

NAME : \_\_\_\_\_

CLASS : \_\_\_\_\_



**JURONG PIONEER JUNIOR COLLEGE**  
**JC2 Preliminary Examination 2024**

**BIOLOGY**  
**Higher 2**

**9744/01**  
**17 September 2024**

Paper 1 Multiple Choice

**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, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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 **21** printed pages and **3** blank pages.

1 Which eukaryotic cell structures all contain nucleic acids?

- A centrioles, chloroplasts, mitochondria, ribosomes
- B centrioles, mitochondria, nuclei, ribosomes
- C chloroplasts, mitochondria, cytoplasm, ribosomes
- D cytoplasm, Golgi bodies, mitochondria, nuclei

2 *Mimivirus* is one of many giant viruses that have recently been discovered. It has about a thousand protein-coding genes.

Some scientists think that *Mimivirus* evolved from ancient bacteria.

The genes of *Mimivirus* include those for:

- 1 light-driven proton pumps
- 2 Krebs cycle enzymes
- 3 ribosomal-binding sites
- 4 enzymes for linking nucleic acids to amino acids.

Which *Mimivirus* genes are also found in anaerobic gut bacteria in humans?

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

**3** What is true about carbohydrates found in animals?

- 1  $\beta$ -glucose monomers are used to synthesise cellulose.
- 2 Glucose, ribose and deoxyribose are monosaccharides.
- 3 Glycogen is insoluble in water.
- 4 All carbohydrates are reducing sugars.

**A** 1, 2 and 3

**B** 1 and 2 only

**C** 1 and 4

**D** 2 and 3 only

**4** Which statements about ester bonds are correct?

- 1 Condensation between glycerol and fatty acids uses water and forms triglyceride.
- 2 Triglyceride forms three ester bonds through condensation.
- 3 Phospholipids and triglycerides contain ester bonds.
- 4 The hydrolysis of triglyceride releases saturated fatty acids and glycerol.

**A** 1, 2, 3 and 4

**B** 1, 2 and 3 only

**C** 1 and 4 only

**D** 2 and 3 only

- 5** The cells in the roots of beetroot plants contain a red pigment.

When pieces of root tissue are soaked in cold water, some of the red pigment leaks out of the cells into the water.

An experiment was carried out to investigate the effect of temperature on the loss of red pigment from the root cells. It was found that the higher the temperature of the water, the higher the rate of loss of red pigment from the root cells.

Which statements could explain this trend?

- 1 Enzymes in the cells denature as the temperature increases, so the pigment can no longer be used for reactions inside the cells and diffuse out.
- 2 As the temperature increases, the tertiary structure of protein molecules in the cell surface membrane changes, increasing the permeability of the membrane.
- 3 Phospholipid molecules gain kinetic energy as the temperature rises, increasing the fluidity of the phospholipid bilayer and allowing pigment molecules to diffuse out more easily.

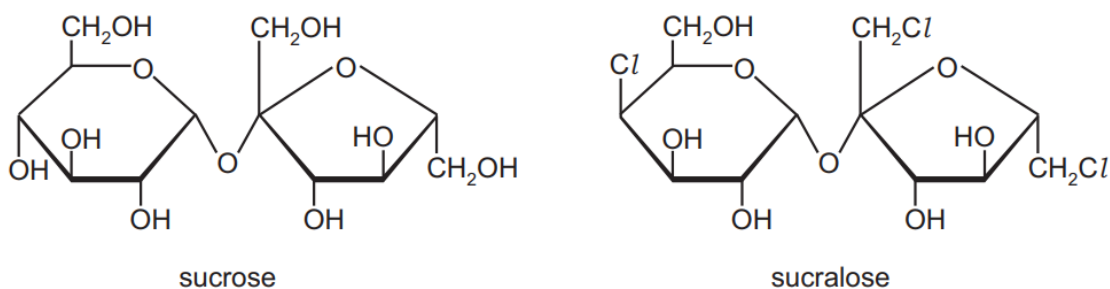
- A** 1 and 2
- B** 2 and 3
- C** 2 only
- D** 3 only

- 6 Glutamine is a polar amino acid found in many globular proteins. Within a single polypeptide chain of a globular protein, bonds can form between two glutamine amino acids that are widely separated in the amino acid sequence. These bonds can help to stabilise the secondary and tertiary structure of the protein.

