



PLANT PRODUCTION SYSTEMS

ATAR course examination 2023

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

Section Two: Short answer

50% (105 Marks)

Question 21

(12 marks)

- (a) Outline
- two**
- factors that increase the rate of transpiration in plants. (4 marks)

Description	Marks
For each of the two factors (2 x 2 marks)	
Outlines a factor	2
States a relevant factor	1
Total	4
Answers could include: <ul style="list-style-type: none"> • temperature – as temperature increases more water evaporates from leaf cell surfaces, increasing the transpiration rate • humidity – as humidity decreases it reduces the concentration of water outside of the leaf, increasing the transpiration rate • air movement – an increase in air movement removes water from the leaf surface, increasing the rate of transpiration • light intensity – as light intensity increases the rate of photosynthesis increases, increasing the rate of transpiration. Accept other relevant answers.	

- (b) Describe how a lack of water in the soil can influence the absorption and translocation of nutrients in plants. (3 marks)

Description	Marks
Describes how a lack of water in the soil can influence the absorption and translocation of nutrients in plants	3
Outlines how a lack of water in the soil can influence the absorption and translocation of nutrients in plants	2
States a relevant influence	1
Total	3
Answers could include: <p>Water is the universal solvent where nutrients are held. Lack of water in the soil restricts transpiration rate, which restricts nutrient uptake through absorption. There is a reduction in photosynthesis which reduces the flow of nutrients back through the plant via translocation.</p> Accept other relevant answers.	

Question 21 (continued)

- (c) Describe a sustainable strategy a producer could implement in a plant production enterprise that is affected by unreliable rainfall. (3 marks)

Description	Marks
Describes a sustainable strategy	3
Outlines a sustainable strategy	2
States a relevant strategy	1
Total	3
<p>Answers could include:</p> <ul style="list-style-type: none"> • mulching – used to reduce soil-water loss by reducing soil surface evaporation, reducing soil erosion from the impact of water droplets hitting the soil surface, limiting weed growth, and their competition for water and nutrients from weeds • perennials rather than annuals – achieve better water utilisation than annual species with deeper root systems, reducing the frequency of waterlogging, lowering the water table which assists the reduction of dryland salinity, reduced effect of soil acidification and nutrient loss through run-off • drought tolerant varieties – physiological tolerance of hot and dry conditions including: <ul style="list-style-type: none"> ▪ able to maintain cell turgor ▪ more resistant leaf stomatal cells ▪ long coleoptile for deeper seeding ▪ shorter growing season. <p>Accept other relevant answers.</p>	

- (d) Outline a method for monitoring the availability of water in a plant production system. (2 marks)

Description	Marks
Outlines a method of monitoring the availability of water	2
States a method of monitoring the availability of water	1
Total	2
<p>Answers could include:</p> <p>Soil moisture sensors (electronic/manual/smart), are able to measure moisture at the target plants' root depth.</p> <p>Accept other relevant answers.</p>	

Question 22

(18 marks)

- (a) (i) Outline how a hybrid is created in a plant breeding system. (2 marks)

Description	Marks
Outlines how a hybrid is created	2
States a fact about how a hybrid is created	1
Total	2
<p>Answers could include:</p> <p>Pollen grains from one selected parent plant are collected and introduced to another plant of the same species that either is not bisexual or has been emasculated to remove male parts (anthers).</p>	

- (ii) Describe a more efficient method of breeding a new variety of plant. (3 marks)

Description	Marks
Describes a more efficient breeding method	3
Outlines a more efficient breeding method	2
States a fact about a more efficient breeding method	1
Total	3
<p>Answers could include:</p> <p>Genetically modified organism (GMO) technology enables plant breeders to insert DNA into the genome of the plant cells. Generally these cells are then grown in a tissue culture where they develop into plants. The seeds of these GM plants will inherit the new DNA. The efficiency is in the selection of DNA for a particular characteristic; for example, disease resistance, whereas with traditional breeding methods discovering this characteristic will take time and multiple crosses.</p> <p>Accept other relevant answers.</p>	

