AQA

General Certificate of Education
Advanced Level Examination
June 2010

Biology   BIO6X/TN

Unit 6X   A2 Externally Marked Practical Assignment

Teachers' Notes   Confidential

To be given immediately to the teacher(s) responsible for GCE Biology

Open on receipt

BIO6X/TN

Teachers' Notes

CONFIDENTIAL

These notes must be read in conjunction with *Instructions for the Administration of the Externally Marked Practical Assignment: GCE Biology* published on the AQA Website.

The effect of different concentrations of sodium chloride on the growth of lettuce seedlings

Task 1

Materials

In addition to access to general laboratory equipment, each candidate needs the following

- 50 to 100 lettuce seedlings approximately three days old
- ruler with millimetre measurements
- a pair of forceps
- method of generating random numbers

Technical Information

Lettuce seeds should be germinated in containers from which they can be extracted by the students using forceps e.g. Petri dishes. Provide one container for each student.

To germinate, they should be soaked in distilled water for one hour during which time they should be kept in the light. The germinating seeds will be ready for use after about three days.

The task will need to be trialled before use.

Managing the task

One week before Task 1, teachers may give their candidates the following information.

- you will measure the size of lettuce seedlings

There should be no further discussion of the topic.

In this investigation, teacher must **not** give candidates the following information

- what aspect of growth to measure
- how to select seedlings.

Task 2

Materials

In addition to access to general laboratory equipment, each candidate needs the following

- at least 100 lettuce seeds
- 5 Petri dishes with lids
- 5 filter papers to fit Petri dishes or their lids
- 100 cm^3 sodium chloride solution (0.2 mol dm^{-3})
- distilled water
- small measuring cylinder or syringe to measure 10 cm^3
- 5 boiling tubes
- rack for boiling tubes
- 5 stoppers for boiling tubes or cling film
- ruler with millimetre measurements
- pair of forceps
- marker pen or labels
- 2 beakers to hold solutions
- AQA Students' Statistics Sheet (version 2) provided at the back of the Task Sheet.

Technical information

Each candidate will be required to set up an investigation and measure one aspect of growth or germination after approximately 3 days (or when there is sufficient growth).

The candidates' soaked seeds must be kept in light conditions for the first hour. After this time they can be placed in a convenient place.

The investigation was trialled successfully by several teachers using 'All year round' lettuce seeds germinated at room temperature on moist filter paper.

The task must be trialled before use.

Managing the task

One week before Task 2, teachers may give their candidates the following information.

- you will investigate the effect of different concentrations of sodium chloride on the growth of lettuce seedlings.

There should be no further discussion of the topic.

In this investigation, teachers must **not** give candidates the following information.

- what concentration of sodium chloride to use
- how many lettuce seeds to use
- what aspect of growth or germination to measure
- which statistical test to use.

Centre Number					Candidate Number						For Examiner's Use
											Total Task 1

Surname	
Other Names	
Candidate Signature	

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General Certificate of Education
Advanced Level Examination
June 2010

Biology   BIO6X/PM1

Unit 6X   A2 Externally Marked Practical Assignment
Task Sheet 1

To be completed before Task Sheet 2.

For submission by 15 May 2010

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Task 1

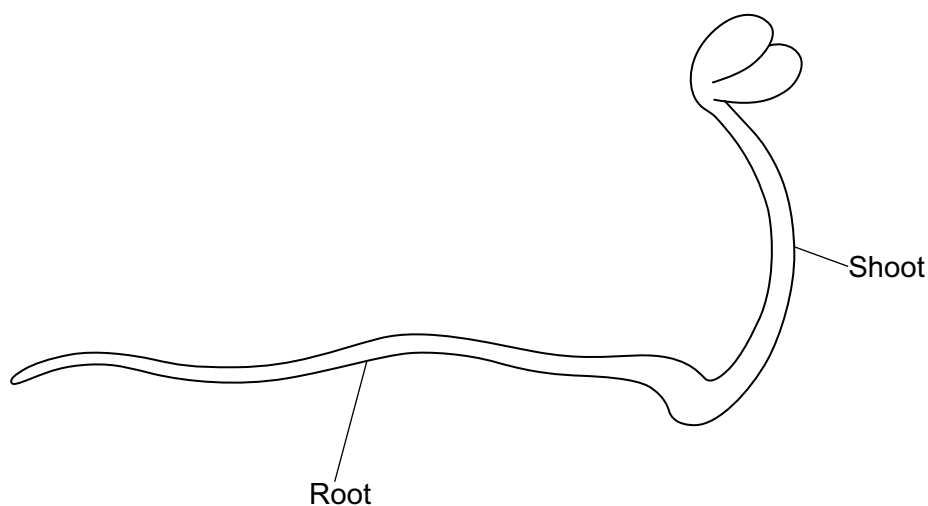You will measure the size of lettuce seedlings.

