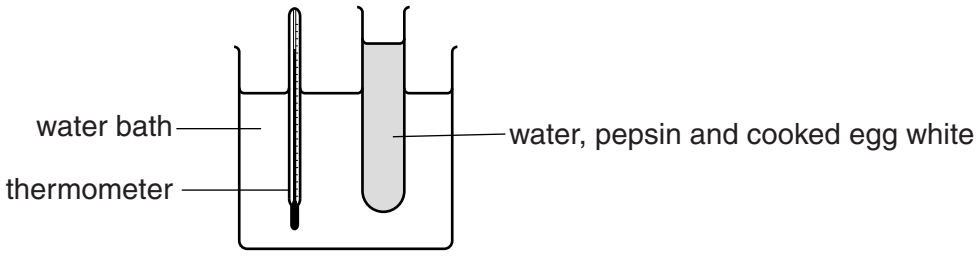
1 (a) Egg white contains protein.

Natasha is investigating how a protein-digesting enzyme, called pepsin, breaks down cooked egg white.



The pepsin breaks down the cooked egg white.

This makes the mixture in the test tube change from white to colourless.

Natasha times how long it takes for the mixture to go colourless at different temperatures.

She keeps everything else the same.

The table shows her results.

Temperature in ^{o}C	Time for mixture to go colourless in minutes
20	14
25	9
30	6
35	3
40	3
45	6

(i) Look at the results. What is the optimum temperature for the pepsin?

..... °C **[1]**

(ii) Describe and explain what results you would expect as the temperature increases **above** 45 °C.

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..... **[3]**

(b) Proteins have many jobs in the body.

(i) Proteins can be broken down in aerobic respiration.

They have a respiratory quotient (RQ) of 0.9.

$$\text{Respiratory quotient (RQ)} = \frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen used}}$$

When proteins are used in respiration, how does the volume of carbon dioxide produced compare with the volume of oxygen used?

Put a tick (✓) in the box by the correct answer.

The volume of carbon dioxide is greater than the volume of oxygen. ☐

The volume of carbon dioxide is less than the volume of oxygen. ☐

The volume of carbon dioxide is the same as the volume of oxygen. ☐

[1]

(ii) Apart from being used in respiration, proteins have many other jobs in the body.

Write about **other** jobs of proteins.

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..... **[3]**

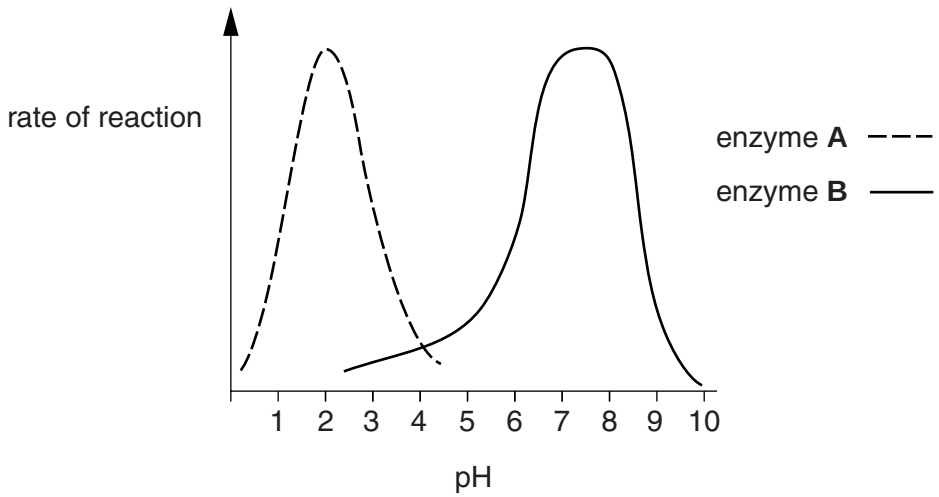
[Total: 8]

2 This question is about digestion.

(a) Scientists investigate two enzymes and pH levels in the digestive system.

Look at the graph.

It shows the rate of reaction of enzyme **A** and enzyme **B** in different pH conditions.



Look at the table.

It shows the pH in different parts of the digestive system.

Part of digestive system	pH
mouth	6.5
stomach	2.0
small intestine	7.5
large intestine	7.0

The scientists claim their results show enzyme **A** is a protease enzyme and is found in the stomach.

Do the results back up their claim?

Explain your answer.

.....

.....

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..... **[2]**

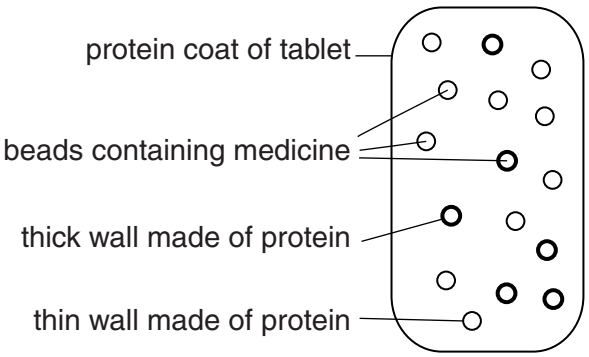
(b) Jemma's stomach is not working properly.

