



Cambridge Pre-U

CANDIDATE
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BIOLOGY

9790/01

Paper 1 Structured

October/November 2020

2 hours 30 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [].

For Examiner's Use	
Section A	
21	
22	
23	
24	
25	
Total	

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document has **32** pages. Blank pages are indicated.

Section A

Answer **all** the questions.

You are advised to spend no more than 30 minutes on this section.

1 A student set up a light microscope using:

- an objective lens with a magnification of $\times 4$
- a stage micrometer
- an eyepiece graticule placed in the $\times 10$ eyepiece of the microscope.

The actual length of one division on both the graticule and on the micrometer is $10\ \mu\text{m}$.

What happens when the objective lens magnification is increased to $\times 10$?

- A The appearance of one eyepiece graticule division increases to $40\ \mu\text{m}$.
- B The appearance of one eyepiece graticule division increases to $100\ \mu\text{m}$.
- C The image of one stage micrometer division increases to $0.4\ \text{mm}$.
- D The image of one stage micrometer division increases to $1\ \text{mm}$.

answer [1]

2 A printed slide shows five patterns, each consisting of pairs of alternating black and white lines. Table 2.1 shows the number of line pairs per μm in each pattern.

Table 2.1

pattern	number of line pairs per μm
1	0.25
2	0.50
3	1.00
4	2.00
5	4.00

Microscope **P** distinguished between patterns 1 to 4. Microscope **Q** distinguished between patterns 1 to 5.

What describes the capability of microscope **Q** compared with microscope **P**?

- A decrease in magnification
- B decrease in resolution
- C increase in magnification
- D increase in resolution

answer [1]

- 3 A student compared glucose solutions using a standardised Benedict's test. Soluble Cu^{2+} ions were reduced to insoluble Cu^+ ions, forming solid precipitates. These precipitates were removed by filtering and the remaining solutions were placed in a colorimeter to measure their percentage light absorbance at a particular wavelength.

The data obtained is shown in Table 3.1.

Table 3.1

glucose concentration / mmol dm^{-3}	percentage light absorbance by colorimeter
5	25
4	38
3	46
2	52
1	65

What explains the trends in glucose concentration and percentage light absorbance?

- A** serial dilution of a 5 mmol dm^{-3} glucose solution and a decrease in the mass of precipitate formed
- B** serial dilution of a 5 mmol dm^{-3} glucose solution and an increase in the mass of precipitate formed
- C** proportional (simple) dilution of a 5 mmol dm^{-3} glucose solution and a decrease in the mass of precipitate formed
- D** proportional (simple) dilution of a 5 mmol dm^{-3} glucose solution and an increase in the mass of precipitate formed

answer [1]

- 4 Polar bears live in the Arctic and use sea ice as a base for hunting seals underwater.

Which properties of water make it a useful physical component of the polar bears' habitat?

- 1 the ability of liquid water to dissolve polar molecules
 - 2 the high surface tension of liquid water
 - 3 the lower density of solid water compared to liquid water
- A** 1 and 2 only
- B** 1, 2 and 3
- C** 2 only
- D** 3 only

answer [1]

5 Which molecules must be present at the cell surface membrane of an **axon** for the repeated propagation of action potentials?

- 1 ATP
- 2 channel proteins
- 3 ligand-gated receptor proteins

- A** 2 and 3 only
B 1 and 2 only
C 1 and 3 only
D 1, 2 and 3

answer [1]

6 In what stages of the cell cycle do centromeres perform their function?

- 1 G₁ of interphase
- 2 S of interphase
- 3 mitosis
- 4 cytokinesis

- A** 2 only
B 3 only
C 1, 2 and 3 only
D 2, 3 and 4 only

answer [1]

7 Which line of Table 7.1 explains the movement of water molecules:

- into a plant, from the soil into a root hair cell
- out of a plant, from leaf spongy mesophyll cell walls to the air?

Table 7.1

	soil → root hair cell	spongy mesophyll cell walls → air
A	simple diffusion	facilitated diffusion
B	simple diffusion	osmosis
C	osmosis	simple diffusion
D	osmosis	osmosis

answer [1]

8 Components of blood plasma leave the capillaries of the glomerulus to form the glomerular filtrate in kidney nephrons.

Which aspects of the blood vessels in the kidney will influence the rate of formation of this glomerular filtrate?

