

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

4.4.1 PLANT REPRODUCTION

SCORE

/63

PERCENTAGE

%

STEMUP

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1 Which of the statements, **A** to **D**, describes vernalisation in flowering plants?

- A** Exposure to high temperatures for an extended time period to encourage flowering.
- B** Exposure to high temperatures for an extended time period to encourage germination.
- C** Exposure to low temperatures for an extended time period to encourage flowering.
- D** Exposure to low temperatures for an extended time period to encourage germination.

Your answer

[1]

2 Which of the biological events, **A** to **D**, results from the activity of gibberellins during germination?

- A** synthesis of amylase in the aleurone
- B** synthesis of amylase in the endosperm
- C** synthesis of amylose in the aleurone
- D** synthesis of amylose in the endosperm

Your answer

[1]

3 Which of the options, **A** to **D**, is the component of a cereal grain that contains starch?

- A** aleurone layer
- B** embryo
- C** endosperm
- D** seed coat

Your answer

[1]

4(a) Fig. 7 is a diagram of a maize plant showing the male and female flowers.

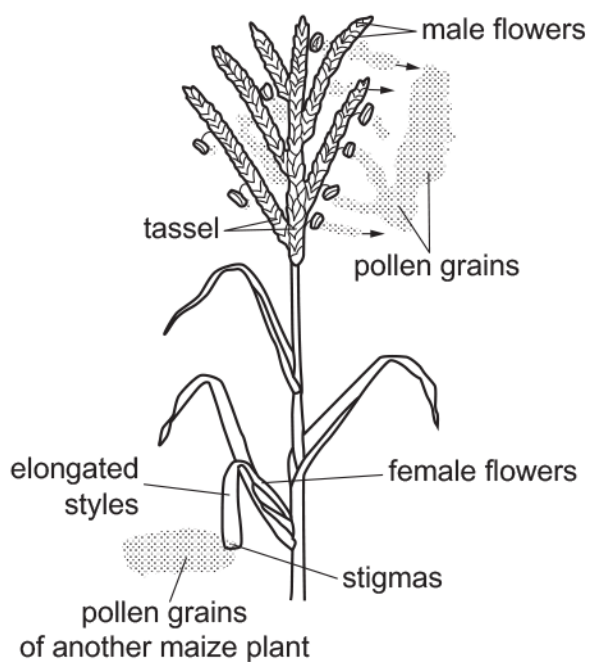


Fig. 7

Using the information in Fig. 7, identify **one** way in which maize is adapted for wind pollination.

[1]

- (b) When maize pollen grains land on the stigma of a maize plant, a pollen tube grows towards the ovule.

Describe the events that lead to the formation of the embryo **and** the endosperm.

[3]

[3]

5(a) Winter wheat seeds are usually sown in the autumn and flower the following summer. Seeds sown in the spring will usually not flower.

The Russian geneticist Lysenko discovered that winter wheat seeds can be treated with cold and moisture.

Explain why winter wheat seeds treated in this way and sown in spring are able to flower.

[2]

(b) Chrysanthemums normally flower only in autumn.

Commercial growers obtain flowers earlier in the year by growing the chrysanthemums in greenhouses where they can use screens or curtains to provide at least 12 hours of darkness.

Explain how this method stimulates early flowering and why it will not work if the plants are exposed to a brief period of light during the 12 hours of darkness.

[3]

6 Which of the options, **A** to **D**, would promote flowering in a short-day plant?

A longer exposure to cold temperatures

B longer exposure to darkness

C shorter exposure to cold temperatures

D shorter exposure to darkness

Your answer

[1]

7(a)

Fig. 5.1 shows the changes in population, annual birth rate and annual death rate in Europe and Africa since 1950 and projected beyond 2080.

