Government of South Australia

SACE Board of SA

External Examination 2011

2011 AGRICULTURAL AND HORTICULTURAL SCIENCE

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SUPERVISOR CHECK

RE-MARKED

ATTACH SACE REGISTRATION NUMBER LABEL TO THIS BOX

Friday 11 November: 1.30 p.m.

Time: 2 hours

Pages: 20
Questions: 14

Examination material: one 20-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 12)
   Answer ***all*** questions in the spaces provided in this question booklet.

   Part 2: Extended-response Questions (Questions 13 and 14)
   Answer ***either*** Question 13 ***or*** Question 14.
   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 12)

(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. *Refer to the following diagram, which shows the digestive system of a cow:*

Source: Adapted from www.tutorvista.com/biology/ruminant-stomach, © Addison Wesley Longman Inc. 1999

(a) Identify the four numbered components in the diagram above.

1 _____ 2 _____

3 _____ 4 _____

(2 marks)

(b) Identify the type of digestive process that occurs in each of the following components.

(i) Component 1:_____

_____ (1 mark)

(ii) Component 4:_____

_____ (1 mark)

(c) The digestive process in a ruminant is slow; digestion takes 70–100 hours compared with 4–12 hours in a non-ruminant animal, such as a pig.

(i) Explain *one* reason why ruminant digestion takes such a long time.

_____

_____

_____

_____ (2 marks)

(ii) Despite the longer digestion time, ruminant digestion is more efficient than non-ruminant digestion when the animals are grazing only on pasture.

Explain *one* reason why.

_____

_____

_____

_____ (2 marks)

(d) Ruminants are highly adapted to pasture-based grazing (high-fibre, low-grain diets), yet ruminants in feedlots are fed high-grain diets to optimise their growth.

(i) Explain why feedlotting improves the growth rate of ruminants.

_____

_____

_____

_____ (2 marks)

(ii) Identify and explain *one* problem ruminants may face when first introduced to a high-grain diet.

Problem: _____

Explanation: _____

_____

_____ (2 marks)

(iii) State the components of a typical feedlot mix that enable optimal growth and minimal digestive disorders for a ruminant.

_____

_____ (1 mark)

(e) Water tends to be 'assumed' when considering animal nutrition. Describe *two* roles of water in animal nutrition.

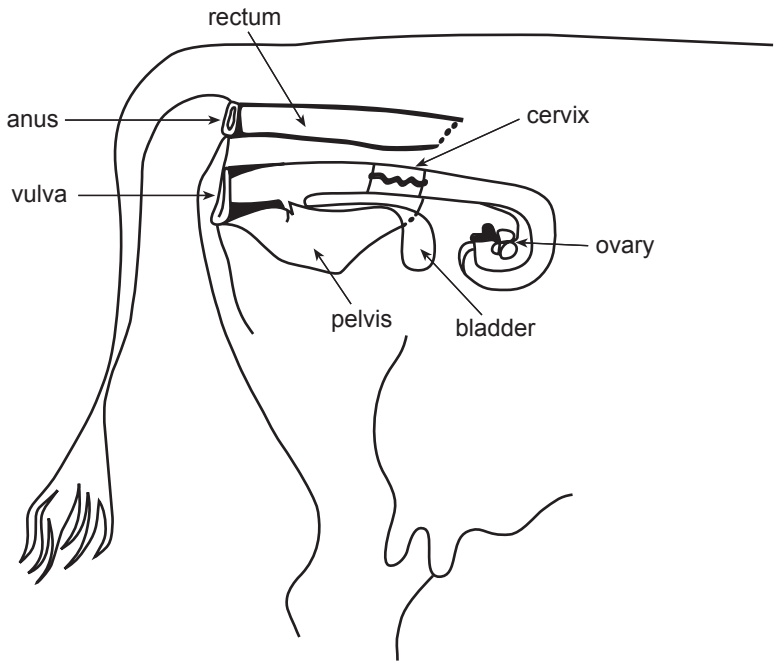
(i) Role 1: _____

_____ (1 mark)

(ii) Role 2: _____

_____ (1 mark)

2. *Refer to the following diagram, which shows the reproductive system of a cow:*



Source: Adapted from Figure 3.1 in Ian Lewis *et al.* (eds), *Cattle Breeding Technologies*, Genetics Australia, Bacchus Marsh (Vic.), 1996, p. 10

(a) (i) On the diagram, mark with an **X** the site where semen is deposited by natural service. (1 mark)

(ii) Name the site where semen is deposited by natural service.