Materials

You are provided with the following

- lettuce seedlings that are three days old
- ruler with millimetre measurements
- pair of forceps
- method of generating random numbers

You may ask for any other apparatus you need.

Outline method

Read these instructions carefully before you start your investigation.

Select and measure **one** aspect of size for 10 seedlings.

You should select seedlings to measure in a way that ensures your results are reliable and representative.

Recording your results

You should record your data in this table. Put an appropriate heading in the second column.

You will complete the third column later in Question **4**.

Seedling number		Running mean
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Questions on Task 1

Answer **all** questions in the spaces provided.

1   Which aspect of size did you choose to measure? Explain why.

2 (a)   Describe how you selected the seedlings you measured.

2 (b)   Explain the reason for selecting the seedlings in this way.

3   Give **one** problem that you encountered in obtaining accurate measurements. Explain how you overcame this problem.

4   The running mean is a mean which is recalculated each time you have taken a measurement.

4 (a)   Use the values you have collected to calculate the running mean for your data. Record these data in the third column of the table on page 3.

4 (b)   A representative sample is required. This can be achieved by determination of the running mean of a sample. Suggest how.

END OF TASK 1

Centre Number					Candidate Number					For Examiner's Use
Surname										Total Task 2
Other Names										
Candidate Signature										

AQA

General Certificate of Education
Advanced Level Examination
June 2010

Biology   BIO6X/PM2

Unit 6X   A2 Externally Marked Practical Assignment
Task Sheet 2

To be completed before the EMPA Written Test.

For submission by 15 May 2010

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Task 2

Introduction

In icy weather salt is put onto roads. Road salt contains sodium chloride and this produces a solution that can run off onto fields.

This may affect plants growing in the fields.

In this part of the investigation you will examine the effect of different concentrations of sodium chloride on root growth in lettuce seedlings.

Materials

You are provided with the following

- lettuce seeds
- 5 Petri dishes with lids
- filter paper to fit the Petri dishes
- sodium chloride solution (0.2 mol dm^{-3})
- distilled water
- syringe or pipette
- boiling tubes
- rack for boiling tubes
- stoppers for boiling tubes or cling film
- ruler with millimetre measurements
- pair of forceps
- marker pen or labels
- beakers
- AQA Students' Statistical Sheet (version 2) provided at the back of this booklet

You may ask for any other apparatus you require.

Outline Method

Read these instructions carefully before you start your investigation

You will need to set up your investigation and measure the seedling roots when instructed by your teacher.

You will need to make some decisions for yourself.

Remember that you will need to carry out a suitable statistical test on your results.

1. Use the sodium chloride solution and distilled water to produce a series of 5 dilutions.
2. Place a filter paper in the bottom of each Petri dish.
3. Add 5 cm^3 of one of the sodium chloride solutions you have made to one Petri dish.
4. Place lettuce seeds on the moistened filter paper. Put the lid on the Petri dish and leave.
5. Repeat steps 3 to 5 with each of the sodium chloride solutions you have made using a different Petri dish each time.
6. Measure and record the length of the seedling roots when your teacher tells you.

You will need to decide for yourself

- what concentrations of sodium chloride to use
- how many seeds to use
- how to arrange the seeds in the Petri dishes

