



PLANT PRODUCTION SYSTEMS

ATAR course examination 2016

Marking Key

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

Section One: Multiple-choice

20% (20 Marks)

Question	Answer
1	b
2	d
3	a
4	a
5	c
6	c
7	a
8	a
9	d
10	b
11	b
12	b
13	c
14	a
15	d
16	c
17	b
18	b
19	c
20	d

Section Two: Short answer

50% (94 Marks)

Question 21

(18 marks)

- (a) Write an hypothesis for the investigation. (2 marks)

Description	Marks
Hypothesis states a relationship between the independent and dependent variables without any personal pronouns	2
Hypothesis links the independent and dependent variables	1
Total	2
Answers includes, but are not limited to the following: High rates of nitrogen improve grain yield.	

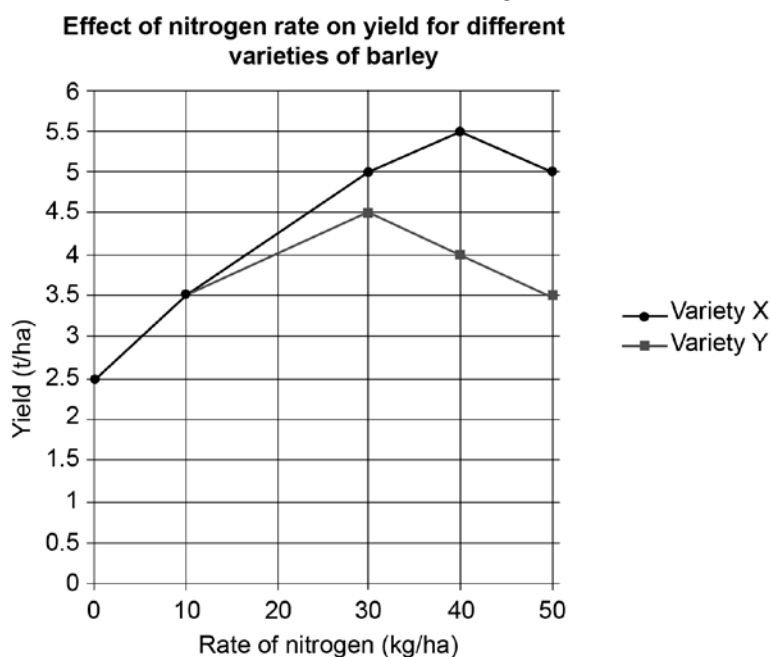
- (b) Name the independent variable and the dependent variable for the investigation. (2 marks)

Description	Marks
Dependent variable – grain yield	1
Independent variable – rate of nitrogen applied	1
Total	2

- (c) Graph the grain yield for the **two** varieties of barley at different rates of nitrogen applied. (5 marks)

Description	Marks
Title of the graph includes independent and dependent variables	1
Title of the X axis and scale	1
Title of the Y axis and scale	1
Data correctly graphed	1
Both graphed lines are clearly labelled using a key	1
Total	5

Answers could include, but are not limited to the following:



Question 21 (continued)

- (d) Outline the grain yield trend shown on the graph as the rate of nitrogen applied is increased. Also state which rate of nitrogen applied gives the highest yield for **each** variety. (3 marks)

Description	Marks
Outline clearly the trend of the graph – increase then decrease	2
States an increase (yield)	1
Best rate of nitrogen applied for variety X is 40 kg/ha and variety Y is 30 kg/ha	1
Total	3
<p>Answers could include, but are not limited to the following:</p> <p>Barley grain yield increases as nitrogen rates are increased then decrease around 40 kg/ha for variety X and around 30 kg/ha for variety Y.</p>	

- (e) Explain how the barley growers conducting this investigation could use randomisation, replication and controls to produce more reliable results. (6 marks)

Description	Marks
Explains randomisation clearly	2
States some valid information about randomisation	1
Explains replication clearly	2
States some valid information about replication	1
Explains controls clearly	2
States some valid information about controls	1
Total	6
<p>Answers could include, but are not limited to the following:</p> <ul style="list-style-type: none"> randomisation is the process of making sure each plot has equal chance of receiving the treatment effectively. Randomisation assists in preventing bias in the treatment allocation in the trial replication is where each treatment is repeated several times within the experiment to reduce error. Replications increase the reliability and accuracy of the results in the experiment controls are used as points of reference to compare the effects of changing the independent variable. 	

