



**BIOLOGY**

**9790/01**

Paper 1 Multiple Choice

**May/June 2011**

**1 hour 15 minutes**

Additional Materials:      Multiple Choice Answer Sheet  
   Soft clean eraser  
   Soft pencil (type B or HB is recommended)



**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any working should be done in this booklet.

This document consists of **24** printed pages.



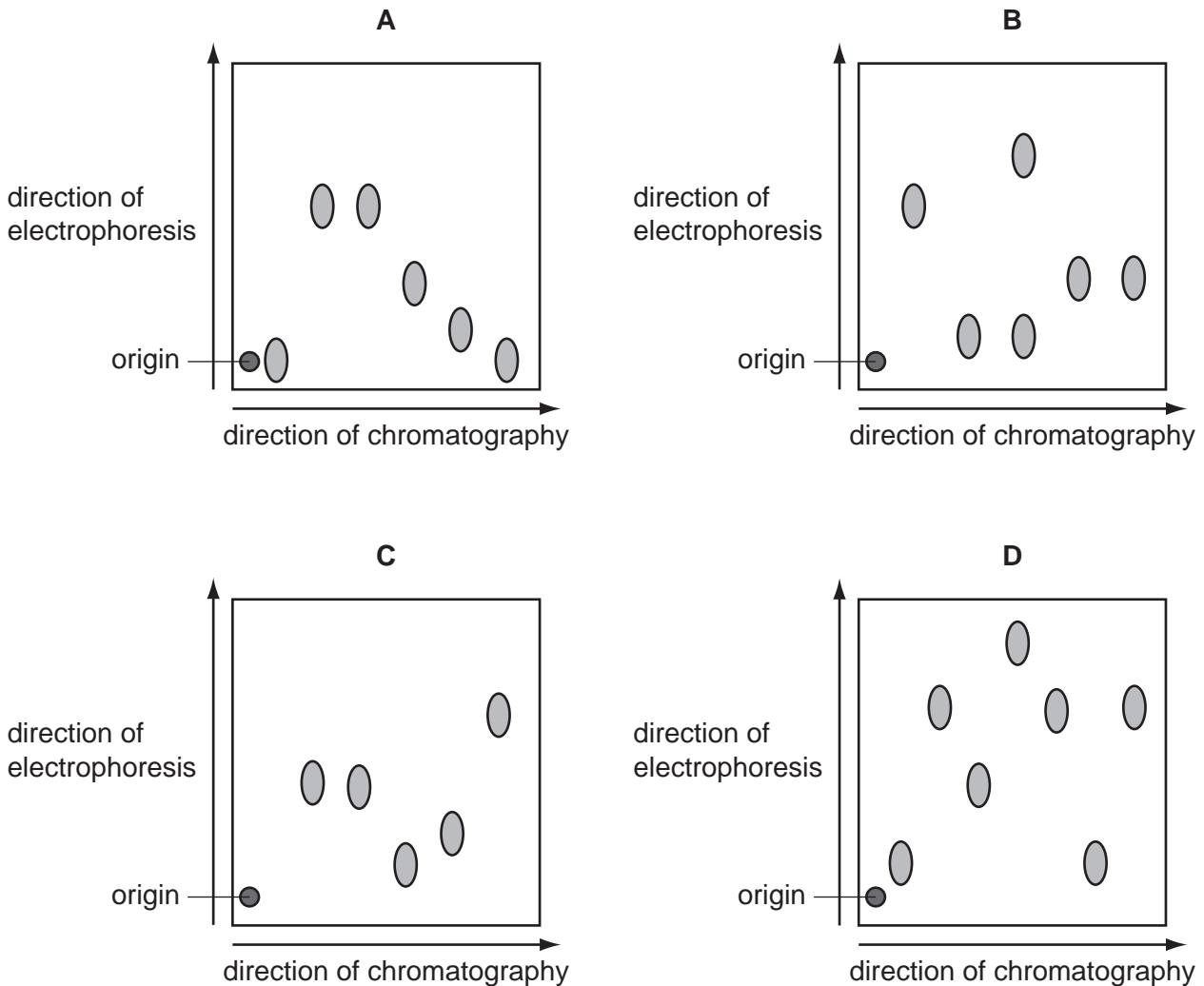
- 1 The ratio of stable carbon isotopes  $^{12}\text{C}$  and  $^{13}\text{C}$  in sedimentary rocks can be used as evidence for the origins of life.

Which statement is correct?

- A A high ratio of  $^{13}\text{C}$  to  $^{12}\text{C}$  suggests that life may have begun 3.9 million years ago.
  - B A high ratio of  $^{13}\text{C}$  to  $^{12}\text{C}$  suggests that life may have begun 4.6 billion years ago.
  - C A high ratio of  $^{12}\text{C}$  to  $^{13}\text{C}$  suggests that life may have begun 3.9 billion years ago.
  - D A high ratio of  $^{12}\text{C}$  to  $^{13}\text{C}$  suggests that life may have begun 4.6 million years ago.
- 2 Which monomers and types of bond are found in both glycogen and amylopectin?
- A  $\alpha$ -glucose, glycosidic, 1,6
  - B  $\alpha$ -glucose, hydrogen, 1,4
  - C  $\beta$ -glucose, glycosidic, 1,4
  - D  $\beta$ -glucose, hydrogen, 1,6

- 3 The diagrams show the results of an investigation into the composition of different mixtures of amino acids. Each mixture of amino acids was separated using chromatography. Each chromatogram was then turned through 90° and the amino acids separated again by electrophoresis.

