Surname	Centre Number	Candidate Number
First name(s)		0

GCSE – CONTINGENCY

3400UD0-1

Z22-3400UD0-1

WEDNESDAY, 22 JUNE 2022 – AFTERNOON

BIOLOGY – Unit 2:
Variation, Homeostasis and Micro-organisms

HIGHER TIER

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**10**	
3.	**4**	
4.	**6**	
5.	**4**	
6.	**5**	
7.	**9**	
8.	**11**	
9.	**7**	
10.	**14**	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the questions correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **10**(c)(iii) is a quality of extended response (QER) question where your writing skills will be assessed.

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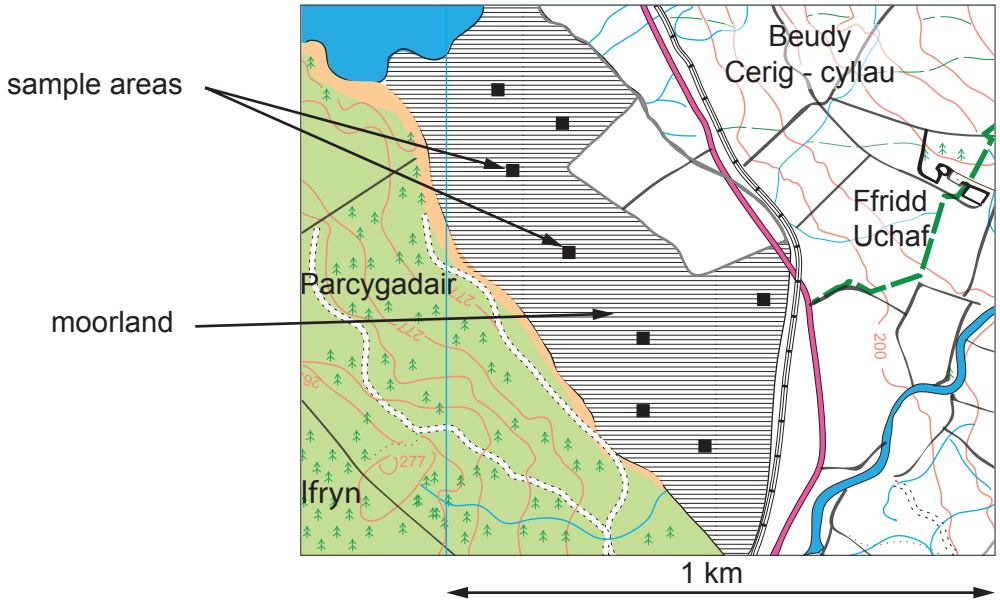
Answer **all** questions.

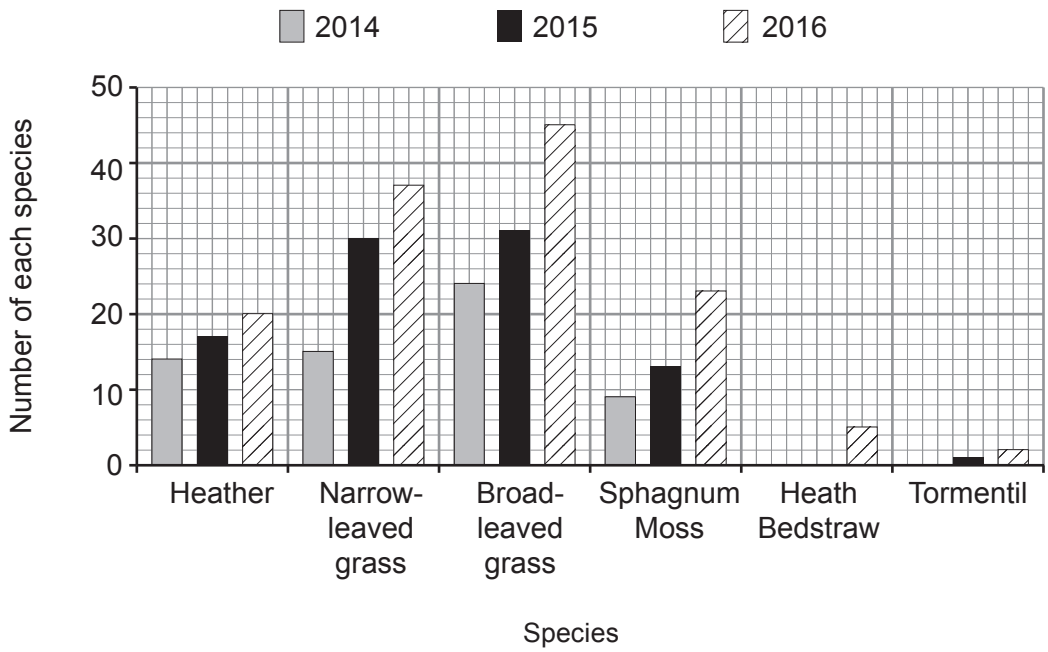
1. A group of students investigated the biodiversity of a moorland over a period of three years. Two years before the investigation started, the drainage ditches in the moorland had been closed in order to increase the water content of the land. **Image 1.1** is a map showing the moorland (shaded area) being investigated. The black squares represent locations of eight sample areas. Each sample area is 625 m^2 (25 m × 25 m).

