Global Challenges– 2021/20 GCSE Gateway Biology A

1. Nov 2021/Paper_J247/01/No.15

   Q_{10} is a measure of the rate of change of a reaction when temperature is increased by 10°C.

   Q_{10} is calculated using this formula:

   Q_{10} = rate at higher temperature ÷ rate at lower temperature

   An enzyme reaction has a rate of 36 units/min at 30 °C and 16 units/min at 20 °C.

   What is the Q_{10} for this enzyme?

   A   0.44

   B   2.25

   C   20

   D   576

   Your answer ☐   **[1]**

Global Challenges– 2021/20 GCSE Gateway Biology A

1. Nov 2021/Paper_J247/01/No.15

2. Nov 2021/Paper_J247/01/No.21

Polymenorrhea is a condition which affects the menstrual cycle.

Symptoms of the condition include the time between ovulation and the next period being shorter than usual.

(a) (i) What is the name of the hormone that could treat the symptoms of this condition?

Tick (✓) **one** box.

FSH ☐

Oestrogen ☐

Progesterone ☐

Testosterone ☐

[1]

(ii) Describe how the hormone chosen in part **(a)(i)** would help.

....

.... **[1]**

(b) Stem cells can be obtained from embryos. Stem cells can also be extracted from menstrual blood. These two types of cells are different.

(i) Embryo stem cells can be used to treat a wider range of disorders than menstrual blood stem cells.

Explain why.

....

....

.... **[2]**

2. Nov 2021/Paper_J247/01/No.21

(ii) The time it takes for a population to double in size is called the **doubling time**.
For menstrual blood stem cells, doubling time is 19.4 hours.

Starting with 1 stem cell, assuming a constant growth rate, it is possible to work out how long a population takes to grow.

Calculate the time it takes for the population to reach 16 cells.

Time to reach 16 cells = ... hours **[2]**

(iii) The doubling time for umbilical cord stem cells is 48 hours.

How many times faster is the growth of menstrual blood stem cells?

.... **[1]**

(iv) Discuss why scientists think menstrual blood stem cell extraction is a positive development.

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.... **[2]**
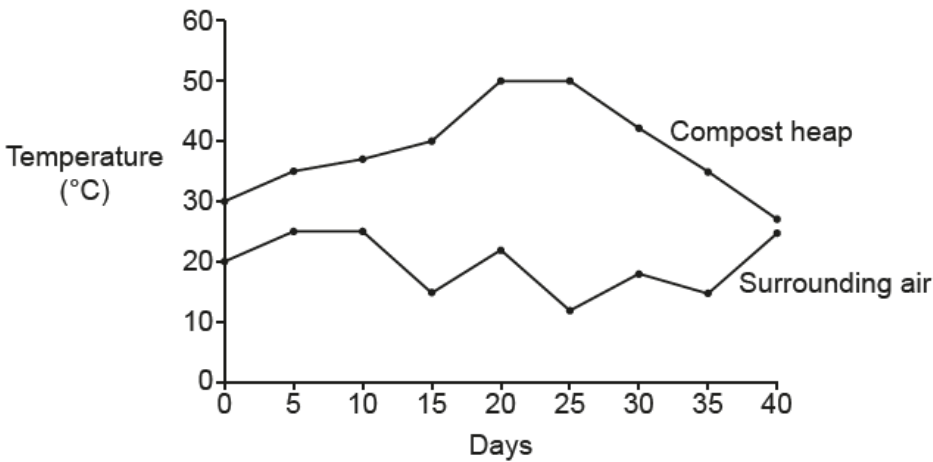
3. Nov 2021/Paper_J247/02/No.6

A student measured the temperature in a compost heap and the temperature of the surrounding air.

The graph shows the results.

Which is an explanation of the student's results?

A   The compost heap is cooler due to the photosynthesis of microorganisms.

B   The compost heap is cooler due to the respiration of microorganisms.

C   The compost heap is warmer due to the photosynthesis of microorganisms.

D   The compost heap is warmer due to the respiration of microorganisms.

Your answer [ ]   **[1]**

4. Nov 2021/Paper_J247/02/No.10

Gene technology can be used to produce new crop plants.

Which is an **ethical** argument against the use of gene technology?

A   It can be very expensive.

B   Only well-trained scientists can carry out the process.

C   Research and development takes a long time.

D   We have no right to change an organism's genes.

Your answer [ ]   **[1]**

5. Nov 2021/Paper_J247/02/No.13

Some diseases can be caused by the action of different risk factors.

Which row in the table gives a correct risk factor for the disease?