- 1 renal arterial blood pressure
- 2 glomerular capillary permeability
- 3 diameter of the afferent arteriole
- 4 diameter of the efferent arteriole

- A** 1 and 2 only
- B** 3 and 4 only
- C** 1, 2 and 4 only
- D** 1, 2, 3 and 4

answer [1]

- 9 Mouse monoclonal antibodies may be introduced into patients to target a particular antigen on a pathogen or on a cancer cell. After a while the patient's immune system recognises the monoclonal antibodies as non-self and destroys them.

What parts of a monoclonal antibody could be redesigned to increase the length of time that the antibody lasts in a patient's body?

- A heavy and light constant regions
- B heavy and light variable regions
- C hinge region
- D light variable region

answer [1]

- 10 Fig. 10.1 shows a small-scale apparatus for processing milk.

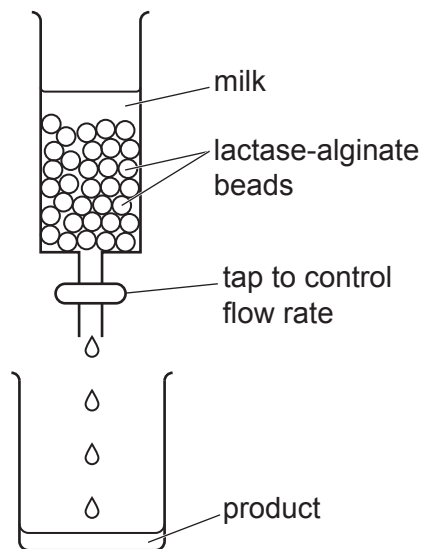


Fig. 10.1

Which statements are true of this apparatus?

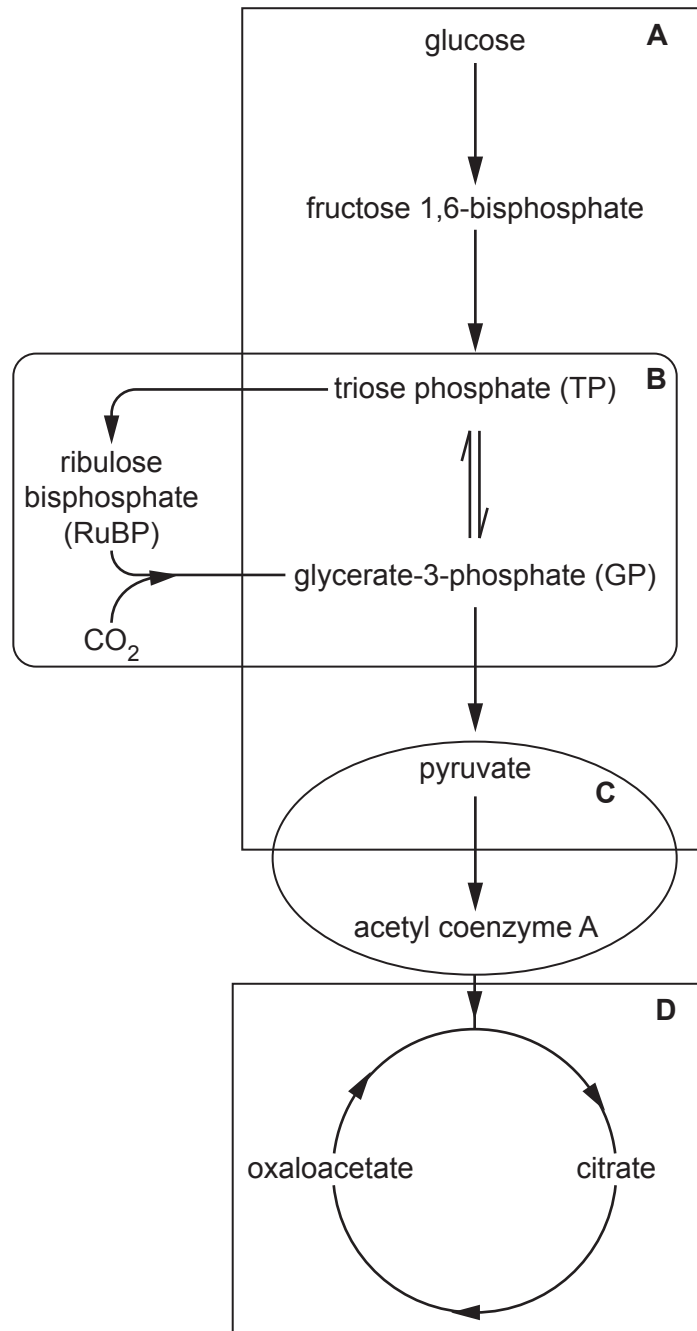
- 1 It is a model of a commercial application of biotechnology.
- 2 An enzyme is immobilised to improve efficiency.
- 3 The product contains more lactose than the original milk.