Image 1.1



The results of the survey are shown in **Graph 1.2**.

Graph 1.2



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(a) Describe the method that the students would have used to investigate the abundance of plant species in the moorland. [4]

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(b) (i) Calculate the percentage change in narrow-leaved grass between 2014 and 2016. [2]

Percentage change = ... %

(ii) State **two** pieces of evidence that show that the biodiversity of the moorland increased between 2014 and 2016. [2]

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(c) (i) Suggest why the students sampled several areas over the whole moorland. [1]

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(ii) Suggest how, over the three years, the students made sure the investigation was a fair test. [1]

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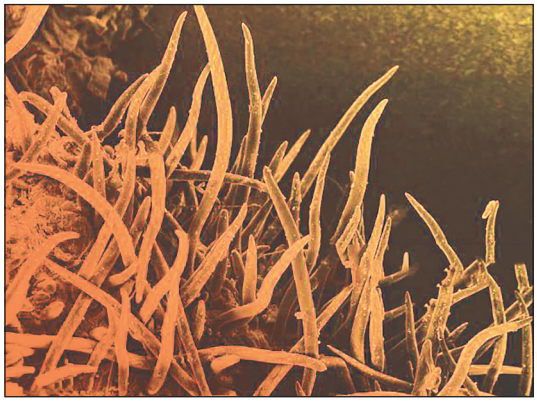
2. A peach is a fruit which has tiny hairs on its surface. A nectarine is a type of peach where the hairs are absent. The production of hair on the surface is controlled by a single gene. A dominant allele codes for the production of hair. A mutation to this gene produces a recessive allele which does not produce hair. **Image 2.1** is a picture produced by an electron microscope showing the hair growing on the surface of a peach.

Image 2.1



Peach scab disease is caused by the fungus *Cladosporium carpophilum* and can affect both peaches and nectarines. Fungi reproduce by producing spores, which are spread by wind and rain. When the spore lands on the surface of a fruit, the fungus begins to grow and scabs soon develop. Nectarines are more likely than peaches to develop scab disease. **Image 2.2** is a picture of a nectarine showing scabs caused by *Cladosporium carpophilum*.