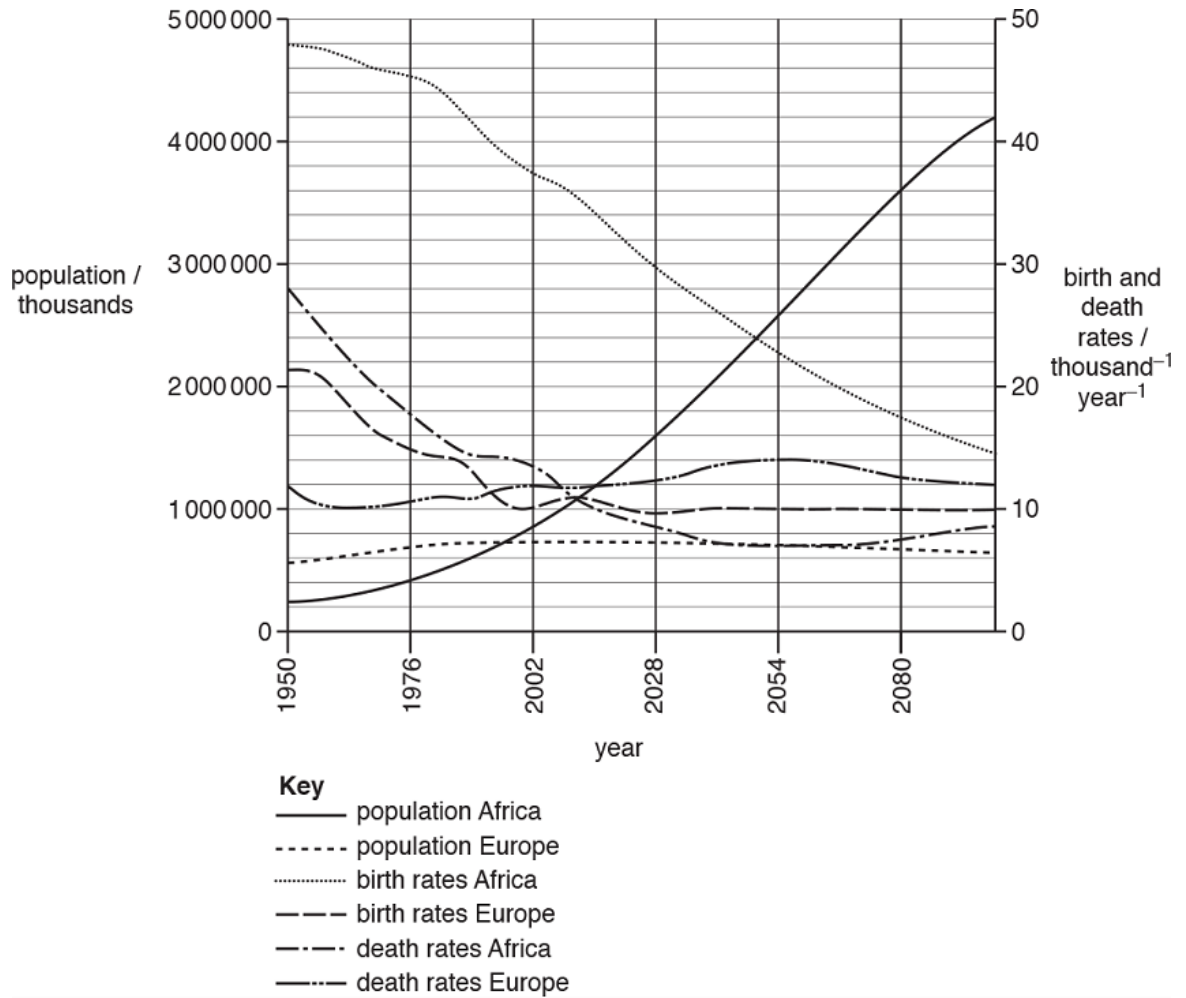


Fig. 5.1

(i) Explain why birth rates and death rates are shown in Fig. 5.1 as 'number per thousand per year'.

----- [1]

- (ii) Use the data in Fig. 5.1 to calculate the projected rate of increase in the population of Africa between 2028 and 2080.

Show your working. Give your answer in standard form to **one** decimal place.

answer = ... thousands year⁻¹ [3]

- (iii) Use the birth rate and death rate data in Fig. 5.1 to explain the different trends in population for Africa and Europe.

----- [3]

(b) Fig. 5.2 shows the total cereal production in Africa and cereal imports into Africa in the period 1960–2010.

