Surname	Date	Tutor
First name(s)		

BioWelsh

GCE A LEVEL

BW-A2-4.2-W1

TOPIC WORKSHEET 1 – 4.2 PLANT REPRODUCTION

BIOLOGY – A2 unit 4

Variation, Inheritance and Options

Suggested time: 3 hours 15 minutes

For Tutor's use only

Question	Maximum Mark	Mark Awarded	Question	Maximum Mark	Mark Awarded
1.	9		9.	9	
2.	10		10.	10	
3.	10		11.	10	
4.	9		12.	9	
5.	10		13.	12	
6.	10		14.	9	
7.	9		15.	9	
8.	10		Total	145	

ADDITIONAL MATERIALS

In addition to this worksheet, you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name and the date in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you are working on screen, write your answers on paper and number each one clearly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question. The worksheet is out of **145** marks.

The assessment of the quality of extended response (QER) will take place in question **15**.

The quality of written communication will affect the awarding of marks.

This worksheet is written by BioWelsh in the style of the WJEC A level Biology examination, following the WJEC specification (topic 4.2). It is not an official WJEC paper.

Tutor only

Answer **all** questions.

1. A student dissected an insect-pollinated flower by cutting it lengthways with a scalpel. **Image 1.1** is a drawing of one half of the flower. It is not drawn to scale.

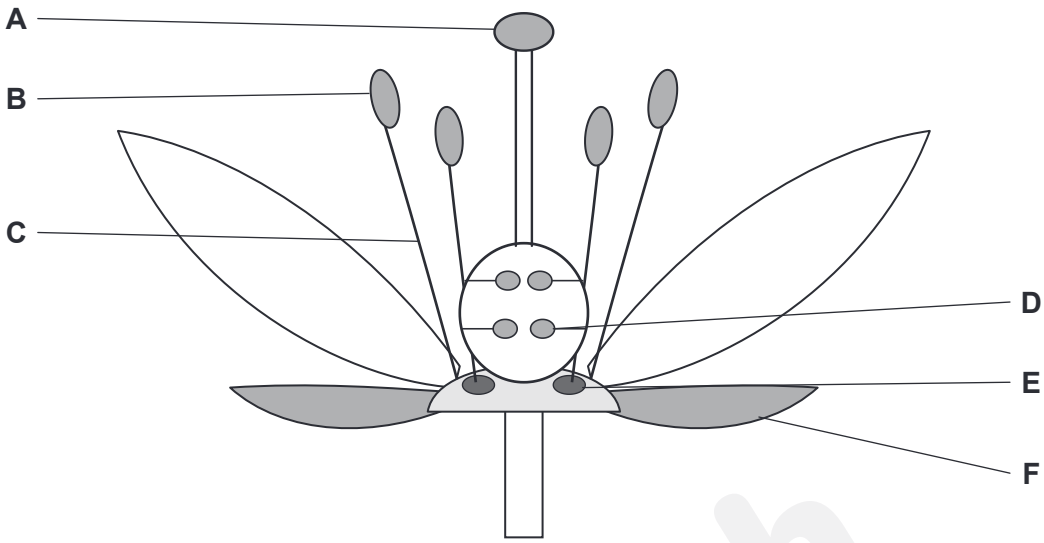

Image 1.1

(a) Identify the structures labelled **A** to **F**. [3]

A .....

B .....

C .....

D .....

E .....

F .....

(b) State the function of structure **E** and of structure **F**. [2]

E .....

F .....

(c) Explain why structures **A** and **B** are found in the positions shown in **Image 1.1** in an insect-pollinated flower. [2]

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Tutor only

(d) Describe how the student should carry out the dissection safely and record the parts of the flower accurately. [2]

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Tutor only

2. Ribwort plantain (*Plantago lanceolata*) is a wind-pollinated plant that is common in grassland across Wales. Its small flowers are packed on a spike at the end of a long stalk. **Image 2.1** shows one spike.

Image 2.1

(a) Name the structures labelled **P** and **Q**. [1]

P .....

Q .....

(b) Using **Image 2.1**, explain how **two** features of the flowers adapt them for wind pollination. [2]

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Tutor only

(c) Complete **Table 2.2** to compare the pollen of a wind-pollinated flower with the pollen of an insect-pollinated flower. [3]

Table 2.2

Feature	Wind-pollinated	Insect-pollinated
Size and mass of pollen grain	.....	.....
Surface of pollen grain	.....	.....
Amount of pollen made	.....	.....

(d) Ribwort plantain flowers from the bottom of the spike upwards. In each flower the feathery stigmas emerge and are receptive about two days before its anthers open. Explain how this reduces self-pollination. [2]

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(e) Explain the advantage to ribwort plantain of cross-pollination. [2]

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Tutor only

3. **Image 3.1** is a drawing of a transverse section through a mature anther.