	Risk factor	Disease
A	High sugar intake	Liver cirrhosis
B	Excessive alcohol intake	Type 1 diabetes
C	Smoking	Bronchitis
D	High levels of exercise	Lung cancer

Your answer [ ] [1]

6. Nov 2021/Paper_J247/02/No.14

What is the best definition of an **antiseptic**?

    A   A chemical that destroys bacteria on the outside of the body.

    B   A chemical that destroys viruses inside the body.

    C   A protein that destroys bacteria inside the body.

    D   A protein that destroys viruses on the outside of the body.

Your answer [ ] [1]

7. Nov 2020/Paper_J247/02/No.7

The graph shows the number of reported cases of measles in England and Wales between 1940 and 2010.
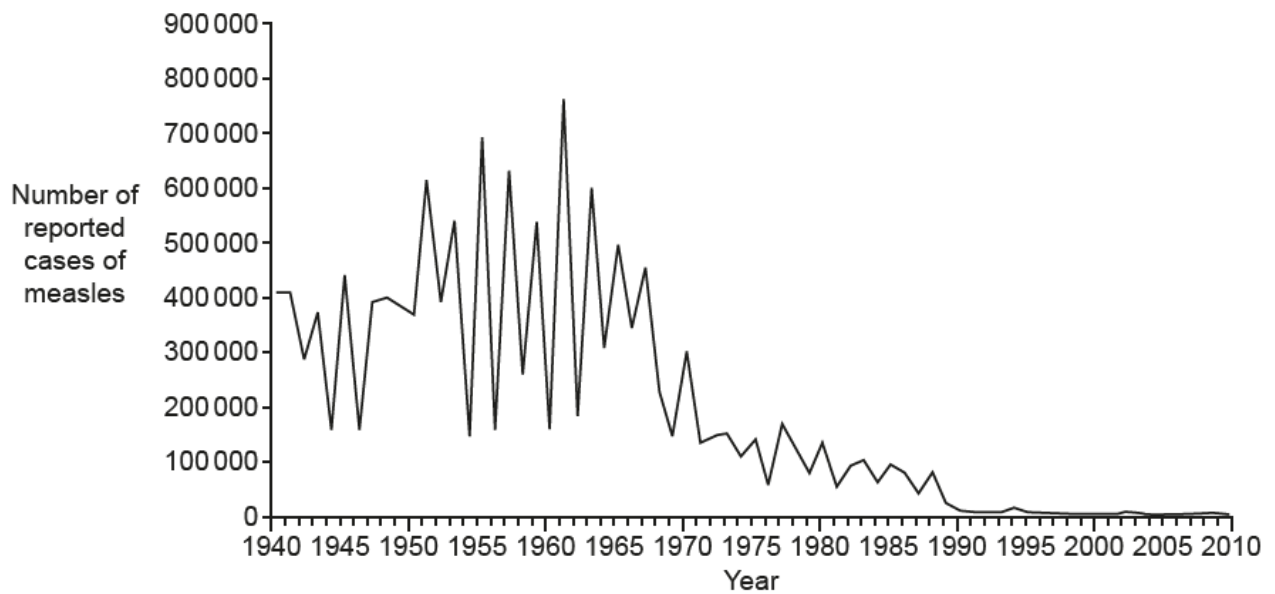
In which year was the measles vaccine likely to have been introduced?

A 1940

B 1952

C 1968

D 1982

Your answer ☐ [1]

6

8. Nov 2020/Paper_J247/02/No.8

The drawing shows a leaf from a tobacco plant that has tobacco mosaic disease.

What type of pathogen causes tobacco mosaic disease in plants?

A   Bacterium

B   Fungus

C   Protist

D   Virus

Your answer [   ]   **[1]**

9. Nov 2020/Paper_J247/02/No.14

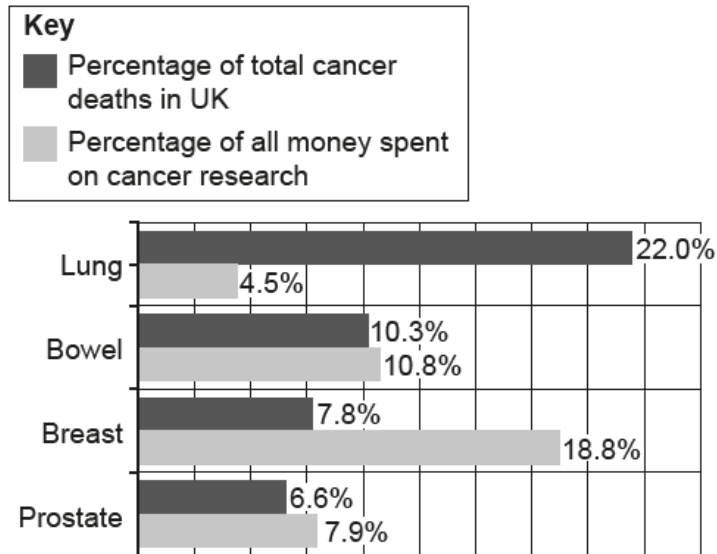Which of these is an **advantage** of using hydroponics for crop production?

