Government of South Australia

SACE Board of SA

External Examination 2013

2013 AGRICULTURAL AND HORTICULTURAL SCIENCE

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SUPERVISOR CHECK

RE-MARKED

ATTACH SACE REGISTRATION NUMBER LABEL TO THIS BOX

Friday 15 November: 1.30 p.m.

Time: 2 hours

Pages: 24
Questions: 15

Examination material: one 24-page question booklet
one 8-page script book
one SACE registration number label

Approved dictionaries and calculators may be used.

Instructions to Students

1. You will have 10 minutes to read the paper. You must not write in your question booklet or script book or use a calculator during this reading time but you may make notes on the scribbling paper provided.

2. This paper is in two parts:

   Part 1: Short-answer Questions (Questions 1 to 13)
   Answer ***all*** questions in the spaces provided in this question booklet.

   Part 2: Extended-response Questions (Questions 14 and 15)
   Answer ***either*** Question 14 ***or*** Question 15.
   Write your answer in the separate script book.

3. In Part 1 there is no need to fill all the space provided; clear, well-expressed answers are required. If you delete part or all of an answer, you should clearly indicate your final answer and label it with the appropriate question number.

4. The allocation of marks and the suggested allotment of time are as follows:

Part 1	100 marks	95 minutes
Part 2	20 marks	25 minutes
Total	120 marks	120 minutes

5. Attach your SACE registration number label to the box at the top of this page. Copy the information from your SACE registration number label into the box on the front cover of your script book.

6. At the end of the examination, place your script book inside the back cover of this question booklet.

STUDENT'S DECLARATION ON THE USE OF CALCULATORS

By signing the examination attendance roll I declare that:

- my calculators have been cleared of all memory
- no external storage media are in use on these calculators.

I understand that if I do not comply with the above conditions for the use of calculators I will:

- be in breach of the rules
- have my results for the examination cancelled or amended
- be liable to such further penalty, whether by exclusion from future examinations or otherwise, as the SACE Board of South Australia determines.

PART 1: SHORT-ANSWER QUESTIONS (Questions 1 to 13)

(100 marks)

*Answer **all** questions in this part in the spaces provided. The allocation of marks is shown in brackets at the end of parts of each question. You should spend about 95 minutes on this part.*

1. Earthworms are a common soil invertebrate.

   (a) Outline *two* reasons why earthworms are beneficial to farmers.

   _____

   _____

   _____

   _____ (2 marks)

   (b) Identify *two* management practices that will enhance earthworm populations.

   _____

   _____

   _____

   _____ (2 marks)

   (c) Another common soil-dweller that is sometimes confused with the earthworm is the roundworm. State the correct name for the roundworm.

   _____ (1 mark)

2. A range of micro-organisms are found in the rumen of grazing animals.

(a) Describe the benefit of these micro-organisms to the animals.

_____

_____

_____ (1 mark)

(b) Explain how these micro-organisms are beneficial to agricultural production.

_____

_____

_____

_____ (2 marks)

(c) In tropical Australia, grasses are tougher and more fibrous than in southern regions. Scientists are experimenting with the introduction of microbes from the gut of Asian ruminants (antelopes, camels, and goats) into the rumen of Australian cattle.

(i) State the likely aim of these experiments.

_____

_____ (1 mark)

(ii) Identify *one* risk that these experiments may have for Australian agriculture.

_____

_____ (1 mark)

(iii) Describe *two* precautions that scientists could use in these experiments to minimise risks to Australian agriculture.

_____

_____

_____

_____ (2 marks)

3. Invertebrates and micro-organisms commonly found in Australian agriculture and horticulture include:

aphid	redlegged earth mite
bee	rhizobium
caterpillar	snail
nematode	weevil.

(a) From the list above, select *one* organism that would be most likely to cause:

(i) knotted roots. _____ (1 mark)

(ii) window holes in leaves. _____ (1 mark)

(b) From the list above, select *one* organism and explain why it is beneficial to agricultural or horticultural production.