Which diagram shows an amino acid mixture in which the solubility of some of the amino acids is the same but the charge on those particular amino acids is different?



- 4 The protein cytochrome c functions only when it contains an atom of iron.

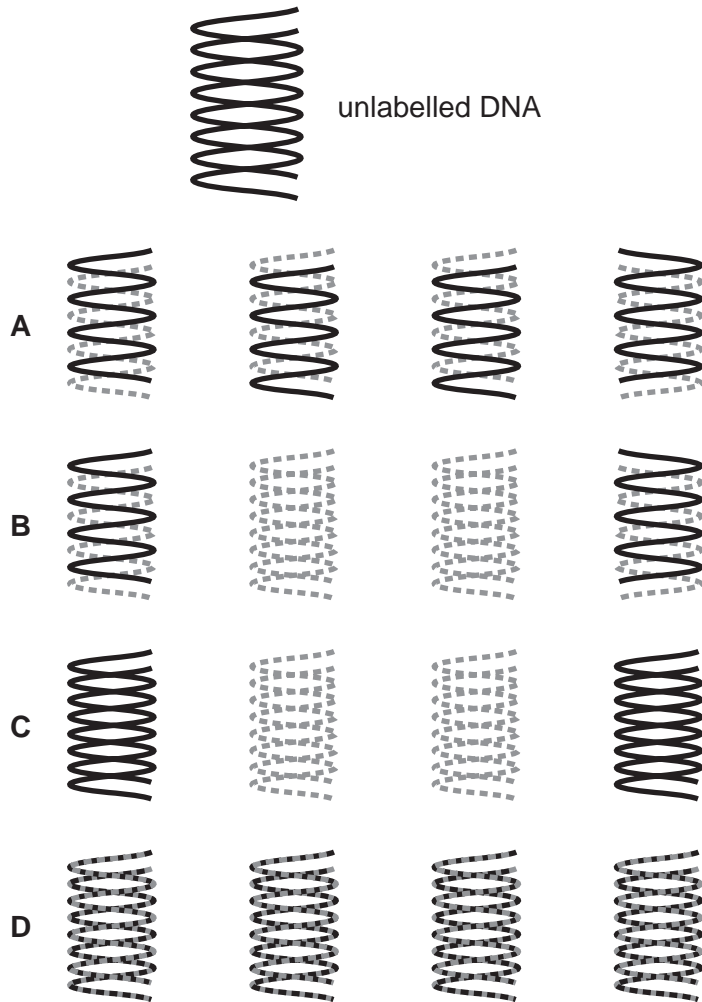
Which term describes the atom of iron?

- A part of an active site
- B part of a coenzyme
- C part of a hydrogen carrier
- D part of a prosthetic group

- 5 The sets of diagrams show four possible outcomes when an unlabelled molecule of DNA is allowed to replicate twice in the presence of  $^{15}\text{N}$ -labelled nucleotides.

Labelled sections of DNA are represented by dotted lines.

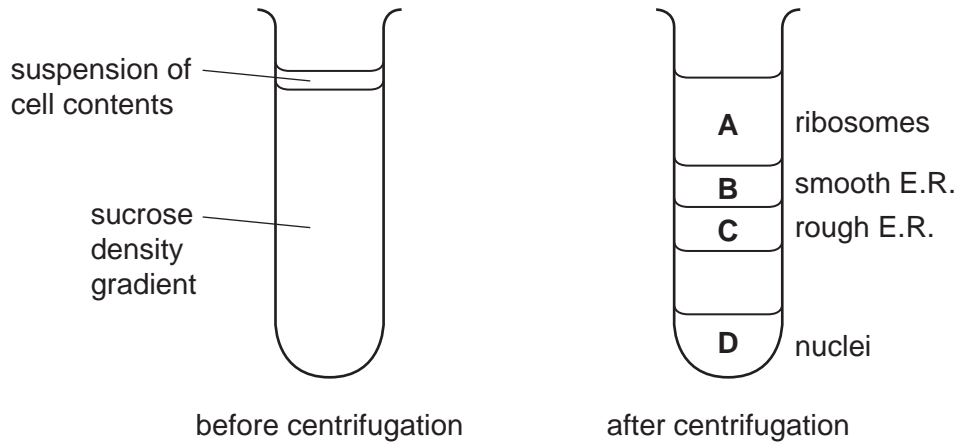
Which set of diagrams correctly shows the result of DNA replication?



- 6 Sometimes scientists need to isolate organelles. This can be achieved by taking a number of cells and breaking their cell surface membranes to release the contents of the cells into a buffer solution.