A   Fertilisers are not required for crop growth.

B   The crops can be grown in areas where the soil is poor.

C   The crop plants do not need extra support.

D   The crops will not be eaten by pests.

Your answer [   ]   **[1]**

7

10. Nov 2020/Paper_J247/02/No.17

The graph shows information about the four most common types of cancer in the UK.

Key
■ Percentage of total cancer deaths in UK
▨ Percentage of all money spent on cancer research

Lung — 22.0% / 4.5%
Bowel — 10.3% / 10.8%
Breast — 7.8% / 18.8%
Prostate — 6.6% / 7.9%

(a) Which type of cancer has the **largest** difference between the percentage of total deaths and the percentage of money spent on research?

Tick (✓) **one** box.

Lung ☐

Bowel ☐

Breast ☐

Prostate ☐ **[1]**

(b) Treatment for cancer often involves powerful medicines that stop cells dividing all over the body.

Write down the name of the type of cell division that occurs when body cells divide.

.... **[1]**

(c) Many types of cancer have been linked to certain genes.

Scientists are trying to find ways to change the genes in embryos to reduce the risks of cancer.

(i) What name is given to the process scientists use to change the genes of an organism?

.... **[1]**

(ii) Write down **one** reason why some people disagree with the process given in **(c)(i)**.

....

.... **[1]**

11. Nov 2020/Paper_J247/02/No.19

Fanconi anaemia is a genetic disorder. The disorder causes a decrease in the number of platelets in the blood.

**(a)** Write down **one** possible symptom of Fanconi anaemia.

....

.... **[1]**

(b) Fanconi anaemia also causes a decrease in white blood cells and red blood cells.

The table shows ranges for blood components in people **without** Fanconi anaemia.

Blood component	Number per mm³
red blood cell	4.5 million – 6.5 million
white blood cell	6.0 thousand – 16.0 thousand
platelet	0.15 million – 0.40 million

(i) The diagram shows a microscope slide containing blood from a patient.
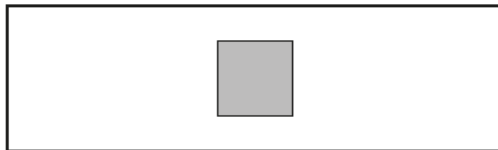
The volume of blood under the slide is $0.1\,mm^3$ and it contains 1000 white blood cells.

Calculate the number of white blood cells per mm^3 of blood.

Number = ... per mm^3 **[2]**

(ii) Does the blood sample provide evidence that the patient has Fanconi anaemia?

Use the table and your answer to part **(b)(i)** to justify your answer.

....

.... **[1]**

12. Nov 2021/Paper_J247/03/No.16

Polymenorrhea is a condition which affects the menstrual cycle.

Symptoms of the condition include the time between ovulation and the next period being shorter than usual.

(a) (i) What is the name of the hormone that could treat the symptoms of this condition?

Tick (✓) **one** box.

FSH ☐

Oestrogen ☐

Progesterone ☐

Testosterone ☐

[1]

(ii) Describe how the hormone chosen in part **(a)(i)** would help.

....

.... **[1]**

(b) Stem cells can be obtained from embryos. Stem cells can also be extracted from menstrual blood. These two types of cells are different.

(i) Embryo stem cells can be used to treat a wider range of disorders than menstrual blood stem cells.

Explain why.

....

....

.... **[2]**

(ii) The time it takes for a population to double in size is called the **doubling time**.
For menstrual blood stem cells, doubling time is 19.4 hours.

Starting with 1 stem cell, assuming a constant growth rate, it is possible to work out how long a population takes to grow.

Calculate the time it takes for the population to reach 16 cells.

Time to reach 16 cells = ... hours **[2]**

(iii) The doubling time for umbilical cord stem cells is 48 hours.

How many times faster is the growth of menstrual blood stem cells?

.... **[1]**

(iv) Discuss why scientists think menstrual blood stem cell extraction is a positive development.

....

....

....

.... **[2]**

11

13. Nov 2021/Paper_J247/04/No.8

Which of these is a step in the process used to make monoclonal antibodies?

A   Fusing hybridoma cells with lymphocytes (plasma cells).

B   Fusing tumour cells with lymphocytes (plasma cells).

C   Injecting antibodies into an animal such as a mouse.