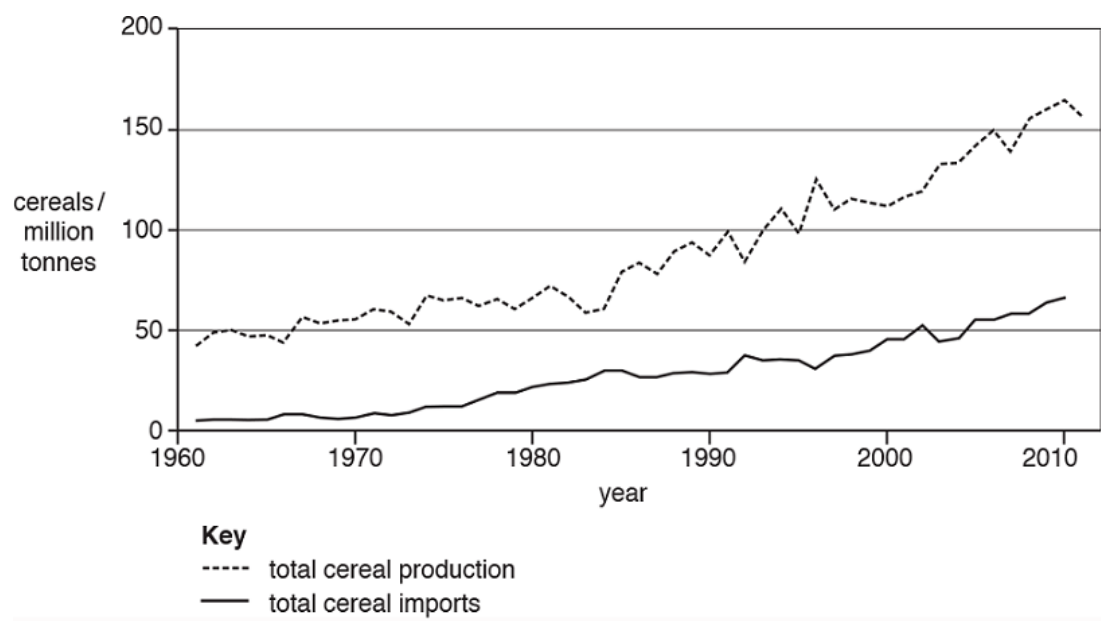


Fig. 5.2

(i) Explain why cereals are staple foods in many African countries.

[2]

(ii) Discuss to what extent the data in Fig. 5.2 explain the changes in death rates in Africa shown in Fig. 5.1.

----- [2]

(c) Using Fig. 5.1 and Fig. 5.2, as well as your own knowledge, what can you conclude about the potential risks to food security and sustainability in Africa?

----- [5]



Gibberellic acid is a type of gibberellin.

Outline a practical method to determine the minimum concentration of gibberellic acid required to stimulate germination of lettuce seeds.

- school or college laboratory resources
- a solution of 100 mg dm⁻³ gibberellic acid.

[9]

- (b) A student is carrying out an experiment to determine the effect of a gibberellin, GA_1 , on the length of radicles (embryonic roots) of germinating pea seeds.

Fig. 2, (below and on the insert), is a photograph of the germinating pea seeds.



Fig. 2

Peas 1, 4 and 8 were placed in a 150 mg dm^{-3} solution of GA_1
Peas 2, 5 and 9 were placed in a 100 mg dm^{-3} solution of GA_1
Peas 3, 6 and 7 were placed in a 50 mg dm^{-3} solution of GA_1

All the seeds were soaked on the same day and have been growing for 5 days. The seeds have been soaked in different concentrations of GA_1 as labelled in Fig. 2.

Using a ruler, measure the radicles in Fig. 2.

In the space below construct an appropriate table and record:

- the raw data to the most appropriate level of precision for this apparatus
- the mean values.

[4]

9 Fertilisation in a flowering plant involves two pollen nuclei.

The first nucleus fuses with the ovule and the second nucleus fuses with the polar nuclei.

Which of the options, **A** to **D**, is the seed structure formed after fusion of the second nucleus with the polar nuclei?

- A aleurone layer
- B embryo
- C endosperm
- D seed coat

Your answer

[1]

10(a) Plants begin flowering in response to changes in day length. This is known as photoperiodism. Some plants, such as cocklebur, are “short-day” plants. They will only begin flowering when they have experienced a relatively long period in the dark.

Table 6.1 shows the results of experiments with cocklebur plants that were kept in darkness for different lengths of time. Some of the plants were exposed to particular wavelengths of light during the experiment.

	Period in darkness (hours)	Light exposure during the dark period	Result
A	8.5	None	Flowers
B	6.0	None	No flowers
C	12.0	Flash of red light (660 nm) after 6 hours	No flowers
D	12.0	Flash of red light followed by flash of far red light after 6 hours	Flowers
E	6.5	Intense exposure to far red light (730 nm) at the beginning of the 6.5 hours	Flowers

Table 6.1

(i) A student examined the data in **Table 6.1** and made the following statement:

Plants will not flower without being kept in the dark for a minimum of 8.5 hours.

