



SAMPLE ASSESSMENT TASKS

PLANT PRODUCTION SYSTEMS GENERAL YEAR 12

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Sample assessment task

Plant Production Systems – General Year 12

Task 2 – Unit 3 and Unit 4

Assessment type: Production project

Conditions

Period allowed for completion of the task: six periods

Task weighting

5% of the school mark for this pair of units

Plant growth stages and nutrient requirements

(69 marks)

Introduction

All plants require nutrients but the amount, rate and timing of nutrient uptake vary with plant species, variety, climate, soil characteristics and management. As well, the amount of a nutrient needed will vary with the stage of growth.

In this task, you will need to:

- choose one annual cereal crop, and
- develop a fertiliser plan for its production cycle.

Name the cereal crop for which you are developing a fertiliser plan.

Part 1 – Soil sampling and testing

1. Identify **three** reasons why farm soil sampling is important when developing a farm's soil fertiliser plan. (3 marks)

2. State why nutrients are lost from a farm paddock when it is under cultivation. (1 mark)

3. State the **two** main ways lost nitrogen is returned to the soil on a farm. (2 marks)

4. Working in groups:
- select sites where a cereal crop can be grown on the school farm
 - collect representative soil samples from the sites
 - keep a record of the locations where samples are collected
 - test the soil for available nutrients (e.g. nitrogen, phosphorus and potassium). This can be done using kits on-site or samples can be sent off-site for soil nutrient testing.

The following website may be helpful in developing your procedure for taking soil samples: https://www.agric.wa.gov.au/soil-productivity/soil-sampling-and-testing-small-property?page=0%2C0#smartpaging_toc_p0_s1_h2.

Marks for collection of soil samples will be allocated on the following basis:

- sampling technique follows prescribed technique (6 marks)
 - preparation of samples (2 marks)
 - accurate labelling of samples (2 marks)
 - record of sampling locations on paddock map (or other suitable method). (2 marks)
5. When results of soil testing are available, present the results in a table, listing each nutrient tested and its concentration in the soil for each sample. The units of concentration need to be included in the titles. Attach your table to your report. (4 marks)

6. For nitrogen, compare the costs of providing the required nitrogen to the paddock for **two** different nitrogen fertilisers. Name the fertilisers and show your calculations below. The following link may assist with your calculations: http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0004/166153/fertiliser-calculations.pdf. (8 marks)

Fertiliser 1: _____

Fertiliser 2: _____

Part 2 – Plant growth stages

7. Plant growth stages can be expressed using a growth scale. The Zadoks growth scale is an internationally accepted scale that has 10 broad stages. Complete the table below by giving:
- the 10 stages in order
 - a brief description of what occurs at each stage.

Germination is done as an example.