Question 22

(11 marks)

(a) For **each** crop, calculate the income, total variable cost and gross margin. (6 marks)

Wheat		Canola	
Income:	A _____	Income:	D _____
Total variable costs:	B _____	Total variable costs:	E _____
Gross margin:	C _____	Gross margin:	F _____

Description	Marks
A = 440	1
B = 181	1
C = 259	1
D = 780	1
E = 414	1
F = 366	1
Total	6

(b) List **two** factors in the budget that account for the differences in gross margins between enterprises. (2 marks)

Description	Marks
One mark for each part of the budget that accounts for the difference. Maximum two marks.	1–2
Total	2
Answers could include, but are not limited to the following: <ul style="list-style-type: none"> • average price per ton is very different • variable costs per hectare are very different • fertiliser costs per hectare are very different. 	

(c) By comparing wheat and canola yields, calculate what wheat yield the farmer would need to achieve to be comparable with the canola gross margin. Show **all** workings. (3 marks)

Description	Marks
Shows clear working and calculates the wheat yield correctly	3
Shows clear working and calculates the wheat yield incorrectly	2
States the correct wheat yield	1
Total	3
Need to have a wheat yield that produces a gross margin of \$366 $(\text{yield} \times \$200) - 181 = \366 $\text{Yield} \times 200 = 366 + 181$ $\text{Yield} = (366 + 181)/200$ $\text{Yield} = 2.735 \text{ tonnes/ha}$	
A wheat yield of 2.73 tonnes/ha will deliver a gross margin similar to the canola crop.	

Question 23

(15 marks)

- (a) (i) Define the term 'comparative advantage'. (2 marks)

Description	Marks
Defines clearly comparative advantage	2
States a fact about comparative advantage	1
Total	2
<p>Answers could include, but are not limited to the following:</p> <p>Comparative advantage refers to the situation when a country (Australia) can produce goods (grain) at a lower cost than other countries.</p> <p>This refers to the ability of countries (Australia) to produce certain products (e.g. grain products) more efficiently than other countries due to the combination of resources such as land, labour and climate conditions. This produce is cheap enough to get other world countries to want to trade.</p> <p>Countries that have efficient production systems should then specialise in the production of these commodities and use them to trade with other countries for scarce resources. By specialising and trading in the product that has comparative advantage results in real income for that country.</p>	

- (ii) Explain
- one**
- example of how Australian producers have a comparative advantage compared to producers in other countries. (3 marks)

Description	Marks
Explains clearly the comparative advantage using an example	3
Outlines briefly the comparative advantage using an example	2
States a fact about comparative advantage	1
Total	3
<p>Answers could include, but are not limited to the following:</p> <p>Over 90% of the wheat, barley, oats, cotton and sugar production in Australia is exported to other countries. This is based on Australia's commodity price that is cheaper than other countries.</p> <p>These lower prices have been achieved by a number of supportive services that make Australians very efficient, low costs and productive farmers. The following factors can help give a producer the ability to develop a comparative advantage with his product.</p> <ul style="list-style-type: none"> • Australia has comparative advantages over other countries of producing grains/products due to the unique combination of Australian resources such as land, labour and climate condition • Australian farmers have good access to digital information via mobile phones, IT apps containing relevant information, new research data, about farming has been development • digital online training programs are available about QA programs and accreditation courses, e.g. chem-cert. Producers need these skills to develop comparative advantages • there are digital apps for rapid access to market information allowing ongoing refining of farm management decisions, e.g. access to information about internal prices on products 	

Question 23(ii) (continued)

- digital data apps with up-to-date information on services available about soil type and weed maps to allow accurate farm management decisions to be made (in relation to fertiliser and herbicides application) to achieve lower cost and greater efficiency
- wide coverage and predictive data on weather conditions and climate information system that farmers can access to refine farm management crop decisions
- marketing systems involving quality assurance programs that promote Australia’s green and clean image
- advanced technology in the operation of modern machinery, e.g. tram lining that improves farm efficiency and lower operating costs
- advances in machinery, particularly in robotics and bulk handling facilities that reduce labour costs.

(b) Using **one** example, describe how Australian quarantine laws help plant producers maintain their global competitiveness. (4 marks)

Description	Marks
States the importance of global economy	1
States one method of competitiveness	1
Provides an appropriate example	1
Demonstrates how quarantine helps global competitiveness	1
Total	4

Answers could include, but are not limited to the following:

Importance:

- high productivity in Australia but only a small domestic market so a large amount of product to export
- maintain a low exchange rate or lock in low exchange rates during transactions that allow Australian products to be available at a price that is competitive
- maintain a consistent, uniform and quality product that is reliable in its performance
- develop free trade agreements between countries where each country benefits. Each country has a different comparative advantage, e.g. export of grains and beef to Japan and import of technical products
- actively promote Australian products to global buyers.

