Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Biology A (Salters Nuffield)

Advanced

Paper 1: The Natural Environment and Species Survival

Specimen Paper for first teaching September 2015

Time: 2 hours

Paper Reference

9BN0/01

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 100.
- 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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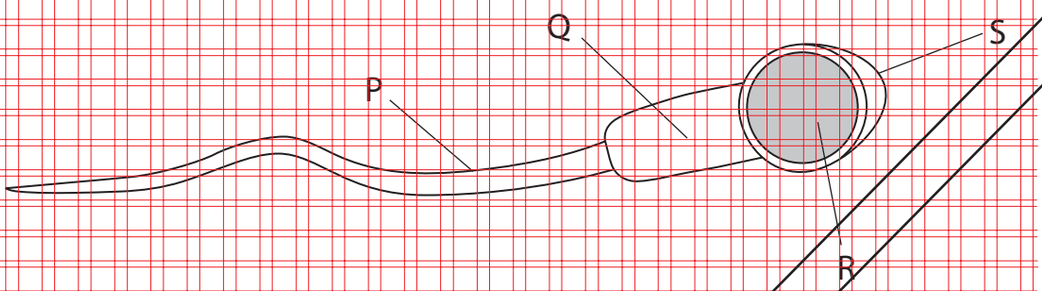
Answer ALL questions.

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 animals reproduce sexually.

The diagram shows a healthy human sperm cell.



Magnification ×4000

(a) (i) In which part of the sperm cell are the mitochondria located?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(ii) Which of the following is the approximate diameter of the sperm cell nucleus?

(1)

☒ **A** [illegible] m

☒ **B** [illegible] m

☒ **C** [illegible] nm

☒ **D** [illegible] nm

(iii) Which of the following describes the chromosome number in this human sperm cell?

(1)

☒ **A** diploid

☒ **B** haploid

☒ **C** polyploid

☒ **D** tetraploid

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(b) Explain why a defective acrosome reaction may result in male infertility.

(4)

(c) Males produce large numbers of sperm cells each with a different genotype.

Describe how the variation in sperm cell genotype arises.

(3)

(Total for Question 1 = 10 marks)

Partial

2 The movement of materials into and out of a cell needs to be controlled.

(a) Describe what is meant by the term **fluid mosaic** with reference to cell membranes.

(2)

(b) Goblet cells lining the bronchi produce mucus. This mucus is released by exocytosis.

(i) Explain how goblet cells release mucus by exocytosis.

(2)

(ii) The consistency of the mucus is determined by the movement of water, by osmosis, from the cells lining the bronchi.

Explain how the partial permeability of the surface membrane of the cells lining the bronchi allows osmosis to take place.

(2)

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(iii) Describe how thicker mucus would affect gas exchange across the walls of the alveoli.

(2)

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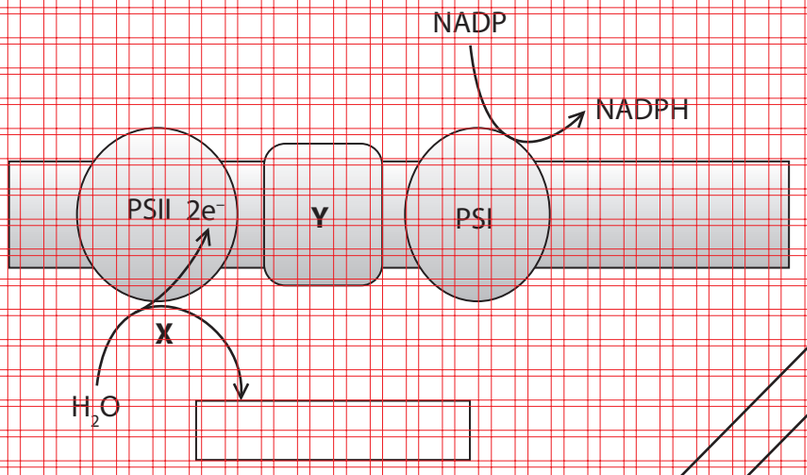
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(Total for Question 2 = 8 marks)

Partial

3 Photosynthesis is the process by which plants fix carbon.

(a) The diagram shows some of the light dependent reactions of photosynthesis.



