

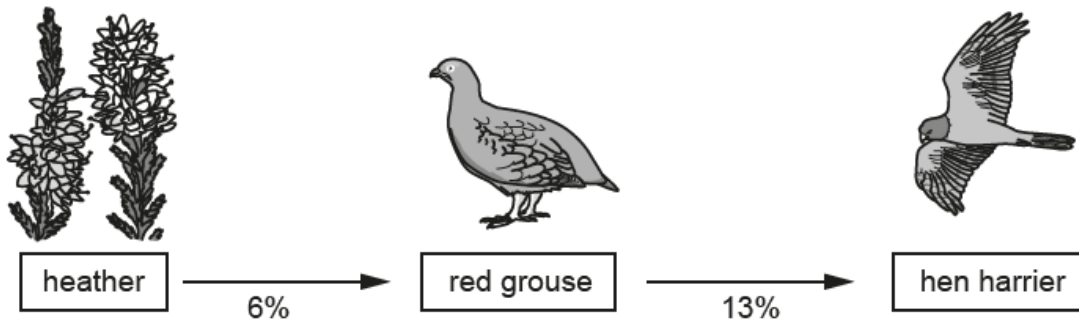
**Practical Skills – 2021/20 GCE Biology A Component 02**

**1. Nov/2021/Paper\_H420/02/No.17**

Heather is a plant with a woody stem that grows on upland areas of the UK such as the North York Moors. These areas are often described as heather moorland.

Heather moorland is a habitat that is relatively common in the UK but rare elsewhere in the world.

The diagram shows an example of biomass transfer in a heather moorland ecosystem.



The numbers below the arrows represent the percentage of biomass transferred to the species shown in the next trophic level.

(a) Sunlight that can potentially be used in photosynthesis by green plants such as heather is called photosynthetically active radiation (PAR).

(i) In one year,  $8.94 \times 10^9 \text{ kJ m}^{-2}$  of PAR fell on an area of heather moorland.

The heather plants then converted  $9.08 \times 10^7 \text{ kJ m}^{-2}$  of this energy into biomass.

Calculate the energy in the PAR that the heather did **not** convert into biomass.

Energy = .....  $\text{kJ m}^{-2}$  [2]

(ii) Scientists were able to estimate the increase in biomass in heather plants in one year.

Suggest how the increase in biomass over time in a plant such as heather could be determined experimentally.

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

- (iii) Some of the solar radiation that falls on the leaves of plants is reflected. Some solar radiation is of a wavelength that is not suitable for use in photosynthesis.

List **one** other reason why much of the PAR is not used by the plant in the production of biomass.

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

- (iv) Suggest and explain why the percentage of biomass transferred between heather and grouse is smaller than the percentage of biomass transferred between grouse and hen harrier.

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

- (b) The hen harrier is the top predator on heather moorland in the UK.

Scientists are concerned about a recent decrease in the population of hen harriers.

The current estimate of the hen harrier population in the UK is 545 pairs. This represents 71% of the estimated population in 2004.

- (i) Calculate the estimated population of UK hen harriers in 2004.

Estimated population = ..... pairs [2]

- (ii) Since 2004, the population of red grouse in the UK has been relatively stable and it is not thought that the population has been affected by changes in climate.

Suggest an explanation for the decrease in hen harrier numbers since 2004.

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

- (c) Heather moorland in the UK is managed in an attempt to conserve the habitat. One of the procedures carried out as part of this management is regular burning of the moorland. Small areas are burnt in the winter and new shoots begin to grow the following year. This helps to maintain a variety of heights of heather plants, and prevents the growth of other larger species of plant.

(i) State why the management of heather moorland is known as *in situ* conservation.

..... [1]

- (ii) Apart from regular burning, suggest another procedure that could be carried out to conserve the heather moorland habitat.

..... [1]

- (d)\*** In a newly-available area of land, the communities change over time. The process of change is known as succession.

Outline the process of primary succession **and** explain why heather moorland is an example of deflected succession.

[6]

**2. Nov/2021/Paper\_H420/02/No.18**

Cells are surrounded by a plasma membrane that contains phospholipids.

- (a) Explain how the structure of phospholipid molecules allows for the formation of plasma membranes.

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..... [3]

- (b) The permeability of plasma membranes can be investigated using beetroot.

Beetroot cells contain a red pigment. The red pigment leaks out of the cells only when the plasma membrane has become damaged.

Some students investigated the effect of pH on the permeability of plasma membranes in beetroot cells.

