Q1.

(a) Give **two** roles of phosphate ions in cells.

1 _____

_____

_____

2 _____

_____

_____

(2)

(b) Diseased lungs can cause carbon dioxide to build up in the blood plasma. This leads to an increase in hydrogen ion concentration in the plasma.

Describe the effect this increase in hydrogen ion concentration has on the plasma **and** on the proteins in the plasma.

Do **not** refer to the Bohr effect.

_____

_____

_____

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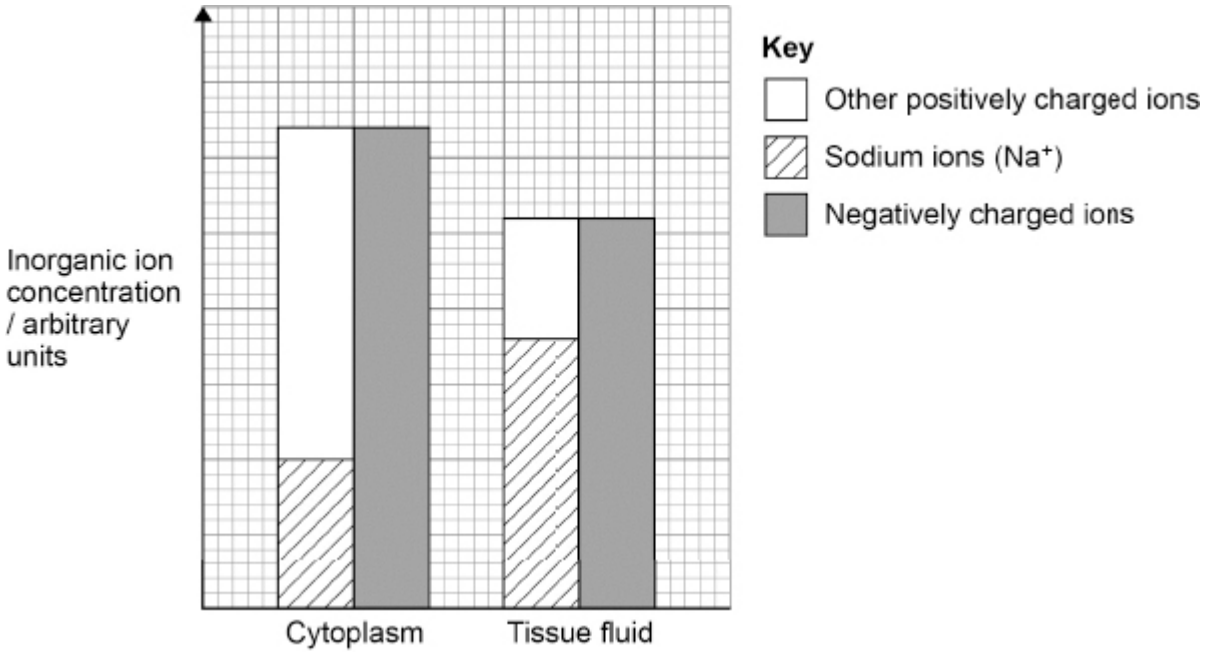
(2)

Scientists measured the concentration of inorganic ions in the cytoplasm of mammalian cells and in the tissue fluid surrounding those cells.

The graph below shows their results.



(c) Use the graph above to describe **two** patterns shown in the **total** concentrations of positively and negatively charged ions in the cytoplasm and in tissue fluid.

1 _____

_____

_____

2 _____

_____

_____

(2)

(d) In these mammalian cells, the:

- cell-surface membrane is permeable to sodium ions
- sodium ion concentration does not increase in the cytoplasm over time.

Use this information and the graph above to suggest and explain the ion transport mechanisms involved in the transport of sodium ions.

_____

_____

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_____

(2)

(Total 8 marks)

Q2.

(a) Describe the processes of facilitated diffusion and active transport.

Facilitated diffusion _____

_____

_____

_____

_____

_____

Active transport _____

_____

_____

_____

_____

_____

(3)

(b) What are microvilli?

_____

_____

_____

(1)

(c) Vitamin A is a fat-soluble substance.

Micelles are involved in the process of vitamin A absorption.

Describe the process of vitamin A absorption into cells lining the ileum.