- (b) (i) From the table above, select the variety that is best suited to each of the following environmental conditions. (2 marks)

Description	Marks
Windy, short growing season is C	1
Long growing season, high humidity is D	1
Total	2

- (ii) Outline the reasons for your choices of selected varieties in part (b)(i). (4 marks)

Description	Marks
For each environmental condition (2 x 2 marks)	
Outlines a reason for choosing the variety	2
Identifies a reason for choosing the variety	1
Total	4
<p>Answers could include:</p> <p>C – shorter/thicker stem to counter wind, early ripening for short growing season and not susceptible to disease</p> <p>D – late ripening for long growing season, not susceptible to leaf/stem disease due to high humidity.</p>	

Question 22 (continued)

- (c) Describe how plant breeding has become important in maintaining Australia's global competitiveness. (3 marks)

Description	Marks
Describes how plant breeding maintains Australia's global competitiveness	3
Outlines how plant breeding maintains Australia's global competitiveness	2
States a valid fact about how plant breeding maintains Australia's global competitiveness	1
Total	3
Answers could include:	
Allows producers to maintain critical markets with product that suits their needs (keeping up with current consumer trends), stay on top of disease threats that reduce yields and/or taint product quality, improve yields so Australia can meet market needs/orders.	
Accept other relevant answers.	

- (d) Discuss the emergence of genetically modified organisms (GMO) in Australian plant production by highlighting the impact on the economic aspect of the triple bottom line. (4 marks)

Description	Marks
Discusses the emergence of GMO and its economic impact	4
Describes the emergence of GMO and its economic impact	3
Outlines a fact about the economic impact of GMO	2
Identifies a fact about the economic impact of GMO	1
Total	4
Answers could include:	
Accept answers in support of using GMO or answers against the use of GMO with relevant reasoning for their choice.	
For – increased income/reduced costs – increased yields lead to higher profits, less loss to disease and less time spent on pest control, provides greater flexibility to farming businesses.	
Against – need to buy seed each year, high input costs, cross contamination with non-GM may cost producer valuable markets due to a ban on GM products.	
Accept other relevant answers.	

Question 23

(17 marks)

- (a) Complete the table by indicating, using the symbols provided, the optimum time of application for each nutrient/treatment for your selected crop. (4 marks)

Description							Marks
For each nutrient (4 x 1 mark)							
Indicates the optimum time of application							1
Total							4
Answers could include:							
	Pre-season	Seeding	Germination	Vegetative	Flowering	Harvest	
Cereal	L,T	N P		N			
Legume	L,T	P,N					
Brassica	L,T	N P		N			
Vegetable	L,T	N P		N			
Accept other relevant answers.							
Note:							
<ul style="list-style-type: none"> legumes require a small amount of N at seeding some trace elements are applied during vegetative, if deficient. 							

- (b) Explain how a plant producer can apply the correct type and amount of fertiliser to their crops efficiently. (4 marks)

Description		Marks
Explains how tests, such as soil and tissue tests, provide information that enables a plant producer to select the correct fertiliser and rate		4
Describes the role that tests such as, soil and tissue tests, can be used to determine the correct type of fertiliser and amount		3
States a valid fact about applying the correct type and amount of fertiliser		2
States a valid fact about applying the correct type or amount of fertiliser		1
Total		4
Answers could include:		
Soil tests determine what is available in the soil profile, and enables the producer to select correct fertiliser to provide those nutrients that are depleted in the soil. The application rate will be determined by the expected needs and potential yield of the crop. Tissue test used during the vegetative stage determines which nutrients are not available or deficient and which can then be applied using the correct fertiliser and rate.		
Accept other relevant answers.		

Question 23 (continued)

- (c) (i) Outline an impact phosphorus fertiliser has on the natural environment. (2 marks)

Description	Marks
Outlines the impact of phosphorus on the natural environment	2
States a fact about the impact of phosphorus on the natural environment	1
Total	2
Answers could include: Phosphorus gets into waterways and creates eutrophication, excessive plant and algal bloom – reducing light penetration, depleting dissolved oxygen levels and in some cases releasing toxins that kill aquatic animals. Accept other relevant answers.	

