2015 VCE Agricultural and Horticultural Studies examination report

General comments

For the 2015 Agricultural and Horticultural Studies examination, students needed to prepare for the major component of the study: modifying the climate, soils and topography to maximise plant and animal production. Most students were able to show a reasonable understanding of how to modify climate and soils; however, many responses lacked sophistication. Students' responses to Question 2, about fixing a pH problem on an oval, were not strong. Many students did not state that the soil needed to be tested using a pH test kit to determine whether the soil was either acidic or basic and, from these results, suggest a plan of action. The reasons for changing topography were well understood; however, students were not always able to explain how a farmer would physically undertake these changes. Many responses showed that students did not understand what was required.

When preparing for the examination, students should refer to the current *VCE Agricultural and Horticultural Studies Study Design* and the examination specifications and sample questions for Agricultural and Horticultural Studies. 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.

This report should be read in conjunction with the 2015 VCE Agricultural and Horticultural Studies written examination.

Specific information

This report provides sample answers or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding resulting in a total more or less than 100 per cent.

Question 1

Marks	0	1	2	3	4	5	6	Average
%	2	2	10	17	32	23	14	4

Students were required to state ann action that could be taken to improve plant production in two different production types.

Method 1: Greenhouse production

Reduce the humidity of the greenhouse.

Possible responses included (one of):

- minimise water use
- provide good air flow/fans/vent

- do not use overhead water – use drippers
- plant further apart
- increase air flow by pruning
- water at the start of the day, not night.

Provide UV protection for plants in summer.

Possible responses included (one of):

- paint the covering
- provide shade from the sun
- place shade cloth over the roof.

Improve moisture capacity in the growing media.

Possible responses included (one of):

- add water-retaining crystals to the mix
- add organic matter/compost/sawdust/peat
- add vermiculite
- add clay.

Method 2: Field cropping

Improve the organic composition of the soil.

Possible responses included (one of):

- plant a green manure crop
- add compost
- add manure
- incorporate previous cropping waste/stubble mulching.

Reduce the effect of wind on a cut flower crop.

Possible responses included (one of):

- plant a windbreak
- plant taller species for crop protection
- align the rows across prevailing wind.

Reduce the effect of soil compaction.

Possible responses included (one of):

- use minimum tillage
- use wide tyres on tractor and/or wide implements
- use tram lines
- control traffic lanes in paddock
- deep rip the soil.

Question 2a.

Marks	0	1	2	Average
%	57	38	5	**0.5**

Students were required to describe a plan to fix the pH problem on a sports oval that had bare patches with no grass and some yellowing of the grass in certain areas caused by incorrect soil pH.

The first step is to test the pH of the soil. From these results the students then needed to state the course of action.

- If acid, add lime.
- If alkaline, add sulfur or iron sulfate.

Question 2b.

Marks	0	1	2	Average
%	28	63	9	**0.8**

Students needed to describe how the use of a green manure crop, such as legumes, could improve the future productivity of a growing area for a vegetable or cereal crop. Possible responses included:

- when turned into the soil it will improve soil structure
- it can provide a break in pests/diseases for following crops
- it adds organic material to the cropping area
- it improves the nutrient levels in the soil
- legume crops can provide nitrogen for following crops
- it increases organic matter, earthworms and beneficial microorganisms
- it aids in moisture retention in the soil.

Question 3a.

Marks	0	1	2	Average
%	30	43	27	**1**

Students were asked to identify two reasons for modifying farm topography. Reasons included:

- can aid flooding or water control on slopes
- can increase area that can be farmed
- allows for precision irrigation
- steep land surfaces can be farmed
- improves drainage and reduces waterlogging.

Question 3b.

Marks	0	1	2	Average
%	35	58	7	**0.7**

This question required students to describe how the modification identified in part a. could be achieved.

