



ATAR course examination, 2023

Question/Answer booklet

PLANT PRODUCTION SYSTEMS

Please place your student identification label in this box

WA student number: In figures

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In words

Time allowed for this paper

Reading time before commencing work: ten minutes

Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet

Multiple-choice answer sheet

Number of additional
answer booklets used
(if applicable):

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	20	20	30	20	20
Section Two Short answer	6	6	90	105	50
Section Three Extended answer	3	2	60	40	30
Total					100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2023: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write your answers in this Question/Answer booklet, preferably using a blue/black pen. Do not use erasable or gel pens.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.
4. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

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

This section has **20** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/ tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 30 minutes.

1. Translocation of nutrients is through the
 - (a) roots.
 - (b) phloem.
 - (c) xylem.
 - (d) stomata.

2. Soil water management should start with
 - (a) pre-crop practices.
 - (b) crop selection.
 - (c) in-crop management.
 - (d) water drainage systems.

3. A plant that mutates initially influences
 - (a) disease resistance.
 - (b) pollination rates.
 - (c) future biodiversity.
 - (d) genetic diversity.

4. Mass selection is a technique used in
 - (a) bud grafting.
 - (b) seed collection.
 - (c) chemical thinning.
 - (d) plant breeding.

5. Which of the following is **not** a short-term solution to the creation of a sustainable future?
 - (a) release more irrigation licences in low rainfall areas
 - (b) encourage rotational cropping to mitigate low returns
 - (c) adopt zero tillage techniques to minimise soil loss
 - (d) minimise the use of chemicals to control pests