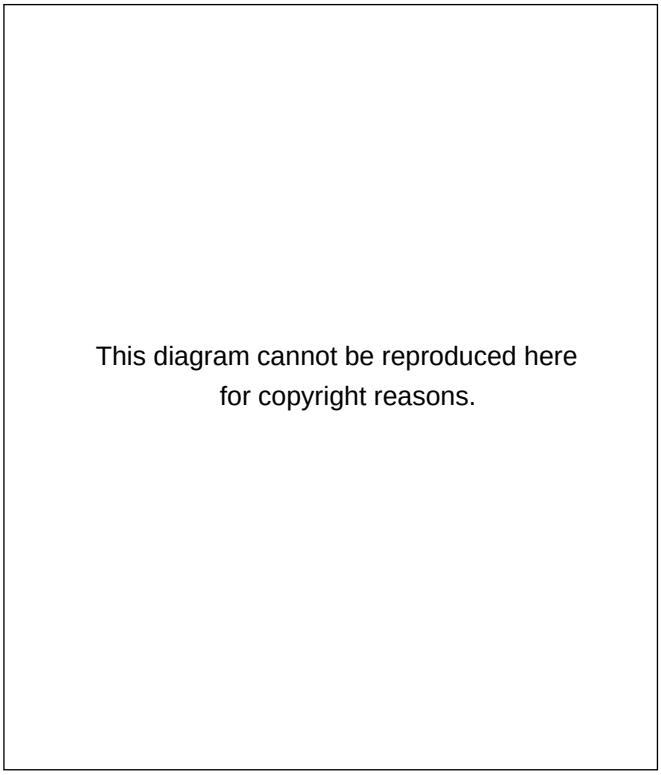
Organism: _____

Explanation: _____

_____

_____ (2 marks)

4. *Refer to the following diagram, which shows a leguminous plant:*



Source: Adapted from an illustration by A. Parson in K.O. Campbell & J.W. Bowyer (eds), *The Scientific Basis of Modern Agriculture*, Sydney University Press, 1995, p. 112

(a) Complete the empty cells in the table below.

Label	*Component*	*Function*
A		Contains the seeds of the plant
B	Bud (axillary)	
C		Supports the leaf and connects it to the stem
D	Leaf blade	

(2 marks)

(b) Select *two* features from the diagram that indicate this plant is a dicotyledon.

_____

_____

_____

_____ (2 marks)

(c) Cotyledons are food stores used during germination. ***Draw*** on the diagram where they would have been found on this plant.

(1 mark)

(d) One characteristic feature of leguminous plants is the presence of many root nodules, labelled E on the diagram.

Describe the significance of these root nodules and explain why many farmers include leguminous plants in their paddock rotations.

_____

_____

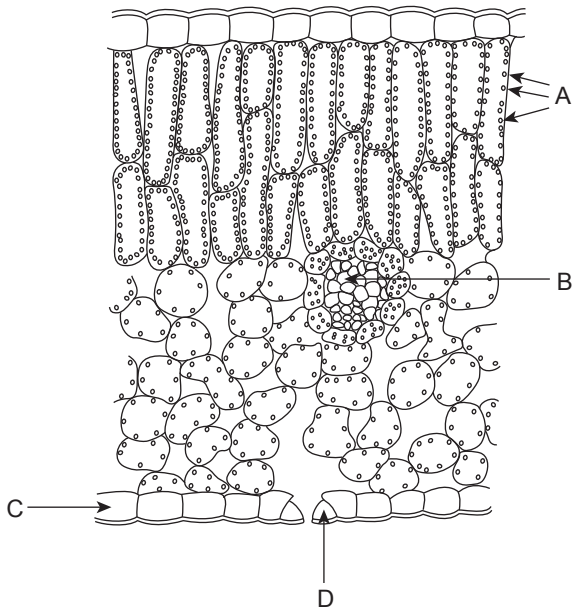
_____

_____

_____

_____ (3 marks)

5. (a) *Refer to the following diagram, which shows the internal structure of a leaf:*



Source: Adapted from an illustration by I. Parbery in J.V. Lovett *et al*., *Plant Production Systems*, Australian Agriculture Series, Book 3, University of New England, 1982, p. 20

(i) Identify the four structures labelled on the diagram.