She needs to take some medicine.

A tablet is developed containing the medicine.

It releases the medicine in the stomach over a long period of time.

The diagram shows the structure of the tablet.



Explain why the medicine is **not** released until it reaches the stomach and why it is released over a long period of time.

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..... **[4]**

[Total: 6]

3 Weever fish are small fish that live in sand in shallow waters on some of Britain's beaches.

They have poisonous spines on their back.

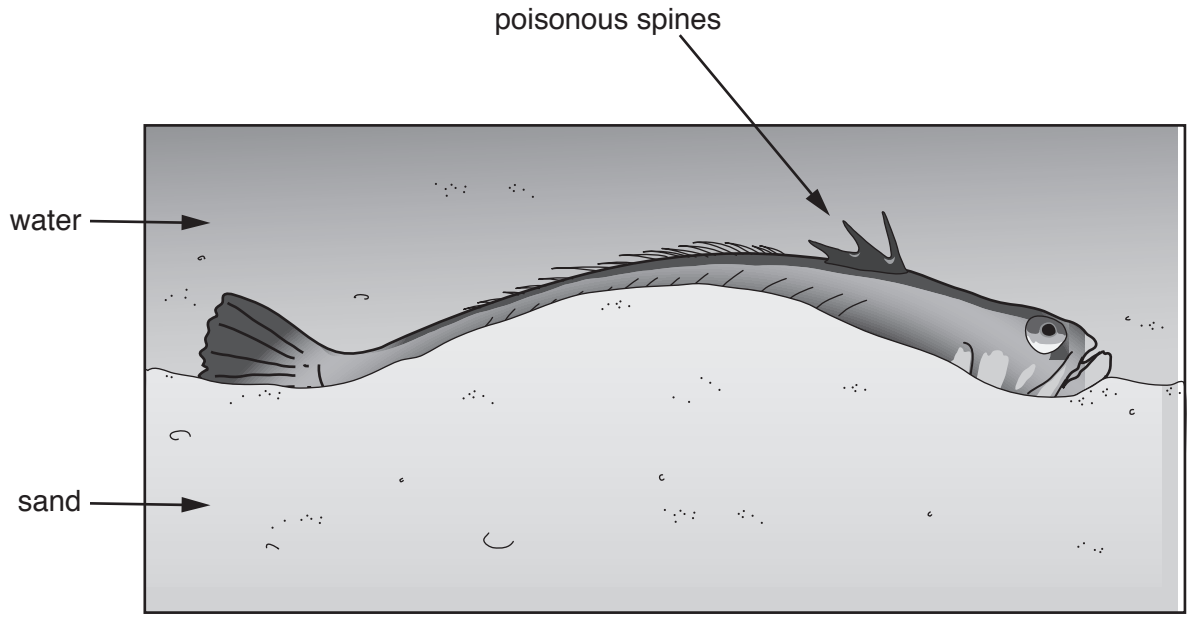
Anyone touching the spines can get a painful sting.

The spines inject a nerve poison made of protein.

The first aid treatment is to put the affected area in hot water, as hot as the victim can bear.

The pain will start to ease after a few minutes.

Although the sting is very painful, it does not usually cause any lasting harm.



(a) The weever fish poison is made of protein.

What are proteins made of?

..... **[1]**

(b) The treatment involves hot water, the hotter the better.

Suggest why.

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..... **[2]**

(c) The information for making the poison is coded in the fish's DNA and is in every cell.

However, the poison is only produced in the spines.

Explain why the poison is **not** produced in every cell.

.....

..... **[1]**

(d) On Britain's beaches in 2011, over 1000 holiday-makers were stung by weever fish.

Some people want to close the beaches where people have been stung.

Should the beaches be closed?

Explain your answer.

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..... **[2]**

4 Read the newspaper article.

Scientists make eggs from skin cells

In 2012, Japanese scientists reported that they had used normal skin cells from mice to make mouse stem cells.

They then used these stem cells to make eggs.

The eggs were fertilised with sperm from a male mouse and implanted into a female mouse.

When the baby mice were born they were perfectly healthy and grew up to breed normally and have babies of their own.

The scientists have also produced sperm cells in a similar way.

If these techniques could be used with humans they could help infertile couples have children.

(a) What are stem cells?

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..... **[2]**

(b) The stem cells used by the Japanese scientists were different from normal mouse stem cells.

How were these stem cells different from normal mouse stem cells?

.....

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..... **[2]**

(c) The stem cells are all clones of the skin cell they were made from.

Would the egg cells be clones of each other?

Explain your answer.

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..... **[2]**

(d) In the future, scientists could try to use similar techniques to produce human children. This will be controversial.

Some people think that it is unethical and goes against religious beliefs.

Suggest **other** reasons why it is controversial.