- (ii) Describe a strategy to minimise the impact phosphorus fertiliser has on the natural environment. (3 marks)

Description	Marks
Describes a strategy to minimise phosphorus fertiliser impact on the natural environment	3
Outlines a strategy to minimise phosphorus fertiliser impact on the natural environment	2
States a relevant strategy to minimise phosphorus fertiliser impact on the natural environment	1
Total	3
Answers could include: <ul style="list-style-type: none"> • retain riparian zones between waterways and farmland so that phosphorus that is dissolved in water and moving towards water sources is intercepted by plants that can use the phosphorus • use a less mobile form of phosphorus, such as rock phosphate • soil test to make sure the soil needs phosphorus for whatever plant production system is being used • use split applications to reduce losses of mobile phosphorus that hasn't been taken up • avoid spreading fertiliser before rainfall events • improve light sandy soils by applications of clay Accept other relevant answers.	

- (d) Design a paddock production record that could be used in nutrient management. Use the space at the bottom of this page, if you wish to answer in diagrammatical form.

(4 marks)

Description	Marks
Record includes four or more relevant production parameters	4
Record includes three relevant production parameters	3
Record includes two relevant production parameters	2
Record includes one relevant production parameter	1
Total	4
Answers could include:	
Production parameters:	
<ul style="list-style-type: none">• fertiliser type• date applied• application method• amount/rate• crop type• harvest tonnages• paddock name/number• weather conditions.	
Accept other relevant answers.	

Question 24

(19 marks)

- (a) Outline, using economic threshold (ET) principles, how an organism becomes a pest. (2 marks)

Description	Marks
Outlines how an organism becomes a pest using ET principles	2
Makes a relevant statement about how an organism becomes a pest	1
Total	2
Answers could include:	
When the pest density is high enough for management to take action to minimise the chance of a pest reaching economic injury level (EIL).	
Accept other relevant answers.	

- (b) (i) Identify **two** pest control methods. (2 marks)

Description	Marks
Any two of (2 x 1 mark)	
<ul style="list-style-type: none"> • chemical • physical/mechanical • cultural • genetic • biological 	1–2
Total	2
Accept specific examples of these control methods	

- (ii) Compare the effectiveness of the pest control methods identified in part (b)(i) above. (6 marks)

Description	Marks
Compares the effectiveness of both selected pest control methods	6
Discusses the effectiveness of both selected pest control methods	5
Explains the effectiveness of both selected pest control methods	4
Describes the effectiveness of both selected pest control methods	3
Outlines the effectiveness of one or both selected pest control methods	2
States a fact about the effectiveness of one of the selected pest control methods	1
Total	6
Answers could include:	
Compares implies similar/different	
<ul style="list-style-type: none"> • chemicals are efficient, can target specified pests or be non-selective, but pests can become resistant and their environment is at risk of contamination • physical/mechanical methods, such as barriers/traps work on small populations and are time consuming to apply • cultural means changing the growing conditions to disrupt the pest, such as time of planting/crop rotation/cultivation to expose pests, but can be disrupted by unreliable rainfall and exposure of soil to erosion • genetic improvement of superior varieties by breeding or genetic engineering, but it can take years to release a suitable variety • biological agents are introduced to predate on pests, suppressing their numbers; however, they only build their numbers in response to large outbreaks. 	
Accept other relevant answers.	

- (c) Describe the strategies that would need to be put in place, if a pest becomes resistant to control methods on a farm, nationally and internationally. (9 marks)

Description	Marks
For each level on a farm, nationally and internationally (3 x 3 marks)	
Describes a strategy	3
Outlines a strategy	2
States a strategy	1
Total	9
<p>Answers could include:</p> <ul style="list-style-type: none"> • on a farm: isolate infected crop, quarantine area, destroy pests' host plant, grow crops that are not affected by that pest, select a variety that has resistance • national: prevent entry/exit of infected material into WA, provide support through government agencies to assist producers • international: prevent import/export of contaminated material through border control, quarantine and inspection of cargo. 	
Accept other relevant answers.	

