Root Tip Squash and Mitosis (Core Practical 5): Edexcel SNAB A Level Biology Exam Questions

13 questions · 49 marks · about 59 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 2 · October 2020 · Q3(b) · 4 marks

(b) Cell division in a plant such as an onion can be observed using a light microscope.

Explain why the following techniques are used when producing a root tip squash to observe cell division.

(4)

Adding hydrochloric acid to the root tip

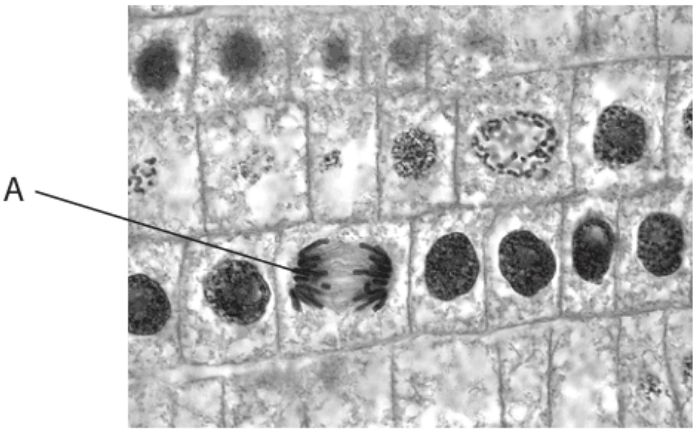
Adding a stain to the root tip

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Question 2 · information from earlier in the question

4 Stages of cell division in plant tissue can be observed using a light microscope.

The image shows the result of a root tip squash.



(Source: AL1323910 – Jose Luis Calvo / Shutterstock / PAL)

Question 2 · AS Paper 2 · November 2021 · Q4(a)(iii) · 3 marks

(iii) Describe how a slide can be prepared from a root tip sample to produce this image.

(3)

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Question 3 · A level Paper 1 · June 2023 · Q4(a)(ii) · 3 marks

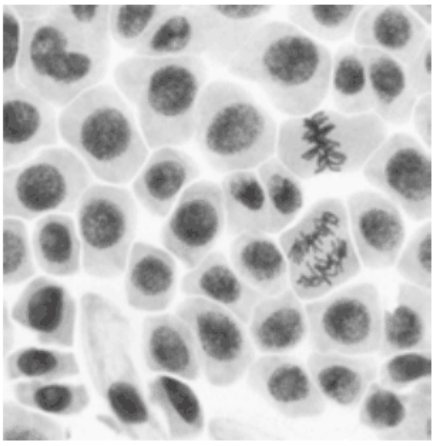
(ii) Describe how other plant tissues can be prepared to find out if the cells are undergoing mitosis.

(3)

Question 4 · AS Paper 2 · June 2017 · Q5(a)(i) · 2 marks

5 Cell division can be affected by various chemicals. The effects of these chemicals can be studied by observing tissues.

(a) The photograph shows onion root cells undergoing mitosis.



(i) Draw a line labelled **M** to one cell at metaphase and a line labelled **A** to one cell at anaphase.

(2)

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Question 5 · AS Paper 2 · June 2017 · Q5(a)(ii) · 2 marks

(ii) The rate at which cells are dividing can be determined by calculating the mitotic index.

The mitotic index is the percentage of cells in a sample undergoing mitosis.

The table shows the number of cells at different stages of the cell cycle in one sample.

Stage	Number of cells
Interphase	462
Prophase	23
Metaphase	24
Anaphase	4
Telophase	16

Calculate the mitotic index for the sample of cells shown in the table.

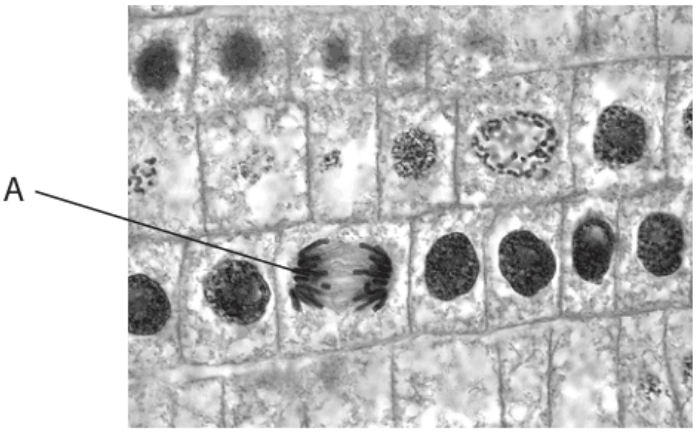
(2)

Answer ..... %

Question 6 · information from earlier in the question

4 Stages of cell division in plant tissue can be observed using a light microscope.

The image shows the result of a root tip squash.



