

Past-paper walk-through

Control and coordination in plants ■ 15.2

eXercise

Questions in this set

- 9700/51 N25 Q1 ■ 18 marks
- 9700/52 N25 Q3 ■ 5 marks

Reading the mark scheme

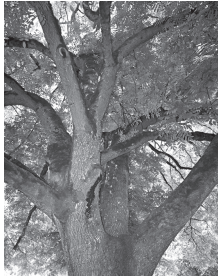
- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 1

9700/51 N25 ■ Q1 ■ 18 marks

- 1 Juglone is a chemical produced by plants in the genus *Juglans*, which includes different species of walnut tree.

Fig. 1.1 shows a black walnut tree.



Question 1



Fig. 1.1

Juglone produced by a black walnut tree can diffuse into the soil surrounding the tree.

Groups of scientists have observed that juglone affects different species of plant growing close to black walnut trees.

Juglone can reduce the percentage of seeds that germinate, delay the start of germination or reduce growth. In some studies, juglone has no effect on germination or growth.

A student planned to investigate the effect of juglone on the cucumber plant, *Cucumis sativus*.

In the investigation, the student:

- placed some damp soil containing juglone in a tray
- added some cucumber seeds to the soil

Question 1

- added some cucumber seeds to the soil
- placed the container in a suitable environment for germination and growth.

Fig. 1.2 shows cucumber seedlings (young plants) a few days after germination.



Fig. 1.2

Question 1

The student planned to compare the effect of exposing cucumber seeds to:

- juglone solution with a concentration of $1.0 \times 10^{-3} \text{ mol dm}^{-3}$, which is a concentration that has been measured in soils surrounding black walnut trees
- a control treatment.

The student planned to determine:

- the percentage of cucumber seeds that germinated in soil
- the growth of each cucumber seedling 10 days after the appearance of the seedling above the soil.

(a) Identify the independent variable in this investigation.

Question 1

(b) Juglone solutions are prepared using a mixture of solvents.

The student was provided with:

- a juglone solution with a concentration of 0.1 mol dm^{-3}
- the mixture of solvents.

Using the solution provided, the student prepared a juglone solution with a volume of 500 cm^3 and a concentration of $1.0 \times 10^{-3} \text{ mol dm}^{-3}$.

The student carried out 1 dilution to prepare the $1.0 \times 10^{-3} \text{ mol dm}^{-3}$ solution using measuring cylinders.

- (i) State the volumes that the student used to carry out the dilution to produce 500 cm^3 of $1.0 \times 10^{-3} \text{ mol dm}^{-3}$ juglone solution.

Question 1

- (ii) Outline **one** improvement the student could make to reduce the percentage error while carrying out the dilution.

Question 1

- (c) (i) State a suitable control that the student could use, **and** explain why the student decided to include a control in the investigation.

Question 1

Question 1

Question 1

[2]

(ii) Describe a method the student could use to investigate the effect of juglone on:

- the percentage of cucumber seeds that germinate
- the growth of each cucumber seedling 10 days after the appearance of the seedling above the soil.

The description of your method should be set out in a logical way and be detailed enough for another person to follow.

Question 1

- (d) Another student investigated the effect of juglone on a different species of plant called crimson clover, *Trifolium incarnatum*.

The student recorded the number of days required for germination of:

- 10 seeds treated with a juglone solution with a concentration of $1.0 \times 10^{-3} \text{ mol dm}^{-3}$
- 10 seeds not treated with a juglone solution.

- (i) The student used the *t*-test to analyse the results. The *t*-test is appropriate for the number of seeds that were used.

Suggest **two other** reasons why the *t*-test is an appropriate statistical test to use for this investigation.

Question 1

(ii) The null hypothesis for this t -test was:

There is no difference between the time taken for seeds to germinate when treated with juglone and the time taken for seeds to germinate when not treated with juglone.

The calculated value of t was **2.090**.

The student compared **2.090** to the values in Table 1.1.

Table 1.1

Question 1

degrees of freedom	probability level (p)			
	0.10	0.05	0.01	0.001
17	1.740	2.110	2.898	3.965
18	1.734	2.101	2.878	3.922
19	1.729	2.093	2.861	3.883
20	1.725	2.086	2.845	3.850
21	1.721	2.080	2.831	3.819

Using Table 1.1 and the calculated value of t of **2.090**, state **and** explain what the student can conclude about the results.

