
grape vines Table: harvest, grade, pack, chill, transport, wholesale market, transport, retail, eat Dried: harvest, grade, drying racks, pack transport, process, packaging transport, retail, use	**production of fruit/nuts from trees** Table: harvest, grade, pack, chill, transport, wholesale market, transport, retail, eat Dried: harvest, grade, drying racks, pack transport, process, packaging transport, retail, use
fish or yabbies Harvest, ice, grade, process, pack, transport, retail, use	**horses for recreation** assemble equipment and feeds, etc. at site, maintain, exercise, groom, cyclical frequency, review, prepare for events, ride
turf production cut and roll, pack onto pallets/truck, transport, use	**rearing rabbits for pet or meat market** Meat: slaughter, skinning, gutting, cleaning, grading, packaging, refrigerating (freezing), delivery, retailer, use Pet: breeder, transport, retail market, or wholesaler to retailer, end owner

Answers should start with the producer preparation involved in harvesting, packaging and transporting to next stage: auction, market, wholesaler, warehousing, storage, slaughtering, processing, packaging, wholesaler, warehousing, storage, transporting, retailer delivery, use.

Three marks were awarded for a detailed description of the marketing channel, two marks if a number of aspects were considered but there were major deficiencies and one mark if only one or a very limited number of stages were described.

Students generally did not understand what the marketing channel was. All aspects of product marketing need to be covered by students in their small business project.

Question 7d.

Marks	0	1	Average
%	41	59	**0.6**

See table in Question 7e.

One mark was awarded for correctly identifying a risk that could be the major risk.

Many students appear not to have considered risk factors associated with their small business project's industry, and hence could not adequately answer this question.

Question 7e.

Marks	0	1	2	3	Average
%	33	41	21	4	**1**

Type of business: possible major environmental risks	How to minimise the impact of this risk
cereal cropping: unseasonal weather, acidification, catchment-wide problems of salinisation, rusts	Insurance, irrigation, adoption of ecological principles
poultry for meat: Infectious Bursal Disease (IBD), also known as Gumboro, Avian flu	Vaccinate, keep wild birds away from poultry, hygiene

poultry for eggs: Infectious Bursal Disease (IBD), also known as Gumboro, Avian flu	Vaccinate, keep wild birds away from poultry, hygiene
beef cattle: soil structure decline, rainfall reliability, seasonal climate variation influencing pasture availability	Fodder reserves, monitoring, soil compaction, acidification, maintaining appropriate soil cover
Pigs: disease, effluent treatment and disposal, animal welfare	Maintain access restrictions to property to reduce disease, strong hygiene protocols on the property, recycle and reuse effluent, monitor water quality in area, invest in welfare friendly structures and practices
sheep or goats: soil structure decline, rainfall reliability, seasonal climate variation influencing pasture availability	Adoption of ecological principles, fodder reserves, monitoring, soil compaction, acidification, maintaining appropriate soil cover
dairy cows: effluent management and environmental degradation, rainfall reliability, seasonal climate variation influencing pasture availability	Adoption of ecological principles, fodder reserves, monitoring, soil compaction, acidification, maintaining appropriate soil cover, recycle and reuse effluent, monitor water quality in area
grape vines: Managing herbicide and pesticide use, rainfall levels, root aphid.	Resistant rootstock use, adoption of IPM practices, mulching, adoption of ecological principles. Improve water harvesting and reuse
fish or yabbies: water quality/pollution, disease spread	Limit and control quality of inputs, monitoring and swift action of containment if problems occur
turf production: water shortage leading to urban restrictions	Use of drought tolerant species, diversify into artificial turf, add installation of grey water irrigation systems to business
garden design/construction: injury to workers from heavy outdoor work and weather exposure, machinery	Occupational health training for all staff, regular equipment checks and safety refreshers, reward correct use of equipment. Stretching and physiotherapy. Sunscreen and protective uniforms
ornamental garden maintenance: injury to workers from heavy outdoor work and chemicals, machinery	Occupational health training for all staff, regular equipment checks and safety refreshers, reward correct use of equipment. Stretching and physiotherapy. Sunscreen and protective uniforms. Chemical training and handling practices monitored
glasshouse plants: water shortage leading to urban restrictions	Grow low water use species, improve water recycling and use efficiency, water holding crystals in media
container-growing ornamentals: rainfall reliability, seasonal climate variation	Grow low water use species/varieties, improve water recycling and use efficiency, water holding crystals in media
field grow vegetables, herbs or flowers: rainfall reliability, seasonal climate variation	Grow low water use species and varieties, improve water recycling and use efficiency, water holding crystals in soil
production of indigenous plants: water shortage leading to restrictions	Improve water recycling and use efficiency, water holding crystals in soil
hydroponic production: water shortage leading to urban restrictions, cost of energy/chemicals	Only grow high return crops to cover costs of the inputs. Monitor inputs carefully to reduce waste, improve water recycling and use efficiency

production of fruit/nuts from trees: rainfall reliability, seasonal climate variation	Grow low water use species/varieties, improve water recycling and irrigation use efficiency, mulching, improve water harvesting and storage
horses for recreation: effluent management and environmental degradation, rainfall reliability, seasonal climate variation influencing pasture availability	Monitor inputs carefully to reduce waste, improve water recycling and use efficiency, harvest and sell horse manure, reduce water runoff, Monitor nature and density of pasture and soil changes
rearing rabbits for pet or meat market: disease outbreak, effluent treatment and disposal, animal welfare	Maintain access restrictions to property to reduce disease, strong hygiene protocols on the property, recycle and reuse effluent, monitor water quality in area, invest in welfare friendly structures and practices

Three marks were given if an overall strategy to minimise the impact of the risk was given, two marks were given if no overall approach was presented but more than one action to reduce the risk was suggested, and one mark was given if only one point was listed.

Many students appear not to have considered risk factors associated with their small business project's industry, and hence could not adequately answer this question.

Question 7f.

Marks	0	1	2	3	Average
%	32	30	33	5	1.1

Records that a business must keep to document its cash flow include:

- a record of expenditure (receipts)
- a record of income (invoices)
- the date payments are made/received.

One mark, up to a maximum of three, was given for each item listed.

Students are expected to be able to evaluate the performance and outcomes of a small commercial agricultural or horticultural business in relation to its business plan. Cash flow is one of the most basic measures that all businesses need to monitor; hence students should know what is involved to record it. Only a small percentage of students could answer this question correctly.

Question 7g.

Marks	0	1	2	3	Average
%	34	31	27	8	1.1

Productivity: A measure of the efficiency of production. Tonnes per hectare, stocking rate, etc.

Profitability: The difference between income and expenditure for business over a nominated period of time (profit), but more correctly a ratio of some type.

Sustainability: The ability of the business to survive long term without impacting negatively on the environment or community

One mark, up to a maximum of three, was awarded for each term that was correctly explained.

As stated above students are expected to be able to evaluate the performance and outcomes of a small commercial agricultural or horticultural business in relation to its business plan. Understanding the three terms examined in this question is critical to being able to do this. The percentages above give a clear indication of how many students were able to do this.

'Profit' was an acceptable answer to profitability but in future profitability ratios that allow better comparison of a businesses financial efficiency would be expected. For example, profit as a per cent of investment or turnover.