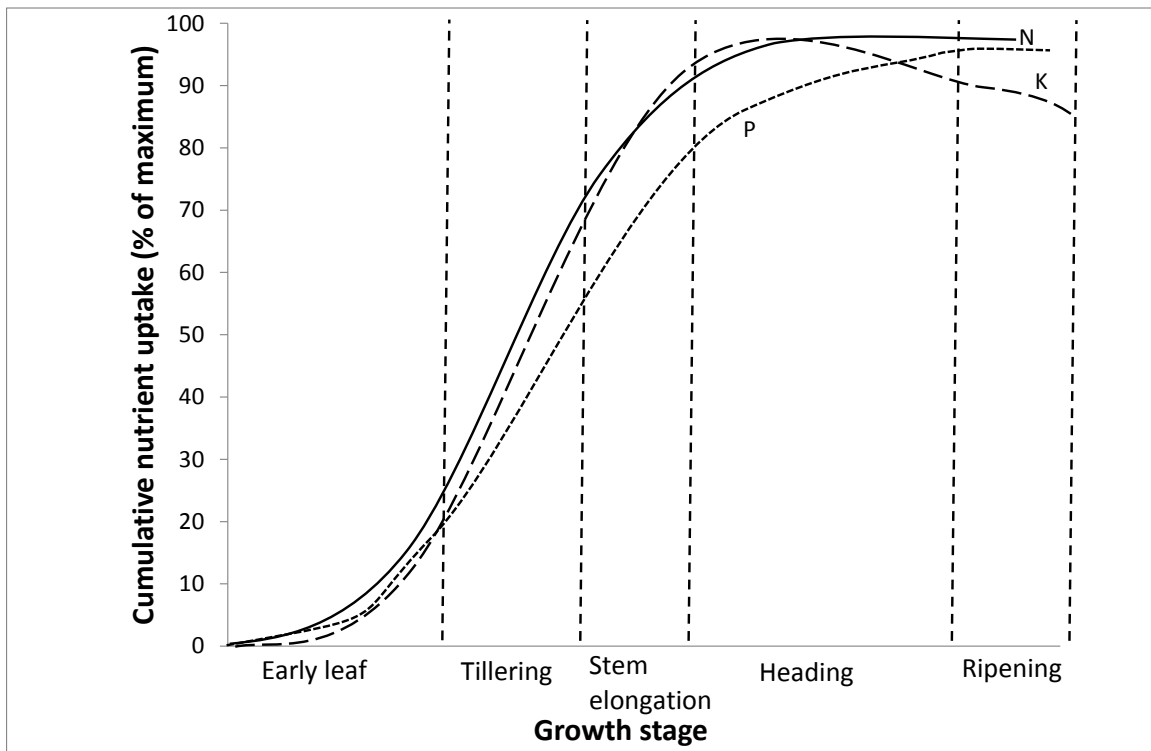
(18 marks)

Growth stage	Description of what is occurring in plant
Germination	Seed absorbs water and swells, first root tip and coleoptile (sheath covering emerging shoot) emerges

8. Provide a monthly calendar indicating when each of the growth stages typically occurs during the crop's growth cycle. This can be attached to your report. (10 marks)

9. Nutrient requirements vary during a plant's growth cycle. Describe the general pattern of nutrient requirements for an annual plant over its life cycle. (3 marks)

10. The following graph shows the typical **cumulative** use of nitrogen (N), phosphorus (P) and potassium (K) over the growth cycle of wheat, which is reasonably typical of cereal crops.



- (a) State during which growth stage the **rate** of nutrient use is highest. (1 mark)

- (b) Relate the growth stage identified from the graph to the appropriate stage on the Zadoks growth scale. (5 marks)

Growth stages from graph	Growth stages from Zadoks scale
Early leaf	
Tillering	
Stem elongation	
Heading	
Ripening	

11. Although nutrient requirements vary during the growth phases, it is usual for most fertilisers to be applied at the time of sowing or very early in the crop's growth rather than multiple applications during the growth of the crop. Explain why this is done. (2 marks)

Marking key for sample assessment Task 2 – Unit 3 and Unit 4

1. Identify **three** reasons why farm soil sampling is important when developing a farm's soil fertiliser plan.

Description	Marks
Reasons for soil sampling when developing a farm's soil nutrient plan	1–3
Total	/3
Answer could include, but is not limited to:	
It is important to know the nutrient status of the soil so that the correct <ul style="list-style-type: none"> • fertilisers can be applied • amount of fertiliser can be added • decisions about legume and/or green manure crops can be made • economic decisions can be made – avoid purchasing and so applying too much fertiliser; adding the correct amount so that plants grow optimally. 	

2. State why nutrients are lost from a farm paddock when it is under cultivation.

Description	Marks
Part of the crop leaves the farm (paddock), taking nutrients with it	1
Total	/1

3. State the **two** main ways lost nitrogen is returned to the soil on a farm.

Description	Marks
Nitrogen-based fertilisers	1
Legume or green crops	1
Total	/2

4. Working in groups:

- select sites where a cereal crop can be grown on the school farm
- collect representative soil samples from the sites
- keep a record of the locations where samples are collected
- test the soil for available nutrients (e.g. nitrogen, phosphorus and potassium). This can be done using kits on-site or samples can be sent off-site for soil nutrient testing.