Modification	Description of how modification could be achieved
laser levelling	using laser levels and earth scrapers to remove or build up areas as in a paddock
contouring	raising banks to follow the contours around sloping land
terracing	cutting terraces using earthmoving machinery
raised beds	plowing paddocks to build raised beds and drains in between using laser and earthmoving equipment

Most responses stated the name of the modification but did not state how this modification could be achieved; for example, what machinery is needed and how the modification is performed. Many students interpreted the question as asking what advantages this would bring to the farm; for example, better application of water on property. This was not the correct way to respond.

Question 3c.

Marks	0	1	2	3	Average
%	44	35	19	2	**0.8**

This question asked students to describe the effect that the modification described in part b. would have on productivity and explain how this would affect sustainable production on a farm.

Modification	Description of effect on productivity	Explanation of how it would affect sustainable production
laser levelling	• better control over water management • allows for precision irrigation • collection and re-use of irrigation water • less water being wasted • reduces water entering and raising the water table, leading to an even pasture or crop growth rate • efficient use of irrigation water	efficient use of irrigation water, reducing water quantity required and reducing costs
contouring	• reduces run-off and helps to retain moisture in the soil • improves production output • reduces erosion issues, leading to retention of top soil and greater productivity • collects and retains irrigation water for re-use	more efficient use of rainwater, reducing erosion, reducing costs and maintaining productive land
terracing	• creates useful cropping land on steep sites • increases the area of productive land • retains moisture and prevents erosion, leading to improved cropping results • improves drainage through the soil and allows root penetration and improved crops	takes land that may not have been very productive and allows greater usage while reducing erosion risks
raised beds	• improved drainage, leading to less waterlogging • reduced compaction	allows for waterlogged land to be brought into production

Question 4

Students demonstrated a thorough understanding of the general effects of weeds on commercial horticultural or agricultural businesses. However, some students were unable to make the distinction between weeds that are crop-specific and those that are generally a problem in grazing situations. Question 4c., which related to producing weed-free oaten hay, was not answered well. Very few students suggested the biosecurity measures that could have been implemented.

Question 4a.

Marks	0	1	2	Average
%	16	46	38	**1.2**

Students were required to choose a weed from the given table and describe two effects that this chosen weed has on commercial agricultural or horticultural business production. Possible answers included (any two of):

- competition with plants for light, nutrients, moisture and space, reducing availability of farming land
- reduced biodiversity of production system as weed becomes dominant
- reduced yields or quality of products such as wool, meat, grain and plant products such as hay, potted plants, etc., because of the presence of weed seeds and plant material
- weeds may harbour plant and animal diseases/pest animals
- weeds use stored soil water that could be used by subsequent crops
- weeds can be toxic to stock
- weeds can cause tension between neighbours
- increased costs to the business due to control.

Although students were generally able to suggest effects that weeds have on production, many were not able to distinguish between weeds that are predominately or exclusively related to grazing situations and not cropping, and vice versa. Students require a better understanding of the situation that these weeds are found in.

Question 4b.

Marks	0	1	2	Average
%	39	37	24	**0.9**

Students were required to outline the responsibilities of a landowner in relation to the control and management of their chosen category of noxious weed in relation to The Victorian *Catchment and Land Protection Act 1994.* The Act describes four categories of noxious weeds.

Category of noxious weed	Responsibilities of a landowner in relation to the control and management of the category of noxious weed
state prohibited weeds	They are to be eradicated from Victoria if possible, or excluded from the state. The Victorian Government is responsible for their eradication but, under Section 70(1) of the *Catchment and Land Protection Act*, it may direct landowners to prevent their growth and spread if it is reported.
regionally prohibited weeds	Landowners, including public authorities responsible for crown land management, must take all reasonable steps to eradicate regionally prohibited weeds on their land.
regionally controlled weeds	These invasive plants are usually widespread in a region. To prevent their spread, ongoing control measures are required. Landowners have the responsibility to take all reasonable steps to prevent the growth and spread of regionally controlled weeds on their land.
restricted weeds	This category includes plants that pose an unacceptable risk of spreading in this state and are a serious threat to another state or territory of Australia. Landowners are prohibited to trade in these weeds and their propagules, either as plants, seeds or contaminants in other materials.