Question 25

(19 marks)

- (a) (i) Complete the table below by calculating the cost/punnet and cost to harvest 3000 punnets. (4 marks)

Description	Marks
A = \$2.50	1
B = \$2.60	1
C = \$7500	1
D = \$7800	1
Total	4

- (ii) State the most profitable picking option. (1 mark)

Description	Marks
pickers	1
Total	1

- (iii) Outline how the producer could justify a change to their harvesting method. (2 marks)

Description	Marks
Outlines a justification of changing harvesting method	2
States a fact about a justification of changing harvesting method	1
Total	2
Answers could include: <ul style="list-style-type: none"> • if pickers became difficult to employ/increase reliability in picking rate is required • improvements in technology resulting in increased yield picks • cost of the technology goes down • inability of pickers to work longer hours to take advantage of conditions/prices/avoid weather events that could impact yields Accept other relevant answers.	

- (b) (i) Outline **four** aspects of experimental design you would consider for a trial to measure the efficiency of the robotic harvester. (8 marks)

Description	Marks
For each aspect of experimental design (4 x 2 marks)	
Outlines an aspect of experimental design	2
States a relevant fact of experimental design	1
Total	8
Answers could include:	
<ul style="list-style-type: none"> control – efficiency needs to be measured against the time taken for a group of pickers. The number of pickers must be the same for each plant and the plants selected for the pickers should be the same size as those for the robot harvester variables – weight of fruit picked, and time taken need to be measured and recorded a number of times at each site replication – repeated in several orchards under different environmental conditions to increase accuracy of results randomisation – harvested plants to be selected at random, away from the edge of the orchard, same height/width to reduce bias. 	
Accept other relevant answers.	

- (ii) Explain how experimental bias and experimental error could be minimised in the trial in part (b)(i). (4 marks)

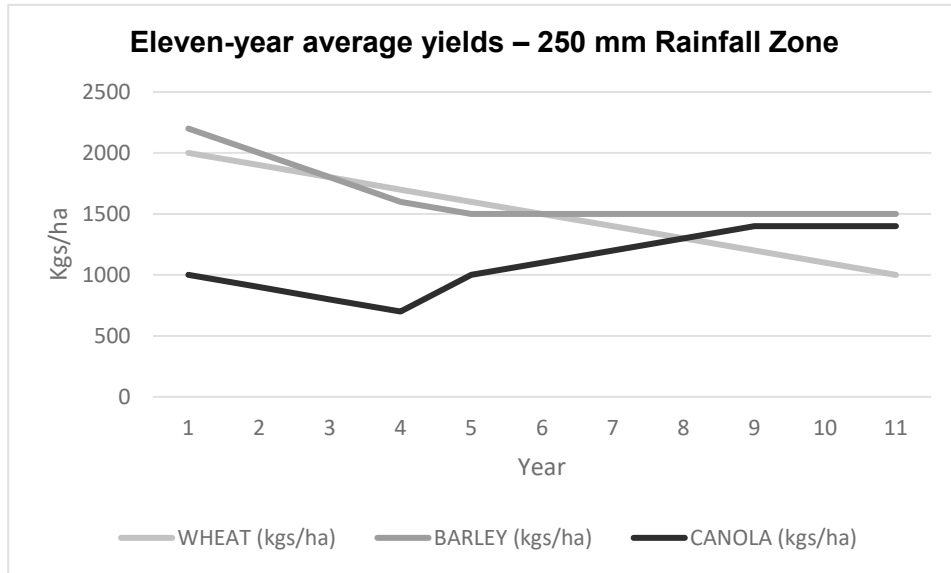
Description	Marks
Explains how experimental error and bias can be minimised in the trial	4
Describes how experimental error and bias can be minimised in the trial	3
Outlines how experimental error and bias can be minimised	2
States a fact about minimising bias or experimental error	1
Total	4
Answers could include:	
<ul style="list-style-type: none"> bias – trial data collected by independent body, not robotic company experimental error – each punnet weighed so that weight rather than number of punnets determines more efficient. Punnets would be observed full rather than a standard number of fruit. 	
Accept other relevant answers.	