(Source: AL1323910 – Jose Luis Calvo / Shutterstock / PAL)

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Question 6 · AS Paper 2 · November 2021 · Q4(a)(iv) · 2 marks

(iv) The mitotic index gives the percentage of cells in a sample undergoing mitosis.

Calculate the mitotic index for the 30 cells in this image.

(2)

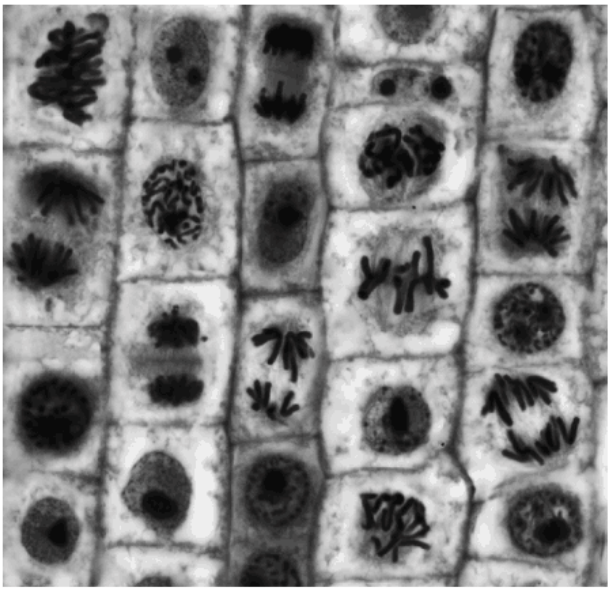
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Question 7 · AS Paper 2 · June 2024 · Q7(c) · 2 marks

(c) A mitotic index can be calculated to show the proportion of cells in a tissue undergoing mitosis.

The photograph shows a selection of cells in a tissue.



(Source: STEVE GSCHMEISSNER / SCIENCE PHOTO LIBRARY)

Calculate the mitotic index for the intact cells in the photograph using this formula.

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}} \times 100$$

(2)

Answer .....

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Question 8 · information from earlier in the question

(b) Herbicides are chemicals used to kill weeds. Some herbicides work by disrupting the cell cycle.

An investigation was carried out to study the effect of different concentrations of the herbicide Agil on mitosis in onion root tips.

The roots of onions were exposed to different concentrations of Agil for 24 hours.

Root tip squashes were then prepared and the mean mitotic index was calculated for each Agil concentration.

The results are shown in the table.

Agil concentration / ppm	Mean mitotic index (% ± SE)
0.0	40.7 ± 0.22
0.5	33.7 ± 0.32
1.0	31.1 ± 0.15
1.5	30.8 ± 0.19

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Question 8 · AS Paper 2 · June 2017 · Q5(b)(ii) · 6 marks

(ii) Devise an investigation to determine the effect of exposure time to Agil on the rate of mitosis in onion root tips.

(6)

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Question 9 · AS Paper 2 · June 2019 · Q3(b)(iii) · 5 marks

(iii) Devise an investigation to study the effect of temperature on the rate of nuclear division in a plant meristem.

(5)

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Question 10 · AS Paper 2 · June 2022 · Q4(b)(ii) · 5 marks

(ii) Devise an investigation to study the relationship between the distance from the tip of a root and the percentage of cells undergoing nuclear division.

(5)

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Question 11 · AS Paper 2 · June 2024 · Q7(d) · 5 marks

(d) Some plants grown for fruit have extra sets of chromosomes.

The table shows the chromosome number for three different species of strawberry plant.

Species	Chromosome number
Fragaria moschata	42
Fragaria orientalis	28
Fragaria chiloensis	56

Describe how root tip squashes can be used to find out if chromosome number affected mitosis in these species of strawberry plant.