- A 2 only
- B 3 only
- C 1 and 2 only
- D 1, 2 and 3

answer [1]

Questions 11, 12, 13 and 14

Some metabolic pathways that take place in a plant cell are shown below.



State the letter or letters indicating the section or sections of the pathway that:

11 occur in animal cells answer [1]

12 involve decarboxylation answer [1]

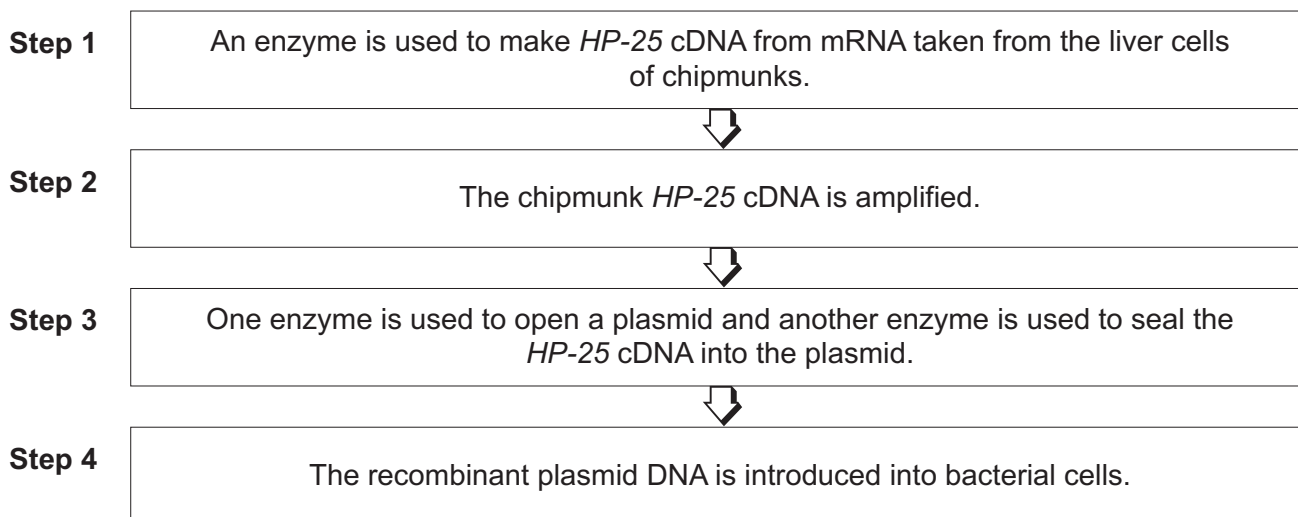
13 generate ATP answer [1]

14 make an overall net use of ATP. answer [1]

Questions 15, 16, 17 and 18

Chipmunks are small rodents that hibernate (spend the winter in a dormant state). Researchers were interested in the role of the chipmunk hibernation-specific gene, *HP-25*, and its protein product.

Four steps that can be used to obtain a supply of bacteria that express the HP-25 protein are outlined below.



Some enzymes and techniques are listed as **A–J**.

A	DNA fingerprinting
B	DNA ligase
C	gel electrophoresis
D	gene therapy
E	polymerase chain reaction
F	RNA polymerase
G	restriction endonuclease
H	reverse transcriptase
I	<i>Taq</i> polymerase
J	transformation

15 Which letter identifies the enzyme used in **Step 1**? answer [1]

16 Which letter identifies the enzyme used in **Step 2**? answer [1]

17 Which letters identify the enzymes used in **Step 3**? answer [1]

18 Which letter identifies the technique used in **Step 4**? answer [1]

Questions 19 and 20

A–G list names given to types of animal behaviour.

- A** classical conditioning
- B** habituation
- C** innate
- D** kinesis
- E** learned
- F** operant conditioning
- G** taxis

State **all** the letters that apply to these examples of behaviour.

