VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2010 Agricultural and Horticultural Studies GA 3: Written examination

GENERAL COMMENTS

Areas of strength and weakness

Techniques for modifying climate, water, soil/growing media and topography were generally well understood and students were familiar with environmental modifications that influence plant and animal production. When considering environmental modifications, students needed to consider the impact on financial, marketing and human aspects as well as biophysical aspects.

Students demonstrated an adequate knowledge of management of a specific pest and disease, and many could apply Integrated Pest Management (IPM) strategies. It was pleasing to see many students apply IPM strategies correctly to weed management.

Students described a good range of technological innovations. They demonstrated knowledge of new and emerging techniques in a number of technical areas, and most students were able to correctly name and discuss two or three techniques. However, some students used examples that were not new or emerging.

Students were aware that sustainability involves the biophysical and socioeconomic environment, but very few could present specific examples related to a specific business type's activities and community concerns.

The main weakness demonstrated by students was the inability to answer questions that required judgment, evaluation or interpretation of a case study or the provision of specific information related to an example. This may be improved if students are given more opportunity to be involved in discussions that help them to form a considered opinion about topical issues in agriculture and horticulture. The collection of information, and the interpretation and evaluation of it so as to form a well-supported opinion, should be fostered through class or small group debate of industry and local issues.

While students generally understood the role of indicators in aiding resource management, specific use of them in business decision-making and land management was poor. The concept that the best 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 good general knowledge of the management of environmental degradations affecting agriculture and horticulture, although many could not distinguish between strategies for fixing existing degradation and preventing degradation from occurring.

Some aspects of agricultural and horticultural business management were not well understood by most students. Very few students could use a business example to demonstrate an understanding of quality management. Quality management involves quality control of the inputs, processes and outputs of a business. All students should be able to give examples of these for at least one business type. Students' knowledge of the difference between the information used to evaluate a suitable business location, a property management plan and a business plan with its various components could be improved.

Choice of options to answer

Students needed to select an option from the provided lists of alternatives in Questions 2 and 6.

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. Marks were allocated to specific elements of the correct answer or according to descriptive criteria. Marks were not deducted if students provided incorrect answers.

SPECIFIC 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 1ai.

Marks	0	1	2	Average
%	21	50	29	**1.1**

Methods to improve soil fertility on the property, besides adding fertiliser, include (any two of):

- change the pH
- add manure
- grow and incorporate a nitrogen-fixing crop/green crop
- add compost or an organic mulch (mulching only was not accepted)
- add worms.

This question was generally well answered.

Question 1aii.

Marks	0	1	2	Average
%	29	54	17	**0.9**

Methods to improve the drainage of the soil on the property include (any two of):

- add gypsum or lime
- add worms
- add organic matter
- drainage pipes
- grow a deep-rooted cover crop
- raise beds/alter topography
- deep rip and cultivate.

Some students ignored the fact that this question related to managing a field crop and not container-grown plants, and included options that were not appropriate.

Question 1bi.

Marks	0	1	2	3	Average
%	1	28	65	6	**1.8**

Advantages of changing the environment by growing herbs in a fully enclosed polyhouse instead of in the open field include better control over:

- the temperature
- soil/growing-medium moisture levels
- light levels
- humidity
- wind or air movement
- pests, vermin and some diseases
- spray drift from chemical/water application
- the protected working environment
- the security of crop from theft
- the protection from physical damage storms/hail/sunburn)
- the ability to extend growing season
- growing plants unable to be grown in the field
- the planting height – better ergonomics for workers.

Students achieved two marks by stating the physical environmental advantages of polyhouses. Students who discussed broader issues such as the working environment and impact on production usually achieved full marks.

Question 1bii.

Marks	0	1	2	3	Average
%	16	62	22	0	**1.1**

Advantages of changing water management by growing herbs hydroponically instead of in soil beds include:

- accurate water and nutrient application
- exclusion of soil-borne pests and disease
- better control of root environment – temperature and moisture level
- easy application of some pesticides
- no weed competition
- possible advantages to harvesting for some crops
- plants may be marketed in their growing container/medium
- growing medium is often lighter than soil, so transport costs are reduced
- may more readily satisfy hygiene and quarantine standards for export or interstate trade
- less waste water from run-off and easier collection
- prevention of water stress to plant
- more intensive cropping – uses less land.

It was evident that many students understood the concept of hydroponics. Many students equated hydroponics to the use of glasshouses or polyhouses.

Question 1ci.

Marks	0	1	2	3	Average
%	23	36	31	10	**1.3**

The effect on crop yields of correct fertiliser application includes:

- increased crop yield and quality. Some fertilisers are better for leaf production and some for flower/seed production. Choosing the correct balance of nutrients for the production type will ensure efficient production
- correct levels of application. Ensure there is no environmental damage through leaching of excess chemicals, the maintenance of soil health, avoidance of nutrient toxicity/deficiency problems and the best benefit/cost balance
- healthy plants will have reduced pest disease problems. This leads to reduced pest disease management costs and lowers the potential for environmental impact
- increased turnover/productivity.

