

**Biology**  
**Higher level**  
**Paper 1A**

Specimen Paper

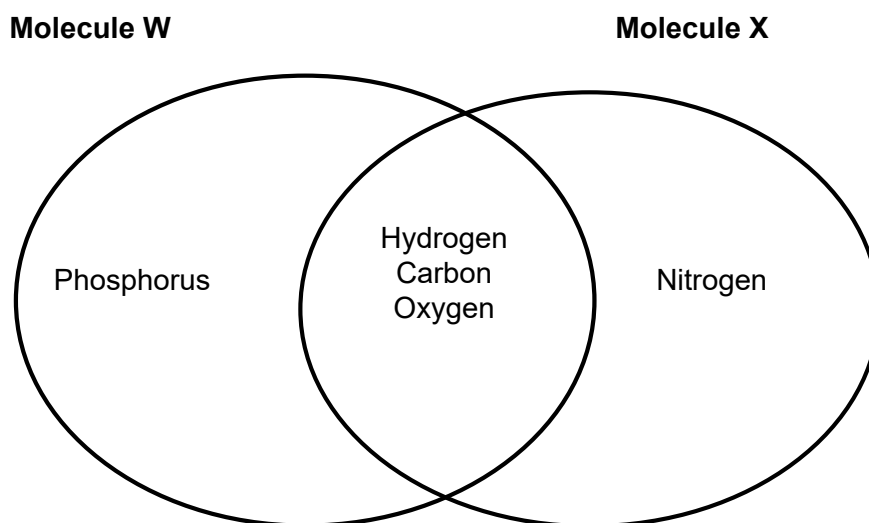
2 hours [Paper 1A and Paper 1B]

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**Instructions to candidates**

- Do not open this examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- The maximum mark for paper 1A is **[40 marks]**.
- The maximum mark for paper 1A and paper 1B is **[75 marks]**.

1. What allows the movement of water under tension in the xylem?
  - A. Adhesion of water molecules to dissolved mineral salts
  - B. Cohesion of water molecules due to hydrogen bonding
  - C. Adhesion between water molecules due to uneven sharing of charges
  - D. Cohesion between water molecules and other polar substances
  
2. The diagram shows the elements present in two organic molecules, W and X. Which molecules could W and X be?

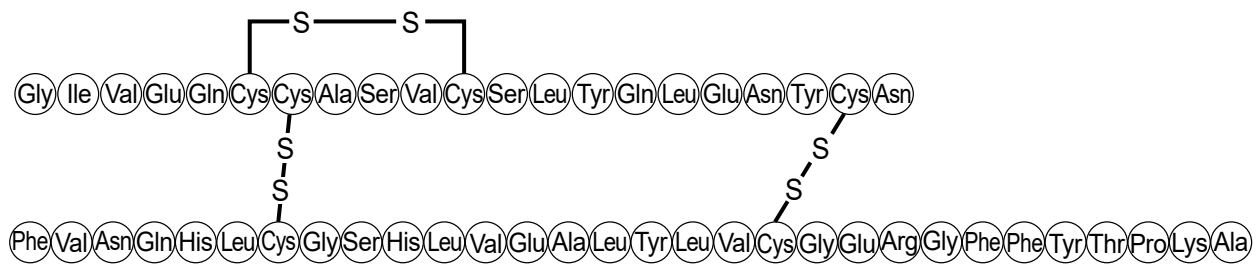


|    | <b>Molecule W</b> | <b>Molecule X</b> |
|----|-------------------|-------------------|
| A. | monosaccharide    | amino acid        |
| B. | nucleic acid      | triglyceride      |
| C. | phospholipid      | protein           |
| D. | triglyceride      | fatty acid        |

3. Which property of DNA explains how genetic information can be replicated accurately?
- Complementary base pairing
  - The double helical shape
  - 5' – 3' bonding in the sugar-phosphate backbone
  - The ability of DNA to bind to histones
4. Which molecules are produced during the hydrolysis of a triglyceride molecule?
- Water and glycerol
  - Fatty acids and glycerol
  - Water and fatty acids
  - Water and lipids
5. The structure of monomers affects the structure and function of the polymers they form. Which row describes the structural features of polysaccharides made from alpha-glucose and beta-glucose?