19 Bumblebees on their first day of foraging move towards flowers that are yellow or blue.

answer [1]

20 After four weeks, bumblebees who have been taking nectar and pollen from mainly white flowers move towards white flowers when presented with a choice of white, yellow and blue flowers.

answer [1]

(b) (i) Name organelle **B**.

..... [1]

(ii) Name the type of microscope that produced the image in Fig. 21.1.

..... [1]

(iii) **B** and **C** are both the same type of organelle.

Suggest why **B** and **C** appear to have different shapes.

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

(iv) The mean diameter of organelle **B** in Fig. 21.1 is 34 mm.

The magnification of Fig. 21.1 is $\times 20\,000$.

Calculate the actual mean diameter of organelle **B**. Give your answer in micrometres.

You must show your working.

..... μm
[2]

(c) **D** is a ribosome attached to a membrane. **A** is not attached to a membrane.

(i) Use Fig. 21.1 to identify one **other** way in which **D** can be distinguished from **A**.

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

(ii) Suggest how the composition of the inner membrane of **C** may differ from the membrane attached to **D**.

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

[Total: 12]

22 (a) Plant growth substances like auxins and gibberellins control growth and reproduction in plants, while hormones control growth and reproduction in mammals.

Outline **two** similarities and **two** differences between plant growth substances and mammalian hormones.

similarities

.....

.....

.....

.....

differences

.....

.....

.....

.....

[4]

- (b) Rapid-cycling brassicas are plants that have been selectively bred to complete their life cycle in less than 40 days. Normal rapid-cycling brassicas have leaves spaced out on a tall stem.

A mutation in a rapid-cycling brassica resulted in a plant with leaves clustered together at a similar height close to the ground. The leaves were arranged like this because the internode gaps between the leaves had failed to expand.

- (i) State the name given to the growth form shown by the mutant plant.

..... [1]

Table 22.1 summarises some differences in the rate of growth and development of the normal and mutant plants.

Table 22.1

growth stage	time after planting seed / days	
	normal	mutant
emergence of seedling	2	5
flower buds visible	12–15	22–28
flowers open	20–23	>40
seed pods present	26–28	>40

- (ii) The process of mutation produces genetic variation that may enable organisms with mutant alleles to survive better and reproduce more.

Comment on this statement with reference to Table 22.1.

.....

 [2]

(e) Experiments show that gibberellins can be moved through plant phloem by translocation.

(i) Explain what is meant by translocation in the phloem.

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

(ii) Describe how loading occurs at a source, such as a photosynthesising leaf.

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

[Total: 19]

- (b) Tobacco smoke contains many carcinogenic compounds, including benzopyrene. A large number of research studies conducted over many years have established a link between smoking tobacco and developing lung cancer.

In 1978 Doll and Peto published epidemiological data which showed the relationship between tobacco smoking and lung cancer in men. This is shown in Fig. 23.1.

