Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number	Candidate Number

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Monday 12 June 2017 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
WBI04/01

You must have:
Calculator, HB pencil, ruler

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.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

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.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

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

Turn over ▶

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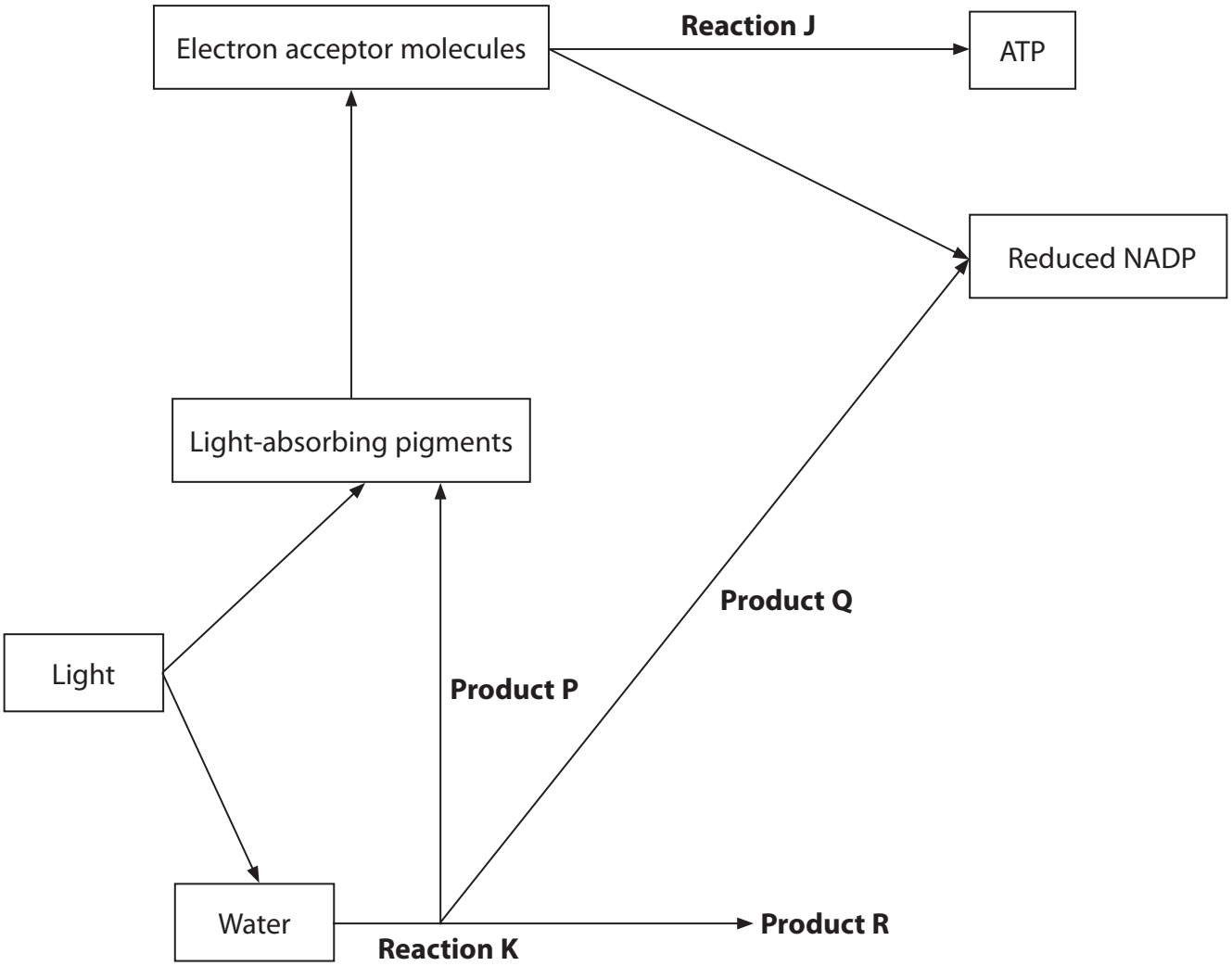
Pearson

Answer ALL questions.

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 Photosynthesis involves light-dependent and light-independent reactions.

The diagram below shows some of the stages in the light-dependent reaction of photosynthesis.



(a) Put a cross (☒) in the box next to the row in the table that correctly identifies the products **P**, **Q** and **R** made from **one** molecule of water.