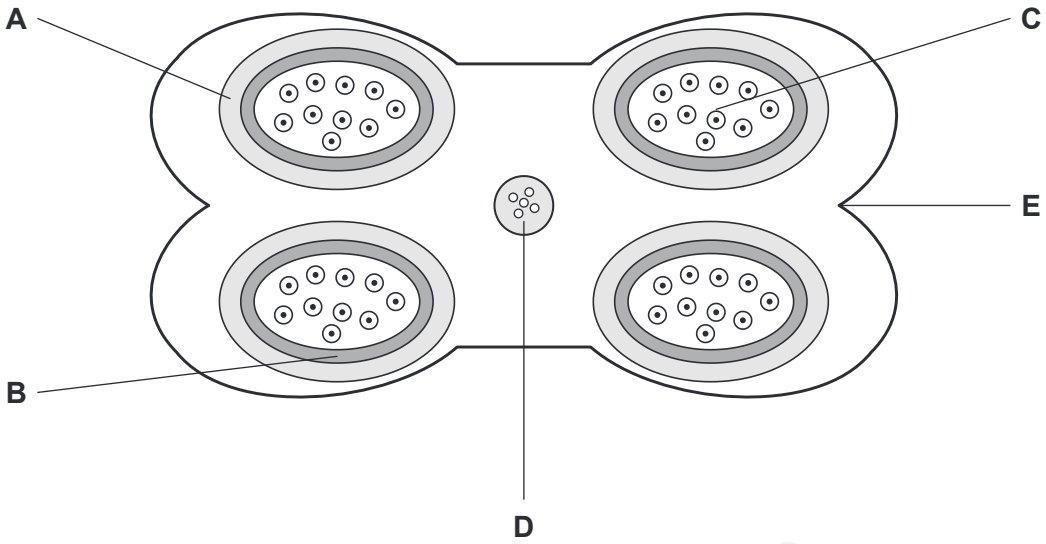

Image 3.1

(a) Identify the structures labelled **A**, **B**, **C** and **D**. [2]

A .....

B .....

C .....

D .....

(b) State the function of **B**. [1]

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(c) Explain how the anther splits open along line **E** to release its pollen. [2]

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Tutor only

Image 3.2 is a light micrograph of cells taken from a developing anther of a lily. **T** is a tetrad of four cells. **G** is a pollen grain.

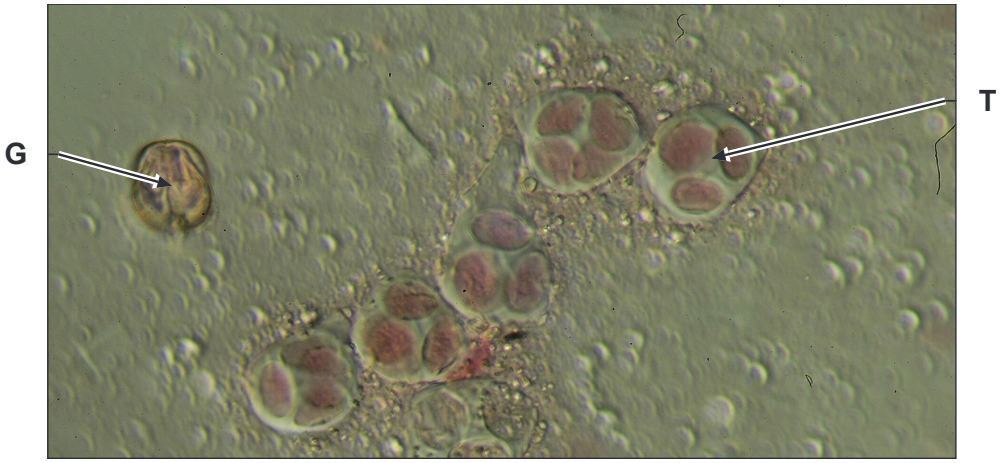

Image 3.2

(d) (i) Name the type of cell that divided to form tetrad **T** and the type of division. [2]

Cell .....

Division .....

(ii) Lily cells have 24 chromosomes. State the number of chromosomes in one cell of tetrad **T**. [1]

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(iii) Before pollen grain **G** is released, its nucleus divides. Name this division and the **two** nuclei formed. [2]

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Tutor only

4. A student made a low power plan of a transverse section of an anther from a prepared slide. **Image 4.1** shows the plan.

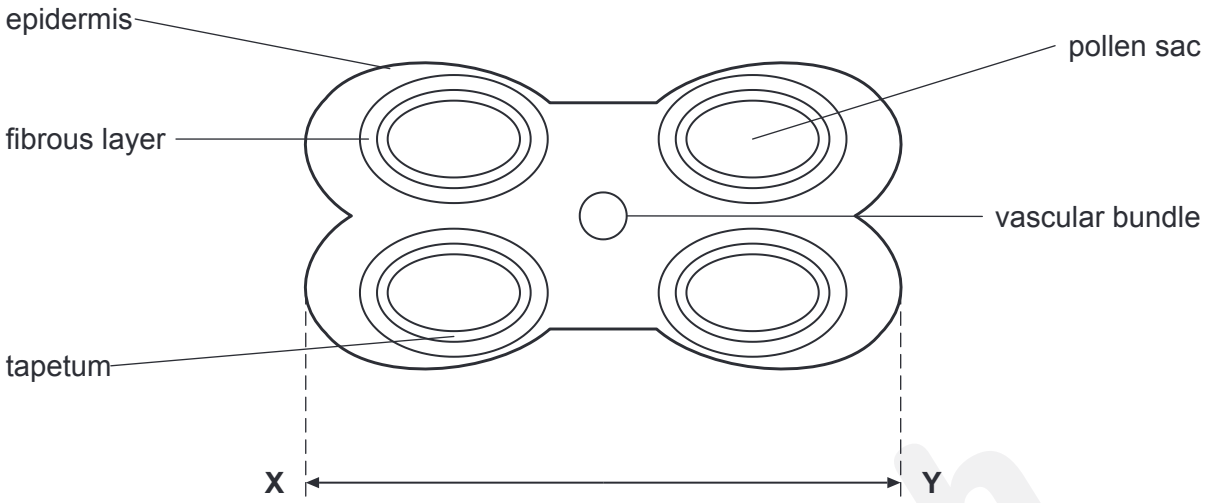

Image 4.1

(a) State **two** features of the drawing in **Image 4.1** that show it is a low power plan. [2]

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The student calibrated the eyepiece graticule with a stage micrometer. Using the low power objective lens, 100 eyepiece units matched 2.5 mm on the stage micrometer. The width of the anther from **X** to **Y** was 48 eyepiece units.