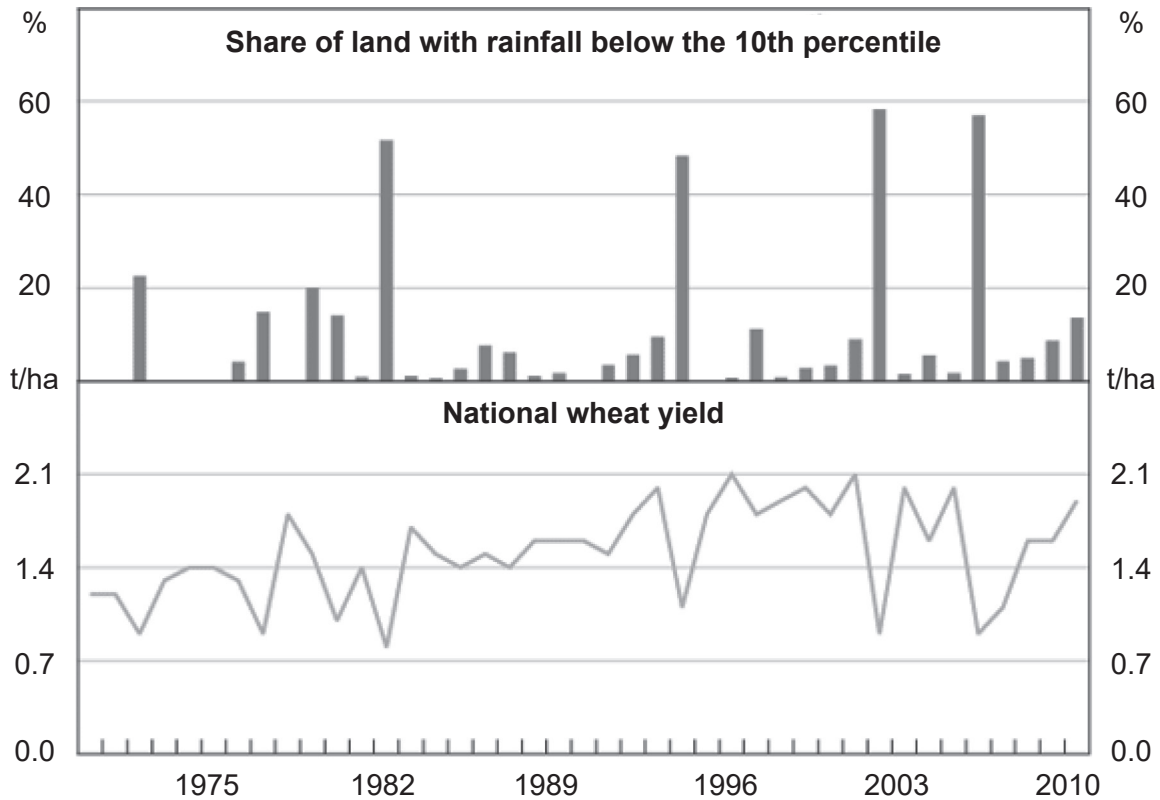
See next page

6. In the long-term, sustainability will need to consider a combination of
- (a) economic, social and production innovations.
 - (b) production, social and environmental innovations.
 - (c) economic, social and environmental innovations.
 - (d) economic, production and environmental innovations.
7. Which of the following industry initiatives provides advice on the use of all-terrain vehicles (ATV's) on farms?
- (a) Worksafe Smartmove
 - (b) Safe Farms WA
 - (c) AusChem Training WA
 - (d) National Centre for Farmer Health
8. As an employee, your duty of care is about
- (a) individual wellbeing, providing instruction, compliance and good practice.
 - (b) individual wellbeing, welfare, compliance, and good practice.
 - (c) providing instruction, welfare, compliance, and good practice.
 - (d) individual wellbeing, welfare, compliance and providing instruction.
9. Which plant process **cannot** be manipulated by changing the air temperature?
- (a) photosynthesis
 - (b) transpiration
 - (c) respiration
 - (d) absorption
10. In general, what needs to happen for optimum plant growth to occur?
- (a) photosynthesis must be greater than respiration
 - (b) respiration must be greater than photosynthesis
 - (c) photosynthesis must be equal to respiration
 - (d) respiration must only happen during daylight
11. The **most** common synthetic hormone used in broadleaf weed control is
- (a) gibberellin.
 - (b) auxin.
 - (c) ethylene.
 - (d) cytokinin.

12. Pest and disease control are **best** addressed by adopting
- economic threshold levels.
 - integrated pest management.
 - economic injury levels.
 - integrated chemical management.

Questions 13 and 14 relate to the graphs shown below.

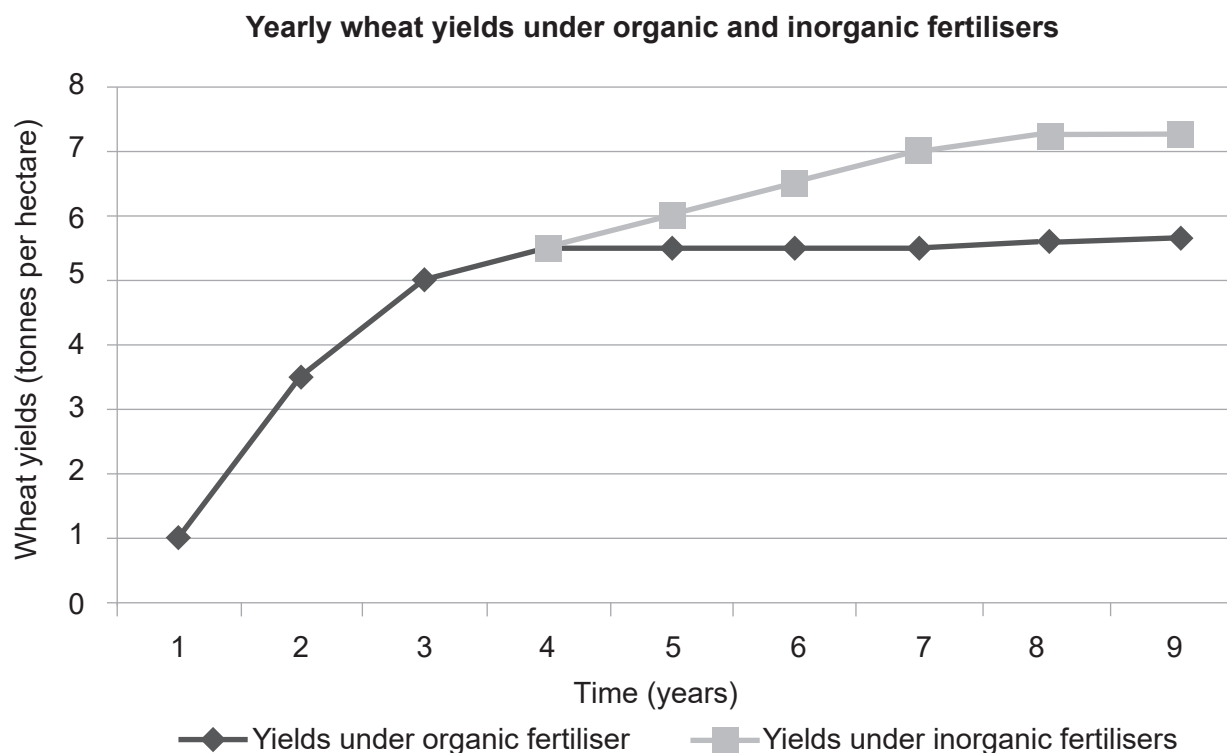
Annual drought and wheat yields



13. How many of the droughts (rainfall below the 10th decile) would have occurred from 1975 to 2010.
- 0
 - 2
 - 4
 - 6
14. Which statement about the national wheat yields is true? Yields
- have been going down gradually.
 - responded well after a drought year.
 - fluctuate regardless of rainfall.
 - have remained about the same.