A: _____

B: _____

C: _____

D: _____

(2 marks)

(ii) Describe the function of *two* of the structures identified in part (a)(i).

(1) Structure: _____

Function: _____

_____ (1 mark)

(2) Structure: _____

Function: _____

_____ (1 mark)

(b) Two essential reactions occurring in leaves are photosynthesis and respiration.

(i) (1) Name the part of a cell in which respiration takes place.

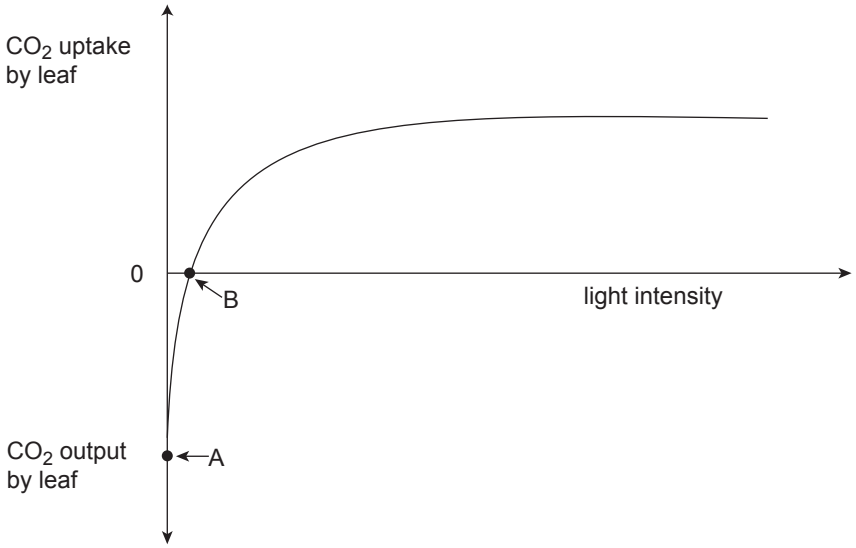
_____ (1 mark)

(2) Write the equation (word or chemical) for the process of respiration.

_____

_____ (1 mark)

(ii) *Refer to the following graph, which identifies the uptake and output of carbon dioxide by a leaf:*



Comment on the rates of photosynthesis and respiration taking place at points A and B.

Point A: _____

_____

_____

_____

Point B: _____

_____

_____

_____

(4 marks)

(c) Respiration also occurs in plant products when they are placed in storage.

Explain *one* method for reducing the rate of respiration in stored plant products.

_____

_____

_____

_____ (2 marks)

6. *Refer to the following table, which displays the results of an experiment by a potato breeder showing the effects of adding the auxin naphthaleneacetic acid (NAA) to the potato varieties Canoga and Russet Burbank:*

	Average per plant			
	Canoga		*Russet Burbank*	
	Control	*+NAA*	*Control*	*+NAA*
Buds formed	19.5	26	22	23
Buds abscised	16.5	2	22	19
Flowers pollinated	3	19	0	4
Fruits set	1.5	13	0	1.2
Seeds per fruit	46.5	90	0	43.5

(a) Describe the difference that the addition of NAA makes to the development of these potato plants.

_____

_____

_____

_____ (2 marks)

(b) Explain why a potato breeder would be more interested in adding NAA to the Russet Burbank variety compared to the Canoga variety.

_____

_____

_____

_____ (2 marks)

(c) Explain why the average number of fruits set is usually lower than the average number of flowers pollinated.

