Government of **Western Australia**
School Curriculum and Standards Authority

PLANT PRODUCTION SYSTEMS

ATAR course examination 2017

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.

2017/69585

Section One: Multiple-choice **20% (20 Marks)**

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

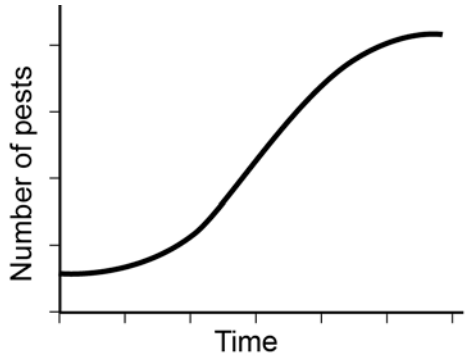
Section Two: Short answer **50% (104 Marks)**

Question 21 **(15 marks)**

(a) Define the term 'pesticide resistance'. (2 marks)

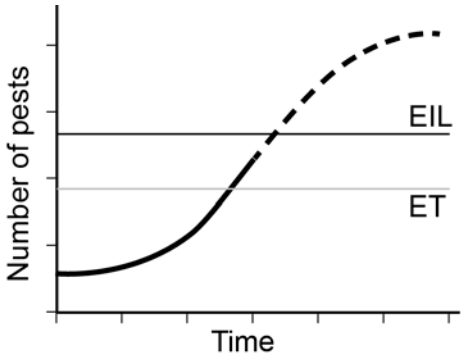
Description	Marks
Defines pesticide resistance	2
States a fact about pesticide resistance	1
Total	**2**
Answers includes, but are not limited to the following: • decreased susceptibility of a pest population to a pesticide that was previously effective at controlling the pest.	

(b) Draw and label a diagram in the space below to represent the expected population growth curve of a pest if left untreated. (3 marks)

Description	Marks
X axis labelled: Time	1
Y Axis Labelled: Population number of pests	1
Exponential growth curve that peaks and plateaus  	1
Total	**3**

Question 21 (continued)

(c) Define Economic Injury Level (EIL) and Economic Threshold (ET). Draw and label these lines on the graph in part (b). (6 marks)

Description	Marks
	
Defines correctly economic injury level	2
States a fact about economic injury level	1
Defines correctly economic threshold	2
States a fact about economic threshold	1
Line drawn horizontally on diagram and EIL line is above ET line	1
Line drawn horizontally on diagram and ET line is below EIL line	1
Total	**6**
Answer could include: • EIL: is the population of a pest where the costs on control measures are less than the damage caused by the pest • ET: is the population of a pest where damage is starting to occur and control measures need to be started • control measures should be started before EIL is reached.	

(d) List **two** practices that can decrease the chances of pesticide resistance occurring and state how each practice is carried out. (4 marks)

Description	Marks
Two marks for each valid practice. Maximum four marks.	
Lists a practice and states how it is carried out	2
Lists or states a fact about a practice that will decrease pesticide resistance	1
Total	**4**

Answers can include, but not limited to the following;
• correct dosage rate: insures that the chemical kills the pests not just injuring it to recover later
• correct application timing: applying at a time where the pest is most vulnerable
• follow up application if needed: ensure that all selected pests are killed, also necessary if a new flush of pests are produced
• using integrated pest management such as:
  • changing pest control strategies
  • changing pesticide families
  • monitor and keep records of pesticide resistance
  • follow the label instructions.	

Question 22 **(17 marks)**

(a) Calculate the income and the gross margin for each crop and state which crop is the more profitable option. (5 marks)

Description	Marks
A = $750	1
B = $800	1
C = $557	1
D = $633	1
More profitable is D – Feed barley	1
Total	**5**

(b) Recalculate the gross margins and explain how this information might influence your decision to grow malting or feed barley. Show all workings. (4 marks)

Description	Marks
Gross margin for Malting barley now 3.5 x $350/tonne = $1225 – 193 =$1032	1
Gross margin for Feed barley now 4.2 x $250/tonne = $1050 – 167 = $883	1
Assesses financial change of circumstances and gives clear explanation why the producer should swap to malting barley	2
States that malting barley will now be more profitable	1
Total	**4**
Answers includes, but are not limited to the following; • no increase in costs, so no extra investment required to swap to malting to make a higher profit • there is an opportunity to make an extra $399/ha if the producer grows malting barley. If the season and prices remain the same the producer will risk a loss of $76/ha.	

