GCSE Biology B (Twenty First Century Science)

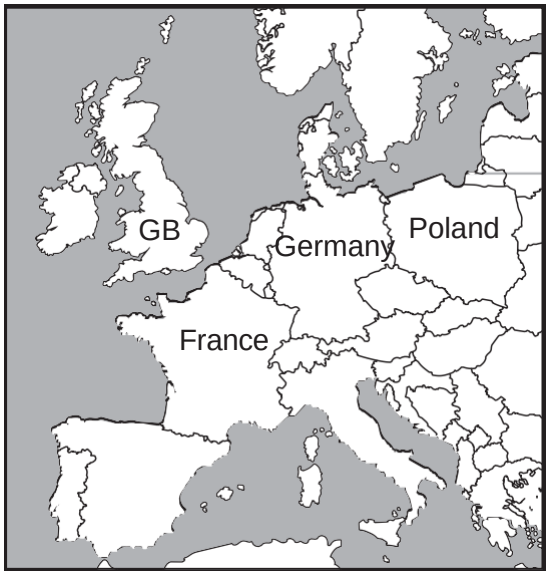
J257/04 Depth in biology (Higher Tier)

Question Set 4

1 Plants can be infected by diseases caused by pathogens.

The plant disease ash dieback was first recorded in the early 1990s in Poland.

Since then, many thousands of trees in northern Europe have become infected.



Ash dieback was first found in eastern parts of Great Britain (GB) in 2012, and has been spreading across the country ever since.

(a) Suggest **two** ways in which ash dieback could have been spread from mainland Europe to Great Britain.

Fungal spores carried by the wind or movement of material from infected ash trees.

[2]

(b) The British outbreak of ash dieback started in woodland in Norfolk.

Much of the woodland has died, but one ash tree has shown tolerance to the disease. This tree was named 'Betty' by scientists. Tolerant trees have also been found in mainland Europe

(i) Explain how scientists could use selective breeding to produce ash trees with improved tolerance.

Cross Betty with other tolerant trees. Identify the offspring for tolerance to ashdieback. Then breed the most tolerant offspring and repeat.

[3]

(ii) New woodland could be planted using cuttings from Betty.

Explain why this could be a **disadvantage** during a future outbreak of plant disease.

The cuttings will be genetically identical to Betty and could all have an allele that codes for susceptibility to a different pathogen.

[2]

(iii) Explain how gene technology could be used to produce ash trees with improved tolerance

Sequence of genomes of Betty and other tolerant trees. Look for alleles they have in common and isolate alleles associated with tolerance. Finally use genetic engineering to introduce tolerance alleles into new ash trees. **[4]**

(c) Amir works in a laboratory. His job is to identify pathogens that cause plant diseases.

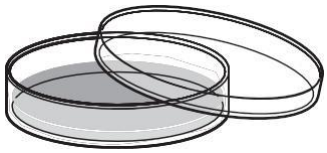
Amir has a sample of one species of bacteria from an infected plant.

He wants to test the effectiveness of different antibiotics against this species of bacteria.

Amir must start by transferring bacteria from the sample bottle into four Petri dishes containing agar jelly.

He needs to set up four identical dishes of this species of bacteria.

glass bottle containing the sample of bacteria



Petri dish containing agar jelly

He intends to pour some of the liquid from the glass bottle into each Petri dish.

(i) Write down **two** ways he could improve his method and explain why each is an

improvement: Put on gloves before starting.
explanation: prevent risk of contaminating dish. **[4]**
improvement: Don't take lid of Petri dish fully off.
explanation: prevent risk of contaminating dish.

