Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Biology B

Advanced
Paper 2: Advanced Physiology, Evolution and Ecology

Specimen Paper for first teaching September 2015
Time: 1 hour 45 minutes

Paper Reference
9BI0/02

You may need a ruler, a pencil and a calculator.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
  – there may be more space than you need.
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Many of the chemicals found in living organisms are polymers.

(a) (i) Which of the following molecules are all polymers?

(1)

☒ **A** polypeptides, nucleotides, starch

☒ **B** polypeptides, starch, lipids

☒ **C** proteins, carbohydrates, lipids

☒ **D** proteins, nucleic acids, starch

(ii) Which of the following molecules is made of different monosaccharides?

(1)

☒ **A** amylose

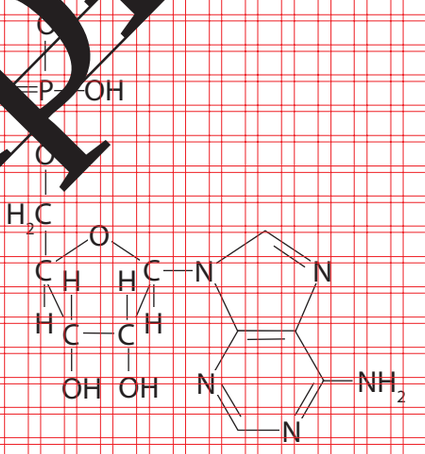
☒ **B** glycogen

☒ **C** lactose

☒ **D** maltose

(iii) The diagram shows the structure of a monomer.

(1)



This monomer is found in

☒ **A** DNA

☒ **B** DNA polymerase

☒ **C** haemoglobin

☒ **D** mRNA

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(b) Enzymes are polymers. A mutation in DNA can lead to a change in the primary structure of an enzyme.

Explain why a mutation might lead to a change in the activity of an enzyme.

(4)

(Total for Question 1 = 7 marks)

Partial

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Exemplar

2 Viruses possess some of the features of living organisms.

(a) (i) Which of the following are found in **all** viruses?

(1)

- ☒ **A** DNA and protein
- ☒ **B** RNA and protein
- ☒ **C** nucleic acid and protein
- ☒ **D** nucleic acid and ribosomes

(ii) Which of the following is a retrovirus?

(1)

- ☒ **A** Ebolavirus
- ☒ **B** human immunodeficiency virus
- ☒ **C** λ (lambda) phage
- ☒ **D** tobacco mosaic virus

(b) Describe two ways in which viruses replicate.

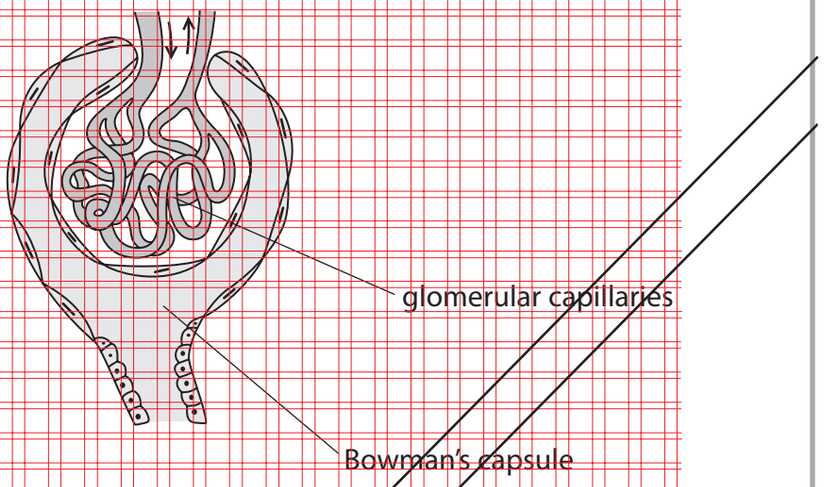
(4)

(Total for Question 2 = 6 marks)

Partial Removal

3 If untreated, high blood pressure can cause kidney damage.

The diagram shows a Bowman's capsule and the glomerular capillaries in a human's kidney.



The table shows the hydrostatic pressure in the glomerular capillaries and in the Bowman's capsule. It also shows the oncotic pressure of the blood in the glomerular capillaries.