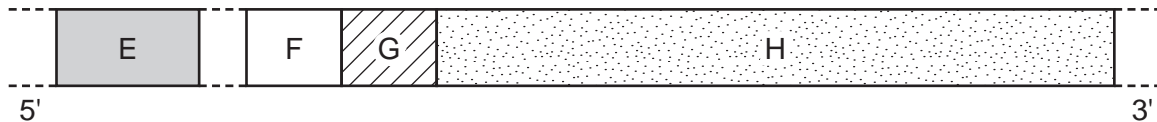
In zonal centrifugation the suspension of cell contents is placed on top of a sucrose density gradient. The tube is then placed in a centrifuge and spun at high speed. The larger and denser particles will move towards the bottom of the tube faster than smaller and less dense particles as shown below.

If a sample of intact prokaryotes had been added to a suspension of eukaryotic cell contents, where would you expect them to be found?



- 7 The diagram represents a length of DNA which forms a structure called an operon.

Parts of the operon are labelled E, F, G and H. They have different functions.



What identifies the functions of parts E, F, G and H?

	E	F	G	H
A	operator	structural gene(s)	regulator/repressor	promoter
B	promoter	regulator/repressor	structural gene(s)	operator
C	regulator/repressor	promoter	operator	structural gene(s)
D	structural gene(s)	operator	promoter	regulator/repressor

- 8 Ribonuclease is an enzyme that digests RNA. The first five amino acids of the functioning molecule of ribonuclease are:

lys – glu – thr – ala – ala .....

The mRNA of the gene coding for ribonuclease, for the first 15 nucleotides, has the following sequence.

AUGAAGGAAACUGCU

A genetic code, showing mRNA codons, is shown below.

first position	second position				third position
	U	C	A	G	
U	phe phe leu leu	ser ser ser ser	tyr tyr STOP STOP	cys cys STOP trp	U C A G
C	leu leu leu leu	pro pro pro pro	his his gln gln	arg arg arg arg	U C A G
A	ile ile ile met	thr thr thr thr	asn asn lys lys	ser ser arg arg	U C A G
G	val val val val	ala ala ala ala	asp asp glu glu	gly gly gly gly	U C A G

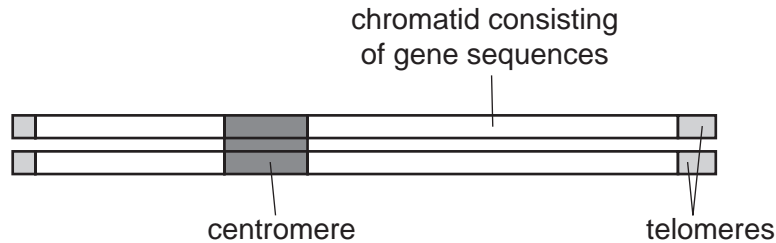
Which event occurs to explain the information given above?

- A** The first amino acid on the polypeptide chain is removed in post-translational modification.
- B** The first codon is removed from the mRNA transcript in post-transcriptional modification.
- C** The mRNA binds to the rRNA in the second codon position.
- D** There is no tRNA with an anticodon complementary to the first codon.

- 9 In order to replicate, the ends of a eukaryotic chromosome contain a special sequence of DNA called a telomere. Human telomeres consist of repeating TTAGGG sequences which extend from the ends of the chromosomal DNA.

When cells undergo mitotic division, some of these repeating sequences are lost. This results in a shortening of the telomeric DNA.

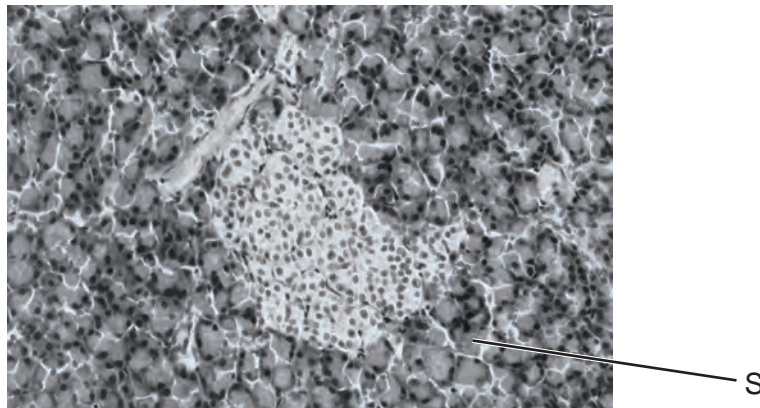
The diagram shows a eukaryotic chromosome.



What is a consequence of the loss of repeating DNA sequences from the telomeres?

- A The cell will begin the synthesis of different proteins.
  - B The cell will begin to differentiate as a result of the altered DNA.
  - C The number of mitotic divisions the cell can make will be limited.
  - D The production of mRNA will be reduced.
- 10 The diagram shows some of the cells of an organ which secretes digestive juices.

