RIVER VALLEY HIGH SCHOOL
YEAR 6
PRELIMINARY EXAMINATION II

CANDIDATE NAME											
CENTRE NUMBER	S					CLASS		INDEX NUMBER			

H2 BIOLOGY **9744/01**

Paper 1 Multiple Choice **22 Sep 2017**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number, index number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

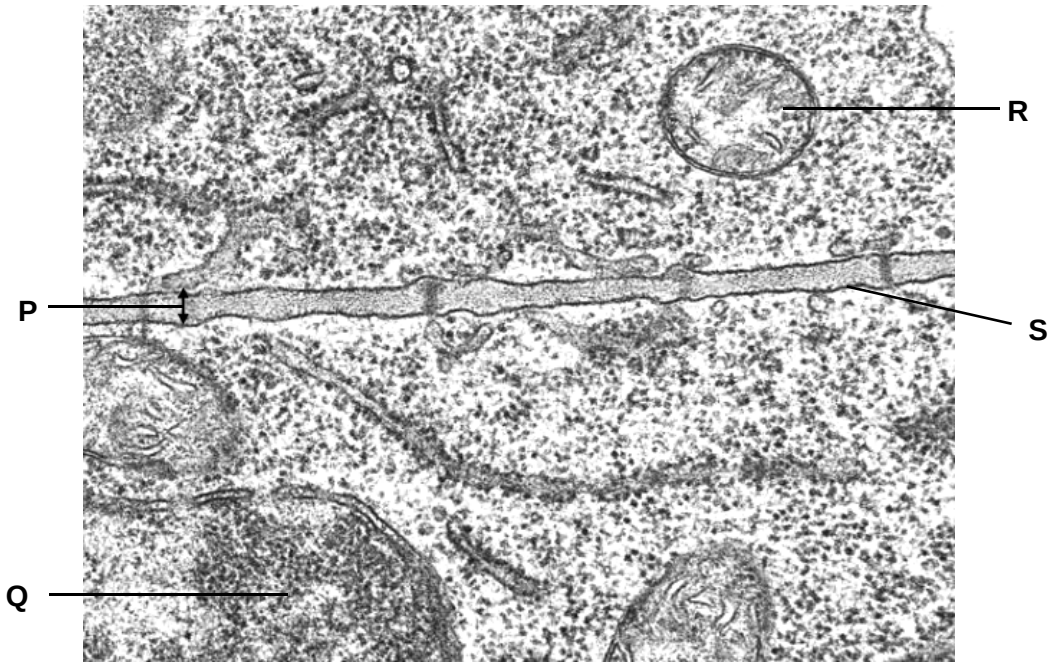
There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the one you consider correct and record your choice **in soft pencil** on the separate Answer Sheet.

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 Question Paper consists of **20** printed pages.

1 The figure below shows an electron micrograph with two plant cells.



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Which of the following statements correctly describes the labelled structures?

1 **R** contains circular DNA and is found in both prokaryotic and eukaryotic cells.

2 **P** has a fluid mosaic structure and regulates the movement of substances between the two plant cells.

3 **S** acts as a selective permeable barrier.

4 **Q** contains enzymes which play an important role in cell specialisation.

A 1 and 3

B 3 and 4

C 1, 2 and 3

D All of the above

2 Which of the following statements regarding stem cells are not correct?

1 Stem cells are present within various organs of the adult body.

2 Stem cells can develop into a whole organism when implanted into the womb.

3 Stem cells can be grown indefinitely in culture under appropriate culture conditions.

4 Stems cells isolated from a 3-5 day old human embryo can differentiate into only one kind of cells.

5 Induced pluripotent stem cells have the same developmental potential as embryonic stem cells.

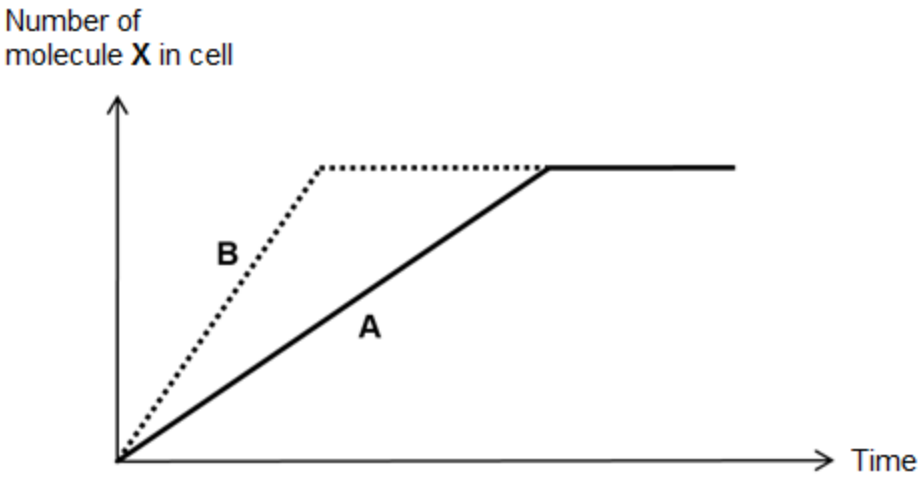
A 1 and 3 only

B 2 and 4 only

C 2, 3 and 5

D 1, 2 and 3

3 Graph **A** shows the transport of molecule **X**, with the help of carrier proteins, over time.



A student predicted that the alteration of one variable would result in graph **B**.