Using your knowledge of the control of flowering in plants and the information in **Table 6.1**, evaluate the validity of the student's conclusion.

[3]

(ii) With reference to **C, D** and **E** in **Table 6.1**, what conclusions can you draw about the role of phytochrome in the control of flowering in plants?

[41]

[2]

11 Germination is the process in which a seed begins to grow into a plant.

Which of the statements, **A** to **D**, is an early event in germination?

- A glucose in the endosperm is polymerised into starch
- B glucose in the embryo is polymerised into starch
- C starch in the endosperm is broken down into glucose
- D starch in the embryo is broken down into glucose

Your answer

[1]

12(a) * Evaluate the role of GA and ABA in the control of germination as shown by the results of the experiment in Fig. 32.2 and Table 32.1.

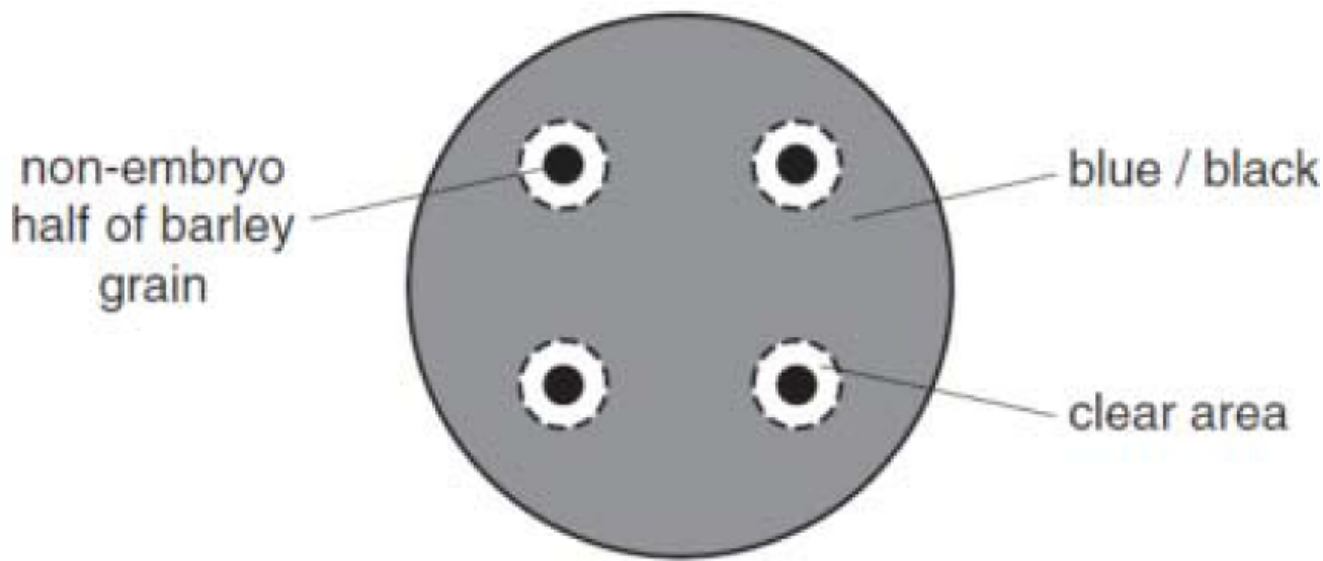


Fig. 32.2

Agar plate		Maximum diameter of the clear area surrounding halved seed (cm)					
		Halved seed 1	Halved seed 2	Halved seed 3	Halved seed 4	Mean	Standard deviation
1	Distilled water	1.5	2.4	1.5	1.4	1.7	0.47
2	GA	2.0	1.3	2.5	2.2	2.0	
3	ABA	0.9	0.8	1.5	1.3	1.1	0.32
4	GA and ABA	1.2	1.2	1.0	1.2	1.2	0.10

Table 32.1

[6]

(b) The seeds used in the experiment were a variety of winter barley.

Suggest one treatment that would need to be carried out on the germinated seedlings in order to ensure a grain harvest from the matured plants.

Explain your suggestion.