(5)

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Question 12 · A level Paper 3 · June 2018 · Q4(c) · 5 marks

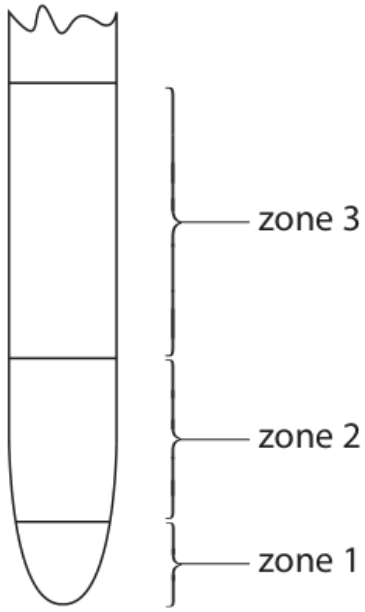
(c) It is claimed that the percentage of cells in a root tip undergoing mitosis during the day is different from the percentage during the night.

Devise an investigation to test this hypothesis.

(5)

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6 The diagram shows three different zones found in a plant root.



(a) Cells in zone 1 carry out interphase, mitosis and cytokinesis.

A student stated the hypothesis that:

In zone 1, the percentage of cells carrying out mitosis decreases from the tip to the start of zone 2.

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Question 13 · A level Paper 2 · June 2019 · Q6(a)(ii) · 5 marks

(ii) Devise an investigation to test this hypothesis.

(5)

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Mark schemes

Question 1 · AS Paper 2 · October 2020 · Q3(b) · 4 marks

Question Number	Answer
3(b)	An explanation that makes reference to four of the following: Adding hydrochloric acid • breaks down middle lamella (1) • allowing cells to be separated / produce a thin layer (of cells)(1) • to allow light to pass through (1) Adding stain • makes the chromosomes visible (1) • so that stages of mitosis can be identified (1)

Additional guidance	Mark
ALLOW one cell can be observed at a time	**(4)**

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Question 2 · AS Paper 2 · November 2021 · Q4(a)(iii) · 3 marks

Question Number	Answer
4(a)(iii)	A description that makes reference to the following: • description of use of appropriate part of the root tip (1) • an appropriately named stain (1) • details of root tip squash procedure (1)

Additional guidance	Mark
e.g. toluidine blue, (ethanoic) orcein e.g. use of hydrochloric acid to prepare tissue sample, maceration procedure, squashing under cover slip	**(3)**

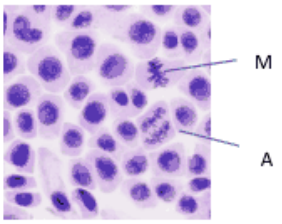
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Question 3 · A level Paper 1 · June 2023 · Q4(a)(ii) · 3 marks

Question Number	Answer
4(a)(ii)	An answer that makes reference to three of the following • tissue treated with hydrochloric acid (1) • tissue heated (1) • stained with {toluidine blue / (acetic) orcein} (1) • tissue {macerated / squashed } (1)

Additional guidance	Mark
ALLOW HCl IGNORE concentration of acid ALLOW other appropriate stains e.g. methylene blue ALLOW description	(3)

Question 4 · AS Paper 2 · June 2017 · Q5(a)(i) · 2 marks

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	• cell correctly labelled M **(1)** • cell correctly labelled A **(1)**		**(2)**

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Question 5 · AS Paper 2 · June 2017 · Q5(a)(ii) · 2 marks

Question Number	Answer
5(a)(ii)	• correct number of cells undergoing mitosis and correct total number of cells calculated • correct answer

Additional Guidance	Mark
Example of calculation 67 and 529 Correct % calculated = 12.665(%) / 12.67(%) / 12.7(%) Correct answer with no working gains full marks	(2)

Question 6 · AS Paper 2 · November 2021 · Q4(a)(iv) · 2 marks

Question Number	Answer
4(a)(iv)	• number of cells undergoing mitosis divided by total number of cells (1) • correct answer given as a percentage (1)

Additional guidance	Mark
Example of calculation 7 ÷ 30 = 23.3% Correct answer with no working gains full marks	(2)

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Question 7 · AS Paper 2 · June 2024 · Q7(c) · 2 marks

Question number	Answer
7(c)	• number of cells in mitosis identified (1) • correct calculation of mitotic index (1)

Additional guidance	Mark
<u>Example of calculation</u> 11 – 14 (out of 22-24 cells) ALLOW one mark ECF for correct calculation using other numbers of cells	(2)

	11	12	13	14
22	50.0	54.5	59.1	63.6
23	47.8	52.1	56.5	60.9
24	45.8	50.0	54.2	58.3

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Question 8 · AS Paper 2 · June 2017 · Q5(b)(ii) · 6 marks