Description	Marks
Sampling technique follows protocol <ul style="list-style-type: none"> • 10 cm depth • number of samples taken appropriate to paddock size • appropriate number of cores per sample • zig-zag pattern for sampling 	1 1–2 1–2 1
Preparation of samples	1–2
Accurate labelling of samples	1–2
Paddock map shows sampling locations	1–2
Total	/12

5. When results of soil testing are available, present the results in a table, listing each nutrient tested and its concentration in the soil for each sample. The units of concentration need to be included in the titles. Attach your table to your report.

Description	Marks
Appropriate rows given with their title	1
Appropriate columns given with their title	1
Units of concentration included in titles, as appropriate	1
Accurate data entered into table from report	1
	/4

6. For nitrogen, compare the costs of providing the required nitrogen to the paddock for **two** different nitrogen fertilisers. Name the fertilisers and show your calculations below. The following link may assist with your calculations: http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0004/166153/fertiliser-calculations.pdf.

Description	Marks
Names of fertilisers	1
Identifies amount of nutrient (kg/ha) from soil sample report	1
Amount of fertiliser (kg/ha) = kg/ha nutrient ÷ % nutrient in fertiliser × 100 (1 mark each fertiliser)	1–2
Total mass of fertiliser (kg) = number of hectares × amount of fertiliser (kg/ha) (1 mark each fertiliser)	1–2
Cost = price per kg of fertiliser × total mass of fertiliser (kg) (1 mark each fertiliser)	1–2
Total	/8

7. Plant growth stages can be expressed using a growth scale. The Zadoks growth scale is an internationally accepted scale that has 10 broad stages. Complete the table below by giving:
- the 10 stages in order
 - a brief description of what occurs at each stage.

Germination is done as an example.

Growth stage	Description of what is occurring in plant
Germination	Seed absorbs water and swells, first root tip and coleoptile (sheath covering emerging shoot) emerges
Seeding growth	Nine or more leaves emerge during this stage
Tillering	Main stem and nine or more tillers emerge
Stem elongation	Six nodes detectable and flag leaf ligule just visible
Booting	Flag leaf sheath extending and opening; boots swollen; first awns visible
Ear emergence from boot	Ear emergence begins and reaches completion
Flowering (anthesis)	Beginning of anthesis and reaches completion
Milk development	The grain begins to form; kernel water ripe and progresses to late milk
Dough development	Kernel no longer watery but still soft and dough-like; progresses to hard dough
Ripening	Grain hard, difficult to divide; progressing to secondary dormancy lost

Description	Marks
1 mark for each correct response (other than germination)	1–18
Total	/18

8. Provide a monthly calendar indicating when each of the growth stages typically occurs during the crop's growth cycle. This can be attached to your report.

Description	Marks
Each of the Zadoks stages are shown on the monthly calendar	1–10
Total	/10

9. Nutrient requirements vary during a plant's growth cycle. Describe the general pattern of nutrient requirements for an annual plant over its life cycle.

Description	Marks
Plant nutrient needs start low while the plants are young and small	1
Plant nutrient needs increase rapidly through vegetative growth	1
Plant nutrient needs decrease again around the time of reproductive development	1
Total	/3

10. The following graph shows the typical **cumulative** use of nitrogen (N), phosphorus (P) and potassium (K) over the growth cycle of wheat, which is reasonably typical of cereal crops.

- (a) State during which growth stage the **rate** of nutrient use is highest.

Description	Marks
Tillering	1
Total	/1

- (b) Relate the growth stage identified from the graph to the appropriate stage on the Zadoks growth scale.

Growth stages from graph	Growth stages from Zadoks scale
Early leaf	Germination to seedling growth
Tillering	Tillering
Stem elongation	Stem elongation
Heading	Flowering through to dough development
Ripening	Ripening

Description	Marks
1 mark for each correct answer in the Zadoks scale column of table above	1–5
Total	/5

11. Although nutrient requirements vary during the growth phases, it is usual for most fertilisers to be applied at the time of sowing or very early in the crop's growth rather than multiple applications during the growth of the crop. Explain why this is done.