(1)

	Product P	Product Q	Product R
☒ **A**	electrons	hydrogen ions	oxygen atom
☒ **B**	electrons	hydrogen molecule	oxygen molecule
☒ **C**	oxygen atom	electrons	hydrogen ions
☒ **D**	oxygen molecule	hydrogen molecule	electrons

(b) Put a cross (☒) in the box next to the name of reaction **K**.

(1)

☒ **A** condensation

☒ **B** hydrolysis

☒ **C** photolysis

☒ **D** reduction

(c) Explain how reaction **J** is involved in the production of ATP in chloroplasts.

(3)

(d) Explain the roles of ATP and reduced NADP in the light-independent reaction.

(3)

(Total for Question 1 = 8 marks)

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2 Understanding the rate of decomposition of different types of tree is important in forest management.

Pine trees have modified leaves called pine needles. The decomposition rate of pine needles was studied.

The photograph below shows some pine needles.

Magnification ×0.5

One kilogram of pine needles was left to decompose for 50 months. The mass of needles remaining was recorded every five months.

The results of this study indicated that there were three phases of decomposition:

Phase 1 starch breakdown

Phase 2 cellulose breakdown

Phase 3 lignin breakdown

The table below shows the results of this study.

Phase of decomposition	Time / months	Mass of needles remaining (g)
Phase 1 starch breakdown	5	900
Phase 2 cellulose breakdown	10	780
	15	680
	20	580
	25	480
	30	380
	35	280
	40	180
Phase 3 lignin breakdown	45	180
	50	180

(a) Suggest how the starch content of the pine needles is decreased in phase 1.

(2)

(b) Calculate the percentage of mass lost in phase 2.

(2)

Answer .....%

(c) The breakdown of the starch in phase 1 and of the cellulose in phase 2 is related to their structure.

Compare the structure of cellulose with that of starch.

(2)

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(d) In phase 3, lignin is broken down.

Describe the role of lignin in xylem vessels.

(2)

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(Total for Question 2 = 8 marks)

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3 *Paramecium* is a single-celled eukaryotic organism. *Paramecium* feeds on bacteria.

The photograph below shows a *Paramecium*.

Magnification ×300

(a) The table below shows some structures which may be found in *Paramecium* and / or bacteria.

For each structure, put **one** cross in the appropriate box (☒), in each row, to show where these structures are found.

(3)

Structure found in	Cell membrane	Mitochondrion	Small (70S) ribosome	Chloroplast
Both *Paramecium* and bacteria	☒	☒	☒	☒
Paramecium but **not** bacteria	☒	☒	☒	☒
Bacteria but **not** *Paramecium*	☒	☒	☒	☒

(b) The concept of niche is supported by the work of Gause in the early 1930s.

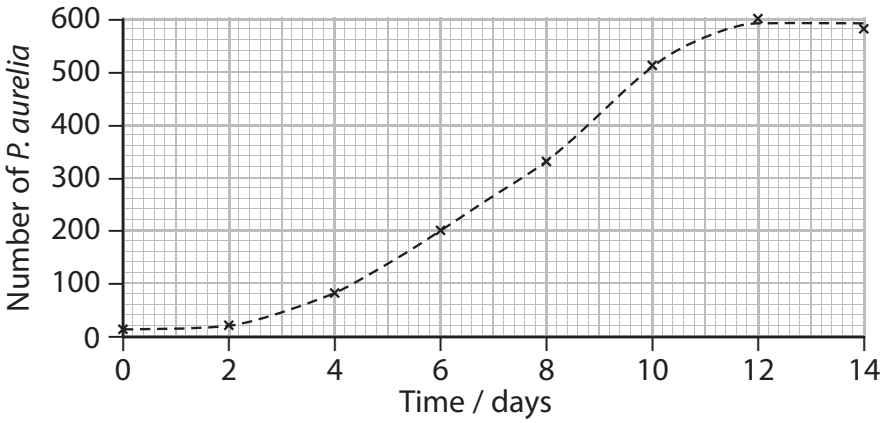
Gause grew two species of *Paramecium*, *P. aurelia* and *P. caudatum*, in separate cultures. Each culture contained the same concentration of bacteria as a food source for the *Paramecium*.

Gause also grew these two species of *Paramecium* together in the same culture under the same conditions.

