

24 It is possible to introduce an allele for a functioning CFTR protein into lung epithelial cells of patients suffering from the genetically inherited condition cystic fibrosis.

Why can this strategy **never** provide a permanent cure for the patient?

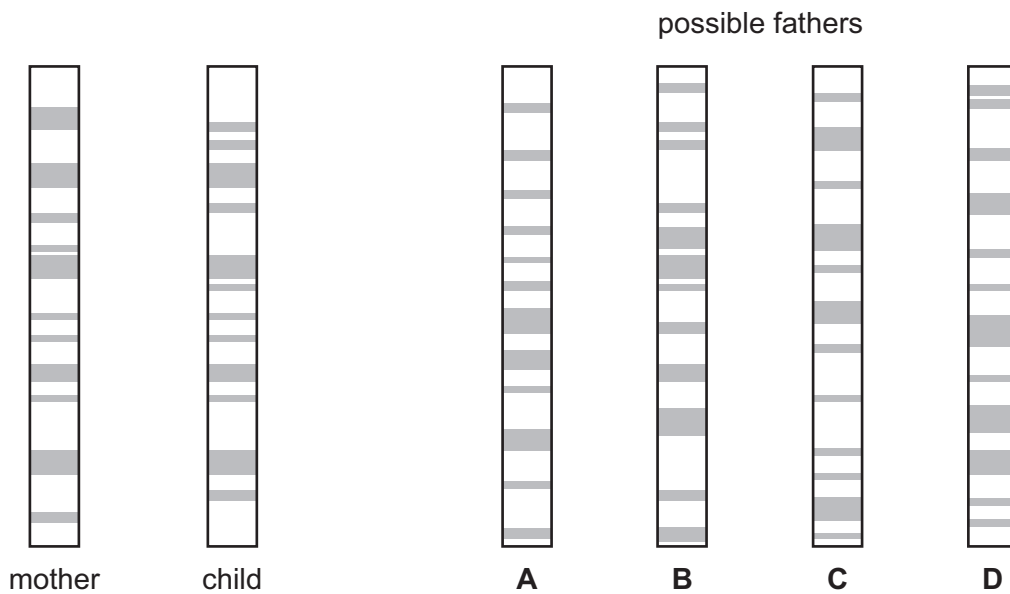
- A epithelial cells are continually dying and being replaced
- B the DNA molecule that makes up the functioning allele is very unstable
- C the methods of inserting the allele have low success rate
- D this is only somatic and not germ line therapy

25 Genetic profiling can be used to determine the paternity of a child.

DNA from the mother and the child is cut into fragments, separated by electrophoresis and made visual using a stain.

The diagram shows the genetic profiles of a mother and child, and four possible fathers.

Who is the father?



Section B

26 Which statements describe properties of water that are useful to living things?

- 1 Strong cohesive forces between water molecules at the water surface mean that it is a good medium for support.
- 2 Cohesive forces between water molecules and the sides of xylem vessels allow water to move in the transpiration stream.
- 3 Hydrogen bonds between water molecules attract the molecules to each other, but are weak so that the water molecules can move easily in relation to one another.
- 4 Water has a minimum density at 4°C, hence ice forming at the surface of ponds acts as a thermal insulator for organisms in the water.

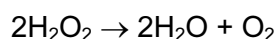
A 1 and 3 only **B** 1 and 4 only **C** 2 and 3 only **D** 2 and 4 only

27 Which two features contribute to the great tensile strength of cellulose?

- 1 glycosidic bonds linking the long chains of 1,4 α -glucose molecules
- 2 the -OH groups of the glucose molecules project outwards and form H bonds with neighbouring chains
- 3 the strength of the glycosidic bonds between the neighbouring chains of molecules
- 4 the successive glucose molecules are orientated at 180° to each other

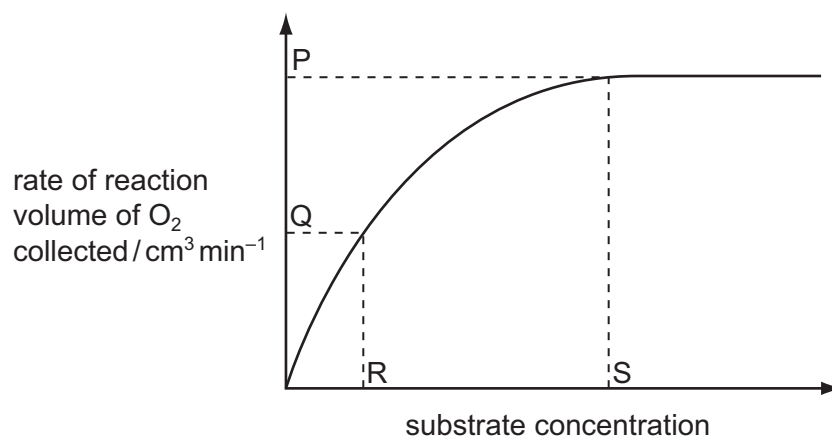
A 1 and 3 only **B** 1 and 4 only **C** 2 and 3 only **D** 2 and 4 only

- 28 Liver tissue produces an enzyme called catalase which breaks down hydrogen peroxide into water and oxygen.



