## Q1.

(a) The table below contains information on the digestion of two biological molecules.

Complete the below table.

| Biological molecule | Enzyme | Name of bond hydrolysed | Product of digestion |
|---|---|---|---|
| Starch | | | Maltose |
| Dipeptide | Dipeptidase | | |

**(4)**

A student investigated starch digestion by mixing starch with a solution of the enzyme used to digest starch.

The student did a biochemical test for **protein** when starch digestion was completed.

(b) Describe a biochemical test to show the presence of protein.

**(2)**

(c) The student's test for protein was positive.

Explain why.

**(2)**

(d) An enzyme's turnover number ($k_{cat}$) is the number of substrate molecules converted into product molecules by one enzyme molecule in 1 second. It is determined using this equation.

$$k_{cat} = \frac{\text{Maximum rate of enzyme-controlled reaction / } \mu\text{mol dm}^{-3}\text{ s}^{-1}}{\text{Enzyme concentration / } \mu\text{mol dm}^{-3}}$$

A scientist investigated the action of a protease enzyme. The scientist prepared a reaction mixture with a protease concentration of 0.0118 μmol $dm^{-3}$. The $k_{cat}$ for the protease is 110 substrate molecules per second.

Use this information and the formula to calculate the maximum rate of the protease-controlled reaction.

Give your answer to **3** significant figures.

Show your working.

Answer _____ μmol $dm^{-3}$ $s^{-1}$

**(2)**

**(Total 10 marks)**

**Q2.**

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

Facilitated diffusion _____

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_____

_____

_____

_____

Active transport _____

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_____

_____

**(3)**

(b) What are microvilli?

_____

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_____

**(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) Describe the hydrolysis reactions involved in the digestion of triglycerides.

Do **not** write about the activity of lipase.

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**(2)**

(b) All mammals produce a lipase called CEL.

CEL digests triglycerides.

CEL is activated by bile salts binding to the enzyme.

Describe **two** other functions of bile salts.

1 _____

_____

_____

2 _____

_____

_____

**(2)**

(c) Mammals feed their young on milk. CEL digests the triglycerides in milk. The ability to produce CEL occurred due to a gene mutation.

Describe how natural selection may have led to all mammals in a population producing CEL.

**(4)**

**(Total 8 marks)**

## Q4.

(a) Some hospital patients suffer from diarrhoea caused by infection with the bacterium *Clostridium difficile*. The *C. difficile* bacteria release toxins. These toxins cause the diarrhoea.

The toxins damage the cells lining the ileum, causing them to lose their microvilli. The damage to the cells reduces the absorption of the products of digestion and reduces the absorption of water, resulting in diarrhoea.

Explain why the damage to the cells lining the ileum reduces absorption of the products of digestion **and** why this reduces absorption of water.

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**(3)**

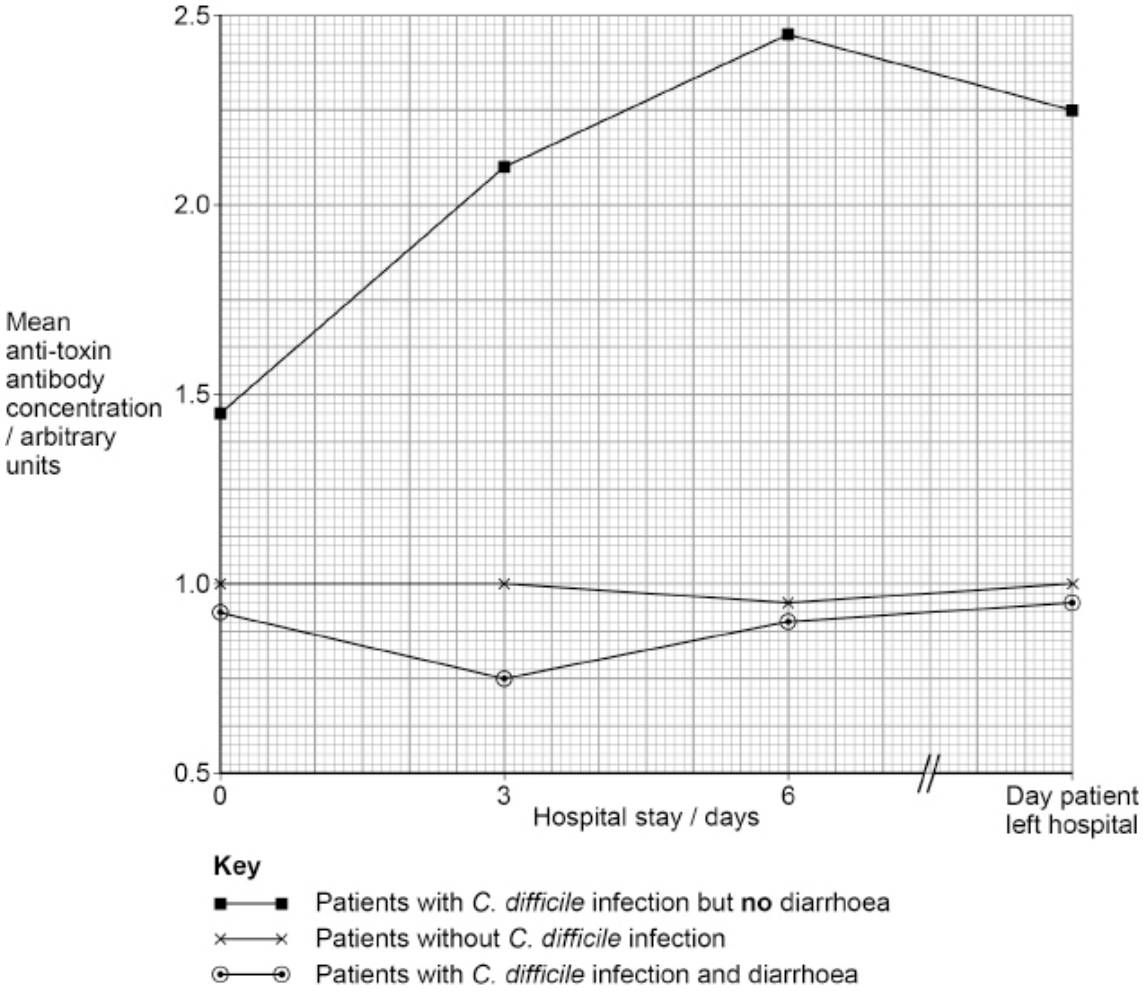
Not all patients in hospital with *C. difficile* develop diarrhoea.

Scientists measured the anti-toxin antibody concentration in hospital patients with and without *C. difficile* infection.

They measured the anti-toxin antibody concentration **four** times:

- on admission to hospital (day 0)
- on day 3
- on day 6
- on the day the patient left the hospital.

The figure below shows the scientists' results.




(b) The scientists suggest that the anti-toxin antibody could be given to some patients as a form of passive immunity.

Use the figure above to suggest how this passive immunity would work **and** which patients should be offered this anti-toxin antibody.

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**(3)**

(c) To be used as passive immunity treatment, the anti-toxin antibody would be injected. If it was given by mouth, it would be digested.

Describe how the anti-toxin antibody would be digested.

_____

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_____

_____

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_____

_____

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_____

**(3)**

**(Total 9 marks)**

**Q5.**

(a) Describe the transport of carbohydrate in plants.

**(5)**

(b) Compare and contrast the structure of starch and the structure of cellulose.

**(6)**

(c) Describe the complete digestion of starch by a mammal.

**(4)**

**(Total 15 marks)**