Description	Marks
Economically, it is usually better to do a single application or as few applications as possible	1
Crop damage may arise from machinery if applications are done after germination or when plants are high enough to be damaged by undercarriage of machinery	1
Total	/2

Sample assessment task

Plant Production Systems – General Year 12

Task 5 – Unit 3 and Unit 4

Assessment type: Investigation

Conditions

Period allowed for completion of the task: 10 weeks

Task weighting

10% of the school mark for this pair of units

Response of plant growth to nutrients

(61 marks)

In this activity, each group will:

- grow oats under different application rates of a nitrogen fertiliser
- make observations about various responses by the oats to the fertiliser.

Your oats will be grown in pots and, as a class, there will be **five** different fertiliser concentrations used. You will be sharing the results for your fertiliser concentration with the whole class for the analysis and evaluation of the experiment.

This task will be carried out over 10 weeks:

- Week 1 – planning and preparation
- Week 2 to Week 9 – growing the oats and taking measurements
- Week 10 – analysing results and finalising report

What you need to do

- Working individually, complete the questions in the *Planning* section of the activity sheet. Show this to your teacher before moving to the next part.
- Working in your group, discuss your individual planning and amend your plans, if necessary.
- Working in your group, prepare your experiment and collect your data as in the *Experimental* section of the activity sheet.
- Working individually, complete the questions in the *Processing and Analysis, Conclusion and Evaluation* sections of the activity sheet. Show this to your teacher before moving to the next part.
- Working in your group, discuss your individual *Processing and analysis, and Conclusion and evaluation* sections and amend your answers, if necessary.

Investigating the effect of nitrogen fertiliser on the growth of oats

Part 1 – Planning

1. Based on your background reading, write a suitable hypothesis for the investigation. This should be a concise, testable statement about the relationship you expect to find between the amount of nitrogen fertiliser applied and plant responses. (2 marks)

Individual ideas

Any refinements after group discussion

2. Make a prediction about the results. How do you think the amount of nitrogen fertiliser will affect various plant characteristics? (1 mark)

3. Identify the following variables for the investigation:

(a) Independent variable – what is being changed? (1 mark)

Individual ideas

Any refinements after group discussion

(b) Dependent variables – what is being measured? (2 marks)

Individual ideas

Any refinements after group discussion

(c) Control variables – what factors need to be kept the same between each experimental trial? (3 marks)

Individual ideas

Any refinements after group discussion

Part 2 – Experimental

There will be a total of **five** different concentrations of fertiliser used in the experiment. The allocation of fertiliser concentrations to each group will be done in discussion with your teacher so that there will be at least

- **five** pots at each of the five different fertiliser concentrations
- **five** control pots with no fertiliser.

That is, there will be at least six sets each of five pots.

Preparing your pots

1. Collect your pots and ensure they are clean. Rinse the pots with sterilising solution and allow them to dry.
2. Each pot will have ten oat seeds. Soak the required number of seeds in water overnight.
3. Weigh out the required mass of soil for each pot (each pot should have the same mass of soil). The soil for each pot should come from the same source.
4. Add the amount of nitrogen fertiliser to the soil to give the correct concentration.
5. Add the required amount of the other nutrients to the soil and mix the fertilisers and soil thoroughly.
6. Label each pot with the concentration of fertiliser to be applied to it and from numbers one to five. The label needs to be robust enough to last for many weeks and to potentially get wet.
7. Plant ten oat seeds in each pot to a depth of about 0.5 cm.
8. Add the same volume of water to each pot.
9. Identify an area in the glass house to place the pots. Placement of the pots in this area should be random.
10. Pots will need to be watered regularly.

Taking measurements

Pots will need to be examined on a regular basis (2–3 times per week) to take a range of measurements.

