Diploma Programme
Programme du diplôme
Programa del Diploma

# Biology
# Higher level
# Paper 1A

12 May 2025

**Zone A** afternoon | **Zone B** afternoon | **Zone C** afternoon

2 hours [Paper 1A and Paper 1B]

## 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]**.

22 pages

2225 – 6019
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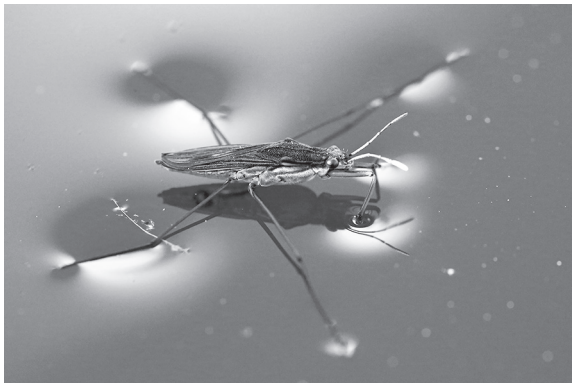
**1.** The photograph shows a pond skater.



Which property of water allows the insect to walk on water?

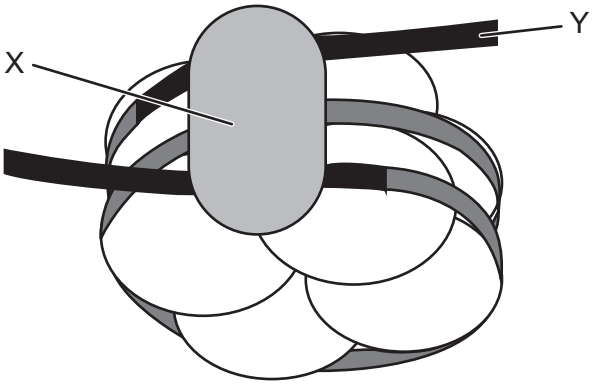
A. Adhesion

B. Capillarity

C. Surface tension

D. Transparency

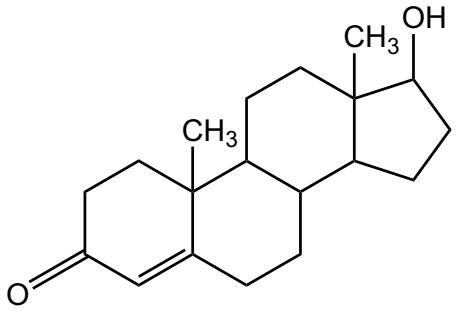
**2.** The diagram shows a structure found in a eukaryotic nucleus.




What is represented by X and Y?

| | **X** | **Y** |
|---|---|---|
| A. | Ribosome | mRNA |
| B. | Histone | Linker DNA |
| C. | Nucleosome | mRNA |
| D. | RNA polymerase | Linker DNA |

**3.** A simplified diagram of molecule X is shown.




What describes molecule X?

A. Lipid able to pass through the bilayer of membranes

B. Lipid used for energy storage in mammals

C. Carbohydrate transported in the blood

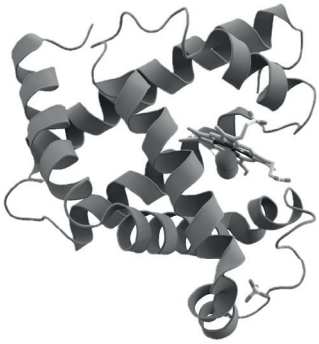
D. Carbohydrate used for energy storage in plants