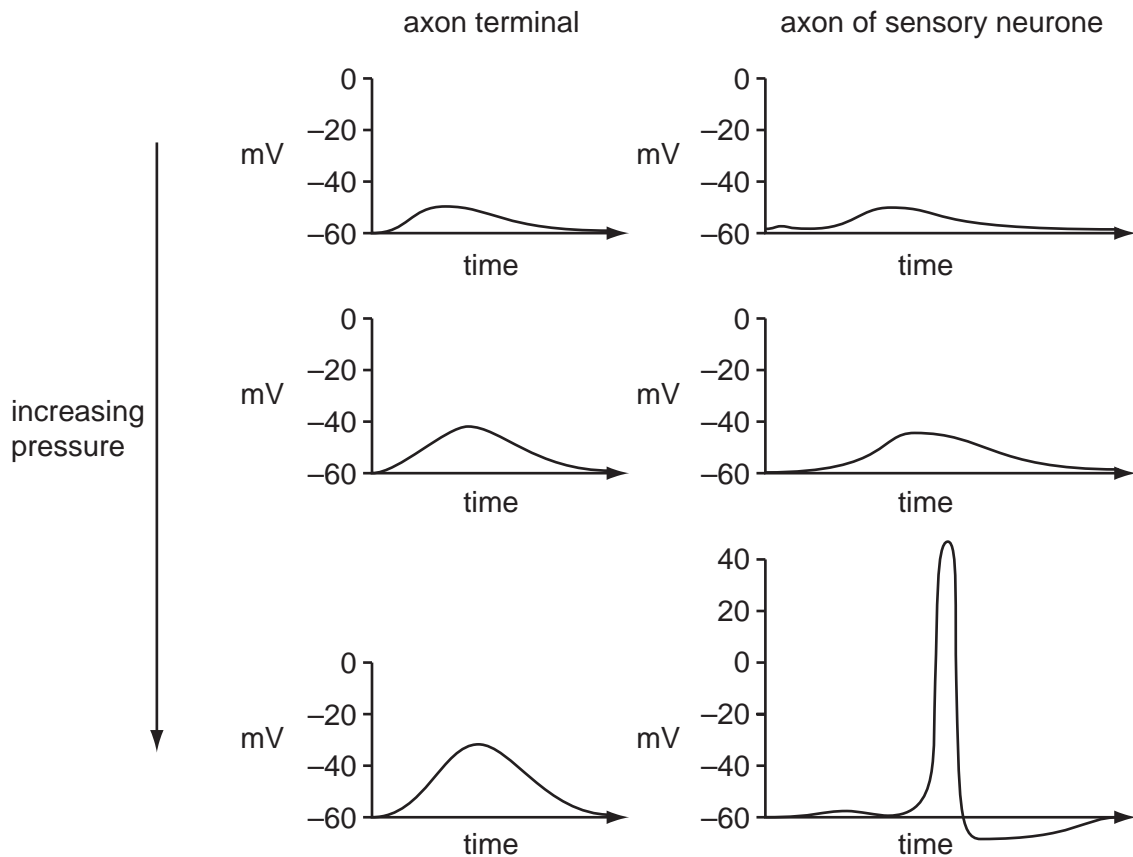
Some of the secretory cells present in this organ are labelled S.



Which row in the table is correct?

	organ	structure producing the secretion	name of secretion	mode of action
A	stomach	gastric pit	pepsin	endopeptidase
B	pancreas	acini	trypsin	endopeptidase
C	duodenum	mucosa	bile	exopectidase
D	ileum	villus	chymotrypsin	exopectidase

- 11 The graphs show the response of sensory neurones to increasing pressure on the Pacinian corpuscles in mammalian skin.



Which conclusion about increasing pressure is correct?

- A** As pressure increases the depolarisation of the corpuscle and sensory neurone increases.
- B** As pressure increases the axon terminal depolarisation reaches a value that depolarises the sensory neurone.
- C** If the corpuscle is stimulated for long enough the depolarisation of the sensory neurone increases.
- D** If the corpuscle is stimulated for long enough the axon terminal depolarisation reaches a value that depolarises the sensory neurone.
- 12 The drug frusamide is a diuretic used in the treatment of fluid retention. This drug reduces the diffusion gradient in the medulla by blocking some reabsorption of sodium ions. In this way it decreases the reabsorption of water.

In which part of a kidney tubule does frusamide act?

- A** collecting duct
- B** distal tubule
- C** loop of Henle
- D** proximal tubule



- 13** Following a liver allograft, transplant patients are given drugs such as cyclosporin and may remain on the drug for their lifetime.

Which statement best describes the reasons for taking cyclosporin after a liver transplant?

- A** Cyclosporin decreases the activity of all cells in the immune system and improves the patients' artificial passive immunity.
- B** Cyclosporin helps the donated organ to grow and function effectively and increases the patients' quality of life.
- C** Cyclosporin reduces the function of the T-cells and reduces the patients' organ rejection.
- D** Cyclosporin reduces the vulnerability to opportunistic fungal and viral infections and improves the patients' survival rates.

- 14** Various conditions in the human body can be treated by using a transplant. In most cases the part being transplanted is tissue-typed to obtain a good match between donor and recipient and the recipient will need to take immunosuppressant drugs.