Question Number	Answer
5(b)(ii)	An answer that makes reference to the following: • controlled concentration of Agil **(1)** • one other variable controlled **(1)** • roots exposed (to Agil) for a range of time intervals **(1)** • details of root tip squash procedure **(1)** • an appropriate named stain **(1)** • counting number of cells undergoing mitosis (to calculate mitotic index) **(1)**

Additional Guidance	Mark
e.g. temperature / onions of same type – age, source ALLOW root tips e.g. correct use of hydrochloric acid or maceration procedure e.g. toluidine blue / (acetic) orcein / Schiff's /methylene blue	**(6)**

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Question Number	Answer
3(b)(iii)	An answer that makes reference to five of the following: • grow plant in a suitable range of temperatures (1) • description of a suitable named variable to be controlled when growing the plants(1) • sample meristem tissue from same area of plant (1) • an appropriately named stain (1) • details of root tip squash procedure (1) • detail of how to compare number of cells undergoing nuclear division / calculate mitotic index (1)

Additional Guidance	Mark
e.g. a range up to 40°C e.g. plant {species / age } / growing conditions such as light, mineral ions, water, pH e.g. either root tips / shoot tips e.g. toluidine blue, (ethanoic) orcein e.g. use of hydrochloric acid to prepare tissue sample, maceration procedure, squashing under cover slip e.g. number of cells with {visible / condensed} chromosomes compared to the total	**(5)**

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Question 10 · AS Paper 2 · June 2022 · Q4(b)(ii) · 5 marks

Question Number	Answer
4(b)(ii)	An answer that makes reference to the following: • samples from different distances from the tip of the root taken (1) • measure distance from tip using an eyepiece graticule (1) • details of root tip squash procedure (1) • use of an appropriate named stain (1) • detail of how to assess percentage of cells undergoing mitosis (1)

Additional guidance	Mark
ALLOW sensible range of distances stated that could be measured with a ruler e.g. correct use of hydrochloric acid, maceration procedure, squashing to produce single layer of cells e.g. toluidine blue, (ethanoic) orcein e.g. count total number of cells and number of mitotic cells	(5)

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Question 11 · AS Paper 2 · June 2024 · Q7(d) · 5 marks

Question number	Answer
7(d)	A description that makes reference to five of the following: • strawberry plants of different species grown in same conditions (1) • (standardised) sample of root tips (1) • soften tissue with hydrochloric acid / tease tissue with mounted needle to separate cells / maceration of tissue (1) • use of named stain (to make chromosomes more visible) (1) • count number of cells visible under microscope and number of cells undergoing mitosis (1) • {calculate/compare} mitotic index for each species (1)

Additional guidance	Mark
e.g 5mm in length e.g. toluidine blue, (acetic) orcein	(5)

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Question Number	Answer
4(c)	An answer that makes reference to the following: • description of how {day and night / light and dark } conditions provided / collect root tips { during day and night / from plants grown in light and dark conditions } (1) Plus four of the following: • use same source of root tips (1) • controlled environmental variable in which plants grown (1) • use of appropriate named stain (1) • squash { under a coverslip / on a microscope slide } (1) • description of how comparison considered (1)

Additional Guidance	Mark
ALLOW same species / same variety / type Q / same plant / same age of plant e.g. temperature, humidity, mineral ion concentration e.g. (propionic) orcein, toluidine blue, Schiff's reagent, Feulgen's reagent ALLOW macerated or a description of maceration e.g. percentage of cells undergoing mitosis, mitotic index calculated	(5)

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Question 13 · A level Paper 2 · June 2019 · Q6(a)(ii) · 5 marks

Question Number	Answer
6(a)(ii)	An answer that makes reference to five of the following: • samples from different regions of zone 1 / samples from zone 1 and (start of) zone 2 (1) • details of root tip squash procedure (1) • use of an appropriate named stain (1) • detail of how to assess percentage of cells undergoing mitosis (1) • use of a named appropriate statistical test (1) • comparison of calculated value to critical value (to accept or reject the student's hypothesis) (1)

Additional Guidance	Mark
e.g. correct use of hydrochloric acid, maceration procedure, squashing to produce single layer of cells e.g. toluidine blue, (ethanoic) orcein e.g. number of cells with visible chromosomes compared to the total or use of mitotic index e.g. Spearman's rank correlation, or (Student's) T test (to compare two different regions)	**(5)**

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