**4.** Diagrams of three different proteins, X, Y and Z, are shown.

X

Y

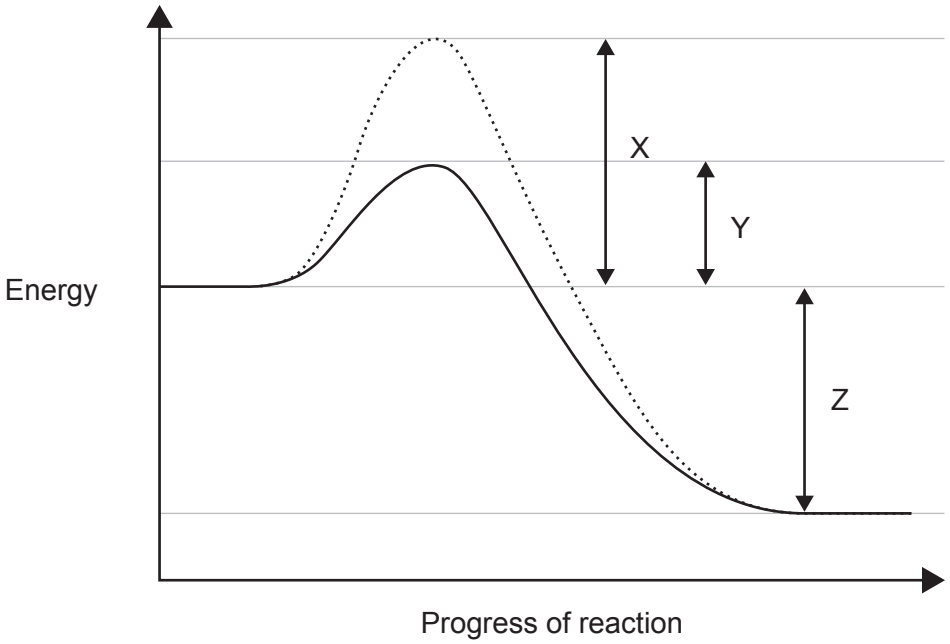
Z



Which row describes the structure of each protein shown?

| | X | Y | Z |
|---|---|---|---|
| A. | quaternary | globular | secondary |
| B. | conjugated | fibrous | globular |
| C. | tertiary | quaternary | primary |
| D. | globular | secondary | fibrous |

**5.** The graph shows energy changes during a reaction both with and without an enzyme present.




Which statement correctly identifies two of the regions labelled X, Y and Z in the graph?

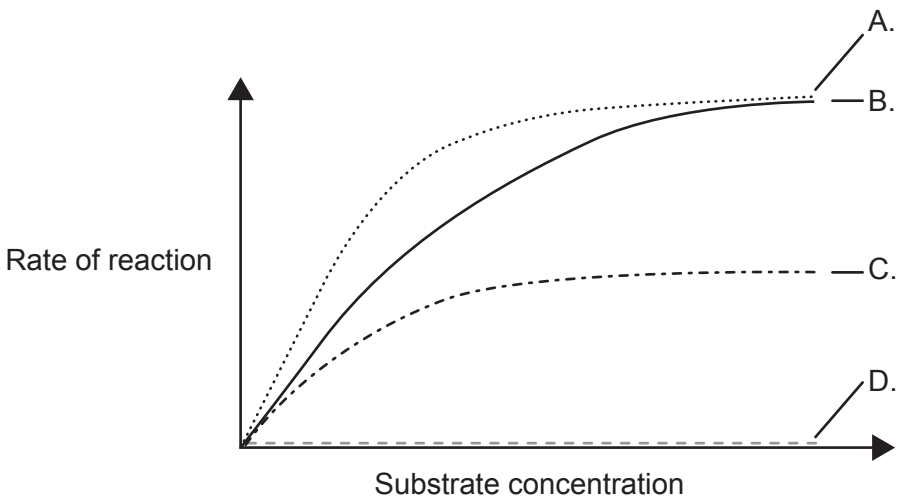
A. X is the activation energy with an enzyme and Z is the net energy released from the reaction.

B. X is the energy released from the reaction and Y is the activation energy with an enzyme.

C. Y is the energy released with an enzyme and Z is the energy released when bonds are broken.

D. Y is the activation energy with an enzyme and Z is the net energy released.

**6.** The graph illustrates how enzyme-catalysed reactions can be affected by inhibitors.
Which curve shows the effect of statins on the rate of cholesterol synthesis in the body?