Full marks were given for two well-explained points. Most responses included one or two points, but the quality of explanations varied greatly. It was of concern that many students could not give one effect of correct fertiliser application on plants.

Question 1cii.

Marks	0	1	2	3	Average
%	18	31	38	13	**1.5**

A grower may best decide how much fertiliser to apply to a crop by:

- using test strips/plots. On small portions of the area being cropped, apply different rates/types of fertiliser and measure/compare the results. Use this to guide next year's fertiliser application
- laboratory soil/leaf testing and analysis. Take samples across the field being used and map the soil nutrient status. Use this to guide application types, rates and variations
- crop/paddock records. If paddock/soil type has previous cropping history, review this history for trends and issues (for example, leaf discolouration indicating a deficiency) and then apply fertiliser to alter the trend or to solve the issue appropriately
- basing the decision on the crop grown. Different crops have different fertiliser needs at different times of the year
- considering pH and nutrient uptake. The pH of soil influences availability of nutrients
- following the recommendations on the packaging.

Full marks were given for two well-described points.

This question was generally well answered. The most common answers included some form of testing and visual monitoring/records of previous crops.

Question 1ciii.

Marks	0	1	2	3	Average
%	10	41	34	15	**1.6**

Problems that may occur as a result of the use of too much fertiliser on a crop:

- poor plant growth/death of plant. Too much fertiliser interferes (salt concentrations stops water transfer and fine roots die) with water uptake of the plant and can 'burn the roots'
- water flowing through the soil and leaching the excess fertiliser, leading to environmental problems such as water pollution, algal build-up, salting and biodiversity reduction
- soil health reduction. Chemical overload causing soil organism deaths, reduced biodiversity, loss of soil structure and health, perhaps leading to acidification
- uneconomic and wasteful – due to the cost of fertilisers, which may then need to be leached
- rapid weak growth, making plants more vulnerable to pest and disease attack.

Full marks were given for two well-explained problems.

Poor plant growth, death and environmental issues were common answers. Some students' explanations were insufficient to be awarded full marks.

Question 2a.

Marks	0	1	Average
%	33	67	**0.7**

Weed	Business type affected
African lovegrass	Grazing – Palatable only in the early stages of growth when other more palatable feed is available and becomes unpalatable when seeding
Scotch thistle	Grazing – Can injure the mouths of stock and reduce the value of meat/wool if seeds are within the thistle
Paterson's curse	Grazing
St John's wort	Grazing – Poisons animals and affects those with less coverage to skin (poison is activated by sunlight). Can kill sheep if they eat 4% of live weight (less when the plant is flowering). Horses are the most sensitive, followed by cattle and sheep, and goats are the least affected. Affected animals generally recover after three–six weeks once their access to the plant is removed, but sheep with early signs of poisoning typically recover within 12 hours if they are moved indoors. Poisoning can reduce milk yield and cause abortions in animals. The plant is more toxic when it is in flower and may contain more than 50 times more hypericin in early summer than in late winter. Narrow leaf forms of the plant can be twice as toxic as broad-leaved biotypes. Plants become markedly more poisonous when the flowering shoots have grown 5–10 cm high. Hay containing St John's wort also causes poisoning.
Wild radish	Cropping – Wild radish can cause substantial crop yield reduction, seed contamination and tainting, and can make combine harvesting difficult. The weed is relatively unpalatable to stock and can be toxic if ingested. Wild radish is also an alternative host or reservoir for a number of pathogens and insect pests of grain crops.
Wild oats	Cropping – Winter cropping cereal systems. Phytotoxic chemicals that leach from wild-oat straw can inhibit the germination and growth of other plants.
Flick weed	Gardening and lawn care, nurseries, amenity horticulture
Oxalis	Gardening – May invade lawns and displace desirable grasses Grazing – May cause oxalate poisoning in livestock if eaten Nursery – A problem in pots
Dandelion	Amenity horticulture – Lawns Nurseries

One mark was awarded for correctly identifying a business type affected by the selected weed.

Question 2b.