(b) (i) Calculate the actual width of the anther from **X** to **Y** in µm. [2]

Actual width = ... µm

Tutor only

(ii) On the student's original drawing, the distance from **X** to **Y** was 120 mm. Calculate the magnification of the drawing. [2]

Magnification = × .....

(iii) Explain why the eyepiece graticule must be calibrated again if the student changes to the high power objective lens. [2]

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(c) The student's teacher said that a plan of one anther is not enough to state the typical width of anthers of this species. Suggest how the student could improve the estimate. [1]

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Tutor only

5. **Image 5.1** is a light micrograph of a transverse section through part of the ovary of a lily flower.

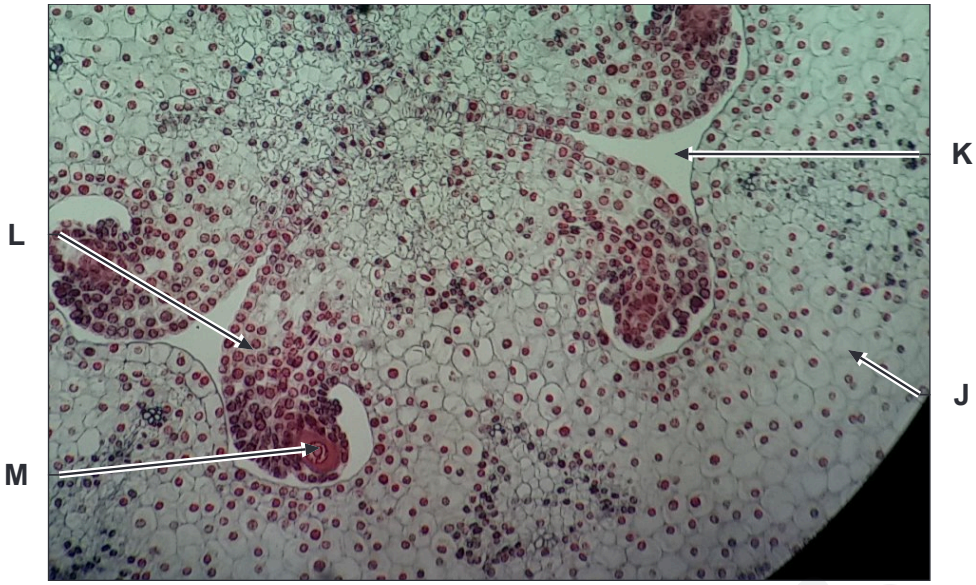

Image 5.1

(a) Identify the structures labelled **J**, **K** and **L**. [2]

J .....

K .....

L .....

Tutor only

Cell **M** is a large cell in the nucellus of an ovule. **Image 5.2** shows how the embryo sac develops in most flowering plants.

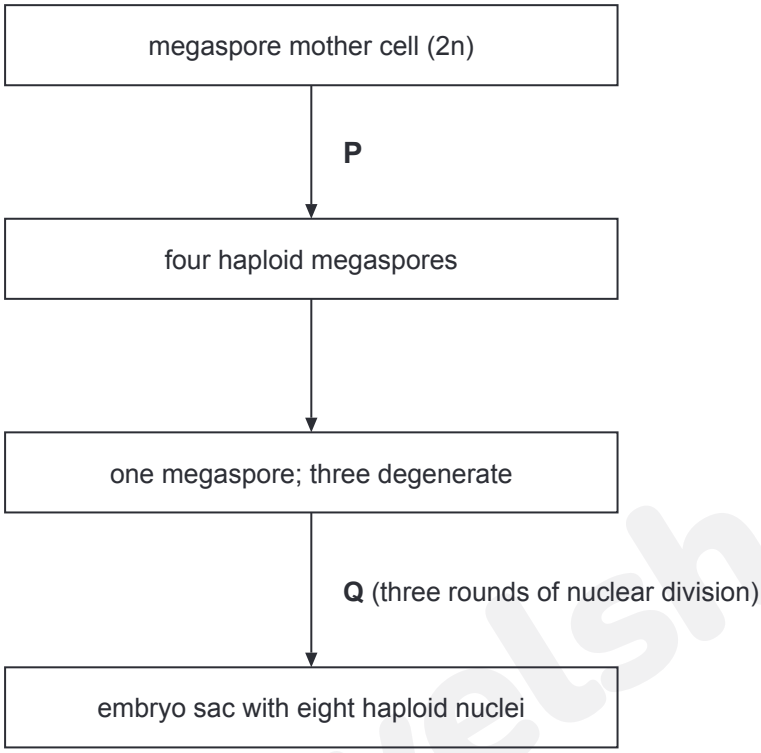

Image 5.2

(b) (i) Name the types of division labelled **P** and **Q**. [2]

P .....

Q .....

(ii) A flowering plant has 24 chromosomes in each body cell. Complete **Table 5.3** to show the number of chromosomes in each cell or nucleus. [2]

Table 5.3

Cell or nucleus	Number of chromosomes
megaspore mother cell	.....
one megaspore	.....
egg cell (female gamete)	.....
one polar nucleus	.....