The rate of this reaction can be determined by measuring the volume of oxygen produced in a given length of time.

Students added small cubes of fresh liver tissue to a range of hydrogen peroxide solutions and measured the volumes of oxygen produced. Their data were used to produce the graph showing how changing the concentration of hydrogen peroxide affected the rate of oxygen production.



Which statements are correct?

- 1 At P, the rate of reaction is limited by the concentration of enzyme.
- 2 At Q, all of the enzyme active sites are occupied by substrate molecules.
- 3 At Q, the rate of reaction is limited by the concentration of the substrate.
- 4 R represents K_m where the reaction rate = $V_{max}/2$.
- 5 At S, all of the enzyme active sites are occupied by substrate molecules.

- A** 1, 3, 4 and 5 only
B 1, 4 and 5 only
C 2 and 3 only
D 2 and 5 only

29 Which cell organelle is able to produce ribosomes?

- 1 endoplasmic reticulum
- 2 mitochondrion
- 3 chloroplast
- 4 lysosome
- 5 Golgi apparatus

- A** 2 and 3 only
B 1, 2 and 3 only
C 3 and 5 only
D 2 and 4 only

30 Many xerophytes have the following characteristics.

- 1 Crassulacean acid metabolism (CAM), with reversed stomatal cycles
- 2 high concentration of solutes in the vacuoles
- 3 cells have a more negative water potential (Ψ) than other plants
- 4 high root to shoot ratio
- 5 reduced leaf area and sunken stomata

Halophytes are plants adapted to live in salty habitats.

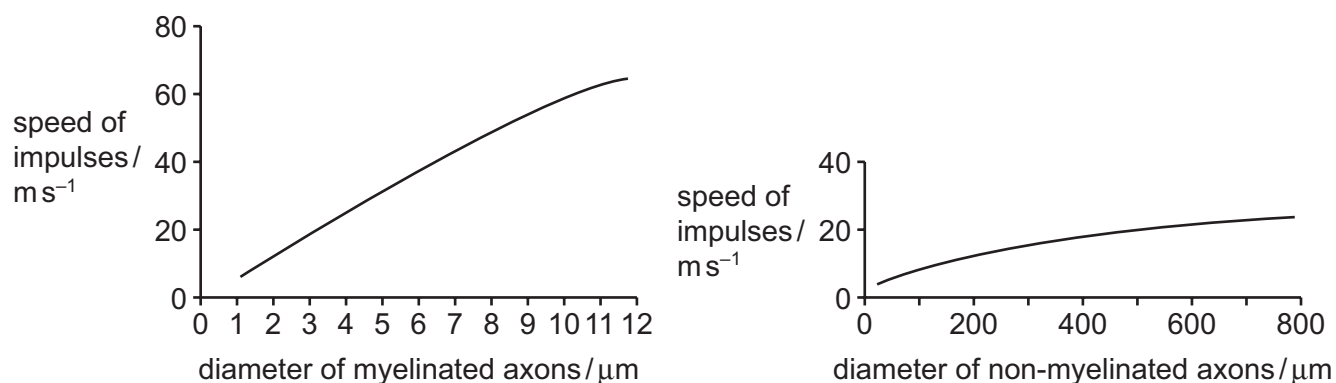
Which characteristics of xerophytes could also be found in halophytes?

- A** 1, 2 and 4 only
B 2, 3 and 5 only
C 3, 4 and 5 only
D 1, 2, 3, 4 and 5

- 31 The ability of organisms to respond rapidly to stimuli is limited by the speed of the impulses in their neurones.

The axons of invertebrate neurones lack a myelin sheath. The axons of most vertebrate neurones are myelinated.