Marks	0	1	2	3	Average
%	39	38	16	7	**0.9**

Weed	Practices to prevent the weed from becoming a problem for the business
African lovegrass	Seed can be spread short distances by wind and is also dispersed by animals, machinery, vehicles and in hay. It is readily spread during road construction in contaminated soils. Prevention • control of movement of machinery, hay and stock through infested areas • windbreaks may reduce movement from nearby areas • vigorous competition from crops and pasture
Scotch thistle	Scotch thistle is a competitive weed in improved pastures where it favours soils with high levels of nitrogen. Scotch thistle is avoided by stock because of its dense spines; this encourages its spread in heavily grazed pastures. The main dispersal method is by seed, but cultivation can spread root pieces, which will establish if soil moisture is adequate. Seeds have a pappus of toothed hairs that helps dispersal by attaching to clothing and animal coats. The pappus is not adequate for wind dispersal of seed, but seed heads and stems can be transported by strong wind and water. Seed can be spread in contaminated hay, silage, grain and farm machinery. Prevention • Avoid using contaminated hay, silage, grain and farm machinery. • Windbreaks may reduce movement from nearby areas. • Clean areas should be kept free of the thistle and managed to prevent infestation. • Careful grazing management is necessary to minimise bare ground, which assists thistle seedling establishment.
Paterson's curse	The aim of prevention activities is to avoid the deposition of Paterson's curse seed in areas free of the weed. Preventative management is a good investment because it requires few resources and minimises the chances that large expenses will later be incurred for control works. Prevention • Ensure hay and other fodder is free of seed and that seed for planting is not contaminated. Obtain verification from fodder and seed suppliers that their products are grown in clean areas and are free of contamination. If contaminated fodder is used, it should be fed out only in areas that are already infested or in a defined area that is regularly monitored and can be readily treated should an outbreak occur. • Maintain a competitive cover of desirable pasture species. • Apply the same standards to soil, sand and gravel as are applied to fodder. Work towards an infested area when earthworks are undertaken, not away from it. • Seed can be carried in the coats and digestive tracts of livestock. Sheep that have recently been shorn are less likely to have contaminated fleeces. Sheep require three days to void internally carried seed. Stock that has grazed in infested areas should be quarantined for several days to minimise the risk of the introduction of seed. The quarantine area should be regularly inspected and any plants that appear should be removed before they flower. • Use only vehicles, machinery and equipment, including those of contractors, which have been thoroughly cleaned after being used in infested areas. • Where a property already has infested areas, internal quarantine measures should be practised. Produce from infested areas should be separated from that grown in clean areas. Weed-free buffer zones should be maintained between infested and non-infested land. • Contractors, roadside maintenance staff, etc. should be trained to identify and report infestations and to manage them in a way that will prevent spread.
St John's wort	Seeds adhere to stock and other animals and are carried in their digestive tract. Seedlings have been observed in cattle dung. Seed spreads only short distances by wind, but can be carried long distances by water, machinery and animals. Rhizomes grow horizontally, producing buds

	that form new crowns. Cultivation may spread pieces of rhizome that produce new plants. Prevention • Be aware of potential sources of infestation. • Stock grazed in infested areas should be quarantined before movement to clean areas. Removal of plants from laneways, stock routes and roadsides should be a priority. • Machinery and vehicles used in infestation areas should be cleaned. • Ensure fodder is not contaminated and use certified seeds. • Isolated plants are readily identified and conspicuous when in flower. Pull seedlings by hand and use hand tools to dig out larger plants before the seed is shed. Ensure that most of the rootstock is removed. Revisit the site regularly to check for new growth. • Elimination of rabbits will remove the selective grazing pressure that favours the weed and assists with limiting spread as seeds stick to rabbits' fur and feet.
Wild radish	Prevention • avoid the introduction of seed in contaminated crop seed • thorough cleaning of machinery and equipment • sow clean seed from wild radish-free areas • avoid buying hay or chaff from wild radish infested areas and quarantine stock that have recently been in infested areas to reduce wild radish spread
Wild oats	Prevention • Sow clean crop seed. • Prohibit a new seed set that will result in exhaustion of the seed store over time (3–5 years). • Have a fallow period of up to three months after harvest as seed is likely to germinate in freshly cultivated soil. If you wait, the viability of the seed decreases and is more likely to be affected by fungal diseases. • Machinery and equipment should be cleaned when moving between paddocks. • Harvest clean paddocks first. • Cover grain loads, use only clean seed (always check the certificate and be aware that certified seed may still contain small amounts of wild oat seeds). • Feed out hay or silage in specified areas (especially if brought in) as it may contain herbicide-resistant wild oat seeds.
Flick weed	Prevention • Use clean potting mix from reputable suppliers. • Keep records of any problems with potting mixes. • Have a weed management program. Cooperate with neighbours. • Undertake regular inspections and follow-up work. • Be persistent in implementing a long-term management plan. Seek professional advice. • Keep all nursery areas 'weed free' – do not allow seed banks to establish in and around working areas. • Inspect all new plant materials for infestation (very common in nurseries). Hand weed before seed ripens.
Oxalis	There are masses of underground bulbs that are spread by water, birds, in dumped garden waste and during cultivation. Seeds are readily spread by soil and water movement and may also be scattered by machinery such as lawn mowers. Prevention • Mulching is effective in late winter for preventing the germination of dormant seed. • Use clean potting mix from reputable suppliers. • Keep records of problems with potting mixes. • Have a weed management program. Cooperate with neighbours. • Undertake regular inspections and follow-up work. • Be persistent in implementing a long-term management plan. Seek professional advice. • Keep all nursery areas 'weed free' – do not allow seed banks to establish in and around working areas. • Inspect all new plant materials for infestation (very common in nurseries). Hand weed before seed ripens.

Dandelion	Because dandelion seed can be wind-borne for several miles, prevention of new infestations is difficult. Solitary new dandelion plants along fence rows, roadsides, flower beds and in turf grass should be grubbed out (digging out the entire plant – including the taproot) before it produces seed. Monitor the area for several months to make sure that removal is complete. • Areas with infestations should be isolated and seed heads removed until control can be accomplished. Keep a healthy lawn so that there is nowhere for weeds to germinate, and if they do germinate, they are smothered by preferred grasses. • Use clean potting mix from reputable suppliers. • Keep records of any problems with potting mixes. • Have a weed management program. Cooperate with neighbours. • Undertake regular inspections and follow-up work. • Be persistent in implementing a long-term management plan. Seek professional advice. • Keep all nursery areas 'weed free' – do not allow seed banks to establish in and around working areas. • Inspect all new plant materials for infestation (very common in nurseries). Hand weed before seed ripens.