(i) Complete the box with the products of the reaction at PSII.

(1)

(ii) Which of the following is the type of reaction taking place at **X**?

(1)

- ☒ **A** condensation
- ☒ **B** hydrolysis
- ☒ **C** photolysis
- ☒ **D** reduction

(iii) Which of the [illegible] molecules are found in the PSI and PSII?

(1)

- ☒ **A** ATP
- ☒ **B** ATP synthase
- ☒ **C** chlorophyll
- ☒ **D** RUBISCO

(iv) Which part of the chloroplast does the reduction of NADP take place?

(1)

- ☒ **A** chloroplast outer membrane
- ☒ **B** chloroplast stroma
- ☒ **C** granum
- ☒ **D** thylakoid lumen

Draft

(v) Describe the role of the group of membrane proteins represented by **Y** in the diagram.

(2)

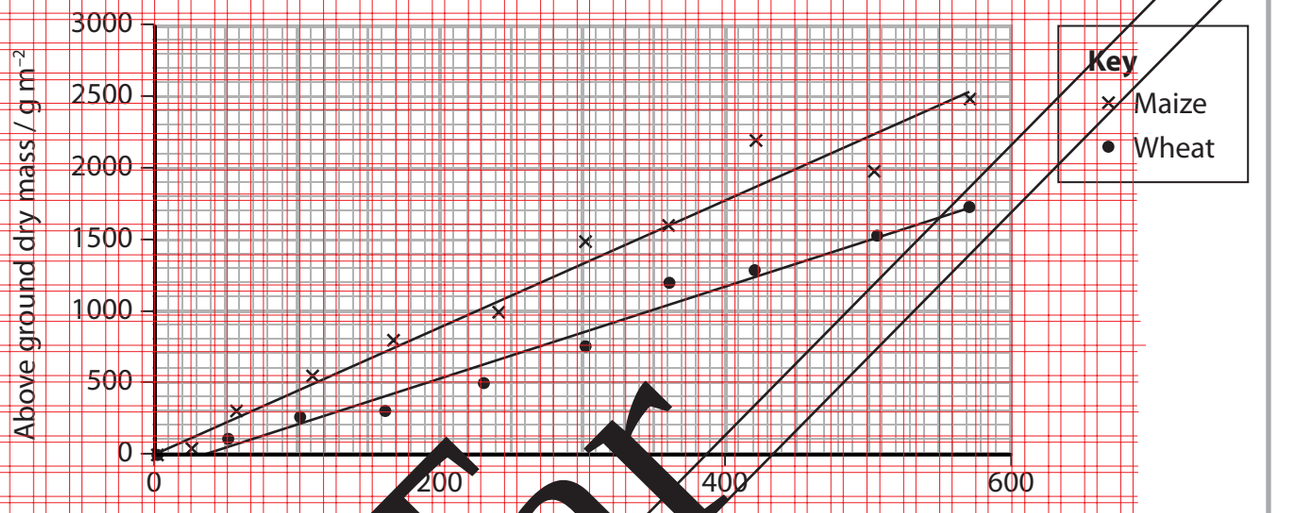
Exemplar

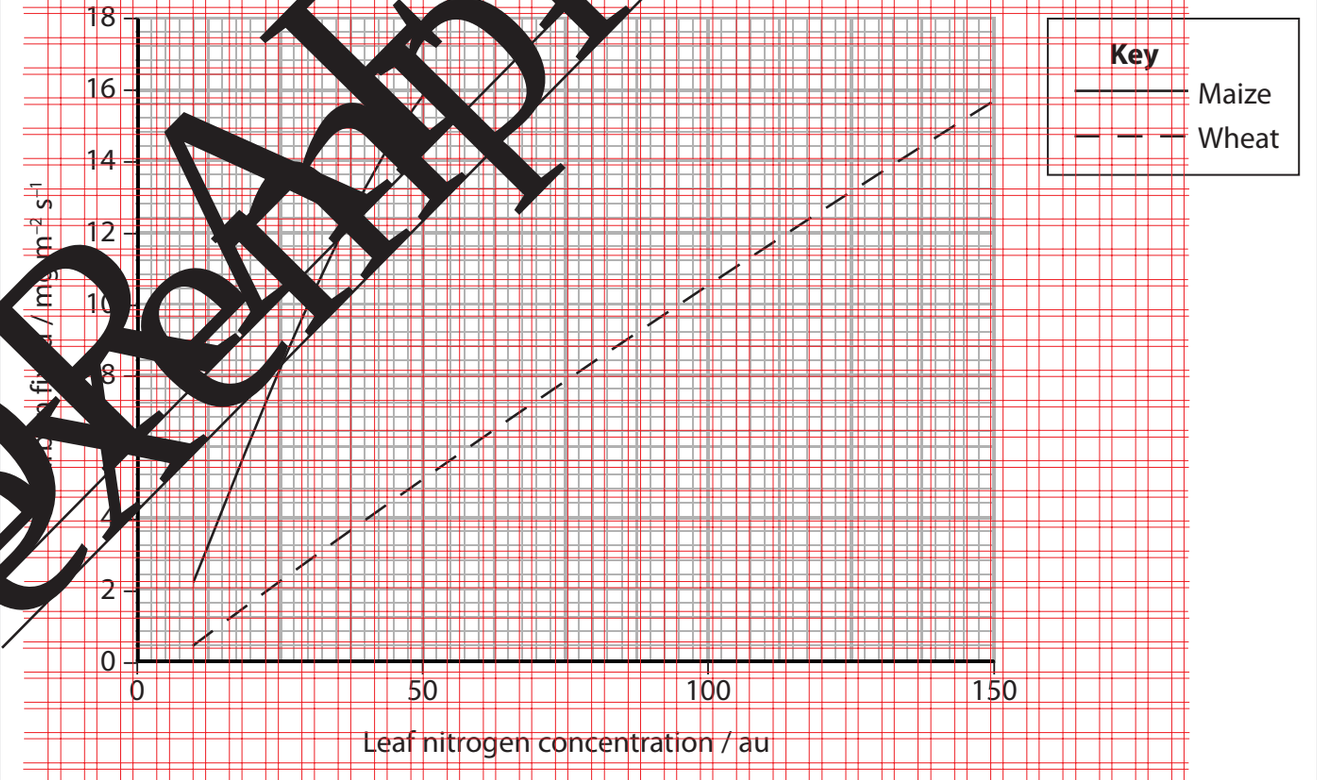
(b) Wheat and maize are used as biofuel crops.

Scientists have investigated the effect of incident radiation and leaf nitrogen concentration on the growth of wheat and maize.

