



---

**H2 Biology**

**9744/01**

Paper 1 Multiple Choice

**19 September 2024**

**1 hour**

Additional Materials: Multiple Choice Answer Sheet

---

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use paper clips, glue or correction fluid/tape.

Write your name, civics group and registration number on the Answer Sheet in the spaces provided.

There are **thirty** 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 rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

---

This document consists of **18** printed pages and **2** blank pages.

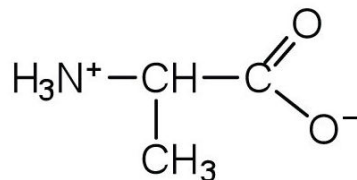
**BLANK PAGE**

Answer **all** questions.

- 1 Which statement describes how the molecular structure of starch is suited to its function?
- A Amylose has a branched structure and amylopectin is coiled to give a compact molecule for transport.
  - B In the breakdown of amylose and amylopectin, many condensation reactions release stored energy.
  - C In the formation of amylose and amylopectin, many hydrolysis reactions allow the release of stored energy.
  - D Amylose and amylopectin form a complex that is insoluble and so does not affect the water potential of the cell.
- 2 The structure of phospholipids includes:
- 1 polar phosphate heads
  - 2 hydrophobic fatty acid chains
  - 3 saturated fatty acid chains.

What are essential for the formation of a phospholipid bilayer in a cell surface membrane?

- A 1 and 2
  - B 1 and 3
  - C 2 and 3
  - D 3 only
- 3 The diagram shows the structure of an amino acid.



What is true about this amino acid?

- 1 It has a hydrophobic R group.
  - 2 It is amphoteric.
  - 3 It is insoluble in water.
- A 1 only
  - B 3 only
  - C 1 and 2 only
  - D 1, 2 and 3

4 What determines the specificity of an enzyme?

- 1 the covalent and other bonding between R groups of the polypeptide
- 2 the optimum pH of the enzyme
- 3 the covalent peptide bonds between amino acids of the polypeptide
- 4 the shape of the substrate molecule

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

5 Which row shows features that occur in plant cells **and** bacterial cells?

key

✓ = found in plant cells **and** bacterial cells

X = **not** found in at least one of these two types of cell

	70S ribosomes	80S ribosomes	centrioles	circular DNA
<b>A</b>	✓	X	✓	X
<b>B</b>	✓	X	X	✓
<b>C</b>	X	✓	✓	X
<b>D</b>	X	✓	X	✓

6 A student used a light microscope to observe a blood smear on a microscope slide.

An eyepiece graticule was used to measure the diameter of a white blood cell on the slide. The student recorded that the white blood cell was 5 eyepiece graticule units in diameter.

Which additional information does the student need to determine the diameter of the white blood cell in micrometres?

- A** calibration of the eyepiece graticule using a stage micrometer only  
**B** calibration of the eyepiece graticule using a stage micrometer and the magnification of the eyepiece lens  
**C** the magnification of the eyepiece lens only  
**D** the magnification of the eyepiece lens and the magnification of the objective lens

- 7 The plasma membrane is the cell's protective barrier as it prevents foreign molecules from entering the cell. However, in drug research experiments, foreign molecules such as drugs or short DNA fragments need to be transported into the cell.

Electroporation is a technique used to increase the permeability of the membrane transiently by treating the cell with short electrical pulses.

Which statement most likely explains how electroporation works?

- A The short electrical pulses denature the membrane proteins, allowing foreign molecules to pass through.
  - B The short electrical pulses cause the foreign molecules to be attracted to the surface of the membrane.
  - C Electricity increases the hydrophobic nature of foreign molecules, allowing them to pass through the hydrophobic core of the phospholipid bilayer.
  - D Electroporation causes the phospholipids to move apart to create pores for foreign molecules to pass through.
- 8 During the mitotic cell cycle, the chromosomal DNA is replicated. The specific points in DNA molecules where replication is occurring are known as replication forks.

A typical human chromosome has about 150 million base pairs of DNA. It takes about 1 hour to replicate the DNA of a typical human chromosome.

The rate of replication using a single replication fork is approximately 50 base pairs per second.

Approximately how many replication forks must occur in a typical human chromosome during DNA replication?