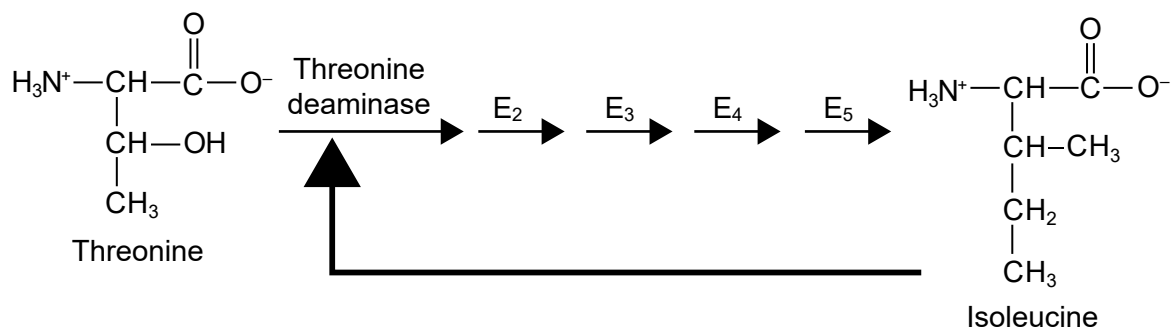
|    | Monomer                       | Polymer             | Shape of polymer                          |
|----|-------------------------------|---------------------|-------------------------------------------|
| A. | alpha-glucose<br>beta-glucose | starch<br>cellulose | unbranched, straight<br>branched, helical |
| B. | alpha-glucose<br>beta-glucose | starch<br>cellulose | branched, helical<br>unbranched, straight |
| C. | alpha-glucose<br>beta-glucose | cellulose<br>starch | branched, helical<br>unbranched, straight |
| D. | alpha-glucose<br>beta-glucose | cellulose<br>starch | unbranched, straight<br>branched, helical |

6. The diagram shows the structure of insulin.



From the diagram, what can be concluded about the structure of insulin?

- A. It is composed of two polypeptide chains stabilized by disulfide bonds.
  - B. It is a simple protein composed of one continuous polypeptide chain.
  - C. It is a fibrous protein.
  - D. Its molecules do not display quaternary structure.
7. The diagram represents the metabolic pathway that converts threonine to isoleucine.



What is a feature of this pathway?

- A. The pathway is regulated by positive feedback.
- B. Isoleucine is a competitive inhibitor.
- C. Isoleucine is a substrate for threonine deaminase.
- D. Isoleucine is an allosteric inhibitor.

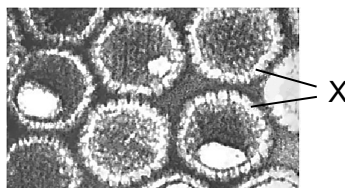
8. What is a common feature of enzymes?
- A. They all react with substrates.
  - B. They all decrease the rate of reaction.
  - C. They are all secreted from cells in vesicles.
  - D. They all bind to the active site of their substrate.
9. What is a reason that Taq polymerase is a suitable enzyme for use in the polymerase chain reaction (PCR)?
- A. It can work at a wide range of pH.
  - B. It works at higher temperatures than most enzymes.
  - C. It can separate two strands of DNA.
  - D. It allows DNA to be replicated without the use of primers.
10. Which are examples of non-coding DNA?
- A. Dominant and recessive alleles
  - B. Promoters and telomeres
  - C. Oncogenes and tumour suppressor genes
  - D. Introns and exons
11. The table shows the mRNA codons for three amino acids.

| <b>Valine</b> | <b>Threonine</b> | <b>Proline</b> |
|---------------|------------------|----------------|
| GUU           | ACU              | CCU            |
| GCC           | ACC              | CCC            |
| GCA           | ACA              | CGA            |
| GCG           | ACG              | CCG            |

Which substitution mutation of a base triplet on a DNA strand will lead to the same polypeptide being formed at translation?