Question 4c.

Marks	0	1	2	Average
%	52	36	12	**0.6**

Students were asked to describe two processes that a farmer could use to ensure her oaten hay met the Japanese market specifications and remained weed free. Answers needed to consider treatments that aimed to:

- deplete weed set and seed bank

- kill weed seedlings
- prevent seed set
- stop additional seeds entering cropping areas from viable seed sources.

Control method	Process
physical control methods	• good crop hygiene – cleaning machinery and equipment before moving paddocks, feeding livestock in controlled areas to minimise seed spread, using clean certified seed to establish crop • cultivation, hard grazing, cutting hay/silage (before seed set) to reduce seed burden in paddocks • well-maintained fallow • burning of plant residues after cropping completed • establish shelter belts to intercept seed spread in the wind
chemical controls	• crop rotation allows for the use of different post-emergent chemicals to target particular grass or broad leaf weeds (selective herbicides) • spot spraying of affected areas • rotation of chemicals with different modes of activity to prevent chemical resistance • spray topping affected areas and grazing • delaying sowing to allow weed germination controlled by knockdown herbicides
biological controls	Introducing biological control methods for any of the prevalent weeds, such as: • capeweed – insect biological control options • scotch thistle – insect biological control (weevils), goats • wild radish – pathogens of *Brassica* family • annual rye grass – no recognised biological control.

Question 5a.

Marks	0	1	Average
%	22	78	**0.8**

This question required students to choose a pest or disease they had studied and state a specific agricultural or horticultural business that their chosen pest or disease had affected.

Most students could state a specific business type. An example of a response that was too general was: ‘the livestock industry’.

Question 5b.

Marks	0	1	2	Average
%	13	58	29	**1.2**

Students needed to state two effects that their chosen pest or disease would have on the agricultural and horticultural business given in part a.

Question 5c.

Marks	0	1	2	3	Average
%	7	26	34	34	1.9

This question required students to list three symptoms or signs that would indicate the presence of the chosen pest or disease.

Question 5d.

Marks	0	1	2	3	4	5	Average
%	15	19	23	26	13	4	2.2

This question required students to describe an integrated pest management strategy for the chosen pest or disease and outline of a management timeline that could be used to efficiently manage or control the chosen pest or disease. Also required were strategies that would need to be used to monitor and record an integrated pest management strategy to see if it was working.

Students are required to study the specific pests and diseases listed in the table for Question 5. A suggested management plan to either prevent or control these pests or diseases is a basic requirement of the study. The scores achieved show that improvement is needed in this area of study.

Common name of pest or disease	Business	Effects on business	Symptoms or signs	Integrated pest management strategies
aphids	ornamental plants, vegetable production, nurseries	reduced productivity, visual look, cost of control	visible wilting, discolouration, visible secretions, presence of ants	sticky strips, mesh on air intakes, predatory insects, host plants
intestinal worms (ruminants)	cattle, sheep, horses, poultry, etc.	reduced productivity, cost of control	anaemia, loss of condition, eggs in manure, dirty back end of animals	drench and quarantine new animals, rotational grazing
Johne's disease	sheep, cattle, goats	reduced productivity, cost of de-stocking	wasting, death of animal	buy from clean herds or vaccinated animals, sell stock under 12 months of age
leaf rust	nurseries; e.g. roses	lower value of stock, cost of control	discolouration of leaves, stunted growth	remove diseased stock, reduce humidity
one of: • *wheat rust* • *barley rust* • *grapevine rust* • *rose rust*	wheat, barley, grapevine, rose	lower value of stock, cost of control	discolouration of stems and leaves	improve varieties, wider planting
one of: • *cattle lice* • *sheep lice* • *equine lice*	cattle, sheep, horses, poultry	lower value of stock, reduced productivity, cost of control	scratching, rubbing, hair/wool on fences, dull coat	drench and quarantine new animals, double fencing