Pressure and location in kidney	Pressure / kPa
hydrostatic pressure in glomerular capillaries	+9.2
hydrostatic pressure in Bowman's capsule	+2.0
oncotic pressure in glomerular capillaries	−4.0

(a) Use the data from the table to explain why glomerular filtrate is produced.

(2)

DRAFT

(b) Explain how water is reabsorbed in the loop of Henle.

(4)

(c) Which of the following is correct when an individual becomes dehydrated?

(1)

☒ **A** decreased secretion of ADH and decreased permeability of the collecting duct

☒ **B** decreased secretion of ADH and increased permeability of the collecting duct

☒ **C** increased secretion of ADH and decreased permeability of the collecting duct

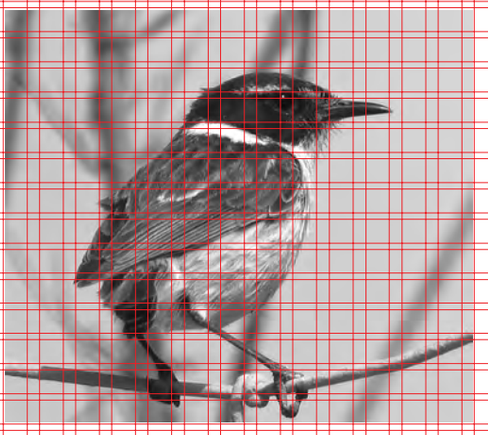
☒ **D** increased secretion of ADH and increased permeability of the collecting duct

(Total for Question 3 = 7 marks)

Partial Redacted

4 The photograph shows a stonechat, *Saxicola dacotiae*.

The species breeds only on the island of Fuerteventura.



(a) Which of the following is the best definition of a species?

Individuals of the same species can interbreed to produce

(1)

- ☒ **A** fertile offspring
- ☒ **B** hybrid offspring
- ☒ **C** sterile offspring
- ☒ **D** viable offspring

(b) Explain how the stonechat may have evolved on the island of Fuerteventura.

(5)

Exemplar

(c) A survey has shown that there may be fewer than 1 000 pairs of *S. dacotiae* on Fuerteventura.

The number has declined over the last 20 years due to habitat loss.

Explain the role of zoos in the conservation of species such as *S. dacotiae*.

(3)

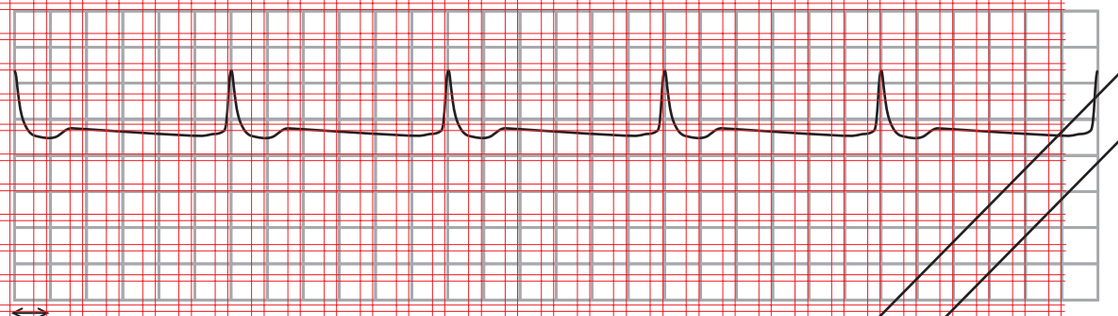
(Total for Question 4 = 9 marks)

Pearson

5 A person visited their doctor with symptoms of fatigue, dizziness and mental confusion.

The doctor suspected a heart condition and carried out an electrocardiogram (ECG).

The chart shows this ECG trace.



(a) (i) Which wave of a normal ECG trace is missing?