Image 2.2

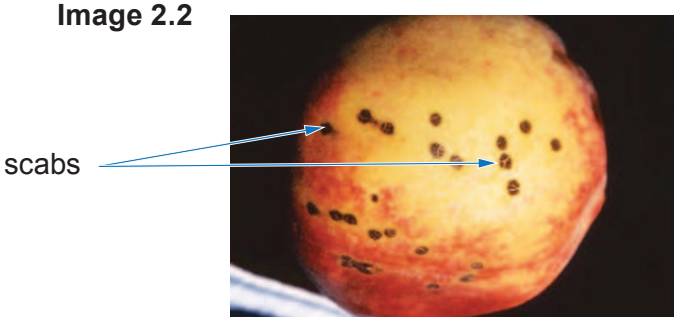
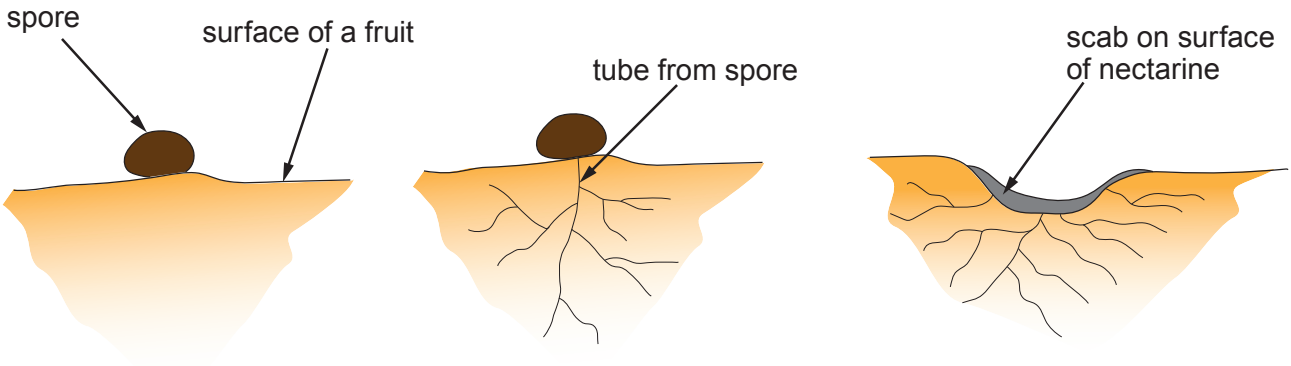


Image 2.3 shows a fungal spore developing and forming a scab.

Image 2.3



1. Spore on surface of fruit
2. Tube grows out from spore and forms a network in the fruit
3. Network of tubes causes the fruit to form a scab

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(a) (i) State why scientists use the name *Cladosporium carpophilum* rather than the common name peach scab when discussing this disease. [1]

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(ii) Using all the information given, suggest why nectarines are more likely than peaches to develop scab disease. [2]

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(b) (i) State what is meant by the term allele. [1]

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(ii) State what is meant by a mutation. [1]

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(iii) Give **one** example of an **environmental** factor which increases the rate of mutations. [1]

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Continued overleaf

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(c) (i) Use the letters **H** and **h** to show the result of a genetic cross between two peach trees that would result in the production of seeds that could grow into nectarine trees. [3]

Key: **H** = allele for hairy fruit
h = allele for hairless fruit

Phenotype = peach tree × peach tree

Genotype = ... × .....

Gametes		

(ii) Using your answer from the Punnett square above, state the probability of producing a nectarine tree from this cross. [1]

Probability = ...

10

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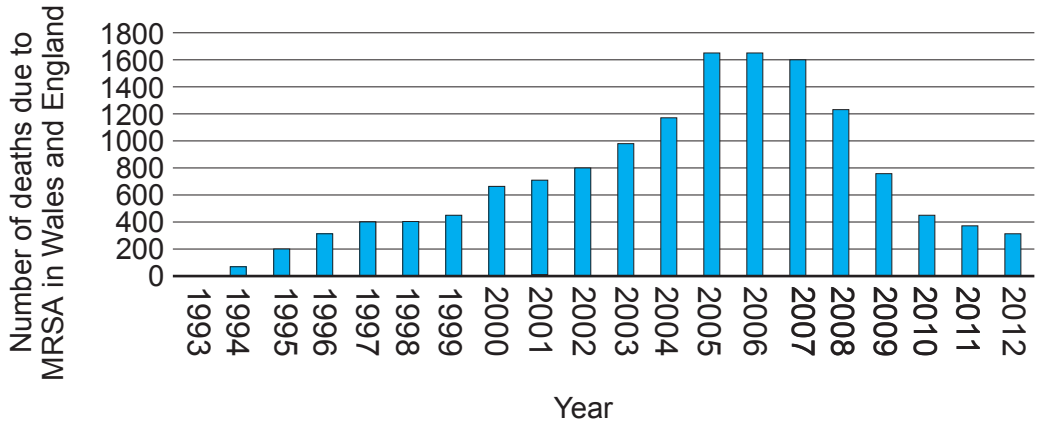
3. Methicillin is a type of antibiotic which has often been used to treat infections. **Graph 3.1** shows the number of deaths in Wales and England from methicillin resistant *Staphylococcus aureus* (MRSA) between 1993 and 2012.