Examples:

- stops incoming products that may contain pests and diseases and be a danger to Australian production by reducing yields
- stops pests and diseases in Australian export crops that may damage Australia’s Clean and green image and safe food image
- quarantine prevents foreign pests and diseases entering Australia, therefore lower risk to producers of new pests that could threaten crops and be costly to control.

The example can be fungal spores, e.g. like leaf smut or the, e.g. can be a new insect pest eggs or larvae. E.g. Root Rot can be prevented from entering Australia therefore Australia can produce higher yields.

Question 23 (continued)

- (c) Countries that produce similar primary products to Australia often pay their farmers subsidies. Explain how the Australian Government can use tariffs to overcome the problems of competing with countries that pay their producers subsidies. (3 marks)

Description	Marks
Explains clearly a strategy the federal government may introduce	3
Outlines briefly a strategy	2
States a strategy about tariffs	1
Total	3
<p>Answers could include, but are not limited to the following:</p> <ul style="list-style-type: none"> • developing Free Trade agreements between countries to avoid having products dumped on the open markets • help producers to keep costs down by developing better bulk handling methods and procedures • help producers develop better Quality Assurance programs that allow producers to develop a reputation of producing safe food and so compete against cheap imports • help producers develop an International Clean and Green image for Australian and so make our product more popular on a global market. • develop a reliable supply chain from Australia to a global market that is organised and vetted through Australian trade organisations • develop a passive form of Tariffs against imported products based on pest and disease import barriers. Barriers enforced through the Custom Department. 	

- (d) Identify a change in consumer trends relevant to a plant enterprise you have studied. Explain **one** way in which you could modify your production system in response to the change in the consumer trends. (3 marks)

Description	Marks
States a change in consumer trends	1
Explains clearly one way to change to meet consumers trends	2
States briefly one way to change to meet consumers trends	1
Total	3
<p>Answers could include, but are not limited to the following:</p> <ul style="list-style-type: none"> • consumers trend toward organic fruit and vegetables <ul style="list-style-type: none"> ◦ development of the farm in such a way to achieve organic production status • consumer trend towards prepared products due to time constraints (e.g. mixed salads) <ul style="list-style-type: none"> ◦ farmer attempts to value add the product on farm to match consumer trend (washing, cleaning, grading packing) • use of substituted products when first choice not available <ul style="list-style-type: none"> ◦ a cheaper substituted product may be acceptable • preference to products that have been produced in some environmentally way <ul style="list-style-type: none"> ◦ production of the product does not affect the environment (excessive ground water use, excessive fertiliser pollution) • preference for products that have a value pack high nutritional content <ul style="list-style-type: none"> ◦ particularly with food for children parents are conscious about nutrition standards, too much salt, too much sugar, too much fat. 	

Question 24

(13 marks)

- (a) Name an environmental issue that could affect a plant production enterprise and explain how each of the **three** parts of the triple bottom line could impact a farmer's ability to deal with it. (6 marks)

Description	Marks
Two marks for each part. Maximum six marks	
Explains clearly the impact on the farmer	2
States some valid information about the issue	1
Total	6
<p>Answers could include, but are not limited for the following:</p> <p>Economic:</p> <ul style="list-style-type: none"> • less arable land so less income • yields decrease less income • quality of the grain will decrease so less income • use drought tolerant varieties. <p>Social:</p> <ul style="list-style-type: none"> • farmers can be pressured by the community to pay more attention to maintaining their farm and take action on environmental problems. Loss of respect if no action taken • farm has a lower value and resale value if there are too many environmental problems to rectify • less arable land have less income, less profit and less disposable money for the family • pressure to be involved in the tree planting programs in the community to grow more trees on farm to reduce surface temperature, reduce water logging and reduce atmosphere carbon • remnant bushland can add value to the local community by providing a habitat for wildlife, tourism to the area and increased property values <p>Environmental:</p> <ul style="list-style-type: none"> • the farmer regularly tests their soil and takes appropriate action for any environmental problems that may occur • soil test to avoid over fertilising • apply lime to acid soil to improve soil pH • apply gypsum to compact soils to improve texture • deep ripping to avoid water logging and improve drainage • plant trees and belong to a community catchment plan to avoid salinity problems from developing • improved water quality and less risk of salinity, reduced flood risk, lower pollution, habitat for native flora and fauna conserved 	

- (b) Using land clearing as an example, justify how you would balance short-term profitability with the long-term sustainability of a plant production enterprise. (3 marks)