However, transplants of the transparent cornea at the front of the eye do not need to come from tissue-typed donors and immunosuppressant drugs are not used.

The photomicrograph shows a section through a cornea, x 150.

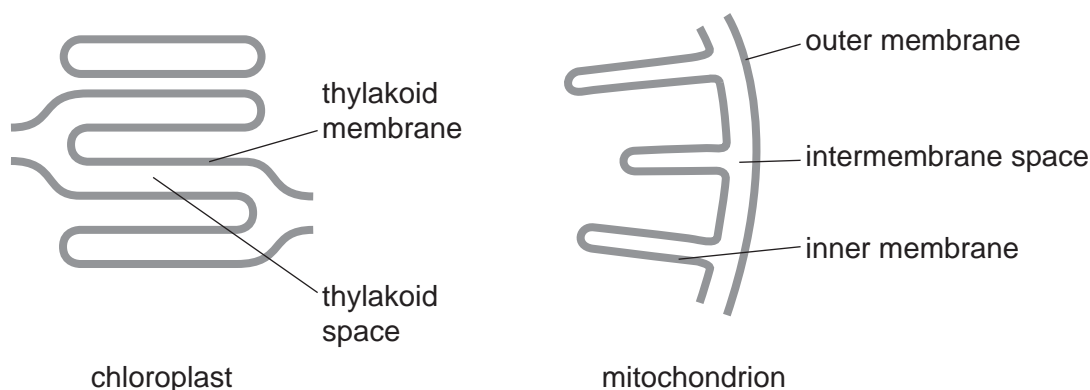


A number of corneal transplants are still rejected.

What is the correct explanation for these observations?

- A** The cornea has no cells as it is not living tissue.
- B** The cornea has few antigens as it contains few proteins.
- C** All corneas have the same antigens in them and so very rarely initiate an immune response as they are almost always treated as self.
- D** The cornea has many antigens, but they do not usually come into contact with antibodies as there are no blood vessels in the cornea.

15 The diagram shows part of a chloroplast and part of a mitochondrion.



Where does electron transport take place and where does the highest concentration of protons occur in these two organelles?

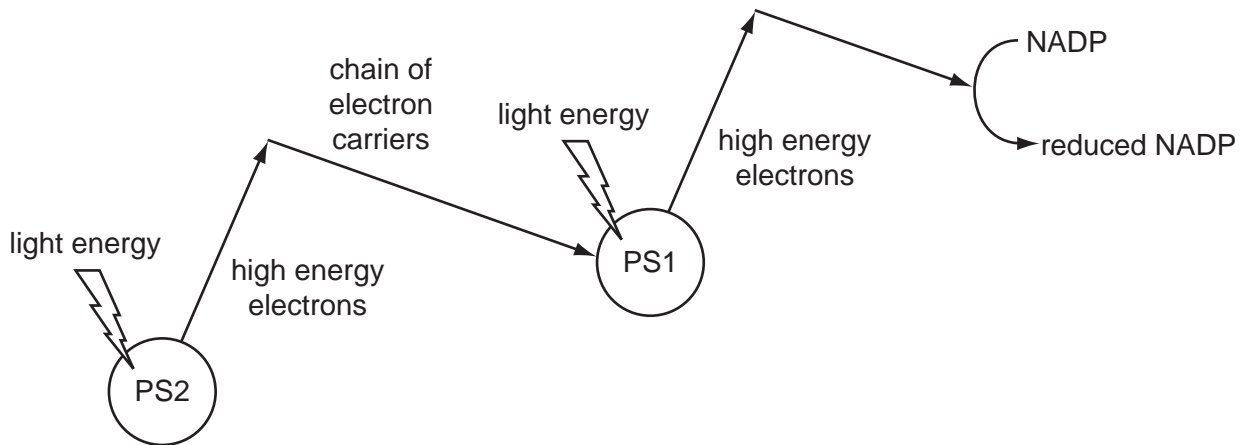
	electron transport		highest concentration of protons	
	chloroplast	mitochondrion	chloroplast	mitochondrion
<b>A</b>	thylakoid membrane	inner membrane	thylakoid space	intermembrane space
<b>B</b>	thylakoid membrane	outer membrane	thylakoid space	inner membrane
<b>C</b>	thylakoid space	outer membrane	thylakoid membrane	intermembrane space
<b>D</b>	thylakoid space	inner membrane	thylakoid membrane	inner membrane

16 During substrate-level phosphorylation, ATP is synthesised from ADP and inorganic phosphate.

What is the immediate source of energy for this reaction?

- A** chemical bond energy released during the light-independent stage of photosynthesis
- B** chemical bond energy released during glycolysis and the Krebs cycle
- C** kinetic energy of protons diffusing through mitochondrial membranes into the mitochondrial matrix
- D** kinetic energy of protons diffusing through thylakoid membranes in chloroplasts

17 The diagram shows some of the processes in the light-dependent stage of photosynthesis.



For the light-dependent stage to continue, photosystem two (PS 2) must gain electrons. Where do these electrons come from?