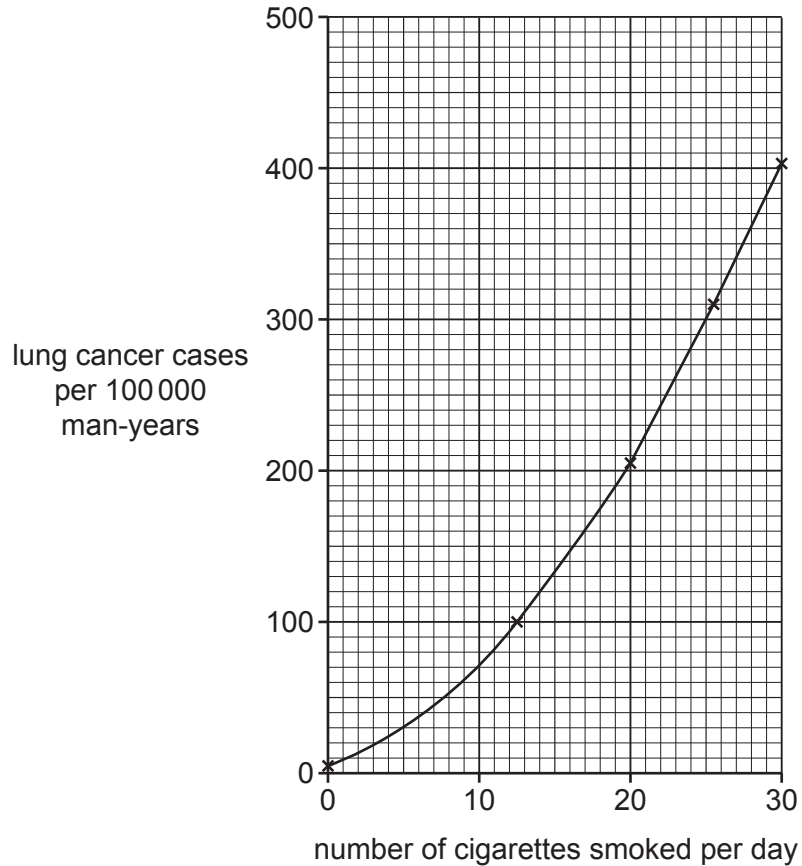


Fig. 23.1

In 1996 the effect of benzopyrene on cells and DNA was investigated *in vitro*. Researchers identified three sites where benzopyrene binds to the tumour suppressor *p53* gene, at codons 157, 248 and 273. When benzopyrene bound to guanine bases at these three sites, substitution mutations to thymine occurred.

The researchers then identified the *p53* mutations present in the lung cancer cells of people who smoked tobacco.

Fig. 23.2 shows the number of mutations occurring at different locations of the *p53* gene in the lung cancer cells of these people.

- 24 Coral reefs cover 0.1% of the ocean floor but support nearly 25% of marine species. Rising ocean temperatures, pollution and destructive fishing methods damage corals.

Fig. 24.1 shows part of a coral reef ecosystem.



Fig. 24.1

- (a) Coral reefs are described as biodiversity hotspots.

Suggest why coral reefs are described as biodiversity hotspots.

.....

.....

..... [1]

- (b) Each coral consists of a colony of animals called polyps that form by asexual budding. The polyps secrete the calcareous skeleton on which they rest.

Each coral polyp has the following structure.

- It consists of two layers of epithelial cells that enclose a central gut cavity.
- The two layers of epithelial cells are separated by a non-cellular gelatinous layer.
- Symbiotic bacteria form a thin layer over the polyp's outer epithelial cells.

Single-celled photosynthetic eukaryotes called zooxanthellae live within the polyp's inner epithelial cells. The zooxanthellae and the polyp have an endosymbiotic relationship.

Fig. 24.2 shows a transverse section through a polyp.

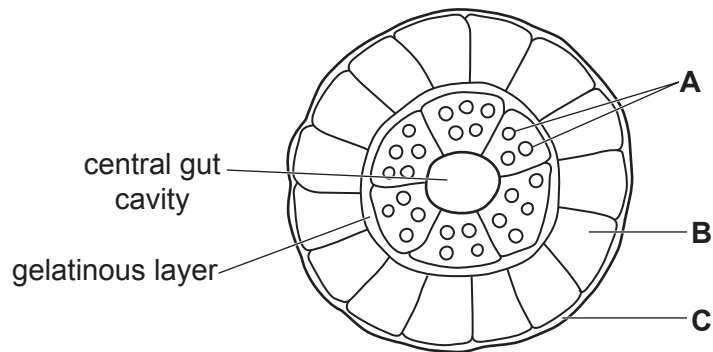


Fig. 24.2

- (i) State **one** difference in cell structure between a cell of type **A** and cell **B**.

.....

.....

..... [1]

- (ii) State **two** differences in cell structure between cell **B** and a cell in layer **C**.

.....

.....

.....

.....

..... [2]

- (c) Rising ocean temperatures harm corals, causing them to expel their endosymbiotic zooxanthellae. These zooxanthellae contain pigments like chlorophyll and xanthophylls and when the zooxanthellae have been expelled the coral is said to be bleached. Bleached corals lose the benefit of having endosymbiotic zooxanthellae and usually die.

Suggest why bleached corals may die.

.....

.....

.....

.....

..... [2]

- (d) Extensive coral bleaching, tropical storms and predation by starfish have caused the area of ocean floor covered by coral to halve since 1990.

- (i) Outline the social and economic reasons for trying to conserve coral reefs.

-

.....

.....

.....

..... [2]

- (ii) Outline the implications of the species-area concept for coral reef ecosystem conservation.

-

.....

.....

.....

..... [2]

- (c) Multiple sclerosis is an autoimmune disease that involves loss of myelin from nerve cells in the brain and spinal cord. Repeated loss and repair of myelin results in scar lesions forming in nerve tissue.

Fig. 25.1 shows a transverse section of a lower region of the spinal cord.