Common name of pest or disease	Business	Effects on business	Symptoms or signs	Integrated pest management strategies
• *chicken body lice* *pinkeye (conjunctivitis)*	sheep, cattle, goats	potential blindness, lower value of stock, reduced productivity, cost of control	cloudiness and discharge from eyes, loss of body condition from poor eyesight	reduce working stock on windy/dusty days, remove infected stock
subacute ruminal acidosis (SARA)	sheep, cattle, goats	reduced productivity, possible death of animal	hard to detect until fatal, may have reduced appetite, reduced milk production in lactating animals	manage feed intake, maintaining fibre ratio
western flower thrips	nurseries and vegetables	reduced productivity, cost of control	visible distortion of new growth, discolouration	removal of infected plants, predators

In response to Question 5d., students satisfactorily stated the signs and symptoms of their pest or disease and explained how the business could be impacted. However, few were able to state ways of controlling and monitoring the pest or disease using a specific methodology. Students need to have a detailed knowledge of a range of tools needed to control their chosen pest or disease and this is a core requirement of the study.

Question 6

Students were required to read a brief case study focusing on various forms of land degradation. Responses ranged from simplistic to comprehensive. Most students were able to identify the degradation type but struggled with methods to manage the situation. Explaining how to measure the success of the management technique was not well achieved. Many students misread the question. Students were also limited in their response when required to state, using a scientific method, how to determine the correct measures that should be taken to rectify the problem. Sufficient time should be spent focusing on this area of study throughout Units 3 and 4.

Question 6a.

Marks	0	1	2	3	4	5	6	Average
%	9	12	11	20	21	18	9	3.2

Students were asked to identify three environmental degradation issues evident in the scenario given in the question and describe an appropriate method to manage and resolve the issue.

Issue	**Method to manage and resolve the issue**
Soil acidification • mainly free of large trees or shelter belt • paddocks near the creek have thistles and nettles present • paddock histories indicate large amounts of nitrogenous fertiliser	• soil test for a correct fertiliser application, test and adjust the soil pH • limit or cease application of urea • limit nitrogen application; minimise grazing • adjust with a cropping program • test pH and add lime if required • rotate crops • strategically apply fertiliser
Waterlogging Soil compaction • there are patches within cropping paddocks of the new farm that stay wet in winter • the pasture is stunted	• wet patches in cropping paddocks • treat for poor drainage with increased drainage • deep rip to increase drainage for short-term improvement • apply gypsum for long-term improvement • consider raised beds
Eutriphication • water in the creek becomes stagnant and turns green • the creek banks become boggy	• fence from stock to prevent cows from entering the water • adjust the fertiliser program to prevent excess fertiliser from leaching • improve the drainage and plant buffer area to reduce run-off into the waterway • establish a riparian zone • ensure no overgrazing, fence and plant shelter belts • fence the creek area from stock, plant grasses to filter the run-off water • plant water-tolerant species in the creek to naturally filter the water
Salinity • in the lower regions of the creek a white substance is evident when the water levels decrease • barley grass, dominant grass species • yellowing grasses	• plant salt-tolerant species in the creek area • improve drainage to limit flooding • plant trees in recharge area and fence off
Weed infestation • paddocks near the creek have thistles and nettles present	• spray with glyphosate • physically remove weeds • adjust pH of soil towards pH 6.5 • use biological methods to control weed infestation; for example, goats
Turbidity in creek • cows like to cool off in the water and the creek banks become boggy	• fence off creek to stock • use alum as a flocculent

Question 6b.

Marks	0	1	2	3	4	5	Average
%	32	25	17	16	9	1	**1.5**

Students were required to select one method from their response to part a. and explain how the success of that method could be measured.

