

1)

(a) Phagocytes form part of the body's non-specific response to disease.

Fig. 3.1, on the insert, shows a photograph of some blood cells.

(i) Identify which of the cell(s) labelled **A**, **B** and **C**, are phagocytes.

..... [1]

(ii) Why are phagocytes described as a secondary defence against pathogens?

..... [1]

(iii) Why is the response involving phagocytes regarded as **non-specific**?

..... [1]

(iv) Explain how phagocytes, such as those shown in Fig. 3.1, are able to pass from the blood into the tissue fluid.

..... [2]

(v) Bacterial pathogens initially attach to receptors on the surface of phagocytes.

Describe the process by which a pathogen is destroyed after it has become attached to the surface of a phagocyte.



In your answer you should describe clearly the sequence of events that takes place.

[7]

.....

(b) The infective agent that causes TB is not easily destroyed by phagocytes.

(i) Name the infective agent that causes TB.

..... [1]

(ii) Describe how the infective agent that causes TB is transmitted from one individual to another.

..... [2]

(c) The World Health Organisation (WHO) collects data about diseases worldwide.

Table 3.1 shows data published by the WHO about the incidence of TB in the years 2000 and 2008 for four different income groups.

Income group	Incidence of TB per 100 000 population	
	In 2000	In 2008
Low	280	280
Lower middle	150	150
Upper middle	100	110
High	17	14

Table 3.1

(i) Using the information in Table 3.1, compare the data for 2000 and 2008 in the four income groups.

..... [3]

(ii) The highest incidence of TB is associated with the low income group.

Suggest **three** reasons why the incidence of TB is higher in the low income group. [3]

2)

On a biology field trip, a pair of students collected some data about plant species in an area of ash woodland. Their results are shown in Table 4.1.

Species	Number of individuals (n)	n/N	$(n/N)^2$
Dog's mercury	40		
Wild strawberry	13	0.13	0.0169
Common avens	43		
Wood sorrel	4		
	$N =$		$\Sigma(n/N)^2 =$
			$1 - (\Sigma(n/N)^2) =$

Table 4.1

- (a) (i) Use the information in the table to work out the Simpson's Index of Diversity (D) for the area of woodland sampled using the formula:

$$D = 1 - (\Sigma(n/N)^2)$$

Where: n = number of individuals of a particular species.
 N = total number of individuals in all species.
 Σ = sum of.

Complete Table 4.1.

You may use the space below for your working.

[3]

- (ii) Simpson's Index of Diversity takes into account both species richness and species evenness.

In a school exercise book a student wrote the following definitions:

Species richness is a measure of the amount of species in an area.

Species evenness shows how many individuals there are of a species in an area.

The teacher did not award a mark for either of these statements.

Suggest how each statement could be improved.

Species richness

.....

Species evenness

.....

[2]

- (iii) If the value for Simpson's Index of Diversity is high, this indicates that the biodiversity of the habitat is high.

Outline the **implications** for a habitat if the Simpson's Index of Diversity is **low**.

..... [2]

- (b) When collecting data on the field trip, the students placed quadrats in 15 locations and calculated a mean number of plants for each species.

Suggest two **other** steps they could have taken to ensure that their value for Simpson's Index of Diversity was as accurate as possible.

[2]

3)

At the beginning of the nineteenth century, one species of squirrel, *Sciurus vulgaris*, the red squirrel, inhabited Great Britain.

In 1879, some individuals of *Sciurus carolinensis*, the grey squirrel, were introduced to southern England from the USA. Since then, the number and range of grey squirrels have increased and the number and range of red squirrels have decreased dramatically.

Grey squirrels are larger, spend more time on the ground and are less frightened of people than red squirrels.

- (a) Northumberland is one of the few areas of England that still has a large population of red squirrels.

In an attempt to preserve the population of red squirrels, and the biodiversity of the UK, the government has funded a cull (trapping and killing) of grey squirrels in Northumberland.

- (i) Define the term *biodiversity*.

[2]

.....

- (ii) Suggest **two** specific reasons why the government feels it is important to conserve red squirrels in a particular area, such as Northumberland.

..... [2]

- (iii) Some local residents have objected to the culling of grey squirrels.

Give **one** reason why people might disagree with the culling of grey squirrels.

..... [1]

- (b) Environmental groups have asked members of the public to report sightings of grey and red squirrels. In parts of Northumberland, the **reported number of sightings** of grey squirrels is higher than that of red squirrels.

Suggest **two** reasons why the **actual number** of grey squirrels might **not** be higher than the actual number of red squirrels in these areas.

..... [2]

- (c) In 2010, a company applied for permission to build a wind farm in rural Northumberland. Before permission was granted for the development, an Environmental Impact Assessment (EIA) was carried out by the local authority.

State **three** criteria that would have been considered when the EIA was carried out.

..... [3]

4)

In the first half of the nineteenth century, a large proportion of the population of Ireland relied on potatoes as their main source of food.

In 1845, almost the whole of the Irish potato crop became infected with a disease known as potato blight, which ruined the crop and led to widespread starvation.

Some varieties of potato plants, including wild types growing in South America, are unaffected by the disease.

(a) Genetic variation in the Irish potato plant population was very low following years of selective breeding and asexual reproduction.

(i) Suggest why this lack of genetic variation might have contributed to the rapid spread of the disease.
..... [1]

(ii) Suggest why, despite the low genetic variation, the average yield of potato plants varied from year to year.
..... [2]

(iii) Some potato plants carry a gene that gives the plants resistance to potato blight.
State the most likely cause of this genetic variation.
..... [1]

(b) Describe how it is possible to use selective breeding to improve the overall disease resistance of a crop, such as potatoes, in both the short and long term.



In your answer you should include precautions that should be taken to ensure disease susceptibility does not become a problem in the future.

[7]
.....

5)



0.1 mm

Fig. 8.1

Fig. 8.1, on the insert, shows an electron micrograph of an invertebrate known as a 'water bear'.

- (a) Complete the following passage about the classification of water bears using the most appropriate terms.

The water bear, *Echiniscus trisetosus* is a member of the genus
and the family *Echiniscidae*. This family belongs to the
Echiniscoidea, which forms part of the class *Heterotardigrada*. Water bears, also known
as tardigrades, are classified into a of their own called the
Tardigrada. Tardigrades form part of the kingdom within the
domain [5]

- (b) State the meaning of the term *phylogeny* and explain how phylogeny is related to classification.

..... [3]

- (c) Water bears are extremely common in many habitats, including household gardens. However, they were not discovered until approximately 300 years ago.

Suggest reasons why they were not known before this time.

..... [2]

6)

- (a) List **three** reasons why a large, multicellular animal, such as a mammal, needs a transport system.

..... [3]

Fig. 1.1, on the insert, shows the nervous pathways that coordinate heart action.

Above the diagram is a trace showing the electrical activity associated with one heart beat.

- (b) (i) State the full name given to a trace showing the electrical activity of the heart.

..... [1]

- (ii) Identify the components of the heart labelled **A** and **B** on Fig. 1.1.

A

B [2]

- (c) (i) During the electrical stimulation of the heart, there is a short delay between the excitation of the atria and excitation of the ventricles.

Explain why this delay is essential.

..... [2]

- (ii) The Purkyne tissue carries the excitation wave down the septum to the apex of the heart.

Explain why the excitation wave is carried to the apex.

..... [2]