_____

_____

_____

_____ (2 marks)

(d) State the purpose of control plants in this experiment.

_____

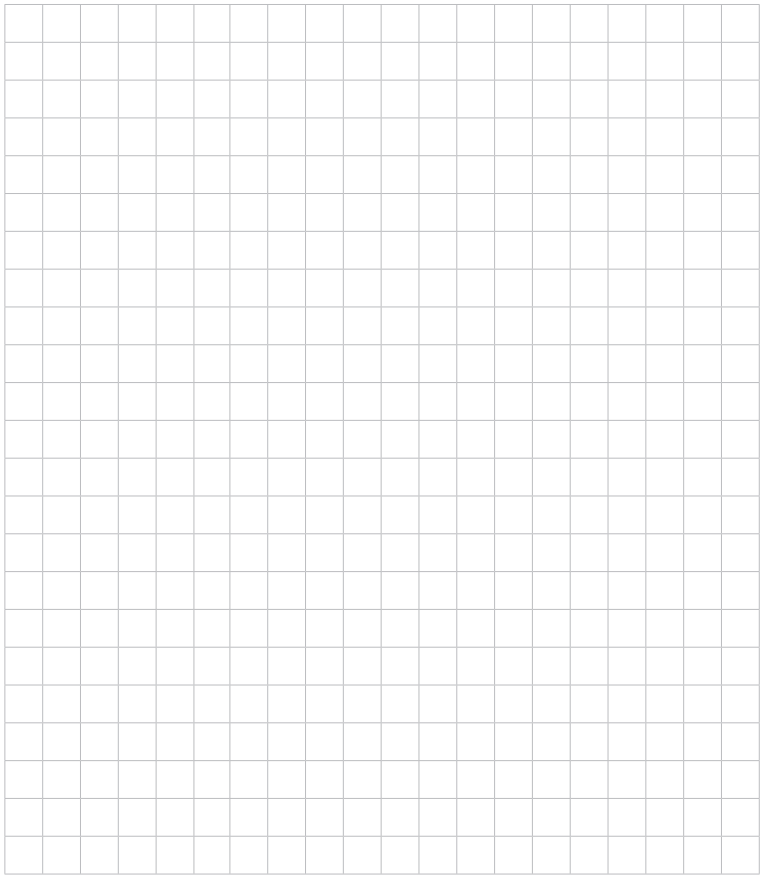
_____ (1 mark)

7. The dry weight of a plant is the weight of the plant that remains when all water is removed.

In an experiment to determine the growth curve of a plant, over 100 bean seeds were planted and watered regularly. The first green leaves appeared after about 24 hours. At various intervals the dry weight of a sample of six bean plants was determined and the following results obtained:

Age of plants (days)	0	7	12	20	28	35	40	63	80	90
Dry weight of sample (g)	2.0	1.9	1.8	1.7	1.5	1.4	1.6	4.0	7.0	10.5

(a) On the grid below, draw a growth curve for the bean plants. Label the axes and include a title.



(4 marks)

(b) Explain why the dry weight of the bean plants decreased in the first 35 days.

_____

_____

_____

_____ (2 marks)

(c) Explain why the dry weight of the bean plants increased rapidly after 40 days.

