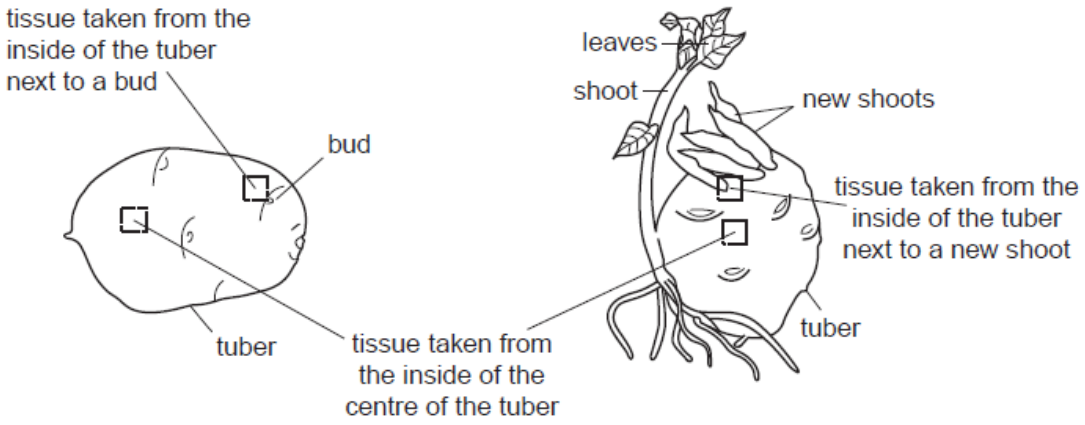
1 A student investigated the storage tissue in potato tubers of different ages

- a newly formed tuber
- an old tuber that was just beginning to form new shoots.

In one investigation, the water potential of different parts of the tubers was estimated using discs of potato tissue and sucrose solutions of different concentrations.

Fig. 1.1 shows

- the appearance of the tubers
- the places from where the tissues were removed.




**newly formed tuber**

**old tuber developing new shoots**

**Fig. 1.1**

The results of the investigation are shown in Fig. 1.2.

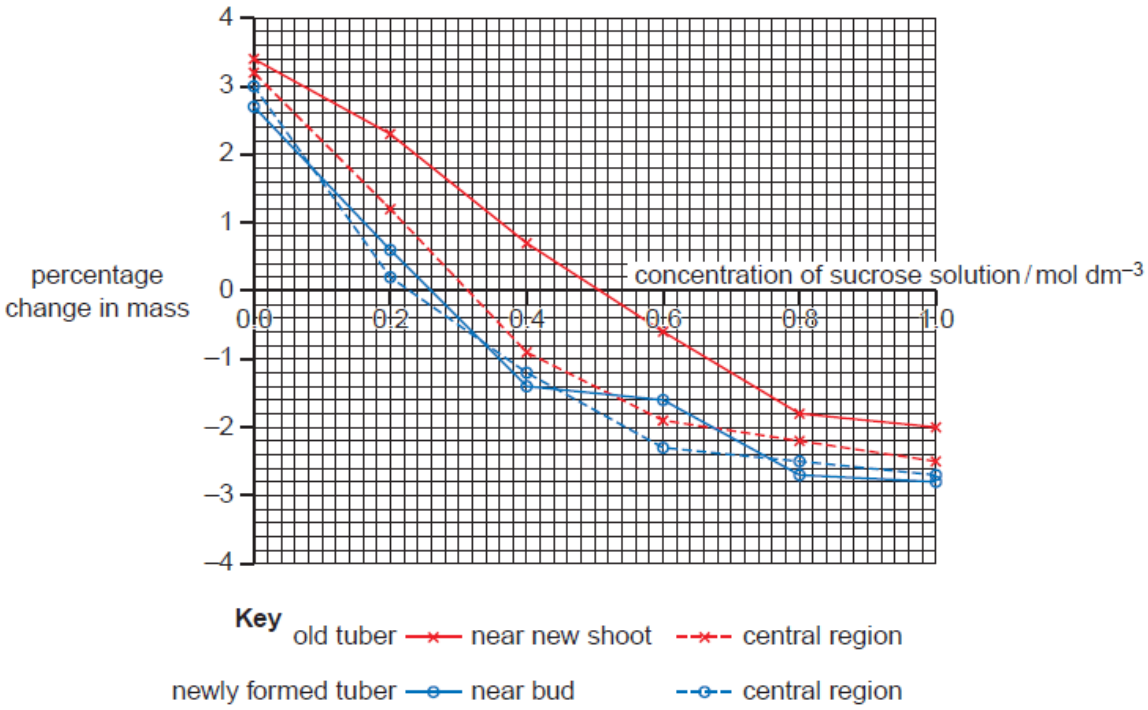



**Fig. 1.2**

**(a)** Describe a procedure by which the student could have obtained the results in Fig. 1.2.

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**(b)** **(i)** State how the percentage change in mass is calculated.

