Q1.(a) (i) Describe the role of DNA polymerase in DNA replication.

.....

.....

(1)

(ii) Other than being smaller, give **two** ways in which prokaryotic DNA is different from eukaryotic DNA.

1 .....

2 .....

(2)

(b) The table shows the percentage of each base in the DNA from three different organisms.

Organism	**Percentage of each base in DNA**			
	Adenine	Guanine	Thymine	Cytosine
Human	30.9	19.9	29.4	19.8
Grasshopper	29.4	20.5	29.4	20.7
Virus	24.0	23.3	21.5	31.2

(i) Humans and grasshoppers have very similar percentages of each base in their DNA but they are very different organisms.

Use your knowledge of DNA structure and function to explain how this is possible.

.....

.....

.....

.....

.....

(2)

(ii) The DNA of the virus is different from that of other organisms. Use the table above and your knowledge of DNA to suggest what this difference is. Explain your answer.

.....

.....

.....

.....

.....

[Extra space] .....

.....

(2)
(Total 7 marks)

Q2.(a) The events that take place during interphase and mitosis lead to the production of two genetically identical cells. Explain how.

.....

.....

.....

.....

.....

.....

.....

.....

.....

[Extra space] .....

.....

.....

.....

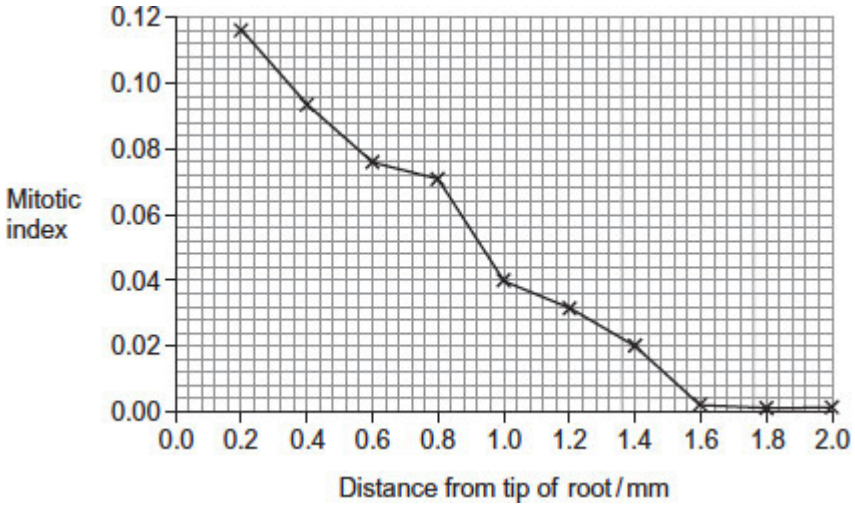
(4)

(b) A student cut thin sections of tissue at different distances from the tip of a root. She stained the sections and viewed them with an optical microscope.

For each section, the student counted the number of cells in mitosis and the total number of cells in each field of view. She then calculated a **mitotic index** for each section using the equation:

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}}$$

The student's results arer shown in the graph.



(i) The student cut thin sections of tissue to view with an optical microscope. Explain why it was important that the sections were thin.

.....

.....

.....

.....

.....

(2)

(ii) What does the graph show about the growth of roots?
Use the data to explain your answer.

.....

.....

.....

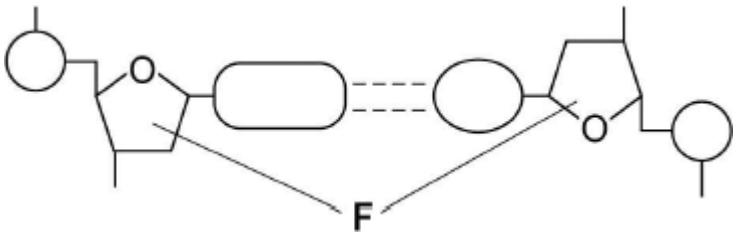
.....

.....