Graph 3.1



(a) (i) Using the five-kingdom system of classification, name the kingdom to which *Staphylococcus aureus* belongs. [1]

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(ii) State what is meant by the term methicillin resistant *Staphylococcus aureus*. [1]

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(b) (i) Describe the trend in the numbers of deaths due to MRSA in Wales and England between 1993 and 2012. [1]

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(ii) Suggest **one** explanation for the trend in the numbers of deaths due to MRSA in Wales and England between 2006 and 2012. [1]

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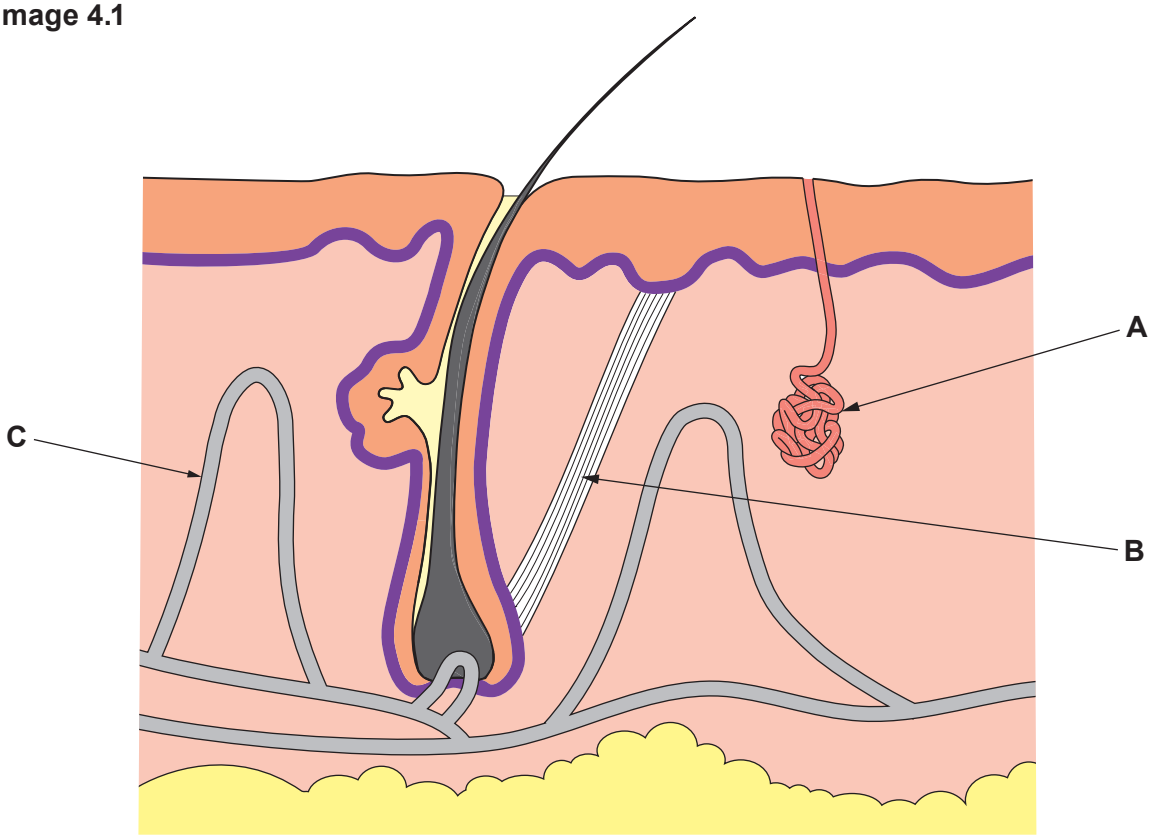
4. **Image 4.1** shows a section through the human skin.

Image 4.1



(a) State the name of structures **A** and **B** in **Image 4.1**. [1]

A .....

B .....

(b) Explain how structure **B** helps to maintain the normal body temperature in cold conditions. [3]

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(c) Frostbite occurs when the skin and tissues are damaged by long-term exposure to freezing temperatures. The most common parts of the body that frostbite affects are the fingers, toes, nose, ears, cheeks and chin.
Using **Image 4.1** suggest how the response of the blood vessels labelled **C** to freezing temperatures can lead to frostbite developing in the fingers. [2]

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5. Scientists conducted DNA profiling of the critically endangered smalltooth sawfish (*Pristis pectinata*).