Tutor only

(iii) State the names and positions of **three** types of cell or nucleus found in the mature embryo sac. [3]

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(c) In most flowering plants, pollen development and embryo sac development both involve meiosis. Give **one** difference between them in the number of functional cells produced from each cell that undergoes meiosis. [1]

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Tutor only

6. Field beans (*Vicia faba*) can self-pollinate, but their flowers are also visited by bumblebees. Researchers grew four groups of 20 plants in a field. **Table 6.1** shows the mean results for each group.

Table 6.1

Group	Treatment of flowers	Mean pods per plant	Mean seeds per pod
1	open to bees	14.2	3.4
2	covered with mesh bags to keep insects out	6.1	2.9
3	bagged; pollen from the same plant placed on the stigmas	7.0	3.0
4	bagged; pollen from a different plant placed on the stigmas	14.8	3.6

(a) Define the terms self-pollination and cross-pollination. [2]

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(b) Calculate the percentage decrease in the mean number of pods per plant when insects were kept out (group 2 compared with group 1). Give your answer to **1 decimal place**. [2]

Percentage decrease = ... %

(c) Explain why group 3 was included in this investigation. [2]

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(d) Use **Table 6.1** to explain the importance of bees for pod and seed production in field beans. [3]

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Tutor only

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(e) Suggest **one** advantage to a plant of being able to self-pollinate. [1]

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Tutor only

7. A student investigated the effect of sucrose concentration on the growth of pollen tubes. Pollen from the same flower was placed in drops of sucrose solution on cavity slides and kept at 25 °C. After 2 hours the lengths of the pollen tubes were measured using an eyepiece graticule. **Table 7.1** shows the lengths of five pollen tubes in 15 % sucrose solution.

Table 7.1

Pollen tube	1	2	3	4	5	Mean
Length / μm	480	530	505	545	490	.....

(a) Complete **Table 7.1** by calculating the mean length. [1]

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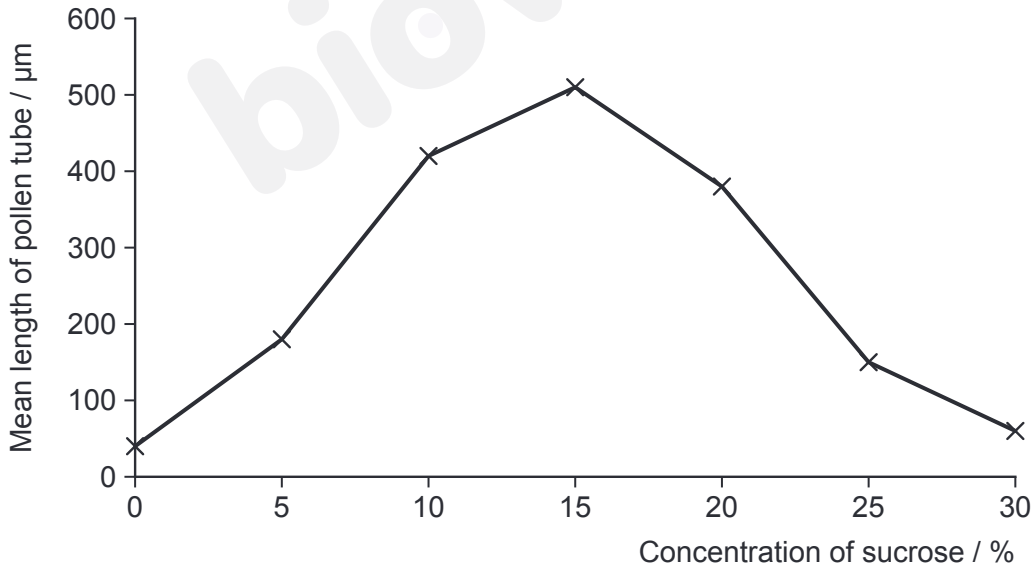
(b) Calculate the mean rate of growth of the pollen tubes in 15 % sucrose solution in μm minute^{-1}. [2]

Rate = ... μm minute^{-1}

Graph 7.2 shows the mean pollen tube length after 2 hours at each concentration of sucrose.



Graph 7.2

Tutor only

(c) (i) Suggest why pollen tubes grew very little in 30 % sucrose solution. [2]

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(ii) State **two** variables, apart from temperature, that the student should have controlled. [2]

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(d) In a flower, the tip of the pollen tube grows from the stigma to the micropyle. Describe the role of the tube nucleus and of the two male nuclei in this process. [2]

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Tutor only

8. **Image 8.1** shows a mature ovule of maize with a pollen tube growing into it. It is not drawn to scale.