Which row shows the type of bond formed between these glutamine amino acids and where in the protein these bonds are most likely to be located?

	type of bond	location in the protein
A	hydrogen bond	inner core
B	hydrogen bond	outer edge
C	hydrophobic interaction	inner core
D	hydrophobic interaction	outer edge

- 7 The diagram shows sucrose and sucralose.



The enzyme sucrase breaks down sucrose but cannot break down sucralose. Four students were asked to suggest why sucrase can break down sucrose but not sucralose.

Three of the students gave correct suggestions.

Which suggestion is **not** correct?

- A The Cl atoms change the shape of the sucralose molecule so it is not the same shape as the active site of sucrase.
- B The Cl atoms of the modified fructose cannot bind to the active site of sucrase.
- C The Cl atoms cannot cause an induced fit, so sucralose does not enter the active site of sucrase.
- D The Cl atoms cause fewer temporary hydrogen bonds between sucralose and the active site of sucrase.

- 8 Cancer is believed to often arise from stem cells, rather than fully differentiated cells.

Which statements are consistent with this view?

- 1 DNA replication is necessary for mutations to occur, and stem cells are replicating their DNA whereas differentiated cells are for the most part not replicating their DNA.
- 2 Stem cells are actively dividing and express few differentiated functions, so they may have fewer changes to undergo than do fully differentiated cells in becoming cancer cells.
- 3 Since all stem cells are totipotent, tumours can easily arise from stem cells without further mutation.
- 4 Stem cells require certain genes for the maintenance of their stem cell function, and many such genes can also function as oncogenes.

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

9 The following steps describes the events taking place during the elongation of a polypeptide.

- 1 Free tRNA molecules bind to their corresponding amino acids at their specific anticodon and transport it to the ribosome.
- 2 A tRNA with a complementary anticodon binds to the A site bringing its specific amino acid along.
- 3 The initiator tRNA moves from the P to the E site on the ribosome where it initiates translation.
- 4 The amino acid carried by the tRNA at the P site is linked to the polypeptide chain by a peptide bond.
- 5 tRNA carrying the peptide chain moves from the A site to the P site as the ribosome moves in the 5' → 3' direction along the mRNA molecule.

Which steps contain information that is **not** correct?

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

10 Which statements on viruses are **not** correct?

- 1 The HIV polyprotein is synthesised from a polycistronic mRNA template.
- 2 Influenza virus undergoes genetic drift as there is an accumulation of mutations in the haemagglutinin gene with time.
- 3 T4 phage is the agent involved in specialised transduction.
- 4 Replication cycles of both HIV and lambda phage have a latent phase.

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

11 How many statements about bacterial genetic transfer are correct?

- 1 In transformation, bacterial cells which possess competence factors can take up only plasmids from the surroundings.
- 2 Homologous recombination is always involved in bacterial genetic transfer.
- 3 After conjugation, the donor and recipient cells always contain the same genetic information.
- 4 Binary fission will not contribute to genetic variation in bacterial chromosomes.

- A 1  
B 2  
C 3  
D 4

12 A regulatory protein binds to a site on an mRNA molecule and covers the triplet AUG.

What is the result of this?

- A Transcription of the mRNA is prevented.  
B Transcription of the mRNA is promoted.  
C Translation of the mRNA is prevented.  
D Translation of the mRNA is promoted.

13 Multiple copies of a wanted DNA fragment can be made by the polymerase chain reaction (PCR).

Which description of this procedure is **not** correct?

- A After 'n' turns of the PCR cycle, up to  $2^n$  copies of the wanted DNA are produced.  
B Using heat-stable enzyme, such as Taq polymerase, means that the enzyme does not lose activity over time.  
C Using an enzyme with a high optimum temperature allows DNA polymerisation above the annealing temperature.  
D Using specific primers means that only the wanted DNA is replicated.



- 14** The diagram shows part of the DNA sequence of a gene and a mutated sequence of the same gene.

normal DNA sequence     ...CCG GAT TAT TGC GAG AAA TGG CAT TCT AGG ...

mutated DNA sequence     ...CCG GAT GTA TTG CGA GAA ATG CAT TCT AGG ...

What are possible effects of the mutated sequence?