The results of the DNA profiling showed that a number of female sawfish had been able to reproduce without mating. All of the offspring from these fish were female.

(a) Describe the process of DNA profiling. [2]

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(b) State the name of the type of reproduction carried out by the female sawfish described above and explain why all of their offspring were female. [2]

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6. The GloFish is a genetically modified Zebrafish which has become popular in aquariums in the United States and parts of Asia.

The fish were produced by inserting a gene from a jellyfish into a Zebrafish. The gene controlled the production of a fluorescent protein (GFP). The fish produced were brightly coloured.

GloFish are not approved for sale in Australia, Canada, California or Europe. **Image 6.1A** shows a Zebrafish and **Image 6.1B** shows a GloFish.

Image 6.1A

Image 6.1B

(a) (i) State the name of the molecule that makes up genes. [1]

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(ii) Explain how the gene controls the production of the GFP protein. [3]

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(b) Suggest why GloFish are not approved for sale in some parts of the world. [1]

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7. According to the World Health Organisation, the failure of parents to vaccinate their children in 2016 led to the biggest surge in measles cases in Europe for over a decade. Across 53 countries, there were 37 deaths reported from a total of 41 000 cases of measles.

(a) (i) Calculate the death rate for measles per 1000 cases of measles. [1]

Death rate = ... per 1000 cases of measles

(ii) Suggest a reason why some parents choose not to have their children vaccinated despite the risk to their health. [1]

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(b) Explain why an individual who has contracted measles once is unlikely to contract the disease a second time. [4]

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(c) Typhoid is a serious disease caused by the bacterium *Salmonella typhi*. Individuals who travel to the Indian subcontinent, Africa, South America and southeast Asia are advised to be vaccinated. The typhoid vaccine contains fragments of *S. typhi*.

(i) Explain why an individual receiving the typhoid vaccine will not develop the disease even though it contains fragments of *S. typhi*. [1]

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(ii) Explain why the typhoid vaccine does not prevent fevers or infections caused by other species of *Salmonella* bacteria. [1]

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(d) State how an increased understanding of the human genome can be important for medicine. [1]

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9

8. Diabetes is a condition where the concentration of glucose in the blood can become too high. Over time, this may cause complications including damage to blood vessels and nerves.

(a) (i) Apart from high blood glucose levels, state **one** other symptom of diabetes. [1]

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(ii) Insulin is essential in the control of blood glucose. With reference to insulin, explain the difference between Type 1 and Type 2 diabetes. [2]

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(iii) Apart from insulin injections, describe **one** other possible treatment for people with diabetes. [1]

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(b) Explain how a negative feedback mechanism raises blood glucose levels in a healthy individual when their glucose levels are decreasing. [3]

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(c) **Table 8.1** and **Table 8.2** show information on the ethnic categories of 26 907 children and young people up to the age of 24 years in Wales and England in 2016/17 who were diagnosed with either Type 1 or Type 2 diabetes.
Table 8.3 shows the ethnic categories of **all** children and young people in Wales and England.

Table 8.1 – Ethnic categories of children and young people with **Type 1 diabetes**, 2016/17

Ethnic category	Number	Percentage of the sample of children who had **Type 1** diabetes (%)
White	22 111	84.0
Mixed	699	2.7
Asian	2 136	8.1
Black	956	3.6
Other	421	1.6
Total number of children with **Type 1** diabetes =	26 323	

Table 8.2 – Ethnic categories of children and young people with **Type 2 diabetes**, 2016/17

Ethnic category	Number	Percentage of the sample of children who had **Type 2** diabetes (%)
White	246	42.1
Mixed	29	5.0
Asian	212	36.3
Black	79	13.5
Other	18	3.1
Total number of children with **Type 2** diabetes =	584	

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Table 8.3 – Ethnic categories of **all** children and young people in Wales and England

Ethnic category	Percentage of population of **all** children and young people in Wales and England (%)
White	86.0
Mixed	2.2
Asian	7.5
Black	3.3
Other	1.0

(i) Calculate the ratio of the total number of children and young people with Type 1 diabetes against the total number with Type 2 diabetes. [1]

Type 1 ..... : Type 2 .....