Incident radiation is a measure of the useful light energy hitting the plant.
Leaf nitrogen concentration is a measure of the availability of nitrogen in the soil.

The results of these investigations are shown in the graphs.





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(i) Scientists calculated the dry mass produced per MJ of incident radiation for wheat. This is shown in the table.

Plant	Above ground dry mass / g MJ^{-1}
Wheat	3.25

Calculate the above ground dry mass produced per MJ of incident radiation for maize.

(2)

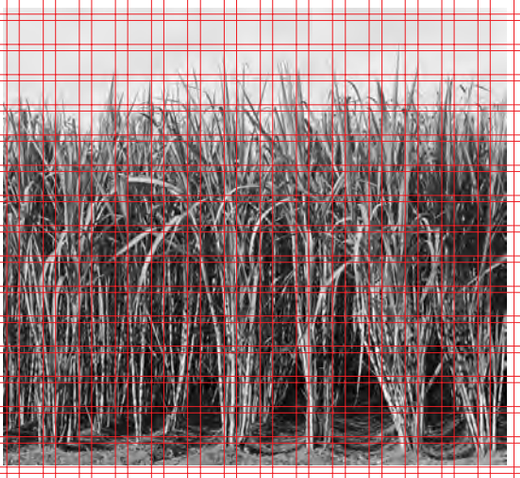
Answer ..... g MJ^{-1}

(ii) Analyse the information provided about maize and wheat to determine which crop should be used for the production of biofuels.

(2)

Sample

(iii) Sugar cane crops are also being grown for the production of biofuel.



Devise an experiment to investigate the effect of light intensity on the above ground dry mass of sugar cane crops grown in a field.