[2]

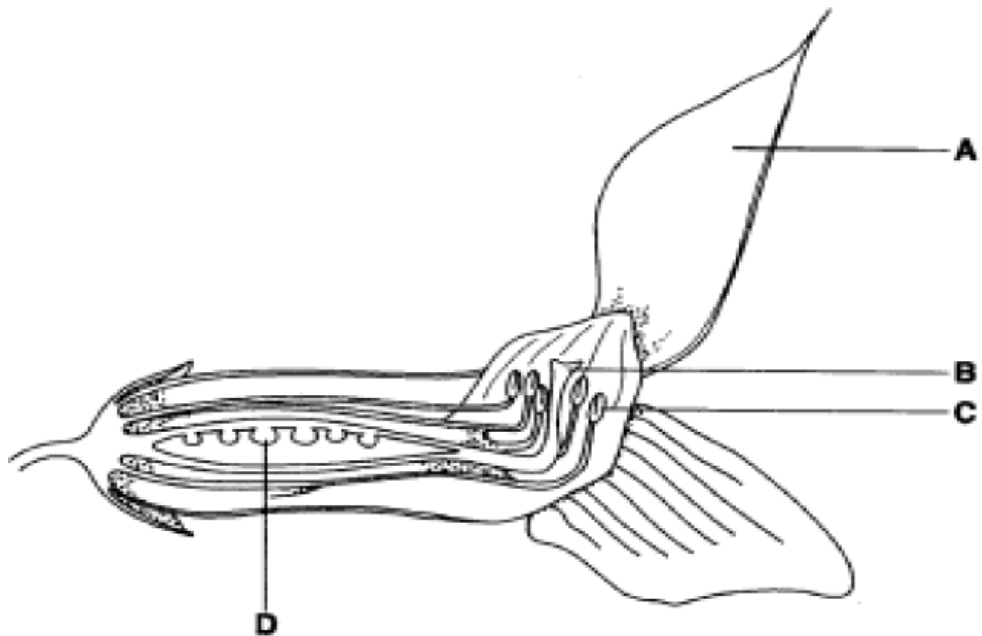


Fig. 29.1

Which of the following is likely to be correct about the flowers of *Vicia fabia*?

- A The flowers have a nectary and are wind pollinated
- B The flowers have a nectary and are insect pollinated
- C The flowers are scented and are wind pollinated
- D The flowers are unscented and are insect pollinated

Your answer ☐

[1]

14 Fig. 29.1 is a diagram of a section through the flower of the bean plant, *Vicia fabia*.

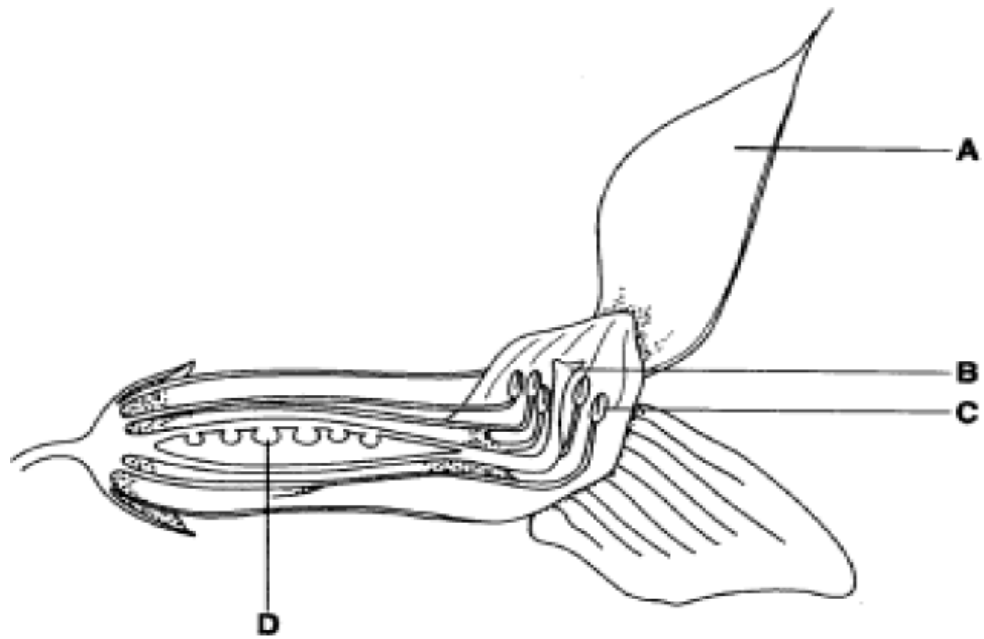


Fig. 29.1

Which of the letters on the diagram indicate sites where meiosis occurs?

