1 All mammals, such as harp seals, feed their young on milk produced by mammary glands. This continues until the young are old enough to eat the same diet as their parents.

The photograph below shows a female harp seal feeding her pup.

magnification ×0.002

(a) The table below shows the composition of human milk and harp seal milk.

Milk	Protein (%)	Lipid (%)	Lactose (%)
Human	1.4	3.8	7.0
Harp seal	13.8	36.5	0.0

(i) Suggest **two** substances (other than protein, lipid and lactose) that milk should contain for the development of the harp seal pups.

(2)

1 .....

2 .....

(ii) Harp seal pups are born in the Arctic where it is extremely cold and there is little shelter.

After nine days of feeding, the mass of a harp seal pup can increase by about 300%.

Using information from the table, suggest why a harp seal pup increases in mass more quickly than a human baby.

(4)

(b) The composition of human milk can be affected by the diet of the mother.

The table below shows the concentration of eight fatty acids found in milk from two different groups of women.

One group of women were vegans who ate food obtained only from plants. The other control group had a mixed diet of food from plants and animals.

Fatty acid	Number of double bonds in the hydrocarbon chain	Concentration of fatty acid / mg per g of milk	
		Vegans	Control group
lauric	0	39	33
myristic	0	68	80
palmitic	0	166	276
stearic	0	52	108
palmitoleic	1	12	36
oleic	1	313	353
linoleic	2	317	69
linolenic	3	15	8

(i) State the difference between the structure of a saturated fatty acid and an unsaturated fatty acid.

(1)

(ii) Complete the table below by calculating the total concentration of unsaturated fatty acids in the milk from the women in the vegan and control groups.

(1)

Group	Total concentration of saturated fatty acids / mg per g milk	Total concentration of unsaturated fatty acids / mg per g milk
Vegan	325	
Control	497	

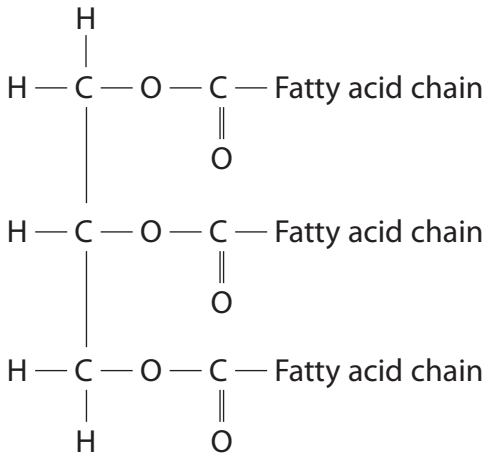
(iii) Using the information given, suggest why there are differences in the concentrations of saturated and unsaturated fatty acids in the milk from the women in the vegan and control groups.

(2)

(Total for Question 1 = 10 marks)

2 Triglycerides are lipids that are an important source of energy for the body. Triglycerides are broken down and reassembled in the body.

(a) The diagram below shows the structure of a triglyceride.



In the space below, draw a diagram to show the molecules produced from the complete hydrolysis of the triglyceride.

(3)

(b) Suggest the possible consequence of a very low fat diet for someone who has a very active lifestyle.

(2)

*(c) Groups of enzymes help the body to break down and process triglycerides. Abnormalities in these enzymes can lead to the build-up of lipids that would have been broken down.

Explain why a gene mutation can result in an enzyme that is unable to break down lipids.