The students used a valid method for the investigation, which is outlined below:

- Equal-sized disks of beetroot were cut.
- The disks were each immersed in an equal volume of buffer solution.
- After a set time, the solution was stirred and the absorbance measured using a colorimeter.
- The procedure was replicated three times in each of six different pH buffers.

The students recorded their results in the format shown below.

pH2 - 80%, 78%, 78%: average = 78.67%  
 pH3 - 61%, 60%, 60%: average = 60.33%  
 pH4 - 19%, 23%, 22%: average = 21.33%  
 pH5 - 9%, 10%, 11%: average = 10 %  
 pH6 - 0%, 0%, 0%: average = 0  
 pH7 - 0%, 0%, 0%: average = 0

- (i) Present the students' results in an appropriate table in the space below.

[4]

- (ii) The students concluded that the red pigment began to leak out of the beetroot cells at any pH below pH6.

Suggest and explain why a low pH might cause the red pigment to leak out of the beetroot cells.

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..... [2]

- (iii) Outline how the students could modify their investigation to get a more accurate value for the pH at which the red pigment begins to leak out of the beetroot cells.

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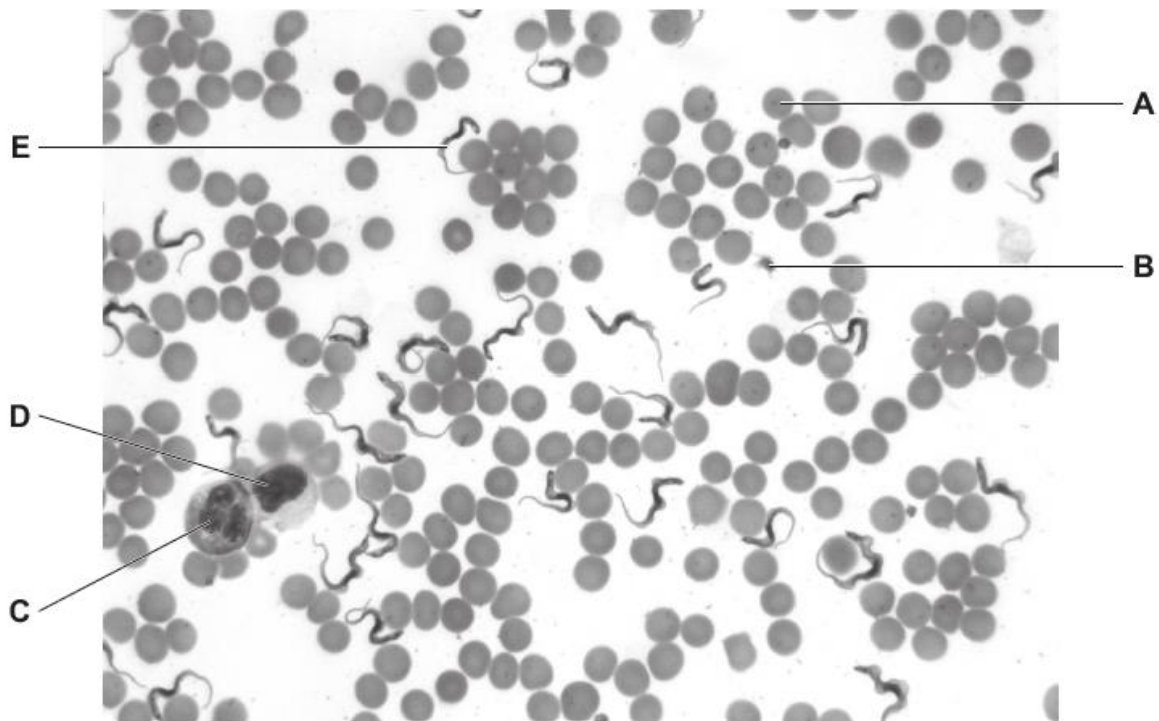
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..... [2]

## 3. Nov/2020/Paper\_H420/02/No.4



Which of the blood components, labelled **A** to **D**, shows a lymphocyte?

Your answer

[1]

## 4. Nov/2020/Paper\_H420/02/No.7

Scientists self-pollinated some pea plants that were heterozygous for the gene controlling height.

They expected a 3:1 ratio of tall plants to short plants in the offspring.

1046 plants grew in the next generation. 798 were tall and 248 were short.

Which of the following, **A** to **D**, is a statistical test that could be used to determine if these numbers are significantly different from a 3:1 ratio?

- A** chi-squared
- B** Spearman's rank
- C** standard deviation
- D** Student's t-test

Your answer

[1]

## 5. Nov/2020/Paper\_H420/02/No.16(b)

The body plan of multicellular organisms is under genetic control.

