

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use Total Task 2



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 cm³ 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

Turn over ►

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.

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(1 mark)

5 (b) Give your choice of statistical test.

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(1 mark)

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

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(1 mark)

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5 (d) Calculate the test statistic.

(1 mark)

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

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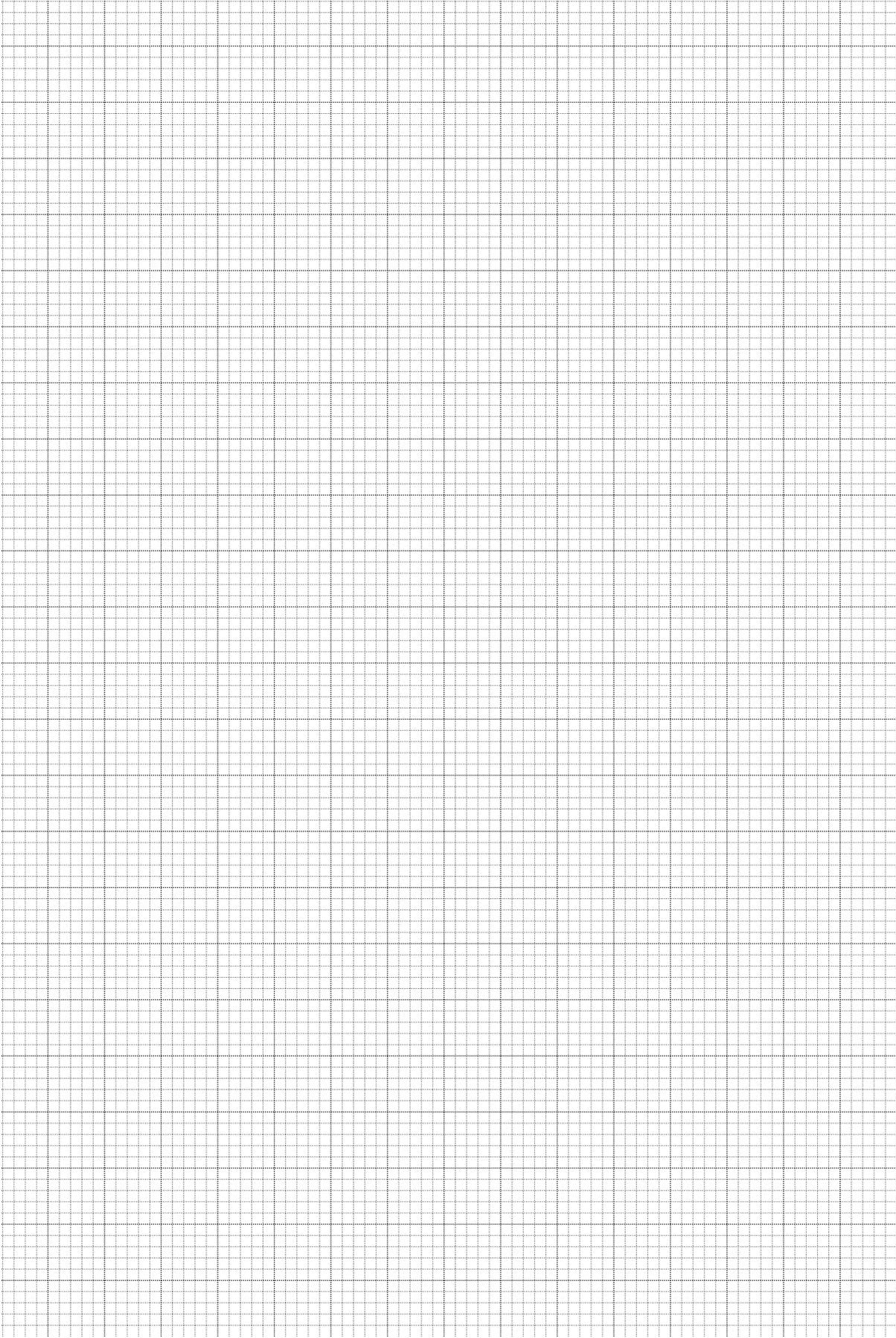
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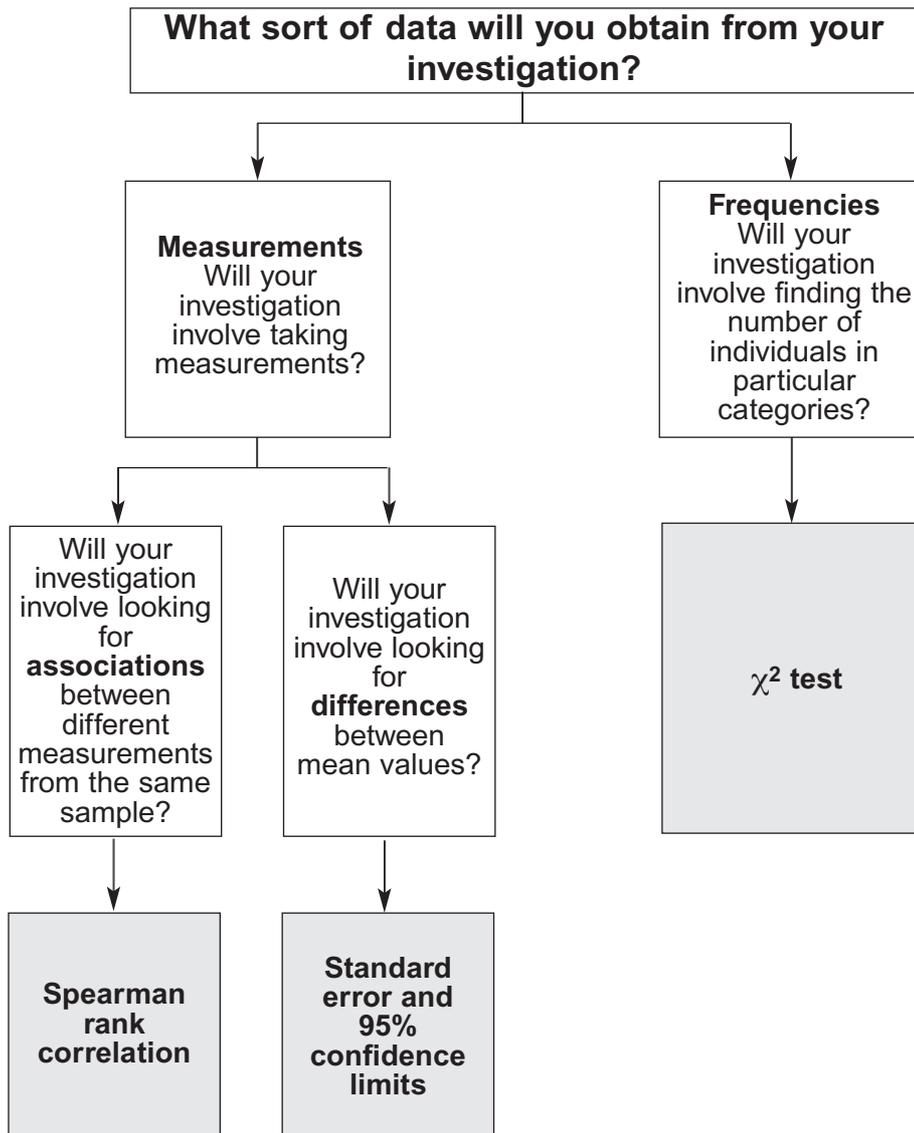
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You may use this if you wish.



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AQA Students' Statistics Sheet (version 3)



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

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