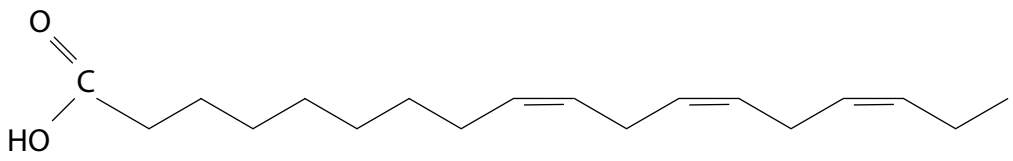
(5)

(Total for Question 2 = 10 marks)

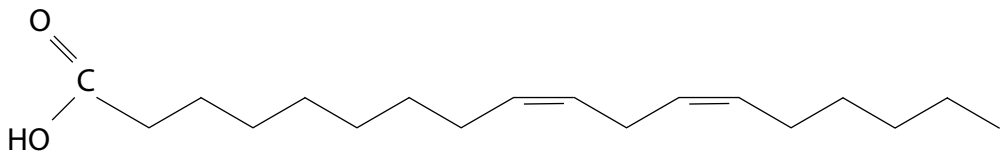
3 Some fatty acids are classed as essential fatty acids. These fatty acids need to be included in our diet, because the human metabolism cannot synthesise them. Omega 3 and omega 6 are two examples of essential fatty acids.

(a) The diagrams below represent the structures of the fatty acids omega 3 and omega 6.

Omega 3



Omega 6



(i) Using the diagram of omega 3 above, describe its structure.

(2)

.....

.....

.....

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.....

(ii) Give **one** difference between the structure of omega 3 and the structure of omega 6.

(1)

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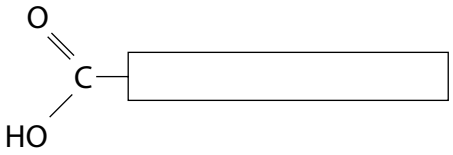
.....

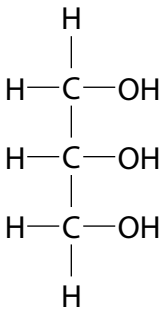
.....

(iii) The diagram below shows a more simplified structure of omega 3.



A glycerol molecule is drawn below. Use these diagrams to show how **one** omega 3 molecule bonds to the glycerol molecule, by means of a condensation reaction, during the synthesis of a triglyceride.

(3)