- Germination rate – note the number of seeds that germinate in each of your five pots after one week. You will need to calculate the average germination rate for your five pots. Record this information in a table (see results section).
- Height measurements – take and record regular measurements of the height of your oat plants in your pots (2–3 times per week). Record your results in a table. You may use a spreadsheet to make your table.
- Other observations – keep a record of other factors, such as colour (shade of green), date flowering begins, number of heads of grain etc.
- Dry matter yield – at the conclusion of the growth cycle, cut your oats at soil level. Tie the oats from each pot in separate bundles, label them with the concentration of fertiliser and dry your oats in a drying oven for about 24 hours. After drying, weigh each bundle and record the weight in a table (see results section). You will need to calculate the average dry weight for your five pots.

Mark allocation for the *Experimental* section will be as follows:

- | | |
|---|-----------|
| • Pot preparation | (5 marks) |
| • Cleaning up of work space after pot preparation | (2 marks) |
| • Safe work practices | (2 marks) |
| • Measurement of germination rates | (1 mark) |
| • Height measurements | (2 marks) |
| • Other observations | (2 marks) |
| • Dry matter measurements | (4 marks) |

Part 3 – Results**Your group results**

Concentration of fertiliser: _____

Present your results in tables, as indicated below. Tables with these headings can be done in a spreadsheet and the spreadsheet attached to the report.

Germination and dry matter yield

(4 marks)

	Pot 1	Pot 2	Pot 3	Pot 4	Pot 5	Average
% germination						
Dry matter yield (g/pot)						

Height

(2 marks)

Prepare a table with the headings indicated below to record height.

Date/timing	Height (cm)				
	Pot 1	Pot 2	Pot 3	Pot 4	Pot 5

Other observations

(3 marks)

Attach a description of your other observations, and any photographs of your plants, to your report. A copy of each group's descriptive observations will be provided to each person to assist with the *Processing and analysis* section.

Class results

You will need to share the averages of the germination rate, final height and dry matter yield of your results with the entire class and present the combined results in a table as below.

Concentration	Percentage germination	Final height (cm)	Dry matter yield (g/pot)
0 (Control)			

Part 4 – Processing and analysis

- 4. For your height results, prepare a graph of time against height. (4 marks)
- 5. Explain the shape in your height graph. (3 marks)

Individual ideas

Any refinements after group discussion

- 6. For the combined class results, prepare a graph of
 - (a) percentage germination against concentration
 - (b) final height against concentration
 - (c) dry matter yield against concentration. (6 marks)

7. Describe and explain any trends in the graph for

(a) germination

(2 marks)

Individual ideas

Any refinements after group discussion

(b) final height

(2 marks)

Individual ideas

Any refinements after group discussion

(c) dry matter yield.

(2 marks)

Individual ideas

Any refinements after group discussion

8. Describe any trends in the observations of plant colour or other features of the plants in relation to the concentration of nitrogen fertiliser used. (2 marks)

Part 5 – Conclusion and evaluation

9. Do the data support the hypothesis? Explain using the results of the experiment. (3 marks)

Individual ideas

Any refinements after group discussion

10. State the reason the experiment is done with five pots of oats at each concentration. (1 mark)

Individual ideas

Any refinements after group discussion

Marking key for sample assessment Task 5 – Unit 3 and Unit 4

Part 1 – Planning

- Based on your background reading, write a suitable hypothesis for the investigation. This should be a concise, testable statement about the relationship you expect to find between the amount of nitrogen fertiliser applied and plant responses.

Description	Marks
Appropriate statement relating nitrogen concentration to growth of oats	1–2
Total	/2
Answer could include, but is not limited to:	
For 1 mark, a statement relating nitrogen concentration to one plant growth characteristic: for example, <ul style="list-style-type: none"> as nitrogen concentration increases, the plants are taller. 	
For 2 marks, statement relating nitrogen concentration to two plant growth characteristics: for example, <ul style="list-style-type: none"> as nitrogen concentration increases, the plants are taller and the dry matter yield is higher. 	

- Make a prediction about the results. How do you think the amount of nitrogen fertiliser will affect various plant characteristics?