Which row shows the correct transport process and the alteration in variable that would result in graph **B**?

	transport process	**alteration resulting in graph B**
A	facilitated diffusion	increase in environmental temperature to 90 °C
B	active transport	increase in concentration of **X** in cell
C	facilitated diffusion	increase in number of carrier proteins
D	active transport	increase in availability of ATP

4 A student prepared three solutions of sugars, **X**, **Y** and **Z**, and diluted them to varying concentrations. A sample of each was heated with Benedict's reagent, with or without prior acid hydrolysis. The results are shown below.

	concentration of solution/moldm^{-3}					
	0.0001		**0.001**		**0.01**	
	no acid	**with acid**	**no acid**	**with acid**	**no acid**	**with acid**
X	Blue solution	Blue solution	Green mixture	Green mixture	Orange mixture	Orange mixture
Y	Blue solution	Green mixture	Blue solution	Green mixture	Blue mixture	Orange mixture
Z	Blue solution	Green mixture	Green mixture	Green mixture	Orange mixture	Orange mixture

Based on the results, which of the following conclusions are not correct?

A Solution **Y** does not consist of monosaccharides.

B Solution **X** and solution **Y** consists of disaccharides only.

C Solution **X** consists of monosaccharides only.

D Solution **Z** contains disaccharides.

5 The R groups of two amino acids are shown below.

amino acid	**R group**
Serine	$-CH_2-OH$
Alanine	$-CH_3$

When placed in aqueous medium, where in a globular protein will these amino acids be found?

A Both serine and alanine will be found in the interior of the globular protein.

B Both serine and alanine will be found on the exterior of the globular protein.

C Alanine will be found in the interior, and serine on the exterior of the globular protein.

D Alanine will be found on the exterior, and serine in the interior of the globular protein.

6 The equations below show the relationship between an enzyme (**E**) and its substrate (**S**), product (**P**) and an inhibitor (**I**).

Pathway **A**: **E** + **S** → **E** + **P**

Pathway **B**: **E** + **S** + **I** → **E** + **S** + **I**

In the above reactions, assume that

- increasing the concentration of **S** increases the activity of the enzyme,
- at low substrate concentrations the presence of **I** reduces rate of reaction velocity, and
- the same maximum rate of reaction can be reached in the presence or absence of **I**.

Which mechanism is operating in pathway **B**?

A Positive feedback

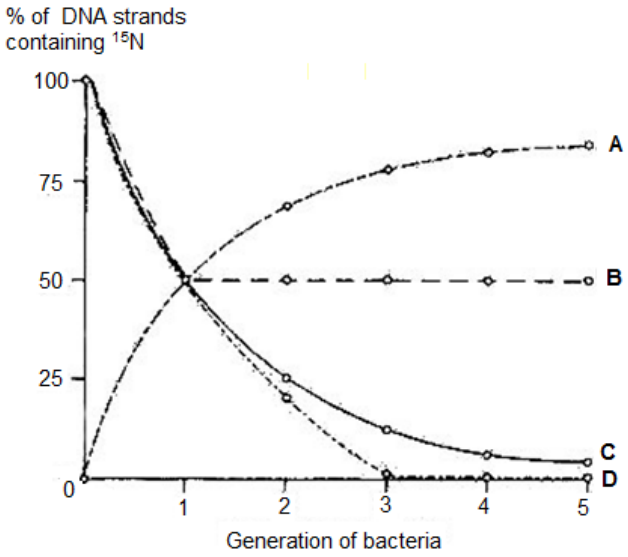
B Negative feedback

C Competitive inhibition

D Non-competitive inhibition

7 Bacteria were cultured in a medium containing heavy nitrogen (^{15}N) until all their DNA were labelled. These bacteria were then grown in a medium containing only light nitrogen (^{14}N) for five generations. The percentage DNA strands containing ^{15}N in each generation was estimated.

Which curve provides evidence that each daughter DNA molecule produced consists of a parental strand and a newly synthesised daughter strand?



8 Part of the amino acid sequence in β-globin chains of normal and mutant haemoglobin are shown.

Normal haemoglobin	thr-pro-glu-glu
Mutant haemoglobin	thr-pro-val-glu

Possible mRNA codons for these amino acids are

Glutamine (glu)	GAA GAG
Threonine (thr)	ACU ACC
Proline (pro)	CCU CCC
Valine (val)	GUA GUG

Which tRNA molecule is not involved in the formation of this part of amino acid sequence in mutant haemoglobin?

A

B

C

D

9 Tay-Sachs disease is characterised by abnormal accumulation of lipid-related compounds, which results in deterioration of cognitive and motor abilities.

It is caused by an autosomal recessive mutation in the allele coding for hexosaminidase A (HEXA), an enzyme that regulates the metabolism of phospholipids.

The base triplets in part of the coding DNA sequences for a normal HEXA allele and a mutant Tay-Sachs allele, as well as their corresponding amino acids are shown.

Normal HEXA allele	CGT Arg	ATA Ile	TCC Ser	TAT Tyr	GCC Gly	CCT Pro	GAC… Asp	
Tay-Sachs allele	CGT Arg	ATA Ile	TCT Ser	ATC Ile	CTA Leu	TGC Cys	CCC Pro	TGA… Thr

Which combination correctly describes the nature of mutation that results in the Tay-Sachs allele?

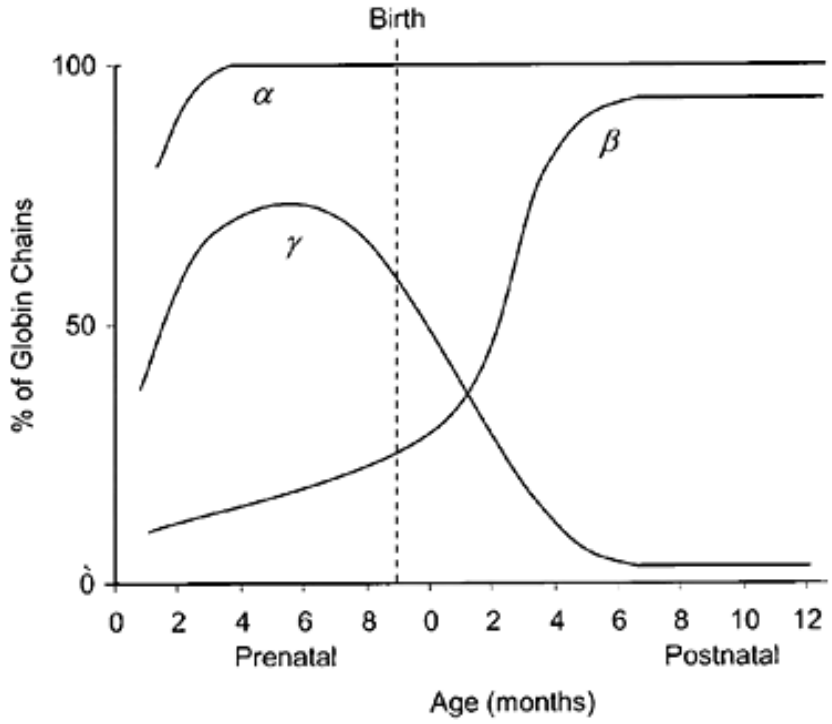
	changes to nucleotide sequences	**alteration of reading frame**	**length of polypeptide**
A	Deletion of 2 bases	Yes	Shorter
B	Insertion of 2 bases	Yes	Longer
C	Substitution of 4 bases	No	Unchanged
D	Insertion of 4 bases	Yes	Longer

10 Which row correctly identifies the characteristics of the human genome?

	promoter	**histone proteins bound to DNA**	**centromeres**	**repeated sequences**
A	Multiple	Always	Position varies for every chromosome	Absent
B	One	Always	Position varies for every bivalent	Present
C	Multiple	Sometimes	Position varies for every bivalent	Present
D	One	Sometimes	Position varies for every chromosome	Absent

11 The globin gene family in humans consists of α, β and γ genes. These genes code for the globin chains that make up haemoglobin and are expressed at different levels during different developmental stages.

The graph shows the expression of the various globin chains during the prenatal (fetal) and postnatal (after birth) periods.



Which of the following cannot account for the differences in the levels of expression of globin chains?

A Methyl groups are added to regulatory sequences of γ-globin genes during the postnatal period, allowing for some proteins to bind.

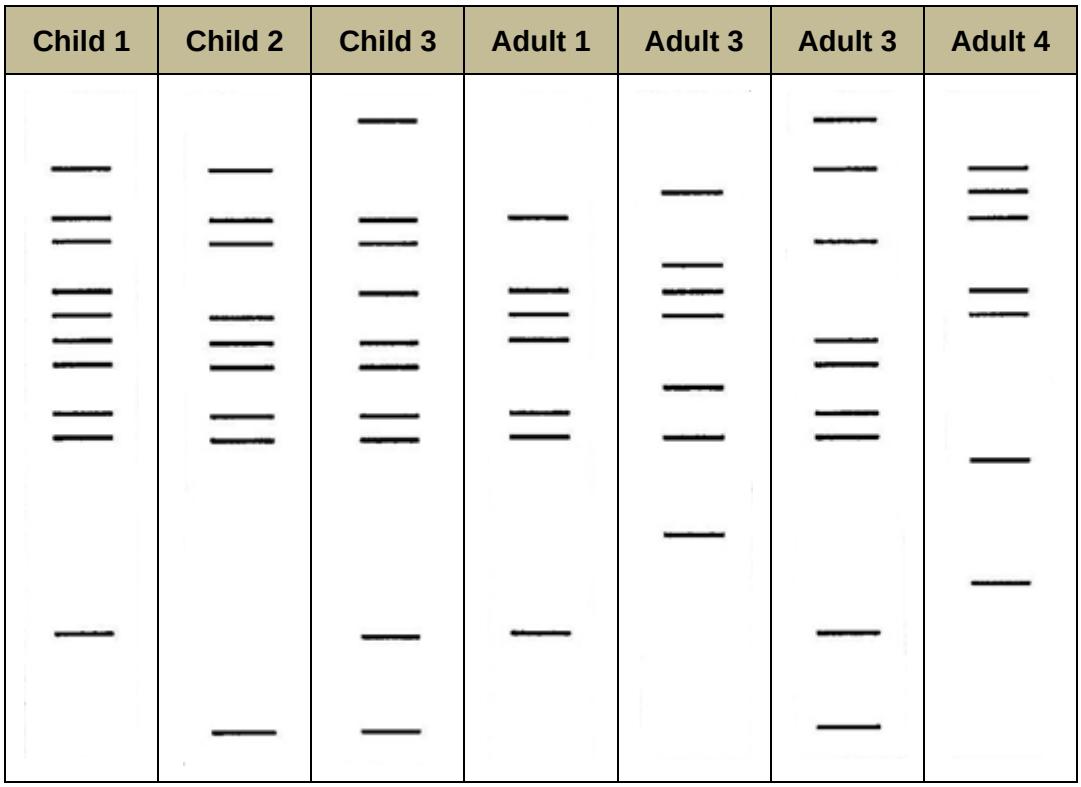
B A growth factor triggers the expression of a transcription factor that increases the rate of β-globin gene expression during the postnatal period.

C Alternative splicing occurs in the mature mRNA of the α-globin and β-globin genes, resulting in differences in the rate of expression of globin chains during the prenatal period.

D The shortening of poly(A) tail in the mRNA of globin genes reduces its stability, resulting in a decrease in the rate of expression of γ-globin chains during the postnatal period.

12 Seven skeletons were found in an unidentified grave. To establish the relationship between these seven individuals, DNA were isolated from these skeletons and then analysed using gel electrophoresis.

The results obtained from the skeletons, three children and four adults, are shown below.



Other analysis showed that all three children have the same parents. Which two adults may be the parents of these children?

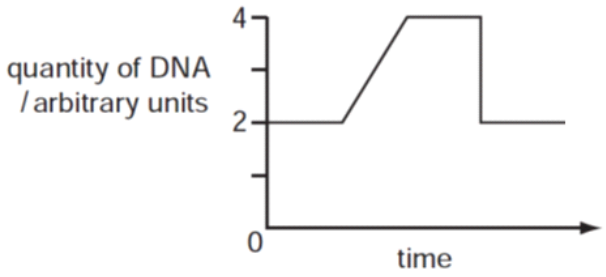
A Adults 1 and 2

B Adults 1 and 3

C Adults 2 and 3

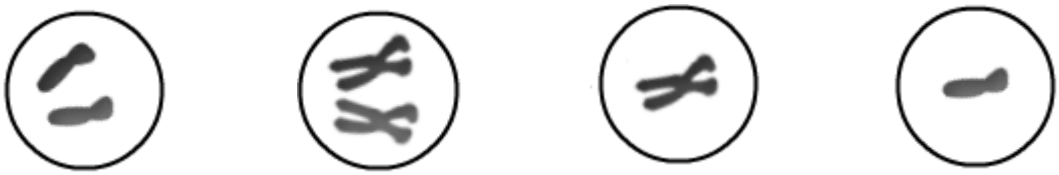
D Adults 2 and 4

13 The graph shows the change in the quantity of DNA in a cell with one pair of chromosomes during a cell division.

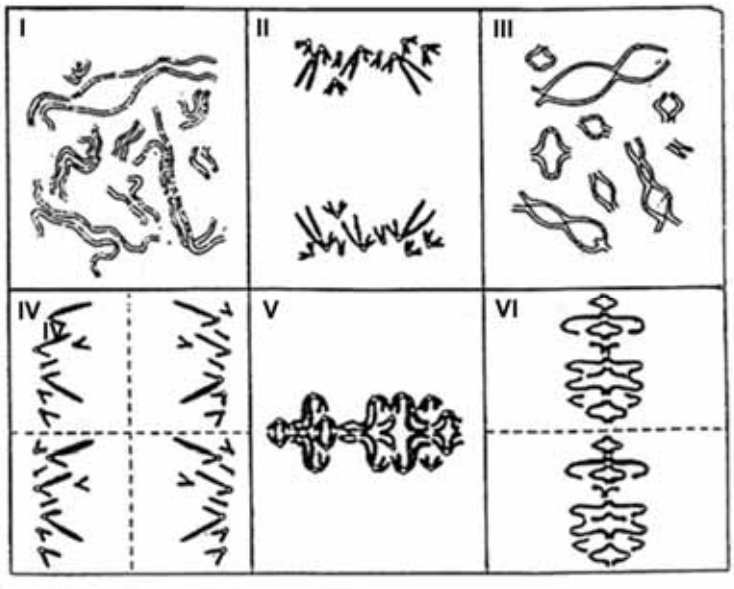


Which nucleus is formed as a result of this division?

A **B** **C** **D**



14 The diagram depicts the behaviour of chromosomes at various stages of meiosis of the same cell.



Which of the following shows the correct order of the stages?

A **III → V → II → VI → IV → I**

B **III → I → V → II → VI → IV**

C **II → III → I → V → VI → IV**

D **I → III → V → II → VI → IV**

15 Which of the following are necessary for tumourgenesis to occur?

1 Gain of function mutation to proto-oncogenes

2 Loss of function mutation of tumour suppressor genes

3 Inactivation of telomerase enzymes preventing cell apoptosis

4 Production of chemical factors that induce angiogenesis

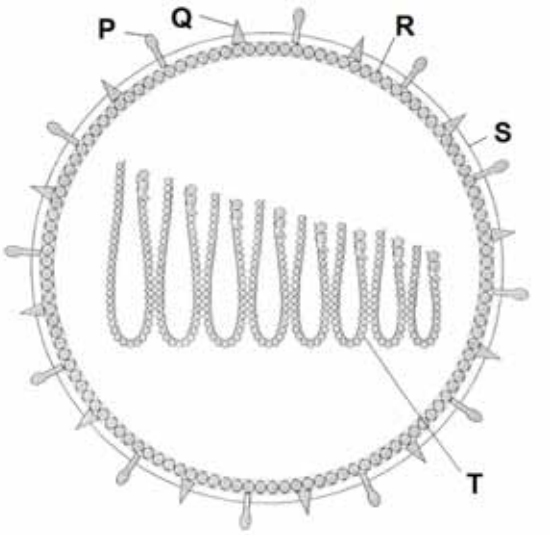
A 1 only

B 1 and 2 only

C 1, 2 and 3 only

D All of the above

16 The diagram shows the structure of an influenza virus.



Which of the following statements concerning the lettered components are correct?

1 Mutations that disrupt the function of **R** will result in the inability of the virus to initiate infection in the host cell.

2 **P** and **Q** are unlikely targets for vaccination because they undergo mutation constantly.

3 New influenza viruses acquire **S** from host cell during budding.

4 The host cell enzymes are not required to form the complementary RNA from **T**.

A 1 and 2 only

B 3 and 4 only

C 1, 2 and 3

D 2, 3 and 4

17 Which statements about viruses are true?

1 They encode genes for synthesising their own ATP.

2 They are single-cell organisms.

3 They can have genomes made of DNA.

4 They package ribosomes into their virion.

5 They can have a single-stranded or double-stranded RNA genomes.

6 They can have a membrane-like envelope.

A 5 and 6 only

B 3, 5 and 6

C 1, 3, 5 and 6

D All of the above

18 Which of the following statements about the *lac* operon are correct?

1 *lac Z*, *lac Y* and *lac A* are structural genes that will be expressed when the operator is switched on.

2 In the absence of alloactose, the repressor protein will be unable to bind to the operator.

3 When glucose and lactose are available and the repressor becomes inactive as allolactose binds to it.

4 *lac Y* codes for a protein that increases uptake of lactose from environment.

5 Catabolite activator protein binds to promoter to increase rate of transcription.

A 1 and 2

B 1 and 3

C 1, 2 and 5

D 3, 4 and 5

19 A black-haired female rabbit was crossed with a white-haired male rabbit. Eight offspring were born. Two were white-haired males, two were white-haired females and all the others were black-haired females.

What can be deduced about the inheritance of hair colour in rabbits?

A Hair colour is sex-linked in rabbits.

B The allele for black hair is dominant to the allele for white hair.

C The allele for white hair is dominant to the allele for black hair.

D The results of this cross are inconclusive.

20 Two genes, Q and R, affect the size of the petals and the pigmentation of a flower.

Gene Q has two alleles, Q^L and Q^A. The genotype Q^LQ^L produces large petals, Q^LQ^A produces small petals, and in Q^AQ^A, petals are absent.

Gene R has two alleles. R produces a red pigment and is dominant over the allele r that produces no pigment.

A plant that is heterozygous at both gene loci was selfed. How many different phenotypes will be observed in the next generation?

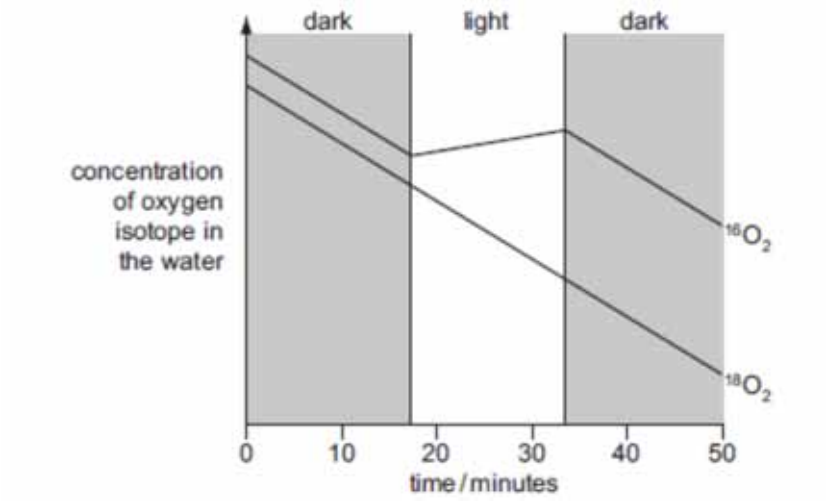
A 4

B 6

C 9

D 12

21 The common isotope of oxygen is ^{16}O. Air containing $^{16}O_2$ and $^{18}O_2$ was bubbled through a suspension of algae for a limited period. After this, the concentration of these two isotopes of oxygen in the water was monitored for the next 50 minutes whilst the algae were subjected to periods of dark and light. The results are shown in the diagram.



What is the best explanation for these results?

A Both isotopes of oxygen are used by the algae in the dark in respiration, but in the light oxygen is produced from water in photorespiration.

B The algae can distinguish chemically between the two isotopes.

C The algae produce oxygen from the water used in photosynthesis, but only in the light.

D The two isotopes have different rates of diffusion.

22 After vigorous exercise, changes occur in the muscle tissue. Compared with 'at rest' conditions, what will the changes be?

	ATP	lactate	pH
A	decreased	increased	decreased
B	increased	increased	increased
C	decreased	decreased	increased
D	increased	decreased	decreased

23 The hormone insulin binds to the tyrosine kinase receptors and initiates various signal transduction pathways to generate cellular responses. Which of the following shows the correct sequence of events, following the binding of insulin to the receptor?

1 phosphorylation of tyrosine residues

2 signal amplification

3 dimerisation of tyrosine kinase receptor

4 signal transduction

5 activation of transcription factors

A 1 → 3 → 2 → 4 → 5

B 3 → 4 → 1 → 2 → 5

C 1 → 3 → 5 → 4 → 2

D 3 → 1 → 4 → 2 → 5

24 During pregnancy, glucose is transferred from the bloodstream of the mother to the bloodstream of the foetus through the placenta.

In an experiment conducted on a pregnant female subject, experiments **X** and **Y** were conducted with control periods of no treatment before them.

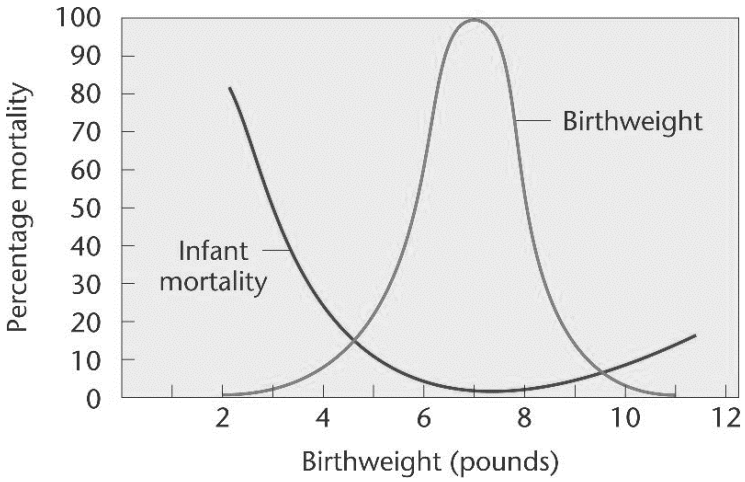
Measurements of blood glucose levels in both mother and foetus were made. Also, the glucose transfer rates from mother to placenta, and from placenta to foetus were monitored. The experimental data is shown in the table below.

Experiment	glucose concentration / mg cm^{-3}		glucose transfer rate / mg min^{-1}	
	maternal blood	foetal blood	from mother to placenta	from placenta to foetus
control period	54	15	38	9
after X	54	9	38	16
control period	52	14	39	8
after Y	211	30	58	34

Which of the following is likely to describe experimental steps **X** and **Y**?

	X	Y
A	Glucagon injection given to foetus	Insulin injection given to mother
B	Insulin injection given to foetus	Glucagon injection given to foetus
C	Insulin injection given to mother	Glucagon injection given to foetus
D	Insulin injection given to foetus	Glucose injection given to mother

25 The graph below shows the relationship between birthweight and infant mortality in humans.



What type of selection is demonstrated above?

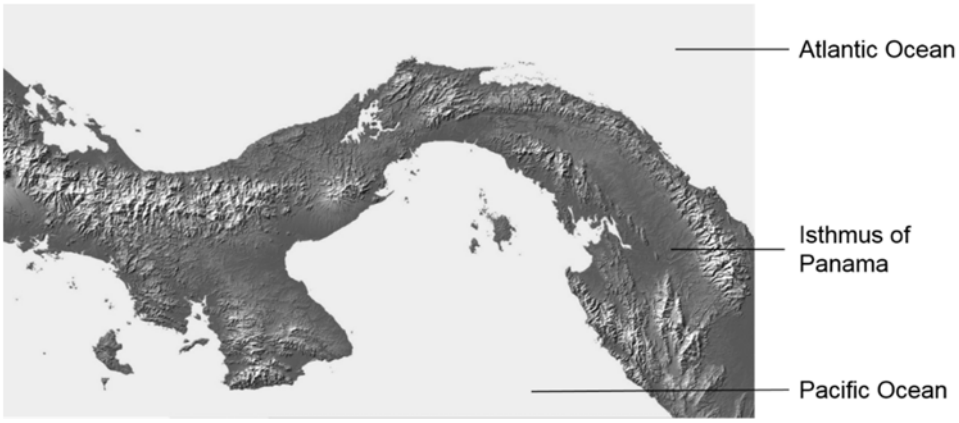
A Directional selection

B Disruptional selection

C Stabilising selection

D Artificial selection

26 The formation of the Isthmus of Panama around 3 million years ago (*Mya)* led to the separation of the Pacific and Atlantic oceans. Pistol shrimps of the *Alpheus* genus can be found in both oceans, surrounding the Isthmus. *Alpheus nuttingi* resides in the Atlantic ocean and *Alpheus millsae* resides in the Pacific ocean.



Despite being physically separated, *A. nuttingi* and *A. millsae* are morphologically and genetically very similar. The two species have also been shown to be capable of interbreeding in captivity. Which of the following statements are likely to be true?

1 *A. nuttingi* and *A. millsae* are derived from a common ancestral species.

2 The formation of the Isthmus resulted in geographical isolation of the two species 3 *Mya*.

3 *A. nuttingi* and *A. millsae* are two separate species because they are geographically isolated.

4 Similar environmental conditions around the Isthmus exerted similar selection pressures, leading to convergent evolution between *A. nuttingi* and *A. millsae*.

A 1 only

B 1 and 3

C 2 and 3

D 3 and 4

27 Myxomatosis is a viral disease of rabbits. It spreads rapidly and most rabbits die within 14 days of being infected. Myxomatosis has been deliberately used to reduce the number of rabbits in countries where they are a significant crop pest.

The initial release of the virus caused populations to fall by over 90%. Resistance to myxomatosis increased in the 70 years following initial release, so at the present time up to 50% of infected rabbits are able to survive.

Which of the following statements could explain the increasing frequency of resistance to myxomatosis in the years following release of the virus?

1 In populations with high incidences of myxomatosis, mutations leading to resistance are more likely to occur.

2 Infected rabbits die quickly, hence the alleles that code for myxomatosis are eliminated from the population.

3 The initial release of the virus led to a bottleneck event, greatly altering the frequency of alleles in rabbit populations.

4 During disease outbreaks there is greater food availability for the surviving rabbits, increasing the probability that they survive.

A 4 only

B 1 and 2 only

C 2 and 4 only

D 2, 3 and 4 only

28 Which statements correctly describe lymphocytes?

1 Each B lymphocyte has the ability to make several types of antibody molecules.

2 Some B lymphocytes and T lymphocytes become memory cells.

3 Plasma cells secrete antibodies into the blood plasma.

4 Some T lymphocytes stimulate macrophages to kill infected cells.

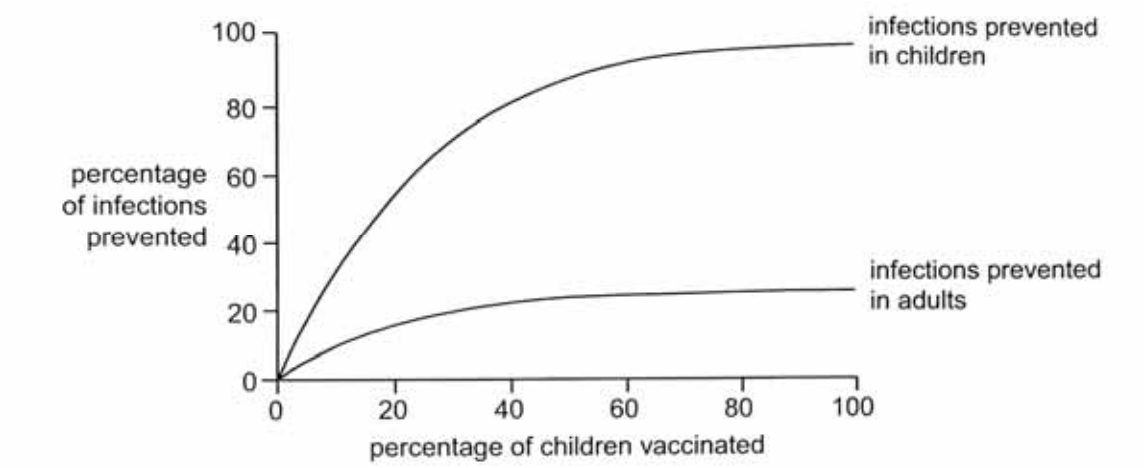
A 1, 2, 3 and 4

B 1, 2 and 3 only

C 2, 3 and 4 only

D 1 and 4 only

29 When sufficient individuals are vaccinated, the disease transmission cycle can be broken. The diagram shows the effect of vaccination of children on the prevention of infection.



What can be concluded about the effect of vaccination of children from this data?

1 When approximately 80% of children are vaccinated, the cycle of disease transmission in children is broken.

2 Vaccination of children reduces the percentage of infections in both adults and children.

3 The effect on adult infections is less than that of infection in children, because adults will have been vaccinated as children.

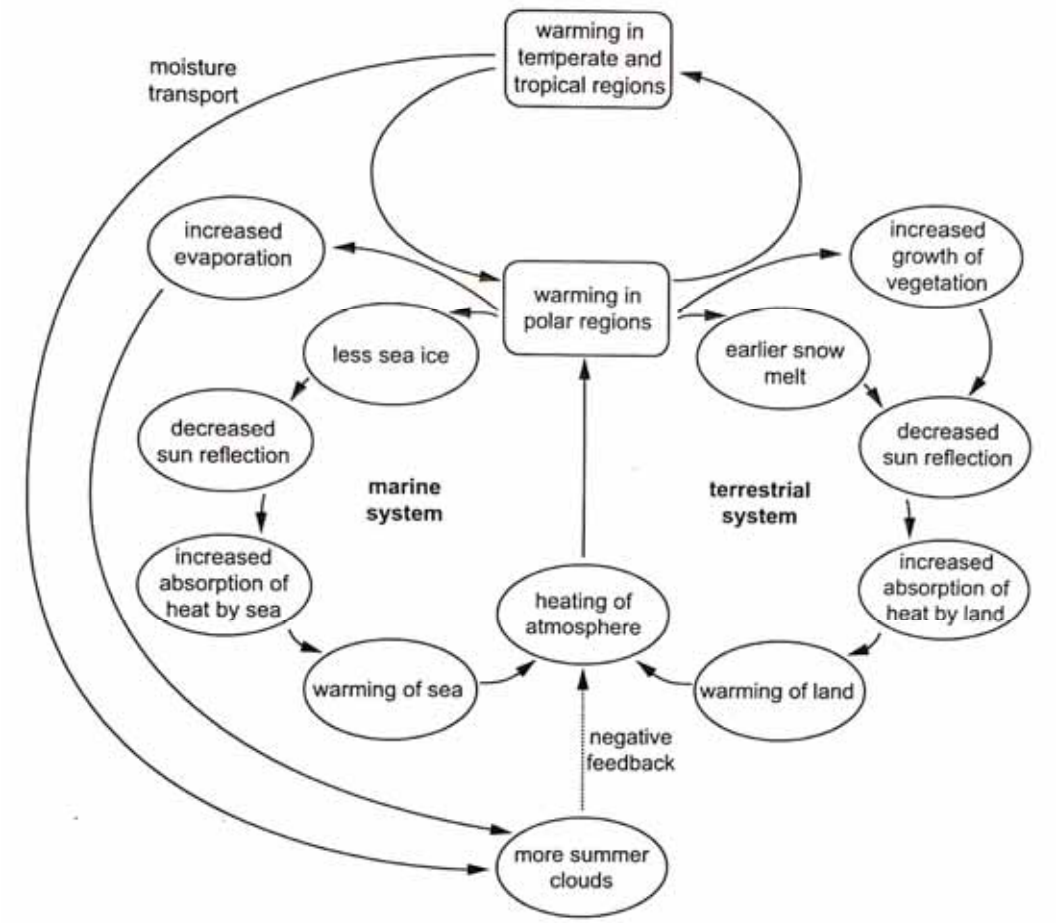
A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

30 The diagram shows the effect of increasing temperatures 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.