Question 26

(20 marks)

(a) (i) Using the grid below, graph the data from the table on page 18. (6 marks)

Description	Marks
Title accurately reflects the content of the data	1
Axes are correctly scaled with numbers placed correctly	1
Data points are placed correctly on graph	1
Each axis labelled with both the correct title and units	1
Data graphed as distinct lines	1
Clear key	1
Total	6



Accept other relevant answers.

(ii) If the average annual rainfall between 2010 and 2020 was decreasing, state the trend for the yields of each crop. (3 marks)

Description	Marks
wheat is trending down, half of its original yield, yields continue to drop	1
barley has trended down, then levelled	1
canola began to trend down but has recovered to yield higher than when it started, but has levelled off	1
Total	3

The reduction in annual rainfall is likely a result of climate change.

- (iii) Outline **one** short-term and **one** long-term strategy a crop producer could adopt to remain viable in this rainfall zone. (4 marks)

Description	Marks
Short-term	
Outlines a short-term strategy a producer could adopt to remain viable	2
States a short-term strategy a producer could adopt to remain viable	1
Subtotal	2
Long-term	
Outlines a long-term strategy a producer could adopt to remain viable	2
States a long-term strategy a producer could adopt to remain viable	1
Subtotal	2
Total	4
Answers could include:	
Short-term – do not plant wheat, increase area of barley and canola, pest control, fertiliser/soil test, use better quality of seed.	
Long-term – adopt new drought tolerant varieties, phase out cropping in favour of grazing, and diversify by purchasing cropping land in a higher rainfall zone as an alternative.	
Accept other relevant answers.	

Question 26 (continued)

- (b) (i) A producer in the low-rainfall zone plans to replace their current crops with the new crop. Using the risk severity matrix above, outline the risk of replacing their current crops. (4 marks)

Description	Marks
Likelihood	
Outlines the risk of replacing their current crops	2
States a relevant risk of replacing their current crops	1
Subtotal	2
Consequence	
Outlines the consequence of replacing their current crops	2
States a relevant consequence of replacing their crop	1
Subtotal	2
Total	4
Answers could include:	
Replacing crops with new crop – likelihood possible/consequence critical if crop fails resulting in no income.	
Marketing crop to Canada – likelihood possible/consequence major, if Canada does not purchase crop, possibility of finding another market.	
Accept other relevant answers.	

- (ii) Propose a strategy to mitigate the risk identified in part (b)(i) on page 21. (3 marks)

Description	Marks
Proposes a strategy to mitigate a risk	3
Outlines a strategy to mitigate a risk	2
Makes a relevant statement about mitigating risk	1
Total	3
Answers could include:	
<ul style="list-style-type: none"> • strategy – retain current crops, integrate new crop into crop rotation • monitor yields and price of new crop without committing to a complete change • unable to mitigate market risk of Canadian buyers at the farm gate, explore other marketing options. 	
Accept other relevant answers.	

Section Three: Extended answer

30% (40 Marks)

Question 27

(20 marks)

- (a) Outline how quality assurance practices can minimise variations in product quality caused by variety, handling and transport. (6 marks)