15. The **most** significant factor that is likely to influence long-term enterprise selection is
- (a) current prices.
 - (b) new technology.
 - (c) climate change.
 - (d) plant breeding.
16. Which of the following is **not** a variable?
- (a) dependent
 - (b) independent
 - (c) controlled
 - (d) manipulated

Questions 17 and 18 relate to the graph below.



17. From a production perspective, organic fertiliser
- (a) cannot compete with inorganic fertilisers for yield.
 - (b) will eventually outperform inorganic fertiliser.
 - (c) is comparable to inorganic fertiliser until Year 4.
 - (d) reduces the rate of soil nutrient depletion.
18. Using an organic manure over several years will
- (a) improve the soil structure.
 - (b) result in a lower yields.
 - (c) reduce fertiliser costs.
 - (d) put the producer out of business.

19. An adaptation to improve the efficiency of a plant production system in a marginal area would be
- (a) a change in planting time.
 - (b) the use of a different type of fertiliser.
 - (c) to grow less variation of crop types.
 - (d) investment in an irrigation system.
20. Which statement **best** represents a changed circumstance in a plant production system?
- (a) switching to a cheaper nitrogen fertiliser
 - (b) replacing machinery to achieve greater working widths
 - (c) growing a crop variety that can cope with lower rainfall
 - (d) undertaking a training program to use new equipment

End of Section One

See next page

Section Two: Short answer

50% (105 Marks)

This section has **six** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 21

(12 marks)

Water management is critical for viable plant production systems.

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

One: _____

Two: _____

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

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

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

Question 22

(18 marks)

Plant breeding techniques keep Australia in the forefront of world food production.

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

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

Question 22 (continued)

Table of varietal characteristics of plants

Characteristics	Varieties			
	A	B	C	D
Leaf disease	S	S	NS	NS
Stem disease	S	S	NS	NS
Stem height	T	SH	SH	T
Stem thickness	TN	TH	TH	TN
Grain ripening	E	L	E	L

Key:

S = susceptible T = tall TH = thick E = early
 NS = not susceptible SH = short TN = thin L = late

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

Windy, short growing season: _____

Long growing season, high humidity: _____

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

Windy, short growing season: _____

Long growing season, high humidity: _____

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

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

Question 23

(17 marks)

Select a crop with which you are familiar.

Crop: _____

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

N – Nitrogen
P – Phosphorus
T – Trace elements
L – Lime

(4 marks)

Pre-season	Seeding	Germination	Vegetative	Flowering	Harvest

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

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

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

- (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)

Question 24

(19 marks)

Pest control needs to be managed at all levels of the plant production system.

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

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

One: _____

Two: _____

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

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

On a farm: _____

Nationally: _____

Internationally: _____

Question 25

(19 marks)

The harvesting of produce requires technological solutions to remain viable. A producer was considering using a robotic harvester instead of a team of pickers.

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

Harvesting methods	Cost \$/hour	Yield punnets/hour	Cost \$/punnet	Cost to harvest 3000 punnets
Pickers	50	20	A =	C =
Robotic harvester	390	150	B =	D =

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

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

A robotic harvester manufacturer wants to run a trial to prove the efficiency of their machine.

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

One: _____

Two: _____

Three: _____

Four: _____

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

Question 26

(20 marks)