Presenting data

Record your raw data in an appropriate table in the space below.
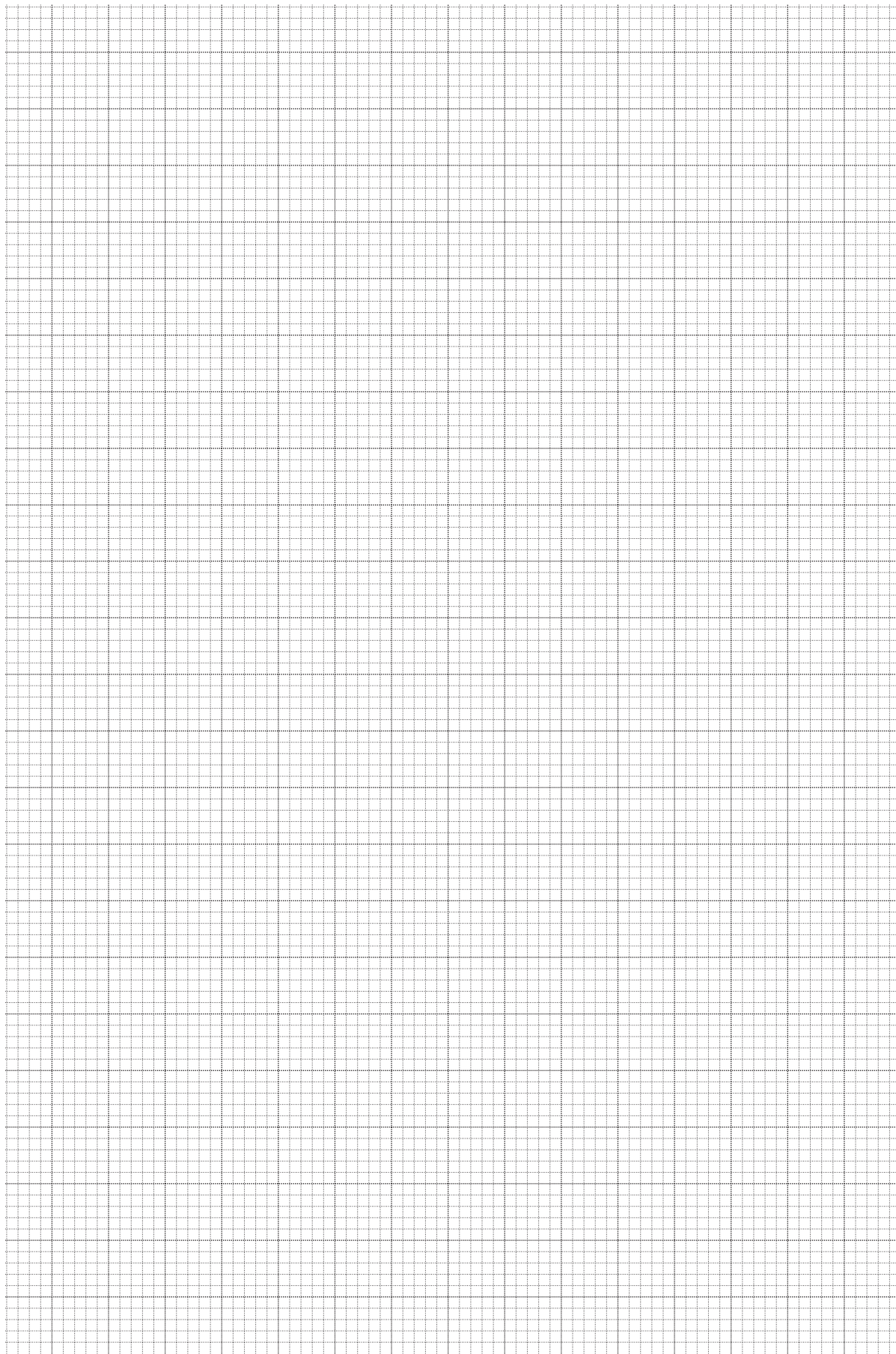
Processing your data