Full marks were given for an answer that demonstrated that the student knew how to prevent the chosen weed from becoming a problem for the business.

Question 2c.

Marks	0	1	2	3	Average
%	17	54	23	6	**1.2**

Weed	Practices to control the weed, including timing
African lovegrass	Control of African lovegrass must be integrated into an overall land management program. In arable areas, cultivation and cropping or the establishment of vigorous perennial pasture will give good control. Newly sown pastures should be spelled for at least a year to aid their establishment, and African lovegrass seedlings should be removed from the sward by hoeing or with herbicides. In non-arable areas, the possibility of utilising the plant as a pasture species should be investigated, especially at its palatable early growth stages. The plant quickly loses palatability after jointing occurs, although feed quality can be maintained by top dressing, especially with nitrogen, and heavy rotational grazing. All dead matter should be removed by burning in autumn or mid-spring (not winter), and the pasture should be grazed heavily in the first summer then over-sown with clovers the following autumn. Heavy rotational grazing should be commenced when the African lovegrass grows through the clover sward.
Scotch thistle	Seed can germinate at any time of the year; however, there are two main germination times – late summer to autumn and late winter to spring. Priorities for controlling different infestations must be worked out when planning a Scotch thistle management program. Clean areas should be kept free of the thistle and managed to prevent infestation. Lightly infested areas are best cleaned up as soon as possible to prevent spread. Extensive infestations are best quarantined and tackled progressively as part of pasture improvement programs in conjunction with other control techniques. • Cultivation – Ploughing is effective in killing young plants, provided they are completely turned over. This is best achieved with a mouldboard plough. • Slashing or mowing – These techniques are usually not effective because cut plants can regrow from the base and cut flowering stems may still produce fertile seed. • Pasture management – Strong, competitive, well-managed pastures are effective in shading thistle seedlings, reducing establishment of the weed during the main germination periods. Careful grazing management is necessary to minimise bare ground, which assists thistle seedling establishment. • Grazing – Goats have been used at the flowering stage to reduce seed production. Fencing must be adequate to restrict the animals to the chosen control area. Keep in mind that browsing animals eat a range of vegetation and may destroy desirable plants as well as thistles. • Manual Control – Isolated plants can be grubbed. Remove as much of the taproot as possible to prevent regrowth.

	• Chemical Control can be used – herbicides • Biological Control – A program is underway to introduce a number of natural enemies of Scotch thistle from Europe. Insects that reduce seed production are being released and several others are being evaluated. Biological control is a long-term program that is best used on large chronic infestations with a low priority for control due to inaccessibility, remoteness or low threat of spread.
Paterson's curse	In intensively managed pastures, a combination of autumn treatment with a herbicide that is selective for broadleaf weeds, spring grazing and pasture renovation after the following autumn break is the best approach. Extensive infestations on grazing land are best quarantined and tackled progressively as part of pasture-improvement programs. In general, a management plan should involve the integration of a number of control techniques coupled with good pasture management to give the best long-term results. After re-sown pastures establish, appropriate grazing management, fertiliser regimes and weed control maintenance programs are vital to keep them free of the weed. In more extensive, lower productivity grazing systems, grazing management, with biological control and spray grazing during winter, is the best strategic approach. All management programs in pastures should integrate control techniques with complementary changes to overall management that ensure the maintenance of a competitive cover of desirable pasture species. Spot spraying or herbicide application through a wiper and manual removal techniques should be used to control infestations on roadsides and small outbreaks in other areas. Slashing and mowing before flowering may be effective, but timing is critical to prevent seed set. The use of residual or non-selective herbicides is a major factor contributing to vigorous regrowth of the weed in following seasons. Often all that grows in areas treated this way is Paterson's curse, and it flourishes owing to the lack of competition. The lack of competing vegetation has a huge influence on the growth of the weed. The most important aims of a control program are to: • target the rosette stage with a selective broadleaf herbicide • ensure there is competition from other plants that can replace the weed • follow up and persist in implementing a long-term management plan.
St John's wort	General approach Integrated management strategies are required to effectively control St John's wort. These strategies must involve setting priorities for controlling different levels of infestation and choosing appropriate treatment methods for each infestation. Clean areas should be kept free of St John's wort and managed to prevent infestation. Lightly infested areas should be cleaned up as soon as possible to prevent spread. Extensive infestations are best quarantined and tackled progressively over several years. Specific actions • Cultivation – Cultivation can be effective on arable land when followed by the sowing of competitive pasture or crops. Cultivate in summer to expose and to dry out as many of the roots as possible. • Pasture management – Superphosphate and subterranean clover have been used to control St John's wort since the early 1950s. The clover provides dense shade, which kills the non-flowering stems of the weed. Phalaris is a suitable grass for the pasture mix. Soil testing should be carried out to help determine the most appropriate fertiliser strategy to apply. Advice on superphosphate application and choice of effective pasture species should be sought from a pasture specialist. • Grazing – Stock generally avoid St John's wort and light stocking of infested areas can favour the weed by reducing competing plants. However, cattle, sheep and goats can be used very effectively in an integrated control program and the feed value of St John's wort leaves is high. In the past, coloured breeds of goats and cattle and dark-skinned sheep have usually been recommended, as they are less affected by the plant's toxicity. But recent research has demonstrated that ordinary grazing stock can be used if certain precautions are taken. Light infestations can be controlled by heavy grazing, and heavy infestations on non-arable land can be controlled by a long-term grazing management program or on arable land by