D   Injecting tumour cells into an animal such as a mouse.

Your answer [   ]   **[1]**

14. Nov 2021/Paper_J247/04/No.9

What is the purpose of a placebo in a clinical trial?

A   To calculate the lowest effective dose of the medicine.

B   To make sure the results of the trial are reproducible.

C   To see if the effects of the medicine are due to the expectations of the patient.

D   To see if the effects of the medicine last for a long period of time.

Your answer [   ]   **[1]**

15. Nov 2021/Paper_J247/04/No.10

Researchers studied over 200 DNA samples from giraffe cells. Some populations of giraffe, which were geographically isolated, were found to be genetically very similar.

Which technique would the researchers have used to find that the giraffe populations were genetically similar?

A   Cloning using stem cells

B   DNA sequencing

C   Genetic engineering

D   Transcription

Your answer [   ]   **[1]**

16. Nov 2021/Paper_J247/04/No.12

Scientists studied how the mass of alcohol drunk per day affects the relative risk of getting heart disease. The graph shows the results of their study.

$$\text{relative risk} = \frac{\text{the number of people getting heart disease who drink each mass of alcohol}}{\text{the number of people getting heart disease who drink no alcohol}}$$

Mass of alcohol drunk per day (g)
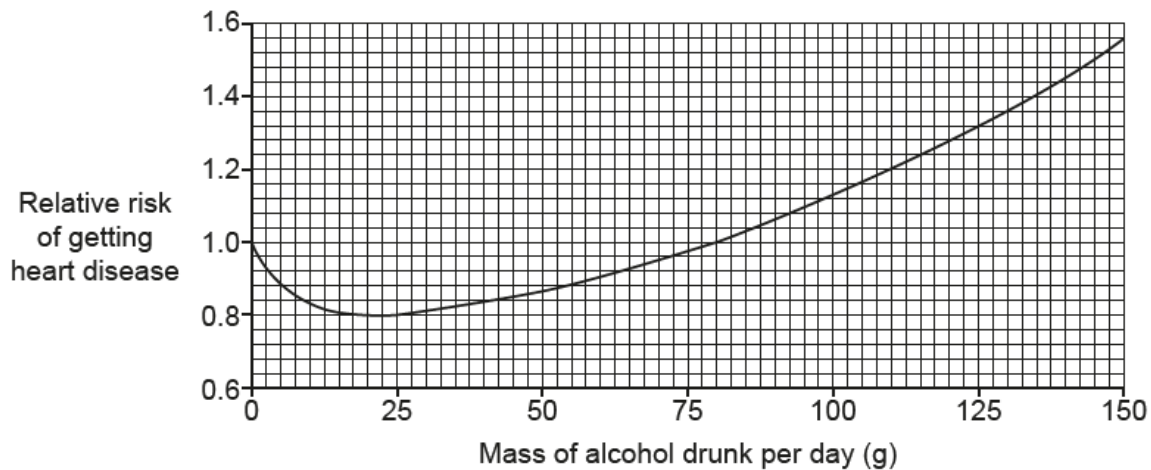
Which conclusion can be made from this graph?

A   Drinking 80 g of alcohol a day does not increase the risk of heart disease.

B   Drinking above 80 g of alcohol per day reduces the risk of heart disease.

C   Drinking alcohol has little effect on the risk of heart disease.

D   Drinking any mass of alcohol increases the risk of heart disease.

Your answer [ ]   [1]

17. Nov 2021/Paper_J247/04/No.16

Farmers' fields are usually surrounded by hedges. An example of this is shown in **Fig. 16.1**.
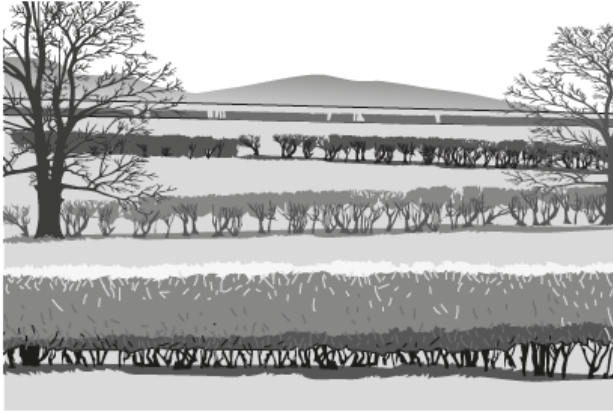
Fig. 16.1

Different plant species grow in the hedges. Scientists are studying hedges to find the number of different plant species.

(a) Write down why they would use a quadrat and a biological key in this process.

Quadrat ....

....

....

Key ....

....

