



RIVER VALLEY HIGH SCHOOL

YEAR 6

PRELIMINARY EXAMINATION II

H1 BIOLOGY 8875

PAPER 1
22 SEP 2017
1 HOUR

CANDIDATE
NAME

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CENTRE
NUMBER

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INDEX
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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 index number on the Answer Sheet in the spaces provided.

DO **NOT** WRITE IN ANY BARCODES.

There are **thirty** questions in 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.

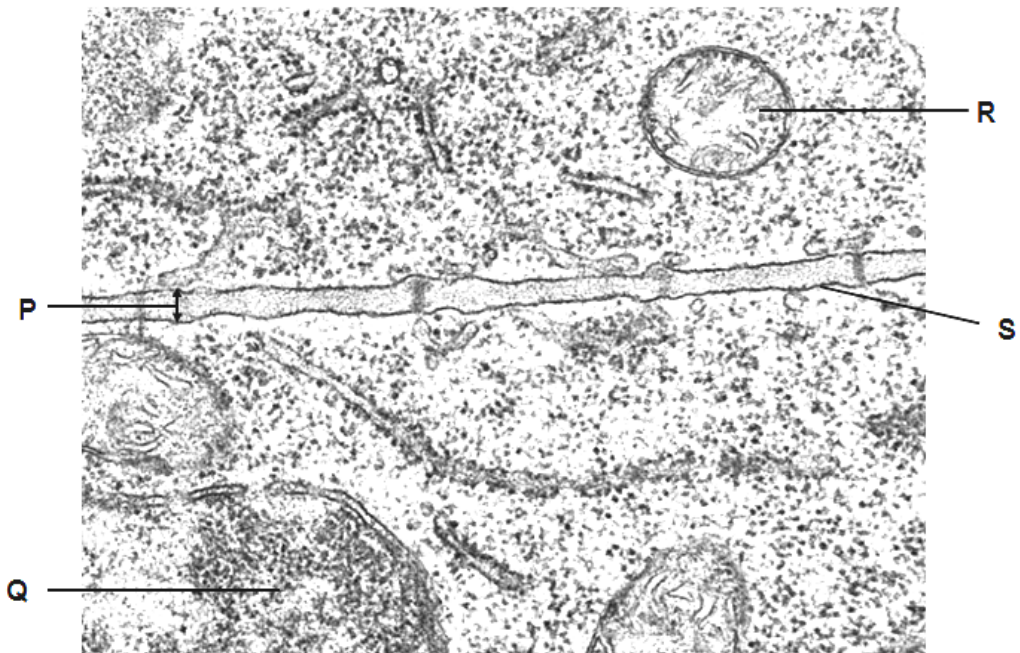
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

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 describe the labelled structures?

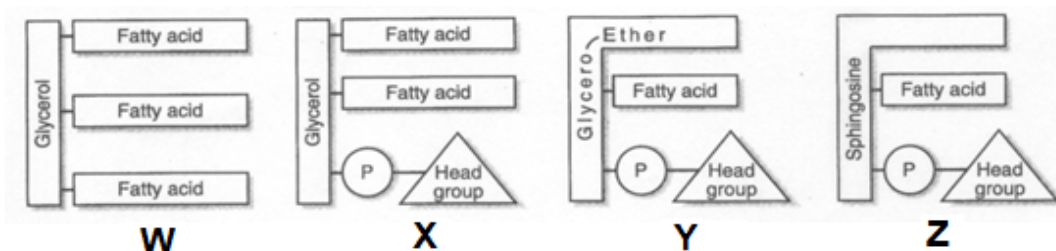
- 1 **R** contains circular DNA and is found in both prokaryotic and eukaryotic cells.
 - 2 **P** has a fluid mosaic structure and regulates the movement of substances between the two plant cells.
 - 3 **S** acts as a selective permeable barrier.
 - 4 **Q** contains enzymes which play an important role in cell specialisation.
- A** 1 and 3
- B** 3 and 4
- C** 1, 2 and 3
- D** All of the above

- 2 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 / mol dm^{-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.
- 3 The diagram below shows the components of different types of lipids.



Which statement(s) correctly describes the four lipid molecules?