ploughing, sowing of improved pasture and heavy grazing. All livestock are more susceptible to hypericin poisoning in sunny conditions. Sheep that have been recently shorn are more susceptible because their skin has greater exposure to sunlight. Sheep with fine and superfine wool appear to be better protected and are therefore more tolerant of the plant. Heavy grazing of broad-leaved biotypes of St John's wort with Merino wethers with at least four months' wool growth from late autumn to early spring will suppress the weed and is safe. Safe grazing of narrow-leaved biotypes with sheep is only possible from early July to mid September. Fencing to create smaller paddocks should be used to increase the grazing intensity. The presence of adequate shade will improve the performance of the sheep. Cattle can be used to graze the weed before and after sheep because they are more tolerant of hypericin. Alternatively, rotational grazing with the stock removed after a one- or two-week exposure to the weed and returned after five weeks can allow infested pastures to be grazed with limited ill effect on stock. Heavy grazing on the prostrate stems during winter and early spring can significantly reduce the vigour of the weed. Because new growth has lower hypericin production, the safe grazing period can be extended by heavy grazing, and as the density of an infestation is reduced, less of the plant will be ingested by grazing livestock, allowing for further extension of the safe grazing period. Animals showing symptoms of poisoning should be moved into full shade, preferably inside a shed, for at least four to seven days. Graziers intending to use livestock to control the weed should familiarise themselves with the recent research.

- Afforestation – St John's wort cannot survive in dense shade. Planting of pines will suppress the weed, but St John's wort is often the last plant to disappear as the canopy closes and reappears when the plantation is harvested.
- Chemical treatment – Chemical (herbicide) treatment can be a key part of the St John's wort integrated management plan but it is not desirable to have it as the only control action. Herbicide applications tend to be least effective in dry, rocky, hill country with shallow soils. Herbicides should be applied to actively growing plants early in the flowering period (late October to December) and when the soil is moist. In pasture situations, grazing can be used before herbicide application to reduce grass cover and expose more of the weed. Seedlings are most readily killed by herbicides than established plants, which may require repeat applications. When spot spraying, aim to completely wet the plant to cause run-off. Add a dye or spray marker to the spray mixture to identify treated areas.
- Ongoing management
  - Cooperate with neighbours.
  - Undertake regular inspections and follow-up work.
  - Be persistent in implementing a long-term management plan.
  - Seek professional advice.
- Biological control – Two species of beetle, first released in the 1930s, have established in Victoria: *Chrysolina hyperici* and *C. quadrigemina*. The adult beetles are bronzy black, dark blue or purple, about 6 mm long and oval in shape. The larvae are orange with dark heads and the eggs are orange. Larvae and adults defoliate the weed. Larvae attack the winter growth and adults attack the spring growth. Within a few years at favourable sites, the beetles reach densities that are high enough to cause complete defoliation. The beetles are effective in open, unshaded country in conjunction with improved pasture.
  The St John's wort gall midge *Zeuxidiplosis giardi*, first released in Australia in 1953, has red larvae that develop in circular galls on the leaves. It is generally ineffective but is most abundant in damp, shaded situations. An aphis, *Aphis chloris*, released in 1986–87, spreads rapidly and is well established. It contributes to biological control of the weed; however, it only weakens plants for a short time. The St John's wort aphis has no preference between sunny and shaded areas and is most commonly found on flowering stems in summer. The St John's wort mite *Aculus hyperici*, first released in 1991, has no preference between sunny or shaded areas. The mites stunt the growth of both rosettes and flowering stems, gradually weakening plants over a period of months and reducing vigour and seed production. The mite is invisible to the naked eye. It is present throughout the area infested by St John's wort in Victoria and has a significant impact. The crown and root-boring beetle *Agrilus hyperici* was introduced many years ago but failed to persist in Victoria. Several native insects attack St John's wort and may occasionally cause significant damage. Biological control is a long-term program that is best used on large, chronic infestations with a low priority for control due to inaccessibility, remoteness or low threat of spread.