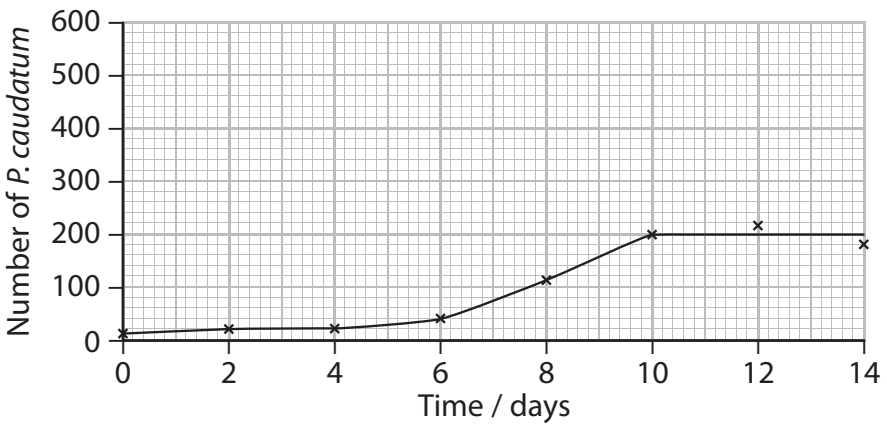
He determined the number of each species of *Paramecium* in each culture over a 14-day period.

The graphs below show the results of these experiments.

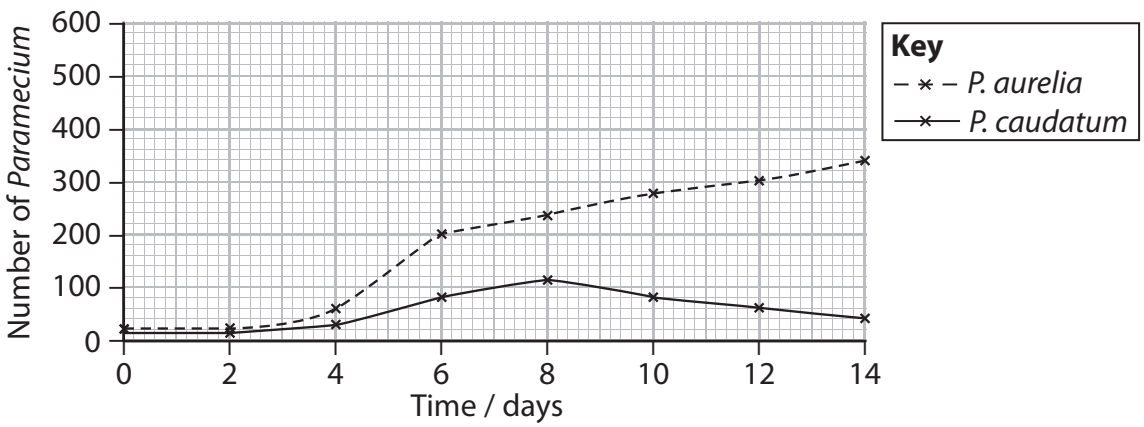
P. aurelia



P. caudatum



P. aurelia and *P. caudatum* cultured together



(i) Compare the growth of *P. aurelia* with the growth of *P. caudatum* when the two species are grown in separate cultures.

(3)

(ii) Describe how culturing *P. aurelia* and *P. caudatum* together affected the growth of each species after 10 days.

(2)

(iii) Explain how the results of these experiments support the concept of niche.

(3)

(Total for Question 3 =11 marks)

4 Seaweeds are plant-like organisms that live attached to rocks on seashores. They have cell walls and possess chloroplasts for photosynthesis.

(a) Describe the structure of a plant cell wall.

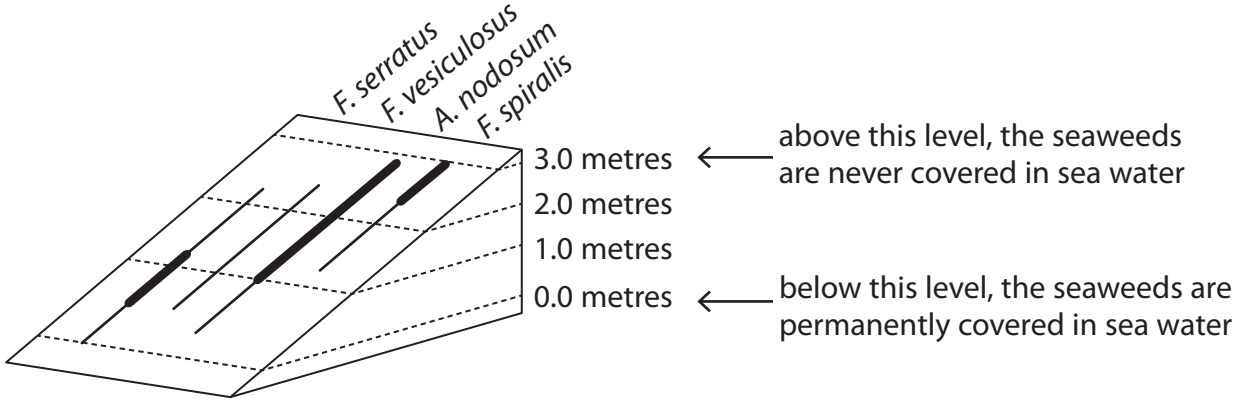
(3)

(b) The table below shows information about four species of seaweed.