- 1 the presence of mRNA stop codons, UAG, UAA or UGA
- 2 a change in the sequence of amino acids
- 3 a non-functional protein
- 4 ribosomes cannot translate the mRNA

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

**15** Each of the following events takes place during mitosis.

- 1 Chromosomes uncoil.
- 2 Chromatids move to opposite poles of the cell.
- 3 Centromeres divide.
- 4 Chromosomes line up along the equator of the spindle.
- 5 Two chromatids are joined by a centromere.

In which order do the events take place?

	First  Last				
<b>A</b>	1	2	4	5	3
<b>B</b>	3	1	2	4	5
<b>C</b>	4	5	3	1	2
<b>D</b>	5	4	3	2	1

**16** The p53 protein plays a pivotal role in preventing cancer development by activating various cellular responses.

Which statement best describes how p53 functions to suppress tumour formation?

- A** p53 directly interacts with DNA polymerase during DNA replication to correct mismatched base pairs, thereby preventing mutation accumulation.
- B** Upon DNA damage, p53 promotes the activation of the cyclin-dependent kinase inhibitor p21, leading to cell cycle arrest in the G1 phase, allowing time for DNA repair.
- C** p53 enhances the expression of genes involved in angiogenesis, ensuring adequate blood supply for rapidly dividing cells and promoting healthy cellular growth.
- D** p53 acts by inhibiting the mTOR pathway, which primarily responds to nutrient availability, thereby directly decreasing the rate of cellular metabolism and growth under conditions of stress.

**17** How many statements are true for the process of meiosis?

- 1 It is a mechanism of nuclear division that occurs in all cells.
- 2 It produces haploid cells during the first nuclear division.
- 3 It involves two rounds of interphase, followed by prophase, metaphase, anaphase, and telophase.
- 4 It is the only process that generates genetic variation.

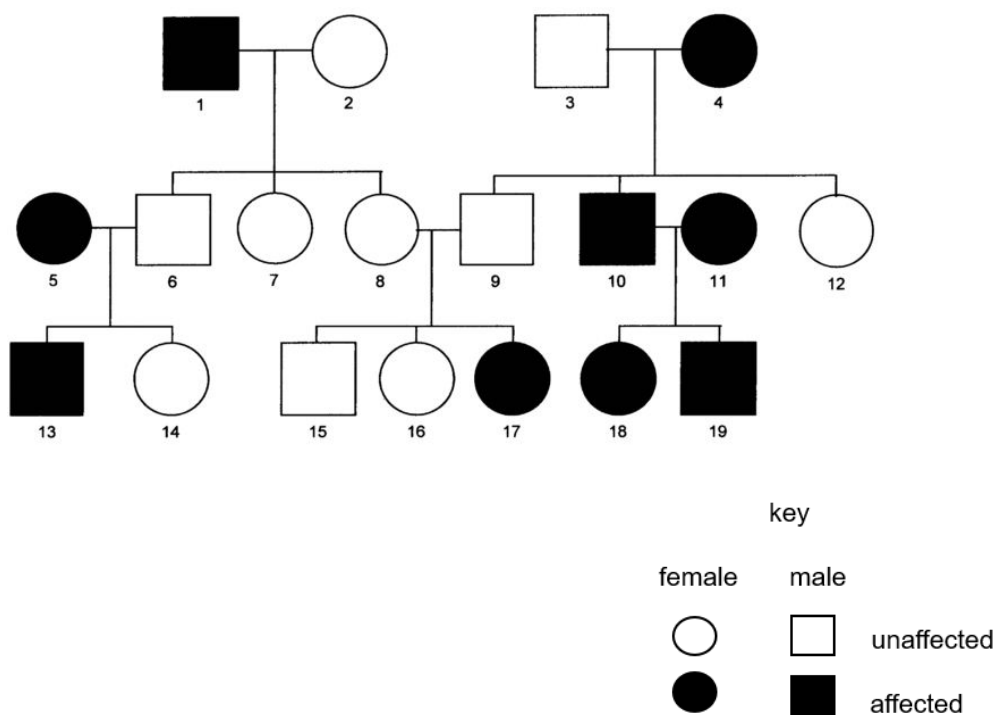
**A** 1

**B** 2

**C** 3

**D** 4

18 The inheritance of a given disorder in a family is recorded in the pedigree shown.



Which is the correct mode of inheritance?