5   Use a statistical test to analyse your data and test your null hypothesis. You may use a calculator and the Students' Statistical Sheet that has been provided.
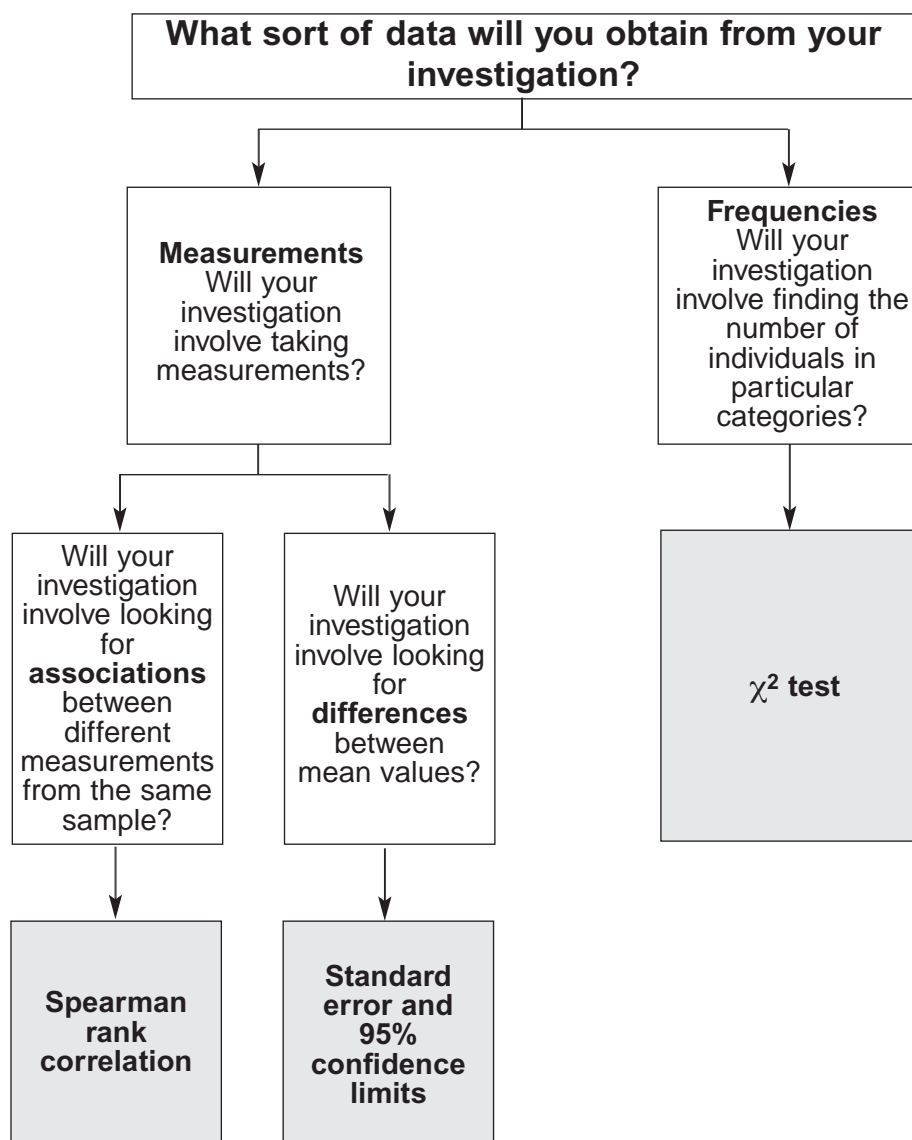
You are provided with a sheet of graph paper. You may use this if you wish.

5 (a) State your null hypothesis.

5 (b) Give your choice of statistical test.

5 (c) Give reasons for your choice of statistical test.

5 (d) Calculate the test statistic.

5 (e) Interpret the test statistic in relation to your null hypothesis.

You may use this if you wish.

AQA Students' Statistics Sheet (version 3)

What sort of data will you obtain from your investigation?

Measurements
Will your investigation involve taking measurements?

Frequencies
Will your investigation involve finding the number of individuals in particular categories?

Will your investigation involve looking for **associations** between different measurements from the same sample?

Will your investigation involve looking for **differences** between mean values?

χ² test

Spearman rank correlation

Standard error and 95% confidence limits

Standard error and 95% confidence limits

Calculate the standard error of the mean, *SE*, for each sample from the following formula

$$SE = \frac{SD}{\sqrt{n}}$$

where SD = the standard deviation
and n = sample size

95% confidence limits = $2 \times SE$ above and below the mean

For use in the ISA and EMPA assessment

Turn over ▶

The χ^2 test

The chi-square (χ^2) test is based on calculating the value of χ^2 from the equation

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

where O represents the results you observe in the investigation
   and E represents the results you expect.

Table showing the critical values of χ^2 at P = 0.05 for different degrees of freedom

Degrees of Freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92
10	18.31

Spearman rank correlation test

Calculate the value of the Spearman rank correlation, r_s, from the equation

$$r_s = 1 - \left[\frac{6 \times \sum D^2}{n^3 - n} \right]$$

where n is the number of pairs of items in the sample and D is the difference between each ranked pair of measurements.