(ii) Use **Table 8.1**, **Table 8.2** and **Table 8.3** to state **one** conclusion that can be drawn on the effect of ethnicity on the percentage of children and young people affected by:

I. Type 1 diabetes; [1]

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II. Type 2 diabetes. [1]

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(d) A politician looking at these data concluded that the number of people in the whole population of Wales and England with Type 1 diabetes is far higher than the number with Type 2 diabetes. State why this is not a valid conclusion. [1]

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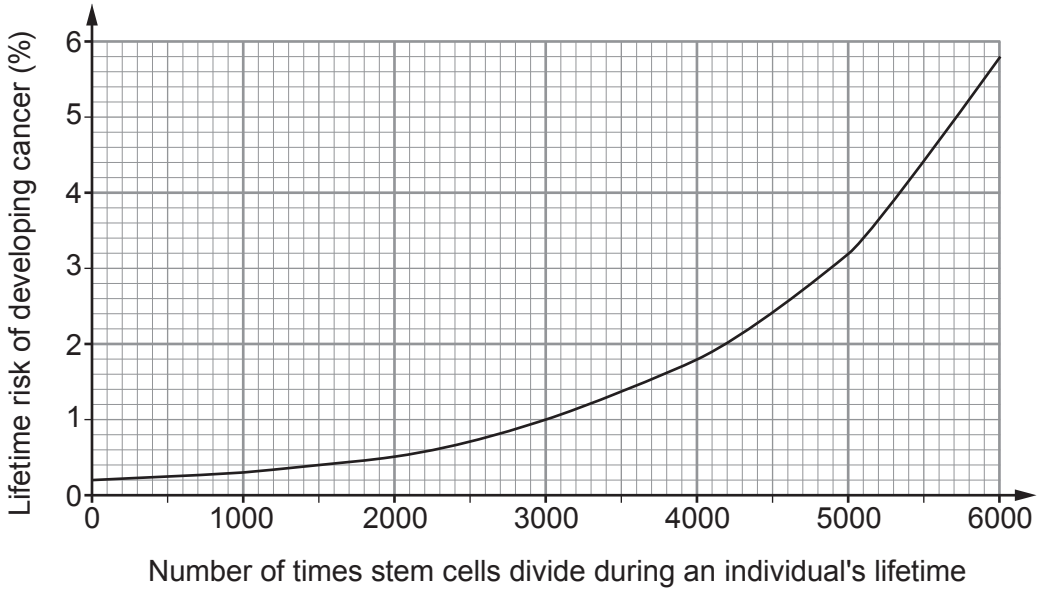
9. In humans, the number of times a stem cell undergoes cell division varies. For example, some stem cells in the skin will divide up to 200 times during an individual's lifetime whilst other stem cells found in the large intestine may divide up to 5800 times.
The lifetime risk of developing a cancer is different for each type of tissue in the human body. For example, the lifetime risk of developing skin cancer is 2%. The lifetime risk of developing a cancer of the liver is 0.71%.
Scientists have suggested that some of the variation in cancer risk can be explained by the number of times stem cells divide in each tissue during an individual's lifetime, as shown in **Graph 9.1**.

Graph 9.1



(a) (i) State what is meant by a stem cell. [2]

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(ii) State the name of the type of cell division responsible for growth and explain how it can lead to cancer. [2]

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(b) (i) Use all the information given to identify the percentage lifetime risk of developing cancer of the large intestine. [1]

Lifetime risk = ... %

(ii) Suggest **one** reason why the incidence of cancer is rare amongst young people, but tends to increase with age. [1]

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(c) Other than environmental factors and the number of times a cell divides, name **one** other factor which could be responsible for the variation in the risk of cancers in different tissues.

[1]

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10. Urine samples from four individuals were tested in a laboratory. Some of the results are shown in **Table 10.1**. ✓= present, × = absent.

Table 10.1

Sample	Sodium chloride (salt)	Glucose	Protein
1	✓	×	×
2	✓	✓	×
3	✓	×	✓
4	✓	✓	✓

(a) (i) State the name of **one** other substance that you would expect to be present in each of the samples. [1]

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(ii) Explain why you would not expect to find either protein or glucose in the urine of a healthy individual. [2]

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(b) State the name of the solution you would use to test for protein in a school laboratory and state the expected colour change if sample 3 in **Table 10.1** was tested for protein. [2]

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(c) Kidney failure can be treated using dialysis. **Image 10.2** shows a patient connected to a simplified drawing of a dialysis machine.