- A sex-linked recessive
- B sex-linked dominant
- C autosomal recessive
- D autosomal dominant

- 19** A plant with purple flowers and black fruit was allowed to self-fertilise. Two hundred and fifty seeds were collected and grown. The table shows the colours of the flowers and fruit of the plants obtained from these seeds.

colour of flowers	colour of fruit	number of plants
purple	black	128
purple	red	57
blue	black	65

Which explanation could account for these results?

- A** Flower colour and fruit colour are controlled by two genes, each with two alleles. The pairs of alleles show codominance.
- B** Flower colour and fruit colour are controlled by two linked genes, each with a dominant and recessive allele.
- C** Flower colour and fruit colour are controlled by two unlinked genes, each with a dominant and recessive allele.
- D** Flower colour and fruit colour are controlled by two unlinked genes with multiple alleles.

- 20** The table shows the number of male and female turtles hatching from eggs after incubation at different temperatures. A chi-squared value was calculated at each temperature to test the null hypothesis that equal numbers of male and female turtles will hatch.

egg incubation temperature/°C	number of male turtles hatching	number of female turtles hatching	chi-squared value
28	18	3	10.71
29	6	15	3.86
30	4	17	8.05

A table of chi-squared values is provided.

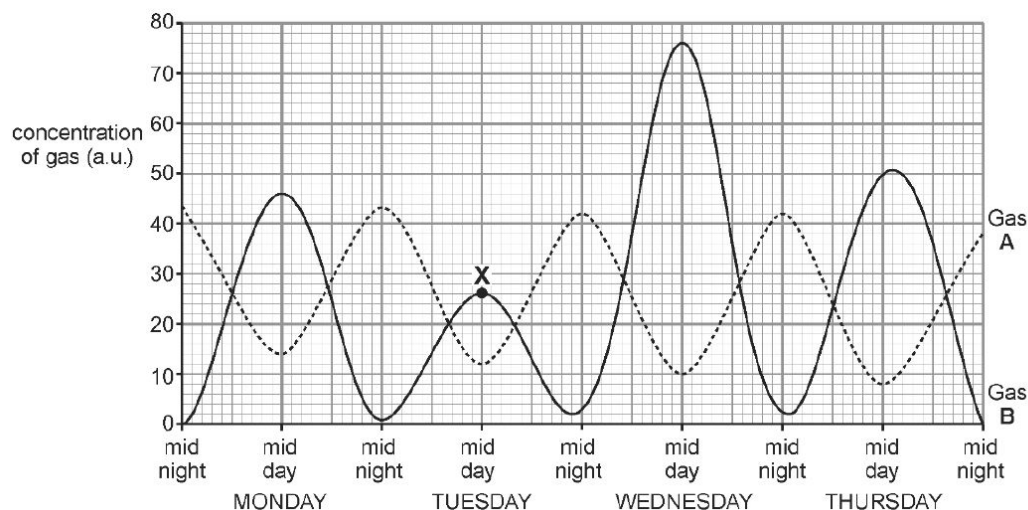
degrees of freedom	p= 0.05	p=0.01	p=0.001
1	3.84	6.63	10.83
2	5.99	9.21	13.82
3	7.81	11.34	16.27

number of degrees of freedom = number of classes - 1

What can be concluded about the determination of sex in these turtles?

- A** Deviation from the expected sex ratio at 29°C is not significant at the 0.01 probability level, so at this temperature the null hypothesis must be accepted.
- B** Deviation from a 1:1 sex ratio at all temperatures is due to chance.
- C** At  $p < 0.05$ , the null hypothesis should be rejected at all temperatures tested.
- D** The null hypothesis should be accepted at all temperatures tested because the sample sizes are too small.