Table showing the critical values of r_s at P = 0.05 for different numbers of paired values

Number of pairs of measurements	Critical value
5	1.00
6	0.89
7	0.79
8	0.74
9	0.68
10	0.65
12	0.59
14	0.54
16	0.51
18	0.48

For use in the ISA and EMPA assessment

Surname	
Other Names	
Candidate Signature	

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Advanced Level Examination
June 2010

Biology   BIO6X

Unit 6X   A2 Externally Marked Practical Assignment

Written Test

For submission by 15 May 2010

For this paper you must have:
- Task Sheet 2, your results and your calculations
- a ruler with millimetre measurements
- a calculator.

Time allowed
- 1 hour 15 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 36.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

Section A
These questions are about your investigation into the effect of sodium chloride concentration on the growth of roots in lettuce seedlings.
Use your Task Sheet 2 and your results and your calculations to answer them.
Answer **all** questions in the spaces provided.

6   You were provided with $0.2\,\text{mol dm}^{-3}$ sodium chloride and distilled water. Describe how you would use these to make up $10\,\text{cm}^3$ of a solution of concentration $0.15\,\text{mol dm}^{-3}$.

7 (a)   How did you decide how many lettuce seeds to use in each Petri dish?

7 (b)   How did you arrange the lettuce seeds in each Petri dish? Why did you choose this arrangement?

8 (a)   The Petri dishes should have been covered to prevent evaporation. Why is it important to prevent evaporation in this investigation?

8 (b)   You used $5\,\text{cm}^3$ of sodium chloride solution in your investigation. Suggest why it was important that the solution did **not** completely cover the seeds.

9   A student carried out a similar investigation to yours. The table shows her results.

Concentration of sodium chloride / mol dm^{-3}	Percentage of lettuce seeds which started to grow roots	Mean root length / mm (± standard deviation)
0.00	100	20.1 (±0.38)
0.05	100	14.5 (±0.25)
0.10	92	7.8 (±0.33)
0.15	60	6.2 (±0.24)
0.20	9	2.0 (±0.05)

9 (a)   Describe what these data show.

9 (b)   Suggest an explanation for the effect of sodium chloride concentration on the germination of seeds.

10   Lettuce is classified in the same family as dandelions. Dandelions commonly grow on roadside verges and may accidentally be sprayed with salt when salt is added to the road in winter.