- A electron carriers
  - B reduced NADP
  - C photolysis
  - D the formation of ATP
- 18 Possession of white or coloured feathers in poultry is controlled by two genes, P/p and Q/q. The phenotypes of offspring that are expected from mating two birds, each of which is heterozygous at both loci, are shown in the Punnett square.

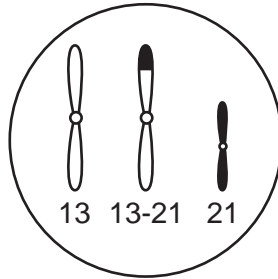
gametes	PQ	Pq	pQ	pq
PQ	white feathers	white feathers	white feathers	white feathers
Pq	white feathers	white feathers	white feathers	white feathers
pQ	white feathers	white feathers	coloured feathers	coloured feathers
pq	white feathers	white feathers	coloured feathers	white feathers

What best explains the proportion of white to coloured feathers in the Punnett square?

- A dominant epistasis in which the epistatic allele is P
- B dominant epistasis in which the epistatic allele is Q
- C recessive epistasis in which the epistatic allele is p
- D recessive epistasis in which the epistatic allele is q

- 19 Down's syndrome can be caused by a trisomy of chromosome 21, but can also result from translocation of chromosome 21 onto chromosome 13, forming a single chromosome 13-21.

The diagram shows chromosomes 13 and 21 in the nucleus of a diploid (2n) testis cell from a phenotypically normal male carrier of a 13-21 translocation. This cell has a chromosome number of 45.



Which is **not** a likely outcome of fertilisation of normal oocytes by sperm from this male?

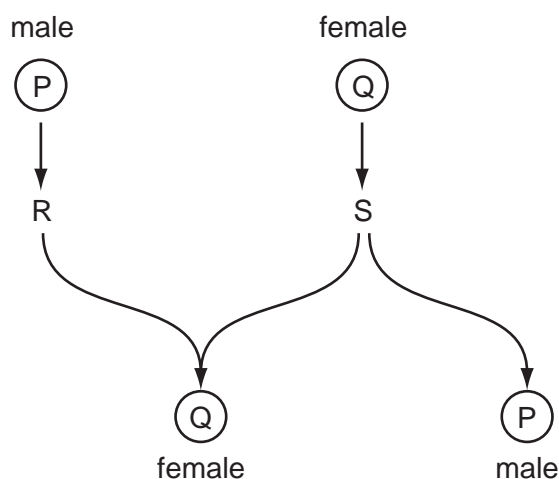
	chromosomes in sperm	embryo
<b>A</b>	13 and 21	2n = 46 normal phenotype
<b>B</b>	13-21	2n = 45 normal phenotype
<b>C</b>	13-21 and 21	2n = 46 Down's syndrome
<b>D</b>	13-21 and 21	2n = 47 Down's syndrome

- 20 Darwin's view of the process of evolution to form new species (speciation) has been reinforced by more recent discoveries in genetics and cell biology.

In this view, which sequence of events is considered most likely to lead to speciation?

<b>A</b>	adaptation of population → competition and predation leading to natural selection → behavioural isolation → sympatric speciation
<b>B</b>	adaptation of population → competition and predation leading to natural selection → behavioural isolation → allopatric speciation
<b>C</b>	competition and predation leading to natural selection → geographical isolation → adaptation of isolated populations → sympatric speciation
<b>D</b>	competition and predation leading to natural selection → geographical isolation → adaptation of isolated populations → allopatric speciation

- 21 Sex determination in some insects such as bees and wasps is not controlled by sex chromosomes.



Using the diagram, which row in the table shows how sex is determined in these insects?

	P	Q	R	S
<b>A</b>	n	n	mitosis	mitosis
<b>B</b>	n	2n	mitosis	meiosis
<b>C</b>	2n	n	meiosis	meiosis
<b>D</b>	2n	2n	meiosis	mitosis

- 22 The huia, *Heteralocha acutirostris*, was found in New Zealand until 1907, when it became extinct. This bird had a ground-feeding habit and was particularly noted for large, attractive tail feathers.

Males and females had very different beak forms, with the males having a short strong beak, whilst the females had a long curved beak to reach into otherwise inaccessible places.

What is the most likely reason for the extinction of the huia?

- A** Huia fed on species introduced by humans. When these declined, the huia population fell.
- B** In the face of a declining population the huia evolved into a tree-living species.
- C** Male and female huia were unable to breed successfully owing to strong sexual dimorphism.
- D** New competitors in New Zealand occupied part of the huia's niche.
- 23 When an animal population is being estimated by the capture-recapture technique, what would lead to the size of the population being underestimated?
- A** a greater attraction of marked than of unmarked animals to traps
- B** a high, equal mortality of both marked and unmarked animals
- C** a higher predation of marked than of unmarked animals
- D** an immigration of animals of the same species into the area between samplings

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?