Description	Marks
States the short-term profitability of land clearing	1
States the long-term sustainability of not clearing land	1
Justifies a position.	1
Total	3
<p>Answers could include, but are not limited for the following:</p> <p>Short-term:</p> <ul style="list-style-type: none"> clearing of bushland would provide a profit in the short term as more land would be available for production short-term measures can supply cash flow for long term strategies <p>Long-term:</p> <ul style="list-style-type: none"> bushland provides various ecosystem services that improve crop and pasture production, conserve biodiversity and can provide a shelter to livestock. These all contribute to the enterprise being sustainable in the long-term <p>Justify a position:</p> <ul style="list-style-type: none"> addresses the need to re-invest profits to maintain sustainability. 	

- (c) Define the term 'intergenerational equity'. Explain how intergenerational equity is affected by environmental problems. (4 marks)

Description	Marks
Defines intergenerational equity	1
Explains clearly how intergenerational equity is affected by environmental problems	3
Outlines how intergenerational equity is affected by environmental problems	2
States a fact about intergenerational equity and environmental problems	1
Total	4
<p>Answers could include, but are not limited for the following:</p> <p>Intergenerational equity is defined as ensuring that the wellbeing of future generations are not compromised by the activities of the current generation</p> <p>Economic:</p> <ul style="list-style-type: none"> the farm should be passed on to the family in a better economical condition, e.g. the farmer needs to have developed a history of higher crop yields, strong fertiliser history, better fencing and modern equipment. The farm needs to have achieved being an economically viable farming business that is producing a strong cash flow to pay for environmental damage caused by agriculture <p>Social:</p> <ul style="list-style-type: none"> the farm should be passed on to the family in a proud state, not run down, neat and tidy, good roads, well maintained house and infrastructure. The farm should be able to financially support future generations allowing them to grow together on the farm. The asset value should have increased. Environmental issues reduce the farms asset value and increase the cost of having a farm. Most environmental issues that occur require community support/community plan to overcome the problem. The farmer must have also developed a safe work place environment <p>Environmental:</p> <ul style="list-style-type: none"> environmental problems are managed and there is a plan to follow/reduce environmental impacts on the farm. The farmer needs to overcome environmental issues before they spread and become too difficult to manage. As environmental issues increase and the problem becomes too large it also becomes too costly to fix. Environmental issues reduced farm land for production and poor quality water problems increase. 	

Question 25

(8 marks)

(a) Give the role of each of the plant hormones listed below.

(4 marks)

Description	Marks
Gives the role of each hormone – one mark each	1–4
Total	4
<p>Answers could include, but are not limited to the following:</p> <p>Gibberellins – the hormone can break seed dormancy and increase stem elongation and increase flowering</p> <p>Ethylene – is important in ripening fruit and leaf expansion</p> <p>Cytokinins – is important in the initiation of roots and the division of cells</p> <p>Auxins – elongation of cells, apical dominance, root initiation.</p>	

(b) Select **two** of the above plant hormones and describe how each can be used to manipulate plant production.

(4 marks)

Description	Marks
Two marks for each hormone selected. Maximum 4 marks.	
Describes clearly the use of the hormone	2
States some valid information about the use of the hormone	1
Total	4
<p>Answers could include, but are not limited to the following:</p> <p>Gibberellins – increase flowering</p> <p>Ethylene – plant producers manipulate ethylene in food storage to reduce or enhance ripening. Fruit picked unripe to assist transport and handling and then ripened with ethylene under controlled conditions</p> <p>Cytokinins – used in powders and gels as rooting stimulants when propagating new plants through cuttings</p> <p>Auxins – synthetic auxin used as a herbicide (2,4-D) to kill weeds. Pruning to remove growing points will stimulate auxin production to encourage growth in desired direction, e.g. training into trellis etc. Training assists with ease of harvest and spraying operations and allows light penetration into canopy.</p>	

Question 26

(12 marks)

- (a) Explain the process of transpiration. Include **two** of the plant structures involved. (4 marks)

Description	Marks
Comprehensively explains the process with details of the roles of two relevant plant structures	4
Outlines the process with reference to the roles of two relevant plant structures	3
States briefly the process with reference to the roles of two relevant plant structures	2
States a fact about the process	1
Total	4
<p>Answers could include, but are not limited for the following:</p> <p>Transpiration is the process by which water is transported from roots to the rest of the plant and is driven by the evaporation of water from leaves (via stomata) to the atmosphere</p> <p>Transpiration is controlled by the stomata in the leaf. Environmental factors and plant processes trigger whether the stomata are open or closed.</p>	

