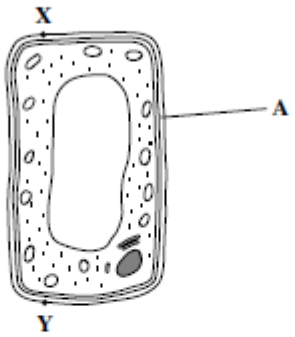
1 (a) Name the process in which cells become adapted for different functions.

.....

(1 mark)

1 (b) Palisade cells are found in leaves. The diagram shows a palisade cell.



1 (b) (i) Name structure **A**.

.....

(1 mark)

1 (b) (ii) The real length of this cell between **X** and **Y** is 20 micrometres (µm). By how many times has it been magnified? Show your working.

Answer .....

(2 marks)

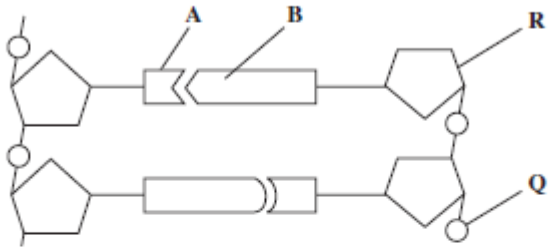
1 (b) (iii) Explain **one** way in which this cell is adapted for photosynthesis.

.....

(1 mark)

2 **Figure 1** shows a short section of a DNA molecule.

Figure 1



(a) Name parts **R** and **Q**.

(a) (i) **R** .....

(a) (ii) **Q** .....

(2 marks)

(b) Name the bonds that join **A** and **B**.

.....

(1 mark)

(c) Ribonuclease is an enzyme. It is 127 amino acids long.

What is the minimum number of DNA bases needed to code for ribonuclease?

(1 mark)

(d) **Figure 2** shows the sequence of DNA bases coding for seven amino acids in the enzyme ribonuclease.

Figure 2

G T T T A C T A C T C T T C T T C T T T A

The number of each type of amino acid coded for by this sequence of DNA bases is shown in the table.

Amino acid	Number present
Arg	3
Met	2
Gln	1
Asn	1

Use the table and **Figure 2** to work out the sequence of amino acids in this part of the enzyme. Write your answer in the boxes below.

Gln						

(1 mark)

(e) Explain how a change in a sequence of DNA bases could result in a non-functional enzyme.

.....

(3 marks)

3 A student found the number of stomata per cm^2 on the lower surface of a daffodil leaf. He removed a small, thin piece of lower epidermis and mounted it on a microscope slide. He examined the slide using an optical microscope.

(a) Explain why it was important that the piece of the epidermis that the student removed was thin.

.....

(2 marks)

(b) Suggest how the student could have used his slide to find the number of stomata per cm^2.

.....

(3 marks)

(c) The stomata on the leaves of pine trees are found in pits below the leaf surface. Explain how this helps to reduce water loss.

.....

(2 marks)

4)

Taxol is a drug used to treat cancer. Research scientists investigated the effect of injecting taxol on the growth of tumours in mice. Some of the results are shown in **Figure 3**.

Figure 3

Number of days of treatment	Mean volume of tumour / mm^3	
	Control group	Group injected with taxol in saline
1	1	1
10	7	2
20	21	11
30	43	20
40	114	48
50	372	87

(a) Suggest how the scientists should have treated the control group.

.....

(2 marks)

(b) Suggest and explain **two** factors which should be considered when deciding the number of mice to be used in this investigation.

.....

(2 marks)

(c) The scientists measured the volume of the tumours. Explain the advantage of using volume rather than length to measure the growth of tumours.

.....

(1 mark)

(d) The scientists concluded that taxol was effective in reducing the growth rate of the tumours over the 50 days of treatment. Use suitable calculations to support this conclusion.

(2 marks)

(e) In cells, taxol disrupts spindle activity. Use this information to explain the results in the group that has been treated with taxol.

.....

(3 marks)

(f) The research scientists then investigated the effect of a drug called OGF on the growth of tumours in mice. OGF and taxol were injected into different mice as separate treatments or as a combined treatment. **Figure 4** and **Figure 5** show the results from this second investigation.