(c) A new herbicide for improving weed control in cereal crops becomes available. It will increase average yield by 10% for an extra cost of $75/hectare. Using your calculations in part (a), how will this new information guide your decision to grow malting or feed barley? Show all workings. (4 marks)

Description	Marks
Gross margin for malting barley now 2.75 x $300 = $825 – 268 = $557	1
Gross margin for feed barley now 3.52 x $250 = $880– 242 = $638	1
Makes it clear that there is no improvement for malting and a small improvement to feed	2
States a fact about the profitability of enterprise	1
Total	**4**

Question 22 (continued)

(d) Describe a new technology for plant production and how it can increase the profitability of a plant enterprise. (4 marks)

Description	Marks
Describes a new technology	2
Lists a new technology	1
Describes how the new technology can increase profitability	2
States a fact about the new technologies affect on profitability	1
Total	**4**
Answers includes, but are not limited to the following; New technology: • Self-steer machinery – operates on GPS • Weed finder (such as Weed Seeker) – targets weeds rather than blanket spray • Genetically modified organisms. How it can increase profitability: • less overlap, less wasted seed/fertiliser/chemical • reduced costs of chemicals.	
Accept other relevant answers.	

Question 23 **(15 marks)**

(a) Explain why replication and randomisation are important in this trial. (6 marks)

Description	Marks
Three marks for each component. Maximum of six marks	
Detailed explanation about component and reason for importance	3
Brief explanation about component	2
States a fact about component	1
Total	**6**
Answer could include: Replication: Plots need to be repeated within the paddock, at least three replications of the trial in different parts of the paddock. An average can be obtained of results and which will help to reduce the effects of the atypical results caused by environmental conditions and increase reliability. Randomisation: Treatments should be distributed in such a way within each replication so that each plot is not affected by its location within the replication. This will help to decrease bias during sampling and treatment.	
Accept other relevant answers.	

(b) Describe **one** aspect of the trial that could result in possible bias. (2 marks)

Description	Marks
A possible bias in the experimental design clearly described	2
A possible bias identified	1
Total	**2**

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

- variations in the soil type
- other weeds in the paddock
- topography of the paddock
- other pests e.g. biological, fungal, insects
- treatment application timing
- random/unseasonal weather events.

(c) Use the headings of aim, treatments and method to outline a future investigation that could improve the farmers understanding of ryegrass control. (7 marks)

Description	Marks
Provides detailed aim, very specific in what is to be tested leading to an improvement in the farmers understanding	2
States an aim, something to be tested	1
Provides detailed list of treatments to be tested leading to an improvement in the farmers understanding	2
States a treatment to be tested	1
Outlines a detailed method of tasks to be carried out with information on how the results will be obtained, information regarding randomisation and repetition to be mentioned	3
Outlines a simple method with some detail of tasks	2
States a simple method	1
Total	**7**

Answers could include, but not limited to the following;

- knockdown versus selective chemicals for ryegrass control
- using different cultivation control methods
- grazing versus cultivation.

Example investigation set up
Aim: Determine the effectiveness of different cultivation machinery on ryegrass establishment.

Treatments: offset discs, chisel plough, mouldboard plough, scarifier.

Method: Any of the following **three** in the correct sequence:

- select a paddock that is uniform in soil type and has a history of ryegrass infestations
- plot design needs to incorporate all cultivation machinery and one plot left untreated as a control. Plots needs to be random in placement and repeated across the paddock at least three times
- cultivation of all plots needs to take place on the same day
- after germination, a ryegrass count using a quadrant is carried out on all plots
- a second ryegrass germination count should take place 2-3 weeks later
- results should be compared to the control to determine effectiveness.

Accept any other relevant answers.