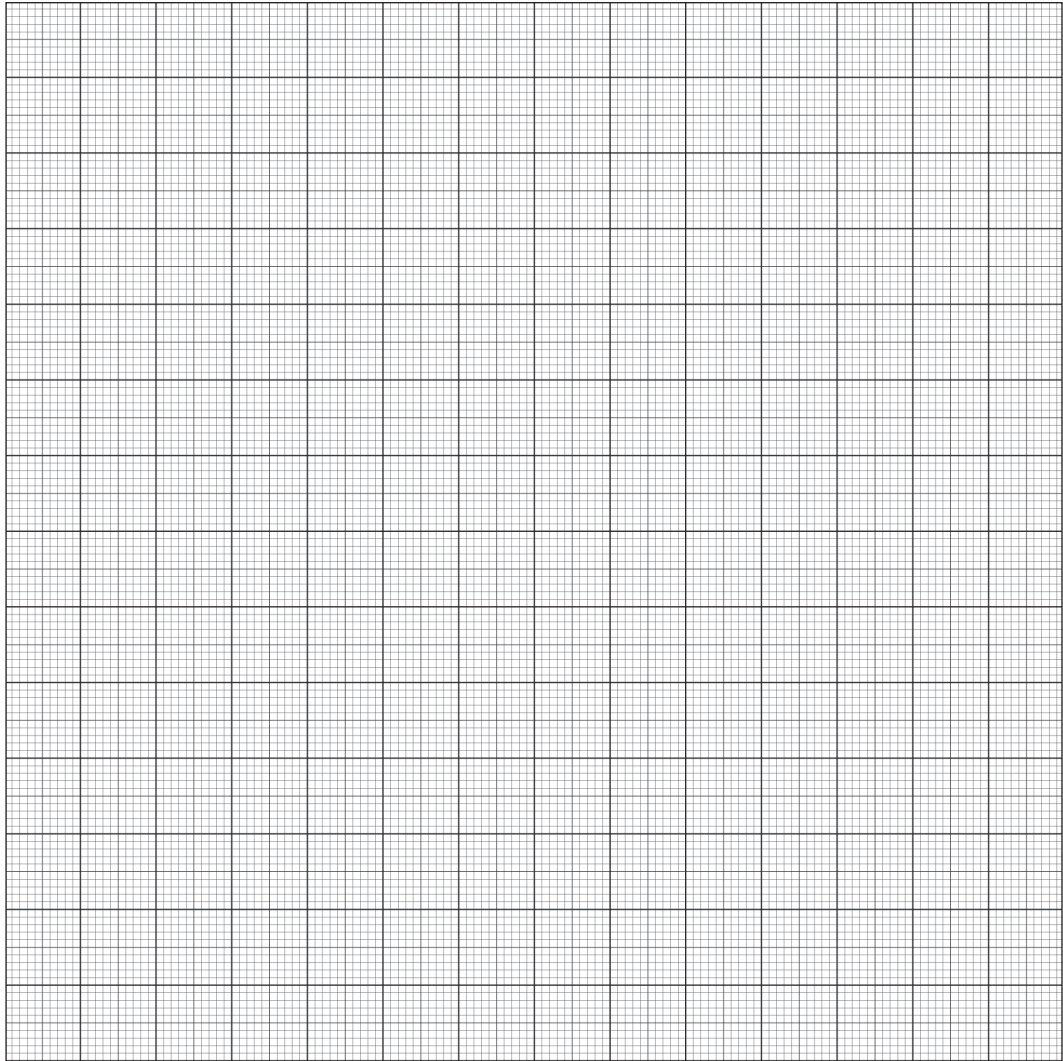
Climate change is causing plant producers to evaluate the type of crop they can grow.

Eleven-year average crop yields in the 250 mm rainfall zone

Year	Wheat (kg/ha)	Barley (kg/ha)	Canola (kg/ha)
2010	2000	2200	1000
2011	1900	2000	900
2012	1800	1800	800
2013	1700	1600	700
2014	1600	1500	1000
2015	1500	1500	1100
2016	1400	1500	1200
2017	1300	1500	1300
2018	1200	1500	1400
2019	1100	1500	1400
2020	1000	1500	1400

See next page

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



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid.

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

Wheat: _____

Barley: _____

Canola: _____

Question 26 (continued)

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)

Short-term: _____

Long-term: _____

A new crop is being promoted by the Grains Research and Development Corporation (GRDC) for low-rainfall zones. The new crop will have a higher yield than the present canola crop, provided it receives 200 mm of rainfall and there is a market in Canada.

Risk severity matrix

Likelihood

Almost Certain 5	Moderate	High	Extreme	Extreme	Extreme
Likely 4	Moderate	Moderate	High	Extreme	Extreme
Possible 3	Low	Moderate	Moderate	High	Extreme
Unlikely 2	Low	Low	Moderate	High	High
Rare 1	Low	Low	Low	Moderate	Moderate
	1	2	3	4	5
	Insignificant	Minor	Moderate	Major	Critical
	Consequence				

- (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)

Question 26 (continued)

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

End of Section Two

See next page

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

This section contains **three** questions. You must answer **two** questions: the compulsory question (Question 27) and **one** of the other questions (Question 28 **or** Question 29). For Question 27, write your answer in the spaces provided. For Question 28 **or** Question 29, write your answers on the lined pages following Question 29.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 60 minutes.

Question 27**(20 marks)**

Select a plant production system with which you are familiar and refer to its product in your answers below.