(1)

- ☒ **A** P
- ☒ **B** QRS
- ☒ **C** ST
- ☒ **D** T

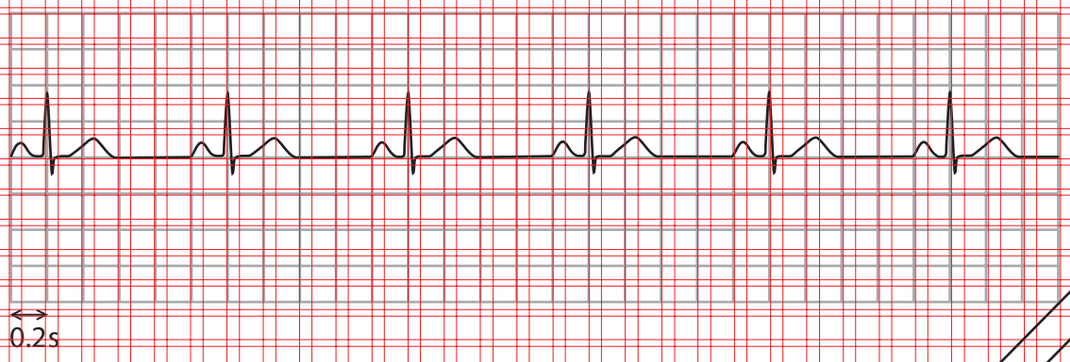
(ii) The doctor diagnosed a heart condition called 'Sick Sinus Syndrome' (SSS).

Use the information in the trace to explain the electrical activity in this person's heart.

(3)

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(iii) The diagram shows a normal ECG trace.



Calculate the difference between the heart rates of this normal ECG trace and that of the person with Sick Sinus Syndrome.

(2)

Answer ..... beats min^{-1}

(iv) Analyse the data to explain the symptoms of Sick Sinus Syndrome.

(2)

.....

.....

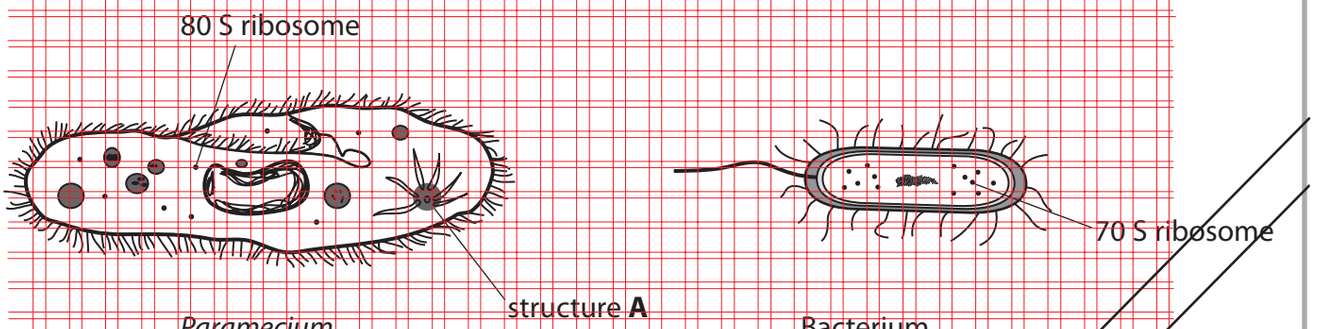
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(Total for Question 5 = 8 marks)

Sample

6 The drawings show two single-celled organisms that live in ponds, *Paramecium* and a bacterium.



Paramecium
Magnification ×200

Bacterium
Magnification ×5000

(a) (i) Which of the following statements is correct?

(1)

☒ **A** Both *Paramecium* and the bacterium are eukaryotes

☒ **B** Both *Paramecium* and the bacterium are prokaryotes

☒ **C** *Paramecium* is a eukaryote and the bacterium is a prokaryote

☒ **D** *Paramecium* is a prokaryote and the bacterium is a eukaryote

(ii) Structure **A** is a contractile vacuole. This removes water from the *Paramecium*.

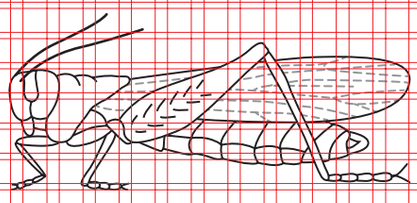
Explain why the *Paramecium* needs to remove water.

(3)

Exemplar

(b) (i) Many living organisms need a gas exchange system.