(5)

Exemplar

(Total for Question 3 = 15 marks)

4 Lysozyme is one component of the non-specific response to infection.

(a) Describe what is meant by a non-specific response to infection.

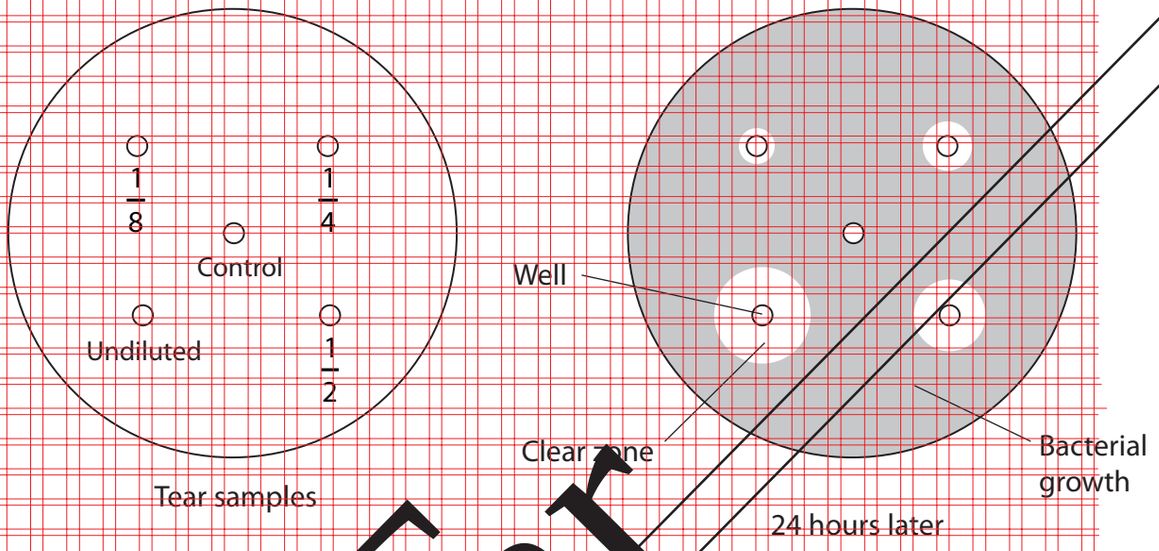
(3)

Partial

(b) A student investigated the activity of lysozyme in tears.

A suspension of bacteria was mixed with molten agar and poured into a Petri dish. After the agar had solidified, wells were cut and different dilutions of tear sample were placed in the wells.

After 24 hours the Petri dish was inspected.



(i) State the relationship between lysozyme dilution and the size of the clear zone.

(1)

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.....

(ii) Calculate the area of the clear zone for the undiluted tear sample.

(Area of a circle = πr^2)

(2)

Exemplar

(c) Explain how the student could adapt the investigation to study the effect of pH on the activity of lysozyme.

(3)

(Total for Question 4 = 9 marks)

Partial

5 Madagascar is an island rich in biodiversity.

Lemurs are a diverse group of primates endemic to Madagascar.

Scientist suggest there may be as many as 100 different species of lemur.

(a) (i) State what is meant by the term **endemic**.

(1)

(ii) Describe what is meant by **biodiversity**.

(2)

(iii) Explain how the biodiversity of two different parts of Madagascar could be compared.

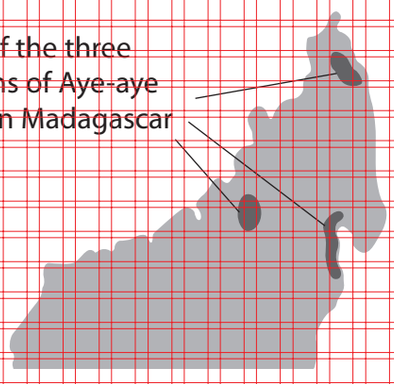
(3)

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(b) One species of lemur, the Aye-aye, is found throughout the forests of Northern Madagascar.

Deforestation is taking place in this part of Madagascar.

Scientists have identified three separate populations of Aye-aye in this area, as shown on the map.