(a) Complete the passage below using the most appropriate words from the list.

analogous	archaea	development	DNA	domains
homeobox	homologous	homozygous	kingdoms	operon
phyla	plant	preserved	prokaryotes	regulator
ribosomes	transcription	translation		

The development of body plan in eukaryotic organisms is controlled by ..... genes. These genes code for proteins that are able to bind to ..... and turn specific genes on and off and are known as ..... factors. These proteins contain a sequence of base pairs that varies little between species within the animal, ..... or fungus .....

[5]

(b) Investigations into the activity of genes that control body plan frequently use fruit flies and mice.

One reason fruit flies are used is that there are fewer public concerns about the ethics of using flies.

(i) Suggest **two other** reasons why fruit flies are chosen for research into genes controlling the development of body plan.

- 1 .....
- .....
- 2 .....
- .....

[2]



## 6. Nov/2021/Paper\_H420/03/No.2(d)

- (d) Scientists recorded the population growth of bacteria in a closed culture. The scientists added various nutrients to the culture, including nitrate ( $\text{NO}_3^-$ ).

Fig. 2.3 shows the growth curve of the bacterial population.

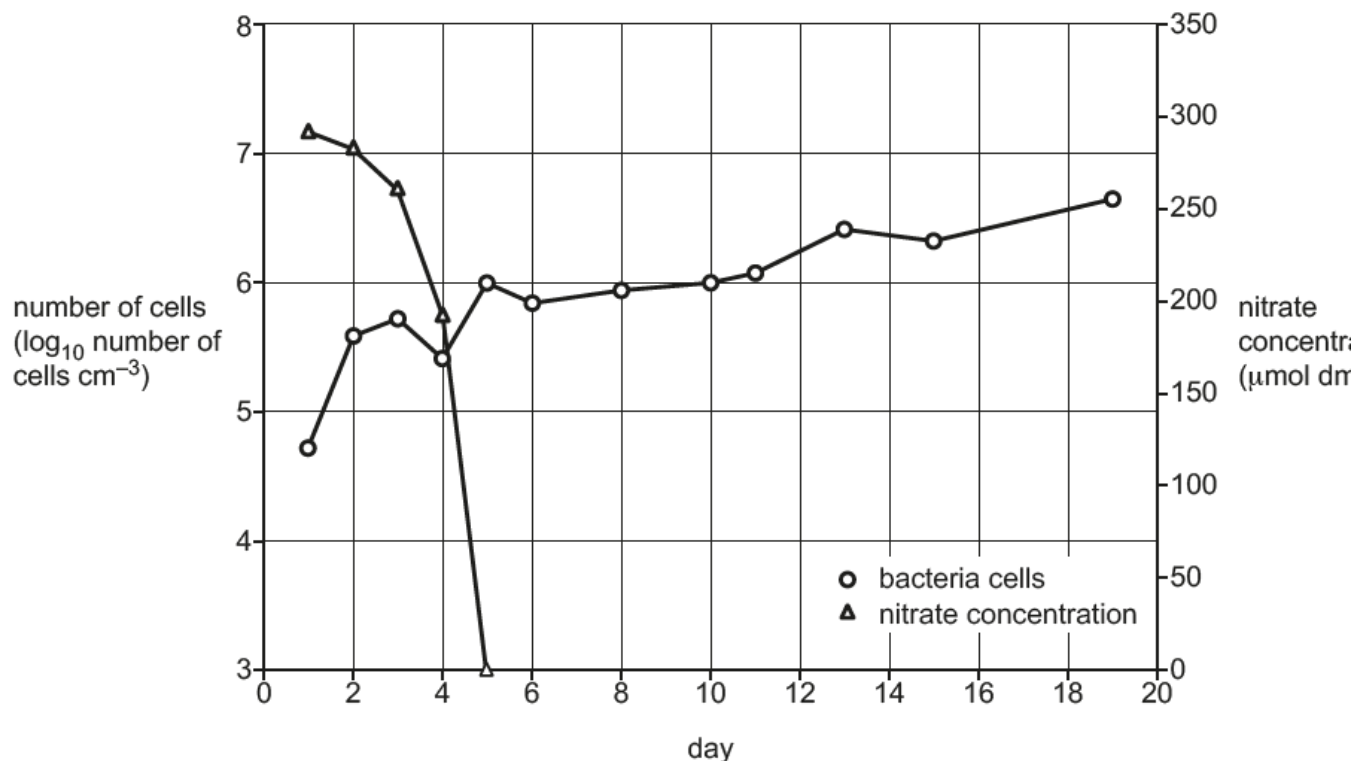


Fig. 2.3

- (i) A student looked at Fig. 2.3 and made the following statement:

'The bacterial growth curve in Fig. 2.3 looks very different from a standard growth curve for bacterial populations.'