Species of seaweed	*Fucus spiralis*	*Ascophyllum nodosum*	*Fucus vesiculosus*	*Fucus serratus*
Photographs not to the same scale				
Thickness of cell wall / μm	1.47	1.02	0.69	0.42

On the diagram below, each line represents the abundance and distribution of these seaweeds on a seashore.

The length of the line shows where each seaweed is found. The thickness of the line shows how much of each seaweed is present.



(i) Use the information in the table and the diagram to explain the distribution of these seaweeds on the seashore.

(4)

*(ii) Describe how an investigation could be carried out to compare the distribution and abundance of these seaweeds on another seashore.

(6)

(Total for Question 4 =13 marks)

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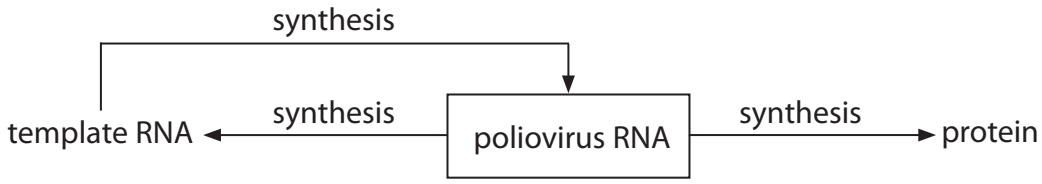
5 Poliomyelitis (polio) is a disease of the central nervous system. It is an infectious disease caused by a poliovirus.

There are three pathogenic strains of poliovirus. These strains have different antigens.

The poliovirus is a single-stranded RNA virus.

The diagram below shows some steps involved in the replication of a poliovirus.



*(a) Explain how protein and copies of the poliovirus RNA are synthesised from the poliovirus RNA.

(6)

(b) Vaccines are available for immunisation against polio.

These vaccines result in artificial active immunity.

(i) Explain the meaning of the term **artificial active immunity**.

(3)

(ii) Explain why vaccines against polio contain inactive forms of all three strains of poliovirus.

(4)

(Total for Question 5 =13 marks)

6 In November 2015, the first genetically modified (GM) organism was declared safe to eat. The organism was a salmon.

Salmon lay eggs.

The GM salmon was created by putting a gene involved in controlling growth into an egg of an Atlantic salmon.

The photograph below shows an Atlantic salmon.

Magnification ×0.25

The GM salmon takes 16 to 18 months to reach the size that the Atlantic salmon reaches in three years.

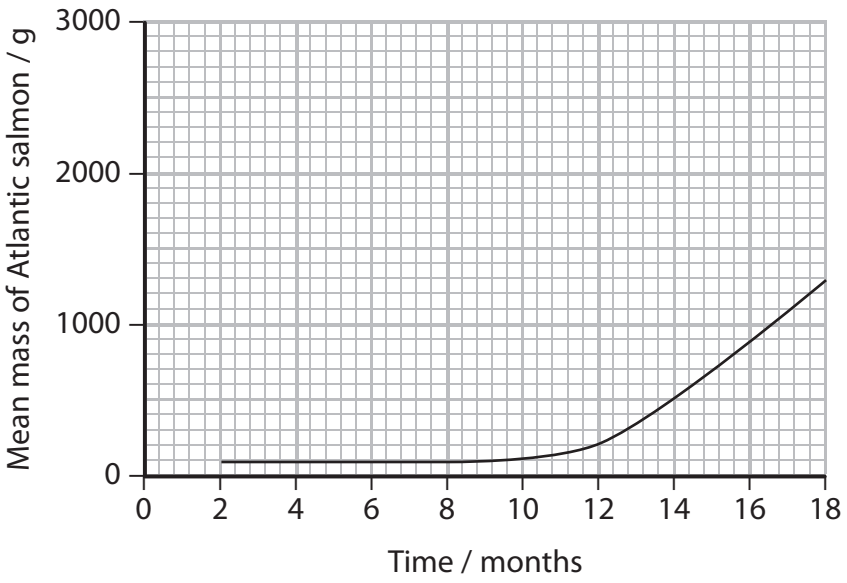
The table below shows the mass and length of each salmon after 18 months.