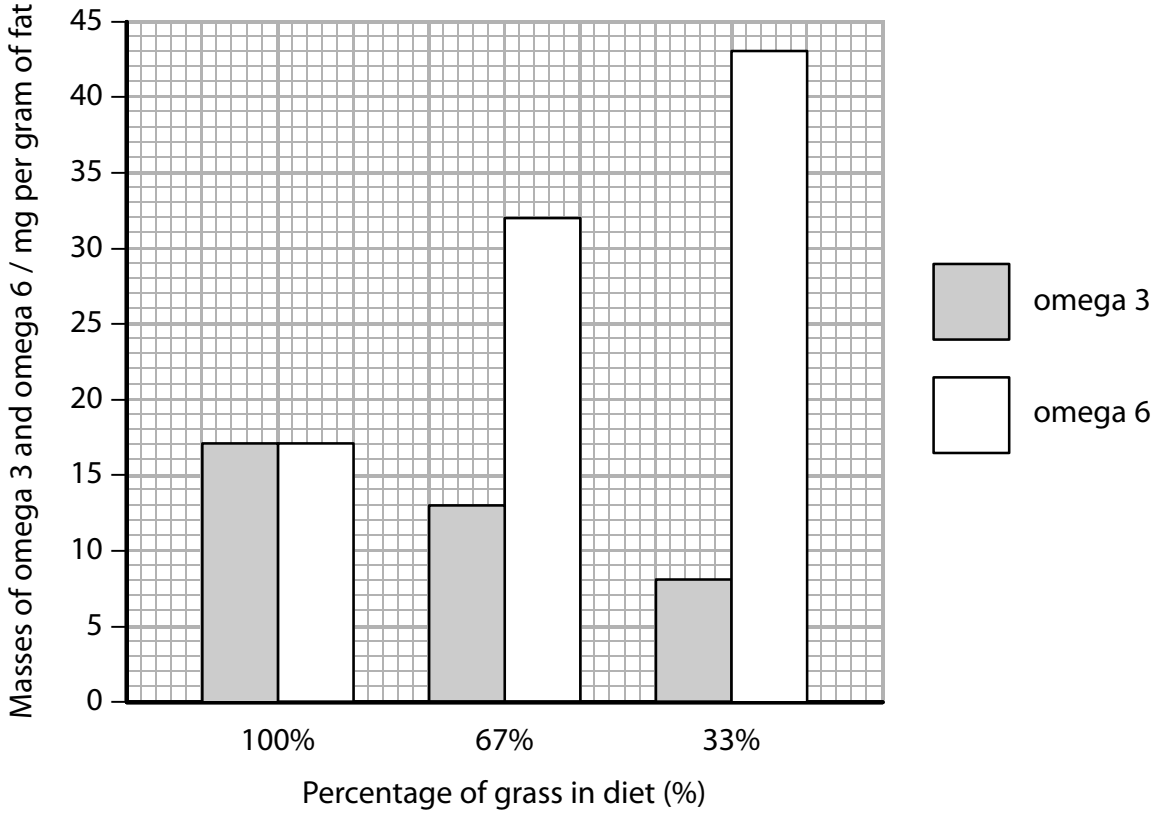


(b) Omega 3 and omega 6 are both present in animal fats.

The proportion of omega 3 and omega 6 in animal fat has been shown to depend on the diet of the animals.

In an investigation, the masses of omega 3 and omega 6, per gram of fat, were determined in the fat from cows fed on a diet containing 100%, 67% or 33% grass.

The results of this investigation are shown in the graph below.



Describe what effect the percentage grass content of a cow's diet has on the proportion of omega 3 and omega 6 in its fat.

(3)

(c) A high ratio of omega 6 to omega 3 has been linked to an increased risk of cardiovascular disease (CVD).

(i) High blood pressure is another factor that increases the risk of CVD.

Give **two** other dietary factors that increase the risk of CVD.

(1)

1 .....

2 .....

(ii) Omega 3 has been shown to lower blood pressure. Antihypertensives can also be used to lower blood pressure.

State **one** risk of using antihypertensives.

(1)

.....

.....

.....

(Total for Question 3 = 11 marks)

4 DNA and lipids are important molecules found in living organisms.

(a) A triglyceride is one type of lipid.

For each of the descriptions below, put a cross (☒) in the box that corresponds to the correct statement about lipids or triglycerides.

(i) Triglycerides are composed of:

(1)

3 glycerol molecules and 3 fatty acid molecules ☐

1 glycerol molecule and 3 fatty acid molecules ☐

1 glycerol molecule and 1 fatty acid molecule ☐

3 glycerol molecules and 1 fatty acid molecule ☐

(ii) The bond between a glycerol molecule and a fatty acid molecule is:

(1)

A glycosidic bond ☐

A peptide bond ☐

A phosphodiester bond ☐

An ester bond ☐

(iii) This bond is formed by:

(1)

Hydrolysis ☐

Condensation ☐

A chain reaction ☐

An automatic reaction ☐

(iv) Unsaturated lipids:

(1)

Do not have any double bonds ☐

Have double bonds only between carbon atoms ☐

Have double bonds between carbon atoms and between carbon and oxygen atoms ☐

Have double bonds only between carbon and oxygen atoms ☐

(v) Saturated lipids have:

(1)

More hydrogen atoms than unsaturated lipids ☒

Fewer hydrogen atoms than unsaturated lipids ☒

The same number of hydrogen atoms as unsaturated lipids ☒

No hydrogen atoms ☒

(b) DNA is a double-stranded molecule composed of mononucleotides.

(i) In the space below, draw a diagram to show **two** mononucleotides joined together in a **single** strand of DNA (polynucleotide). Use the symbols shown below for each component in your diagram.

(3)

Phosphate group  Base 

Deoxyribose sugar  Bond —

(ii) Name an enzyme involved in DNA replication.

(1)