Explain how these three populations could become distinct species.

(3)

SAMPLE

(Total for Question 5 = 9 marks)

6 Ebola haemorrhagic fever is a life-threatening disease caused by the Ebola virus.

(a) Explain why antibiotics are not used to treat Ebola haemorrhagic fever.

(2)

(b) Some of the blood plasma of individuals who have survived infection with Ebola can be collected. This can be used in the treatment of individuals currently infected with Ebola.

Explain why the blood plasma from survivors can be used to treat new cases of Ebola infection.

(3)

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(c) A study of the 2014 Ebola outbreak in Sierra Leone found that the Ebola virus was evolving rapidly.

Explain why the evolution of the virus might reduce the effectiveness of any vaccine being developed.

(4)

SAMPLE

(Total for Question 6 = 9 marks)

7 Tissues of the human body have different stem cell populations.

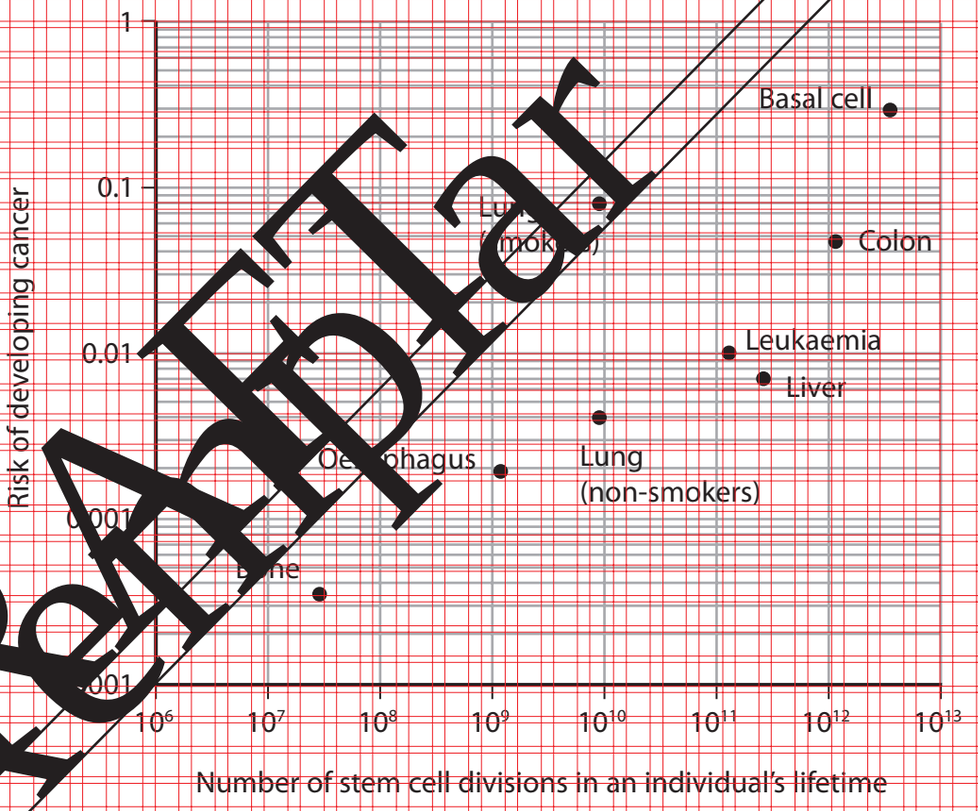
These stem cells divide to replace and renew cells in these tissues.

(a) Describe the properties of a stem cell.

(2)

(b) Scientists have observed a relationship between the number of times a stem cell population divides in a tissue and the risk of developing cancer in that tissue.

This relationship is shown in the graph.



DO NOT COPY

(i) The correlation coefficient for the data is 0.937.

The table shows some critical values for this correlation coefficient.

Critical values for the correlation coefficient	
n	**p = 0.05**
4	1.00
5	0.90
6	0.83
7	0.71
8	0.64
9	0.60
10	0.56

Which of the following correctly describes the correlation?

(1)

☒ **A** non-significant and positive

☒ **B** non-significant and negative

☒ **C** significant and positive

☒ **D** significant and negative

(ii) Explain the relationship between the number of stem cell divisions and the risk of developing cancer.