Wild radish	Wild radish has developed resistance to multiple herbicide groups in Western Australia and is one of the most widespread and troublesome weeds of cereal and grain legume crops in southern Australia. It requires integrated weed management, incorporating a range of chemical, cultural and biological weed control techniques and a proactive approach to weed management (Table 2). In cereal crops, there is a very wide range of effective herbicides available for wild radish control. Fewer herbicides are available for use in pulse crops. The only option for canola is to use herbicide-tolerant varieties. A number of herbicides are available for wild radish control in pastures. Grazing is unlikely to reduce seed production unless the stocking rate is very heavy. Spray grazing is effective if high stocking rates are used. Wild radish, especially the seed, can be toxic to livestock. A non-crop phase should be included at least once every four years in the rotation and preferably two every five years. Tight rotations such as the wheat-lupin rotation commonly used in Western Australia have been shown to favour wild radish. Cereals are more competitive and have more effective, cheaper in-crop herbicide options than pulses, therefore wild radish should be controlled in the cereal phase of the rotation. A high seeding rate, narrow row spacing and precision fertiliser placement should all be used to maximise the competitive ability of the crop. The effects of wild radish competition begin early in the crop. Yield increases are greatest when wild radish is controlled at the 2–5 leaf stage of the crop. Residual herbicides are often preferred due to the staggered germination of wild radish. Survivors of pre-emergent and early post-emergent herbicide applications should be prevented from setting seed in case of resistance.
Wild oats	Seed is dispersed in spring and may be reduced by slashing or grazing infestations. It is not always necessary to remove the plant because, as an annual, it will die at the onset of summer. Management programs should aim to prevent seed production and seedbank inputs every year while minimising reductions in grain yield and quality. Infestations should be controlled as early as possible after emergence as wild oats do the most damage due to competition early in the growing season. Integrated weed management programs should be based on long-term considerations, including seed production and the possibility of herbicide resistance developing. There are significant potential economic benefits associated with long-term integrated weed management systems for the control of wild oats and in particular the inclusion of increased crop competition, selective spray topping, and crop and pasture rotations. The most effective way of reducing wild oat seedbanks is crop and pasture rotation (compared to tillage and herbicide strategies). Alternative crops and pastures enable the use of other control methods such as grazing, slashing, hay making and herbicides with different modes of action. Weed control may also be cheaper in some phases of the rotation, such as in pastures, compared to crops. Incorporating a pasture phase can prevent seed set of wild oats and significantly reduce the seedbank for the cropping phase. There are a number of herbicides available for the control of wild oats in crops. Although these can significantly reduce wild oat populations, when used alone they often fail to give satisfactory control of seed set due to the staggered germination pattern. In addition, several herbicides are no longer effective on wild oats due to the development of herbicide resistance. A variety of pre- and post-emergent herbicides should be used, and herbicide mode of action groups should be rotated to delay the onset of herbicide resistance if it has not already occurred.
Flick weed	For container nurseries • Use pre-emergent herbicides, for example Rout or Ronstar, in pots. Bioweed can be used as an alternative. • Granulated herbicide needs to be applied on dry wind-free days. A blower can be used to remove any herbicide adhering to foliage. Follow up with irrigation over foliage. Normally applied at re-potting. Spring is a common time for re-potting in container nurseries. • Follow up with hand weeding before any surviving weeds are too big and before they produce ripe seed.

<table>
<tr><td></td><td>For gardens
Controlled by spraying, for example, glyphosphate, on actively growing weeds as early in the cool season as possible to avoid seed set.
Hand or mechanically weaken or remove weed before seed ripens.</td></tr>
<tr><td>Oxalis</td><td>Flowers June–October

<table><tr><th>Control</th><th>Time applicable</th><th>Notes</th></tr><tr><td>Grubbing</td><td>All year</td><td>Remove entire plant including bulbs. Due to the numerous small bulbs, this can be a very tedious task.</td></tr><tr><td>Mulching</td><td>All year</td><td>Heavy mulching will suppress oxalis.</td></tr><tr><td>Herbicide</td><td>Spring, summer, autumn</td><td>Herbicides such as glyphosphate, metsulfuron and dicamba.</td></tr></table></td></tr>
<tr><td>Dandelion</td><td>Wind-borne seed – Remove flowers before seeding, taproot must be completely removed or it will regenerate. Apply broad leaf herbicide in autumn just before the weed goes dormant to reduce number/growth in spring. Apply mulch to smother weeds.

For container nurseries – Use pre-emergent herbicides, for example Rout or Ronstar, in pots. Granulated herbicide needs to be applied on dry wind-free days. A blower can be used to remove any herbicide adhering to foliage. Follow up with irrigation over foliage. Normally applied at re-potting. Spring is a common time for re-potting in container nurseries. Follow up with hand weeding before any surviving weeds are too big and certainly before any produce ripe seed.</td></tr>
</table>

Full marks were given for an answer that demonstrated that the student knew how to control the chosen weed when it is present.

Many students confused ‘preventing the weed from becoming a problem’ and ‘controlling the weed where it is present’. Most students knew general management strategies but could not provide detail with regard to a specific weed. Some very detailed answers were presented, often including timing recommendations.

Question 3a.
This question required students to name and describe four different new and/or emerging technologies.

Question 3ai.

Marks	0	1	2	Average
%	36	36	28	**0.9**

Question 3aii.

Marks	0	1	2	Average
%	46	33	21	**0.8**

Question 3aiii.