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**(ii)** Explain why the student used percentage change in mass rather than actual mass.

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Fig. 1.3 shows the same data as Fig. 1.2.

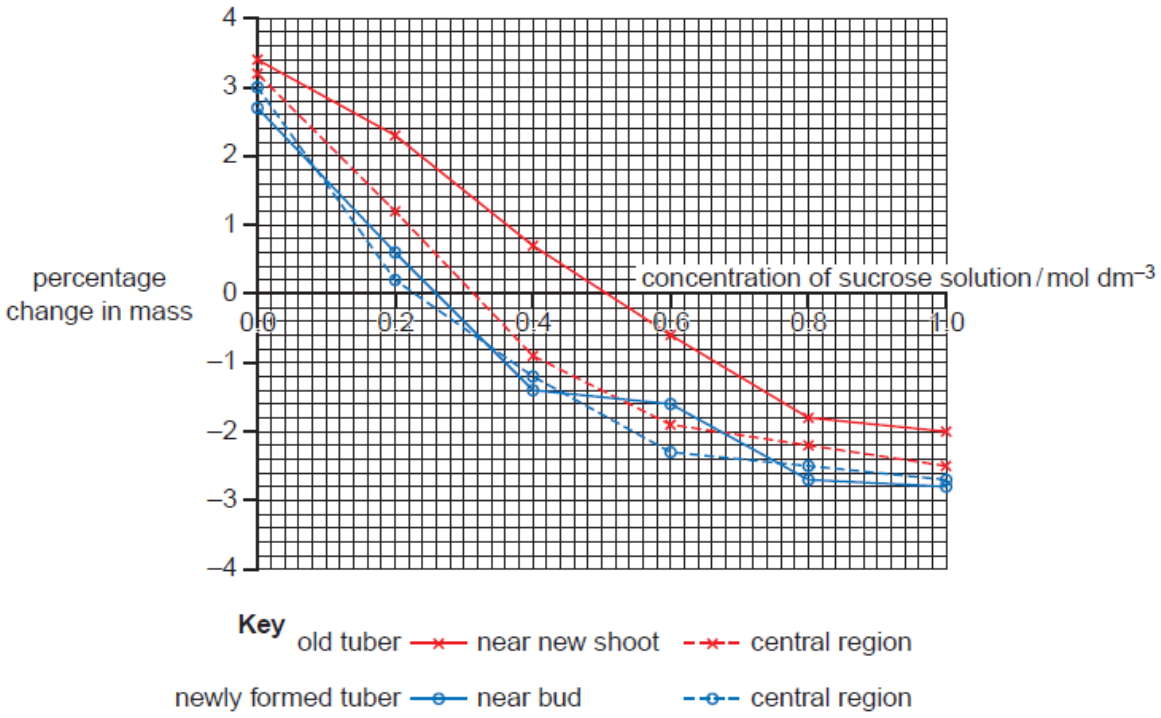


**Fig. 1.3**

The student looked at the graphs in Fig. 1.3 and estimated the water potential from where there was no change in mass.

The student decided to find out if the difference in the water potential between the central region of the old tuber and the central region of the newly formed tuber was significant.

- 20 samples of tissue were taken from the central region of each tuber.
- The change in mass was measured separately for each sample using the same procedure as in the original investigation.

**(c)** **(i)** Give **one** reason why the *t*-test is a suitable statistical test for this investigation.

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**(ii)** Explain how the student should use the value for *t* to find out if the difference in water potential between the tubers is significant.

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From the readings in Fig. 1.3 the student concluded that

- the tissue in the old tuber close to the growing shoot has the **lowest water potential**.
- in the old tuber close to a growing shoot, starch reserves were being converted to sugar.
- in the old tuber central region, starch was being converted to sugar.
- in the newly formed tuber all the sugar had been converted to starch.

**(d)** With reference to Fig. 1.3, state the evidence that supports these conclusions and the evidence that does not support these conclusions.

*evidence to support these conclusions*

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*evidence that does not support these conclusions*

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**(e)** Suggest what further investigations the student could do to provide more support for the conclusions about starch and sugar in the storage tissue.

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**(f)** The student found that newly formed tubers do not form shoots until a period of dormancy lasting several months has occurred.

The student investigated tissues taken from tubers of different ages to test the hypothesis

**Dormancy in tubers is caused by an inhibitory growth regulator.**

Suggest what results would be obtained if this hypothesis was valid.