- A. TGA to TCA
- B. CGT to CTA
- C. CAA to CGA
- D. GCT to GGA

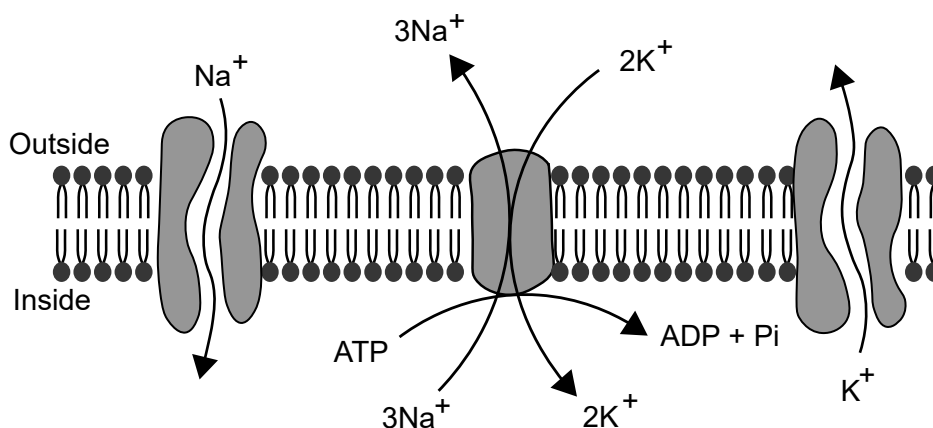
12. Which is a feature of phloem sieve tube cells?
- A. Numerous chloroplasts
  - B. No nucleus
  - C. Lignified walls
  - D. No cytoplasm
13. How does the Miller-Urey experiment contribute to an explanation of the origin of life?
- A. It shows how phospholipids form protocells in specific laboratory conditions.
  - B. It explains how organic molecules arise from inorganic ones under certain environmental conditions.
  - C. It explains the synthesis of RNA, recreating deep sea vent conditions in the laboratory.
  - D. It shows how the last universal common ancestor (LUCA) evolved from vesicles.
14. The image shows a group of enveloped viral particles.



What is the most likely composition of the structure labelled X?

- A. Membrane derived from the host cell
- B. Viral DNA
- C. Viral cell walls
- D. Viral enzymes

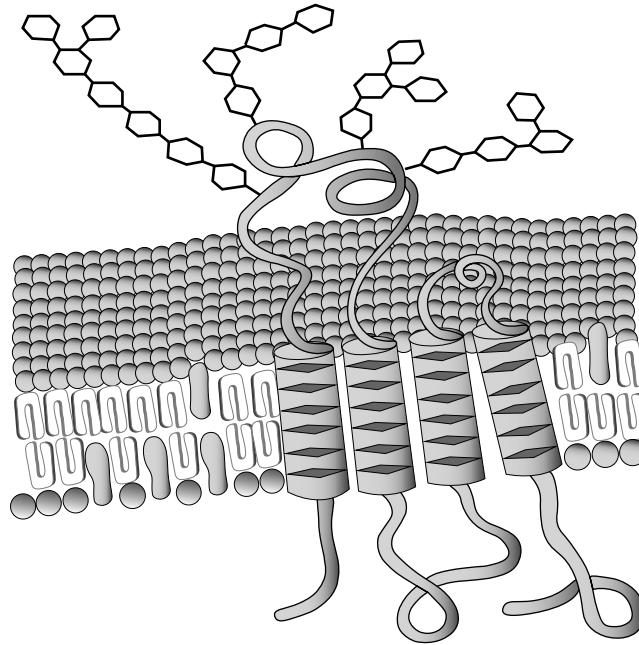
15. The diagram shows the movement of ions that can occur across the membrane of a neuron.