- (b) Explain **two** environmental conditions that can affect transpiration. (4 marks)

Description	Marks
Two marks for each environmental condition. Maximum four marks.	
Explains clearly how the environmental conditions affects transpiration	2
States some valid information about transpiration rates	1
Total	4
<p>Answers could include, but are not limited for the following:</p> <ul style="list-style-type: none"> • humidity of the atmosphere – lower humidity increases the gradient for water to move from the plant to the atmosphere, increasing water use • temperature – warmer air can hold more water so increases the driving force for transpiration, therefore plants use more water at higher temperatures • light – stomata are closed when it is dark so during the day when they are open transpiration can occur; therefore plant water use is greater during the day • wind – removes the leaf boundary layer, therefore increases transpiration • soil moisture – plants lose turgor or begin to wilt under dry soil as water evaporated from leaves is not replaced. Plants with adequate soil moisture will continue to transpire at normal rates as the soil provides the water for roots to take up and transport to the leaves • sun/shade affects temperature and humidity. 	

- (c) Explain how the absorption and translocation of nutrients in the plant occurs. (4 marks)

Description	Marks
Explains clearly how nutrients are absorbed	2
States briefly how nutrients are absorbed	1
Explains clearly how nutrients are translocated	2
States briefly how nutrients are translocated	1
Total	4
<p>Answers could include, but are not limited for the following:</p> <p>Nutrient absorption:</p> <ul style="list-style-type: none"> • nutrients in the soil are absorbed by root hairs, allowing water to enter root cells by the principle of osmosis. Root hairs are efficient at doing this as they have a large surface area • dissolved nutrients are absorbed into the plant by osmosis. The osmotic pressure is due to the difference in solute concentration in the root compared to soil. Water is forced into roots and drawn up by the transpiration stream <p>Translocation of nutrients in the plant:</p> <ul style="list-style-type: none"> • this movement of water allows efficient nutrient uptake into root cells pathways. • nutrients are then translocated from the roots to the shoot via xylem cells, which are under high negative pressure to allow nutrients and water to be transported up stems to shoots via the transpiration stream • water is also pulled up the thin xylem vessels by capillary action • nutrients are translocated inside plant via xylem and phloem • xylem involves movement of nutrients from roots to leaves in transpiration stream • phloem involves movement of nutrients within the plant using energy. Movement varies depending on the nutrient. Some are able to be moved, e.g. N some cannot, e.g. S. 	

Question 27

(17 marks)

- (a) For a plant enterprise of your choice, explain how the following factors affect decision-making involved in fertiliser selection. (6 marks)

Description		Marks
Soil type		1
Crop type		1
Stage of growth		1
Cost of fertiliser		1
Availability of fertiliser		1
Application method		1
Total		6
Answers could include, but are not limited for the following:		
Factor	How the factor affects the decision to apply fertiliser	
Soil type	<ul style="list-style-type: none"> sandy soils have very low levels of nitrogen, phosphorous, potassium, sulfur and trace elements clay soils are generally high in potassium and sulfur and trace elements fertiliser applications of different soil types need to reflect the soil type and the soil reserves light soils are easily leached and may require split or reapplications 	
Crop type	different types of crops will require different fertilisers. Grain crops require nitrogen and phosphorus. Legumes require phosphorus and potassium	
Stage of growth	all crops require fertiliser at seeding. Some crops require specific fertilisers at certain growth stage, e.g. Nitrogen can be applied to grain crops at tillering to boost grain yield. Potassium can be applied to lupins at 2–3 weeks after seeding to boost yields. Trace elements can be applied to orchards at flowering	
Cost of fertiliser	the cost of fertiliser will affect application rate of fertiliser to the crop. The higher the cost of the fertiliser the lower the application rate	
Availability of fertiliser	fertiliser may simply be unavailable at certain times of the year. Fertiliser may not be local and transport costs increases the cost of fertiliser	
Application method	application rates of fertiliser depend on whether the fertiliser is sown in band width with the seed or top dressed on top of the soil. Lower rates can be used if the fertiliser is sown in bands with the seed. The higher rates have to be used if the fertiliser is top dressed. The availability of machinery will affect fertiliser choices, e.g. you can't use a top-dresser to put out a liquid fertiliser.	