Question 24 **(14 marks)**

(a) Describe how quarantine inspection protects Australian plant producers. (2 marks)

Description	Marks
Describes how the protection strategy protects Australian producers	2
States a fact that links quarantine to protecting Australian producers	1
Total	**2**

Answers includes, but are not limited to the following;

Quarantine:
- border security inspects imports to prevent unwanted pests and diseases entering into Australia.

(b) Describe how comparative advantage helps Australian plant producers maintain their global competitiveness? (2 marks)

Description	Marks
Describes how comparative advantage helps to remain competitive	2
States a fact about comparative advantage	1
Total	**2**

Answers includes, but are not limited to the following;
- comparative advantage is present because Australia has a significant advantage in natural resources (land and water), climate, market proximity, technology
- Australia is predominately an exporter of products from extensive production where we have vast tracts of land and have low costs of production.

(c) (i) Select a plant product and state its major export market destination. (2 marks)

Description	Marks
Plant product	1
Relevant major export destination	1
Total	**2**

Answers includes, but are not limited to the following;
- Wheat – South East Asia/Indonesia/China
- Sugar – Asia/Indonesia
- Barley – Middle East/Saudi Arabia

(ii) Describe **two** strategies producers use to ensure that they remain competitive in the export market destination selected in part (c)(i). (4 marks)

Description	Marks
Two marks for each strategy. Maximum of four marks.	
Describes clearly a strategy that helps to remain competitive	2
States a fact about a strategy to remain competitive	1
Total	**4**

Answers include, but are not limited to the following;

- quality assurance programs that ensure the product is contaminant free
- using current varieties/cultivars that have been developed with particular markets in mind
- using new technology to minimise costs and maximise production
- minimise costs to reduce effects of exchange rate/product values on price received
- marketing/promotional strategies.

Note: strategy must relate directly to the product and destination selected in part (c)(i).

(iii) Identify a developing trend in consumer demand for the plant product in part (c)(i). Explain how producers can adapt their plant production systems to take advantage of this trend. (4 marks)

Description	Marks
Identifies a developing trend	1
Explains an adaptation	3
Describes an adaptation	2
States a fact about an adaptation	1
Total	**4**

Answers includes, but are not limited to the following;

Trend towards:

- organically grown food
- non-GMO
- growing heritage varieties/cultivars
- consumers choosing 'house brands' rather than traditional brands.

Adapt by:

- switch to non-chemical fertilisers (synthetic) and pest control, greater use of IPM
- source seed from registered growers, utilise buffers around crops, negotiate with neighbours, keep accurate records, practice strict biosecurity procedures.
- source seed from registered growers
- producers need to secure contracts with large supermarkets or find ways to produce product that can compete with 'house brands'.

Note: developing trend and adaptation to plant production systems must relate directly to the product and destination selected in part (c)(i).

Question 25 **(13 marks)**

(a) (i) Describe how a plant uses the end product of photosynthesis. (2 marks)

Description	Marks
Describes how a plant uses the end product of photosynthesis	2
States a fact about the end product of photosynthesis	1
Total	**2**

Answers includes, but are not limited to the following;

- the end product glucose is converted to starch and used as energy. Glucose is used in respiration to release energy for use by the plant cells.

(ii) State **two** environmental conditions that affect the rate of photosynthesis and explain **one** method of manipulating the photosynthetic process artificially. (4 marks)

Description	Marks
One mark for each statement of an environmental condition	1–2
Explanation about manipulating photosynthesis	2
Makes a statement about manipulating photosynthesis	1
Total	**4**

Answers includes, but are not limited to the following;

Environmental condition	Statement
Light	Light intensity increases the rate of photosynthesis. Artificial lights can be used to increase photosynthesis.
Carbon dioxide	Limited availability of carbon dioxide reduces the rate of photosynthesis.
Temperature	As temperature increases the rate of photosynthesis increases. Plant temperature range is between 5–25 degrees for optimum photosynthesis.
Water	Limiting the availability of water limits the rate of photosynthesis.