Figure 4

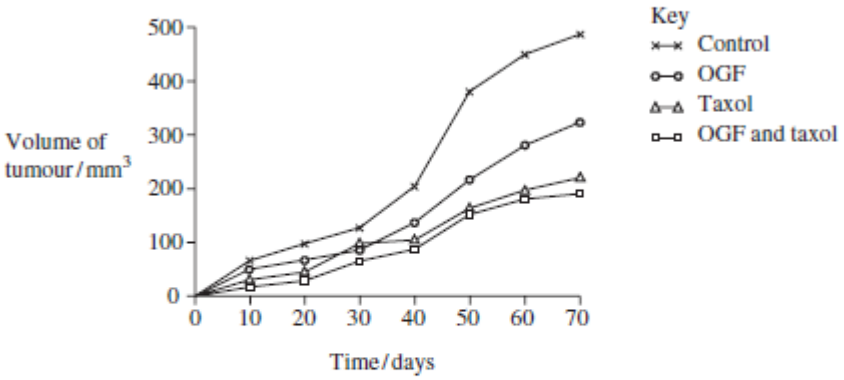


Figure 5

Treatment	Mean volume of tumour following 70 days treatment / mm^3 (± standard deviation)
OGF	322 (± 28.3)
Taxol	207 (± 22.5)
OGF and taxol	190 (± 25.7)
Control	488 (± 32.4)

(f) (i) What information does standard deviation give about the volume of the tumours in this investigation?

.....

(1 mark)

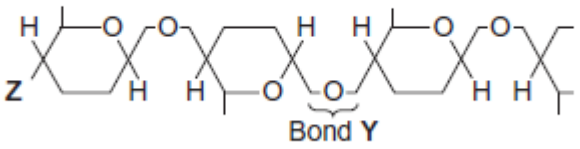
(f) (ii) Use **Figure 4** and **Figure 5** to evaluate the effectiveness of the two drugs when they are used separately and as a combined treatment.

.....

(4 marks)

5)

The diagram shows one end of a cellulose molecule.



(a) (i) Name the monomers that form a cellulose molecule.

.....

(1 mark)

(a) (ii) Name bond **Y**.

.....

(1 mark)

(a) (iii) What chemical group is at position **Z**?

.....

(1 mark)

(b) (i) Complete the table to show **two** ways in which the structure of cellulose is different from the structure of starch.

Starch	Cellulose

(2 marks)

(b) (ii) Explain **one** way in which the structure of cellulose is linked to its function.

.....

(2 marks)

6)

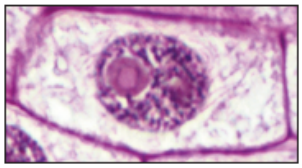
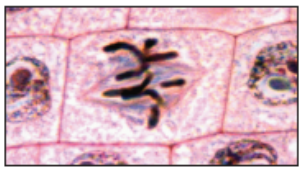
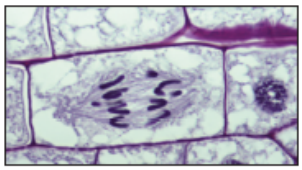
(a) Mitosis is important in the life of an organism. Give **two** reasons why.

.....

(2 marks)

A biologist used a microscope to investigate plant tissue where some of the cells were dividing by mitosis. She examined 200 cells and counted the number of cells in interphase and in each stage of mitosis.

The table shows some of the cells she saw, and the percentage of cells in interphase and in two stages of mitosis, **A** and **B**.

Stage of cell cycle	Percentage of cells
Interphase 	90
Stage **A** 	3
Stage **B** 	1

(b) (i) Explain why the biologist chose to examine 200 cells.

.....

(1 mark)

(b) (ii) Name Stage **A** and Stage **B**. Give the evidence from the photograph that you used to identify the stage.

Name of Stage **A** .....

Evidence .....

Name of Stage **B** .....

Evidence .....

.....