The success could be measured by:

- measuring the pH of the soil after application of lime
- measuring the nitrogen level in the water
- measuring the level of algal bloom in the water
- measuring the electrical conductivity of the water in the creek
- measuring soil compaction using a penetrometer (compaction)
- using a Secchi disc to measure turbidity.

In the second part of the response students were required to indicate the success measures.

Answers to the second part of the response in relation to the success measures should have included:

- a reduced weed presence
- a reduced nitrogen level in the water
- a reduced presence of an algal bloom
- a reduced level of nitrogen in the soil
- an improvement to pasture growth rates
- balanced nutrient levels
- improved drainage of soils
- a reduction of wet patches and stunted growth
- improved water quality of creek water
- a reduced presence of salt on the surface.

Question 6c.

Marks	0	1	2	3	Average
%	56	25	13	6	**0.7**

Students were given a scenario in which a company had completed soil testing across a property and had discovered that the cropping paddocks had been overcropped and the subsoil had a hardpan. They were asked to outline a small-scale trial, based on scientific methodology, that a manager could use to assist in deciding how to rectify the problem.

Students should have stated:

- an aim or purpose for the investigation
- the design of the method to be undertaken to carry out the investigation
- identification of the variables within the experiment; for example, how a hardpan is broken, the amount of organic matter added and which crop is to be sown
- establishment of the controls against which the data is compared
- selection and use of appropriate materials
- application of randomisation and repeatability when necessary
- recognition and elimination of experimental errors whenever possible
- identification of the relevant data to be recorded
- an understanding of how the data would be interpreted and analysed
- what areas needed to be selected for the trial.

Specific treatments that could have been mentioned included:

- sow test crop
- spray out the grasses/weeds
- deep rip dry soil to shatter the hardpan
- cultivate the top soil.

Question 7

For Question 7, students were generally able to state the major greenhouse gases produced through agricultural activity. They were also able to state the likely changes to the Victorian climate. Many struggled to state how these changes would impact on their chosen business. Suggested management strategies to counteract the impact of climate change were also limited.

Question 7a.

Marks	0	1	2	3	Average
%	10	15	21	54	**2.2**

The names of the major greenhouse gases produced as a result of each of the following processes or activities were required.

Process or activity	Major greenhouse gas produced
the transport of supplies and products to and from agricultural and horticultural businesses	carbon dioxide – CO_2
the digestion process in ruminant animals	methane – CH_4
the decomposition of animal urine	nitrous oxide – N_2O

Question 7b.

Marks	0	1	2	Average
%	15	38	47	**1.3**

Students were asked to identify two different changes to Victoria's climate that are expected as a result of global warming. Any two of the following were required:

- more frequent extreme natural events such as storms, heatwaves, drought and flooding
- increase in mean/average temperatures throughout the year
- increased frequency of very hot days
- decrease in average annual rainfall
- shift in rainfall pattern.

Question 7c.

Marks	0	1	2	3	4	Average
%	25	33	22	14	5	**1.4**

Students had to choose a commercial agricultural or horticultural business that they had studied and describe how each change given in part b. might have an impact on their chosen business.

Question 7d.

Marks	0	1	2	3	Average
%	21	34	27	18	1.4

For the business chosen in part c. students needed to describe some management strategies that a manager could introduce to counteract the impact of climate change, while still maintaining production levels.