- A A and B
- B B and C
- C B and D
- D C and D

Your answer

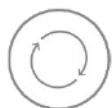
[1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			C	1(AO1.1)	
			Total	1	
2			A	1 AO1.2	
			Total	1	
3			C	1 AO1.1	
			Total	1	
4	a		pollen is produced in large amounts ✓ anthers / stigmas, hang outside the flower ✓	1 max AO1.1	ALLOW in the air for 'outside the flower' <u>Examiner's Comments</u> Well answered with candidates recognising the position of the stigmas but some failing to make it clear that they hang outside of the plant.
	b		double fertilisation ✓ pollen tube delivers two, sperm cells / male gametes ✓ one, sperm cell / male gamete, fertilises egg cell to form embryo ✓ (nucleus of) other sperm cell fuses with (two) polar nuclei to form endosperm ✓	3 max AQ1.1	<u>Examiner's Comments</u> Only a few candidates scored full marks in this question. This was well answered especially by high ability candidates. Some candidates recognised this as double fertilisation even if they could not recall details.
			Total	0	

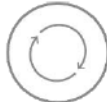
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5	a		<u>vernalisation</u> ✓ (cold and moist conditions) promote, transcription / expression, of genes (associated with flowering) ✓	2 AO2.1	ALLOW production of transcription factors for 'promote transcription of genes'. Examiner's Comments A lot of candidates recognised this example in the context of vernalisation but struggled to connect this with 'switching on' genes. Consequently, most answers reworded the information in the question without providing any further detail. Some answers referred to activating gibberellins, showing a confusion of flowering with germination.  AfL Word bounce is an effective teaching tool to get students to associate key terms correctly, e.g. a student is given the word 'flowering' and needs to bounce a word back that is relevant to this term in their specification. This can be bounced around the class until words are exhausted! It is good to help eliminate wrong words as well, as in this part question example.
	b		chrysanthemums are , short day / long night , plants ✓ P_{fr} is converted (slowly) to P_r during darkness ✓ light, converts P_r to P_{fr} ✓ ratio of $P_{fr} : P_r$ / relative amounts of P_{fr} and P_r , determines when flowering occurs ✓	3 max AO2.1	Examiner's Comments The majority of candidates recognised these as short-day plants. Candidates who were familiar with phytochromes were able to proceed with their answer and gain full marks. Some candidates confused the 2 isomeric forms but clearly understood their role in flowering. Candidates who had not connected phytochromes with this question part, discussed the effect of light on photosynthesis, in terms of light intensity and glucose formation.
			Total	0	
6			B	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7	a	i	allows comparison between (areas with) different population sizes ✓	1	ALLOW can compare as population size doesn't have to be taken into account <u>Examiner's Comments</u> Most candidates discussed this terminology in terms of producing smaller numbers for ease of comparison or not being able to count every member of a population.
		ii	(population increase) 2 100 000 ✓ (divided by 52 years =) 40 385 thousand year⁻¹ ✓ = 4.0×10^4 (thousand year⁻¹) ✓	3	ALLOW figure in the range 1 900 000 – 2 200 000 ECF any value divided by 52 ECF value from previous mark in standard form and 1 dp <u>Examiner's Comments</u> This was well answered with most candidates using a population increase of 2000 000. As seen previously, candidates struggled to express their correct answers in standard form.