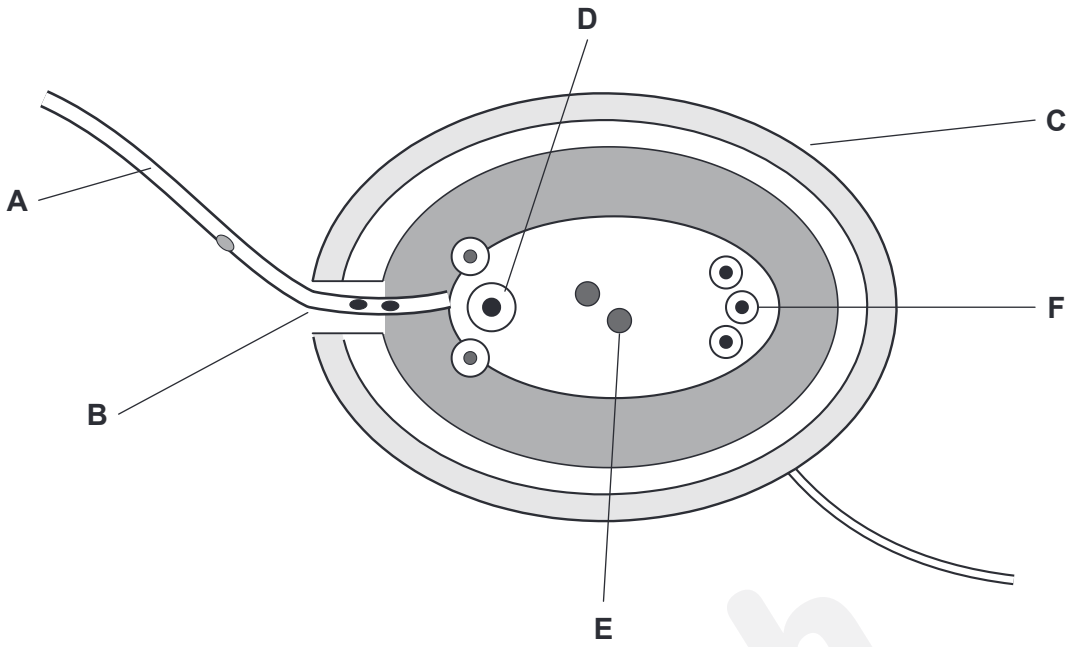

Image 8.1

(a) Identify **A** to **F**. [3]

A .....

B .....

C .....

D .....

E .....

F .....

(b) Describe the events of double fertilisation in this ovule. [3]

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Tutor only

(c) Maize has 20 chromosomes in each leaf cell. Complete **Table 8.2**. [2]

Table 8.2

Cell or nucleus	Number of chromosomes
male nucleus	.....
zygote	.....
endosperm nucleus	.....

(d) After fertilisation the maize ovary develops into a grain. Name the part of the flower that becomes the pericarp of the grain, and the structure in **Image 8.1** from which the endosperm develops. [2]

Pericarp .....

Endosperm .....

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Tutor only

9. **Image 9.1** shows two views of a broad bean (*Vicia faba*) seed that had been soaked in water.

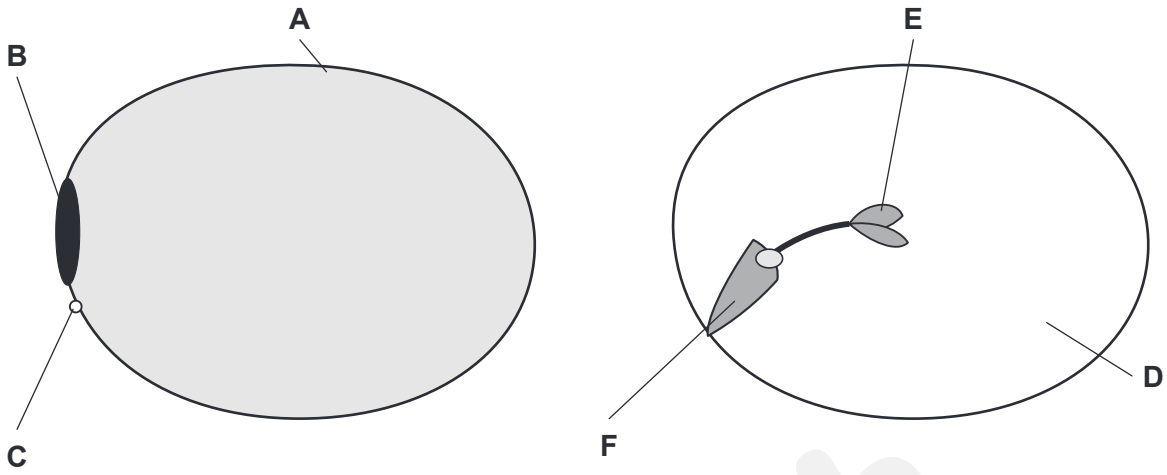

Image 9.1

(a) Identify the structures labelled **A** to **F**. [3]

A .....

B .....

C .....

D .....

E .....

F .....

(b) The broad bean is a non-endospermic seed. Explain what this means. [2]

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Tutor only

(c) A dry broad bean seed had a mass of 1.60 g. After soaking in water for 24 hours, its mass was 3.28 g. Calculate the percentage increase in mass. [2]

Percentage increase = ... %

(d) Explain why the uptake of water is the first step in germination. [2]

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Tutor only

10. **Image 10.1** is a drawing of a longitudinal section through a maize grain.