For all business types

Change in climate	Potential impacts	Potential management strategy
increased occurrence of extreme weather-generated events, e.g. floods, storms, drought, bushfire	• impact will vary from minor to severe/disastrous. Has the potential to affect/harm people (physical and mental health), livestock, fencing • infrastructure severely affected, possibly bringing the business to a halt • the loss of the electricity supply would be crippling for many businesses, e.g. dairy could not run • cool stores and refrigeration would be inoperable	• losses are inevitable but these can be minimised by having a plan for each type and level of emergency • perform a risk assessment of the entire business in the face of the extreme event • consider upgrading business insurance. Decide what might be worth insuring • try to organise backup for essential processes; e.g. power generation

For specific businesses

Dryland cropping

Change in climate	Potential impacts	Potential management strategy
increase in mean temperature	• earlier maturation of crops • reduced grain quality • heat stress on plants, particularly at flowering, susceptibility dependent on crop • increased water use • increased potential for fire • operator heat stress • changed range of potentially suitable crops • reduced frost damage	• change in variety; growing season • change in crop • water retention practices such as mulching and use of weed mats, and weed control • adoption of minimum tillage
decrease in average annual rainfall	• reduced yield • potentially non-viable cropping	• water retention practices • change in variety/crop • agronomic changes; sowing date, spacing • adoption of minimum tillage
shift in rainfall pattern	• changed range of potentially suitable crops • change in pest and disease issues	• water retention practices • change in variety/crop • agronomic changes; spacings

Change in climate	Potential impacts	Potential management strategy
	• potentially increased erosion	• erosion control
increased frequency of very hot days	• operator heat stress • heat stress on plants, particularly at flowering, susceptibility dependent on crop • changed range of potentially suitable crops • increased fire probability	• change in variety/crop • agronomic changes; sowing date, spacings • crop insurance • air-conditioned cab

Dairying

Change in climate	Potential impacts	Potential management strategy
increase in mean temperature	• increased water demand • possible water stress • possible heat stress to plants, workers and animals • potential lasting damage to perennial pastures (haying off) • reduced frost damage • change to milk storage requirements • changes in pasture composition • increased winter productivity	• change pasture variety and adjust agronomy accordingly • implement water retention practices, including improved irrigation efficiency • improve shelter for stock • improve electricity use efficiency • breed or buy livestock that can tolerate/perform better under these conditions (animal genetics)
decrease in average annual rainfall less rainfall expected	• reduced pasture performance • increased demand for irrigation water • increased frequency of irrigation leading to more work • decreased milk production	• begin water retention practices • drill and bore • Make change in variety/crop. • Implement agronomic changes. • buy more water rights • reduce herd • organise feed arrangements • breed or buy livestock that can perform better, i.e. feed conversion (animal genetics).
shift in rainfall pattern	• change in timing of water requirements (if irrigated) • shift in plant species	• implement water retention practices
increased frequency of very hot days	• increased potential for fire • operator heat stress • animal heat stress • heat stress on plants, particularly at flowering, susceptibility dependent on crop	• make change in variety/crop • make agronomic changes; sowing date, spacings • take out crop insurance • install stock shelter • have backup power evaluation

	• changed range of potentially suitable species • blackouts • increased fire probability	• implement animal genetics

Irrigated fruit trees

Change in climate	**Potential impacts**	**Potential management strategy**
increase in mean temperature	• potentially reduced fruit set • earlier maturation • heat stress on plants, particularly at flowering, susceptibility dependent on crop • increased water use, possible water stress and increased irrigation needs • increased potential for fire • operator heat stress • changed range of potentially suitable crops • reduced frost damage	• change tree/rootstock variety and adjust agronomy accordingly • implement water retention practices, including improved irrigation efficiency • use shade cloth • use clay spray to increase reflection • initiate personnel training • implement breeding program to reduce need for chilling
decrease in average annual rainfall	• water stress on plants, reduced yield • potentially non-viable cropping • increased irrigation requirement	• begin water retention practices • make change in variety/crop • implement agronomic changes • buy more water rights • reduce orchard
shift in rainfall pattern	• changed range of potentially suitable crops • change in pest and disease issues • potentially increased erosion and salinity • changed timing of irrigation water requirement • potential waterlogging	• implement water retention practices • make change in variety/crop • implement agronomic changes; spacing • use erosion control • improve irrigation efficiency • re-evaluate pest and disease control
increased frequency of very hot days	• heat stress on plants • damage to fruit • fire probability increase	• make change in variety/crop • install misting devices • use shade cloth • take out insurance