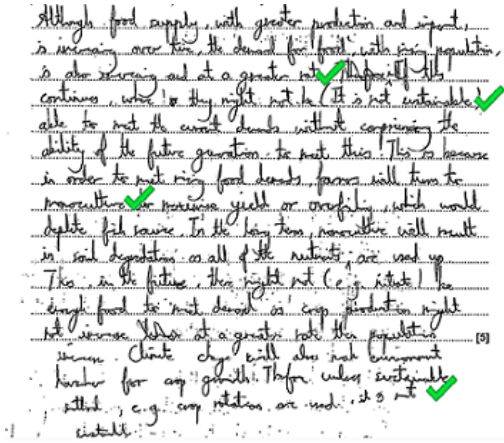
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	<i>population in Africa increase because</i> more births than deaths ✓ birth rate (always) higher in Africa compared to Europe ✓ <i>population in Europe decreases because</i> more deaths than births ✓ death rate (now) higher in Europe compared to Africa ✓	3 max	<u>Examiner's Comments</u> Although candidates discussed birth and death rates, few appreciated the relevance of these to the overall trend in the populations of the two continents. Thus candidates did not gain marks as they did not connect their detailed description of e.g. death rates over time, to the overall population growth.  The use of acetates can help with building up graphical information. Students can place an acetate over the detailed graph and sketch one line only and describe (and explain) that line. Each candidate can sketch a different line and then work in groups and add the lines together by placing the acetates on top of each other. This will eventually build up to the original graph, but having interpreted and described each line first.
	b	i	(cereals endosperm is), rich in starch / a good source of carbohydrate ✓ (endosperm from some) cereals be used to make bread ✓ cereals can grow in hot climates ✓	2max	<u>Examiner's Comments</u> Few candidates appreciated that cereals are a good source of carbohydrates and could be used to make other foods. Most candidates stated cereals cope well with the climate but did not appreciate it would be their growth in a hot climate.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	increase in cereal (imports and production) correlates with decrease in death rate ✓ death rate due to malnutrition decreases ✓ (however) other factors / named example, will reduce death rate ✓	2max	ALLOW negative correlation between cereal (imports and production) and death rate ALLOW more people live as they have plenty of food ALLOW improved sanitation / healthcare <u>Examiner's Comments</u> The majority of candidates correctly related the increase in cereals to the decrease in death rates to gain mark points 1 and 2.
	c		food security ensures access to safe & nutritious foods ✓ (rising population) greater demand for food ✓ Increased risk to food security ✓ (rising population) makes sustainable farming practices less likely (to be maintained) ✓ (increased cereal production) reduces biodiversity ✓ (as) increased use of monoculture ✓ (increased use of) pesticides will kill other insects / herbicides will kill other plants ✓ (increase in) imported foods may not be safe ✓	5 max	ALLOW (rising population) is major threat to food security ALLOW description of food security being at risk (e.g. 'less likely to be able to supply food to everyone') ALLOW genetic diversity is low ALLOW imported cereals may have decreased food security <u>Examiner's Comments</u> Candidates struggled to answer this question with some clearly not understanding the meaning of food security, whilst others did not relate their knowledge of food security to the figures and the increase in the population. Very

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					few candidates quoted the meaning of food security to gain a mark. Many candidates discussed an increased risk to food security in terms of climate change and natural disasters. Exemplar 3  This exemplar shows recognition of relevance to increasing population at the start and a clear understanding of risk to food security, and relating reliance on crops to monoculture and lack of biodiversity.
			Total	16	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
8	a	Summary of instructions to markers: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i> ◦ <i>award the higher mark where the Communication Statement has been met.</i> ◦ <i>award the lower mark where aspects of the Communication Statement have been missed.</i> • <i>The science content determines the level.</i> • <i>The Communication Statement determines the mark within a level.</i> Level 3 (7-9 marks) Comprehensive details of apparatus and a method to produce reliable data are provided to include the preparation of dilutions of the stock solution of gibberellic acid. Most variables are identified and the method states how these are controlled. Details of a control and safety are included. <i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.</i> Level 2 (4-6 marks) Some details of apparatus and a method to produce reliable data are provided. There is an outline of the preparation of dilutions of the stock solution of gibberellic acid. Some variables are identified and the	9	Indicative scientific points may include Apparatus & method: • growing medium (e.g. soil, cotton wool, filter paper) • suitable containers (e.g. pots / Petri dishes etc.) for growing medium • apparatus for precise / accurate volume measurement • distilled / deionised water • details of quantitative preparation of dilution series (for GA) to include volumes & final concentrations • method of determining whether or not germination has occurred • control included (distilled water or 0 mg dm⁻³ GA) • sufficient number of values of IV (different concentrations of GA across appropriate range)