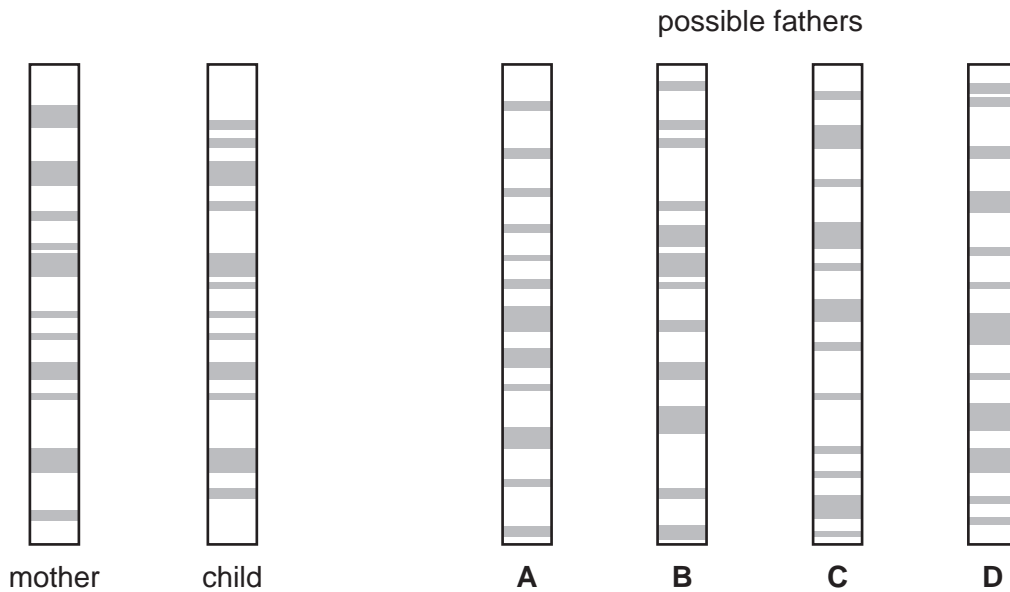
- A epithelial cells are continually dying and being replaced
- B the DNA molecule that makes up the functioning allele is very unstable
- C the methods of inserting the allele have low success rate
- D this is only somatic and not germ line therapy

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

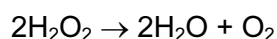
27 Which two features contribute to the great tensile strength of cellulose?

- 1 glycosidic bonds linking the long chains of 1,4  $\alpha$ -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

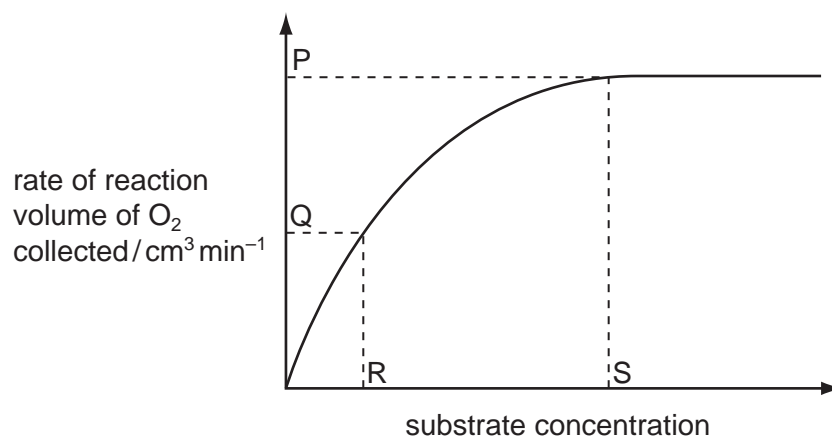


- 28 Liver tissue produces an enzyme called catalase which breaks down hydrogen peroxide into water and oxygen.



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 =  $V_{\text{max}}/2$ .
- 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 ( $\Psi$ ) 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.

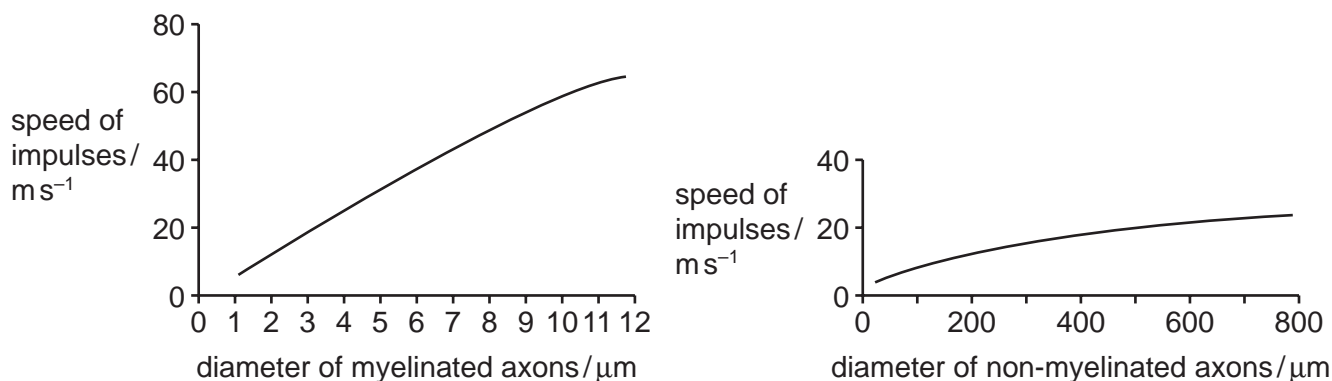
Which characteristics of xerophytes could also be found in halophytes?