Photosynthesis can be manipulated in the following way;

- use of shade cloth can lower the temperature, shade cloth will also reduce light intensity
- increasing carbon dioxide in tunnel houses will increase photosynthesis.
- genetically modify the plants ability to maintain photosynthetic rate in harsh conditions
- by increasing the carbon dioxide levels; the rate of photosynthesis will increase
- by increasing the rate of nitrogen fertiliser an increase in leaf area will occur increasing the rate of photosynthesis
- by increasing the hours of daylight by artificial lights the rate of photosynthesis can be increased
- temperature increases will increase photosynthesis but there is an upper limit.

(b) State

(i) one role transpiration plays in a plant. (1 mark)
(ii) one plant structure that is involved in controlling transpiration. (1 mark)
(iii) one environmental factor that reduces plant transpiration. (1 mark)

Description	Marks
States one role transpiration has in the plant	1
States one plant structure involved in controlling transpiration	1
States one environmental factor that will reduce transpiration	1
Total	**3**

Answers includes, but are not limited to the following;

One role of transpiration in the plant:
- cools the plant
- continues supply of water to the plant to maintain plant turgidity, maintain plant structure and assists in plant processes
- continuous supply of water to the plant to maintain nutrient movement to the cells, movement of nutrients across cell membranes and assists in cellular function
- provides water for photosynthesis.

One plant structure involved in controlling transpiration:
- stomata are pores in the leaf that allow gas exchange (water vapour out and carbon dioxide in) the size of the stomata is controlled by the guard cells
- guard cells control the stomata cells to open and close. Guard cells react to sunlight and cell moisture levels
- leaf cuticle on the leaf that prevents moisture transfer through the cell.

One environmental factor that will reduce plant transpiration:
- large boundary layers around the plant reduce transpiration
- high relative humidity in the air stops transpiration
- stomata's close in the dark and this stops transpiration
- low soil water content
- low air temperatures
- still air or low wind speeds.

Question 25 (continued)

(c) (i) Describe how soluble plant nutrients are absorbed out of the soil into plant roots. (2 marks)

Description	Marks
Describes absorption of nutrients from soil to plant roots	2
Simple outline of absorption of nutrients	1
Total	**2**

Answers includes, but are not limited to the following;

- as water is drawn to the plant root the dissolved ions move with it to the root hairs
- Osmosis allows the plant to take up water through the plant root tips
- the uptake is mainly at the root hairs where the large surface area of the root hair allows a large amount of water to be absorbed
- water soluble nutrients will be taken up into the plants as the water is taken up
- the movement of nutrients into the plant will be by diffusion
- the diffusion gradient is the movement of ions along/across a concentration gradient
- the passive uptake of water is from a high concentration to a low concentration and drags water soluble nutrients with it.

(ii) Describe nutrient movement in phloem vessels of plants. (2 marks)

Description	Marks
Describes translocation of nutrients in the plant	2
Simple description of movement of nutrients in the plant	1
Total	**2**

Answer must refer to translocation for two marks.

Answers include, but are not limited to the following;

- the phloem transports sugars and amino acids made by photosynthesis both up and down the plant from the leaves to the storage organ and the growing part of the plant
- the phloem will also translocate nutrients to the storage organs and the growing parts of the plant if the nutrients are mobile
- the phloem cells are living cells and operates on positive pressure
- the phloem are located in the outside of the vascular bundles.

Question 26 **(15 marks)**

(a) (i) State **two** methods that can be used to increase the availability of water to a growing crop. (2 marks)

Description	Marks
Method 1	1
Method 2	1
Total	**2**

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

Most crops rely on natural rainfall to supply moisture for growth.
Other methods include:

- long term fallow allows moisture to build up in the soil in field crops
- in market gardens/orchards, increasing organic matter content in the soil to increase the soil water holding capacity
- use of mulch that decreases evaporation rates in orchard crops
- the use of irrigation systems to increase water availability.