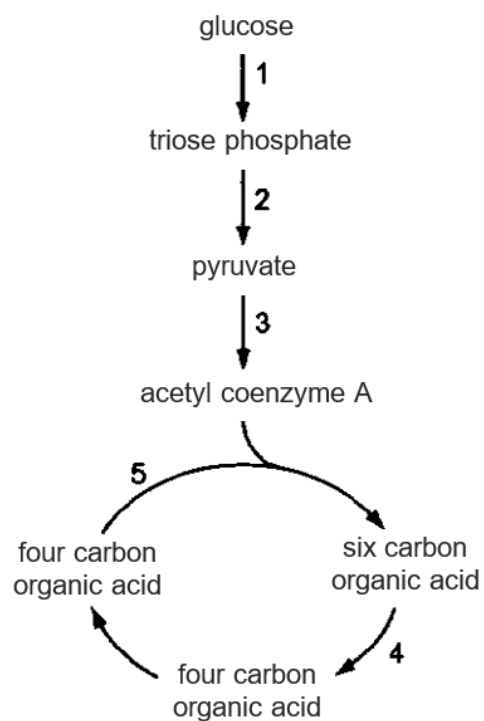
- 21 The graphs below show changes in the concentration of two gases, **A** and **B**, in a rock pool in St Brides Pay, Pembrokeshire over a 4-day period. The rock pool has a high biomass of plants.



Identify gas **A**, gas **B** and a correct reason for the lowest peak at point **X**.

	gas A	gas B	reason for lowest peak at point X
<b>A</b>	carbon dioxide	oxygen	cloudy weather
<b>B</b>	carbon dioxide	oxygen	very sunny weather
<b>C</b>	oxygen	carbon dioxide	cloudy weather
<b>D</b>	oxygen	carbon dioxide	very sunny weather

22 The diagram shows some of the stages in respiration.

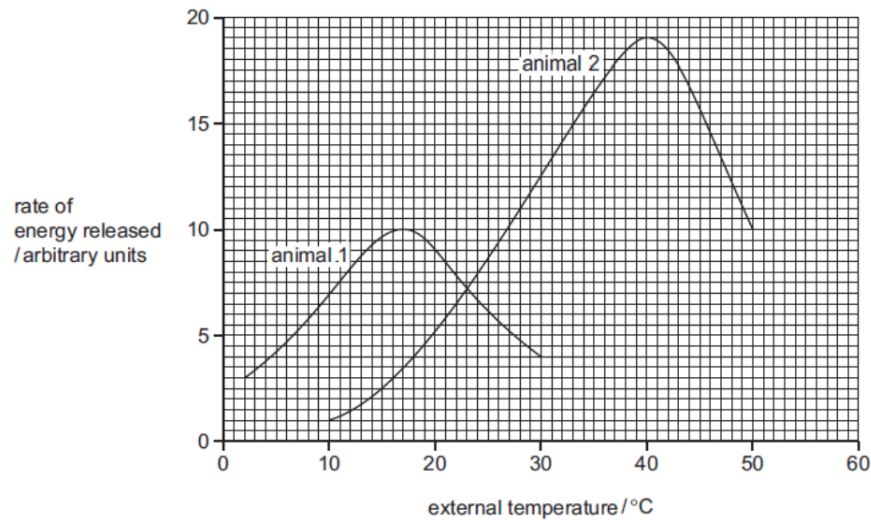


At which stages do decarboxylation occur?

- A 1 and 3
- B 2 and 3
- C 3 and 4
- D 4 and 5



- 23 The graph shows the energy released by two animals through respiration as the external temperature changes.



Which conclusion can be drawn from the graph?

- A Animals 1 and 2 release the least energy at 23 °C.
  - B Animal 2 always respire faster than animal 1.
  - C As the temperature rises, respiration always increases.
  - D The rate of respiration is the same for both animals at 23 °C.
- 24 In humans, uptake of glucose by some cells is dependent on the presence of a ligand.

What is essential for glucose to be transported into these cells?

- 1 tyrosine kinase receptor
- 2 glucagon
- 3 glucose transporter protein
- 4 lower glucose concentration in the cell than outside

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

**25** Which effect of natural selection is likely to lead to speciation?

- A** Differences between populations are increased.
- B** Favourable genotypes are maintained in the population.
- C** Genetic diversity is reduced.
- D** Selection pressure on some alleles reduces reproductive success.

**26** How does the fossil record provide evidence for evolution?

- A** It provides information about all extinct organisms.
- B** It shows that all organisms have evolved at the same rate.
- C** It shows that changes in phenotype occurring during an organism's lifetime can be passed on in the genes.
- D** It shows that many small changes can result in a large change in organisms over time.

**27** On the Lord Howe Island, 600 miles east of Australia, there are two species of palm which seem, from DNA analysis, to be descended from one original species.