Description	Marks
Variety	
Outlines how quality assurance can minimise variation in product quality caused by variety	2
Makes a relevant statement about quality assurance practices around varieties	1
Subtotal	2
Handling	
Outlines how quality assurance can minimise variation in product quality caused by product handling	2
Makes a relevant statement about quality assurance practices around product handling	1
Subtotal	2
Transport	
Outlines how quality assurance can minimise variation in product quality caused by product transport	2
Makes a relevant statement about quality assurance practices around product transport	1
Subtotal	2
Total	6
<p>Answers could include:</p> <ul style="list-style-type: none"> • variety – link quality assurance to minimising variation in variety by focusing on keeping varieties separate, both in storage and in paddocks, use of accurate paddock records • handling – link quality assurance to minimising variation in handling by focusing on cleaning harvesting equipment and making sure it is well maintained and calibrated to harvest product • transport – link quality assurance to minimising variation in the product at transport by focusing on clean shipping containers (trailers, crates, boxes), controlled environment (either refrigeration/sun exposure/rain exposure). <p>Accept other relevant answers.</p>	

Question 27 (continued)

- (b) Propose **one** adaptation to the plant production system that could mitigate variation in the product caused by the effect of weather. (4 marks)

Description	Marks
Proposes an adaptation to mitigate variation in the product caused by weather	4
Describes an adaptation to mitigate variation in the product caused by weather	3
Outlines an adaptation to mitigate variation in the product caused by weather	2
States a fact about an adaptation to mitigate variation in the product caused by weather	1
Total	4
<p>Answers could include:</p> <ul style="list-style-type: none"> • broadacre – select the right variety for the area, be prepared to change to another variety to suit the seasonal conditions (late/early), seeding rates to suit moisture levels at germination and finishing • pasture – adopt regenerative grazing strategies that maximise production through root mass retention, sowing more perennial species to take advantage of unseasonal rain • vegetables – generally irrigated so the weather effect is more likely temperature/sun exposure. Using shade to reduce sun damage, using hothouses to control low temperatures • fruit – planting trees in the espalier form to take greatest advantage of sunlight, reduces effect from destructive winds. <p>Accept other relevant answers.</p>	

- (c) Analyse the financial implications caused by a variation in applied nutrition on the quality and quantity of the plant product. (6 marks)

Description	Marks
Analyses the financial implication caused by a variation in applied nutrition on the quality and quantity of the crop	6
Discusses the financial implication caused by a variation in applied nutrition on quality and quantity of the crop	5
Explains the financial implication caused by a variation in applied nutrition on the quality and quantity of the crop	4
Describes the financial implication caused by a variation in applied nutrition on quality and quantity of the crop	3
Outlines a relevant financial implication caused by a variation in applied nutrition on quality and quantity of the crop	2
States a fact caused by a variation in applied nutrition on either quality or quantity of the crop	1
Total	6
Answers could include: <ul style="list-style-type: none"> • quality – grain size, protein level, falling numbers due to a nutrient deficiency/toxicity will result in a price penalty/discount from the marketer. If the quality is below the receivable standard, the producer will have to sell it privately or use it as a feed source for livestock • quantity – or yield will ultimately determine profit. The growth of the crop through the vegetative stage will set up the potential yield provided enough rainfall is received. Any failure to provide or address a nutrient deficiency will reduce yield. Accept other relevant answers.	

- (d) Explain a new technology that could minimise any variation in the plant product and optimise production. (4 marks)

Description	Marks
Explains a new technology that could minimise variation in the crop and optimise production	4
Describes a new technology that could minimise variation in the crop and optimise production	3
Outlines a new technology that could minimise variation in the crop	2
States a fact about a new technology that could minimise variation in the crop	1
Total	4
Answers could include: <p>Technology: global positioning system (GPS) tracking used to follow a soil nutrient map so that each part of the paddock receives the optimum level of fertiliser, to give crop its optimum potential yield. Information is based on previous crops in the paddock, the type and rate of fertiliser used, yields and soil tests to determine residual nutrient levels.</p> Accept other relevant answers.	