**7.** Which group(s) produce(s) oxygen as a by-product of photosynthesis?

I. Algae

II. Cyanobacteria

III. Fungi

A. I only

B. I and II only

C. II and III only

D. I, II and III

**8.** What is an advantage of free-air carbon dioxide enrichment experiments (FACE)?

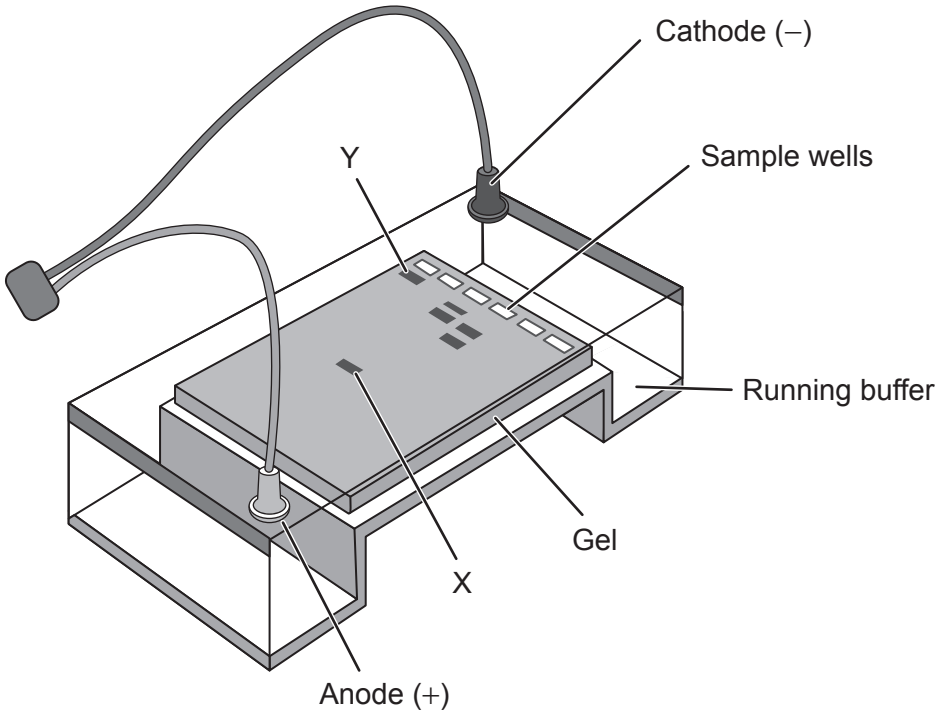
A. The carbon dioxide uptake by plants is controlled.

B. Temperature can be controlled.

C. Water can be controlled.

D. Data can more accurately represent future rates of photosynthesis.

**9.** The diagram shows a gel electrophoresis apparatus.




What can be deduced from the diagram?

A. X is the smallest fragment.

B. Y is positively charged.

C. X is moving towards the cathode.

D. Y travels at the greatest rate.

**10.** The sequence of DNA bases coding for part of a polypeptide is shown.

AAG TTA CCC GAG TTT AGT

↑

What is the fourth mRNA codon transcribed from the DNA if the base indicated by the arrow is deleted?