_____ (1 mark)

(b) Artificial insemination (AI) is a common management technique in livestock enterprises. However, in some situations AI programs have only a 50% success rate; the success rate of natural service is 80–100%.

Suggest *two* reasons why AI may have a lower success rate than natural service.

(i) _____

_____ (1 mark)

(ii) _____

_____ (1 mark)

(c) For a cattle herd, identify a reproductive hormone that is administered to each female in the weeks before AI to ensure successful insemination, and explain its role in the process.

Hormone: _____

Role: _____

_____

_____ (2 marks)

(d) (i) Name the site where semen is usually deposited by AI.

_____ (1 mark)

(ii) Describe the role of this site in reproduction.

_____

_____ (1 mark)

(e) Explain why, in AI, semen is deposited at the site that you named in part (d)(i) rather than at the site where it is deposited by natural service.

_____

_____

_____

_____ (2 marks)

(f) Describe *one* difference between semen and sperm.

_____

_____

_____

_____ (2 marks)

(g) Describe an oestrous cycle.

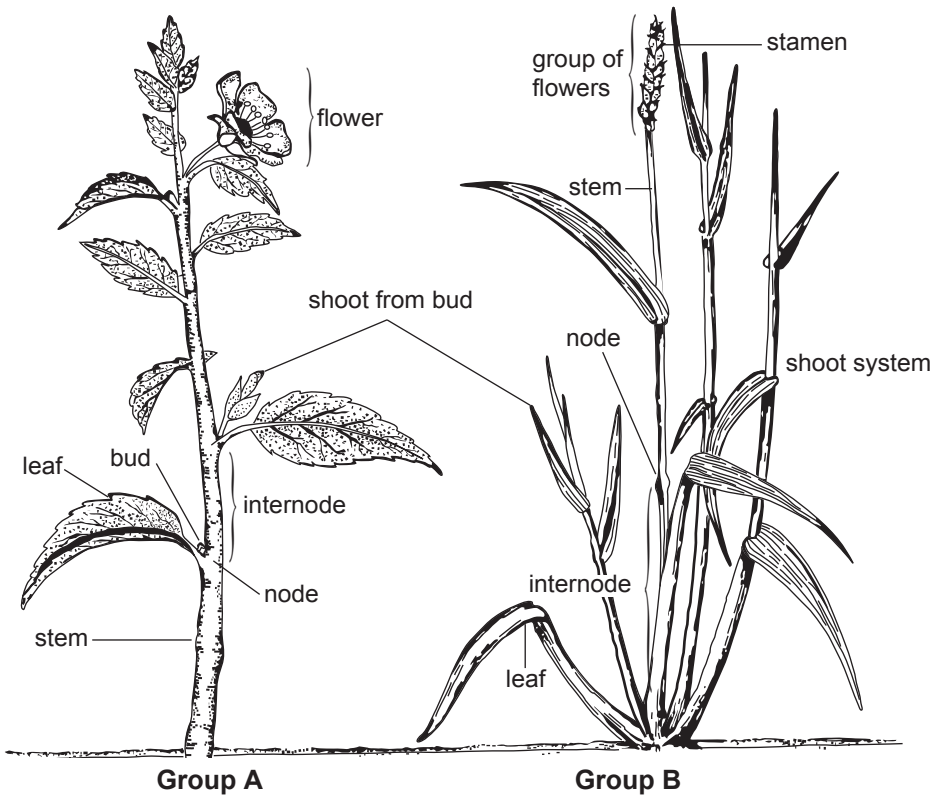
_____

_____

_____

_____ (2 marks)

3. *Refer to the following diagrams, which show examples of agricultural plants from two different plant groups:*



Source: Adapted from an illustration by Gek Choo Thach in Agricultural Studies Curriculum Committee, *Agricultural Studies Stage 2*, Education Department of South Australia, 1977, p. 59

(a) Identify plant group B.