Question 28

(20 marks)

- (a) Select an Australian plant production system and identify its main product, export destination and greatest global competitor. Identify a consumer trend that could affect the product's export potential and discuss a strategy that the producer could use to alter production in response to this trend. (8 marks)

Description	Marks
Product of Australian plant production system	
States relevant product	1
States relevant export destination	1
States relevant main global competitor	1
Subtotal	3
Strategy to alter production	
Discusses a strategy to respond to a consumer trend that would affect the product's export potential	5
Explains a strategy to respond to a consumer trend that would affect the product's export potential	4
Describes a strategy to respond to a consumer trend that would affect the product's export potential	3
Outlines a strategy to respond to a consumer trend that would affect the product's export potential	2
Identifies a relevant consumer trend that would affect the product's export potential	1
Subtotal	5
Total	8
Production: <ul style="list-style-type: none"> • product – wheat, barley, canola • export destination – Indonesia, Japan, Saudi Arabia, Japan, China • main competitor – Canada/USA, France. 	
Strategy to alter production in response to consumer trends: <ul style="list-style-type: none"> • ban on any GM products – producers would need to maintain strict protocols around variety selection, maintain accurate records, keep machinery and storage equipment clean and well maintained to avoid any cross-contamination. Submit samples for random testing that produce certificates of varietal purity • organic – producers need to maintain a chemical free crop, which includes no pesticides or chemical fertilisers. This would require a different approach to seed-bed preparation and nutrition of the crop. The use of non-chemical registered fertilisers allows growers to increase yields without compromising their organic status. Produce samples would need to be submitted for testing to gain organic status. Accreditation can take years to gain organic status and the record keeping to maintain that status needs to be meticulous. 	
Accept other relevant answers.	

- (b) Explain, using an example, the benefits of comparative advantage to Australian plant producers. Consider the effectiveness of tariffs as a protection strategy for Australian plant producers and explain how this strategy could affect Australia's global competitiveness. (12 marks)

Description	Marks
Example of comparative advantage	
Explains the benefits of comparative advantage, using a relevant example	4
Describes the benefits of comparative advantage, using a relevant example	3
Outlines a comparative advantage example or benefit	2
States a relevant comparative advantage example or benefit	1
Subtotal	4
Effectiveness of tariffs	
Considers the effectiveness of tariffs as a protection strategy	4
Describes the effectiveness of tariffs as a protection strategy	3
Outlines the effectiveness of tariffs as a protection strategy	2
States a fact about the effectiveness of tariffs	1
Subtotal	4
Impact on global competitiveness	
Explains the effect of tariffs on Australia's global competitiveness	4
Describes the effect of tariffs on Australia's global competitiveness	3
Outlines the effect of tariffs on Australia's global competitiveness	2
States a fact about the effect of tariffs on Australia's global competitiveness	1
Subtotal	4
Total	12
<p>Answers could include:</p> <p>Benefits of comparative advantage – Australia has a comparative advantage in most broad acre production, such as wheat, barley, canola due to the arable area available to grow crops, the cost of production per tonne/per hectare, the low incidence of pests and diseases, proximity to Asian markets that have large populations, but unsuitable growing conditions, the uptake of conservation farming methods to lower input costs and improve the soil, the ability to move and ship large quantities of product through well-organised ports.</p> <p>Effectiveness of tariffs – as a protection strategy, tariffs will increase the imported costs for goods, making the imported product less competitive. The funds raised by tariffs can be used by the government to assist new industries to become established and gain a consumer base before they start to compete on a level field. There may also be some imports that are deemed harmful to consumers/environment where tariffs would make them more expensive and less desirable by consumers. Tariffs can also be used in retaliation for unfair trade practices such as dumping and can give exporters something to bargain with when trying to break into a new export market.</p> <p>Impact on global competitiveness – Australia is generally an exporter of raw products and an importer of manufactured products. The impact of placing tariffs on products coming into Australia will only push up the price to consumers because the tariff is not protecting an industry, just increasing costs. An example is tractors. None are made in Australia, all are imported so the cost of the tariff is passed directly to the buyer, in this case the farmer. This increases their cost of production, making them less competitive when it comes to selling their product on the world market.</p>	

Question 29

(20 marks)

- (a) Outline, including an illustration, the flow of energy in a plant production ecosystem and describe **two** environmental strategies that could improve the sustainability of this ecosystem. (12 marks)