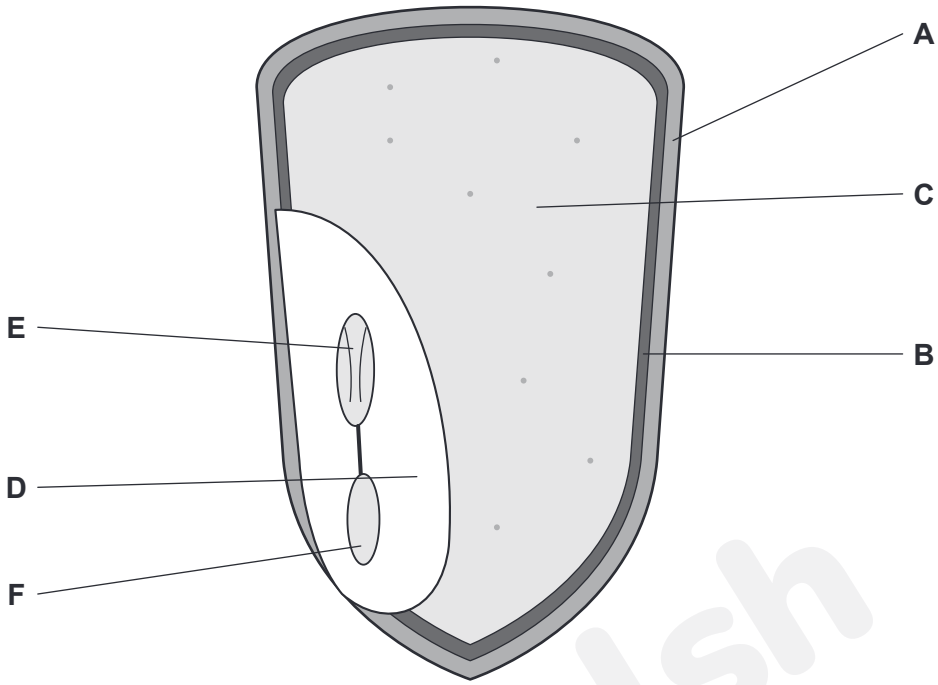

Image 10.1

(a) Identify the structures labelled **A** to **F**. [3]

A .....

B .....

C .....

D .....

E .....

F .....

(b) A maize grain is a fruit, not a seed. Use **Image 10.1** to explain why. [2]

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Tutor only

(c) Complete **Table 10.2** to compare the maize grain with the broad bean seed. [2]

Table 10.2

Feature	Maize grain	Broad bean seed
Main food store	.....	.....
Number of cotyledons	.....	.....

Image 10.3 shows cobs of a sweet corn variety with yellow and white kernels. Each kernel is one grain. The colour of a kernel is the colour of its endosperm.

Image 10.3

(d) Explain why kernels on the same cob can be different colours. [3]

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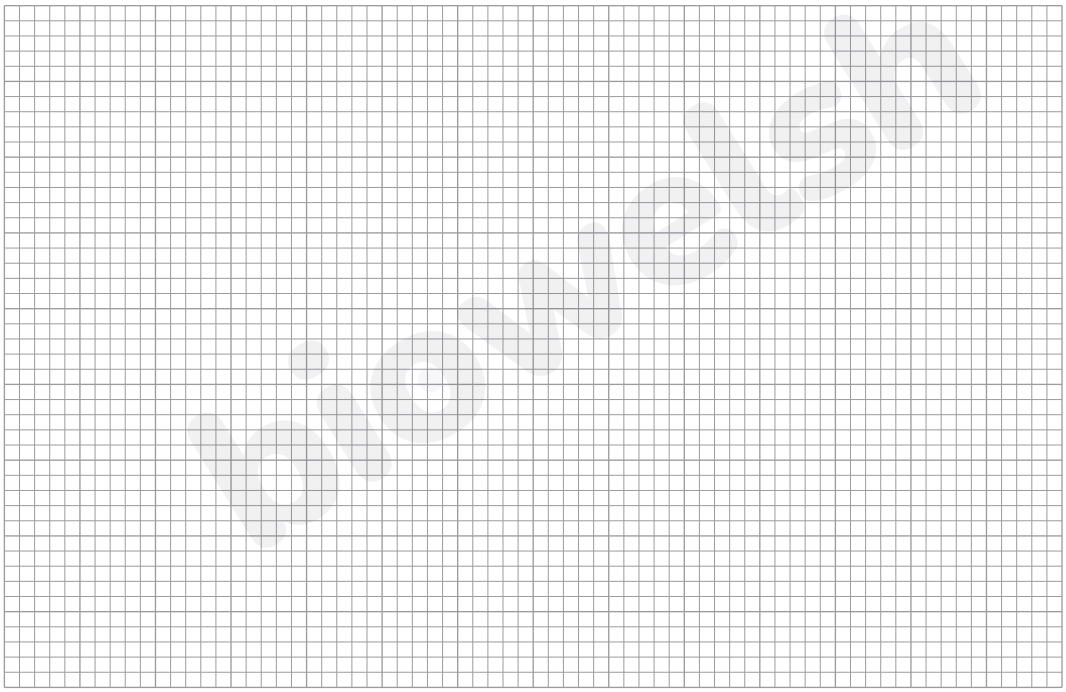
Tutor only

11. Broad bean seeds were soaked and allowed to germinate in the dark at 20 °C. Every two days, ten seedlings were removed and separated into cotyledons and embryo axis (plumule and radicle). Each part was dried at 80 °C until its mass stayed the same. **Table 11.1** shows the mean dry mass of each part per seedling.

Table 11.1

Time / days	0	2	4	6	8	10	12	14
Dry mass of cotyledons / g	1.40	1.38	1.30	1.16	0.98	0.80	0.64	0.52
Dry mass of embryo axis / g	0.02	0.02	0.05	0.12	0.22	0.33	0.44	0.52

(a) Plot a graph of the data in **Table 11.1** on the grid below. Plot both sets of data on the same axes and join the points with straight lines. [4]



(b) Explain why the samples were dried until their mass stayed the same. [1]

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(c) Explain the changes in dry mass of the cotyledons and of the embryo axis between day 4 and day 14. [3]

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Tutor only

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(d) Calculate the total dry mass lost by each seedling between day 0 and day 14, and explain why this mass was lost. [2]

Dry mass lost = ... g

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Tutor only

12. Groups of 50 broad bean seeds were kept under different conditions for 10 days. **Table 12.1** shows the percentage of seeds that germinated in each group.

Table 12.1

Group	Conditions	Germination / %
A	moist cotton wool, 20 °C, in the dark	92
B	dry cotton wool, 20 °C, in the dark	0
C	moist cotton wool, 20 °C, in the light	90
D	moist cotton wool, 4 °C, in the dark	6
E	under boiled, cooled water covered with oil, 20 °C, in the dark	0

(a) Explain why the water in group **E** was boiled and then covered with a layer of oil. [2]

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(b) Use **Table 12.1** to explain why seeds need oxygen and a suitable temperature to germinate. [3]

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(c) A student concluded that broad bean seeds germinate better in the dark. Evaluate this conclusion. [2]

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Tutor only

(d) In broad beans, the cotyledons stay below the soil during germination and the radicle emerges before the plumule. Explain the advantage of the radicle emerging first. [2]

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Tutor only

13. A student investigated how the activity of amylase in barley grains changes as the grains germinate. Grains were soaked in water for 0 to 5 days. Each day, three grains were cut in half and each half-grain containing an embryo was placed cut side down on starch agar in a Petri dish. After 48 hours at 25 °C, the half-grains were removed and iodine solution was poured over the agar. **Image 13.1** shows one plate.

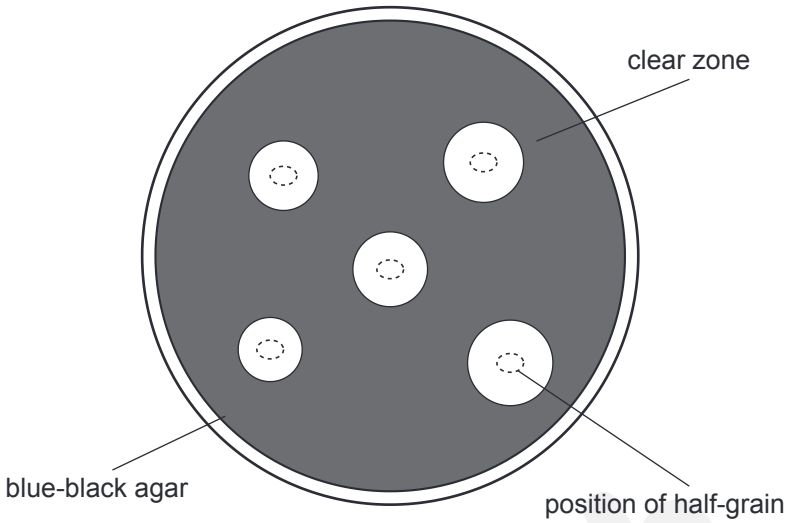

Image 13.1

(a) Explain why a clear zone forms around the position of each half-grain. [2]

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Table 13.2 shows the diameters of the clear zones, in mm.

Table 13.2

Time soaked / days	Grain 1	Grain 2	Grain 3	Mean
0	0	0	0	0.0
1	4	3	5	4.0
2	9	8	10	9.0
3	14	15	25	.....
4	18	20	19	19.0
5	22	21	23	22.0

Tutor only

(b) (i) Identify the anomalous result in **Table 13.2** and calculate the mean for day 3. [2]

Anomalous result .....

Mean for day 3 .....

(ii) Calculate the area of the clear zone for the mean diameter on day 5. Use area = πr^2. Give your answer to **3 significant figures**. [2]

Area = ... mm^2

(c) Describe a suitable control for this investigation and explain its purpose. [2]

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(d) Explain why the size of the clear zone increased with the time the grains were soaked. [3]

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(e) Suggest **one** limitation of using the diameter of the clear zone to compare amylase activity. [1]

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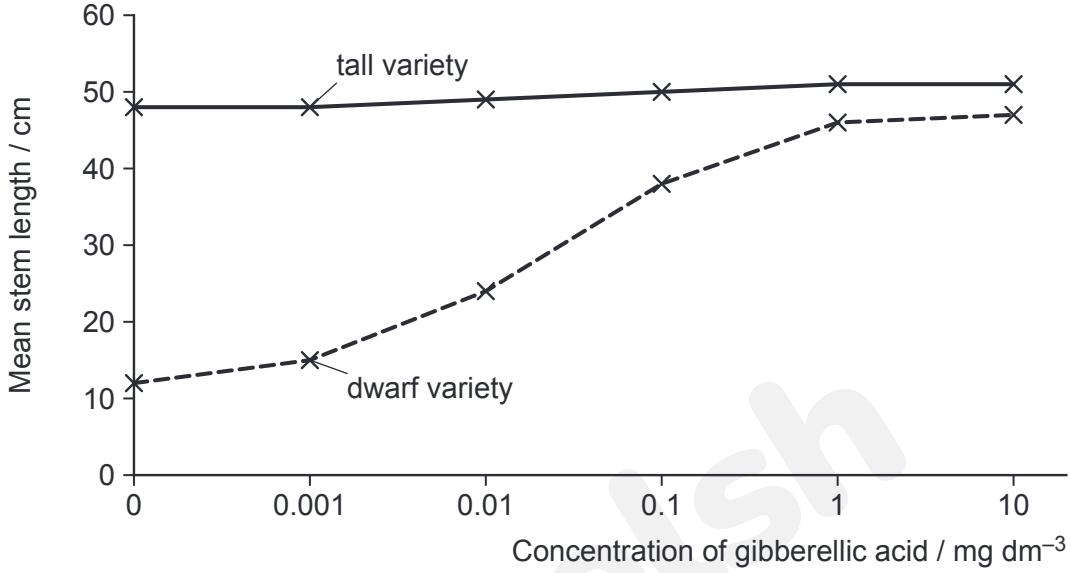
12

Tutor only

14. Some varieties of pea are dwarf because a mutation means they make very little active gibberellin. Seedlings of a dwarf variety and a tall variety were sprayed with different concentrations of gibberellic acid. **Graph 14.1** shows the mean stem length after four weeks.



Graph 14.1

(a) Calculate the percentage increase in mean stem length of the dwarf variety sprayed with 1 mg dm^{-3} gibberellic acid compared with no gibberellic acid. [2]

Percentage increase = ... %

(b) Describe **and** explain the effect of gibberellic acid on the dwarf variety. [3]

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(c) Suggest why the tall variety showed very little response. [1]

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Tutor only

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(d) The concentrations of gibberellic acid on the x-axis increase by a factor of ten each time. Suggest why the researchers chose this range of concentrations. [2]

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(e) Gibberellin also affects germinating seeds. State the effect of gibberellin in a germinating barley grain. [1]

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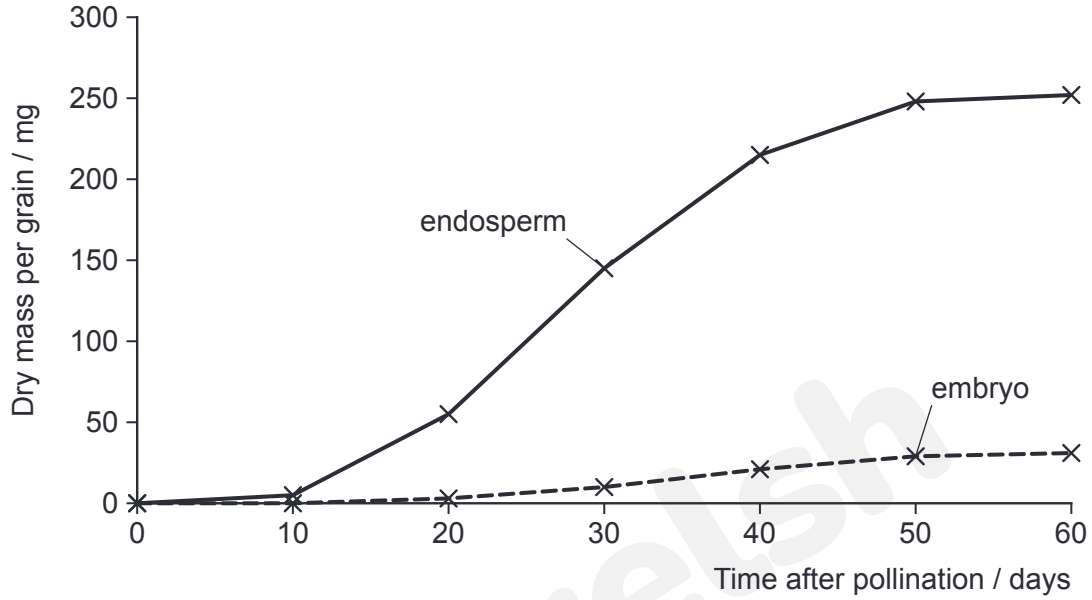
Tutor only

15. Farmers grow F1 hybrid maize, produced by crossing two different parent lines. Maize has separate male and female flowers on each plant: the tassel at the top of the stem carries the male flowers, and the cob lower down carries the female flowers, each with a long silky style. To produce hybrid seed, rows of the two lines are planted side by side and the tassels are removed from one line before they shed pollen. **Graph 15.1** shows the dry mass of the endosperm and of the embryo in the grains on the cob after pollination.



Graph 15.1

Describe how the flowers of maize are adapted for wind pollination and explain how removing the tassels from one line ensures that all the seed on those plants is hybrid. Describe the process of double fertilisation in the ovule. Use **Graph 15.1** to describe how the grain develops after pollination, and explain how the stores in the endosperm are used when the grain germinates. [9 QER]

Tutor only

END OF WORKSHEET

9

A Tutor Meets Tutee project

BioWelsh worksheets are written and checked by Tutor Meets Tutee tutors for WJEC A level Biology students.

Mark this worksheet with the BioWelsh mark scheme **BW-A2-4.2-W1** (MS).

Acknowledgements

Image 2.1: Photo: Harry Rose, CC BY 2.0 (Wikimedia Commons, 'Plantago lanceolata flowerhead2'), https://creativecommons.org/licenses/by/2.0. Cropped; letters and label lines added.

Image 3.2: Micrograph: Massimo Vischi, CC BY 4.0 (Wikimedia Commons, 'Tetrad footprints'), https://creativecommons.org/licenses/by/4.0. Letters and label lines added.

Image 5.1: Micrograph: Ilse Anahi Carrasco, CC BY 4.0 (Wikimedia Commons, 'Lilium Ovary 10x-.25'), https://creativecommons.org/licenses/by/4.0. Cropped; letters and label lines added.

Image 10.3: Photo: Nutrition, Food Safety & Health, CC0 (Wikimedia Commons, 'Corn on the cob (sweet corn)').