The drawing shows a locust.



Magnification ×1

Explain why a locust has a gas exchange system whereas a *Paramecium* does not.

(2)

.....

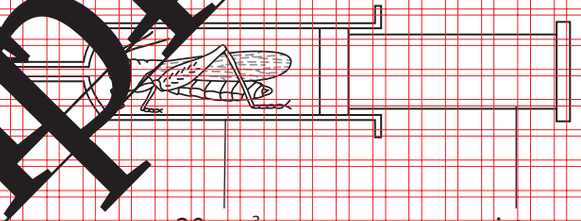
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(ii) A student placed a locust inside a transparent syringe and observed the movement of the abdomen.



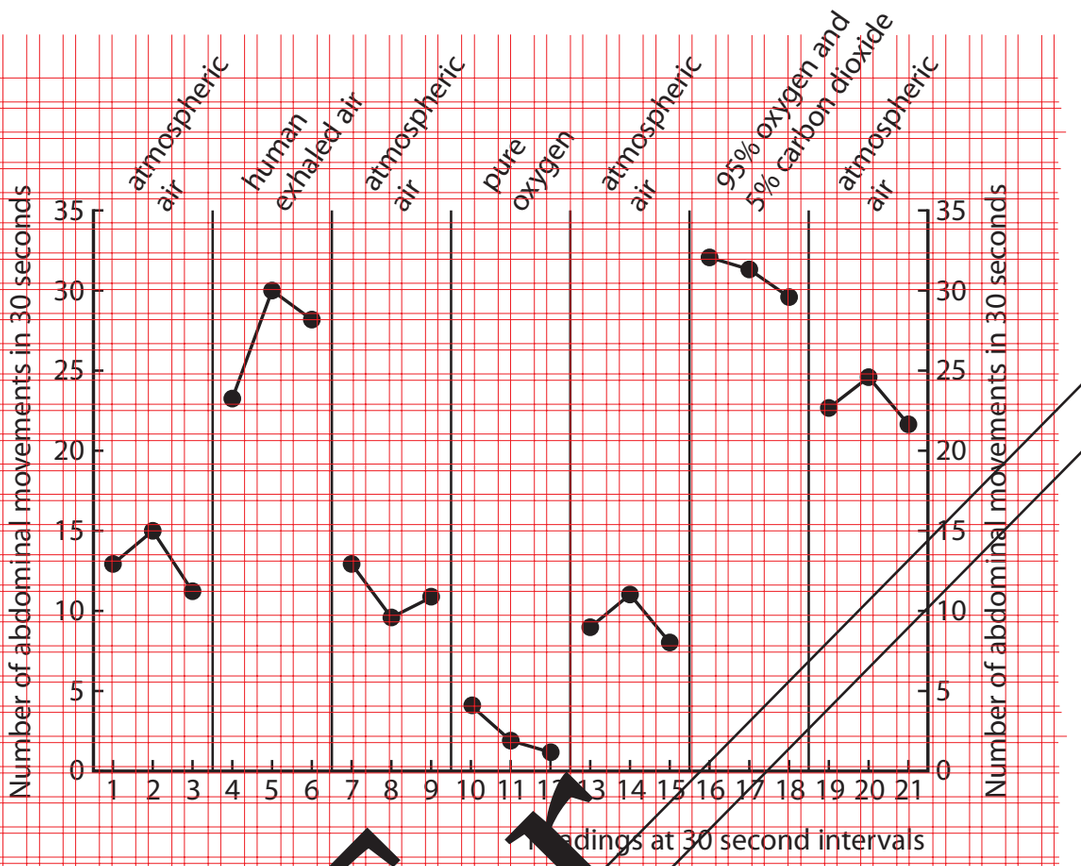
The student recorded the number of times the abdomen pumped in seconds. This was carried out three times.

The syringe was then flushed with atmospheric air and the procedure repeated first with air exhaled by a human, then pure oxygen and then a mixture of 5% carbon dioxide and 95% oxygen.

The syringe was flushed with atmospheric air in between each treatment.

The results are shown in the graph on page 14.

RAPID



* Analyse the data to assess the effect of oxygen and carbon dioxide on locust abdominal pumping.