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			method states how some are controlled. Details of a control or safety are included. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.</i> Level 1 (1–3 marks) Apparatus and an outline method are suggested to provide some results but information, such as how to dilute the stock solution of gibberellic acid, may be missing. Some variables and safety details are omitted. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		Variables • independent variable = dilutions of gibberellic acid • dependent variable = %/proportion / fraction of seeds germinated • control variables = exposure to light / kept in dark / constant day length, watering of seeds (volume of gibberellic acid solution is not critical but the seeds must be kept wet / moist with the appropriate solution), temperature, planting density / number of seeds per container, time Reliability • repeats (for each concentration) Risk Assessment • potential chemical hazards & control Examiner's Comments In responding to Q2(a) some candidates were able to give comprehensive methods providing excellent details of serial dilutions. Many candidates, however, did not provide details of how to dilute the stock solution to provide a range of concentrations of gibberellic acid. There was evidence of a large number of candidates writing at length on this question which was not required. The command word 'outline' should be differentiated from 'describe'. There was some evidence that in some cases this may have hindered candidates later in the paper in terms of time.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		concentration of, gibberellin / GA1, (mg dm⁻³) in first column (ascending or descending order) AND length of radicle (mm) to the right of the IV, with each concentration of GA1 recorded in separate row AND mean column to the right of the DV AND informative column headings with correct unit symbols AND all cells surrounded by straight ruled lines with complete outer border ✓ all radicles measured to nearest whole number or nearest 0.5mm AND within acceptable range ✓ three values for 50 are recorded together AND three values for 100 are recorded together AND three values for 150 are recorded together ✓ all three mean values calculated correctly from candidates own measurements AND recorded to consistent number of decimal places AND all means recorded to, the same / one more decimal place, than raw data ✓	4	DO NOT ALLOW measurements in cm as this is not the most appropriate level of precision for this apparatus as stated in the Q DO NOT ALLOW if the units are in the cells of the table DO NOT ALLOW if column headed as 'average' DO NOT ALLOW if units are incorrectly formatted ALLOW error carried forward for recording values in cm if the measurements are correct Examiner's Comments For Q2(b) candidates needed to be able to construct a table and record both raw and processed data. The number of candidates who did not draw borders around the outer part of the table, used incorrect units or gave readings to different numbers of decimal places was higher than expected. This is a skill that should be developed whilst completing practicals in the 12 PAG groups. Given the variation in how the radicle could be measured there was a range of acceptable values. Candidates should recognise that in this context the appropriate level of precision is +/-0.5 mm and as such should record values to this level. The majority of candidates gained 2 or more marks.
			Total	13	
9			C ✓	1	Examiner's Comments This question was straightforward recall and the majority of candidates chose the correct response.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10	a	i	(lacks validity because) <i>idea of</i> different plant species require different periods of darkness <i>idea of</i> no evidence that periods between 6.5 and 8.5 hours have been tested <i>idea that</i> exposure to far red light reduces the minimum darkness period	3	ALLOW “conclusions can only apply to cocklebur”
		ii	Any 4 from: (high concentration of) P_R is required for flowering darkness, converts / AW, P_{FR} to P_R C red light, produces / AW. P_{FR} AND no flowers D <i>idea of</i> far red light, reverses / cancels, effect of red light E <i>idea of</i> far red light, produces / AW, P_R AND reduces critical period / length of darkness required	4	ALLOW description of P_R as “the phytochrome produced by far red light / darkness” and a description of P_{FR} as “the phytochrome produced by red light.”
	b		Any 2 from: <i>Idea of</i> stigmas, large and feathery / outside the flower dry / light, pollen grains large anthers / large amount of pollen produced	2	
			Total	9	
11			C	1	
			Total	1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
12	a	* Level 3 (5–6 marks) A detailed conclusion of both hormones in germination including detailed and relevant comments on the experimental design and the strength of evidence as shown by the data. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) A conclusion on the roles of both hormones in germination including some relevant information on the experimental design using evidence from the data. <i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i> Level 1 (1–2 marks) A limited conclusion on the role of at least one hormone with some comment on either the experimental design or using supporting data. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i> 0 marks No response or no response worthy of credit.	6	Examples of relevant material: • GA promotes germination • GA produced by embryo & acts on aleurone layer • Aleurone layer present in the seed half without embryo • Enzyme is amylase which breaks down the starch in the endosperm • Enzyme diffuses into the agar plate • GA has largest clear zones • ABA inhibits germination • ABA zones smaller than control plates • Smaller GA zone in the presence of ABA • Sample size is limited • Ref to overlap of data or closeness of means between GA and control reducing confidence in conclusion • Ref to anomalous results • Ref to improvements in design such as more repeats • Ref to use of a named statistical test to test strength of the conclusion (if more repeats are carried out) • Comment on ABA preventing germination at the wrong time of year.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		<i>Treatment</i> vernalisation / described OR period of short day length / AW <i>explanation</i> <i>idea that</i> no flowering will occur in winter cereals without, vernalisation / a short day length OR seeds are from pollination and fertilisation in (barley) flowers	2	ALLOW exposure to a period of cold or low temperatures
			Total	8	
13			B	1	
			Total	1	
14			D	1	
			Total	1	