(2)

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Partial Exemplar

(iii) The graph shows that the risk of developing lung cancer is greater in a cigarette smoker compared to a non-smoker.

Calculate how many times greater.

(2)

Answer .....

(iv) Explain why cigarette smokers have a higher risk of developing lung cancer than non-smokers.

(2)

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(Total for Question 7 = 9 marks)

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8 Crustose coralline algae are a group of photosynthetic red algae that play an important role in the formation of coral reefs.

These algae deposit calcium carbonate in their cell walls to form encrusting and rock-like structures.

(a) (i) Write an expression that describes net productivity.

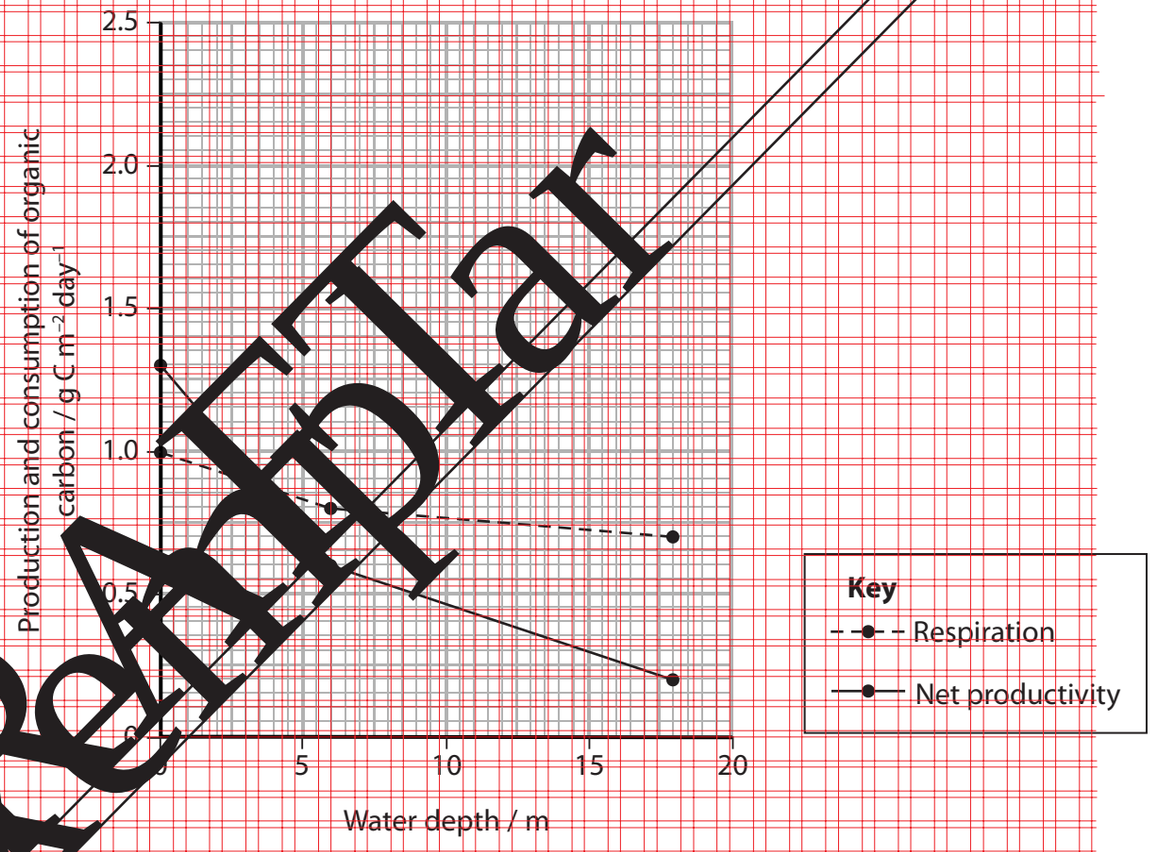
(1)

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(ii) The graph shows net productivity and respiration for one species of crustose coralline algae found at different water depths.



On the graph, plot the gross productivity for this species.

(1)

Partial Redacted

(iii) Analyse the data to explain the effect of water depth on net productivity.