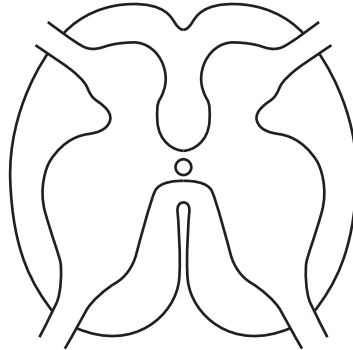


Fig. 25.1

- (i) Add **one** label to Fig. 25.1 to show and name the area of tissue in the spinal cord where scarring is most likely to occur in a multiple sclerosis patient. [1]

A number of factors combine to cause multiple sclerosis. The variation seen in the chance of developing the disease appears to have both genetic and environmental causes.

Fig. 25.2 shows the number of people per 100 000 people who are affected by the disease in different areas of the world.

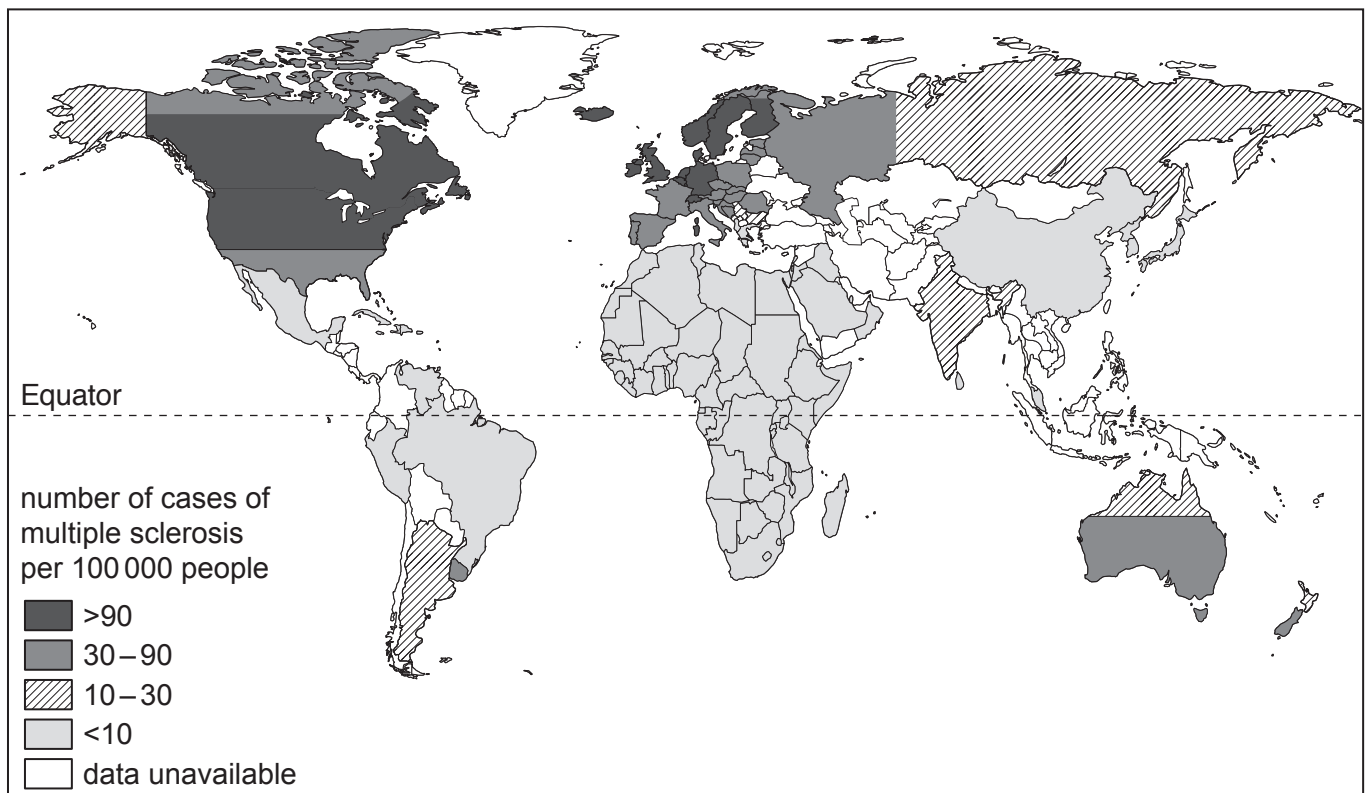


Fig. 25.2

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