Marks	0	1	2	Average
%	56	29	16	**0.6**

Question 3aiv.

Marks	0	1	2	Average
%	66	22	12	**0.5**

For Questions 3ai.–3iv., one mark was awarded if the example given was a new or emerging technology and it was named adequately. Two marks were given if the description showed some understanding of the new or emerging technology, its purpose and/or how it works or how it is applied.

It was pleasing to read the range of new or emerging technologies that students had studied. There was good variety, and in some cases some very specific knowledge was presented.

Of concern, however, was the number of students who did not receive any marks for these questions. The most common reason for this was that the example given was not new or emerging technology. The *VCE Agricultural and Horticultural Studies Study Design* has specific definitions of 'new and emerging' technology.

Question 3b.

Marks	0	1	Average
%	31	69	**0.7**

One mark was given for correctly stating the technology replaced by one of the new or emerging technologies described in 3a.

Question 3c.

Marks	0	1	2	3	4	5	6	Average
%	12	19	23	23	15	6	2	**2.4**

Students needed to evaluate the impact on the economic, social and environmental sustainability of a business from using the technology chosen in 3b.

Most students could list advantages or disadvantages of the technology's introduction, but very few could evaluate and judge the impact of the new or emerging technology.

Question 4
Question 4i.

Marks	0	1	2	3	Average
%	37	40	20	2	**0.9**

Agricultural or horticultural business examples of sustainable management of environmental health should show that:

- water, land and biological resources are managed for long-term maintenance or improvement in biodiversity
- no degradation is likely to occur from practices
- any existing degradation is being addressed.

Full marks were awarded when the answer demonstrated an understanding of the long-term nature of environmental sustainability using a relevant specific example.

Students demonstrated a general understanding that sustainability is 'not harming the environment', but most could not offer much detail regarding or examples of sustainable management practices to show how 'not harming' is achieved.

Question 4ii.

Marks	0	1	2	3	Average
%	53	39	8	0	**0.6**

Agricultural or horticultural business examples of sustainable management of profitability included:

- cover the costs of management over time
- costs and profit margin need to be sustainable with the capital value of business to survive long term
- to maintain a regular, constant customer base a business must be profitable in the long term
- if the business cannot survive in the long term, suppliers may also fail
- all members of the marketing channel (suppliers, customers, agents, transport, consultants, etc.) rely upon the survival of each other and pricing and support must ensure this is possible.

Full marks were awarded when the answer demonstrated an understanding of the long-term nature of sustainable profitability using a relevant specific example.

Many answers to this question were limited to 'a profit is needed to survive'. However, profitability is a bigger issue than a single business's profit margin. Sustainable profits are dependent upon the survival and cooperation of all members of the marketing channel.

Question 4iii.

Marks	0	1	2	3	Average
%	55	35	9	2	**0.6**

Agricultural or horticultural business examples of sustainable management of social responsibility included:

- balance between wages and profits, health and safety in the workplace, education needs
- balance between customer prices and profit
- all members of the marketing channel (suppliers, customers, agents, transport, consultants, etc.) rely upon the survival of each other and community support must ensure that this is possible
- access to staff, demographics – support existing community structures.

Full marks were awarded when the answer demonstrated an understanding of the long-term nature of social responsibility using a relevant specific example.

Students demonstrated little concept of the range of issues that could be included under 'social responsibility'. Most answers were limited to 'getting along with neighbours' or similar. In most areas, local and regional newspapers would provide many examples of issues that could be discussed. The current debate about water allocation in the Murray-Darling River catchment highlights the balancing of environmental, profit and social sustainability goals.

Question 5ai.

Marks	0	1	Average
%	55	45	**0.5**

Given the information presented in the case study, the most likely environmental degradation problem in the smallest paddock is soil compaction. Water logging was also accepted.

Many students listed another form of degradation.

Question 5aii.

Marks	0	1	2	3	4	Average
%	43	38	16	3	0	**0.8**

Changes to the management of the property to fix the degradation problem included:

- fence off the worst-affected areas
- deep rip and incorporate gypsum/lime
- establish deep rooted pasture plants; for example, Lucerne
- incorporate organic matter; for example, manure.

Many students seemed to confuse this and the next question.

Question 5aiii.

Marks	0	1	2	3	4	Average
%	27	35	28	9	0	**1.2**

Changes to the management of the property to prevent the degradation problem from reoccurring include:

- lower stocking rate
- put in a laneway for stock movement
- don't over-graze paddocks, keep a cover of deep rooted vegetation; for example, lucerne
- supplementary feed to reduce grazing pressure
- rotational graze, ensuring paddocks are rested and allowed to build a thick cover of pasture
- don't drive a tractor on the pasture in wet conditions
- feed in laneway during winter.

When degradation occurs it requires treatment to fix it. Properties that do not have a specific degradation issue need to implement management practices to prevent it from developing. The treatment is often different from the prevention practices. Students should consider these two aspects separately for all degradation types. Some students could do this correctly for compaction.

Question 5b.

Marks	0	1	2	3	4	Average
%	22	39	30	7	2	**1.3**

Indicators that could be used to measure the success of the strategies listed in 5a. included:

- visual indicators; for example, is the water pooling?, healthy pasture growth in terms of colour, composition, density
- soil bulk density of subsoil – how easy is it to dig?, readings taken from a penetrometer.