Description	Marks
Illustration	
Includes the sun and four aspects of plant production in the correct sequence	4
Includes the sun and three aspects of plant production in the correct sequence	3
Includes the sun and two aspects of plant production in the correct sequence	2
Includes the sun and an aspect of plant production	1
Subtotal	4
Energy flow	
Outlines the flow of energy in a plant production ecosystem in the correct sequence	2
States a relevant fact about the flow of energy in a plant production ecosystem	1
Subtotal	2
For each environmental strategy (2 x 3 marks)	
Describes an environmental strategy	3
Outlines a strategy	2
Identifies a relevant strategy	1
Subtotal	6
Total	12
<p>Answers could include:</p> <p>Illustration: flow of energy in an agricultural ecosystem – labelled diagram – critical aspects are:</p> <ul style="list-style-type: none"> • sun – arrow points to plant production • farm inputs/operations • plant production • plant product removal/export • soil – there should be arrows going to production and back to soil to show crop material that is residue being recycled. <p>Outline of energy flow:</p> <ul style="list-style-type: none"> • the sun provides the energy for plants to grow, agriculture provides inputs, such as fertiliser to increase production, which is then harvested and sold off-farm. The residue of the plant production is returned to the soil to minimise the farm inputs for the next crop. <p>Environmental strategies that could improve the sustainability of this ecosystem:</p> <ul style="list-style-type: none"> • crop rotations – reduces pest problems, leads to healthier soil and less soil erosion when crops are grown in a pattern to replenish rather than just produce • integrated pest management – using a range of pest control methods that have a lower impact on the ecosystem than just chemical control • alternate sources of energy – using wind/solar systems to make and store energy to run the farms operational power requirements • hydroponics/aquaponics – use of soilless systems to grow food, can be intensive enough to capture and reuse all waste products so that nothing enters the ecosystem • polyculture farming – growing multiple crop species in one paddock where they can complement each other by making the system more resilient to weather fluctuations, promotes a balanced diet and applies natural mechanisms for the preservation of soil fertility • agroforestry – trees are planted strategically to assist with creating a micro-climate, protection from wind/rain storms, stabilise the soil and provide their own long-term products. 	

- (b) Discuss the importance of biodiversity in maintaining the recycling of matter in both natural and agricultural ecosystems. (8 marks)

Description	Marks
Natural ecosystem	
Discusses the importance of recycling of matter in a natural ecosystem	4
Describes the importance of recycling of matter in a natural ecosystem	3
Outlines an importance of recycling of matter in a natural ecosystem	2
States a fact about recycling of matter in a natural ecosystem	1
Subtotal	4
Agricultural ecosystems	
Discusses the importance of recycling of matter in an agricultural ecosystem	4
Describes the importance of recycling of matter in an agricultural ecosystem	3
Outlines an importance of recycling of matter in an agricultural ecosystem	2
States a fact about recycling of matter in an agricultural ecosystem	1
Subtotal	4
Total	8
<p>Answers could include:</p> <p>Natural ecosystem: maintains a balance of clean water, clean air, stable soils that provide a diverse population of animals and plants, from consumers down to producers and decomposers, a source of food and an opportunity to contribute to the energy cycle through use of sunlight or the breaking down of residue by decomposers that also provides a source of energy for producers. The number and diversity are important so that a balance can be achieved and populations don't become weak and struggle to fulfil their role.</p> <p>Agricultural ecosystem: cannot have the balance of a natural ecosystem, but must have enough producers and consumers to sustain a population of predators/pollinators. Large areas of crop use much more energy than they return to the system, so it is critical that decomposers are healthy and can act on the residues once the harvest is taken. Retaining some native vegetation and/or planting back areas of natural protection will help to sustain the population of predators/pollinators. The minimal use of chemicals, both pesticides and fertilisers, will provide a cleaner environment for the decomposers to recycle matter.</p> <p>Accept other relevant answers.</p>	

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