(iii) Explain how gene technology could be used to produce ash trees with improved tolerance

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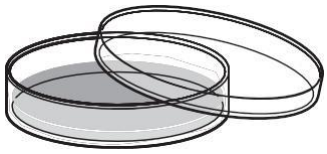

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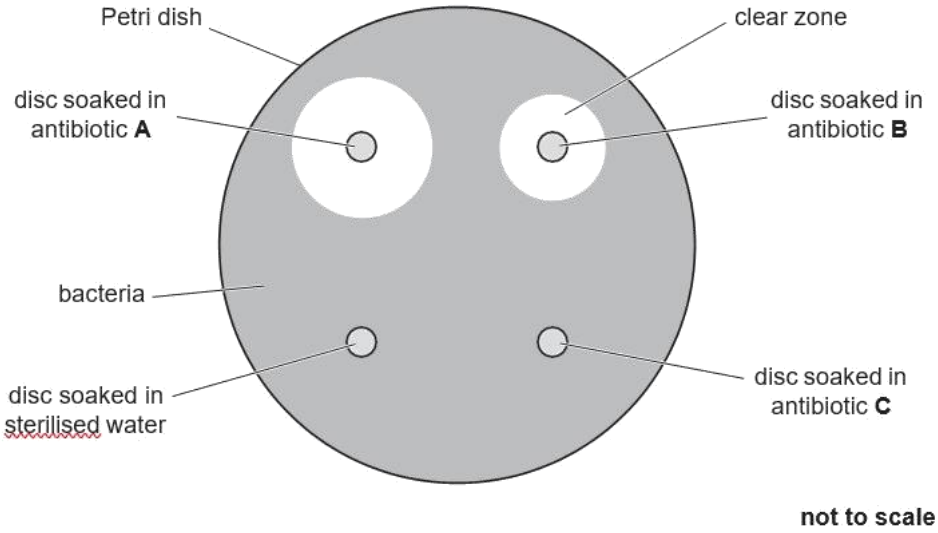
After transferring bacteria from the sample to the four Petri dishes, Amir adds four different paper discs to each dish.

The paper discs have been soaked in different solutions.

Amir places the dishes in an incubator overnight.

The bacteria grow to cover the surface of the agar jelly.

The diagram shows what Amir sees on one of the dishes after it has been incubated



(ii) The diameter of the clear zone around the disc soaked in antibiotic **A** is 23 mm. Calculate the area of this clear zone.

Use the equation: area of clear zone = 3.14 × r^2. Give your answer to **3** significant figures.

Diameter = 23mm
Radius = 23/2 = 11.5mm

$3.14 \times (11.5)^2 = 415.265$
$= 415$

Area of clear zone = 415 mm^2 **[3]**

(iii) **Table 4.1** shows Amir's results for all four dishes.

Disc soaked in	Area of clear zone (mm^2)			
	Petri dish 1	Petri dish 2	Petri dish 3	Petri dish 4
Antibiotic **A**		363	346	346
Antibiotic **B**	227	254	227	214
Antibiotic **C**	0	0	0	0
Sterilised water	0	0	0	0

Table 4.1

Suggest **two** possible explanations for the results for antibiotic **C**. **[2]**

Bacteria are resistant to antibiotic C.
Solution of antibiotic C was too dilute.

(d) **Table 4.2** gives information about plant cells and pathogens.

Cell type	Mean diameter (μm)	Mean diameter (m)
Plant cell		8×10^{-5}
Bacterium	2	
Virus	0.25	

Table 4.2

(i) Give the mean diameter of the plant cell in μm.

8×10^{-5} m = 8×10^{-2} mm = 80 μm

(×1000 between m and mm; ×1000 between mm and μm)

Mean diameter = ……80……μm **[1]**

(ii) Give the mean diameter of the bacterium in

m. Give your answer in standard form.

2 μm = 2×10^{-3} mm = 2×10^{-6} m

(÷1000 between μm and mm; ÷1000 between mm and m)

Mean diameter = ……2×10^{-6}…… m **[1]**

(iii) Give the mean diameter of the plant cell, in m, to the nearest order of magnitude.

$8 \times 10^{-5} \approx 10 \times 10^{-5}$

$\approx 10^{-4}$

Mean diameter = ……10^{-4}…….. m **[2]**

(iv) Show that the sizes of the bacterium and the virus are the same order of magnitude.

2 / 0.25 = 8 so bacterium is 8 times larger.

This is less than 10 times larger so same order of magnitude. **[2]**

Total Marks for Question Set 4: 26