[3]

(b) The scientists want to see if there is a link between the area of a field and the number of plant species growing in the hedge.

They sample hedges in five different sizes of fields, **A**, **B**, **C**, **D** and **E**.

The table shows the scientists' results.

Field	Area of field (m^2)	Mean number of plant species (per m of hedge)
A	3000	2.0
B	4000	1.7
C	7500	1.3
D	1500	2.1
E	10 000	1.2

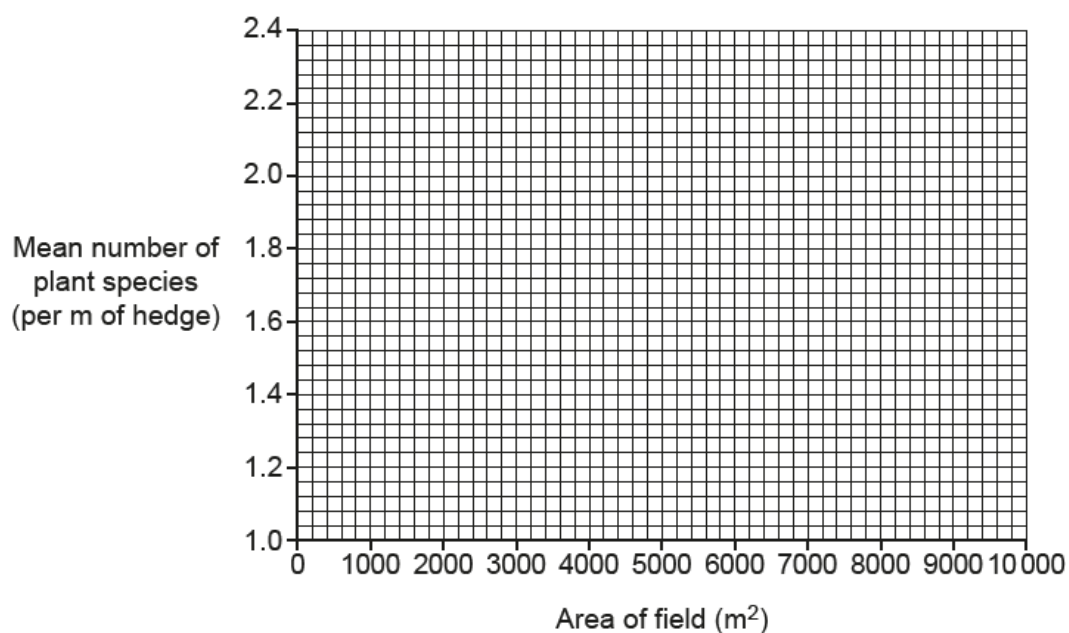**(i)** Plot the data for the five fields on the grid in **Fig. 16.2**.

Fig. 16.2

[2]

(ii) Draw a line of best fit on the graph in **Fig. 16.2**. [1]

15

(iii) There is a formula that can be used to estimate the age of a hedge.

$$\text{age in years} = \left(\begin{array}{c} \text{mean number of} \\ \text{plant species} \\ \text{per m of hedge} \end{array} \right) \times 110 + 30$$

The hedges in field **E** are 162 years old.

Calculate the age of the hedges in field **D**.

Age = ... years **[2]**

(iv) To try to grow more crops, farmers now use larger machines.

Modern farms have larger fields to make it easier to use these machines.

Does the scientists' data support the idea that older fields are smaller?

Explain your answer.

....

....

.... **[2]**

(c) Birds such as blackbirds make nests in hedges.

Fig. 16.3 shows a food web that occurs in a hedge next to a field of wheat.
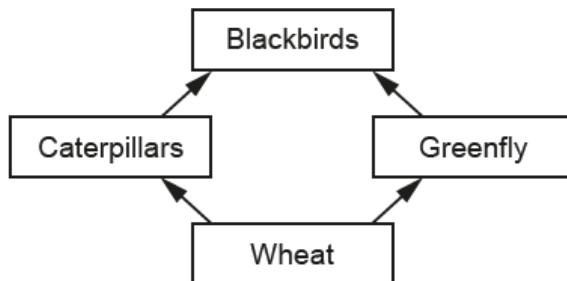
Fig. 16.3

Farmers are replanting hedges in their fields.

Use information from the food web in **Fig. 16.3** to explain how this could increase the yield of wheat.

....

....

.... **[2]**

18. Nov 2021/Paper_J247/04/No.17

Sulfur dioxide is a gas released when coal and oil are burned. Sulfur dioxide dissolves in water to make an acid. Scientists think that this might harm plants by affecting photosynthesis.

(a) Photosynthesis is controlled by enzymes.