(ii) Describe the difference between field capacity and available water. (4 marks)

Description	Marks
For each term two marks. Maximum of four marks	
Describes the difference between terms	2
Limited explanation of the term	1
Total	**4**

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

- the field capacity of the soil is the total amount of water that the soil can hold
- the available water of a soil is the amount of water a plant can use**.**

(iii) Outline how a difference in pore space in the soil can change water availability to a plant. (2 marks)

Description	Marks
Outlines the difference of pore space and water availability	2
Makes a statement about the difference of pore space and water availability	1
Total	**2**

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

- soils with smaller pore space allow a higher availability of water to a plant.
- soils with larger soil pores tend to have a lower availability of water to a plant.

Question 26 (continued)

(b) List **two** production records a farmer should maintain to achieve good nutrient management. (2 marks)

Description	Marks
Production record 1	1
Production record 2	1
Total	**2**

Answers includes, but are not limited to the following;

Production records for nutritional management are;
- soil test results
- fertiliser type and rate applied on the paddock
- tissue tests and any nutrient adjustments
- type of crop grown and the yields achieved
- method of application and results.

(c) For a plant enterprise you have studied, state the decision making involved in selecting a nutrient (fertiliser) that will be applied to a crop in light, sandy soil. Complete the table below.

(5 marks)

Nutrient applied: _____ (0 marks)

Description	Marks
Correct statement for each heading	1–5
Total	**5**

Answers includes, but are not limited to the following;

Criteria	State the critical information you require when selecting the nutrient in the following soil type.
Soil type	Light and sandy
Crop type	Legume and vegetable crops have a much higher nutrient demand for phosphorous and potassium than cereal crop.
Stage of growth at application	Phosphate and nitrogen nutrients are important at early stages of development. E.g. seed germination, bud burst. phosphate and potassium at flowering stage is also important. Lupins and canola crops require large amounts of sulphur at stem elongation.
Cost	Higher fertiliser costs the lower the rate you can afford to apply. Calculate the cost of the nutrient being applied against the amount in the fertiliser to determine the most cost effective fertiliser to use. Different fertiliser companies will sell similar fertiliser at different prices.
Availability	Not all fertilisers are available all year round, some need to be pre-ordered because most fertilisers are imported.
Application Method	Fertiliser effectiveness will vary depending on fertiliser placement. Fertiliser applied near the seed root zone is much more effective than fertiliser that is top dressed on to the soil surface provided it does not come into contact with the germinating seed. Foliar sprays improve plant uptake.

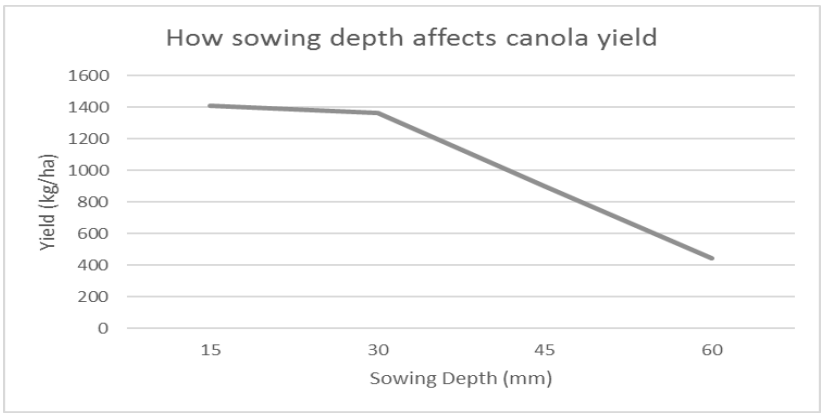
Question 27 **(15 marks)**

A research company tested whether canola emergence from deep sowing could be improved by using larger seed.