From the diagram, what can be deduced about the movement of sodium ions?

- A. They are actively pumped out and some re-enter by facilitated diffusion.
  - B. They are actively pumped out and some re-enter by simple diffusion.
  - C. They diffuse out of the cell along with potassium ions.
  - D. There is a net movement of sodium ions into the cell.
16. In multicellular animals, embryonic stem cells have the ability to differentiate into a range of cells with different functions. What is the term used to describe cells with this property?
- A. Pluripotent
  - B. Multipotent
  - C. Totipotent
  - D. Specialized

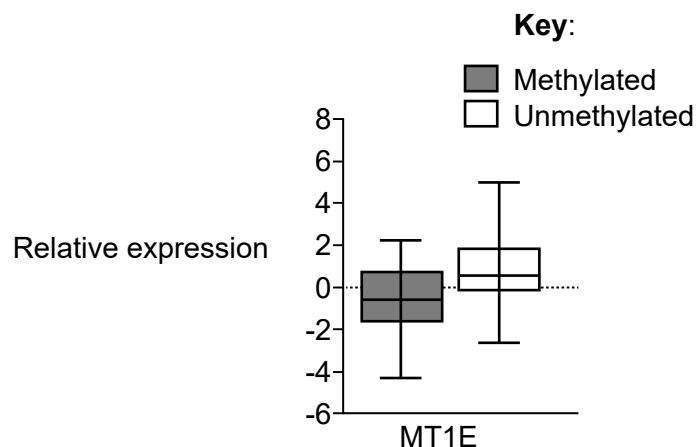
17. The image shows a glycoprotein embedded in the phospholipid bilayer of a cell membrane.



Which feature of this glycoprotein can be deduced from the image?

- A. It is a peripheral protein that allows attachment to neighbouring cells.
  - B. It is a channel protein that provides hydrophilic channels for carbohydrate transport.
  - C. It is an integral protein that may be involved in cell recognition.
  - D. It is a transport protein that increases the permeability of the membrane to glucose.
18. What activates a tyrosine kinase pathway in a cell following binding to a receptor?
- A. Odorant molecules
  - B. Epinephrine
  - C. Taste molecules
  - D. Insulin

19. The graph shows the effect of methylation on the expression of MT1E, a gene involved in the control of prostate cancer development. Patients with a reduced expression of this gene are more likely to develop prostate cancer.



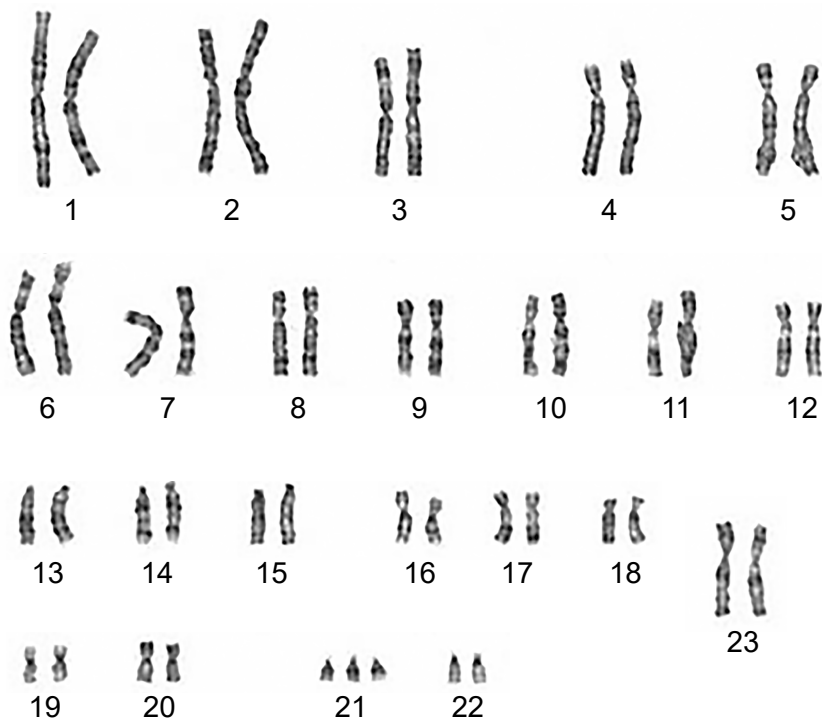
What are effects of MT1E methylation?