Question 1

[Total: 18]

Solution 1

(a)

Mark scheme

- any one from:
- (presence of) juglone (with a concentration of $1.0 \times 10^{-3} \text{ mol dm}^{-3}$)
- and
- control (treatment) / absence of juglone ;
- concentration, of juglone ;
- 1

Solution 1

(b)(i)

Mark scheme

- 5 cm³ of (original / 0.1 mol dm⁻³) juglone (solution) ;
- 495 cm³ of the (mixture of) solvents ;
- 2

Solution 1

(b)(ii)

Mark scheme

- any one from:
- use, syringe / graduated pipette / micropipette / burette ;
- use, volumetric flask ;
- use larger (stated) volumes (of both juglone and mixture of solvents) ;
- 1

Solution 1

(c)(i) Mark scheme

- 1
- (mixture of) solvents / solution, with no juglone ;
- 2
- idea that to show that any effects observed (on the, germination / growth, of seeds) are a result of juglone ;
- 2
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Solution 1

(c)(ii) Mark scheme

- any seven from:
- 1
- method for standardising the exposure of the seeds to juglone ;
- 2
- ref. to use, same / stated, (cucumber) seeds ;
- 3
- method to maintain a, constant / stated, temperature ;
- 4

Solution 1

- method to maintain a, constant / stated, light intensity ;
- 5
- ref. to standardise another key variable ;
- 6
- idea of reapply juglone (to seedlings) after germination ;
- 7
- count / note / record / AW, number of seeds planted and count number of seeds that germinate, after a, set / stated,
- time ;
- 8

Solution 1

- method for measuring growth at 10 days (after the appearance of the seedling above the soil) ;
- 9
- for juglone solution and control treatment, use a large number of seeds and calculate the mean (growth) for
- each group ;
- 10 safety comment with hazard and risk and precaution ;
- hazard
- risk
- precaution
- juglone

Solution 1

- irritant / toxin / allergy
- gloves / mask / PPE
- solvents
- irritant / toxin / allergy
- gloves / mask / PPE
- cucumber
- seeds / plants
- irritant / allergy
- gloves / mask / PPE
- soil

Solution 1

- biohazard / pathogens /
- allergy / irritant
- gloves / mask / PPE
- 7
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Solution 1

(d)(i) Mark scheme

- any two from:
 - 1
 - data is continuous ;
 - 2
 - comparing means (from the two groups) ;
 - 3
 - data is (from populations that are) normally distributed ;
 - 4

Solution 1

- standard deviations (approximately) the same (between the two groups) ;
- 2

Solution 1

(d)(ii) Mark scheme

- any three from:
- 1
- (the critical value at 18 d.f. and $p = 0.05$ is) 2.101 ;
- 2
- calculated value of $t / 2.090$, is less than, critical value / 2.101 (at $p = 0.05$) ; ora
- 3
- null hypothesis is accepted (at $p = 0.05$) ;
- 4

Solution 1

- there is no significant difference (at $p = 0.05$) ;
- 3
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Question 3

9700/52 N25 ■ Q3 ■ 5 marks

- 3 Seeds of the common stork's-bill, *Erodium cicutarium*, are shown in Fig. 3.1.

The awn is an extension on the *E. cicutarium* seed. The seed uses the awn to push the seed head into the soil to allow the seed to germinate. The awn changes shape when the humidity changes.

Humidity is the concentration of water vapour in the air. The higher the humidity, the higher the concentration of water vapour in the air.



Question 3



Fig. 3.1

A student investigated the effect of humidity on the appearance of the awn.

The student set up the apparatus as shown in Fig. 3.2.

Water can be added to the filter paper to change the humidity in the beaker surrounding the seed. Increasing the volume of water added to the filter paper increases the humidity.



Question 3

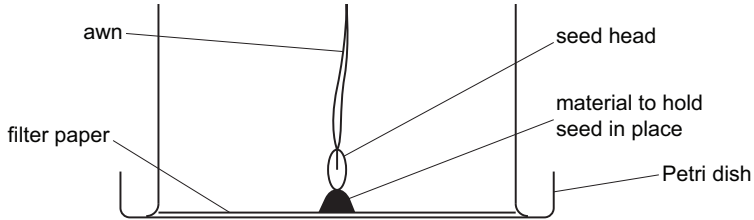


Fig. 3.2

- (a) State **two** variables the student would need to standardise for the investigation using the apparatus shown in Fig. 3.2.

Question 3

- (b) Outline a method the student could use to measure the effect of different levels of humidity on the appearance of the awn, using the apparatus in Fig. 3.2.

Do **not** include standardised variables from (a) or a risk assessment.

Question 3

[Total: 5]

Solution 3

(a) Mark scheme

- any two from:
 - 1
 - age of seeds ;
 - 2
 - all awns are straight / all awns are twisted at the start ;
 - 3
 - temperature ;
 - 4

Solution 3

- light intensity / carry out in a dark room ;
- 5
- time seeds left in the different humidities (before measuring them) ;
- 6
- type / thickness / absorbency / size / dimensions / area, of filter paper ;
- 2
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Solution 3

(b) Mark scheme

- any three from:
 - 1
 - add different volumes of water (to the filter paper) ;
 - 2
 - leave one (filter paper) with no water ;
 - 3
 - ref. to measuring appearance of awn ;
 - 4

Solution 3

- idea of repeat, for each humidity ;
- 3