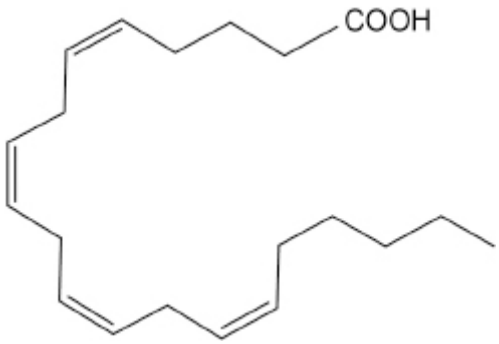
(3)

(Total 7 marks)

Q3.

(a) **Figure 1** shows a fatty acid that contains 20 carbon atoms and four double bonds.

Figure 1

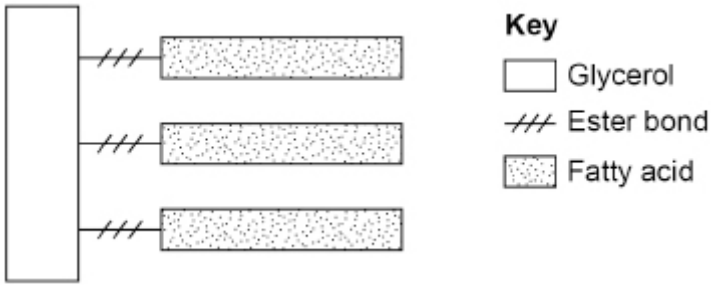


On **Figure 1**, draw a box around the R group of the fatty acid.

(1)

(b) **Figure 2** shows a triglyceride.

Figure 2



Describe **two** differences between the structure of the triglyceride shown in **Figure 2** and a phospholipid.

1 _____

_____

2 _____

_____

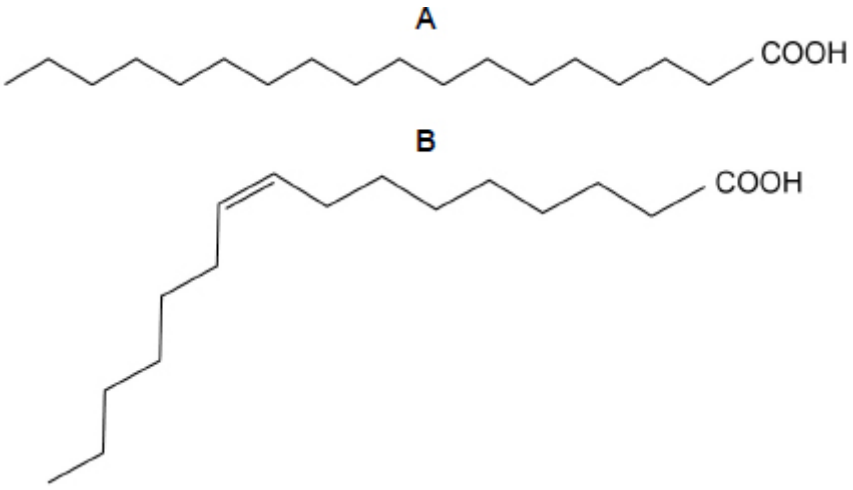
(2)

(c) Explain why phospholipids can form a bilayer but triglycerides cannot.

(3)

(d) **Figure 3** shows two fatty acids, **A** and **B**.

Figure 3



Scientists fed rats a diet with added fish oil for 4 months.

They obtained samples of red blood cells from the rats before starting this diet (0 months) and after 4 months on this diet.

For each red blood cell sample, they separated the cell-surface membranes and measured:

- the percentage of phospholipids containing each of the fatty acids **A** and **B**
- the fluidity of the membrane.

The table below shows the scientists' results.

Time sample of red blood cells obtained / months	Mean percentage of phospholipids containing fatty acid A	Mean percentage of phospholipids containing fatty acid B	Mean fluidity of the membrane / arbitrary units
0	19.8	1.7	31
4	11.7	9.0	97

Suggest why the fluidity of the membrane was higher after 4 months.

Use all the information provided in the question.

(3)

(Total 9 marks)

Q4.

(a) Give **two** features of **all** prokaryotic cells that are **not** features of eukaryotic cells.