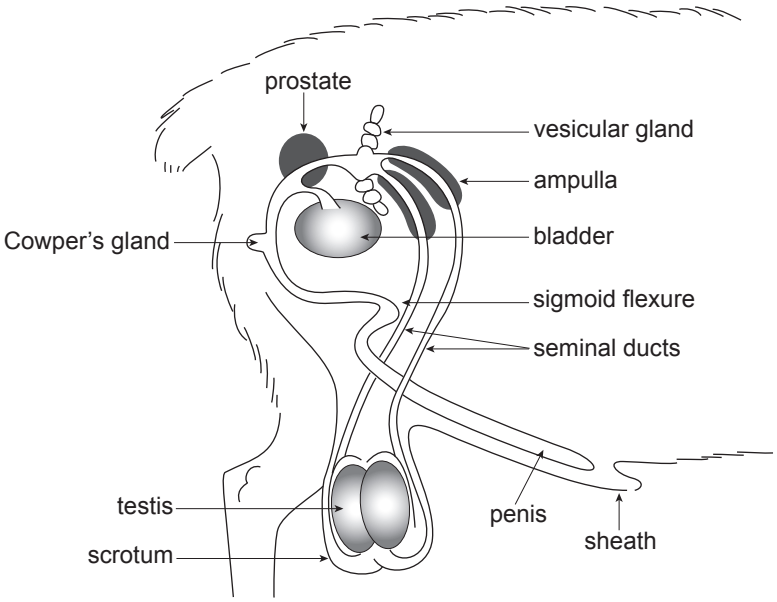
_____

_____

_____

_____ (2 marks)

8. (a) *Refer to the following diagram, which shows the reproductive tract of a ram:*



Source: Adapted from an illustration by D. Booth in L. Brown, R. Hindmarsh & R. McGregor, *Dynamic Agriculture*, Book 3, 2nd edn, McGraw-Hill, Sydney, 2001, p. 120

(i) Complete the empty cells in the table below.

Reproductive component	*Function*
Sigmoid flexure	
	Stores urine prior to excretion from the body
Vesicular gland	
	Protection of the penis

(2 marks)

(ii) Identify and explain *one* physiological process that assists in viable sperm production.

_____

_____

_____

_____ (2 marks)

(iii) Identify the hormone responsible for stimulating sperm production.

_____ (1 mark)

(b) Teasers are used to bring ewes into heat.

(i) Describe how a teaser ram differs from other rams.

_____

_____ (1 mark)

(ii) Wethers can be transformed into teasers. Identify the hormone farmers will use to transform a wether into a teaser.

_____ (1 mark)

(iii) Explain why using a teaser is an advantage for farmers.

_____

_____

_____

_____ (2 marks)

(c) Hormones are used to stimulate embryo production in ewes.

(i) Identify the hormone that induces rupture of the follicle and ovulation.

_____ (1 mark)

(ii) Describe the process of embryo transfer used by farmers. Include the hormones used to ensure multiple ovulations and the synchronisation of donor and recipient ewes.

_____

_____

_____

_____

_____

_____

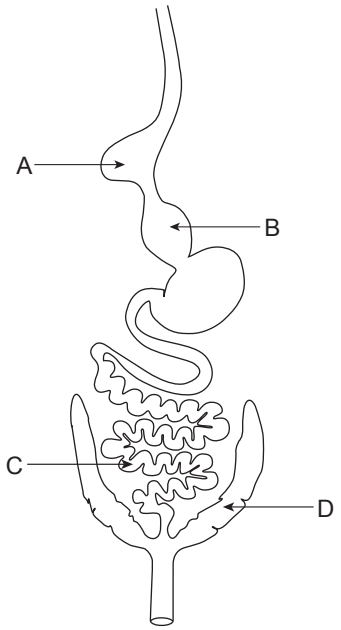
_____

_____

_____

_____ (5 marks)

9. *Refer to the following diagram, which shows the digestive system of a chicken:*



Source: Adapted from an illustration by D. Booth in L. Brown, R. Hindmarsh & R. McGregor, *Dynamic Agriculture*, Book 3, 2nd edn, McGraw-Hill, Sydney, 2001, p. 104

(a) Identify the four organs labelled on the diagram.

A: _____

B: _____

C: _____

D: _____ (2 marks)

(b) State the function of the following organs in the digestive process:

(i) gizzard.

_____

_____ (1 mark)

(ii) pancreas.

_____

_____ (1 mark)

(c) Explain why grass is of low nutritional value to chickens.