Question 27 (continued)

- (b) For your chosen plant enterprise use the following table to outline a fertiliser program that you would recommended for **three** plant growth stages. Give a reason for each choice. (6 marks)

Description		Marks
Early stage fertiliser and reason – one mark each		1–2
Mid growth stage fertiliser and reason – one mark each		1–2
Final stage fertiliser and reason – one mark each		1–2
Total		6
Answers could include, but are not limited for the following:		
Plant growth stage	Fertiliser	Reason for fertiliser
Early growth stage	Top dress urea	Provide nitrogen for leaf formation in young plant.
	Application of phosphate with the seed	Set up plant to increase tillering and grains per head
Mid growth stage	Top dress nitrogen	Improve tillering in wheat which improves yield
	Apply sulfur	Improves leaf area for photosynthesis Canola needs extra sulfur
Final stage of growth	Spray of liquid fertiliser	Sometimes trace element deficiencies show later in growth

- (c) (i) List **two** strategies you could use to monitor your enterprise to ensure plants are receiving the correct amount of fertiliser. (2 marks)

Description	Marks
One mark for each strategy to ensure correct fertiliser	1–2
Total	2
Answers could include, but are not limited for the following:	
<ul style="list-style-type: none"> • leaf test • visual examination 	

- (ii) Describe the impact of excess fertiliser on the environment and identify a strategy to lessen the impact. (3 marks)

Description	Marks
Describes clearly the impact of excess fertiliser	2
States some valid information about excess fertiliser	1
Lists a strategy to lessen the impact	1
Total	3
Answers could include, but are not limited for the following:	
Excess fertiliser	
<ul style="list-style-type: none"> • surface water pollution • plant damage 	
Strategy	
<ul style="list-style-type: none"> • do not overuse, use recommended rates of application • do soil test before any fertiliser program. 	

Section Three: Extended answer

30% (40 Marks)

Question 28

(20 marks)

(a) (i) Marketable product _____ (1 mark)

Description	Marks
States a valid marketable product	1
Total	1

(ii) Outline how the following factors affect quality and quantity of your selected marketable product. (8 marks)

Description	Marks	
Variations caused by plant variety	1–2	
Variations caused by weather condition	1–2	
Variations caused by nutrition	1–2	
Variations caused by product handling and transport	1–2	
Total	8	
Answers could include, but are not limited for the following: <ul style="list-style-type: none"> • quantity variations could include size/weight/yield • quality variation could include disease free/colour/taste/protein/oil content/moisture content/contamination of samples • plant variety – old seed has poor germination/ prone to disease attack/product produced not suited to a modern market • weather conditions – low rainfall low yield/ poor finishing rains so product does not fully develop • nutrition – incorrect nutrition poor production/poor quality/disease prone • product handling – old machinery may have excessive loss of product/bruising. 		
	Product quality	Product quantity
Plant variety	Can affect % of protein Different varieties will produce different amounts of protein in their grain	Different varieties yield differently Different varieties will produce different weight and size of product
Weather conditions	Rain can cause moulds to form on the product Rain can also cause physical damage to the product Can affect colour of the product	Rain increases yield Rain can increase the size of the product
Nutrition	Nitrogen fertilisers will affect % protein in the product	Better nutrition better yield Heavier product Greater number of product
Handling and transport	Could damage grain and therefore germination %	Old machinery may have excessive loss

- (b) (i) Name a quality assurance program relevant to your production enterprise. (1 mark)

Description	Marks
Names a quality assurance program	1
Total	1
Answers could include, but are not limited for the following: <ul style="list-style-type: none"> • grain care • fresh food safety (veg) • SQF • WQA • Global GAP • Austrade • Quality Code of Practice. 	

- (ii) Outline how this program assists in meeting market expectation. (2 marks)

Description	Marks
Outlines how the program assists in meeting market expectations	2
States some valid information about the program	1
Total	2
Answers could include, but are not limited for the following: <p>Reasons for QA program</p> <ul style="list-style-type: none"> • a QA program may not give a direct benefit in higher prices but there is a benefit based on being a preferred product and the QA is seen as guarantee to meet the product food standards requirements of health and safety • when a grower or marketer is marketing a quality assured product to a customer they are marketing <i>confidence</i> – confidence that a customer is purchasing product that is reliably and consistently safe and the product meets health and safety standards • important dimension of product marketing because customers want to be confident that the product they purchase meets health and safety requirements. If the product is not covered by a QA program, customers could be reluctant to buy • growers who can give customers (international companies) this confidence will become long-term preferred suppliers who have better access to markets long-term and may be able to achieve a better price than their competitors • in some circumstances, growers may not be able to access markets if they are not quality assured <p>QA examples:</p> <p>Grain care (grain):</p> <ul style="list-style-type: none"> • cleaning storage facilities before filling/applying chemicals at applicable rates/ • customers are confident that they are purchasing grain that is reliable and consistently safe <p>Food safety program (vegetable):</p> <ul style="list-style-type: none"> • links food safety on farm to the food safety in the supply chain • links tools for growers in production with environmental objectives. 	