- A. It reduces transcription of MT1E, increasing the risk of prostate cancer.
  - B. It increases translation of MT1E, reducing the risk of prostate cancer.
  - C. It reduces replication of MT1E, reducing the risk of prostate cancer.
  - D. It increases the chances of mutation in proto-oncogenes, increasing the risk of prostate cancer.
20. What is a function of histones?
- A. Supercoiling of DNA during binary fission in prokaryotes
  - B. Synthesis of proteins
  - C. Formation of microtubules during mitosis
  - D. Condensation of DNA
21. What is the cause of positive phototropism?
- A. Increased concentration of auxin on the side of the stem closest to the light
  - B. Degradation of auxin on the side of the stem closest to the light
  - C. Increased concentration of auxin on the side of the stem furthest from the light
  - D. Degradation of auxin on the side of the stem furthest from the light

**22.** Which role does positive feedback play in fruit ripening?

- A. The production of ethylene leads to fruit ripening, which stops the production of ethylene.
- B. The production of ethylene leads to fruit ripening, which causes more ethylene production.
- C. The production of RuBP leads to fruit ripening, which stops the production of RuBP.
- D. The production of RuBP leads to fruit ripening, which causes more RuBP production.

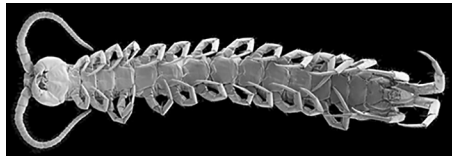
**23.** The karyogram shows a chromosome abnormality in a human female.



What could cause the abnormality to arise?

- A. Failure of homologous chromosomes to separate during gamete formation
- B. Chromosome 21 replicating after fertilization
- C. A gene mutation of the mother's chromosomes during cell division
- D. Polyploidy occurring during anaphase I of meiosis in both parents

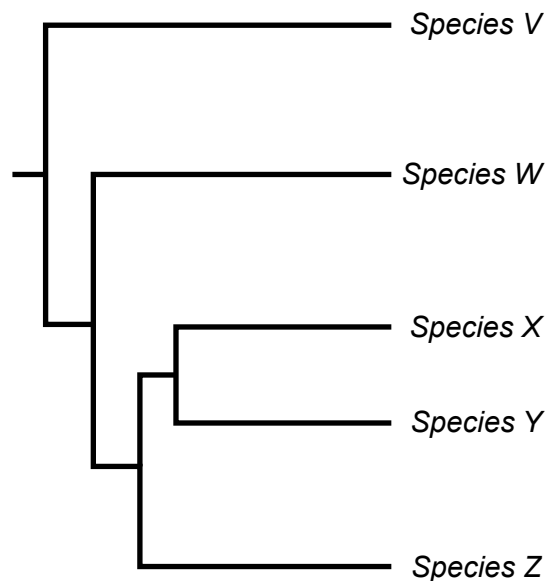
24. The image shows an organism from the phylum Arthropoda.



A dichotomous key was used to classify this arthropod. To which group does it belong?