Description	Marks
Suitable prediction provided to match given hypothesis	1
Total	/1

- Identify the following variables for the investigation:

(a) Independent variable – what is being changed?

Description	Marks
The concentration of nitrogen fertiliser	1
Total	/1

(b) Dependent variables – what is being measured?

Description	Marks
Identifies at least two dependent growth characteristics	1–2
Total	/2
Answer could include, but is not limited to:	
<ul style="list-style-type: none"> plant height rate of growth wet mass yield dry mass yield Although not being measured, students may also include: <ul style="list-style-type: none"> number of grain heads protein content of grain mass of grain 	

(c) Control variables – what factors need to be kept the same between each experimental trial?

Description	Marks
Identifies at least three control variables	1–3
Total	/3
Answer could include, but is not limited to:	
<ul style="list-style-type: none"> • mass of soil in each pot • source of soil • type of fertiliser • temperature to which pots are exposed • same light exposure for all pots • number of seeds in each pot • amount of water each pot is given • amount of other nutrients same for each pot 	

Part 2 – Experimental

Description	Marks
Pot preparation	
• pots cleaned and sterilised	1
• same mass of soil weighed for each pot	1
• same mass of fertiliser added to each soil sample and mixed thoroughly	1
• seeds soaked in water overnight	1
• 10 seeds planted in each pot	1
Cleaning up of work space after pot preparation	1–2
Safe work practices	1–2
Measurement of germination rates recorded after one week	1
Height measurements taken and recorded	1–2
Other observations recorded	1–2
Dry matter measurements	
• plants cut to soil level	1
• cut plants bundled by pot and labelled	1
• plants dried in oven for ~24 hours	1
• weights taken and recorded	1
Total	/18

Part 3 – Results

Description	Marks
Germination and dry matter yield table <ul style="list-style-type: none"> • results for germination rates for each of the five pots recorded • average germination rate entered into table • results for dry matter yield for each of the five pots recorded • average for dry matter yield entered into table 	1 1 1 1
Subtotal	/4
Height table shows measurements for five pots	1–2
Subtotal	/2
Other observations may include things such as <ul style="list-style-type: none"> • colour of leaves/stalk • morphology features • significant dates noted, e.g. flowering, heading 	1–3
Subtotal	/3
Final total	/9

Part 4 – Processing and analysis

4. For your height results, prepare a graph of time against height.

Description	Marks
x and y axes labelled with units	1
Title for graph provided	1
Accurate plot	1
Curved trend line joining points	1
Total	/4

5. Explain the shape in your height graph.

Description	Marks
Shape of curve explained	1–3
Total	/3
Answer could include, but is not limited to:	
<ul style="list-style-type: none"> • Begins slowly in early stages of growth whilst roots establish and leaves develop to enable photosynthesis • Middle stage shows greatest rate of growth during vegetative growth • Slows as it reaches maturity and plant's energy goes in to reproductive structures 	

6. For the combined class results, prepare a graph of
- percentage germination against concentration
 - final height against concentration
 - dry matter yield against concentration.

Description	Marks
x and y axes labelled with units for each graph	1
Title for graph provided for each graph	1
Accurate plot (1 mark each graph)	1–3
Curved trend line joining points for each graph	1
Total	/6

7. Describe and explain any trends in the graph for
- germination

Description	Marks
There is unlikely to be any relationship between germination rate and fertiliser concentration	1
There is no significant relationship because the nutrients required for germination are contained within the seed	1
Total	/2

- final height

Description	Marks
Height increases with concentration of fertiliser	1
Explanation – increased N concentration provides for vegetative growth so growth goes into height	1
Total	/2

- dry matter yield.

Description	Marks
Dry matter yield increases with concentration of fertiliser	1
Explanation – increased N concentration provides nutrient for vegetative growth increasing both height and amount of other structural parts, thus providing plant matter to increase dry weight	1
Total	/2

8. Describe any trends in the observations of plant colour or other features of the plants in relation to the concentration of nitrogen fertiliser used.