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..... **[2]**

(e) Sperm cells contain many mitochondria.

Mitochondria produce ATP.

What is ATP used for?

..... **[1]**

(f) Egg cells contain many ribosomes.

The ribosomes use the genetic code from the nucleus.

(i) What do ribosomes do?

..... **[1]**

(ii) What substance carries the genetic code from the nucleus to the ribosomes?

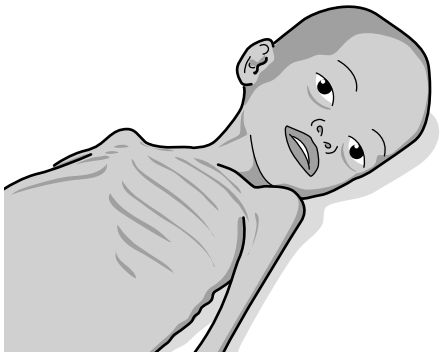
..... **[1]**

(iii) In the nucleus, the genetic code is contained in the base sequence of DNA.

Write down all the different bases.

..... **[1]**

5 Look at the picture of Asad.



He is five years old and lives in Africa.

Asad suffers from marasmus, a disorder caused by starvation.

His muscles have wasted.

This is because his muscle protein is being used as an energy source due to the lack of food.

(a) (i) What molecules are proteins made of?

..... **[1]**

(ii) The estimated average daily requirement (EAR) for protein can be calculated using this formula.

$$\text{EAR in g} = 0.6 \times \text{body mass in kg}$$

Asad has a body mass of 12.0 kg.

Use the formula to calculate Asad's EAR for protein.

Asad's EAR = ... g **[1]**

(iii) The usual EAR for protein for a five year old boy is 11 grams a day.

The usual EAR for protein for a fifteen year old boy is 34 grams a day.

Explain why the EARs are **not** the same.

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..... **[2]**

(b) Beta thalassaemia is caused by a **recessive** allele.

Asad's sister has beta thalassaemia but Asad does **not**.

His parents do **not** have beta thalassaemia.

Asad's mother is pregnant.

What is the probability of this child having beta thalassaemia?

Draw a genetic diagram to explain your answer.

(Use **T** for the dominant allele and **t** for the recessive allele.)

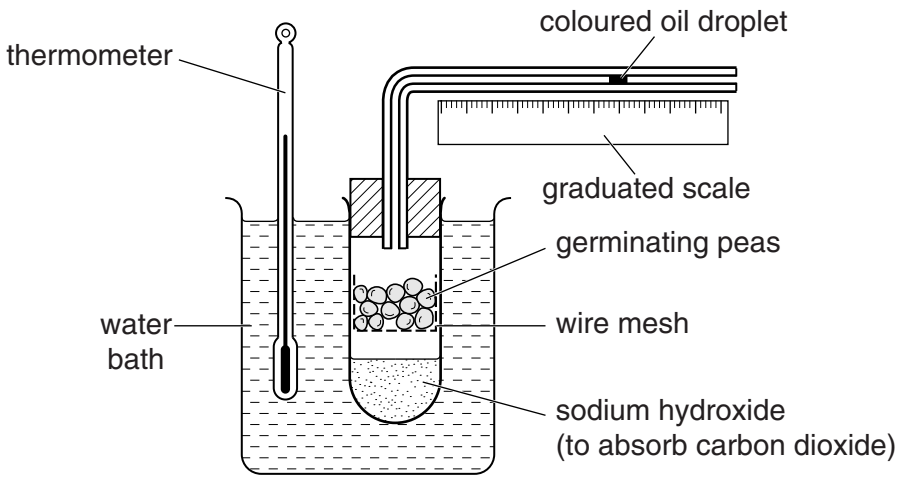
probability of this child having beta thalassaemia ..... **[3]**

[Total: 7]

6 This question is about respiration.

Look at the diagram of a respirometer.

It can be used to investigate the gases involved in aerobic respiration.



(a) Complete the **balanced symbol** equation for aerobic respiration.

$C_6H_{12}O_6$ + ... → ..... + $6H_2O$ **[1]**

(b) Look at the tables.

The first table shows the respiratory quotient (RQ) of three food types.

Food type	Respiratory quotient (RQ)
carbohydrate	1.0
fat	0.7
protein	0.9

The second table shows the results from an experiment investigating aerobic respiration in two types of seed.

Type of seed	Volume of oxygen absorbed in cm^3	Volume of carbon dioxide produced in cm^3	Respiratory quotient (RQ)
Pea	0.6	0.6	.....
Peanut	16.3	13.0	.....

Respiratory quotient (RQ) is calculated using the formula:

$$RQ = \frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen used}}$$

Calculate the RQ for the two types of seed and use your answers to **suggest** how the food type used is different for the two types of seed.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

(c) During respiration, food is broken down by enzymes.

The temperature of the water surrounding the seeds is increased from 25 °C to 50 °C.

This stops respiration.

Explain why.

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..... **[2]**

[Total: 9]