(2)
(Total 8 marks)

Q3.Figure 1 shows one base pair of a DNA molecule.

Figure 1



(a) Name part **F** of each nucleotide.

.....

(1)

(b) Scientists determined that a sample of DNA contained 18% adenine.

What were the percentages of thymine and guanine in this sample of DNA?

Percentage of thymine ☐

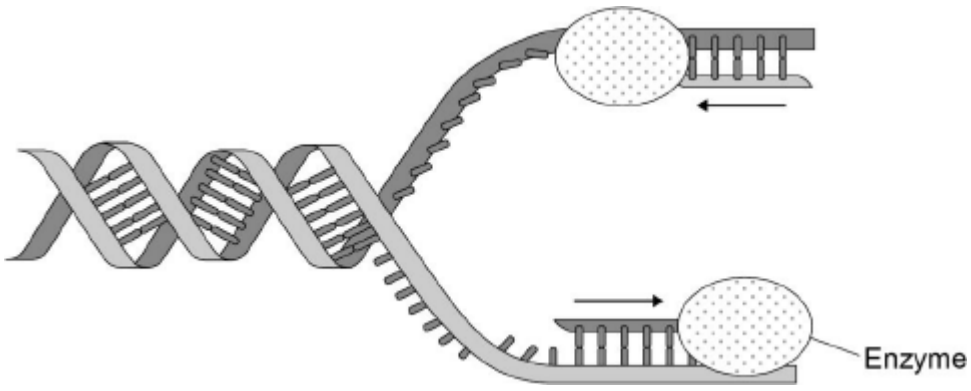
Percentage of guanine ☐

(2)

During replication, the two strands of a DNA molecule separate and each acts as a template for the production of a new strand.

Figure 2 represents DNA replication.

Figure 2



(c) Name the enzyme shown in **Figure 2**.

.....

(1)

The arrows in **Figure 2** show the directions in which each new DNA strand is being produced.

(d) Use **Figure 1, Figure 2** and your knowledge of enzyme action to explain why the arrows point in opposite directions.

.....

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 8 marks)

Q4. Read the following passage.

Herpes simplex virus (HSV) infects nerve cells in the face, including some near the lips. Like many other viruses, HSV can remain inactive inside the body for years. When HSV becomes active, it causes cold sores around the mouth.

Human cells infected with a virus may undergo programmed cell death. While HSV is inactive inside the body, only one of its genes is transcribed. This gene is the latency-associated transcript (*LAT*) gene that prevents programmed cell death of an infected nerve cell.

Scientists have found that transcription of the *LAT* gene produces a microRNA. This microRNA binds to some of the nerve cell's own mRNA molecules. These mRNA molecules are involved in programmed cell death of nerve cells. The scientists concluded that production of this microRNA allows HSV to remain in the body for years.

Use information from the passage and your own knowledge to answer the following questions.

(a) HSV infects nerve cells in the face (line 1). Explain why it infects **only** nerve cells.

.....

.....

.....

.....

.....

.....

(Extra space) .....

.....

.....

(3)

(b) HSV can remain inactive inside the body for years (lines 2–3). Explain why this virus can be described as **inactive**.

.....

.....

.....

.....

(2)

(c) Suggest **one** advantage of programmed cell death (line 4).

.....

.....

(1)

(d) The scientists concluded that production of this microRNA allows HSV to remain in the body for years (lines 10–12).

Explain how this microRNA allows HSV to remain in the body for years.

.....

.....

.....

.....

.....

.....

.....

.....

(Extra space) .....