Factors involved in this speciation on this island include:

- 1 linkage of genes for soil tolerance and flowering time
- 2 variation in flowering time
- 3 variation of soil tolerance
- 4 variation of soil types on the island

What is the correct sequence to explain this speciation?

- A** 1 → 2 → 3 → 4
- B** 2 → 1 → 4 → 3
- C** 3 → 4 → 1 → 2
- D** 4 → 3 → 2 → 1

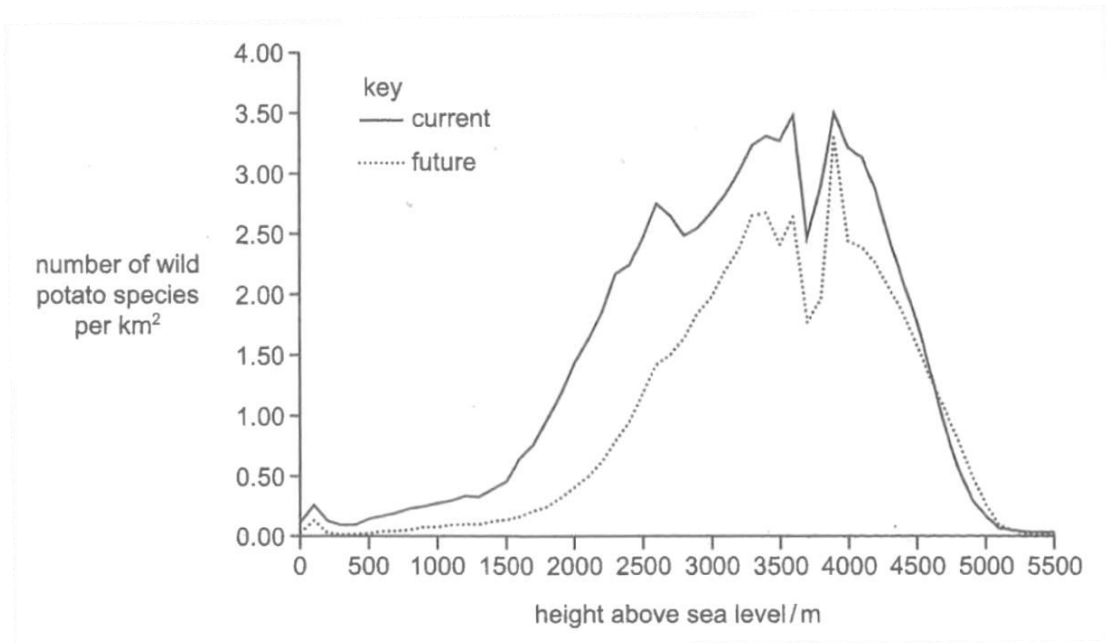
**28** The statements below refer to the functions of antibodies:

- 1 Antibodies can combine with viruses inside cells to prevent them from damaging cells.
- 2 Antibodies can attach to flagella to make the bacteria less mobile.
- 3 Antibodies with single binding sites can cause agglutination of bacteria.
- 4 Antibodies can, with other molecules, make holes in the cell walls of bacteria.
- 5 Antibodies can coat bacteria to mark them for phagocytosis.
- 6 Antibodies can neutralise toxins.

Which of these statements are **not** correct?

- A** 1, 2 and 6
- B** 1 and 3
- C** 2, 3 and 5
- D** 4 and 6

- 29 The ecological niche of over one hundred wild potato species have been analysed in their natural habitats. Projections have been made about the future of these species if global warming occurs. One type of projection is shown on the graph.



Which conclusions about the future effects of climate change can be drawn directly from this graph?

- 1 Some wild potato species may become extinct.
- 2 The distribution of wild potato species may shift north.
- 3 The distribution of some wild potato species may shift to a greater height above sea level.
- 4 There will be less diversity of wild potato species at 5000 m above sea level.

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

**30** Which statement about dengue disease is true?

- A** The dengue virus develops resistance to drug rapidly due to the lack of RNA polymerase proof reading activity.
- B** Increase in temperatures can increase metabolism of the vector, thus leading to longer incubation periods.
- C** People who are exposed to a different dengue serotype a second time will not have an increased risk of dengue shock syndrome compared with those who were not previously exposed.
- D** Due to global warming, there is an increase in vector types beyond mosquitoes that can contribute to the spread of dengue.