(a) Calculate the mean canola yield based on sowing depth. (3 marks)

Description	Marks
A: 1400	1
B: 1300	1
C: 450	1
Total	**3**

(b) Using the information in part (a), construct a graph showing the relationship between canola yield and sowing depth. (6 marks)

Description	Marks
	
Y-axis: Labelled **Yield (kg/ha)**, appropriate scale so that data can be read easily, units labelled	1
X-axis: Labelled **sowing depth (mm)** with units	1
locates averages on graph accurately	1
bar, column, scatter or line graph	1
no connection of data to (0,0) and an indication of continuous data set for sowing depth	1
Graph title: Eg. How sowing depth affects canola yield	1
Total	**6**

Question 27 (continued)

(c) Using the information in the graph and table, discuss the impact on canola yield based on sowing depth and seed size. (4 marks)

Description	Marks
Discusses impact on canola yield based on sowing depth	2
States one fact about the result based on sowing depth	1
Discusses impact on canola yield based on seed size	2
States one fact about the result based on seed size	1
Total	**4**
Answer can include, but not limited to the following; • sowing canola deeper than 30 mm dramatically reduced yield • not much difference in the yield based on seeding depth amongst seed sizes • larger seeds performed slightly better at all seeding depths	

(d) Describe the critical environmental factor that should be considered when deciding on sowing depth. (2 marks)

Description	Marks
Describes soil moisture content and its link to sowing depth	2
States a fact about soil moisture	1
Total	**2**
Answer may include: • Soil moisture content is the critical environmental factor when deciding on sowing depth. Soil moisture content cannot be too low/high as either will adversely impact on germination rate.	

Section Three: Extended answer **30% (40 Marks)**

Question 28 **(20 marks)**

(a) (i) Identify the Quality Assurance (QA) program used for your marketed product. (1 mark)

Description	Marks
Identifies a relevant QA program	1
Total	**1**

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

- Freshcare
- Sureseed
- Graincare
- National Standard for Organic and Bio-Dynamic Produce
- HACCP
- SQF 2000.

(ii) Explains **one** day-to-day operational process that is in place and how it maintains the QA status identified in part (a)(i). (3 marks)

Description	Marks
Explains the operational processes in place to maintain QA	3
Describes some of the operational processes in place to maintain QA	2
States a fact about a QA operational processes	1
Total	**3**

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

- accurate and up-to-date records
- chemical manifest
- on-the-job training
- self-audit process
- biosecurity measures
- standard operating procedures.

Question 28 (continued)

(iii) Identify an aspect of product quality that will vary as a result of inadequate plant nutrition. Describe a strategy that will minimise the effect on your marketed product. (3 marks)

Description	Marks
Aspect identified	1
Describes a strategy that will minimise the effect on product quality due to nutrition	2
States a fact about a strategy	1
Total	**3**

Answers could include, but are not limited to the following;
Aspect of product quality:
- stunted growth
- low seed set
- discoloured leaves
- susceptibility to disease/insect attack
- low protein
- low oil
- small seed size

Strategy:
- soil test
- tissue test.

(iv) Describe **two** ways you might change your plant production methods if the cost of fertiliser rises. (4 marks)

Description	Marks
Two marks for each adaptation. Maximum of 4 marks.	
Describes briefly an adaptation to production method caused by rising cost of fertiliser	2
States a fact about a possible adaptation caused by rising cost of fertiliser	1
Total	**4**

Answers could include, but are not limited to the following;
Adaptations could be:
- use of GPS technology to maximise crop requirements for nutrients
- calibrating devices on seeder to reduce over-fertilising
- improve stubble retention so that more organic nutrients are returned to the soil
- utilise soil ameliorants to improve nutrient uptake
- crop rotation to include legumes for nitrogen fixation
- undertake comprehensive topsoil and sub-soil testing to establish nutrients available for uptake.

(b) Variety development assists producers to maintain a competitive edge. Describe **two** characteristics of a variety used in your nominated enterprise that will improve the quality of the marketable product. (4 marks)

Description	Marks
Two marks for each characteristic. Maximum of 4 marks.	
Describes briefly a characteristic of a variety used that improves product quality	2
States a fact about a characteristic of a varieties quality	1
Total	**4**
Answers could include, but are not limited to the following; Varietal characteristic could be: • drought tolerance • herbicide tolerance • growth rate – higher yields • time of maturity – avoiding poor conditions at harvesting • frost resistance – less loss of production • disease resistant – higher quality, higher yields, less reliance on pesticides • protein levels • oil levels • germination rates • colour.	