- All molecules are made by condensation reactions.
 - The hydrocarbon chains of **W** are always from saturated fatty acids.
 - The hydrocarbon chains of molecules **W** and **Y** may be from saturated or unsaturated fatty acids.
 - The hydrocarbon chains of **X** are always of the same length.
- A 1 only
- B 1 and 4
- C 1 and 3
- D 2 and 4

- 4 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.
- 5 The pathways below show the relationship between an enzyme (**E**) and its substrate (**S**), product (**P**) and an inhibitor (**I**).

Pathway A: $E + S \rightarrow E + P$

Pathway B: $E + S + I \rightarrow E + S + I$

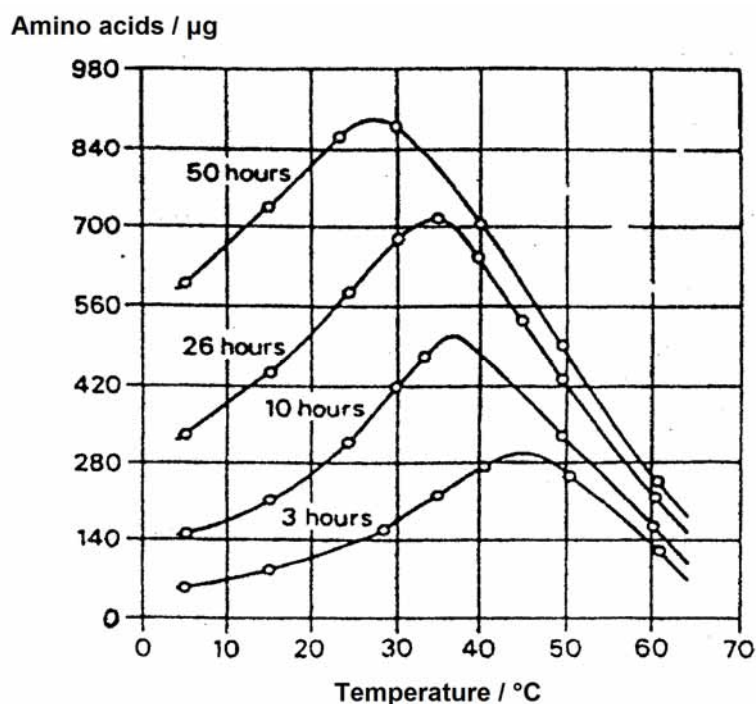
In the above reactions, assume that

- 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

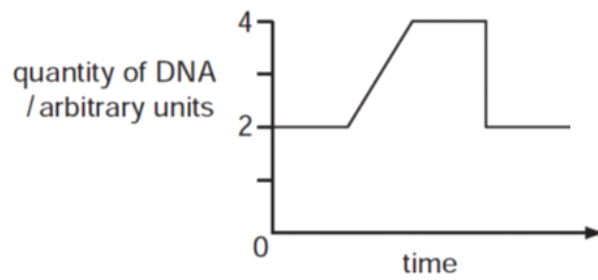
- 6 The graph below shows the effect of temperature on the activity of a proteolytic enzyme incubated at varying durations.



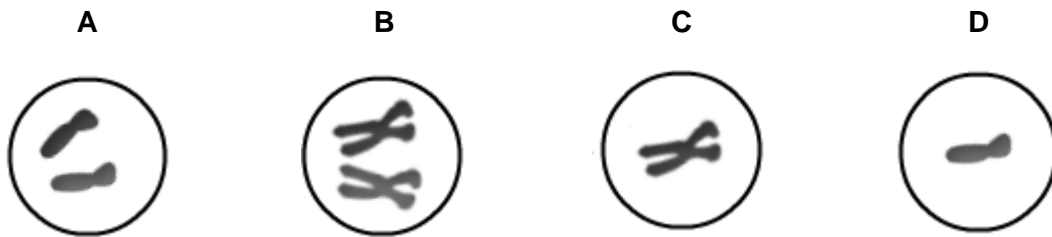
Which of the following can be deduced from the graph?

- A The optimum temperature of the proteolytic enzyme is 27°C .
- B The proteolytic enzyme undergoes denaturation at 27°C .
- C The optimum temperature of the proteolytic enzyme decreases as the incubation time increases, due to time for breaking of covalent bonds.
- D The optimum temperature of the proteolytic enzyme increases with incubation time, causing the hydrolysis to last longer.