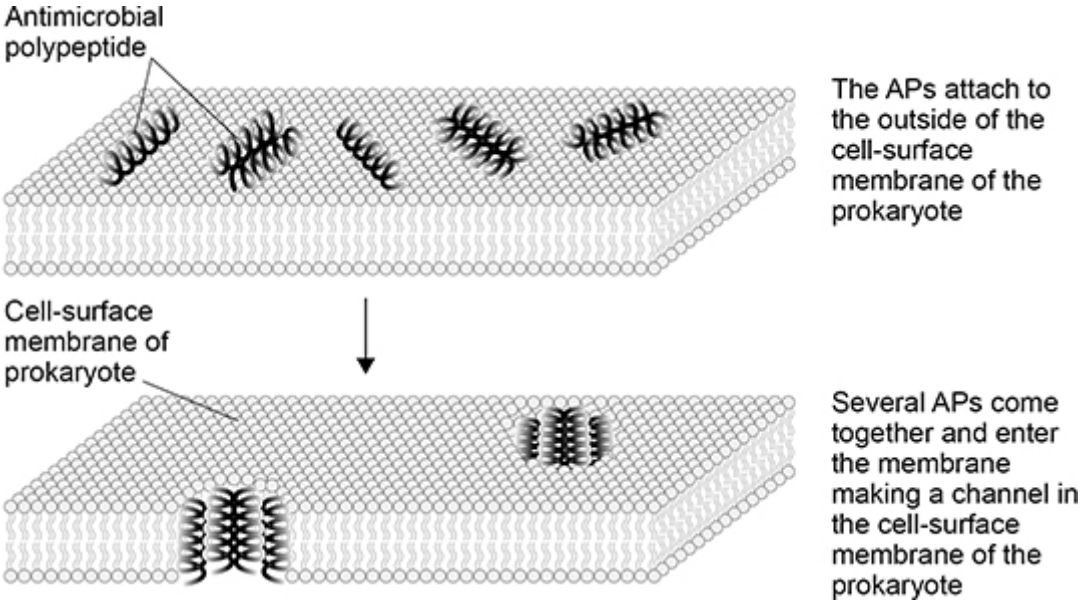
1 _____

2 _____

(1)

Many multicellular organisms produce antimicrobial polypeptides (APs) that protect them against prokaryotes.
Figure 1 shows how one type of AP acts on the cell-surface membrane of prokaryotes.

Figure 1



(b) This AP has a secondary structure in a helical shape.

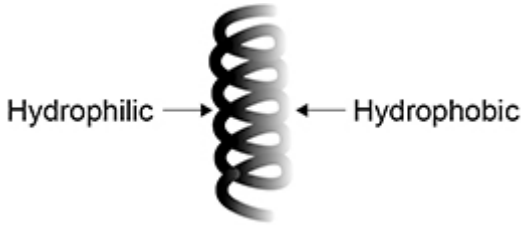
Tick (✓) the box to show which type of bond maintains the helical structure of the polypeptide.

Disulfide	☐
Hydrogen	☐
Ionic	☐
Peptide	☐

(1)

(c) The amino acids on one side of each AP helix have hydrophobic properties. The amino acids on the opposite side of each helix have hydrophilic properties. **Figure 2** shows this.

Figure 2



Suggest how these properties of the APs allow them to become positioned across the membrane (as shown in **Figure 1**) and make a channel through which ions can pass.

_____

_____

_____

_____

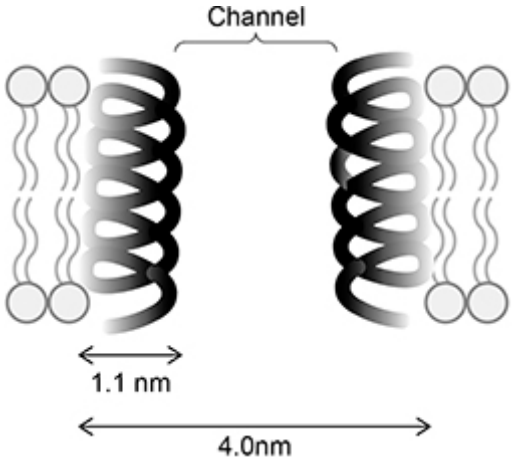
_____

_____

(2)

Figure 3 shows further information about a channel formed in the cell-surface membrane by the APs.