- 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.

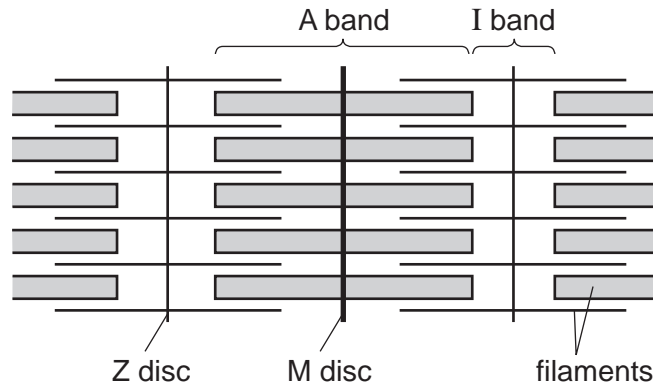
The graphs show the speed of impulses in these two types of axon.



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.

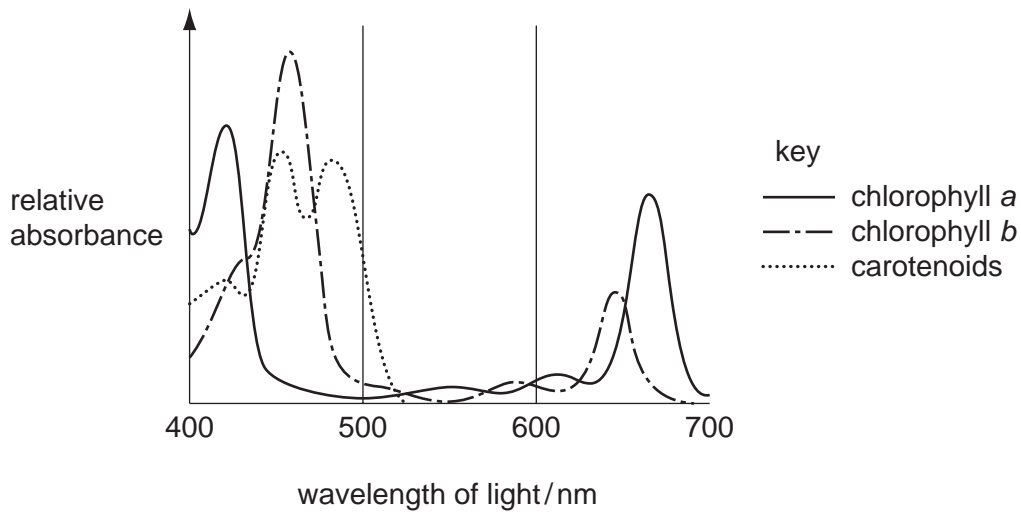
- A** 1, 3 and 4 only  
**B** 1 and 4 only  
**C** 2 and 3 only  
**D** 2, 3 and 4 only

- 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 ( $\chi^2$ ) 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?

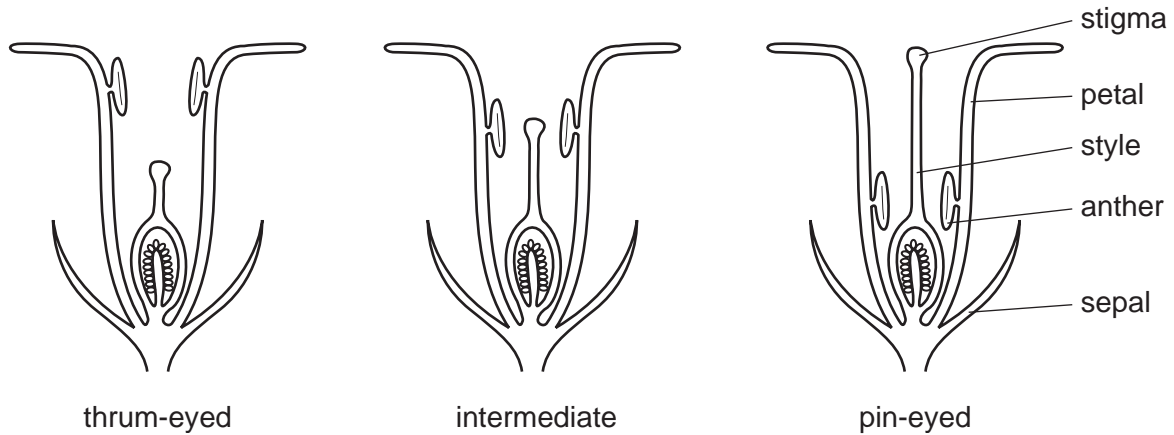
- 1 Advantageous behaviour acquired during the lifetime of an individual is likely to be inherited.
- 2 In competition for survival, the more aggressive animals are more likely to survive.
- 3 Species perfectly adapted to a stable environment will continue to evolve.
- 4 Variation between individuals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

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.