Plant production system: _____

Plant product: _____

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

Variety: _____

Handling: _____

Transport: _____

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)

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

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

Question 28**(20 marks)**

Australian farmers are net exporters of agricultural produce and rely on global markets to stay viable.

- (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)
- (b) Explain, using an example, the benefits of comparative advantage to Australian plant producers. Examine 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)

or

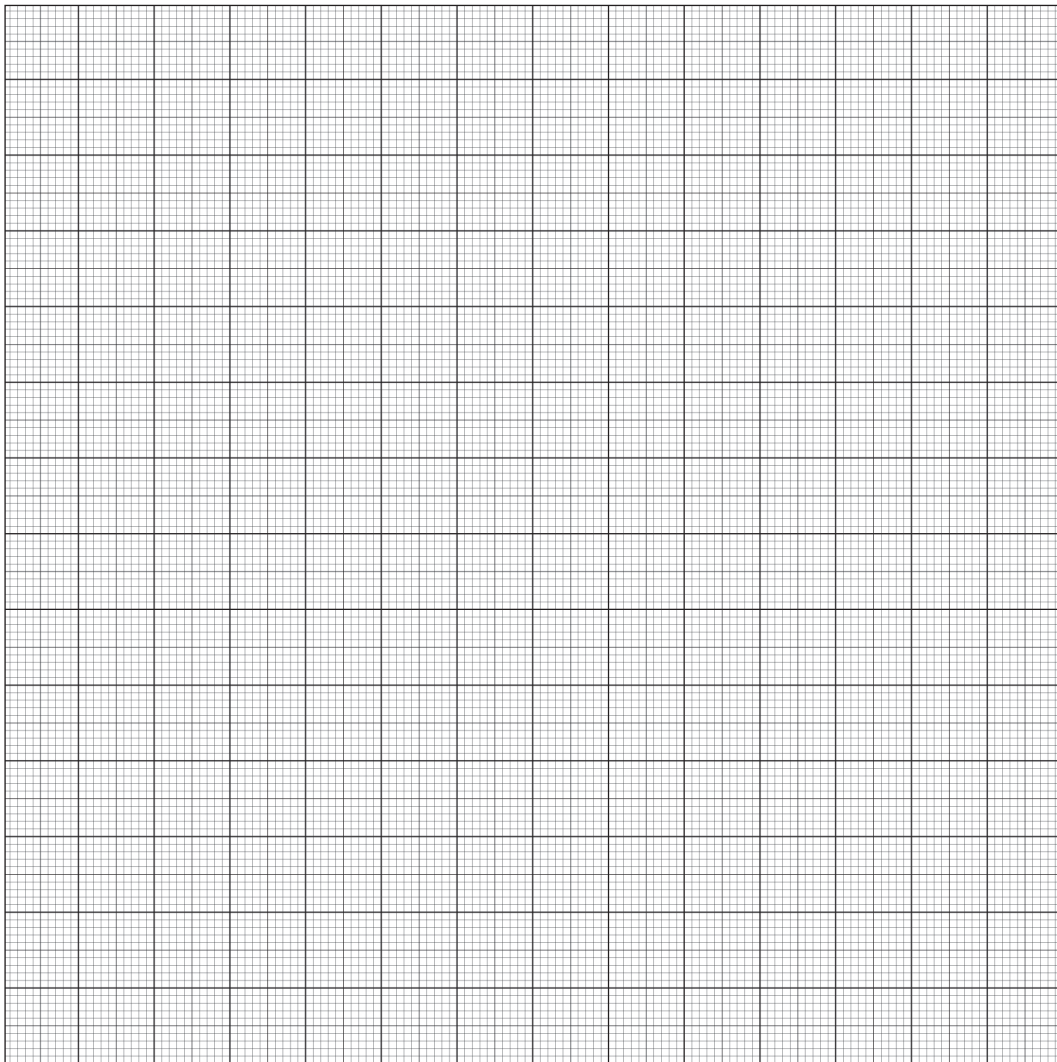
Question 29**(20 marks)**

The environment, its components and sectors compete for energy.

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

End of questions

Spare grid for Question 26(a)(i)



ACKNOWLEDGEMENTS

- Questions 13–14** Rayner, V., Tan, N., & Ward, N. (2010). *Graph 8: Annual Drought and Wheat Yields*. Retrieved May, 2023, from <https://www.rba.gov.au/publications/bulletin/2010/dec/1.html>
Used under a Creative Commons Attribution 4.0 International Licence.
- Question 26(b)** Cordes, S. (2014, August 9). *How to Develop a Recommendation for the Implementation of a System*. Retrieved May, 2023, from <https://www.businessanalyststoolkit.com/solution-assessment-criteria/#Risk>

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