Description	Marks
Trends described highlighting differences between low and high N plants	1–2
Total	/2
Answer could include, but is not limited to:	
<ul style="list-style-type: none"> • Controls and low N plants may show pale yellow colour, particularly older leaves; plant is often light green, fewer flowers • Plants with sufficient N (and even an excess) will be darker green • Excess N may lead to tall thin plants with reduced stem strength 	

Part 5 – Conclusion and evaluation

9. Do the data support the hypothesis? Explain using the results of the experiment.

Description	Marks
Statement about support or not of hypothesis provided	1
Explanation for support or not of hypothesis uses evidence from the experimental work	1–2
Total	/3

10. State the reason the experiment is done with five pots of oats at each concentration.

Description	Marks
Replicates increase reliability of result – less likelihood that observations are due to chance	1
Total	/1

Sample assessment task

Plant Production Systems – General Year 12

Task 11 – Unit 3 and Unit 4

Assessment type: Test

Conditions

Time for the task: 40 minutes

Task weighting

6% of the school mark for this pair of units

Test

Breeding and improvement

(30 marks)

Recommended time: 40 minutes

Structure of this test

Section	Number of questions	Suggested working time (minutes)	Marks available
Section One: Multiple-choice	8	10	8
Section Two: Short answer	4	30	23
		Total	31

Section One: Multiple-choice**(8 marks)**

1. Which one of the following is **not** typically an aim of a plant breeding program for food plants?
 - (a) developing a variety with increased drought tolerance
 - (b) developing a variety with increased pest resistance
 - (c) developing a variety with larger leaf surface area
 - (d) developing a variety with higher protein in the grain

2. What is the first step in the breeding of a new plant variety?
 - (a) select the best offspring
 - (b) select parents with the required traits
 - (c) evaluate using field trials
 - (d) self-pollinate the plants so the trait is homozygous

3. The phenotype of a plant refers to the
 - (a) observed expression of a gene.
 - (b) genetic make-up.
 - (c) dominant gene.
 - (d) recessive gene.

4. When selecting the best variety, visual estimates of plant growth are an example of
 - (a) genotypic traits.
 - (b) phenotypic traits.
 - (c) subjective characteristics.
 - (d) objective characteristics.

5. Which one of the following represents cross pollination?
 - (a) cuttings made from one plant and grown into a new plant
 - (b) genetic material transferred between plants
 - (c) pollen transferred from one flower to another flower on the same plant
 - (d) pollen transferred from one flower to another flower on a different plant

6. A genotype by environment interaction (GxE) is observed when a plant variety has
- (a) the same yield at different sites.
 - (b) a different yield at different sites.
 - (c) a different genotype at different sites.
 - (d) the same phenotype at different sites.
7. Which one of the following represents an individual plant that is homozygous for a dominant gene?
- (a) aa
 - (b) aA
 - (c) Aa
 - (d) AA
8. Which one of the following describes backcrossing?
- (a) crossing of a hybrid with one of its parents
 - (b) crossing of hybrids with the same parents
 - (c) crossing of a hybrid with an unrelated plant
 - (d) crossing of pairs of closely related plants

Section Two: Short answer**(23 marks)**

Write your answers in the space provided on the paper.

1. State **two** plant reproduction strategies that contribute to increased genetic variation. (2 marks)

2. Explain the difference between a gene and a chromosome. (4 marks)

3. A particular plant species has a tall and dwarf variety. The dominant gene responsible for tall is represented by H and the recessive dwarf gene is represented by h.