Dichotomous key:

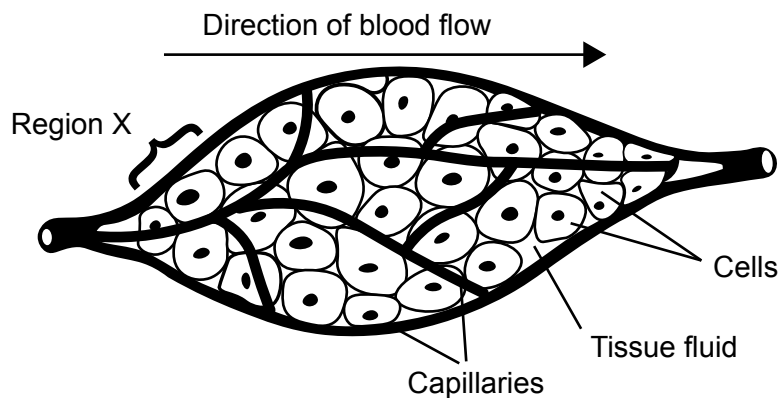
1. antennae pointing forwards ..... go to 2  
antennae pointing sideways ..... go to 3
  2. branched antennae ..... A.  
unbranched antennae ..... B.
  3. one pair of legs in each body segment ..... C.  
two pairs of legs in each body segment ..... D.
25. Scientists studied differences in the base sequences of a gene found in five animal species in order to determine their evolutionary relationships. A cladogram was constructed based on these differences.



What can be deduced from the cladogram?

- A. There are only three clades shown.
- B. Morphological differences between V and Z increase with time.
- C. There is only one difference between the amino acid sequences of X and Y.
- D. Y and Z have a more recent common ancestor than W and X.

26. What is always a consequence of the evaporation of water from mesophyll cells in leaves of a healthy plant?
- Plasmolysis occurs in mesophyll cells.
  - Photosynthesis stops.
  - Stomata close to reduce transpiration.
  - Water moves up the stem in the xylem.
27. The diagram shows where the exchange of substances between blood and tissue fluid occurs in a capillary bed.



What explains the movement of solutes between blood and tissue fluid at region X?

- Blood plasma has a higher concentration of solutes than tissue fluid.
  - Tissue fluid has a more negative water potential than blood plasma.
  - Hydrostatic pressure is higher in blood than in tissue fluid.
  - The permeability of capillary walls is highest at region X.
28. How is involuntary peristalsis in the intestine directly controlled in humans?
- By the endocrine system
  - By the central nervous system (CNS)
  - By the sympathetic nervous system
  - By the enteric nervous system (ENS)