_____

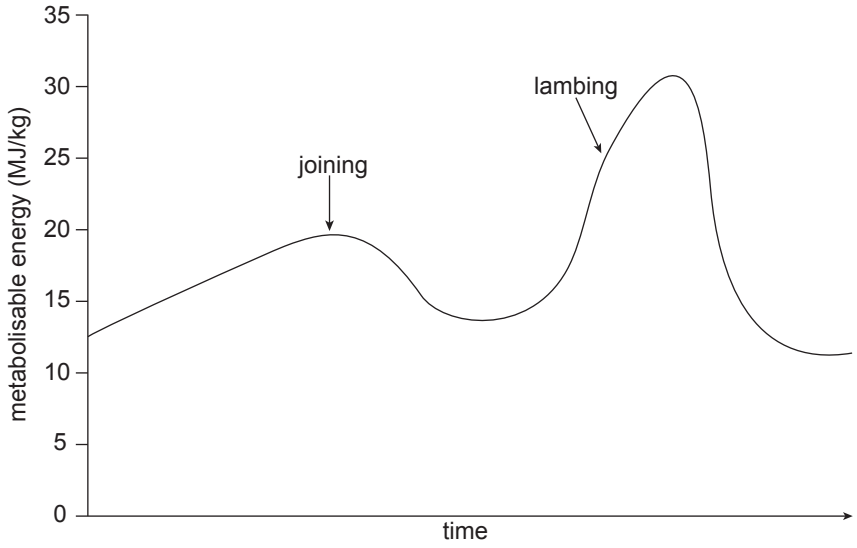
_____

_____

_____ (2 marks)

10. *Refer to the following graph:*

Metabolisable energy levels recommended for a breeding ewe



(a) ***Draw*** an arrow on the graph to indicate the time of early gestation.

(1 mark)

(b) State the component of feed that provides the most metabolisable energy to a grazing, breeding ewe.

_____ (1 mark)

(c) Give *one* reason why farmers should use pasture hay instead of a grain mix for feed during early gestation.

_____

_____ (1 mark)

(d) As the ewe nears lambing, dietary requirements change. Identify *one* feed component that needs to change and explain why this dietary change is needed.

_____

_____

_____

_____ (2 marks)

11. Certain farming practices damage some soils, resulting in a loss of agricultural and horticultural production.

(a) Select *two* farming practices that damage soils. For each practice, describe how the damage occurs and how the damage reduces production.

(6 marks)

(b) Saline soils are a problem for farmers. Describe *two* methods of rehabilitating saline soils.

(2 marks)

12. Cropping farmers commonly retain stubble and rely on microbes to help with stubble management in the paddock.

(a) (i) Identify *two* types of microbes found in soil.

_____

_____ (1 mark)

(ii) Name and briefly describe the three stages of stubble breakdown by microbes.

_____

_____

_____

_____

_____

_____

_____

_____

_____ (3 marks)

(b) (i) State *one* change in soil structure that can result from the action of microbes on stubble.

_____

_____ (1 mark)

(ii) Describe how the action of soil microbes causes this change.

_____

_____ (1 mark)

(c) *Refer to the following table, which shows measurements of cereal crop yield over 5 years on two identical soil types with different stubble management techniques:*

	Crop yield (tonnes/hectare)	
Crop year	*Stubble burnt*	*Stubble retained*
1	1.8	1.9
2	2.1	2.3
3	2.0	2.4
4	1.7	2.3
5	2.1	2.5

Explain a likely reason why stubble retention has resulted in higher crop yields over time.