(3)

*(b) Scientists investigated the effect of water temperature and carbon dioxide concentration on the growth of one species of crustose coralline algae.

The growth was measured by recording the percentage cover of the algae on a surface.

The results of this investigation are shown in the table.

Growth conditions		Percentage cover (%)
Temperature / °C	CO_2 concentration / ppm	
17	400	100
17	700	70
20	400	100
20	700	35

The normal temperature and carbon dioxide concentration in the natural habitat of this species are 17°C and 400 ppm CO_2.

DRAFT

Analyse the data in the graph and the table to assess the possible impact of the continued burning of fossil fuels on crustose coralline algae.

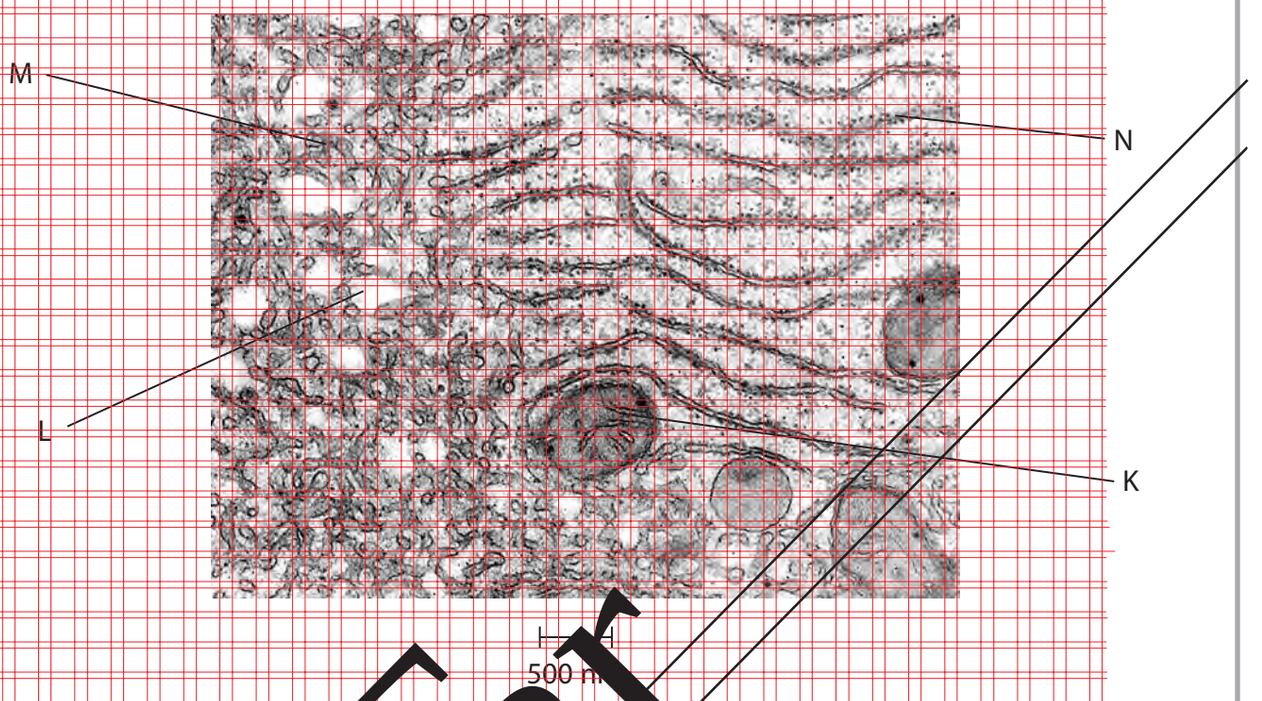
(6)

Exemplar

(Total for Question 8 = 11 marks)

9 Liver cells synthesise and export a variety of proteins.

(a) The image is a transmission electron micrograph of part of a liver cell.



(i) Which of the following structures is involved in respiration?

(1)

- ☒ **A** K
- ☒ **B** L
- ☒ **C** M
- ☒ **D** N

(ii) Which of the following structures is involved in synthesising lipids?