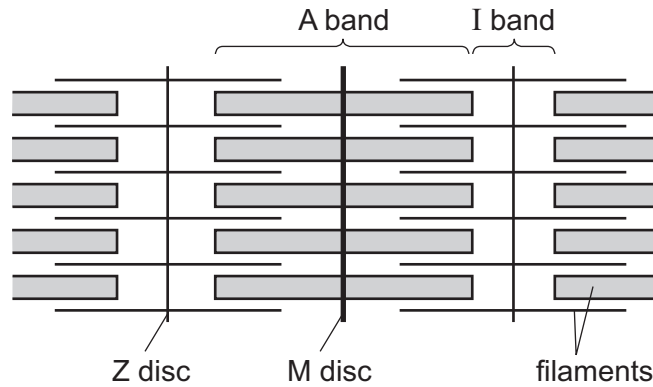
The graphs show the speed of impulses in these two types of axon.



Which statements about these data are correct?

- 1 The action potential in myelinated axons is greater than the action potential in non-myelinated axons.
 - 2 The speed of impulses is changed by the diameter of the axon.
 - 3 Increasing the diameter of a myelinated axon causes a greater change to the conduction speed than increasing the diameter of a non-myelinated axon.
 - 4 The presence of myelin increases the speed at which impulses are conducted.
- A** 1, 2 and 3 only
B 1, 2 and 4 only
C 2, 3 and 4 only
D 3 and 4 only

- 32 The diagram shows the arrangement of thick and thin filaments in a piece of striated (skeletal) muscle.



Which statements about the structure and function of the filaments are correct?

- 1 Filaments of actin are attached to the Z discs of skeletal muscle.
- 2 ATP binds to the heads of the actin filaments.
- 3 Myosin heads are enzymatic and bind to actin when the muscle is stimulated.
- 4 When skeletal muscles contract, the I band gets shorter.

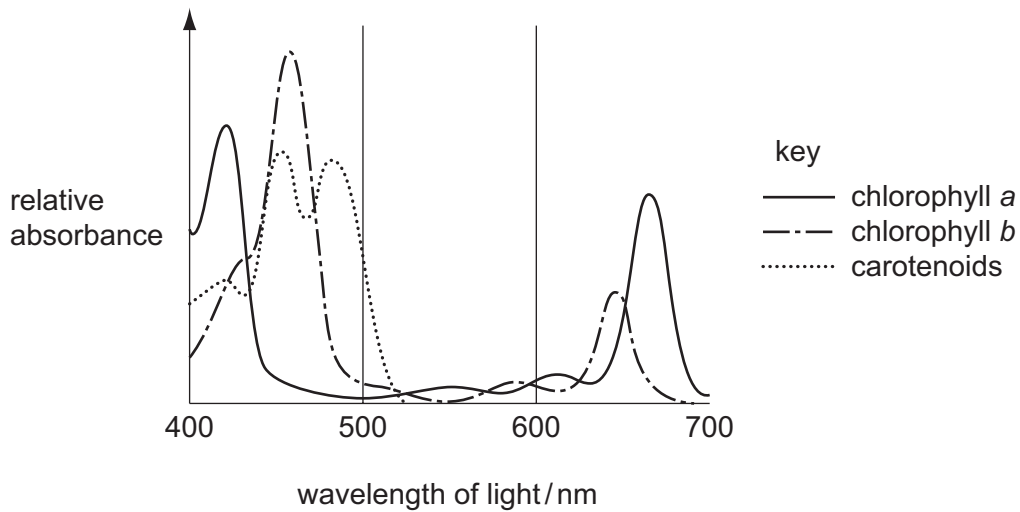
- A** 1, 3 and 4 only
B 1 and 4 only
C 2 and 3 only
D 2, 3 and 4 only

- 33 What is involved in the first step of glycolysis?

- 1 hexose sugars
- 2 hydrolysis of ATP
- 3 mitochondrial matrix enzymes
- 4 reduction of NAD

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

34 The graph shows the absorption spectra of some pigments found in chloroplasts.



Which statements are correct?

- 1 Having several pigments, rather than one, increases the efficiency of photosynthesis.
- 2 Most leaves are green as chlorophyll absorbs light in the blue and red regions of the spectrum.
- 3 Photosynthesis will be fastest in light at the red end of the spectrum, as red light has higher energy than blue light.
- 4 Prior to leaf fall, chlorophyll is broken down, leaving carotenoids which makes leaves look yellow or red.

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

- 35 The phenotypes of 200 offspring of a dihybrid test cross were recorded. The cross involved petal colour and fertility of the anthers of sweet pea flowers. The table shows the observed and expected numbers of each phenotype.

phenotype	purple petals fertile anthers	purple petals sterile anthers	maroon petals fertile anthers	maroon petals sterile anthers
observed numbers	87	14	16	83
expected numbers	50	50	50	50

A chi-squared (χ^2) test was performed and the probability of the difference between the observed and expected results being due to chance was found to be <0.001 .