Image 10.2

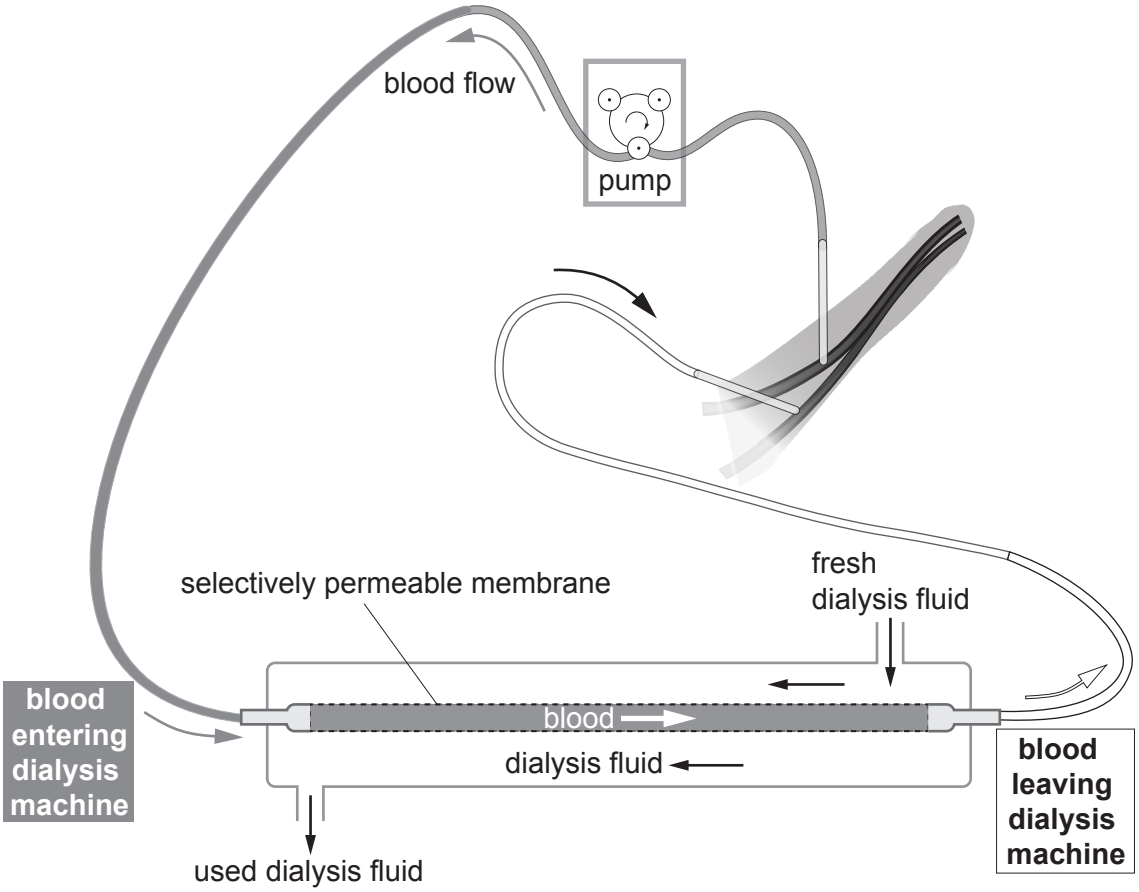

Table 10.3 compares the composition of blood and dialysis fluid.

Table 10.3

	Concentration (arbitrary units)		
Substance	Blood entering dialysis machine	Fresh dialysis fluid	Used dialysis fluid
Sodium ions	140	130	150
Chloride ions	100	90	110
Glucose	100	100	100
Urea	20	0	18
Protein	4	0	0

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(i) The pump in the dialysis machine pumps the blood at a rate of 400 cm^3 **per minute**. Calculate the volume of blood in **dm^3** that would pass through the dialysis machine if a patient was connected to the machine for **four hours**. (1000 cm^3 = 1 dm^3) [2]

Volume of blood = ... dm^3

(ii) Explain why the blood and the dialysis fluid flow in opposite directions through the machine. [1]

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(iii) Using all the information given, explain how the process of dialysis takes place in the kidney machine. [6 QER]

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