Urban wholesale nursery

Change in climate	Potential impacts	Potential management strategy
increase in mean temperature	• heat stress on plants, particularly at flowering, susceptibility dependent on crop • increased water use, possible water stress and increased irrigation needs • increased potential for fire • operator heat stress • changed range of potentially suitable crops • reduced frost damage • faster growth for some plants • change in consumer preference	• change tree/rootstock variety and adjust agronomy accordingly • guide changes in consumer preference • implement water retention practices, including improved irrigation efficiency • use shade cloth • use clay spray to increase reflection • implement personnel training • implement breeding program to reduce need for chilling
decrease in average annual rainfall	• water stress on plants, reduced yield • potentially non-viable cropping • increased irrigation requirement • reduced drainage needs	• implement water retention practices • make agronomic changes • buy more water rights • reduce area • guide changes in consumer preference
shift in rainfall pattern	• changed range of potentially suitable crops • change in pest and disease issues • potentially increased erosion and salinity • changed timing of irrigation water requirement • potential waterlogging	• implement water retention practices • change variety/crop • make agronomic changes/ spacings • establish erosion control • improve irrigation efficiency • re-evaluate pest and disease control • guide changes in consumer preference
increased frequency of very hot days	• heat stress on plants • damage to fruit • seedling damage • increased fire probability	• change variety/crop • install misting devices • use shade cloth • take out insurance

Question 8

For Question 8, students generally provided good examples of new and emerging technologies but some researched old technologies. Students should be encouraged to research widely the latest technologies.

Question 8a.

Marks	0	1	2	3	4	5	6	7	8	Average
%	11	9	22	19	14	7	14	3	1	3.2

This question required students to name four new and/or emerging technologies that are found in the many areas of agriculture and horticulture. Students needed to name them, describe them in terms of what they do and state a business they specifically relate to.

Students were generally able to list new and emerging technologies but some listed technologies that were either too general (for example, drones) or ones that were old technologies. Students' responses in terms of describing the technology frequently lacked depth of understanding. The new technology of Pastures from Space was often described as 'a way of seeing how much grass there is'. No students mentioned satellites, NVDI or computer-aided maps. Students needed to be able to succinctly explain, what their technology does.

The app called 'CliMate App' is not considered a new technology. Also, the app 'RamSelect' is a different way of using paper-based selection criteria to choose a suitable ram for a commercial operation. This is not a new technology.

Question 8b.

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

This question required students to choose one of the technologies named in part a. and identify the technology it has replaced. Students demonstrated a lack of knowledge about new technology.

Question 8c.

Marks	0	1	2	3	Average
%	34	27	26	13	**1.2**

Students were asked to evaluate the impact of the new or emerging technology identified in part b. on the sustainability of its related business.

Students needed to state how this new and emerging technology would be economically, environmentally and socially sustainable. Students needed to outline both advantages and disadvantages.

Question 9

Students had no trouble naming a product that their chosen business would provide and also described production tasks related to their business satisfactorily. However, they struggled with the key quality standards for their product and the ways in which they are measured. Understanding what quality standards are required is an important aspect of the study.

Question 9a.

Marks	0	1	Average
%	10	90	**0.9**

Students needed to state what the main product or service that their chosen type of business would provide.

Question 9b.

Marks	0	1	2	3	4	Average
%	8	20	21	21	31	**2.5**

Students were required to describe four production processes associated with their chosen type of business.

Question 9c.

Marks	0	1	2	Average
%	30	51	18	**0.9**

Students were required to state the key quality standards for the final product of their chosen type of business and how they are measured.

An explanation of market requirements for the chosen commercial business, including how quality parameters are monitored and managed to maintain appropriate standards, was required.