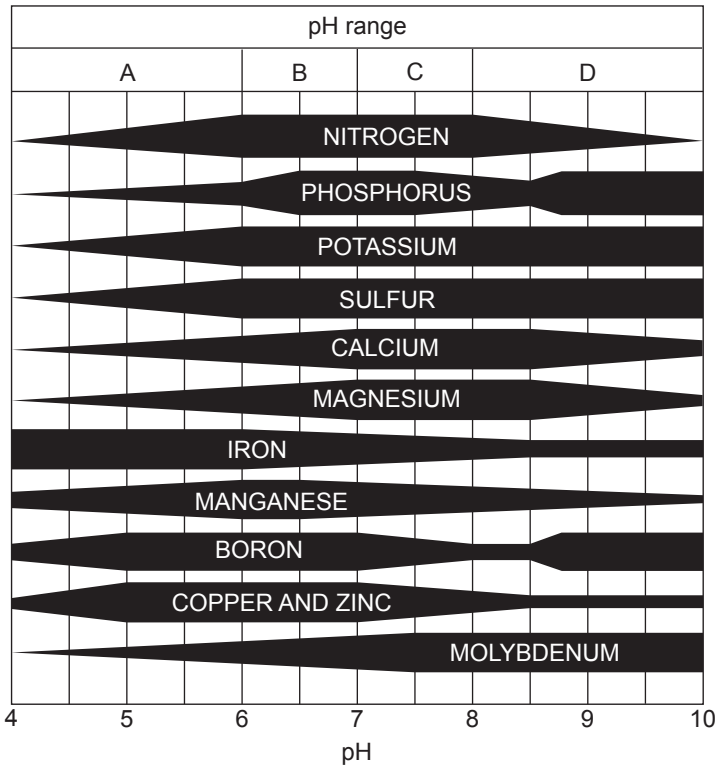
_____

_____

_____

_____ (2 marks)

13. *Refer to the following diagram, which shows nutrient availability in soils at different pH levels:*



Source: Adapted from D.A. Macleod *et al.*, *Soils and Climate in Agricultural Production Systems*, Australian Agriculture Series, Book 2, University of New England, 1984, p. 63

(a) On the diagram, ***draw*** a horizontal line to divide the macronutrients from the micronutrients.

(1 mark)

(b) Describe pH.

_____ (1 mark)

(c) (i) From the diagram, select the letter corresponding to the most acidic pH range.

_____ (1 mark)

(ii) Explain the growth of plants in soils of the most acidic pH range in terms of macronutrient availability.

_____

_____

_____

_____ (2 marks)

(d) Many soils in high rainfall areas become acidic quite quickly.

(i) Describe *one* management practice that often makes this problem worse.

_____

_____ (1 mark)

(ii) Describe *one* treatment that farmers commonly use to rectify this problem.

_____

_____ (1 mark)

PART 2: EXTENDED-RESPONSE QUESTIONS (Questions 14 and 15)

(20 marks)

*Answer **either** Question 14 **or** Question 15.*

Write your answer in the separate script book provided.

You should spend about 25 minutes on this section. Credit will be given for clear, well-expressed answers that are well organised and relevant to the question.

14. Animal production systems are typically at the forefront of the image of farming for many Australians. These systems are usually complex enterprises requiring high-level management knowledge.

    Choose *one animal* production system and answer the following questions:

    - Identify and explain *two* environmental characteristics that are important for successful production in this system.
    - Discuss the role of *one* mineral and *one* vitamin in the successful growth of the animals in this system.
    - Explain how this system could be negatively affected by *one* micro-organism and *one* invertebrate.
    - Describe *two* types of data that could be regularly collected for this system and explain how the data could improve production in the system.

15. Plant production systems account for a significant amount of economic activity in Australian agriculture. These systems involve a complex series of management knowledge and operations.

    Choose *one plant* production system and answer the following questions:

    - Identify and explain *two* environmental characteristics that are important for successful production in this system.
    - Discuss the role of *one* macronutrient and *one* micronutrient in the successful growth of the plants in this system.
    - Explain how this system could be negatively affected by *one* micro-organism and *one* invertebrate.
    - Describe *two* types of data that could be regularly collected for this system and explain how the data could improve production in the system.