Which **two** statements explain how an acid could affect photosynthesis?

Tick (✓) **two** boxes.

Acid will decrease the pH and cause the enzyme to change shape. ☐

Acid will increase the pH and cause the enzyme to change shape. ☐

Acid will increase the pH and cause the substrate to change shape. ☐

The enzyme will not fit into the active site of the substrate. ☐

The substrate will denature. ☐

The substrate will not fit into the active site of the enzyme. ☐

[2]

(b) Students take some spinach leaves and spray them with water containing different concentrations of sulfur dioxide.
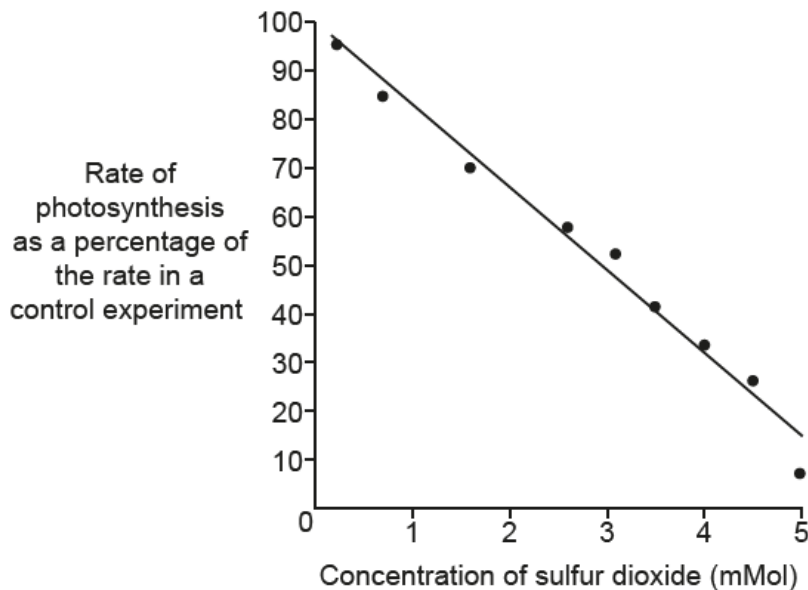
They then measure the rate of photosynthesis of the leaves.

The graph shows their results.

17

(i) The students plotted the rate of photosynthesis as a percentage of the rate in a control experiment. The control experiment involved spraying the leaves with a different substance.

Suggest what substance the students used to spray the leaves as a control.

.... [1]

(ii) One of the students makes this conclusion:

'The results of our experiment show that sulfur dioxide is affecting the plant and it is doing this because it forms an acid.'

Discuss whether this is a reasonable conclusion to make from the students' results.

....

....

....

....

.... [2]

(iii) Suggest how the students could modify their experiment to prove that sulfur dioxide is affecting the plant because it forms an acid.

....

....

.... [1]

19. Nov 2021/Paper_J247/04/No.18

This question is about plant diseases.

(a) Plant diseases can be caused by bacteria, fungi or viruses.

Complete the table by choosing words from this list to identify the **cause** of each of the diseases.

You can use each word once, more than once, or not at all.

bacterium   **fungus**   **virus**

Name of disease	Cause
Barley mildew	....
Crown gall disease	....
Tobacco mosaic disease	....

[3]

(b) Tomatoes are an important food crop. They can be infected by a number of different pathogens.

It is important that farmers can identify which pathogen is infecting their tomatoes as soon as possible.

Give **two** reasons to explain why.

1 ....

....

2 ....

....

[2]

(c) Tomatoes can be infected by two types of disease called early blight and late blight.

The type of disease can currently be identified by taking sections of leaves and examining them using a microscope.

Scientists are developing a new method of identifying these two diseases. They scan a leaf with light for 10 seconds and measure the wavelengths of light that are reflected.

(i) Give **one** reason why the new method may be an improvement on the current method.

....

.... [1]

(ii) The diagram shows the results of scanning three different tomato leaves.

One leaf has early blight, one has late blight and the other is healthy.