- A 835
  - B 41 700
  - C 50 000
  - D 3 000 000
- 9 Which statement(s) is/are not true in all eukaryotes?
1. Polypeptides are only synthesized in the cytosol.
  2. Amino acids are linked by the formation of peptide bonds catalysed by a ribozyme.
  3. Ribosomes contain an amino-acyl tRNA site that is occupied by the initiator tRNA attached to methionine.
  4. Amino-acyl tRNA synthetase attaches an amino acid to the 5' end of a tRNA molecule.
- A 1 and 4 only
  - B 2 and 3 only
  - C 1, 3 and 4
  - D 2, 3 and 4

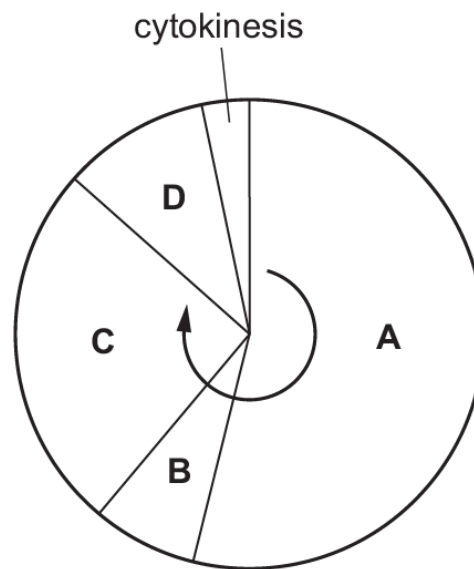
- 10** A mutation of a gene coding for an ion pump in cell surface membranes results in the substitution of one amino acid, arginine, by another, histidine.

The DNA triplet codes for the two amino acids are shown.

Arginine	GCA	Histidine	GTA
	GCG		GTG
	GCT		
	GCC		
	TCT		
	TCC		

Which mutation has occurred in the DNA?

- A** addition of an extra nucleotide  
**B** replacement of a nucleotide with a purine base by one with a different purine base  
**C** replacement of a nucleotide with a purine base by one with a pyrimidine base  
**D** replacement of a nucleotide with a pyrimidine base by one with a different pyrimidine base
- 11** The diagram shows the mitotic cell cycle.



During which phase do chromosomes condense and become visible?

**12** Which are correct statements about the need for a reduction division?

- 1 Reduction division needs to occur so that a parent will contribute to the zygote one set of chromosomes that are similar in size and number to the set contributed by the other parent and contain the same genes, but not necessarily the same alleles.
- 2 There is a requirement to reduce the diploid number of chromosomes, characteristic of the species, to produce cells with a haploid number in preparation for fertilisation and the subsequent restoration of the original diploid number.
- 3 Without reduction division occurring, the fusion of two gametes, each with a diploid number, would give rise to a chromosome aberration and cells that would have more than two copies of any one gene.

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

**13** Chromosomal aberrations cause mutations in cancer-critical genes which may lead to uncontrolled cell division. The following statements describe some possible chromosomal aberrations and their consequences.

1. Formation of a hybrid gene resulting in hyperactive protein, leading to chronic myeloid leukemia.
2. Gene deletion resulting in retinoblastoma.
3. Translocation in a chromosome region resulting in melanoma.
4. Loss of chromosomal regions in solid tumour cells.
5. Amplification of a chromosomal region in many sarcomas.

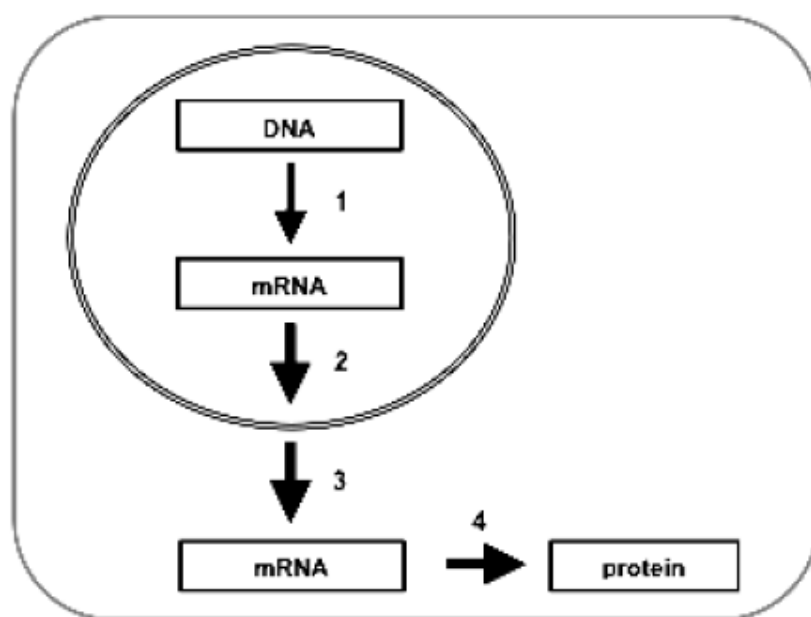
Which statements describe chromosomal aberrations that affect proto-oncogenes and tumour suppressor genes respectively?