(1)

- ☒ **A** K
- ☒ **B** L
- ☒ **C** M
- ☒ **D** N

ExamPlar

(iii) The site of synthesis of proteins to be released by exocytosis is

(1)

- ☒ **A** K
- ☒ **B** L
- ☒ **C** M
- ☒ **D** N

(iv) Calculate the maximum width of the structure labelled **K**.

(2)

Maximum length ..... nm

(b) Collagen is a fibrous protein.

Explain how the structure of collagen is related to its function.

(4)

Partial Removed

(c) Fibrosis of the liver is a chronic condition that can lead to cirrhosis of the liver and liver failure.

In fibrosis of the liver, liver cells secrete excess collagen.

There is an association between fibrosis of the liver and alcohol consumption in humans.

Scientists have investigated the effects of alcohol intake on collagen synthesis in rats.

The results are shown in the table.

Alcohol intake / week	Synthesis of collagen in the liver / au
none	14
small volume each day	16
one large volume on day one	19
one large volume on day one and a small volume from day two and day seven	27

(i) Deduce the effect of alcohol intake on fibrosis of the liver in rats.

(3)

Exemplar

(ii) The scientists have suggested that epigenetic events are involved in regulating collagen synthesis in rats given alcohol.

Explain how epigenetic events might be involved in regulating collagen synthesis in rats given alcohol.

(2)

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(Total for Question 9 = 14 marks)

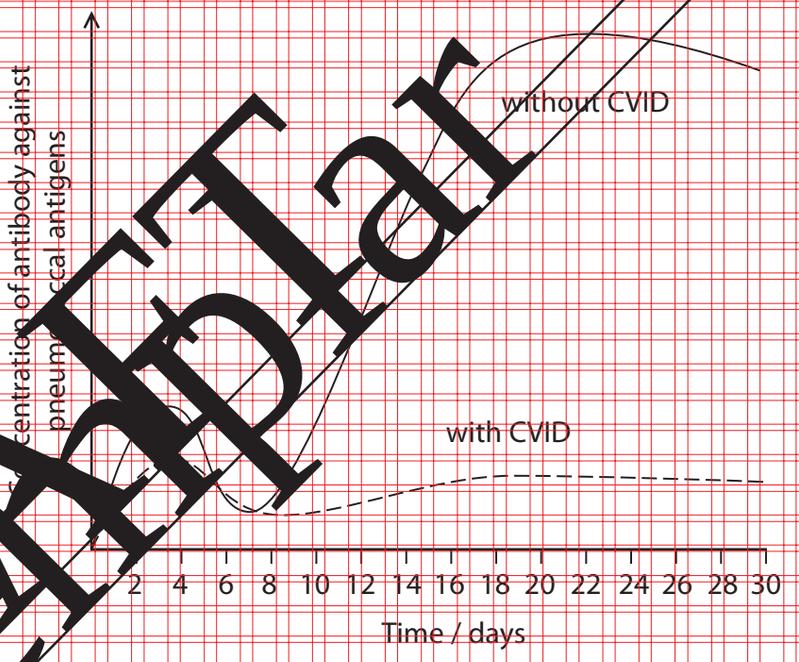
Sample

10 Common variable immunodeficiency (CVID) is one of the most commonly diagnosed immunodeficiency disorders.

The infection history of a group of individuals with CVID is summarised in the table.

Type of infection	Characteristics of infection	
	Frequency of infection	Severity of infection
Bacterial	Much more frequent than expected	Effects of infection are more serious than in the general population
Viral	Slightly higher frequency than expected	Effects of infection are comparable to infection in the general population

The average antibody response of two groups, following immunisation with a bacterial pneumococcal vaccine, is shown in the graph.



DRAFT

The distribution of lymphocytes in the blood for the two groups is shown in the table.

Group	Percentage of white blood cells (%)		T helper cell : T killer cell ratio
	B lymphocytes	T lymphocytes	
With CVID	8	78	1.7 : 1
Without CVID	14	80	1.5 : 1

Analyse the data to evaluate how the immunological defect in the group with CVID might be treated.

(6)

SAMPLE

(Total for Question 10 = 6 marks)

TOTAL FOR PAPER = 100 MARKS

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Exemplar

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