Describe how you could use a transect to investigate whether the distribution of dandelions changed with increased distance from the road.
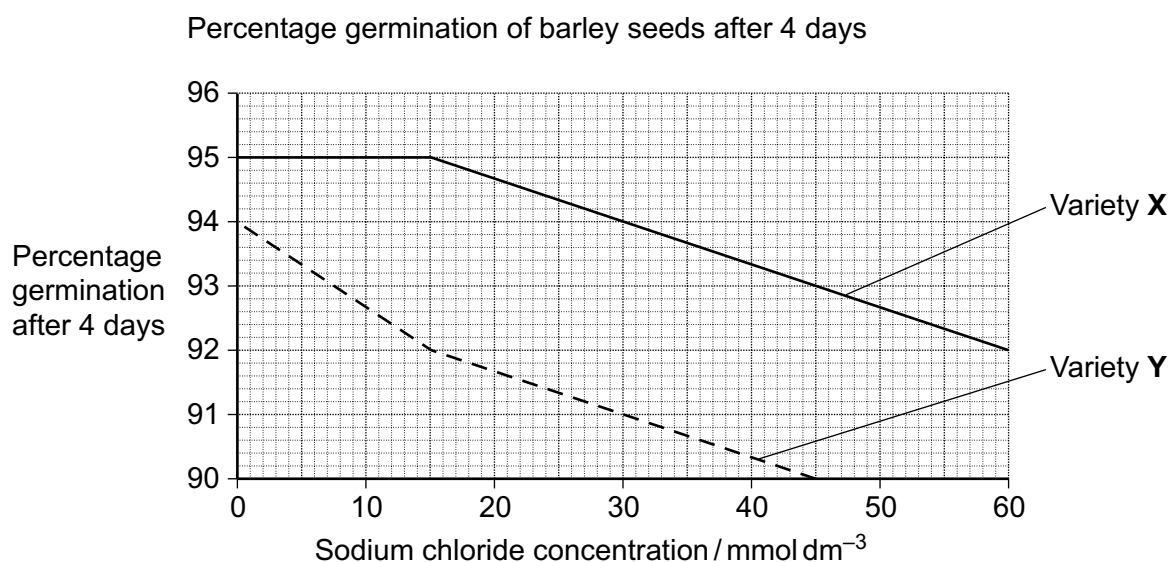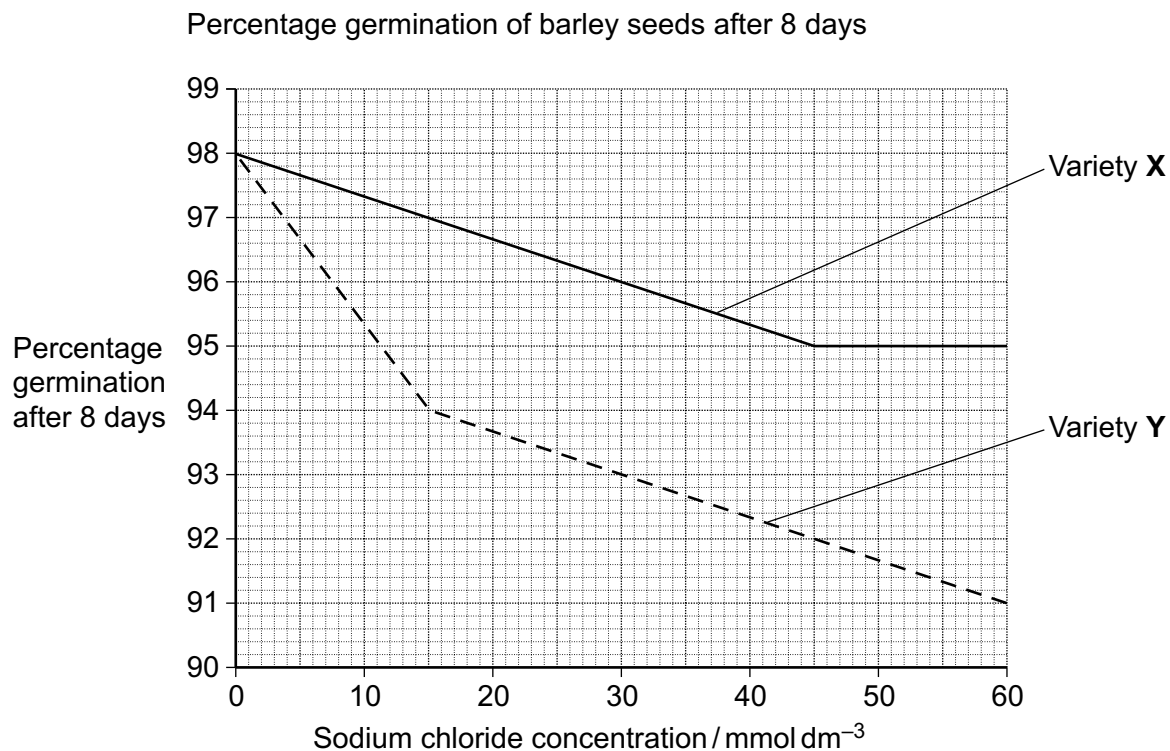
Resource Sheet

Resource A

Lettuce growers investigated the best conditions for germinating lettuce seeds. They soaked lettuce seeds for 8 hours in distilled water at different temperatures. They then germinated some of the seeds at 20 °C and some at 35 °C. The table shows their results.