_____ (1 mark)

(b) Identify and describe *two* external components that distinguish Group A plants from Group B plants.

(i) Component 1: _____

_____

_____ (1 mark)

(ii) Component 2: _____

_____

_____ (1 mark)

(c) Give the common names of *two* agricultural plants from each group.

Group A plants: 1 _____ 2 _____

Group B plants: 1 _____ 2 _____

(2 marks)

(d) A balanced pasture often contains a mixture of plants from groups A and B. Describe *two* advantages in having both plant groups represented in the pasture mix.

(i) Advantage 1:_____

_____

_____ (1 mark)

(ii) Advantage 2:_____

_____

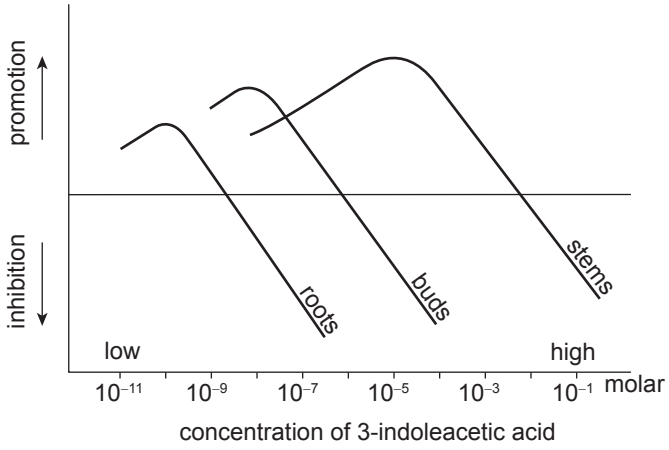
_____ (1 mark)

(e) Many Group A plants have root nodules. Describe a root nodule.

_____

_____ (1 mark)

4. *Refer to the following graph, which shows the response of roots, buds, and stems to different concentrations of an auxin (3-indoleacetic acid):*



Source: Adapted from Figure 18.7 by Di Booth in L. Brown, R. Hindmarsh & R. McGregor, *Dynamic Agriculture*, Book 3, 2nd edn, McGraw-Hill, Sydney, 2001, p. 346

(a) Identify the type of compound an auxin is.

_____ (1 mark)

(b) Predict the effect of a 10^{-10} molar solution of an auxin on the roots of plants.

_____

_____ (1 mark)

(c) Predict the effect of a 10^{-1} molar solution of an auxin on a growing plant stem.

_____

_____ (1 mark)

(d) Identify and explain a potential horticultural application of an auxin.

Application: _____

Explanation: _____

_____

_____ (2 marks)

(e) Explain how the application of a solution with a high concentration of an auxin could lead to an increase in soil macronutrient availability in a broadacre setting.

_____

_____

_____

_____ (2 marks)

(f) Nitrogen is important for a range of plant growth processes. Outline the role of *one* macronutrient, other than nitrogen, in plant growth.

_____

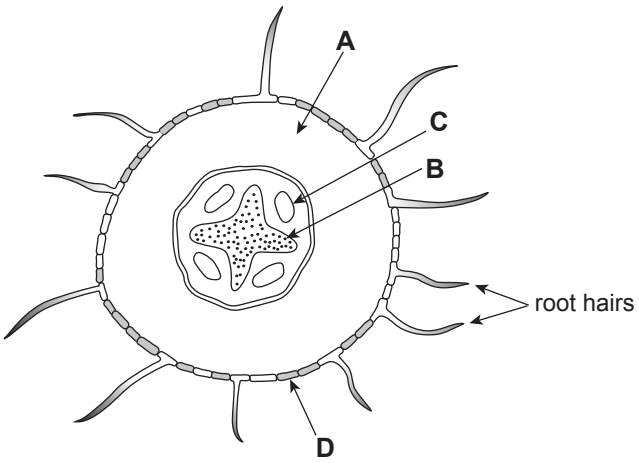
_____

_____

_____

_____ (2 marks)

5. *Refer to the following diagram, which shows the cross-section of a plant root:*



Source: Adapted from Figure 17.10 by Di Booth in L. Brown, R. Hindmarsh & R. McGregor, *Dynamic Agriculture*, Book 3, 2nd edn, McGraw-Hill, Sydney, 2001, p. 319

(a) Identify the internal components that are labelled **A** and **B**.