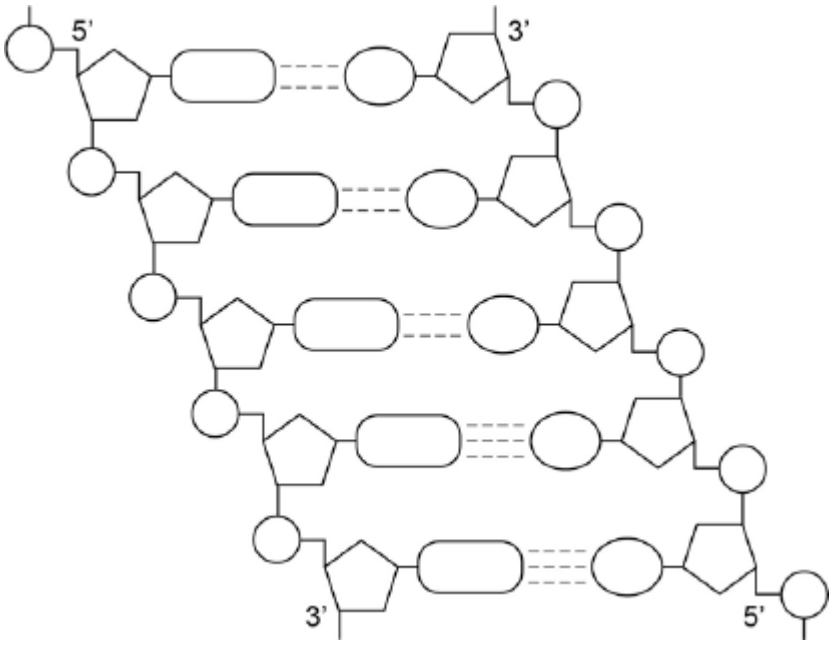
.....

.....

.....

(4)
(Total 10 marks)

Q5. The following figure represents part of a DNA molecule.



(a) Draw a box around a single nucleotide.

(1)

The table below shows the percentage of bases in each of the strands of a DNA molecule.

DNA strand	**Percentage of each base**			
	A	**C**	**G**	**T**
Strand **1**	16			
Strand **2**		21	34	

(b) Complete the table by adding the missing values.

(2)

(c) During replication, the two DNA strands separate and each acts as a template for the production of a new strand. As new DNA strands are produced, nucleotides can only be added in the 5' to 3' direction.

Use the figure in part **(a)** and your knowledge of enzyme action and DNA replication to explain why new nucleotides can only be added in a 5' to 3' direction.

.....

.....

.....

.....

.....

.....

.....

.....

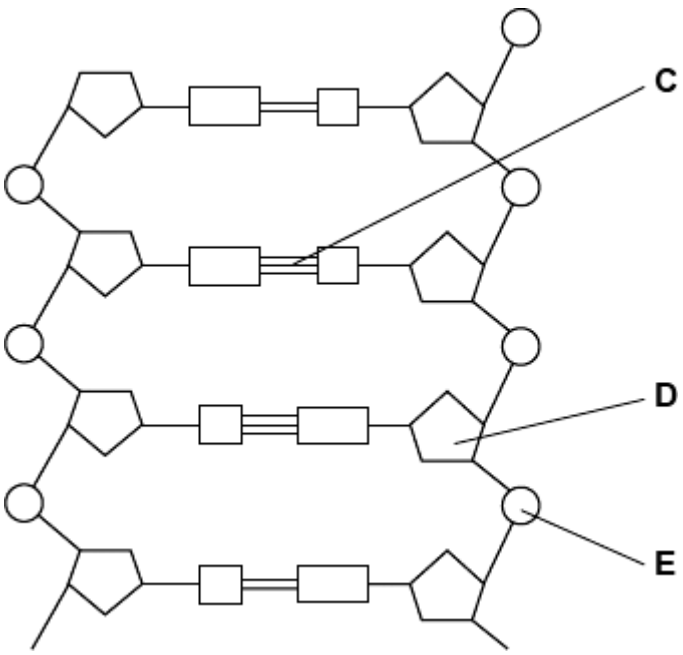
(Extra space) .....

.....

.....

(4)
(Total 7 marks)

Q6. 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)

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

Part **C** .....

Part **D** .....

Part **E** .....

(3)

(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)

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

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

(1)

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

Explain why

.....

.....

.....

(1)
(Total 8 marks)