(c) (i) State the effect on the financial return to your plant production enterprise on the basis of the information in the graph above. (1 mark)

Description	Marks
States a relevant fact about financial return in relation to the graph	1
Total	**1**
Answers could include, but are not limited to the following: • lower rainfall during winter will have a negative impact on yields, so income will be affected	
Any other relevant answers dependent on selected plant production enterprise.	

(ii) If the trend in the graph continues for the next 30 years (2009–2039) describe how you might manage this risk using **one** avoidance and **one** mitigation strategy. (4 marks)

Description	Marks
Two marks for each description. Total of four marks	
Describes how strategy reduces risk	2
States a fact about how strategy reduces risk	1
Total	**4**
Answers could include, but are not limited to the following; Avoidance: • change farm enterprises away from cropping to grazing • diversify in off-farm investments • sell up and relocate to a more reliable district. Mitigation: • change of varieties/cultivars that cope with drier conditions • improving water harvesting techniques before and during cropping phase • improving sowing methods so that seed has best chance of germinating • implementing IPM for weed and pest control to maximise water use by crop.	
Any other relevant answers dependent on selected plant production enterprise.	

Question 29 **(20 marks)**

Changing environments have an impact on the sustainability of a plant enterprise system.

(a) Select **one** environmental factor from the list below and explain how tolerance to that factor could be bred into a cultivar by using **one** conventional breeding technique and **one** genetic engineering technique.

Environmental factors:
- drought
- salinity
- waterlogging
- frost (8 marks)

Description	Marks
Four marks for each technique. Total of eight marks.	
Explains the components of the technique in detail using the chosen environmental trait throughout	4
States the four components with some detail	3
Lists two to three of the components with limited detail	2
Lists one of the components with some detail	1
Total	**8**

Answers could include, but are not limited to the following;
Conventional breeding technique (4 components = collecting, crossbreeding, selecting, and evaluating):
- collecting and selecting- varieties that between them have the characteristics required in the final crop or pasture
- crossbreeding the collected varieties to combine the desired characteristics
- selecting among the offspring of the crosses those individuals that do have the desired characteristics
- evaluating the selected offspring for the presence of the desired characteristics under field conditions.

Genetic engineering (4 components = identification, isolation, cloning, transference):
- identification – the segment of the DNA that code for a particular gene responsible for a desired feature are identified
- isolation – the DNA segment is isolated
- cloning – the DNA segment is cloned by introducing it into a host, such as bacteria or yeast. As the host multiplies, so does the introduced DNA segment
- transference – the cloned DNA can then be transferred to other members of the species that it came from or to another species where it produces the desired effect.

(b) Select **two** environmental factors from the list below and describe the strategies a farmer could put in place to remain profitable in the short term and sustainable in the long term.

Environmental factors:

- salinity
- waterlogging
- frost
- low pH
- water repellent soil
- wind erosion
- water erosion (12 marks)

Description	Marks
Factor 1 – strategy to remain profitable in the short term	
Describes a strategy to remain profitable in the short term	3
Gives a brief description of a strategy to remain profitable in the short term	2
States a relevant strategy	1
Factor 1 – strategy to remain sustainable in the long term	
Describes a strategy to remain sustainable in the long term	3
Gives a brief description of a strategy to remain sustainable in the long term	2
States a relevant strategy	1
Factor 2 – strategy to remain profitable in the short term	
Describes a strategy to remain profitable in the short term	3
Gives a brief description of a strategy to remain profitable in the short term	2
States a relevant strategy	1
Factor 2 – strategy to remain sustainable in the long term	
Describes a strategy to remain sustainable in the long term	3
Gives a brief description of a strategy to remain sustainable in the long term	2
States a relevant strategy	1
Total	**12**

Question 29 (continued)