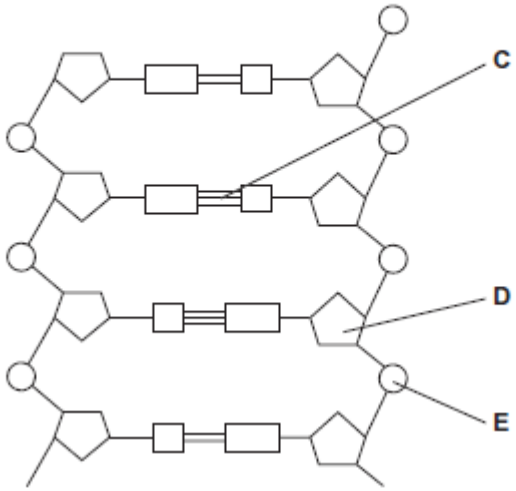
(4 marks)

(c) In this tissue one complete cell cycle took 20 hours.
Using information from the table, calculate the mean time for these cells to complete mitosis. Show your working.

Answer ..... *(2 marks)*

7)

The diagram shows part of a DNA molecule.



(a) (i) DNA is a polymer. What is the evidence from the diagram that DNA is a polymer?

.....

(1 mark)

.....

(a) (ii) Name the parts of the diagram labelled **C**, **D** and **E**.

Part **C** .....

Part **D** .....

Part **E** ..... *(3 marks)*

(a) (iii) In a piece of DNA, 34% of the bases were thymine.

Complete the table to show the names and percentages of the other bases.

Name of base	Percentage
Thymine	34
	34

(2 marks)

(b) A polypeptide has 51 amino acids in its primary structure.

(b) (i) What is the minimum number of DNA bases required to code for the amino acids in this polypeptide?

(1 mark)

(b) (ii) The gene for this polypeptide contains more than this number of bases.

Explain why.

.....

(1 mark)

8)

Staphylococcus aureus is a bacterium that causes disease in humans. Scientists carried out an investigation to find the most effective concentration of antibiotic to treat this disease.

The scientists put equal volumes of a culture of *S. aureus* in five flasks.

- They added nothing further to one flask. This was the control.
- They added different concentrations of antibiotic to the other four flasks.

The scientists incubated all the flasks at 35 °C for 3 hours. They then estimated the number of living bacteria in each flask.

(a) (i) The flasks were incubated at 35 °C. Suggest why they were incubated at this temperature.

.....

(1 mark)

(a) (ii) The scientist put the same volume of bacterial culture into each flask. Explain why.

.....

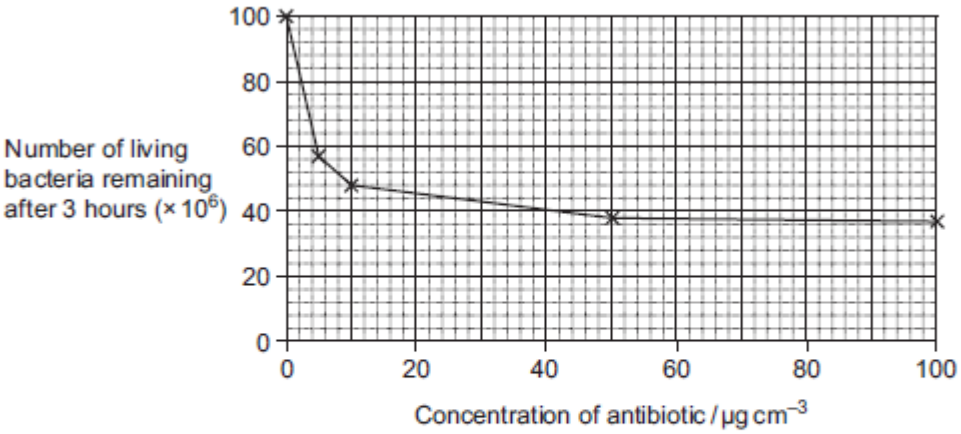
(1 mark)

(a) (iii) What was the purpose of the control flask?

.....

(1 mark)

(b) The graph shows the scientists' results.



(b) (i) Describe the pattern of results shown in the graph.

.....

(2 marks)

(b) (ii) A student concluded from these results that an antibiotic dose equivalent to 50 µg cm^{-3} would be the most effective in treating disease caused by *S. aureus*.

Evaluate his conclusion.

.....

(3 marks)