Question 28 (continued)

- (c) (i) Outline a new technology relevant to your enterprise to make your plant production system more efficient. (2 marks)

Description	Marks
Outlines clearly a new technology that increases efficiency	2
States a fact about a new technology that increases efficiency	1
Total	2
Answers could include, but are not limited for the following:	
<ul style="list-style-type: none">• GM crops – new varieties with specific traits modified• minimum tillage – use of air seeders to drill seeds, results in less disturbance to the soil• GPS technologies for precision farming – new technology for the remote control of machinery.	

- (ii) Evaluate the risk of using this new technology to improve production by completing the risk assessment table below. (6 marks)

Description		Marks	
Two marks each evaluation. Maximum six marks.			
Evaluates clearly the risk of using this new technology to improve production		2	
States a fact about using the new technology to improve production		1	
Total		6	
Answers could include, but are not limited for the following:			
	Technology	Technology	Technology
Describe a risk related to the introduction of this new technology	GM crops can be rejected by the consumer GM crops can cross pollinate	Heavy use of herbicides to control weeds, instead of cultivation	Loss of signal causing down time on machinery
If the farmer continues to use the new technology what could be the long term effects?	Loss of genetic diversity	Reliance on herbicide which develops a major pesticide resistance environment	Long-term the technology should improve and become more reliable
What strategy could the farmer use to decrease the risk effect?	<ul style="list-style-type: none"> Farmer groups and governments to be more informed about GMO and make decision to safe guard the environment Farmers to be more educated about the advantages and disadvantages of GMO so they can chose to use or not use the variety 	<ul style="list-style-type: none"> Rotate chemicals Use herbicides from different groups To avoid chemical resistance follow IPM program 	<ul style="list-style-type: none"> Make sure have good access to IT support services Farmer attends IT training and develops better skills in this area

Question 29

(20 marks)

- (a) Describe the structure of a natural ecosystem and use examples to explain why it is important for plant producers to protect natural ecosystems to maintain productivity. (11 marks)
- (b) Describe **three** impacts climate change has on the natural ecosystem and explain how plant producers could reduce each impact. (9 marks)

Description	Marks
(a) Natural ecosystem/biodiversity	
Describes clearly a natural ecosystem including living and nonliving components	4
Describes a natural ecosystem including living or nonliving components	3
States briefly some components of a natural ecosystem	2
States some valid information about a natural ecosystem	1
Outlines clearly the need to conserve the biodiversity	3
Outlines some valid information about the need to converse biodiversity	2
States a fact about biodiversity	1
Two marks for each example. Four marks maximum.	
Explains clearly how a farmer could maintain the natural ecosystem while maintaining productivity	2
States some valid information about how a farmer could maintain the natural ecosystem while maintaining productivity	1
Total	11

Answers could include, but are not limited for the following:

An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system.

The need to conserve the biodiversity of the system:
 If the natural system is maintained then there is a balance between the producers, consumers and decomposers so that energy flows are maintained and the minerals are recycled.
 In a monoculture system the balance of producers, consumers and decomposers is lost resulting in a very low levels of decomposing and recycling and replenishment.

If the farmer ignores the need for a natural system of biodiversity on his farm

- the monoculture (agricultural crop) will have a higher demand for land, water and fertiliser, as the farmer supplies these demands less water is available for the natural system and higher fertiliser results in acidity
- salinity and soil compaction results from farming activities
- there is an increase in chemical sprays to control pests
- Weeds, disease and pests build up as there is not the natural predators to keep them in balance

Examples how farmers could help maintain the natural ecosystem:

- the farmer can help maintain the natural ecosystem on the farm by fencing off natural bush land areas and prevent stock from grazing in the area
- restrict the use of chemical and chemical drift into the natural areas and avoid killing natural vegetation. The replanting of natural vegetation will encourage the population of native birds
- expand the replanting of natural district species of trees and bush growth on the farms already cleared non-arable land.