Question 10

Many students had difficulty stating the various components of a business plan, and were unable to provide a method for analysing its performance. Similarly, many were unable to state the factors that may determine the location of a business and the effect of local government regulations. During Units 3 and 4, when students undertake their small business, it is important that they recognise the similarities between their own business and a real one.

Question 10a.

Marks	0	1	2	3	4	Average
%	24	23	22	18	13	**1.8**

Students needed to state the main aspects of a business plan. Responses needed to include:

- production plan and timeline (overall description of business and resources required)
- financial plan (including an overall budget and costings over time)
- expected cash flow and returns
- marketing plan (describing promotional strategies, target market, market requirements, quality standards and supply issues).

Question 10b.

Marks	0	1	2	Average
%	33	53	15	**0.8**

Students were required to state methods that could be used to analyse the financial performance of a business. Methods included:

- proposed budget compared to actual budget
- profit and loss, cash flow statements
- cost benefit analysis/gross margin analysis in comparing the profitability of the business.

Question 10c.

Marks	0	1	2	3	Average
%	6	61	28	6	**1.4**

This question required students to state what factors should be considered when choosing a location for a business. Factors to include were:

- physical environment – aspect, topography, water, sunlight, temperature, humidity
- how they match the requirements of crops, stock, infrastructure
- proximity to markets – location in relation to suppliers and customer location
- government regulations associated with business, permit requirements, management of water, use of chemicals and machinery, health and safety

- effects on local community/neighbours – impacts, road traffic, dust, noise, smell.

Question 10d.

Marks	0	1	2	Average
%	38	53	9	**0.7**

Students were required to state how government policy and regulations could affect the location and production of a business. Government regulations and Acts that could have been referred to included:

- *Catchment and Land Protection Act 1994* – business owners are required to protect water resources, control pest plants and animals, conserve soil and avoid causing land degradation. The Act prohibits the movement and sale of all categories of noxious weeds without a permit. Business owners are responsible for managing water on their land so it does not adversely affect neighbours. They must make sure the quality of any water leaving the property has no adverse impact on a waterway.
- Local government zoning and regulation **–** business may be prohibited by local government planning restrictions.
- *Occupational Health and Safety Act 2004* – dangerous goods, hazardous substances, noise, waste, traffic management and dust. All activities are to be compliant with the requirements of the Act.
- *Environment Protection Act 1970* – compliance regarding waste disposal and management, containment and treatment of water.

Question 10e.

Marks	0	1	2	3	Average
%	14	24	30	32	**1.8**

Students needed to give three potential occupational health and safety (OH&S) risks associated with a business and outline how each risk could be managed. Issues that should have been considered were:

- manual handling, safe handling of machinery, safe handling of chemicals, safe handling of animals, safe handling of organic materials, noise hazards, dust hazards and confined spaces
- management strategies including removing the risk and replacing with different methods, using personal protection equipment and instruction on risk strategies.

Question 11

Question 11 required students to discuss the development of property management plans (often called whole farm plans) and there were few high-scoring responses. It is vital that students know that there are different names for the same management plan.

Question 11a.

Marks	0	1	2	Average
%	64	32	4	**0.4**

Students needed to state why property management plans are essential for running a sustainable agricultural or horticultural business. High-scoring responses stated that the farm management plan allows the land owner to:

- recognise and highlight areas of concern on their property
- design a series of steps to improve the viability of the farm with a timeline

- as a result of the above, increase the social, environmental and financial sustainability of the farm.

Question 11b.

Marks	0	1	2	3	4	5	Average
%	39	12	10	12	13	14	**1.9**

Students needed to outline the steps involved in producing a property management plan. High-scoring responses included points from the following:

- vision
- values
- purpose
- map or aerial photograph
- overlays detailing:
  - current situation stated on acetate sheets
  - problem areas identified
  - infrastructure requirements stated
  - future plans
- timeline and budget stated
- review of plan on yearly basis.