(6)

Exemplar

(Total for Question 6 = 12 marks)

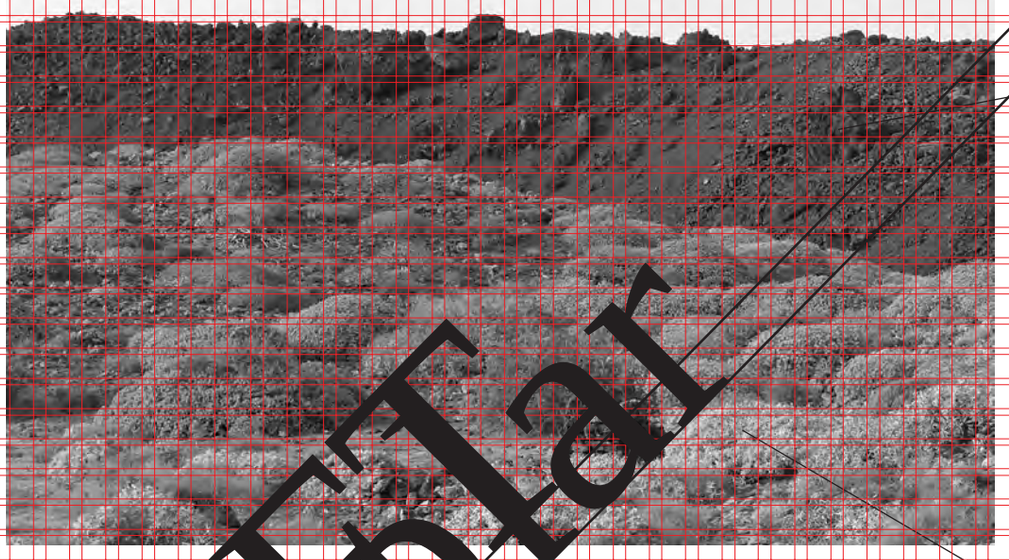
Sample

7 The island of Lanzarote is near the African coast and has a desert climate.

The photograph shows the edge of a lava flow from a volcano that erupted on this island about 200 hundred years ago.

In the foreground is an area that was not covered by the lava flow.

Over a long period of time, the lava will change to look like the climax community seen in the foreground.



(a) Explain how the edge of the lava flow will change over time to look like the foreground.

(4)

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(b) (i) King Juba's spurge, *Euphorbia regis-jubae*, is a plant that occupies a niche in the climax community.

Explain the niche occupied by King Juba's spurge.

(3)

(ii) King Juba's spurge grows very slowly on the island of Lanzarote.

Explain how climate affects the growth of King Juba's spurge on this island.

(4)

Partial Removal

(Total for Question 7 = 11 marks)

8 The stems of tomato plants can be green or purple, hairy or smooth.

The allele for purple stems (P) is dominant to the allele for green stems (p). The allele for hairy stems (H) is dominant to the allele for smooth stems (h).

(a) Two tomato plants, heterozygous for both stem characteristics, were crossed.

Draw a genetic diagram to show the expected ratio of phenotypes of the plants obtained from this cross.

(4)