Question 29 (continued)

(b) Climate change	
Description	Marks
Three marks for each impact. Maximum nine marks.	
States a valid impact of climate change	1
Explains clearly how a farmer could reduce the impact	2
States valid information about how a farmer could reduce the impact	1
Total	9
<p>Answers could include, but are not limited for the following:</p> <p>Climate change impacts on the reserves:</p> <ul style="list-style-type: none"> • dry summers and poor water reserves can result in the death of natural vegetation • poor seed set on the natural plants because of changing seasons • increase risk of fire in the bushland areas • loss of animals and insect habitats in the bushland areas • invasion of previously unviable species into the bushland including weed species <p>Reduce the impact of the climate change:</p> <ul style="list-style-type: none"> • replace dead plants that have become a fire risk and reduce the possibility of fire • control weeds – removal of weeds in the bushland area as they use excess water from the soil which could have been available to the natural vegetation • review natural water catchment in the area so the bushland area receives more water • increase survival of the bushland by selecting drought tolerant species for the area to be planted. 	
Question total	20

Question 30

(20 marks)

- (a) Explain how plants can be improved through the use of seed banks and genetically modified organisms (GMOs). Use examples for each in your answer. (12 marks)
- (b) Discuss why consumers have become more selective on the grounds of ethical concerns about GMOs used in plant breeding. Use examples in your answer. (8 marks)

Description	Marks
(a) Seed bank	
Recognition that a seed bank provides for storage of seeds	1
Recognition that a seed bank provides a source of genetic diversity	1
Recognition that a seed bank allows for preservation of species	1
Recognition that a seed bank can be used for breeding program	1
Provides at least two examples of plants that may be stored or characteristics that improve productivity	2
Provides one example of plants that may be stored or characteristics that improve productivity	1
Sub-total	6
(a) GMOs	
Recognition that GMOs can target specific characteristics of a plant	1
Recognition that GMOs can increase productivity	1
Recognition that GMOs can increase profitability	1
Recognition that GMOs is new technology	1
Provides at least two examples of plants that that have been improved by GMOs or examples of at least two traits that have been engineered into plants (or one of each)	2
Provides one example of plants that that have been improved by GMOs or one example of a trait that have been engineered into plants	1
Sub-total	6
Total	12
GMO: Example/explanation: <ul style="list-style-type: none"> • soy bean – round-up ready • round-up ready canola – tolerant to glyphosate to improve weed control in crop • BT cotton – BT gene to improve tolerance to insect pests • potatoes – resistant to cucumber mosaic virus (CMV) • Bollgard cotton – caterpillar resistant • golden rice – contains more beta-carotene to reduce Vitamin A deficiency • triple stack maize – round-up ready, insect resistance via the BT gene, rootworm control • non-browning Arctic apples – produces less of the chemical that causes browning • Flavr Savr tomatoes – addition of an ACC synthase gene to slow the ripening process 	

(b) Ethical concerns	
Description	Marks
Four marks for each example. Maximum eight marks.	
Discusses clearly an ethical concern	4
Discusses briefly an ethical concern	3
Outlines a valid ethical concern	2
States some valid information about an ethical concern	1
Total	8
<p>Answers could include, but are not limited for the following:</p> <p>Reason for the ethical concerns:</p> <ul style="list-style-type: none"> • potential threat to human health. GMOs involve unnatural plant breeding techniques so there may be threats to human health, particularly as agrobacteria are often used to transfer the genes. However, there is generally a lack of knowledge and education around the exact mechanism of genetic engineering and no human health effects have been reported • environmental damage – potential for pollen transfer between GM and non-GM crops could create 'super weeds'. Also a decrease in biodiversity could occur as less genetic variation and greater use of the same chemicals. Arguments against this claim that regulatory bodies and laws are rigorous enough that risks of contamination to non-GM crops and of the environment can be managed. Overall pesticide use should actually be reduced • food supply concerns – large multinational chemical companies own the technology and thus control our food production, particularly in developing countries. Also there would be high seed costs due to IP rights. Arguments against this claim that the large companies are helping to increase good supply in developing nations and that profits to farmers should increase through greater yields and lower pesticide costs. 	
Question total	20

This document – apart from any third party copyright material contained in it – may be freely copied, or communicated on an intranet, for non-commercial purposes in educational institutions, provided that it is not changed and that the School Curriculum and Standards Authority is acknowledged as the copyright owner, and that the Authority's moral rights are not infringed.

Copying or communication for any other purpose can be done only within the terms of the *Copyright Act 1968* or with prior written permission of the School Curriculum and Standards Authority. Copying or communication of any third party copyright material can be done only within the terms of the *Copyright Act 1968* or with permission of the copyright owners.

Any content in this document that has been derived from the Australian Curriculum may be used under the terms of the Creative Commons Attribution-NonCommercial 3.0 Australia licence.

*Published by the School Curriculum and Standards Authority of Western Australia
303 Sevenoaks Street
CANNINGTON WA 6107*