29. Which cell is a component of the innate immune system?

- A. T lymphocyte
- B. Phagocyte
- C. B lymphocyte
- D. B memory cell

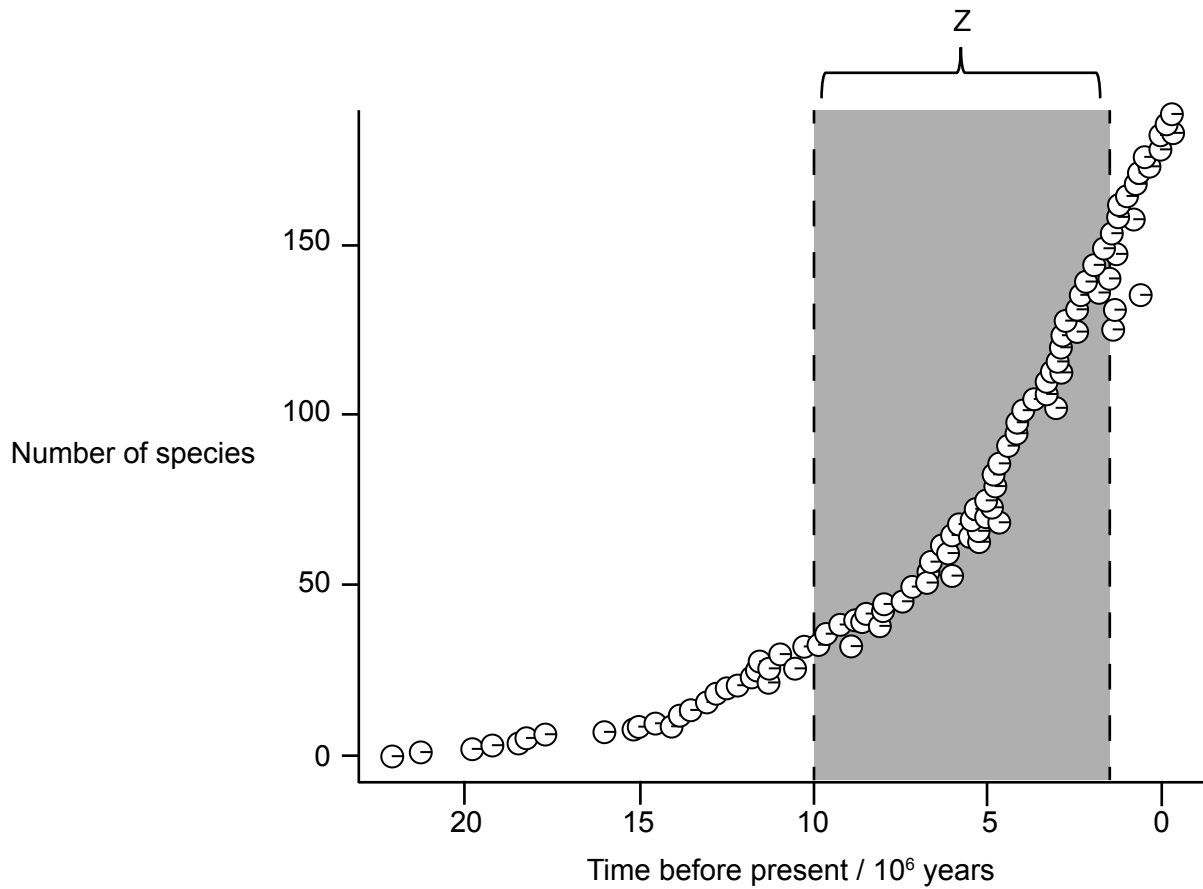
30. How would the body respond to a rise above normal body temperature?

|    | Type of feedback | Response                              |
|----|------------------|---------------------------------------|
| A. | positive         | increased secretion from sweat glands |
| B. | positive         | spread limbs to increase surface area |
| C. | negative         | vasodilation of skin blood vessels    |
| D. | negative         | shivering                             |

31. Female grasshoppers have XX sex chromosomes and males have XO, signifying a single X chromosome. An X chromosome will be present in only half of the male gametes. A recessive mutation is induced by radiation in the X chromosome of a male. In which generation will the effect of this radiation appear?

- A. F1 females
- B. F1 males
- C. F2 females
- D. F2 males

32. The number of hummingbird species in South America has increased continuously as shown in the graph.



What could be a reason for the increase in the number of hummingbird species during the period labelled Z?

- A. Food and shelter are plentiful and there is little intraspecific competition.
- B. Closely related species can coexist indefinitely in the same niche.
- C. A wide range of unoccupied potential niches exists, leading to adaptive radiation.
- D. There are few limiting factors on the population size of hummingbirds.

33. Polyploidy has been a cause of rapid speciation in some plant genera, such as *Helianthus*. Which observation is evidence that speciation has occurred?
- A. A polyploid plant reproduces asexually.
  - B. A polyploid plant produces male and female gametes.
  - C. Fertile offspring are produced when a polyploid plant crosses with a diploid plant.
  - D. Fertilization can occur between polyploid individuals.
34. *Yersinia pestis* is a bacterium that caused an outbreak of bubonic plague in the 14th century. It normally produces ATP in the presence of oxygen but can still produce ATP if oxygen is absent. Which term describes this characteristic?
- A. Facultative respiration
  - B. Facultative anaerobe
  - C. Obligate anaerobe
  - D. Obligate aerobe
35. What are common features of holozoic nutrition and saprotrophic nutrition?

|    | Mostly fungi and bacteria | Secretion of enzymes to digest food | Ingestion of food particles |
|----|---------------------------|-------------------------------------|-----------------------------|
| A. | ✓                         | ✓                                   | ✗                           |
| B. | ✓                         | ✗                                   | ✓                           |
| C. | ✗                         | ✓                                   | ✗                           |
| D. | ✗                         | ✗                                   | ✗                           |

36. The preferred temperature ranges for three species of trout that are found together in freshwater lakes in North America are shown.