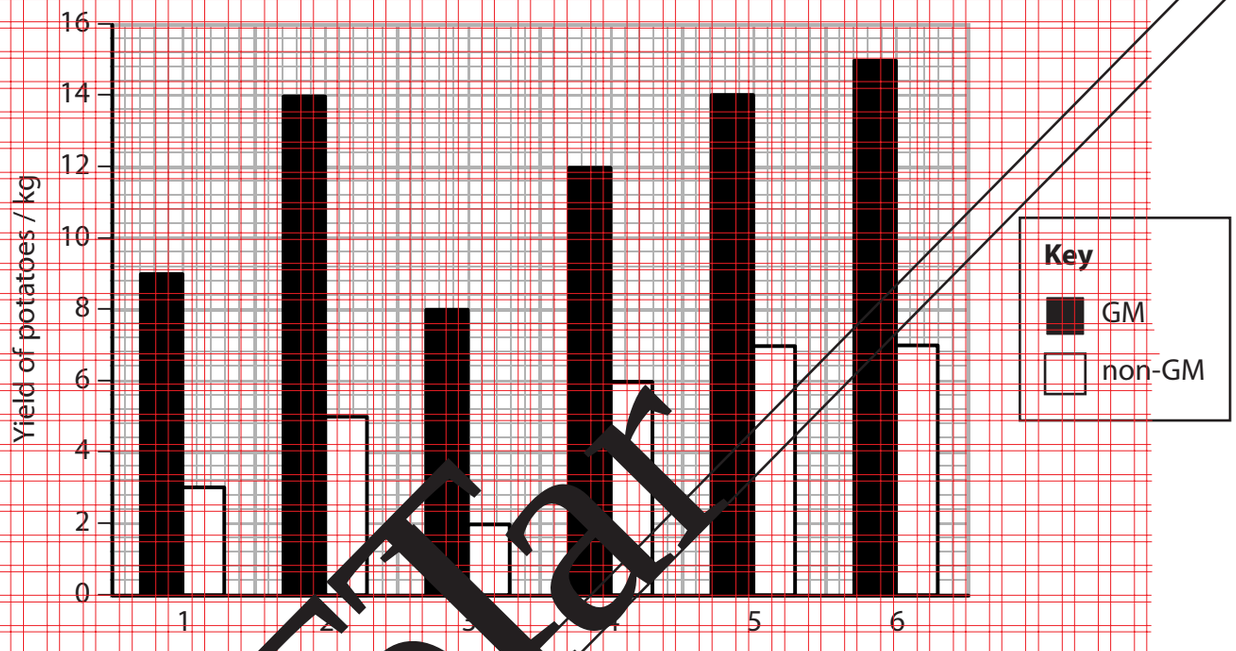
Exemplar

(b) Tomato plants and potato plants are both affected by a fungal disease called blight.

In 2014, a study was carried out to compare the yield of potatoes genetically modified (GM) for blight resistance with the yield of non-modified (non-GM) potatoes.

The study was carried out using 96 plants of each variety, equally divided between six different plots.

The graph shows the results of this study.



(i) Calculate the percentage change in yield due to blight resistance in plot 2.

(2)

Answer ..... %

Rapid

(ii) The raw data for potato yield in this study are shown in the table.

Plot number	Potato yield / kg	
	GM	non-GM
1	9.0	3.0
2	14.0	5.0
3	8.0	2.0
4	12.0	6.0
5	14.0	7.0
6	15.0	7.0
Mean	12.0	5.0
Standard Deviation	2.9	2.1

A Student's *t*-test was used to compare the potato yields.

State a suitable null hypothesis for this test.

(1)

.....

.....

.....

(iii) Calculate the value of *t* for the data to compare GM with non-GM potato yields, using the formula:

(3)

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}\right)}}$$

Answer .....

DRAFT

(iv) The table shows the critical values of *t* with 10 degrees of freedom.

Significance level (p)	0.2	0.1	0.05	0.025	0.01	0.005
Critical value of *t*	1.37	1.81	2.23	2.63	3.17	3.58

Use your value of *t* to test the validity of the null hypothesis.

(3)

(Total for Question 8 = 13 marks)

Sample

9 The ability to taste phenylthiocarbamide (PTC) depends on a single gene.

This gene has two alleles. One is a dominant, tasting allele (T), and the other is a recessive, non-tasting allele (t).

In a survey, it was found that 64% of people could taste PTC.

(a) The Hardy-Weinberg equation is

$$(p + q)^2 = 1$$

Use this equation to calculate the proportion of the population who would be TT, Tt and tt.

(4)

(b) There is no known selective advantage for being able to taste PTC.

(i) Describe two conditions under which these proportions remain the same over many generations.

(2)

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(ii) In native American populations 98% of individuals can taste PTC.

In native Australian population 58% of individuals can taste PTC.

State why these two populations have different frequencies of the T allele.