Answers could include, but are not limited to the following; Salinity: Short – sow high tolerance crops, use perennials to lower the water table Long – regenerate native vegetation in recharge areas, install sub surface drainage, establish salt tolerant shrubs for grazing. Waterlogging: Short – sow tolerant crops like Faba beans, use long season varieties, apply nitrogen to promote growth, sow summer crops Long – deep rip to aid water percolation, install sub surface drainage, install surface drainage to divert excess water into natural waterways, use raised beds to sow crops into, minimise compaction/traffic in paddocks. Frost: Short – avoid sowing wheat in prone areas, use long season varieties, manage nutrition of growing crop Long – use frost tolerant varieties, map high risk areas in paddocks for variation in crop type, clay/delve sandy soils to increase heat holding capacity. In orchards install overhead sprinklers. Low pH: Short – select crops that can tolerate low pH, apply lime products to raise pH, reduce the use of inorganic fertilisers Long – use organic mineral fertilisers, humus and manures to encourage soil biota. Water repellent soil: Short – use wetting agent, improve furrow sowing, retain stubble and zero tillage Long – rotary spade soil, soil inversion, clay spreading. Wind erosion: Short – retain ground cover, don't overgraze, use minimum tillage techniques Long – establish wind breaks, retain natural bush areas, use zero tillage, establish perennial pastures.
Water erosion: Short – retain soil surface ground cover, maintain creek/gully vegetation, use minimum tillage techniques, avoid creating furrows that run down slopes, cultivate using the natural contours of the land Long – construct contour banks, levee banks, diversion drains to slow water runoff on slopes, grow perennials, use zero till methods.

Question 30 **(20 marks)**

(a) Describe the predicted climate changes that may affect the south-west of Western Australia and discuss **three** specific risks that plant producers face as a result of climate change. (11 marks)

Description	Marks
Detailed description of climate change in south-west of Western Australia	2
States a relevant fact about climate change in south-west of Western Australia	1
Three marks for each risk. Maximum of nine marks.	
Discusses a risk that is linked to plant production in south-west of Western Australia	3
Brief description of a risk that is linked to plant production in south-west of Western Australia	2
States a fact about a risk that is linked to plant production in south-west of Western Australia	1
Total	**11**

Answers could include, but are not limited for the following;
Climate change is a change in the average pattern of weather over a long period of time. Climate change in the south-west of Western Australia is predicted to raise the average temperature, lower the average annual rainfall, raise sea levels and cause more extreme weather events
Risk – rainfall reliability; the risk is for extended periods of dryness/droughts during seasonal cropping programs, affecting critical stages of plant growth and development such as germination, flowering, fruiting. Reduced runoff into dams because rain is intermittent and catchments are dry.
Risk – rising temperatures; increased evaporation from topsoil and water storage dams, heat stress/wilting of plants.
Risk – increased extreme climatic events; cyclones, thunderstorms, hail, flooding, wind events associated with high temperatures have a direct impact on production by damaging, destroying crops/fruit, delaying harvest, damaging infrastructure and destabilising soil through wind/water erosion.
Risk – lower annual rainfall; restricts crop growth potential, increases incidence of dry seeding which in turn decreases soil stability. Will preclude long season crops from the production cycle, reducing producers capacity to spread risk.

Question 30 (continued)

(b) For **one** of the risks identified in part (a), describe how the triple bottom line could be managed by farmers in an attempt to maintain sustainability. (9 marks)

Description	Marks
Three marks for each of the triple bottom line factors. Maximum of nine marks.	
Detailed description about a factor and how it needs to be managed to maintain sustainability	3
Brief description about a factor and how it needs to be managed to maintain sustainability	2
States a relevant fact about a factor	1
Total	**9**

Answers could include, but are not limited for the following;
Economic – diversifying output, building and maintaining financial reserves, using peril insurance, forward selling part of the crop to lock in prices, utilising off-farm employment and investments.
Environmental – adopting water harvesting techniques in furrows, modifying seeding techniques (no till), fallowing after rain events using herbicides, improving water catchment, improving irrigation design/timing/delivery, using long term forecasts as a guide to production decisions.
Social – utilise essential services in remote areas such as financial planning/ mental health/ support groups, providing access to broad social welfare benefits to drought/flood affected farmers in a timely manner.
Buy local, support rural businesses.

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Question 21(b)(c) North Carolina State University. (2017). *NC State extension: Economic thresholds and pest control* [Graph]. Retrieved April, 2017, from https://soybeans.ces.ncsu.edu/thresholds/

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