Key:
——— healthy
- - - - early blight
············· late blight

Fraction of light reflected vs Wavelength (nm)
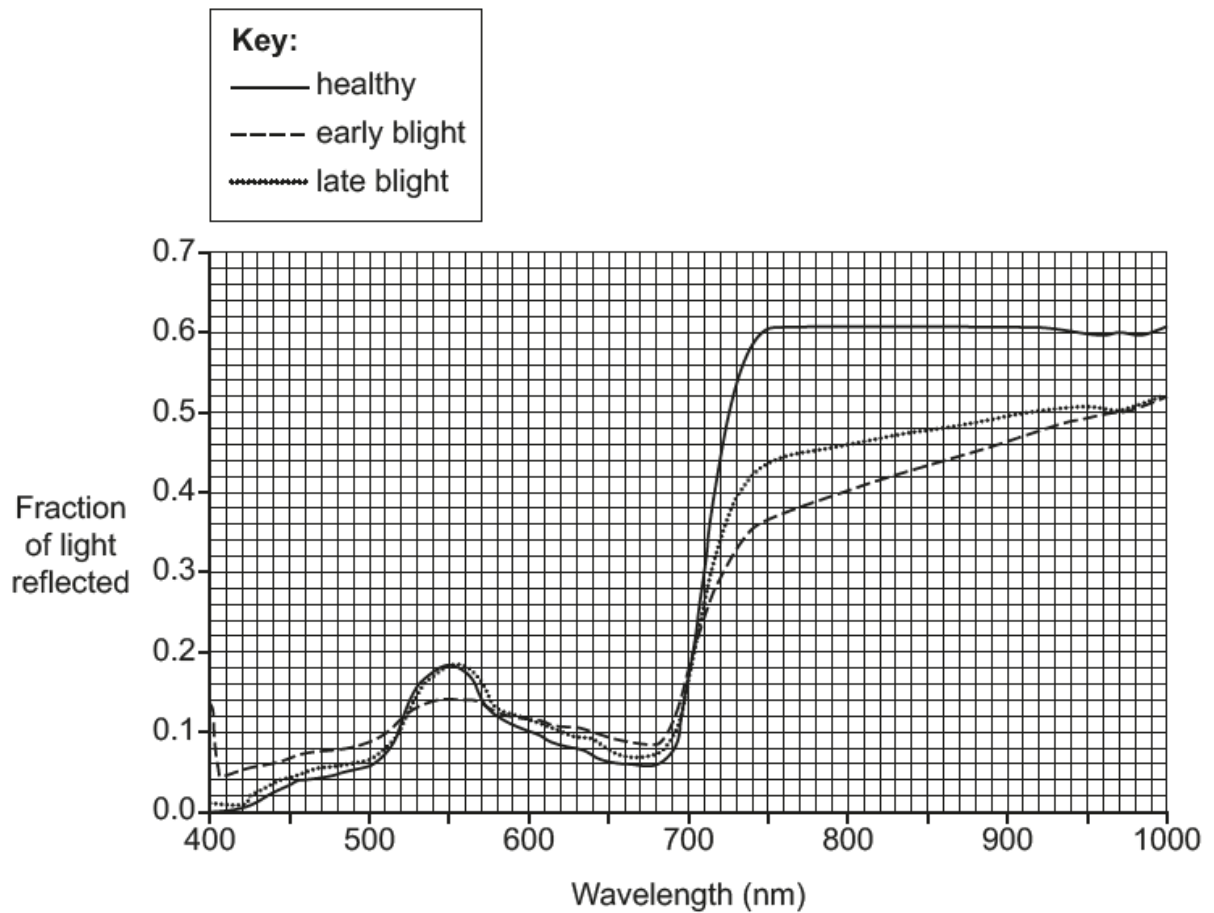
The scientists think that they only need to shine light of one wavelength at the leaf to decide if it is healthy or which disease it has.

Suggest a wavelength that the scientists could use.

Explain your answer.

Wavelength ....

Explanation ....

....

....

[2]

20. Nov 2020/Paper_J247/04/No.1

Which of these is an **advantage** of using hydroponics for crop production?

A   Fertilisers are not required for crop growth.

B   The crops can be grown in areas where the soil is poor.

C   The crop plants do not need extra support.

D   The crops will not be eaten by pests.

Your answer [ ]   [1]

21. Nov 2020/Paper_J247/04/No.10

The table shows estimated data about the global population and the number of deaths from HIV and tuberculosis (TB).

	Year	
	2000	**2017**
Total population in millions	6143.5	7464.0
Number of people with HIV in millions	36.1	36.8
Percentage of total population with HIV	0.6	0.5
Total number of HIV related deaths in millions	3.0	1.0
Total number of TB deaths in millions	2.2	1.6
Number of TB deaths in people with HIV in millions	0.5	0.3

Which is a correct conclusion from the data in the table?

A   Half of HIV related deaths were due to TB in 2000.

B   HIV became more life-threatening between 2000 and 2017.

C   People with HIV are more likely to die from TB than people without HIV.

D   The percentage of HIV in the population has increased between 2000 and 2017.

Your answer [ ]   [1]

22. Nov 2020/Paper_J247/04/No.11

Doctors are able to offer a diagnosis and treatment targeted to a patient's genome, known as genomic medicine.