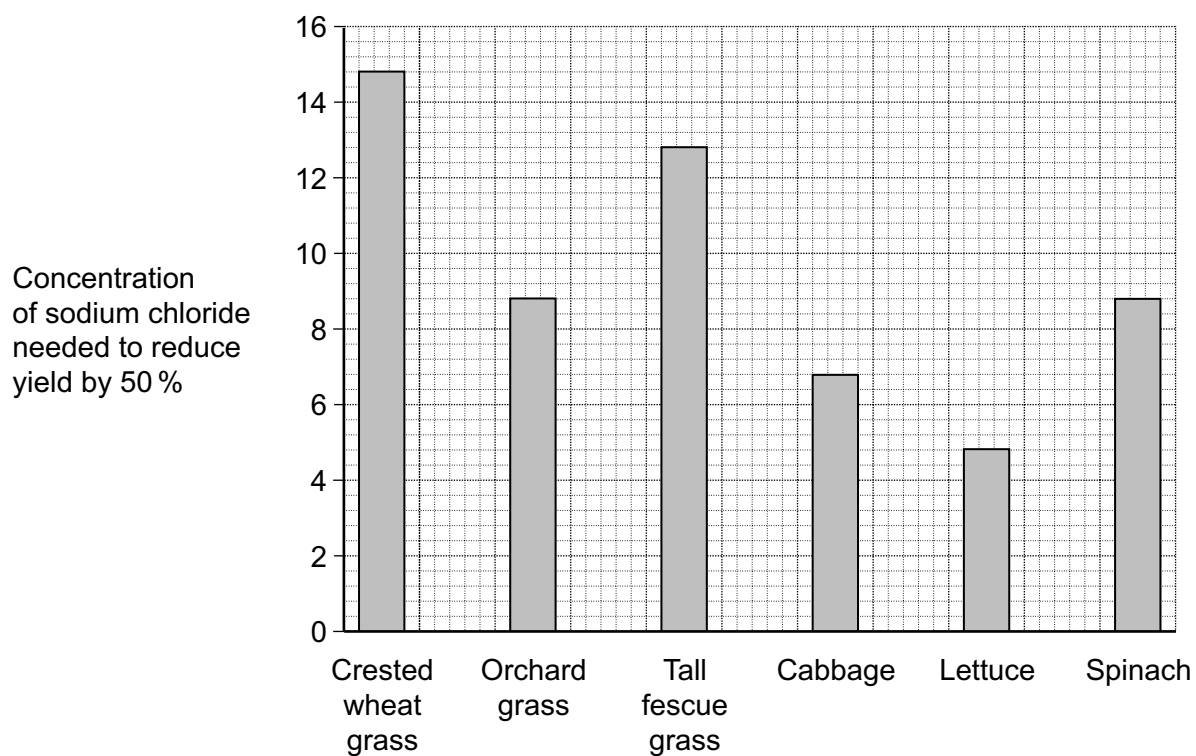| Temperature at which seeds were soaked / °C	Percentage of seeds which germinated	
	at 20 °C	at 35 °C
20	100	89
25	100	43
30	41	1
35	21	0

Resource B

Scientists investigated the effects of different concentrations of sodium chloride on the germination of the seeds of two varieties of barley. The seeds were soaked for one hour in different concentrations of sodium chloride solutions and then germinated in distilled water at 25 °C. The scientists found the percentage of germinated seeds after 4 days and again after 8 days.

Percentage germination of barley seeds after 4 days

Percentage germination of barley seeds after 8 days

Variety **X**

Variety **Y**

Resource C

The Food and Agriculture Organisation is investigating the effect of salt on plant growth. In some countries the water used to irrigate crops contains sodium chloride. The graph shows the effect of sodium chloride on the growth of some grasses and crop plants.

Resource D

Salt is used frequently on the roads in Canada during the winter months. The Highways Agency wants to plant salt-tolerant trees on roadside verges. They surveyed a range of roadside trees to determine how salt-tolerant they were. In the survey each tree was growing in soil with a similar salt concentration.

Tree Species	Number of trees surveyed	Percentage of trees in each class			Mean concentration of chloride ions in the tissues of roadside trees / arbitrary units
		Healthy	Slightly injured	Moderately to severely injured	
Red oak	108	100	0	0	0.02
Paper birch	3	100	0	0	1.15
Black cherry	36	92	8	0	0.09
Basswood	54	57	41	2	0.90
Red maple	282	63	11	26	1.01
Red pine	140	9	15	76	1.08

Section B

You should use the information on the Resource Sheet to answer these questions.

Answer **all** questions in the spaces provided.

11 (a)   Use Resource **A** to describe and explain the effect of temperature on lettuce seed germination.

11 (b)   Explain why the lettuce growers measured germination as a percentage.

Do not write
outside the
box

12 Describe what the data in Resource **B** show about the effect of sodium chloride concentration on germination in these two varieties of barley.

13 Yield can be determined by measuring the dry mass of plants.

13 (a) Suggest how you could determine the dry mass of a sample of plant material.

13 (b) What is the advantage of using dry mass and not fresh mass to compare the yield of plants?

14   The scientists concluded that red oak and paper birch are salt-tolerant but that the
           other species of tree are not. Use the data in **Resource D** to evaluate their
           conclusion.

15   Farmers have suggested that using salt on the roads in winter is damaging the yield
           from their land. Do the data in the Resource Sheet support this claim?

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED