

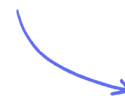
Structured Questions: Paper 2

9.4 Reproduction in Plants

9.4.1 Flowering / 9.4.2 Plant Reproduction / 9.4.3 Skills: Drawing Plant Structures / 9.4.4 Skills: Investigating Factors Affecting Germination

Easy (5 questions)	/49
Medium (5 questions)	/45
Hard (5 questions)	/43
Total Marks	/137

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Easy Questions

- 1 (a) State the name of the phase of a plant's life in which it may be reproducing asexually but not sexually.

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(1 mark)

- (b) Describe the process that takes place in the shoot apical meristem when a flowering plant enters the reproductive stage.

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(2 marks)

- (c) State the name of the type of pigment in the leaf that plays a role in detecting ambient light levels.

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(1 mark)

- (d) The response of plants to a stimulus like night length causes levels of transcription factors to alter within the plant cells' nuclei.

Define the term transcription factor in this context.

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(2 marks)

2 (a) Explain why active phytochrome (P_{fr}) is more present towards the end of the day in the leaves of short-day flowering plants.

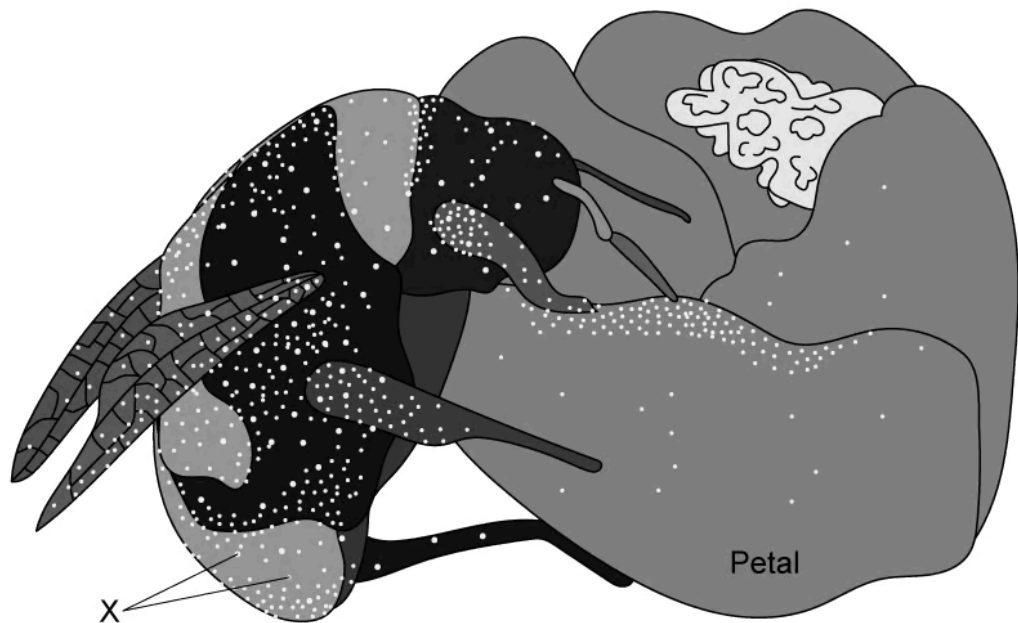
(2 marks)

(b) State **two** possible benefits to humans of being able to manipulate the flowering times of plants.

(2 marks)

(c) The image below shows a bee feeding on nectar from a flower.

(i) Identify the small specks indicated **X**.



[1]

(ii) Explain how the flower benefits from feeding nectar to insects such as bees.

[2]

(3 marks)

(d) State the name of the type of relationship that exists between the bee and the flower in part c) of this question.

(1 mark)

3 (a) Gregor Mendel's landmark experiments on the basis of genetic inheritance, involved the flowering plant the sweet pea (*Lathyrus odoratus*). In these experiments, Mendel transferred the male sexual organs of certain plants to the female sexual organs of separate plants as a way of performing crosses.

Before completing the transfer, he cut away the male sexual organs of the recipient plants before the transfer.

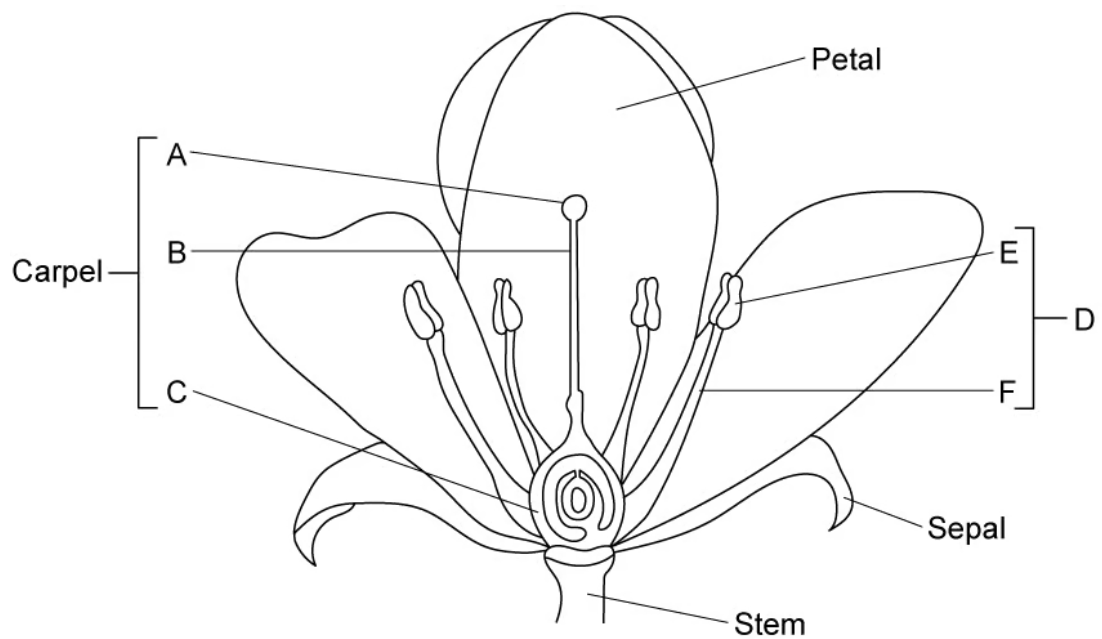
Explain why.

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(2 marks)

(b) The image below shows a flower.



Label the parts **A - F** indicated.

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(6 marks)

(c) State the name of the part of the flower shown in part b) that receives pollen during sexual reproduction.

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(1 mark)

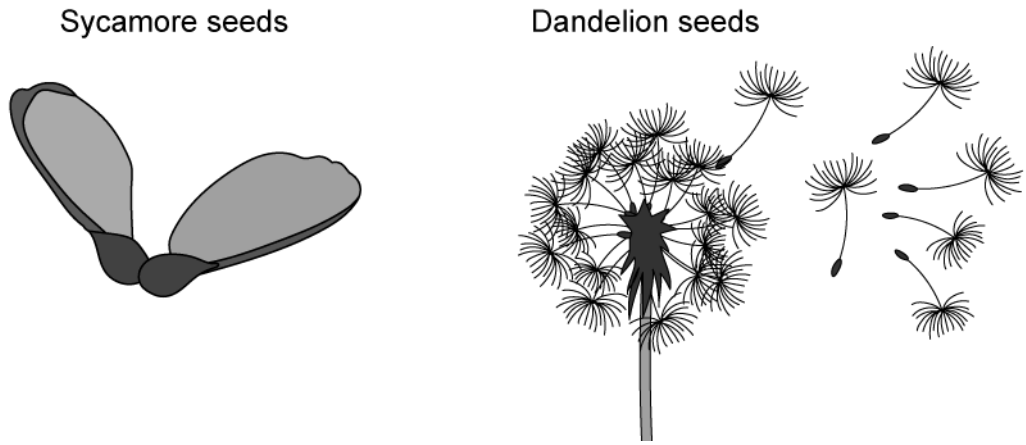
(d) State the principal purpose of the:

(i) Petals

(ii) Sepal

.....
.....
(2 marks)

4 (a) The diagram below shows two types of seed; sycamore and dandelion.



State the method by which these seeds are dispersed and in each case, **one** adaptation of the seed that allows effective dispersal.

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(3 marks)

(b) Seeds such as those shown in part a) are more effective if they can be dispersed far away from the parent plant.

Explain why.

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(2 marks)

The coco de mer is a seed that comes from a type of palm tree native to the Seychelles. *Lodoicea maldivica* is the species that produces the largest seeds known in nature. One such seed was found that had a mass of 25kg. To show the scale, a coco de mer seed is pictured below in the hands of a human.

(c)



Suggest why some plants like the dandelion and sycamore have small, lightweight seeds whereas others produce huge seeds like the coco de mer.

(2 marks)

(d) Describe how seeds found in fruit such as apple pips are dispersed.

(2 marks)

5 (a) One mark is available for clarity of communication throughout this question.

Outline the relationship between levels of inactive phytochrome (P_r) and active phytochrome (P_{fr}) in long-day flowering plants.

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(4 marks)

(b) Draw a labelled diagram of a seed in cross-section.

A suggested example is a bean seed such as the common bean, *aka* French bean.

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(6 marks)

(c) Farmers and landowners are being encouraged to plant hedgerows and grow wildflower meadows amongst their productive crop-bearing farmland.

Explain why.

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(5 marks)

Medium Questions

- 1 (a)** The life cycle of a flower involves a vegetative phase, during which the plant may be able to reproduce asexually, and a reproductive phase, during which sexual reproduction is possible.

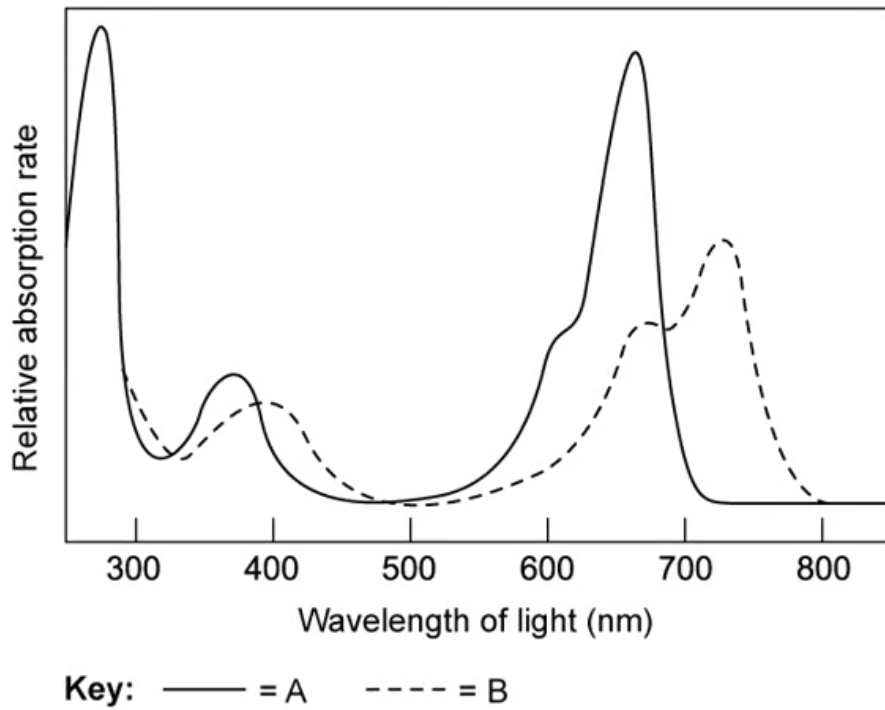
Contrast asexual and sexual reproduction.

(2 marks)

- (b)** Explain the importance of the length of the night in controlling flowering in plants.

(2 marks)

- (c)** The following graph illustrates the relative absorption rate of two important pigments (**A** and **B**) that control flowering in plants.



Identify, with reasons, pigments **A** and **B**.

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(2 marks)

(d) Describe the conversion between pigment **A** and **B** that would take place over the course of 24 hours.

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(2 marks)

2 (a) Poinsettias are short-day plants that are popular in Christmas floral decorations.

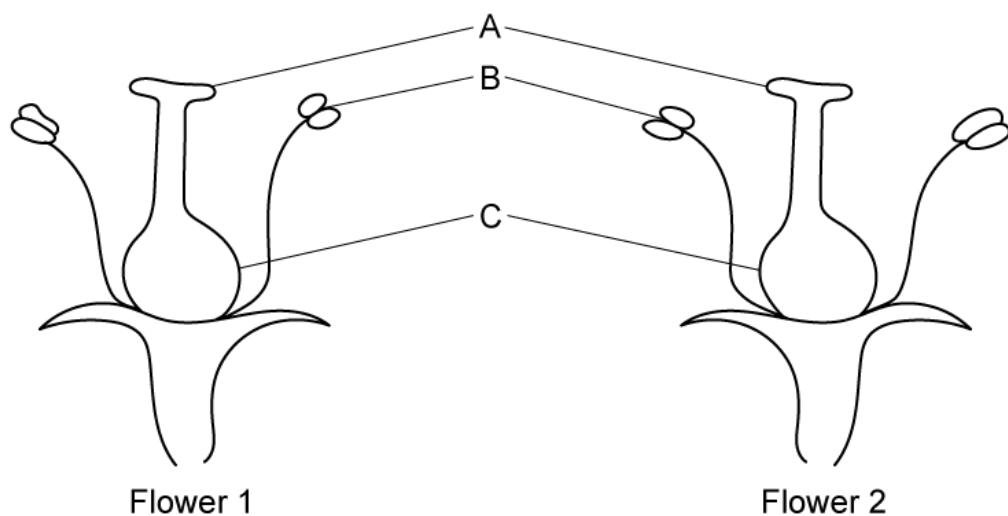
State how poinsettias can be induced to flower in the Southern Hemisphere where it will be summer at Christmas time.

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(1 mark)

(b) Explain why the relationship between flowering plants and pollinators can be considered mutualistic.

.....
.....
(2 marks)

(c) The following diagram shows the reproductive parts of two flowers of the same species.



Identify structures **A** to **C** and state how each contributes to the process of sexual reproduction in the plant.

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.....
.....

(3 marks)

3 (a) Pollination is the first step in sexual reproduction in plants.

Describe the events that occur after a pollen grain lands on the stigma of a flower until fertilisation happens.

(3 marks)

(b) The following table shows the number of honey bee colonies documented by a beekeeper on a farm from 2008 to 2018.

Year	Number of living colonies
2008	36
2010	34
2012	22
2014	23
2016	27
2018	21

Calculate the percentage decrease in bee colonies from 2008 to 2018.

(2 marks)

(c) Describe the impacts that a decline in pollinators would have on the wider ecosystem.

(3 marks)

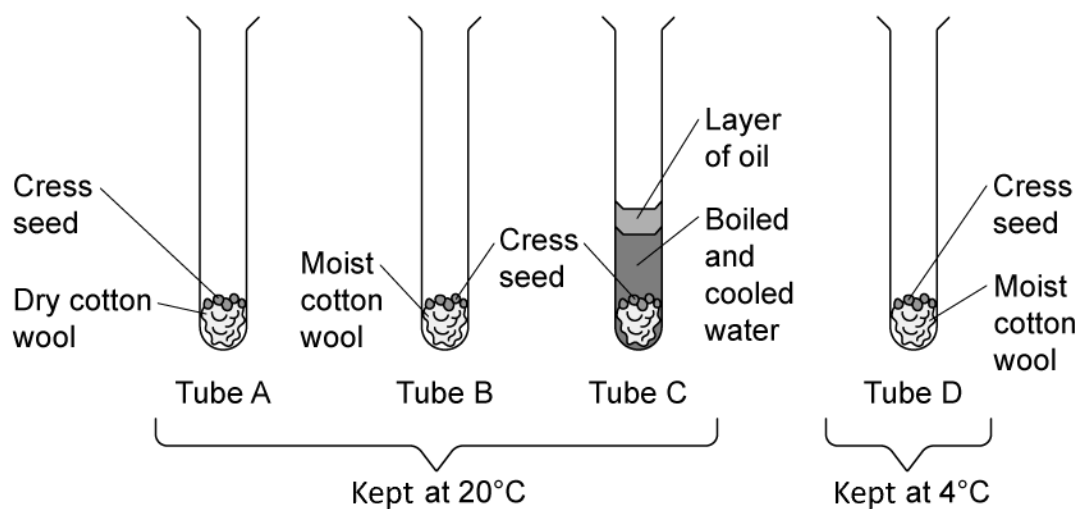
4 (a) Draw a labelled diagram of the internal structure of a dicotyledonous seed.

(4 marks)

(b) State the main function of gibberellin in enabling seed germination.

(1 mark)

(c) The following investigation was set up to determine the conditions needed for germination.



Identify the control in this experiment and explain the importance of including this test tube in the investigation.

(2 marks)

- (d) Explain why no seeds would germinate if test tube **D** from the investigation at c) was placed in an environment with a temperature of 45°C.

(1 mark)

5 (a) *One mark is available for clarity of communication throughout this question.*

Outline the role of phytochrome in controlling flowering in long day plants.

(7 marks)

(b) Outline the adaptations of seeds with different methods of seed dispersal in flowering plants.

(3 marks)

(c) State and explain the factors that growers must consider when growing crops in order to maximise crop yield.

(5 marks)

Hard Questions

1 (a) A group of insects called flower thrips includes the species *Frankliniella intonsa*, as shown in the image below.



Adult *F. intonsa* flower thrips pollinate flowers of the genus *Stellera* in central and southern Asia. In return for the pollination it receives, *Stellera* provides sites for *F. intonsa* to lay their larvae (young).

State how this differs from a more conventional insect-flower mutualistic relationship.

(2 marks)

(b) Changes to abiotic conditions such as those caused by climate change can disrupt mutualism between pollinators and flowering plants.

Suggest the consequences of extinction of a pollinator on other species.

(2 marks)

- (c) A **symbiotic** relationship between two species is defined as any type of a close and long-term biological interaction between two different biological organisms.

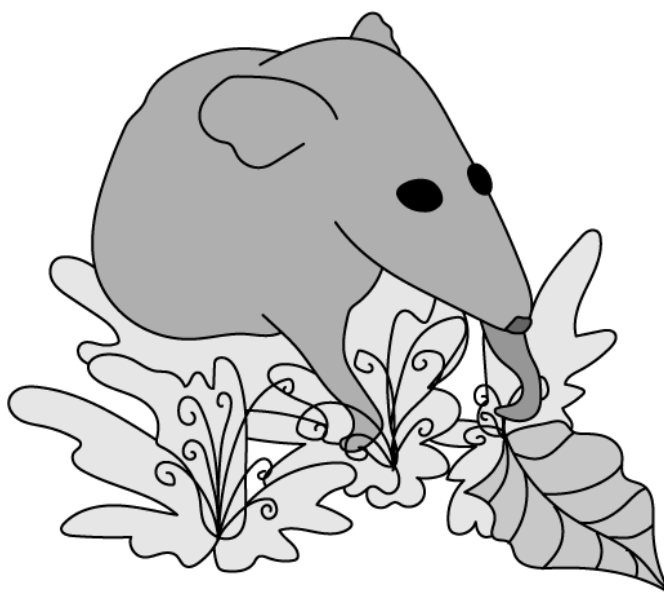
The relationship between a bumblebee and the flowers it feeds from (and pollinates) is referred to as **mutualistic**.

Using this information, distinguish between symbiosis and mutualism.

(2 marks)

- (d) The best-documented examples of animal pollinators include bees and other insects. However, some larger animals are very active pollinators.

One such animal is the honey possum (*Tarsipes rostratus*), a small marsupial native to southwestern Australia. Some of the pollen that a honey possum comes into contact with is used as a food, with all the available nutrients being used by the honey possum for its own dietary requirements.



Suggest **one** adaptation, from the image above, of the honey possum that hints at its role as a pollinator.

(1 mark)

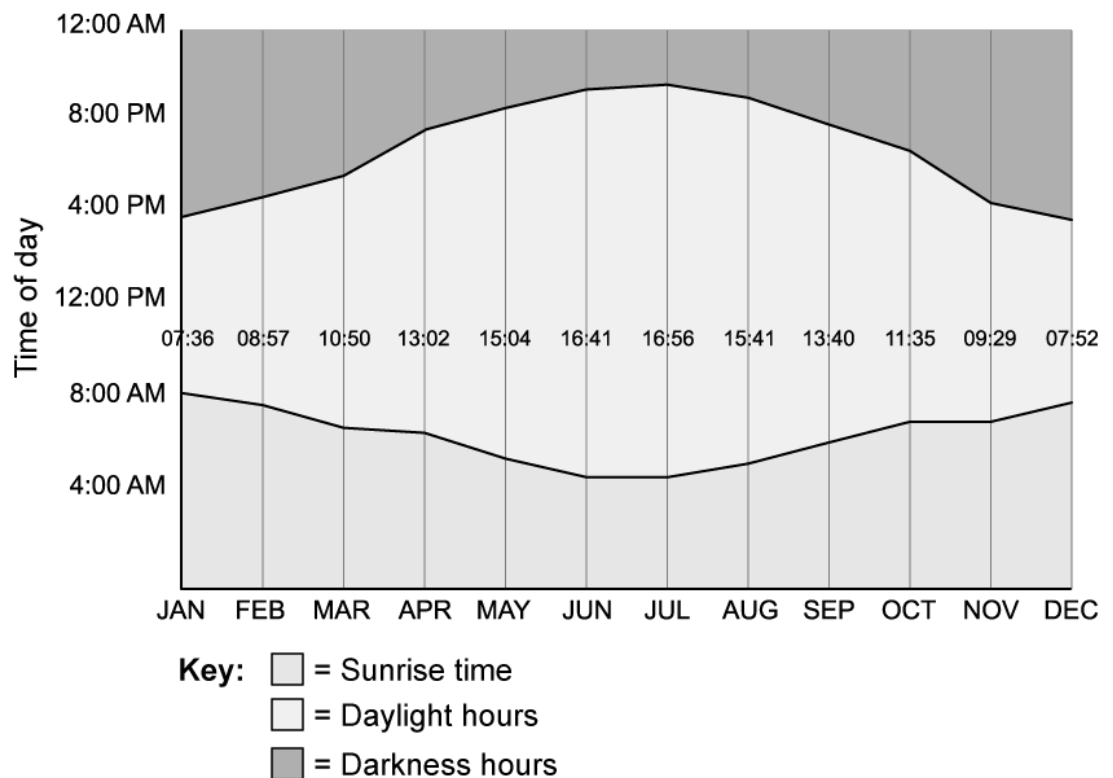
- 2 (a) Complex control mechanisms exist to ensure that a flowering plant does not flower too early in the season.

Explain **one** disadvantage of flowering too early in the season.

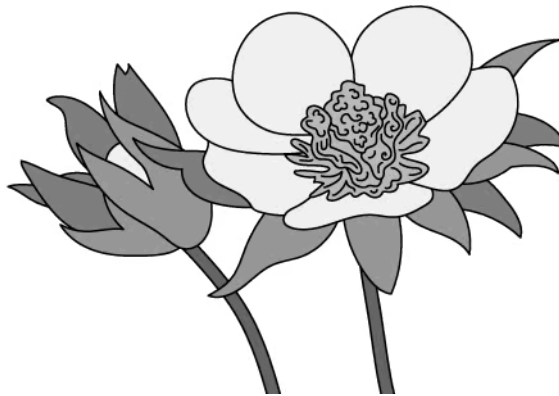
(2 marks)

- (b) The graph shows the average sunrise, sunset and daylight times for a region of northern UK.

The figures along the **centre of the graph** are the duration of daylight hours in hours:minutes.



Strawberry plants flower with small, white flowers as shown in the image below.



Later on, the flowering body develops into the characteristic red, juicy fruits that the plants are grown for.

Using the data in the chart and the fact that the strawberry is a day-neutral plant, predict the month when flowers start to appear on strawberry plants in the northern UK. Give a reason for your prediction.

(2 marks)

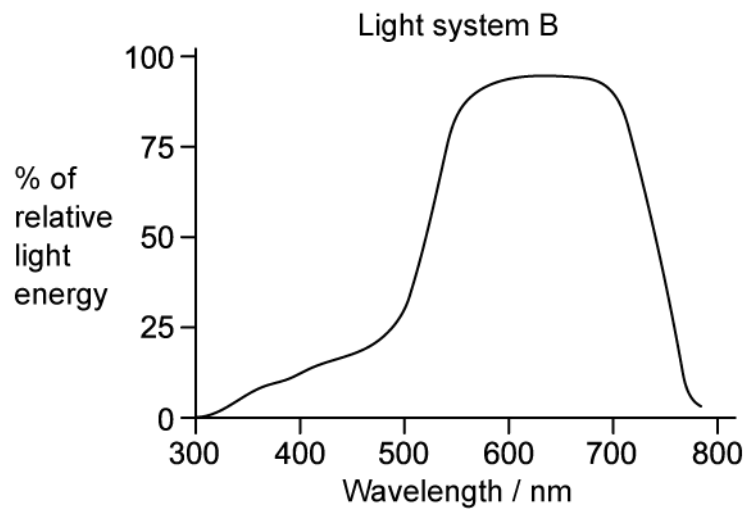
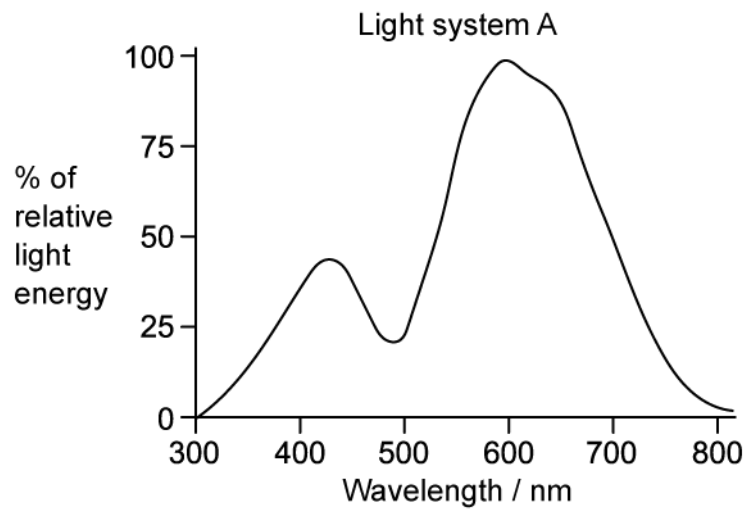
- (c)** Some flowering plants sense stimuli from air and soil temperature fluctuations and express flowering genes in response to changes in those stimuli.

Give **one** reason why flowering based solely on temperature stimuli would be disadvantageous to a plant.

(1 mark)

- (d)** A floriculture company supplying florists shops with flowers uses large commercial growing sheds to cultivate flowers on a large scale. Artificial lighting is controlled to provide optimal lighting conditions.

Spectra **A** and **B** below are those produced by two separate lighting gantries inside the sheds.



Suggest which lighting system is used for the times when flowers are beginning to bloom and give a reason for your answer.

.....

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(2 marks)

- 3 (a)** Studies of flowering in thale cress (*Arabidopsis thaliana*) have revealed that a gene called Flowering Locus T (or FT for short) is expressed when certain repressor proteins are absent.

The FT gene is expressed in the leaf but has its effect in the apical meristem.

Suggest the structure in which FT protein reaches the apical meristem.

(1 mark)

- (b)** Vernalisation is a term used to describe a prolonged period of low temperature, which acts as one environmental stimulus to ensure that flowering occurs in the appropriate season of the year – spring, in many species.

Species that rely on vernalisation are more commonly found in temperate regions of the Earth, as opposed to tropical regions.

Suggest why.

(2 marks)

- (c)** Research into vernalisation in cereal crops has identified differences in the genetic makeup of winter and spring varieties of important crops like barley and wheat.

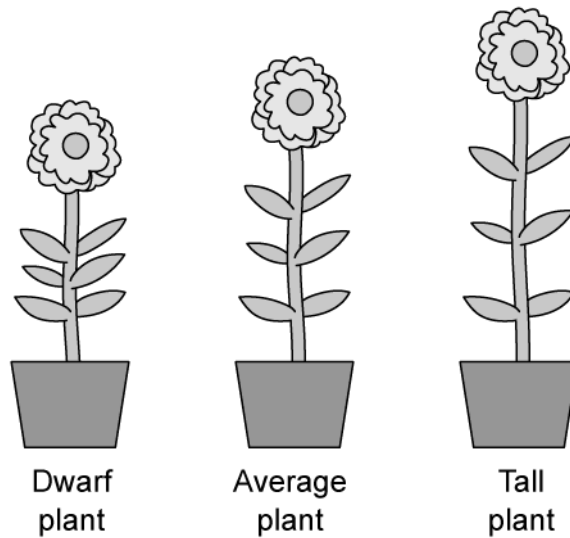
Much of the research has uncovered epigenetic effects that govern the expression of important flower-producing genes.

Outline what is meant by 'epigenetic effects' in this context.

(2 marks)

- (d)** The diagram shows an effect of the plant hormone gibberellin.

The level of gibberellin affects the internodal distance of a plant; this is the length of stem between each set of leaves.



Suggest how the levels of gibberellin may vary between each of the three plants shown. Give a reason for your suggestion.

(2 marks)

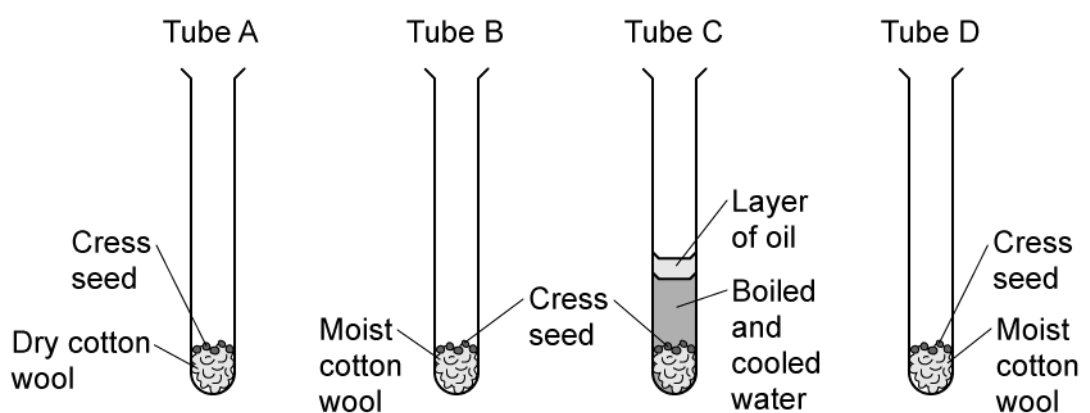
4 (a) Outline the events that take place during the germination of a seed.

(4 marks)

(b) In exploring the effects of subjecting germinating seeds to different growth conditions, the following experiment was set up.

Method summary:

- Set up 4 test tubes, each containing cress seeds on cotton wool
- For test tube **A**, cotton wool left dry
- For test tube **B**, add enough water to the cotton wool so that it becomes moist
- For test tube **C**, add enough water to cover the cotton wool and seeds, then carefully add a layer of oil on top of the water
- For test tube **D**, add enough water to the cotton wool so that it becomes moist
- Leave tubes **A**, **B** and **C** at room temperature or incubated at a specific temperature e.g. 20 °C
- Place tube **D** in a fridge at approximately 4 °C
- Compare the results and see which tube has the greatest number of germinated seeds



Outline the control variables that the scientists would need to adhere to in order to produce valid data.

(2 marks)

- (c)** Rather than counting the number of seeds that had germinated at the end of the experiment, suggest a more accurate measure of the dependent variable.

(1 mark)

5 (a) One mark is available for clarity of communication throughout this question.

Compare and contrast the methods employed by plants for pollen distribution and seed dispersal.

(5 marks)

(b) Explain the process by which phytochrome P_R and phytochrome P_{FR} control flowering in a typical long-day plant.

(5 marks)

(c) The cut-flower industry goes to great lengths to ensure that flowers reach their end-use customers in their best condition, showing vigour and bloom to maximal effect.

This presents particular logistical and scientific challenges at times of high demand such as Valentine's Day and Mothers' Day.

Summarise the methods used to ensure that cut flowers reach their end-use customers in the best possible condition.

(5 marks)