Type of salmon	Mean mass of salmon / kg	Mean length of salmon / cm
Atlantic salmon	1.3	33.0
GM salmon	3.0	61.0

(a) Use the information in the table to describe the differences in these two types of salmon after 18 months.

(2)

(b) The graph below shows the increase in mass of an Atlantic salmon.



(i) Use the information in the graph to calculate the mean growth rate of the Atlantic salmon during this time period.

(3)

Answer .....

(ii) On the graph, draw a line to show the probable increase in mass of the GM salmon over the same time period.

(1)

(iii) Describe an experiment that could be carried out to confirm the increase in mass of the GM salmon for this time period.

(3)

(c) The differences in the DNA of these two types of salmon can be identified.

(i) Put a cross (☒) in the box next to the name of the process that can be used to identify these differences.

(1)

☒ **A** dendrochronology

☒ **B** gel electrophoresis

☒ **C** polymerase chain reaction

☒ **D** proteomics

(ii) Describe the differences in the DNA that might be seen using this process.

(2)

(Total for Question 6 = 12 marks)

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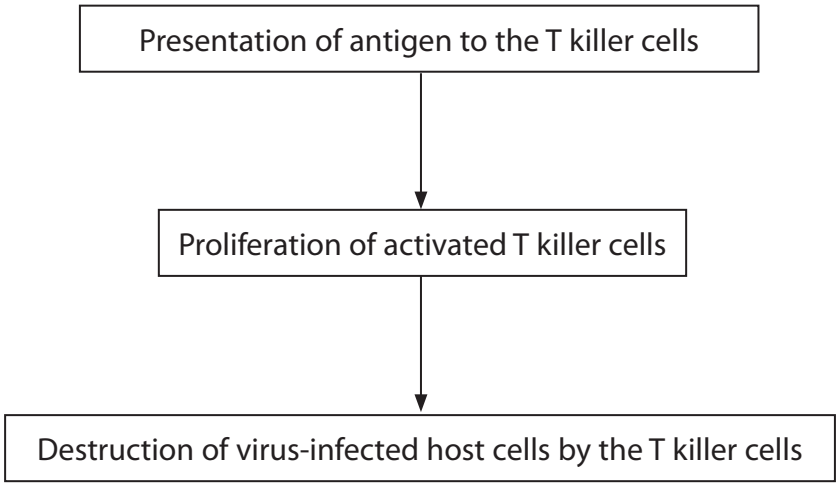
7 Virus-infected host cells are destroyed by T killer cells.

(a) The flow chart below shows some of the steps that occur in this process.



(i) Put a cross (☒) in the box next to the name of the antigen-presenting cell involved in the activation of T killer cells.

(1)

☒ **A** B cell

☒ **B** plasma cell

☒ **C** T helper cell

☒ **D** virus-infected host cell

(ii) Explain the importance of mitosis in the proliferation of activated T killer cells.

(2)

(iii) Explain how virus-infected host cells are destroyed by T killer cells.

(2)

(b) Macrophages are involved in the immune response against virus infections.

(i) Describe the role of macrophages in the activation of T killer cells.