Figure 3



(d) Use **Figure 3** to calculate the cross-sectional area of the channel through which ions can pass.
Assume the cross-sectional area is circular.
Use π = 3.14 in your calculation. Give your answer in nm^2 **and** to 1 decimal place.

Answer _____ nm^2

(2)

(e) The APs damage prokaryotic cells but do not damage the eukaryotic cells in the organisms that produce them.
Prokaryotic cell membranes do not contain cholesterol.

Assess why the APs do not damage the eukaryotic cells of the organisms that produce them.

_____

_____

_____

_____

(2)

(f) Scientists observed these APs on prokaryotes using a transmission electron microscope. They stained the APs using a monoclonal antibody with gold attached to it.

Suggest how these techniques allowed observation of APs on prokaryotes.

_____

_____

_____

_____

_____

_____

_____

(3)

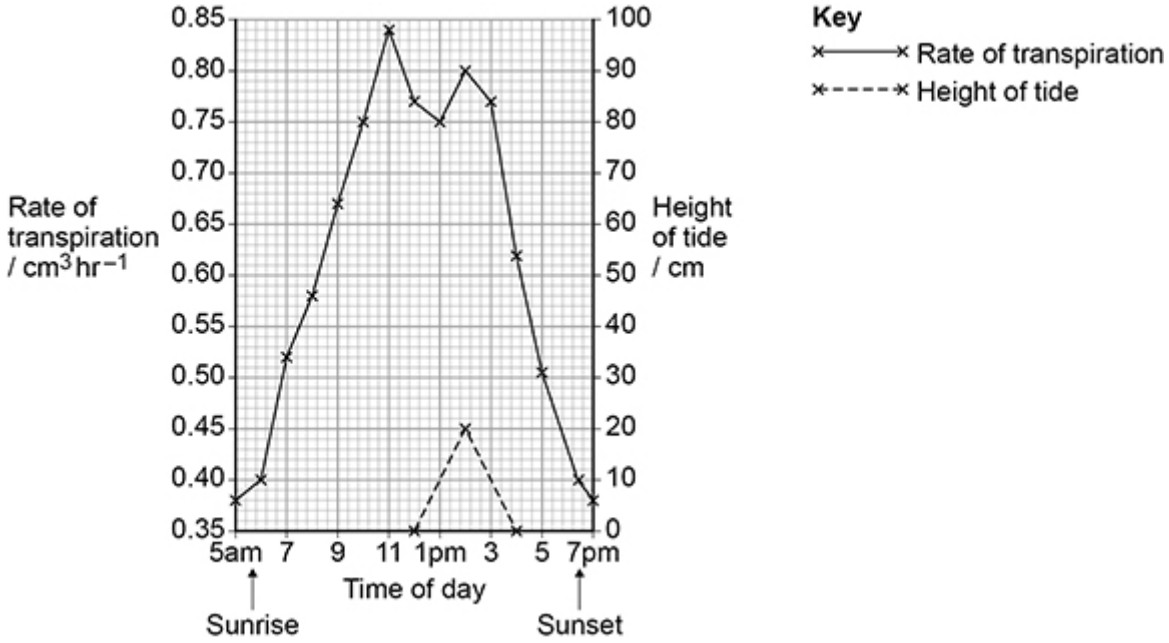
(Total 11 marks)

Q5.

Mangrove trees grow near the sea. Sea water surrounds the lower parts of the trees at high tide.

Scientists investigated the rate of transpiration in a mangrove tree.

The figure below shows the scientists' results.



(a) Explain the rate of transpiration between 5 am and midday shown in the figure above.

(4)

(b) Use the figure above to calculate the percentage increase in the rate of transpiration from 1 pm to 2 pm.

Percentage increase in rate of transpiration _____ %

(2)

(c) The higher rate of transpiration at high tide shows that the mangrove tree is absorbing water from the sea water surrounding its roots.

Describe an experiment that you could do to investigate whether the mangrove root cells have a lower water potential than sea water.

You are given:
- a piece of fresh mangrove root
- sea water
- access to laboratory equipment.

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_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)