- (a) Give the proportion of tall and dwarf offspring from the cross shown below. Show your reasoning using a punnet square. (2 marks)

HH × hh

- (b) In an experiment with the plant species, a researcher finds that a cross between two parent plants gives 75% tall offspring and 25% dwarf offspring. Give the most likely genotype of each of the parent plants. (2 marks)

4. Plant breeding involves creating new varieties with desirable traits for improved production.

(a) For a plant you have studied, describe a type of breeding system. (3 marks)

(b) Outline the steps that could be followed to breed a new variety of the plant you have named in 4 (a) above. (4 marks)

(c) Identify **three** traits that are typically bred for in cereal crops in Western Australia. (3 marks)

(d) Describe how you would select for increased herbicide resistance in a plant-breeding program. (3 marks)

Marking key for sample assessment Task 11 – Unit 3 and Unit 4

Section One: Multiple-choice

Question number	Answer
1	C
2	B
3	A
4	C
5	D
6	B
7	D
8	A

Description	Marks
1 mark for each question	1–8
Total	/8

Section Two: Short answer

1. State **two** plant reproduction strategies that contribute to increased genetic variation.

Description	Marks
Two strategies given	1–2
Total	/2
Answer could include, but is not limited to:	
<ul style="list-style-type: none"> • cross pollination • separate male and female flowers • male and female parts of the flower maturing at different times • separate male and female plants 	

2. Explain the difference between a gene and a chromosome.

Description	Marks
Recognition that a gene is the unit of heredity that codes for a specific trait	1
Recognition that genes	
<ul style="list-style-type: none"> • are located on chromosomes • occur in pairs in the nucleus 	1 1
Recognition that chromosomes contain all the DNA of a species	1
Total	/4

3. A particular plant species has a tall and dwarf variety. The dominant gene responsible for tall is represented by H and the recessive dwarf gene is represented by h.

(a) Give the proportion of tall and dwarf offspring from the cross shown below. Show your reasoning using a punnet square.

$$HH \times hh$$

Description	Marks
Punnet square provided	1
All offspring tall	1
Total	/2

(b) In an experiment with the plant species, a researcher finds that a cross between two parent plants gives 75% tall offspring and 25% dwarf offspring. Give the most likely genotype of each of the parent plants.

Description	Marks
Parent 1 genotype is Hh	1
Parent 2 genotype is Hh	1
Total	/2

4. Plant breeding involves creating new varieties with desirable traits for improved production.

(a) For a plant you have studied, describe a type of breeding system.

Description	Marks
Describes the correct breeding system for their plant	1–3
Total	/3
Answer could include, but is not limited to:	
<ul style="list-style-type: none"> • Inbreeding – plants are selfed by pollinating between flowers on the same plant so that offspring have the exact same genotype as the parent plant (e.g. wheat) • Cross breeding – plants are crossed by transferring pollen from one plant to the stigma of another plant to create genetically different offspring • Line breeding – genetic variation produced by crossing two plants. Selected offspring are then selfed to generate pure breeding lines • Clone breeding – vegetatively propagating plants, or plants that naturally form extra bulbs • Genetic modification 	

- (b) Outline the steps that could be followed to breed a new variety of the plant you have named in 4 (a) above.

Description	Marks
Outlines at least four steps involved in breeding a new variety	1–4
Total	/4
Answer could include, but is not limited to:	
Main steps involved in traditional breeding of a plant variety: <ol style="list-style-type: none"> 1. Selection of elite parents or novel germplasm with desired traits 2. Make crosses by manually transferring pollen to the stigma of the other parent 3. Grow the seed from the crosses 4. Select progeny with the desired traits 5. Backcross to the elite parent 6. Self the offspring through several generations to produce homozygous plants 7. Evaluate the new variety in field trials 8. Bulk up the seed and then variety can be commercially released 	

- (c) Identify **three** traits that are typically bred for in cereal crops in Western Australia.

Description	Marks
Three traits appropriate to cereal crops in WA given	1–3
Total	/3
Answer could include, but is not limited to:	
Traits desired in a new variety could include: <ul style="list-style-type: none"> • drought tolerant • salt tolerant • frost tolerant • low pH tolerance • higher grain protein content • resistance to viral and fungal pests • shorter growing season 	

- (d) Describe how you would select for increased herbicide resistance in a plant-breeding program.

Description	Marks
Spray plants	
• with a range of herbicides	1
• at a range of concentrations	1
Select the plants that survive to grow for breeding	1
Total	/3