Which is an example of the type of treatment used in genomic medicine?

A   Comparing patients' phenotypes so the best treatment can be given.

B   Designing drugs that are specific to a particular variant of a gene.

C   Using genetic engineering to produce new drugs.

D   Using monoclonal antibodies to destroy pathogens.

Your answer [   ]   **[1]**

23. Nov 2020/Paper_J247/04/No.13

When a person has measles they are unlikely to be ill again with the disease for many years.

What is the reason for this?

A   Antigens from the pathogen remain in the body.

B   Memory cells remain in the blood and can release antibodies.

C   The disease can now be treated with antibiotics.

D   White blood cells engulf the pathogens before antibodies are made.

Your answer [   ]   **[1]**

24. Nov 2020/Paper_J247/04/No.21

Hypercholesterolemia (HC) is the result of a mutation in the genome. It is caused by a dominant allele on chromosome 19. The mutation involved causes a change in the DNA nucleotides.

(a) Write the words **allele**, **chromosome**, **genome** and **nucleotide** in the boxes to show their size from smallest feature to largest feature.

Smallest feature

Largest feature

[1]

(b) One in 500 people are heterozygous for HC.

There are 66 000 000 people in the UK.

Calculate how many people in the UK are heterozygous for HC.

Number of people = ... **[1]**

(c) A woman who does not have HC and a man who is heterozygous are expecting a baby.

What is the probability of the baby having HC?

Complete the genetic diagram to explain your answer.

Use **D** for the dominant HC allele and **d** for the recessive allele.

Man

Woman
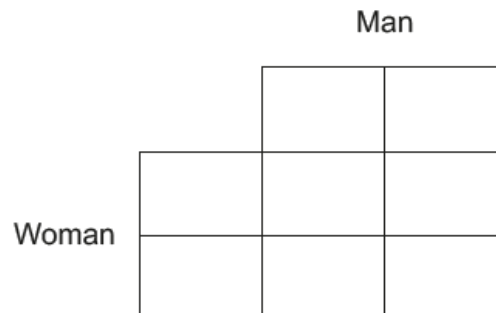
Probability = ... **[2]**

(d) The allele that is affected by HC codes for a protein called LDL receptor protein.
The faulty allele often has four extra nucleotides, making a total of 2521 nucleotides.

Calculate the number of **amino acids** found in the healthy, **unaffected** protein.

Number of amino acids = ... **[2]**

(e)* People with HC are more likely to develop heart disease. **Fig. 21.1** shows the heart of a person who has heart disease.
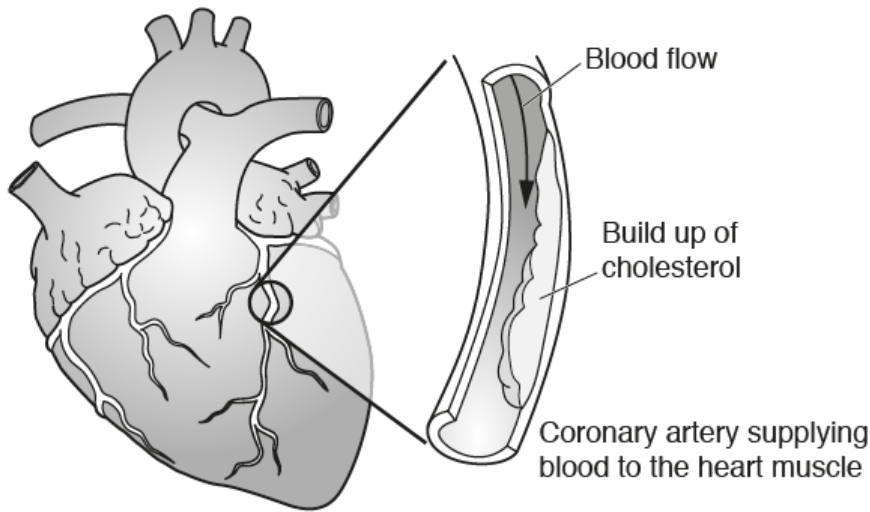
Fig. 21.1

The LDL receptor protein is found on the cell membrane of liver cells. The receptor picks up cholesterol from the blood and transports it into the liver cell. Inside the liver cell the cholesterol is broken down or used.

Explain why people who have the mutation in the allele for the LDL receptor are much more likely to develop heart disease.

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....

....

.... **[6]**

(f) A drug is being developed that might help protect people from heart disease.
To test the drug patients were divided into three groups.
Each group was given a different treatment and their blood cholesterol measured.

The results are shown in **Fig. 21.2**.

Fig. 21.2

Evaluate the results of the test.

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....

....

....

....

.... **[3]**