What can be deduced from this information?

- I. The niches for all three species overlap.
  - II. Brown trout have the most specialized niche.
  - III. Lake trout can avoid competition by living in colder water.
- A. I only
- B. II only
- C. I and III only
- D. I, II and III
37. Which is a density-independent limiting factor for a kangaroo?
- A. A forest fire
- B. Predation
- C. Climate change
- D. Eutrophication
38. Black walnut (*Juglans nigra*) secretes the chemical juglone into the soil surrounding its roots. Juglone inhibits cell respiration in other species of plants. What does this example illustrate?
- A. Mutualism
- B. Intraspecific competition
- C. Allelopathy
- D. Parasitism

39. What assumption is made when using the Hardy-Weinberg equation for calculating changes in allele frequencies in a population?
- A. The population size is large.
  - B. Natural selection is taking place.
  - C. Mutations are occurring in the population.
  - D. There is variation among the phenotypes of the population.
40. Domestic dogs (*Canis familiaris*) have evolved from grey wolves (*Canis lupus*). Evidence suggests that the domestication of dogs first occurred around 30 000 years ago. Which best describes the evolution giving rise to the domestic dog?
- A. The wolf produced offspring in large numbers which underwent natural selection.
  - B. Variations in the wolf population that resembled modern dogs favoured wolf survival.
  - C. Wolves showing favourable traits were selected for breeding.
  - D. Dogs were better suited to changes in the natural environment than wolves.
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#### Disclaimer:

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#### References:

14. Murphy, F. and Whitfield, S., n.d. *Herpes virus image under the microscope*. [image online] Available at: <<https://www.bbvaopenmind.com/en/science/research/virus-inspired-science/>> [Accessed 3 July 2020].
17. University of Delaware, n.d. [Model 2]. [image online] Available at: <<http://www1.udel.edu/chem/white/C527/TransmembraneProteins.pdf>> [Accessed 28 July 2020].
19. Demidenko, R., Daniunaite, K., Bakavicius, D., Sabaliauskaite, R., Skeberdyte, A., Petroska, D., Laurinavicius, A., Jankevicius, F., Lazutka, J.R. and Jarmalaite, S., 2017. Decreased expression of MT1E is a potential biomarker of prostate cancer progression. *Oncotarget*, 8, pp.61709–61718.
23. Hill, M.A., 2020. *Embryology Trisomy 21*. [image online] Available at: <[https://embryology.med.unsw.edu.au/embryology/index.php/Trisomy\\_21](https://embryology.med.unsw.edu.au/embryology/index.php/Trisomy_21)> [Accessed 28 July 2020].
24. Gschmeissner, S., n.d. *Centipede underside, SEM*. [image online] Available at: <<https://www.sciencephoto.com/media/374228/view/centipede-underside-sem>> [Accessed 15 July 2020].
32. McGuire, J.A., Witt, C.C., Remsen Jr., J.V., Corl, A., Rabosky, D.L., Altshuler, D.L. and Dudley, R., 2014. Molecular Phylogenetics and the Diversification of Hummingbirds. *Current Biology*, 24(8), pp.910–916.
36. Mepps.com Staff, n.d. *Favored temperature range*. [image online] Available at: <<https://www.mepps.com/mepps-tactics/article/how-water-temperature-and-oxygen-affect-fishing/418>> [Accessed 8 December 2020].