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[Total: 20]

**2** Organo-mercury compounds are toxic. They are used as pesticides, as preservatives for vaccines and as surface antiseptics.

The effects of an organo-mercury compound on mitosis were investigated in a cell culture of human white blood cells. The cells were exposed to different concentrations of the compound for one hour.

Observations of the chromosomes in these cells were made using a light microscope at □ 400 magnification. Two types of abnormal mitosis were seen.

**Type 1** the chromosomes were clumped close together in the middle of the cell.

**Type 2** the spindle had not formed in the cell.

The frequency of each type of abnormality was obtained by observing 100 cells.

Table 2.1 shows the results.

**Table 2.1**

| concentration of organo-mercury compound / μmol $dm^{-3}$ | frequency of the type of mitosis observed | | |
|---|---|---|---|
| | **Type 1** | **Type 2** | **Normal** |
| 0 | 0 | 18 | 82 |
| 2 | 0 | 19 | 81 |
| 10 | 0 | 38 | 62 |
| 20 | 1 | 44 | 55 |
| 50 | 16 | 50 | 34 |
| 100 | 55 | 28 | 17 |
| 200 | 89 | 11 | 0 |

**(a)** Outline how the white blood cells may have been treated so that the chromosomes could be observed.

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**(b) (i)** Identify the independent and dependent variables in the investigation.

*For Examiner's Use*

*independent* .....

*dependent* .....[2]

**(ii)** Identify the control for this investigation.

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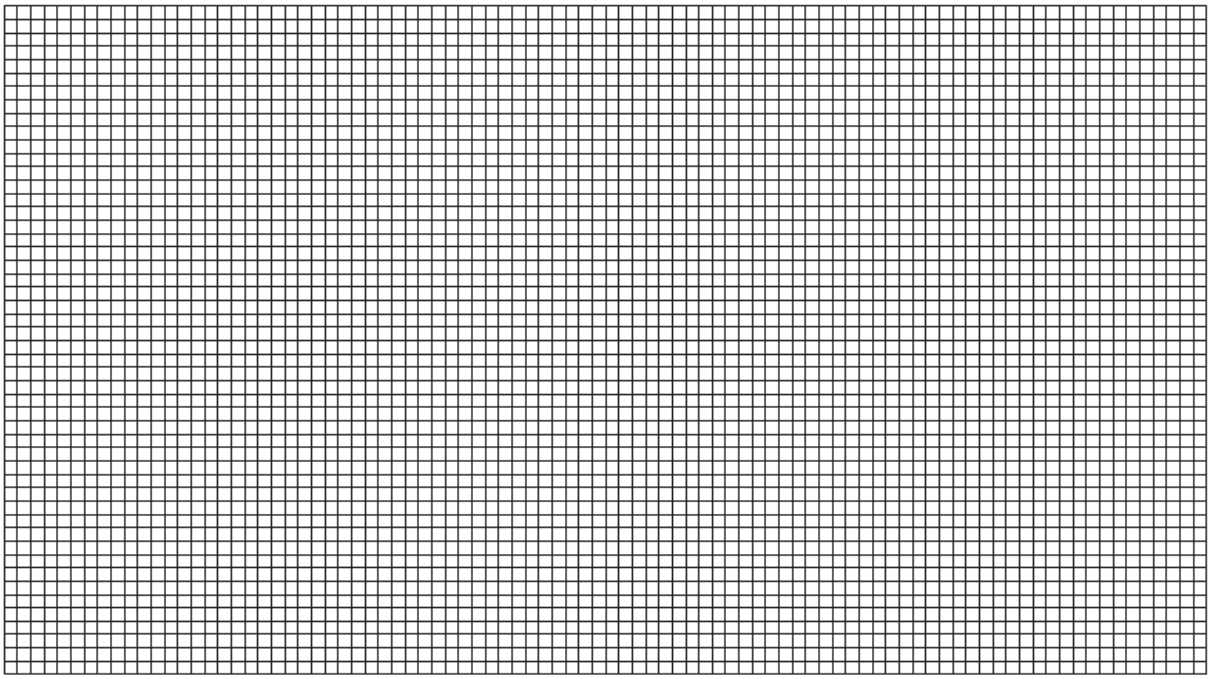
**(iii)** Use the grid and the data in Table 2.1 to plot a line graph showing the frequency of normal mitosis at each concentration of the organo-mercury compound.



[3]

**(c) (i)** Suggest an explanation for the effect of organo-mercury compounds on mitosis.

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**(ii)** The data in this investigation was considered to be reliable.

Suggest **one** reason why this is so.

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[Total: 10]