Use evidence from Fig. 2.3 to evaluate the student's statement.

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- (ii) Calculate the total number of bacterial cells that would have been present in a  $50\text{cm}^3$  container on day 1.

Write your answer in standard form.

Number of bacterial cells = ..... [3]

- (iii) Describe a laboratory procedure that the scientists might have used to estimate the bacterial population.

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

- (e) The passage below describes some uses of microorganisms in biotechnology.

Complete the passage by writing the most appropriate words in the blank spaces.

Microorganisms have many characteristics that make them useful in biotechnology. These characteristics include ..... life cycles and low energy requirements. Species such as *Pseudomonas putida* and *Dechloromonas aromatica* can be used for bioremediation to remove ..... from water. Other species of bacteria are used to manufacture drugs, such as insulin. Antibiotics, which are secondary ....., are produced by fungi and are used to kill pathogenic bacteria.

[3]

**7. Nov/2021/Paper\_H420/03/No.3(b)**

(b)\* Plants produce callose in response to pathogenic infection, injury and changes in environmental temperature. Scientists wanted to investigate the effect of temperature on callose production.

Outline a valid plan that could be used to investigate the effect of temperature on callose production in plants.

You should include a suggestion for how callose production could be observed.

..... [6]

## 8. Nov/2020/Paper\_H420/03/No.3(a)

Students investigated the effect of light on the growth of garden cress seedlings.

- A total of 120 seedlings were divided into 2 groups of 60.
- Group A was grown in darkness for 2 days.
- Group B was grown for 1 day in darkness and then for 1 day in white light using the set-up shown in Fig. 3.1.

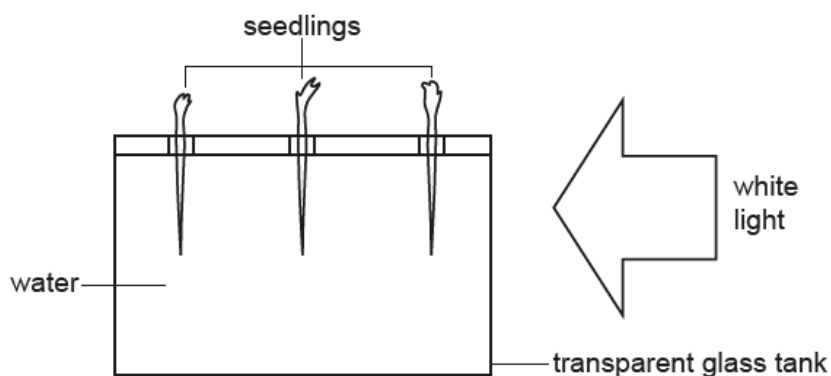


Fig. 3.1

The results of the students' experiment are shown in Tables 3.1 and 3.2.

Group	Mean length (mm)		Mean mass ( $\mu\text{g}$ )	
	stem	root	stem	root
A	13	18	102	60
B	25	23	160	120

Table 3.1

Direction of growth in Group B	Number of seedlings	
	stem	root
Away from light	2	29
Neither away from nor towards light	3	20
Towards light	55	11

Table 3.2

**(a) (i)\*** Describe and explain the results shown in Tables 3.1 and 3.2.

..... [6]

- (ii) The students wanted to test whether there was a significant difference between the stem lengths of the seedlings in Group A and the seedlings in Group B.

State the name of the most appropriate statistical test for the students to use.

..... [1]

- (iii) Justify your choice of statistical test given in part (ii).

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

- (iv) Table 3.2 records the direction of growth as:

- away from light
- neither away from nor towards light
- towards light.

The students used the chi-squared test to determine whether the direction of root growth was significantly different from their expectations.

Their null hypothesis was:

There is no difference between the expected direction of root growth and the observed direction of root growth.

The calculated chi-squared value was 8.10.

The students compared their chi-squared value of 8.10 to the values in Table 3.3.

Degrees of freedom	Probability ( $p$ )		
	0.10	0.05	0.01
1	2.71	3.84	6.64
2	4.60	5.99	9.21
3	6.25	7.82	11.34
4	7.78	9.49	13.28
5	9.24	11.07	15.09

**Table 3.3**

What can the students conclude about their results based on a chi-squared value of 8.10?

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