(3)

(Total for Question 9 = 9 marks)

Exemplar

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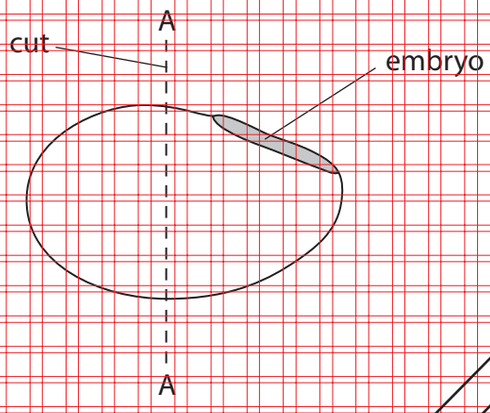
Exemplar

10 Gibberellin stimulates amylase activity. Amylase converts insoluble starch into maltose.

A student suggested that developing embryos in seeds produce gibberellin.

To test this idea, the student carried out two experiments.

In each experiment barley seeds were cut as shown in the diagram.



The seed halves were sterilised by washing in bleach.

In the first experiment, seed halves that contained an embryo were placed on sterile starch agar.

Seed halves without an embryo were placed on sterile starch agar and on sterile starch agar containing gibberellin.

The seed halves were incubated for 48 hours at 25 °C. Iodine solution was then poured over the agar.

The table shows the results of the student's first experiment.

Agar	Seed halves	Result
starch	with an embryo	clear area around seed halves
starch	without an embryo	no clear area around seed halves
starch + gibberellin	without an embryo	clear area around seed halves

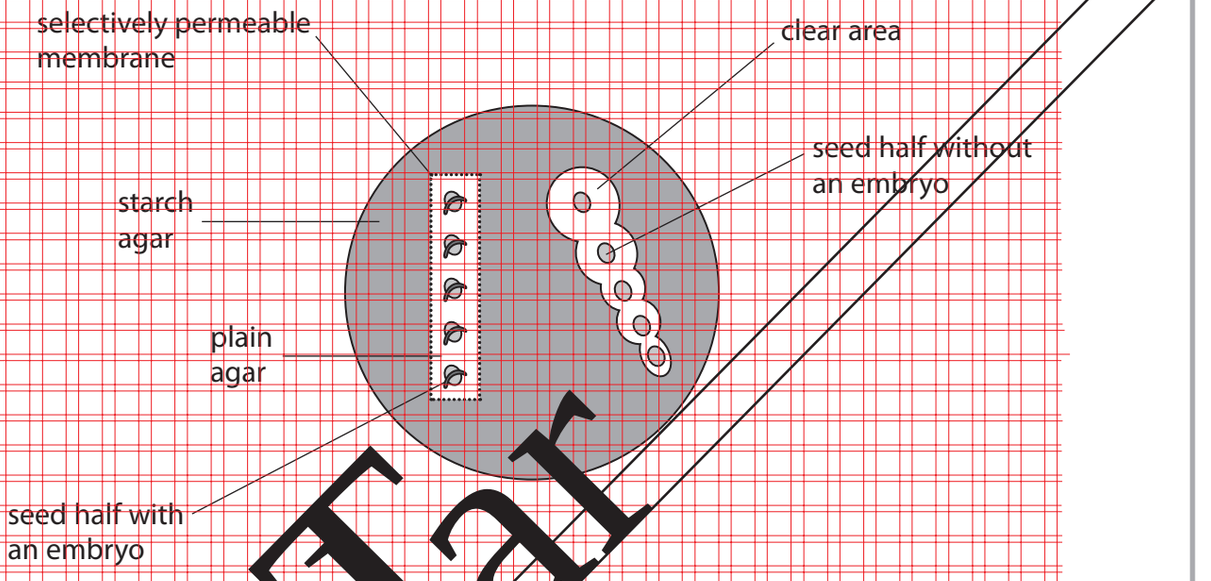
Partial

In the second experiment, seed halves containing an embryo were placed onto plain agar in a "boat" made from a selectively permeable membrane.

This boat was embedded in starch agar.

These seed halves were also incubated for 48 hours at 25 °C. Iodine solution was then poured over the agar.

The diagram shows the results from the second experiment.



(a) Explain why sterile conditions were maintained.

(2)

Exemplar

*(b) Analyse the data from these two experiments to explain the results obtained by the student.

(6)

(Total for Question 10 = 8 marks)

TOTAL FOR PAPER = 90 MARKS

Sample

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