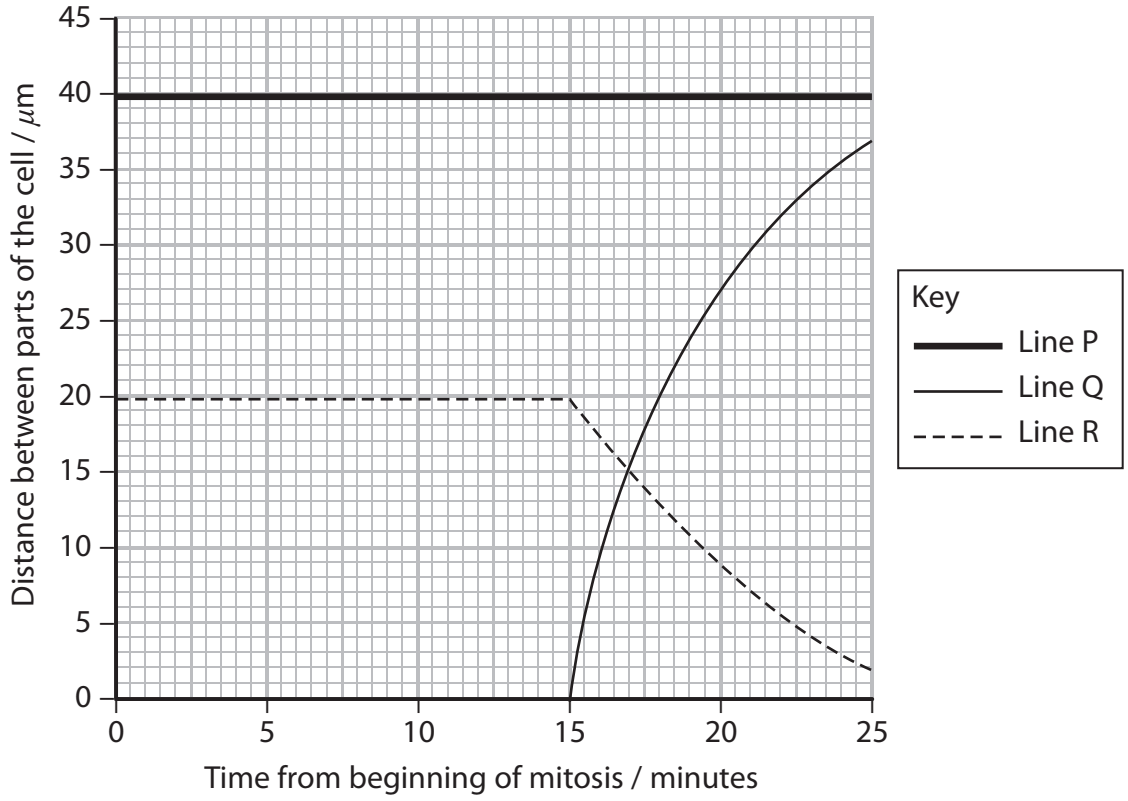
(2)

(ii) Describe the role of macrophages in the destruction of viruses.

(3)

(c) Mitosis takes place during the proliferation of T killer cells.

The graph below shows the changes in distance that occur between the parts of the cell during mitosis.



(i) Complete the table to identify which line represents the distances between parts of the cell.

(2)

Distance between	Line
Two poles of the cell	
A chromosome and a pole	
Two identical chromosomes	

(ii) Put a cross (☒) in the box next to the time at which anaphase begins.

(1)

☒ **A** 0 minutes

☒ **B** 15 minutes

☒ **C** 17 minutes

☒ **D** 25 minutes

(Total for Question 7 = 13 marks)

8 In 1999, scientists used forensic entomology to determine the time of death of two illegally-killed black bear cubs.

When the cubs were discovered, there were adult blow flies on their bodies and blow fly eggs in their wounds.

The table below shows the timeline of the investigation and some of the observations made.

Date	Time	Stage of the investigation	Stage of insect life cycle
14th July	16:00	Cubs discovered	Eggs
14th July	16:45	Evidence collected	Eggs
14th July	17:12	50% eggs preserved in alcohol 50% eggs incubated with bear liver	Eggs
14th July	21:00	Observations of collected eggs	Eggs
15th July	07:45	Observations of collected eggs	30% eggs hatched into maggots
15th July	16:45	Observations of collected eggs	90% eggs hatched into maggots

(a) (i) Suggest why some of the eggs were preserved in alcohol.

(1)

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(ii) Suggest why some of the blow fly eggs were incubated with bear liver.

(2)

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(iii) Use the information in the table to give the time period in which the eggs started to hatch into maggots.

(1)

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(iv) Suggest why all the eggs do not hatch at the same time.

(1)

(b) The eggs of three species of blow fly were found on the cubs.

The scientists knew that these species of blow fly do not lay their eggs when it is dark.

The table below shows the time taken for the eggs of these three species of blow fly to hatch into maggots, at different temperatures.

Species of blow fly	Temperature / °C	Time taken for the eggs to hatch into maggots / hours
P. regina	23.1	21.5 to 22.5
P. sericata	22.0	23.0
L. illustris	21.2	19.3 to 44.0

(i) Explain why the time taken for the eggs to hatch is dependent on the temperature.

(3)

(ii) The scientists estimated that the time of death was in the early hours of the 14th July.

Using the information provided, explain why the actual time of death could only be an estimate.

(2)

(c) Explain why it is necessary to use several pieces of information to determine the time of death of an organism.

(2)

(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 90 MARKS

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