	proto-oncogenes	tumour suppressor genes
<b>A</b>	1, 2	3, 4, 5
<b>B</b>	2, 3, 4	1, 5
<b>C</b>	4, 5	1, 2, 3
<b>D</b>	1, 3, 5	2, 4

- 14 Which statement about the organisation of genomes is **not** correct?
- A In prokaryotes, sections of coding DNA are usually separated by long stretches of non-coding DNA.
  - B Functionally related genes are placed under the control of a single promoter in prokaryotes but not in eukaryotes.
  - C Enhancers and silencers allow for the regulation of gene expression in eukaryotes but not prokaryotes.
  - D For different genes on the same DNA molecule, different DNA strands can be used as a template for transcription.

- 15 The following diagram shows the expression of a particular gene to its protein product in a eukaryotic cell.

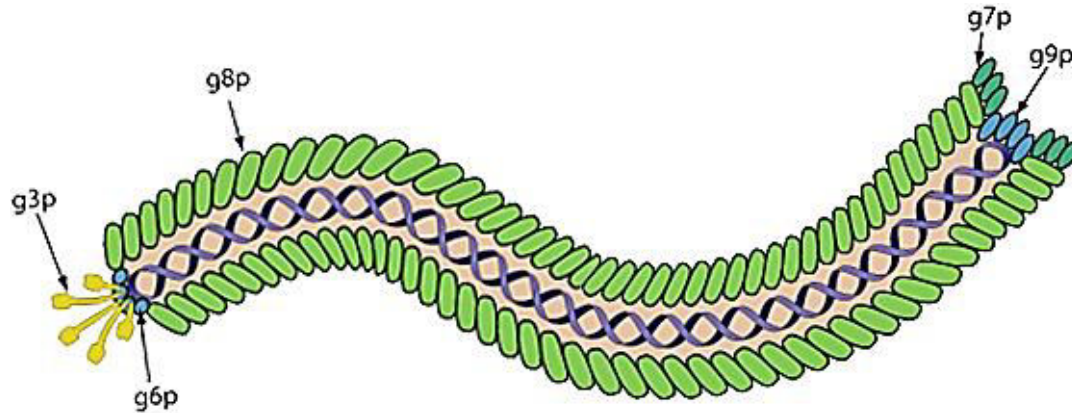
Which combination correctly describes steps 1 – 4?



	1	2	3	4
A	DNA is demethylated	Alternative splicing occurs	Activators bind to enhancers	Ribosome binds to 5' UTR
B	DNA is demethylated	5' capping occurs	RNase does not degrade 5' capped mRNA	Initiation factors bind to ribosome
C	DNA is methylated	Poly(A) tail is added to 3' end	Poly(A) tail is extended	Phosphorylation of protein
D	DNA is methylated	5' capping occurs	Removal of 5' cap	Activators bind to enhancers



- 16** The diagram below shows the structure of an M13 bacteriophage. It consists of a single-stranded circular DNA genome and capsid proteins g3p, g6p, g7p, g8p and g9p.



Based on your understanding of bacteriophages, which of the following statements is true of the M13 bacteriophage?

- 1 The base composition of its genome is such that the ratio of A:T is 1:1.
- 2 At least one of the capsid proteins is responsible for binding to a specific protein on the host cell.
- 3 Its genome is injected into the host cell after the phage attaches to the host cell.
- 4 It acquires its envelope from the cell membrane of its host cell.

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

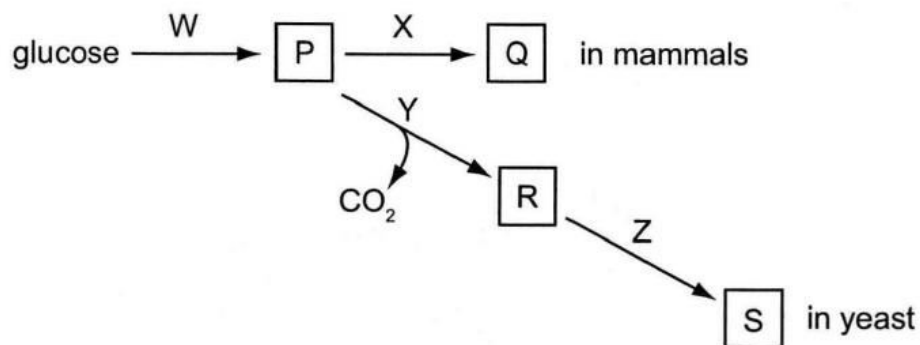
- 17** The following statements describe bacterial conjugation.

- 1 The F plasmid is made of single-stranded DNA.
- 2 When an  $F^+$  donor gives its F plasmid to an  $F^-$  recipient, both become  $F^-$ .
- 3 When an  $F^+$  donor gives its F plasmid to an  $F^-$  recipient, the donor becomes  $F^-$ .
- 4 When  $F^+$  cells are mixed with  $F^-$  cells, eventually all the cells will become  $F^+$ .

Which of the following is correct?

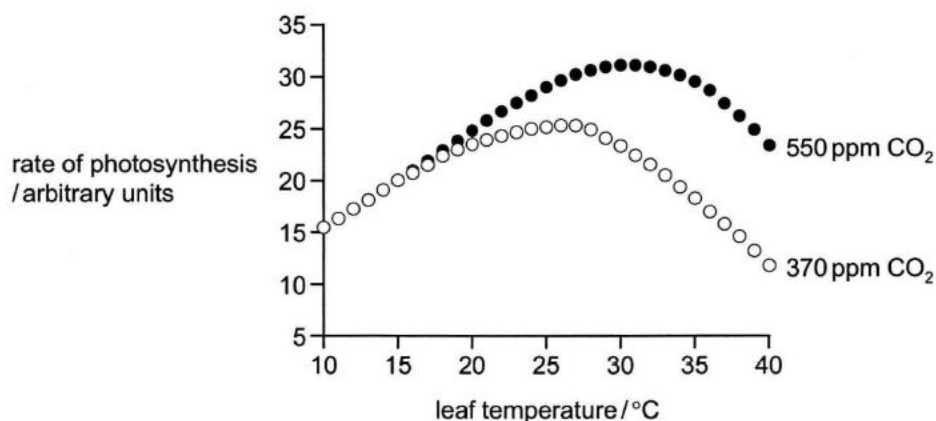
- A** 3 only  
**B** 4 only  
**C** 2 and 4  
**D** 1, 2 and 4

- 18 The diagram shows a summary of the processes of anaerobic respiration.



Which process(es) result(s) in the formation of reduced NAD?

- A W only  
 B X and Z only  
 C W, X and Y only  
 D W, X and Z only
- 19 The graph shows the results of increased concentrations of carbon dioxide on soy bean photosynthesis at various leaf temperatures. Carbon dioxide concentration is measured in ppm (parts per million). Light intensity was at an optimum level.



Which conclusion concerning the data in the graph is valid?

- A At all temperatures up to 15°C, carbon dioxide concentration is limiting. Above 15°C, temperature becomes the limiting factor.  
 B Supplementing plants with carbon dioxide is only effective at temperatures above 25°C.  
 C The photosynthetic rate obtained at the optimum temperature for 370ppm CO<sub>2</sub> could be achieved at a temperature 5°C lower using an increased concentration of CO<sub>2</sub>.  
 D When light intensity and temperature are limiting, increased carbon dioxide concentration increases the rate of photosynthesis.

- 20** Fruit flies (*Drosophila*), homozygous for long wings, were crossed with fruit flies homozygous for vestigial wings. The F<sub>1</sub> and F<sub>2</sub> generations were raised at three different temperatures.

At each temperature, the F<sub>1</sub> generation all had long wings.

The table shows the results in the F<sub>2</sub> generation.

temperature / °C	result
21	$\frac{3}{4}$ long wings, $\frac{1}{4}$ vestigial wings
26	$\frac{3}{4}$ long wings, $\frac{1}{4}$ intermediate wing length
31	all long wings

Which statement explains these results?

- A** Heterozygous flies have vestigial wings only at 21°C or below but have long wings at 31°C or above.
- B** Long wing and vestigial wing illustrate codominance at 26°C.
- C** Long wing is dominant at higher temperatures but vestigial wing is dominant at lower temperatures.
- D** Vestigial wing is recessive but causes a vestigial wing phenotype only at lower temperatures.

- 21** Purple buds of the morning glory flower, *Ipomoea*, open into blue flowers. As the flower opens, the pH on the vacuoles of the flower epidermal cells increases and this results in a change of colour from purple to blue.

A mutant purple-flowered morning glory plant carries recessive alleles of a gene **B/b**, coding for a membrane-bound ion pump, and is unable to increase the pH of the vacuole.

Both normal blue flowers and mutant purple flowers have the same anthocyanin pigment, coded by the dominant allele of the gene **A/a**. Plants with **aa** cannot produce anthocyanin and they have white flowers.

The genes **A/a** and **B/b** are on different chromosomes.

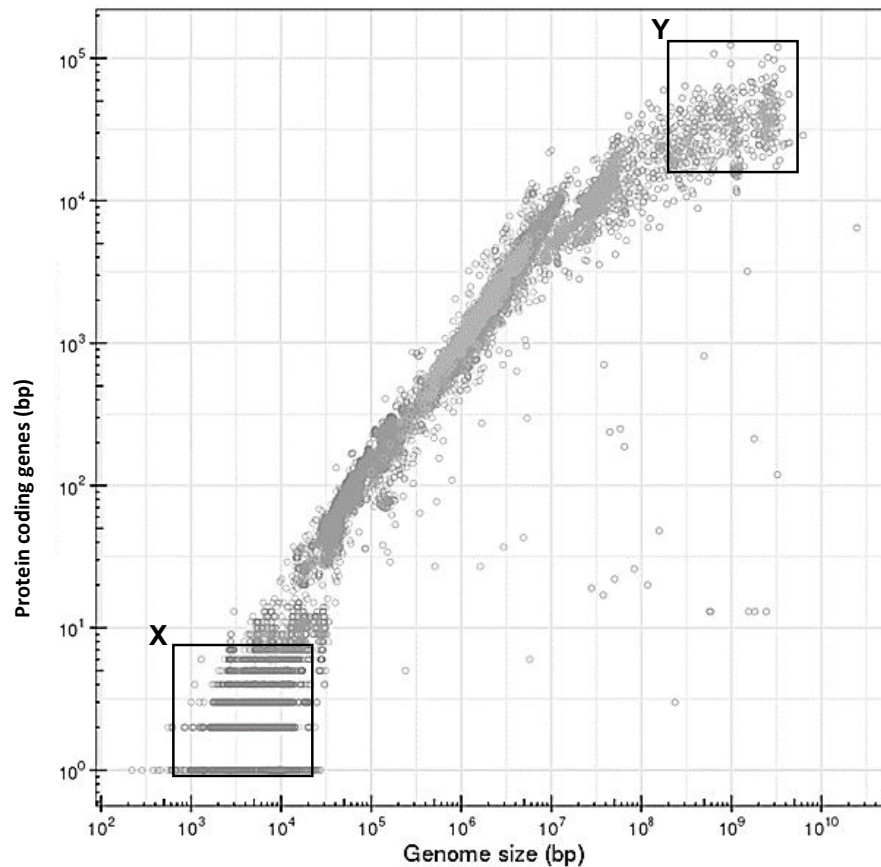
A blue-flowered morning glory plant was crossed with a purple-flowered plant. Their offspring consisted of plants which are blue-flowered, purple-flowered as well as white-flowered.

What were the genotypes of the blue-flowered and purple-flowered parents?

	blue-flowered parent	purple-flowered parent
<b>A</b>	AABB	AaBb
<b>B</b>	AaBb	Aabb
<b>C</b>	AaBB	Aabb
<b>D</b>	AABb	aabb

- 22** The relationship between genome size and size of protein-coding genes is represented in the scatter plot. The individual circles represent different organisms with the respective genome size.

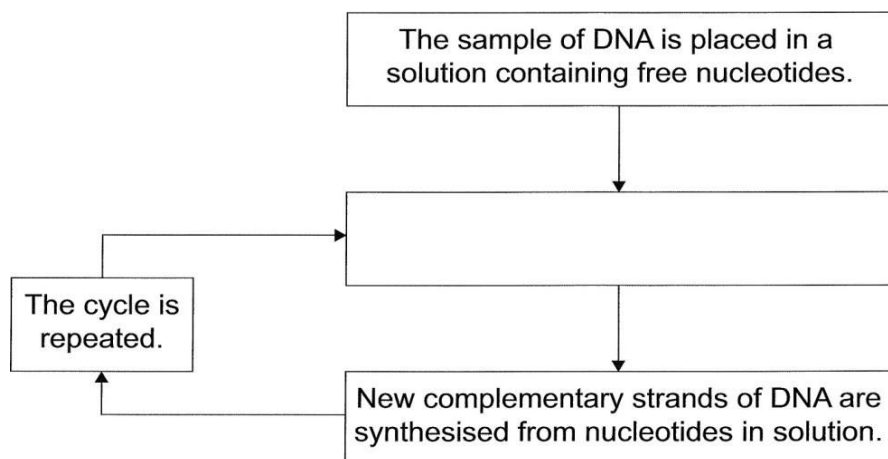
Organisms with large genomes are grouped in the square labelled **Y** and those with small genomes are grouped in the square labelled **X**.



Which statement is correct?

- A** Organisms in **Y** are likely to have the highest gene density.
- B** There are more non-coding sequences in organisms in **Y** than **X**.
- C** The size of genes of organisms in **Y** are likely to be bigger than those in **X** due to the presence of exons.
- D** The complexity of an organism is directly proportional to its genome size.

- 23 The polymerase chain reaction is summarised in the flowchart below.

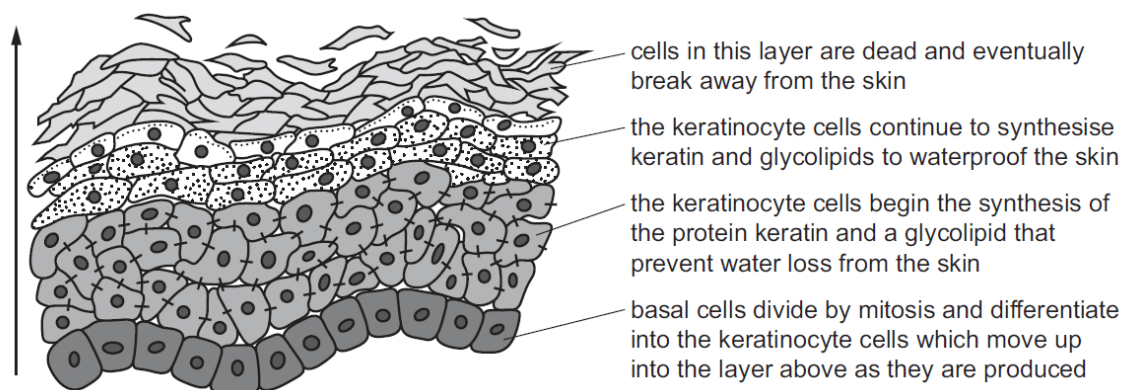


Which statement completes the flow chart?

- A Complementary strands of DNA are separated.
- B Free nucleotides join on the end of DNA strands.
- C Small sections of DNA are formed.
- D Strands of DNA bind to RNA primers.

**24** The diagram shows the epidermis of human skin. This is formed of four layers of cells.

Cells in each layer have specific functions which are outlined on the diagram. As the cells are produced, they move upwards as shown by the arrow.



Which row shows cells that are acting as stem cells in the skin epidermis and an organelle needed by the keratinocytes?

	cells that are acting as stem cells	organelle needed by the keratinocytes
<b>A</b>	basal cells only	centrioles
<b>B</b>	basal cells only	Golgi body
<b>C</b>	basal cells and keratinocytes	centrioles
<b>D</b>	basal cells and keratinocytes	Golgi body

**25** Patients in New Zealand with type I diabetes may be treated with “Diabecells”.

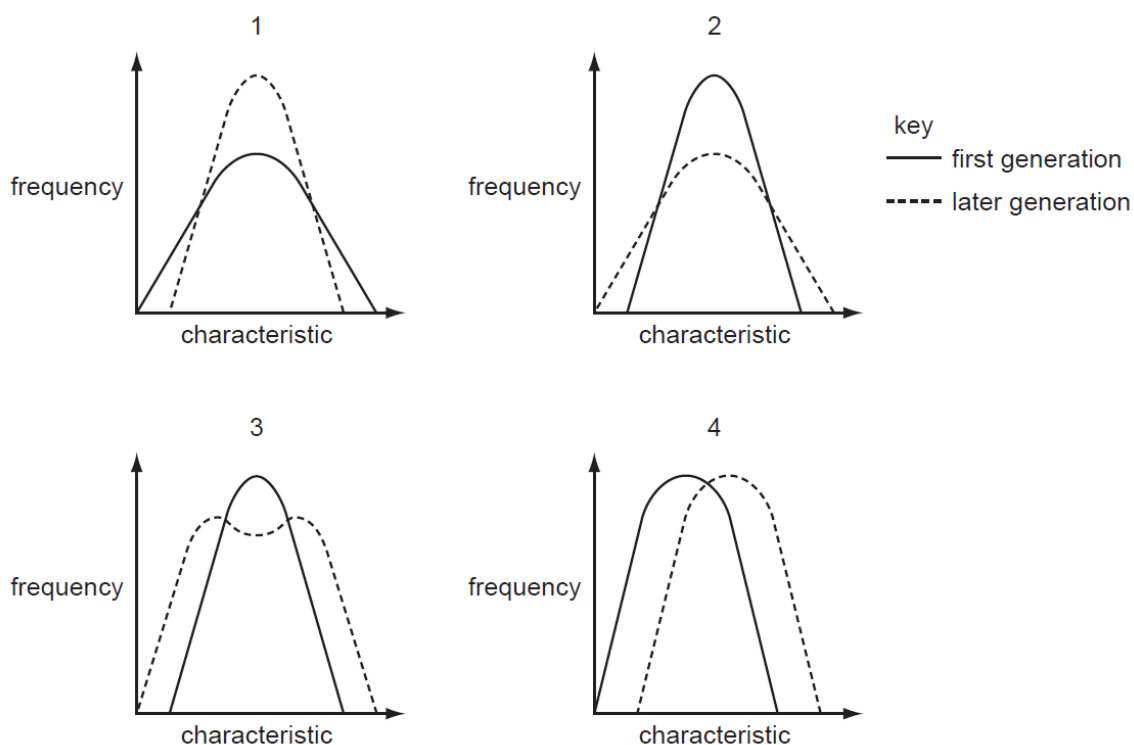
Each diabecells consists of living cells, taken from islets of Langerhans of pigs, inside a gel coating.

The diabecells are implanted into a patient’s abdomen, where they act as an endocrine gland.

What describes the activity of this endocrine gland?

- A** Islet cells secrete glucagon, which diffuses through the gel and increases the rate of uptake of glucose by liver cells.
- B** Islet cells secrete glucagon, which is trapped by the gel and increases the rate at which the islet cells respire glucose.
- C** Islet cells secrete insulin, which diffuses through the gel and stimulates the conversion of glucose to glycogen in liver cells.
- D** Islet cells secrete insulin, which is trapped by the gel and stimulates the islet cells to convert glucose to glycogen.

- 26** The graphs show frequency against a measured characteristic in the first and later generation of an organism.



Which graph represents each type of natural selection?

	directional	disruptive	stabilising
<b>A</b>	1	2	3
<b>B</b>	2	3	4
<b>C</b>	3	1	2
<b>D</b>	4	3	1



- 27** 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

- 28** The camelids are a group of mammals that share a large number of homologies. Recognisable camelids have been found fossilised in rocks that are 45 million years old.

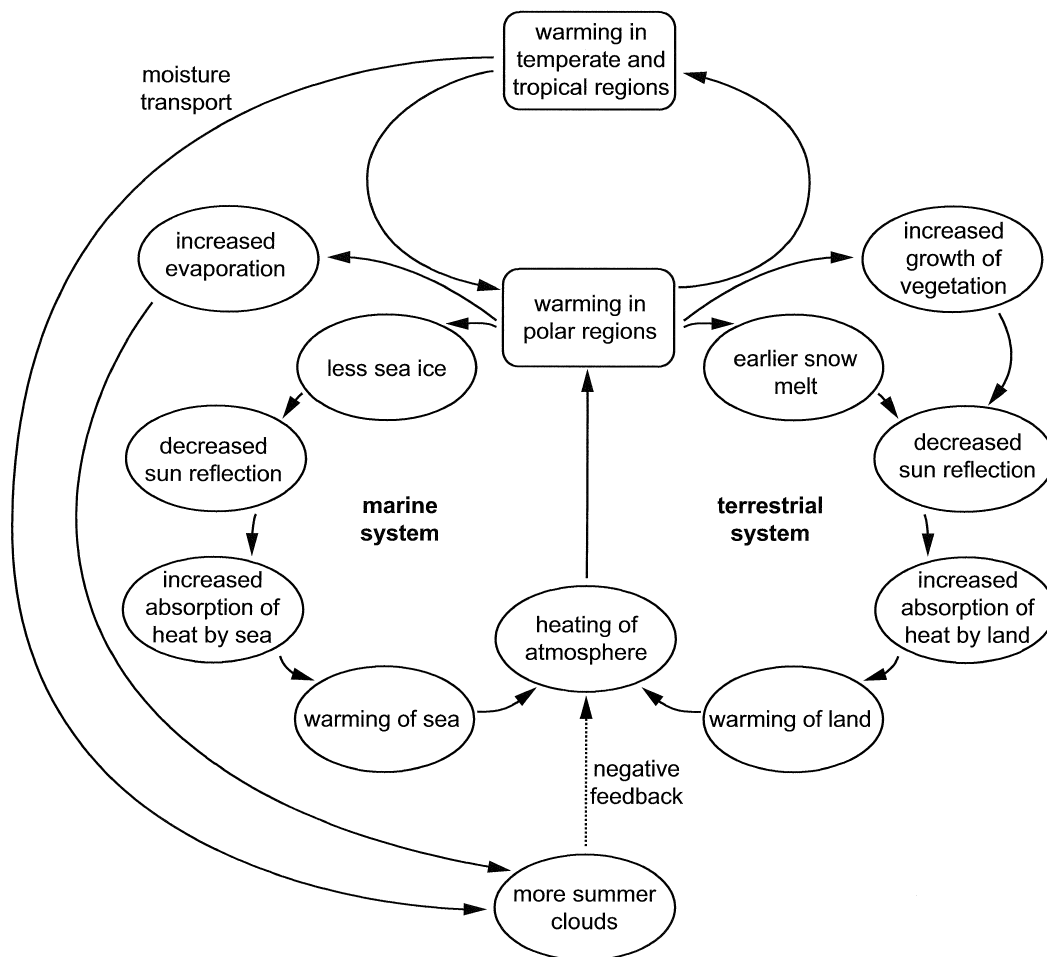
Modern camelids have a discontinuous distribution. Guanacos and vicunas are found in South America, together with the domesticated llamas and alpacas, which have been derived from the guanaco. Camels are found in Asia and Saharan Africa.

Which are likely explanations for the similarities between these different species?

- 1 Guanacos resemble camels because of convergent evolution acting on analogous structures.
- 2 Continental drift separated the ancestors of the modern species of camels and vicunas.
- 3 Llamas and alpacas became separate species because humans acted as selective agents.
- 4 Camels and guanacos were able to become separate species because they were geographically isolated from one other.

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

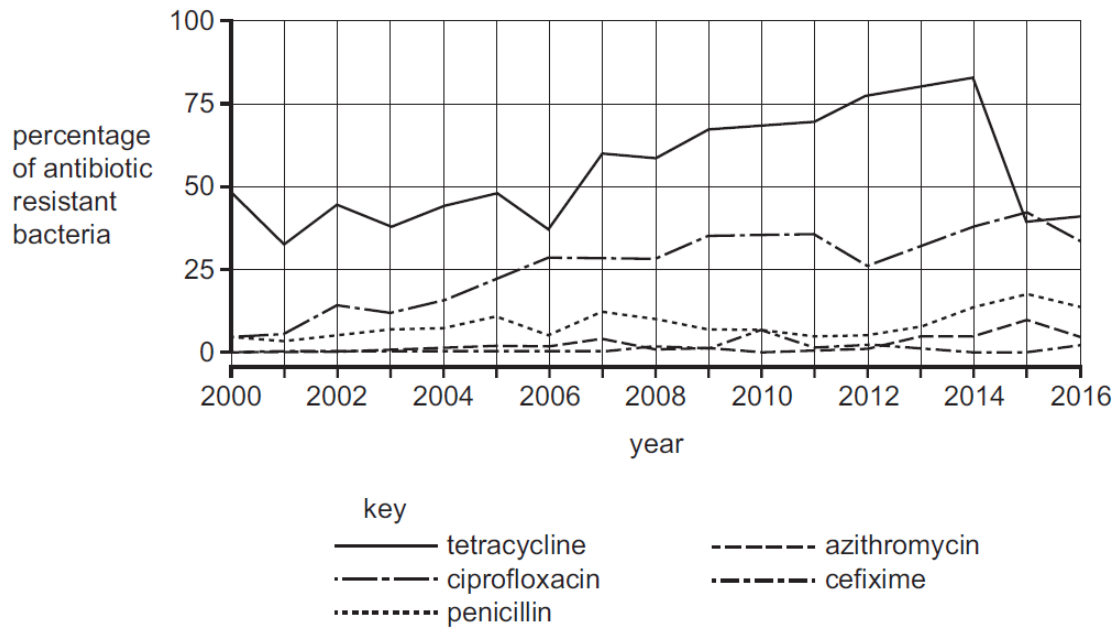
- 29 The diagram shows the effect of increasing temperature on the ice and snow cover at the polar regions.



Which effect of higher temperatures in the polar regions could increase global warming?

- A Increased evaporation leads to more rainfall, which absorbs heat from the land and sea.
- B Melting of ice and snow results in less reflection of sunlight and more heat absorption by the Earth.
- C Melting of sea ice causes more cloud formation, which increases absorption of heat in the atmosphere.
- D Earlier melting of snow allows vegetation cover to increase faster, reducing loss of heat from the surface of the Earth.

- 30** The graph shows changes in the antibiotic resistance of a species of bacterium between 2000 and 2016 in one country. Samples of bacteria were collected every year from 48 hospitals. The bacteria were tested to see if they showed resistance to five different antibiotics.



What can be concluded from the data in the graph?

- A** Overuse of ciprofloxacin has caused antibiotic resistance to increase by more than 20% between 2000 and 2016.
- B** Percentage resistance to three of the antibiotics was at a peak in 2015.
- C** Changes in treatment guidelines have caused resistance to some antibiotics to decrease from 2015 to 2016.
- D** The percentage of resistant bacteria is higher in 2016 than 2000 for all antibiotics.

**BLANK PAGE**