A _____ **B** _____ (1 mark)

(b) Describe the functions of components **C** and **D**.

(i) Component **C**: _____

_____ (1 mark)

(ii) Component **D**: _____

_____ (1 mark)

(c) List *two* materials that are normally transported in component **B**.

(i) _____

_____ (1 mark)

(ii) _____

_____ (1 mark)

(d) Explain the following plant processes, with specific reference to the role of roots in the process:

(i) transpiration.

_____

_____

_____ (2 marks)

(ii) translocation.

_____

_____

_____ (2 marks)

6. (a) Define the following terms:

(i) quarantine.

_____

_____ (1 mark)

(ii) biosecurity.

_____

_____ (1 mark)

(b) Describe and explain *two* practices carried out by vine growers in an attempt to control the spread of an insect pest such as *Phylloxera* or fruit fly.

(i) Practice 1: _____

_____

Explanation: _____

_____ (2 marks)

(ii) Practice 2: _____

_____

Explanation: _____

_____ (2 marks)

7. Insects are the most numerous group of invertebrates and are very important to agriculture.

(a) Draw a typical insect. On your diagram, label the *three* main features that differentiate insects from other invertebrate groups.

(4 marks)

(b) Identify and describe *two* activities of bees that result in food production.

(i) Activity 1: _____

_____

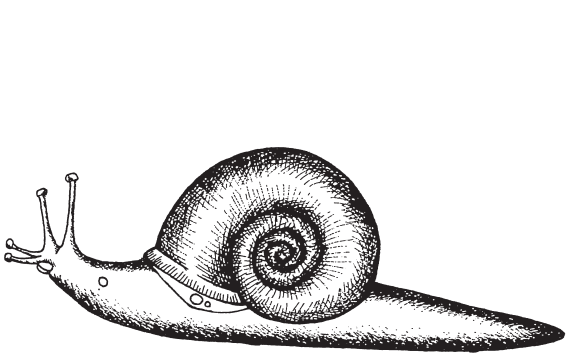
_____ (1 mark)

(ii) Activity 2: _____

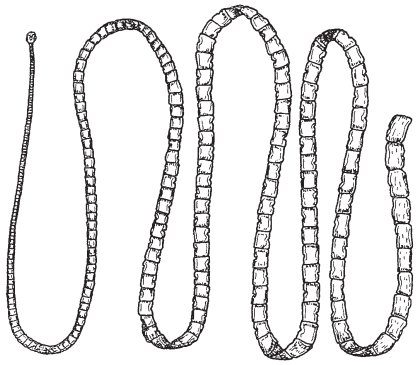
_____

_____ (1 mark)

8. *Refer to the following diagrams, which show two invertebrates:*



Invertebrate A



Invertebrate B

Source: Adapted from figures 4.2.32 and 4.2.40 in R.J. Bawden *et al.*, *Microorganisms and Invertebrates in Agricultural Production Systems*, Australian Agriculture Series, Book 4, University of New England, 1983, pp. 29, 34

(a) Identify the group that Invertebrate B belongs to.

_____ (1 mark)

(b) Identify and explain *one* impact of each invertebrate illustrated, on either agricultural or horticultural production systems.

(i) Impact of Invertebrate A: _____

Explanation: _____

_____

_____ (2 marks)

(ii) Impact of Invertebrate B: _____

Explanation: _____

_____

_____ (2 marks)

(c) Invertebrates A and B are considered agricultural pests. Describe *one* method of how each could be controlled, describing a different method for each.