Most students listed a form of visual assessment, but often gave an inadequate description of exactly what was being measured, monitored or assessed, especially with regard to a relevant criterion that may be compared or recorded for future management planning.

Question 5ci.

Marks	0	1	2	Average
%	30	53	17	**0.9**

Two locations on the property that indigenous seedlings should be planted for maximum long-term benefit are:

- boundary or fence lines
- riparian zone (along the creek).

This question was generally well answered.

Question 5cii.

Marks	0	1	2	3	4	5	6	Average
%	22	17	17	18	16	8	2	**2.3**

The benefits of planting the seedlings in the locations identified in 5ci. included:

- windbreak – reduce seed deposit from north or south west
- windbreak to protect horses from hot/cold winds
- windbreak to increase pasture production
- run-off filter for water entering creek
- protect the creek bank from erosion/mass wasting
- increase biodiversity on the property, reduce the need for pesticides/herbicides
- lower water table and reduce water-logging and possible salinity build up
- the seedlings will grow and become a timber lot in the future.

Answers to this question were often general in nature. Students who achieved high marks related the benefits specifically to the case study property.

Question 6

Answers to this question were to relate to a specific business type chosen from the list in Table 2.

Question 6a.

Mark	0	1	2	3	4	5	6	7	8	9	Average
%	10	10	15	18	15	10	9	7	4	2	**3.6**

The monitoring and management of a business' inputs, processes and outputs to ensure quality standards are achieved and maintained could include the following.

Inputs

- lack of impurities
- correctly formulated
- within use-by dates
- always available when required
- produced in an ethical manner
- produced in a sustainable manner
- produced by appropriate and up-to-date equipment
- healthy trained workforce used to produce inputs
- procedural manuals for use of inputs available where appropriate

Processes

- efficient (done to appropriate standards)
- timely
- safe
- hygienic
- no stress or inappropriate practices on animals or employees
- sustainable (three areas) management/maintenance practices
- ethical procedures

Outputs

- a sustainable product or service
- industry/community standards met; for example, correct labelling used
- no unnecessary packaging or waste
- matched to customer expectations
- no negative health implications

While most students were able to list inputs, processes and outputs for their chosen business type, very few gave an example of or explained how the inputs, processes and outputs would be monitored or managed to maintain appropriate quality standards. Class or group discussion may assist students to become familiar with the components of management that contribute to the maintenance of quality standards.

Question 6b.

Marks	0	1	2	3	Average
%	28	32	25	15	**1.3**

A business plan describes all aspects of how the business will achieve its objectives, including:

- a description of all the operations of the business and the resources, including labour required
- a financial plan including an overall budget and input/output costing over time
- a marketing plan that describes the target market, its requirements and how these will be satisfied (product, people, price, promotion, placement).

The property management plan analyses the available land resource and suggests changes and/or how to use this to achieve sustainable business objectives by:

- mapping the current land use, land classes, soil types, degradation, buildings, fences, water, etc.
- after review, proposing changes to the land use that are necessary to improve degraded areas and prevent further degradation**.**

If the answer showed a complete understanding of the difference, and listed the broad information types included in each then it was given full marks.

This question was answered well by some students. However, some students did not receive any marks for this question. This was surprising given that all students would have been involved in production of a business plan as part of their small business project.

Question 6c.

Marks	0	1	2	3	4	5	6	7	8	Average
%	11	9	14	18	20	14	8	5	1	**3.3**

Examples of factors that need to be considered by a business when choosing a location include the following.

Physical environment

- aspect/topography, soil, water, rainfall, sunlight, extremes, humidity
- requirements of the types of crops and stock and their growing structures

Marketing

- location in relation to suppliers, customers and facilities that add value to the product; for example, an abattoir
- the media is available for the producer to gain knowledge about the product and about markets for the product
- price point based on target customer location

Government policies and regulations

- permits and regulations for operation
- set up structures, zoning, use of chemicals, water management and retention, health and safety/WorkCover

Community members affected by the business

- access to/for workers
- impact on neighbours
- local interest groups, unions

Most students' answers were very general and they did not use their chosen business type as an example. Most marks were gained for answers related to the physical environment and marketing. Students demonstrated little knowledge of the influence of government policies or regulations and community groups on the location of an agricultural or horticultural business.

Question 6di.

Marks	0	1	Average
%	18	82	**0.8**

One mark was given for listing a pest or disease that affected the chosen business type.

Question 6dii.

Marks	0	1	2	3	4	5	6	7	8	Average
%	20	11	18	18	11	9	6	4	3	**2.8**

Using the four main elements of Integrated Pest Management (IPM), a strategy to manage the pest or disease listed in 6di. would include:

- prevention strategies
- monitoring for critical levels
- treatment methods
- appropriate timing/frequency components.

Many students answered this question in some detail, although few chose to use headings based upon the IPM elements. Most students included prevention and control strategies, but often ignored the importance of timing and how to monitor the seriousness of the pest or disease outbreak.