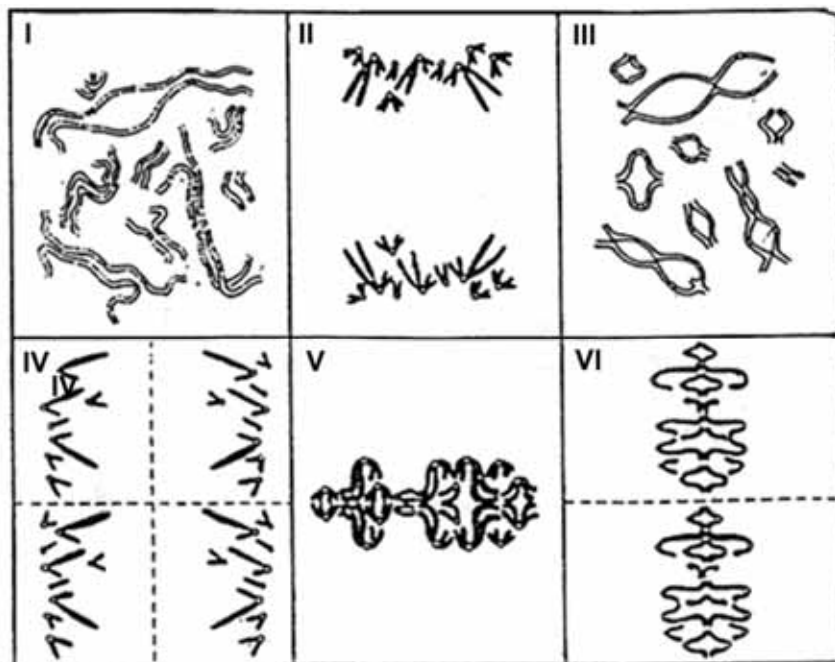
- 7 The graph shows the change in the quantity of DNA in a cell with one pair of chromosomes during a cell division.



Which nucleus is formed as a result of this division?



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

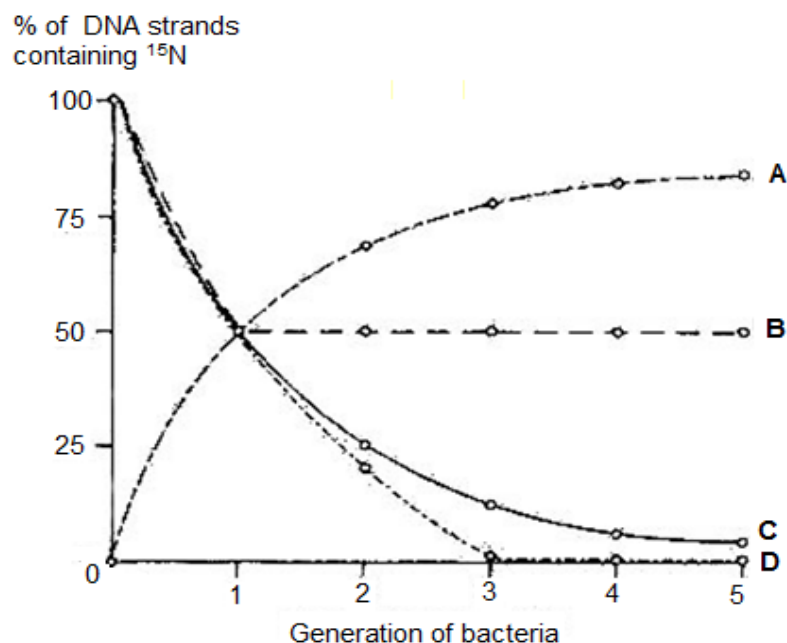


Which of the following shows the correct order of the stages?

- 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

- 9 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 of 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?



- 10 A student obtained a sample of DNA from which mRNA was transcribed. He then separated the two strands of DNA by adding NaOH. While doing so, he accidentally contaminated the DNA-mRNA mixture with another DNA sample. The base composition of each DNA strand and that of the mRNA were analysed. The results of the analysis are shown in the table below.

| | A | G | C | T | U |
|--------------|------|------|------|------|------|
| DNA strand 1 | 19.1 | 26.0 | 31.0 | 23.9 | 0.0 |
| DNA strand 2 | 24.2 | 30.8 | 25.7 | 19.3 | 0.0 |
| DNA strand 3 | 20.5 | 25.2 | 29.8 | 24.5 | 0.0 |
| DNA strand 4 | 25.1 | 24.2 | 18.8 | 29.9 | 0.0 |
| mRNA | 19.0 | 25.9 | 30.8 | 0.0 | 24.3 |

Which strand of DNA was used as a template for the synthesis of mRNA?

- A DNA strand 1
- B DNA strand 2
- C DNA strand 3
- D DNA strand 4

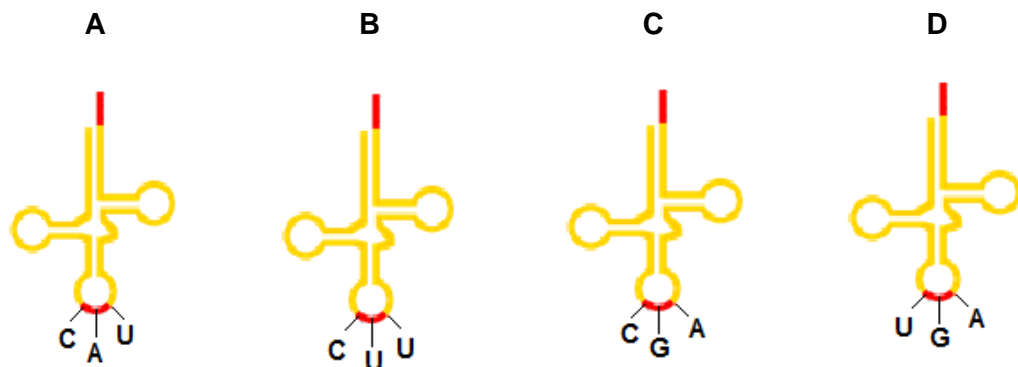
- 11 Part of the amino acid sequence in β -globin chains of normal and mutant haemoglobin are shown.

| | |
|--------------------|-----------------|
| normal haemoglobin | thr-pro-glu-glu |
| mutant haemoglobin | thr-pro-val-glu |

Possible mRNA codons for these amino acids are shown below.

| | |
|-----------------|---------|
| 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?



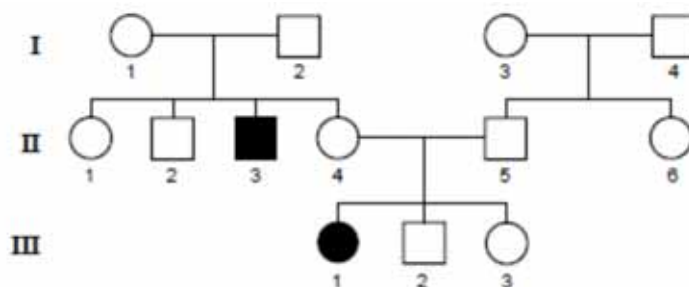
- 12 A black-haired female rabbit was crossed with a white-haired male rabbit. Eight offspring were born. Two were white-haired males, two were white-haired females and all the others were black-haired females.

Which statement is correct, from this evidence, 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.

- 13** Phenylketonuria (PKU) is a condition in which affected individuals fail to produce the enzyme phenylalanine hydroxylase. PKU is inherited as an autosomal recessive condition.

The following pedigree shows a family in which two members have PKU.



In the pedigree shown, individuals that must be heterozygous for PKU include

- A** I–2 **B** I–4 **C** II–1 **D** II–6
- 14** 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 | ATA | TCC | TAT | GCC | CCT | GAC... | |
| | Arg | Ile | Ser | Tyr | Gly | Pro | Asp | |
| Tay-Sachs allele | CGT | ATA | TCT | ATC | CTA | TGC | CCC | TGA... |
| | Arg | Ile | Ser | Ile | Leu | Cys | Pro | 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 |

- 15 The figures below show the complete karyotypes of two rodents of the same species. In this species of rodent, males are the heterogametic sex, where they have two different sex chromosomes.



Rodent **A** (Male)

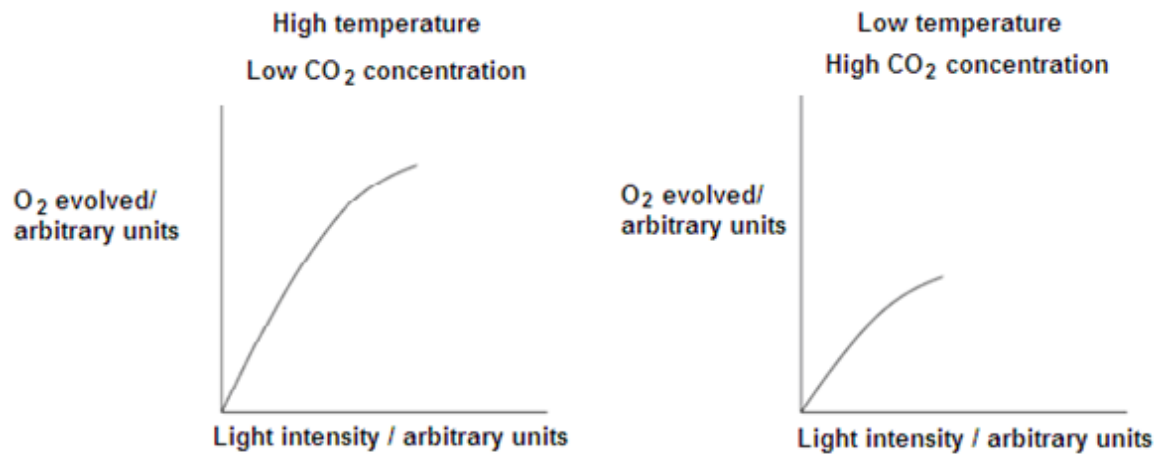


Rodent **B** (Female)

Which of the following observations is not true?

- A A chromosomal aberration occurred in the ovary of the mother of rodent **B**
 - B Rodent **A** is diploid and $2n = 16$.
 - C Rodent **B** has 1 missing chromosome.
 - D Non-disjunction of autosomes occurred in rodent **B**.
- 16 Which of the following statements are true about non-cyclic photophosphorylation?
- 1 NADP^+ is oxidized in non-cyclic phosphorylation.
 - 2 P_{680} and P_{700} are reduced after the electrons are excited to higher energy levels.
 - 3 ATP is synthesised in non-cyclic photophosphorylation.
 - 4 The products of non-cyclic phosphorylation are NADPH/H^+ , ATP and oxygen.
- A 1 and 2
 - B 3 and 4
 - C 1, 2 and 3
 - D 2, 3 and 4

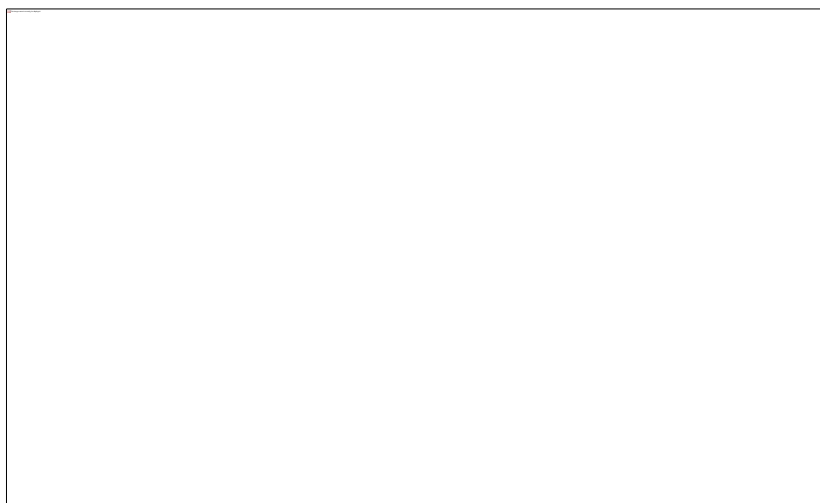
- 17 Students investigated the rate of photosynthesis by measuring the rate of oxygen evolved from an aquatic plant. The results of two experiments that they set up are shown below.



Which conclusion can be drawn from this data?

- A Temperature does not affect the rate of photosynthesis.
- B High concentrations of CO₂ reduce the rate of photosynthesis.
- C Temperature and CO₂ concentration are both limiting factors.
- D The greater the light intensity the greater the rate of photosynthesis.

- 18 The common isotope of oxygen is ^{16}O . Air containing $^{16}\text{O}_2$ and $^{18}\text{O}_2$ 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.

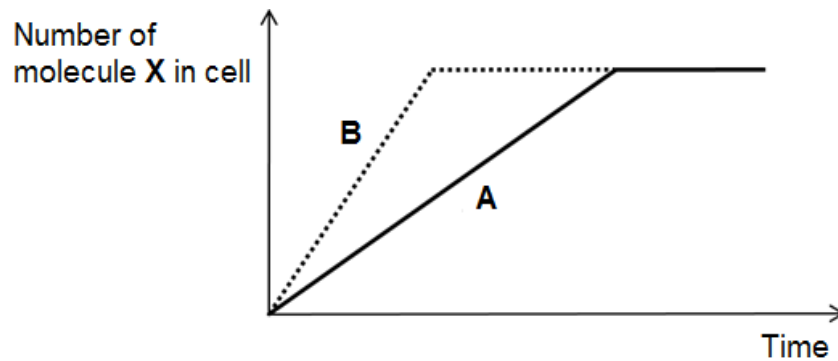


What is the best explanation for these results?

- 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 which is used in photosynthesis, but only in the light.
- D The two isotopes have different rates of diffusion.
- 19 After vigorous exercise, changes occur in the muscle tissue. Compared with 'at rest' conditions what will be changes be?

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

- 20 Graph **A** shows the transport of molecule **X**, with the help of carrier proteins, into a cell over time.

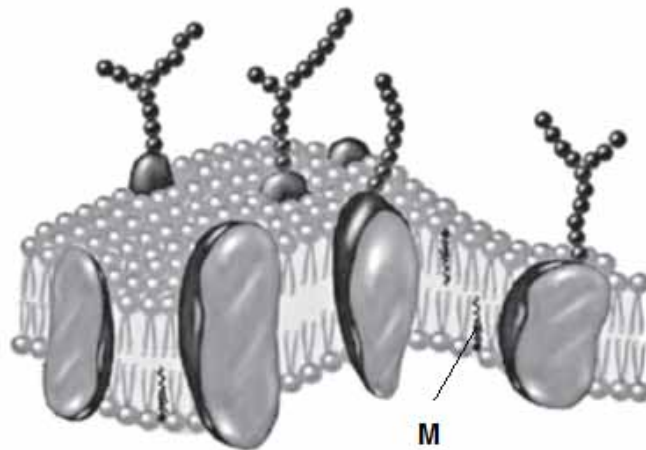


A student predicted that the alteration of one variable would result in graph **B**.

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 |

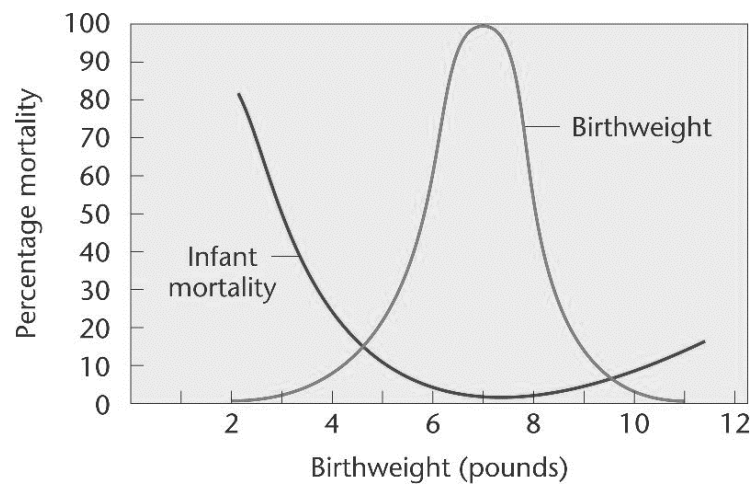
21 The diagram below shows a plasma membrane.



Which of the following correctly describes the function of molecule **M**?

- 1 limits membrane fluidity
 - 2 enhances membrane fluidity
 - 3 limits membrane permeability
 - 4 enhances membrane permeability
 - 5 allows for cell-cell adhesion
- A** 1 and 2 only
- B** 1, 2 and 3 only
- C** 1, 2, 3 and 4 only
- D** All of the above

- 22** The graph below shows the relationship between birthweight and infant mortality in humans.



What type of selection is demonstrated above?

- A** Directional selection
- B** Disruptive selection
- C** Stabilising selection
- D** Artificial selection

- 23** The formation of the Isthmus of Panama around 3 *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

- 24** 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 death of large number of rabbits, 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

- 25** 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.

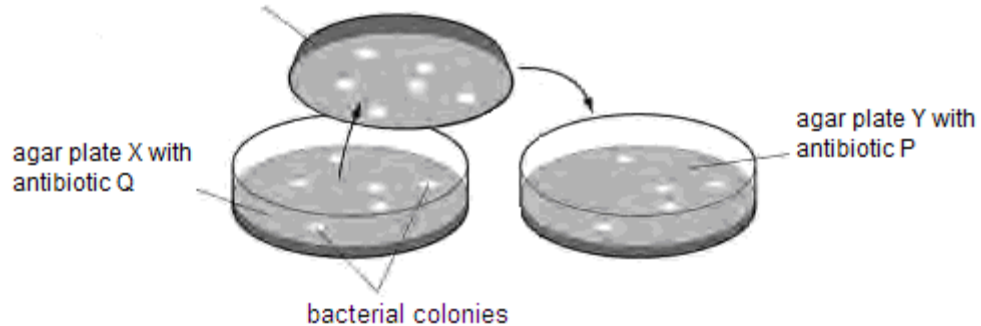
| Child 1 | Child 2 | Child 3 | Adult 1 | Adult 2 | Adult 3 | Adult 4 |
|---------|---------|---------|---------|---------|---------|---------|
| | | | | | | |

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
- 26** Which of the following statements about polymerase chain reaction are true?
- 1 Copy fragments of DNA
 - 2 Amplify fragments of DNA
 - 3 Translate fragments of DNA
 - 4 Requires an excess of RNA primers
 - 5 Requires DNA-dependent DNA polymerase
- A** 1 and 2
 - B** 2 and 5
 - C** 1, 2 and 4
 - D** 1, 2 and 5

- 27 The diagram shows a method used to detect bacteria colonies which are successfully transformed during genetic engineering.

Sponge touched briefly onto agar in plate X and used to transfer small amounts of each colony of bacteria onto agar plate Y



Which explains why other methods for detecting successful transformation are now preferred?

- 1 Incorporating heavy-metal resistance genes along with the desired genes means that you can easily kill cells that have not been transformed.
 - 2 Presence or absence of non-toxic fluorescent markers is easy to detect using ultra-violet light.
 - 3 The antibiotic resistance genes previously used as markers might have escaped into the environment.
 - 4 The antibiotic resistance genes previously used as markers killed the transformed cells so they were difficult to use.
- A 1 and 3
- B 2 and 4
- C 1, 2 and 3
- D 1, 2, 3 and 4

- 28 Which of the following best explains why a genome project is not finished when the sequence has been completed?
- A Genomes change too fast and must constantly be updated.
 - B Without knowing the number, the function, and the location of genes within a genome, the sequence is not very useful.
 - C Individuals within a species are so unique that having a single sequence is insufficient to characterise a species' genome.
 - D Many sections of a genome are too difficult to sequence and have not actually been included in 'complete' genomes.
- 29 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.
- A 1 and 3 only
 - B 2 and 4 only
 - C 1, 2 and 3
 - D 2, 3 and 4
- 30 Maize varieties with leaves that produce protein toxic to insects are being developed. The DNA coding for these toxic proteins was inserted into a maize chromosome via a bacterial plasmid. Many people oppose to this process.
- Which objection is **not** biologically valid?
- A Beneficial insects may be killed if they eat genetically modified maize.
 - B Genes for antibiotic resistance are present in plasmids and these genes may be passed to harmful bacteria.
 - C Hybridisation may transfer the bacterial genes from maize to weeds, giving the weed species new and harmful characteristics.
 - D Mutations may be caused in cattle or humans that eat the genetically modified maize.