(i) Invertebrate A: _____

_____

_____

_____ (1 mark)

(ii) Invertebrate B: _____

_____

_____

_____ (1 mark)

9. (a) The yeast that is commonly involved in the production of bread and wine is *Saccharomyces cerevisiae*. Outline the component of the fermentation process that can affect the quality of the product when making bread and wine.

(i) Bread: _____

_____ (1 mark)

(ii) Wine: _____

_____ (1 mark)

(b) Explain *one* method of preserving food that will prevent microbial spoilage.

_____

_____

_____

_____ (2 marks)

10. (a) Explain ‘soil pH’ using chemical terminology.

_____

_____

_____

_____ (1 mark)

(b) In terms of soil nutrient availability, explain why farmers prefer the soil pH not to drop below 6.0.

_____

_____

_____

_____ (2 marks)

(c) (i) A farmer has the option of adding either lime or gypsum to a soil of pH 5.5. Explain which of these two additives would be more effective in restoring the soil pH to neutral.

_____

_____

_____

_____ (2 marks)

(ii) When applied, lime or gypsum is normally spread over the soil surface. Suggest why incorporating lime or gypsum into the soil is more effective.

_____

_____ (1 mark)

11. (a) The breakdown of organic matter to release nutrients is normally a three-step process. Identify and explain *two* of these steps.

(i) Step: _____

Explanation: _____

_____

_____

_____ (2 marks)

(ii) Step: _____

Explanation: _____

_____

_____

_____ (2 marks)

(b) Distinguish between the terms 'organic matter' and 'humus'.

_____

_____

_____

_____ (2 marks)

(c) Explain how the amount of organic matter and humus in a soil affects water infiltration and water percolation.

_____

_____

_____

_____ (2 marks)

(d) Explain how cation exchange capacity (CEC) is related to the improved soil fertility that usually follows an increase in the level of organic matter in the soil.

_____

_____

_____

_____ (2 marks)

12. There are many factors that influence soil productivity and the sustainable use of soils.

(a) Describe and explain the general characteristics of a productive soil that can be used sustainably.

Description: _____

_____

Explanation: _____

_____ (2 marks)

(b) Describe *two* farming practices that prevent soil degradation by maintaining or improving the soil structure.

(i) Practice 1: _____

_____

_____ (1 mark)

(ii) Practice 2: _____

_____

_____ (1 mark)

(c) Identify and explain *one* rehabilitation technique used to improve a degraded saline soil.

Technique: _____

Explanation: _____

_____

_____ (2 marks)

PART 2: EXTENDED-RESPONSE QUESTIONS (Questions 13 and 14)

(20 marks)

*Answer **either** Question 13 **or** Question 14.*

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.

13. The last year has been one of the wettest on record, following several years of drought and record periods of high temperatures. Severe variations in the climate pose major problems for plant and animal production.
    - Identify and explain *two* farming techniques used to minimise soil degradation in a cropping production system during a wet year.
    - Describe *one* possible effect of excess rainfall on nutrient availability to crops planted in a sandy loam, and provide the symptoms that are likely to be found in crops with a deficiency in *one* macronutrient.
    - In a wet year, micro-organisms and invertebrates often become a major problem in cropping production. Name *two* problems caused by micro-organisms or invertebrates and describe specific, different techniques that farmers might use to control each of these problems.
    - Describe the role of plant propagation and breeding programs in helping farmers to cope with variations in climate and variations in industry requirements.

14. The last year has been one of the wettest on record, following several years of drought and record periods of high temperatures. Severe variations in the climate pose major problems for plant and animal production.
    - Identify and explain *two* farming techniques used to minimise soil degradation in a livestock production system during a wet year.
    - Describe *one* possible effect of excess rainfall on livestock feed intake and production, and provide the symptoms that are likely to be found in livestock with a deficiency in *one* vitamin *or* mineral.
    - In a wet year, micro-organisms and invertebrates often become a major problem in livestock production. Name *two* problems caused by micro-organisms or invertebrates and describe specific, different techniques that farmers might use to control each of these problems.
    - Describe the role of animal breeding programs in helping farmers to cope with variations in climate and variations in industry requirements.