Which conclusions may be drawn from this probability?

- 1 The difference is significant.
- 2 The difference is due to chance.
- 3 The difference is **not** due to chance.
- 4 The difference is due to some factor such as linkage of the genes concerned.

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

- 36 Which statements are acceptable parts of Darwinian evolutionary theory?

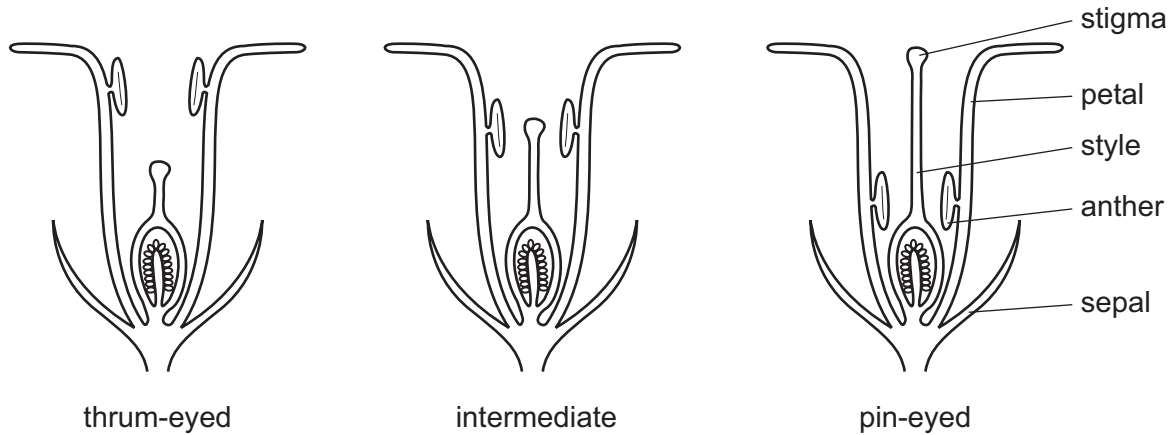
- 1 Advantageous behaviour acquired during the lifetime of an individual is likely to be inherited.
- 2 In competition for survival, the more aggressive animals are more likely to survive.
- 3 Species perfectly adapted to a stable environment will continue to evolve.
- 4 Variation between individuals of a species is essential for evolutionary change.

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

- 37 The primrose, *Primula vulgaris*, is a small herbaceous, yellow-flowered plant which is common in cooler areas of the Northern hemisphere including alpine and Arctic areas.

The flowers of the primrose have different flower shapes (polymorphic), which are adaptations for pollination. 'Thrum-eyed' primroses have a short style. 'Pin-eyed' primroses have much longer styles. Some populations of primrose consist almost entirely of plants with intermediate flowers. These populations are common where there are fewer winged insects.

The diagrams show polymorphic flowers of primroses.



Which statements are correct?

- 1 Cross-pollination will be favoured between pin-eyed and thrum-eyed primroses.
 - 2 Primroses with pin-eyed flowers are likely to show more genetic diversity than primroses with intermediate flowers.
 - 3 Primroses with intermediate flowers are likely to be more able to adapt to changing environmental conditions than pin-eyed and thrum-eyed primroses.
 - 4 Self-pollination is more likely to occur in primroses with intermediate flowers.
- A** 1 and 2 only
B 1, 2, 3 and 4
C 1, 2 and 4 only
D 3 and 4 only

- 38** Human activity often results in habitat loss. The remaining habitat in an area becomes fragmented forming smaller patches of habitat.

Which statements describe how a small habitat patch differs from a larger patch of the same habitat?

- 1 biodiversity decreases
- 2 competition from surrounding habitats increases
- 3 numbers of invasive species increase
- 4 populations of large animals decrease

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

- 39** In the SLOSS debate, some conservationists argued that several smaller reserves were better than one large reserve.

What advantages could they put forward to support their argument?

- 1 A whole species is less likely to be wiped out by a single event.
- 2 This is good for species with a high area requirement.
- 3 The edges are smaller in relation to the total area.
- 4 Diseases are less likely to spread between populations of the same species.

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

- 40** Human immunodeficiency virus (HIV) is a retrovirus. After infecting a host cell, viral DNA is produced which is incorporated into the DNA of the host cell. The modified host genome now codes for the production of new HIV particles.

Which could be used as a potential treatment to slow down the spread of HIV?

- 1 inhibitors of restriction endonucleases
- 2 inhibitors of reverse transcriptase
- 3 restriction endonucleases
- 4 reverse transcriptase

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