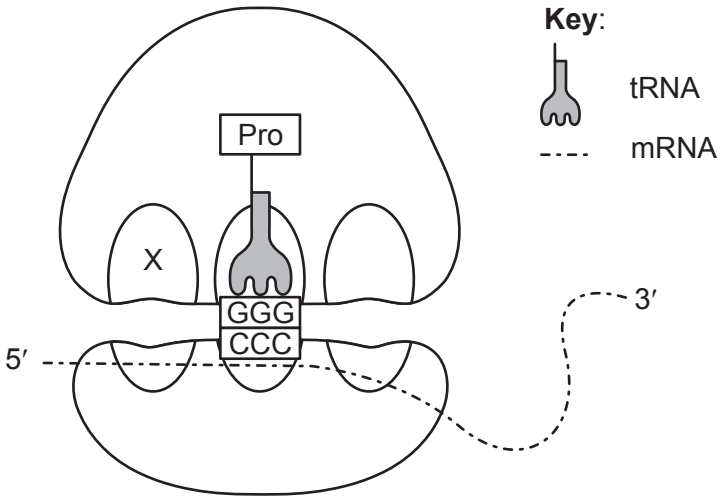
A. UCA

B. CUC

C. TCA

D. AGT

**11.** A ribosome with three binding sites, an mRNA molecule and a tRNA molecule are shown.




What would be the effect of blocking the left-hand binding site labelled X?

A. The GGG tRNA would not be able to exit the ribosome.

B. A second tRNA would not be able to bind.

C. A second tRNA would enter the right-hand binding site.

D. The ribosome would move to the left.

**12.** What is a feature of immunofluorescence in light microscopy?

A. Can only be used on dead cells

B. Enables higher resolution

C. Attaches a fluorescent stain to an antibody

D. Attaches a fluorescent stain to an antigen

**13.** What is a difference between the lytic and the lysogenic cycle of the bacteriophage lambda?

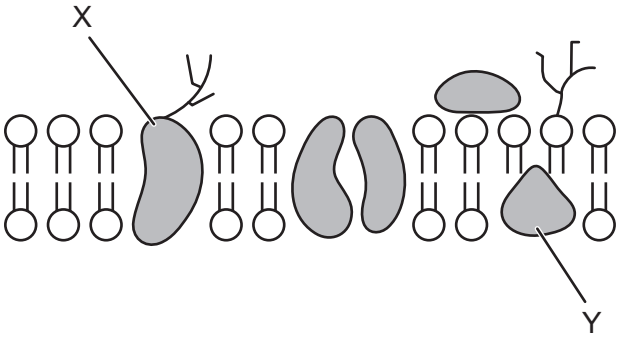
A. Only in the lytic cycle is lambda DNA inserted into the host DNA.

B. Only in the lysogenic cycle is the host metabolism used to replicate.

C. Only in the lytic cycle is the host metabolism used to replicate.

D. Only in the lysogenic cycle is lambda DNA inserted into the host DNA.

**14.** The diagram shows a portion of fluid mosaic membrane.




What are the membrane structures X and Y?

| | **X** | **Y** |
|---|---|---|
| A. | glycoprotein | integral protein |
| B. | integral protein | peripheral protein |
| C. | channel protein | integral protein |
| D. | glycoprotein | peripheral protein |

**15.** Which features are found in both cardiac and striated muscle?

A. Nuclei and branched myofibrils

B. Sarcomeres and unbranched myofibrils

C. Mitochondria and branched myofibrils

D. Sarcomeres and mitochondria

**16.** Which is a description of stem cells?

A. Hair follicle stem cells are pluripotent.

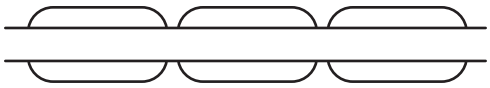
B. Stem cells in bone marrow are multipotent.

C. Very early embryo stem cells are pluripotent.

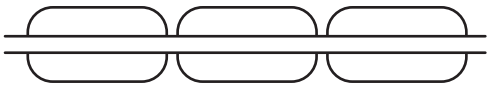
D. Late embryo stem cells are totipotent.

**17.** The diagrams represent sections through different axons. Which axon has the slowest speed of impulse?

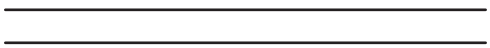
A.



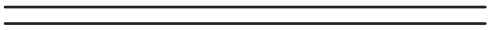
B.



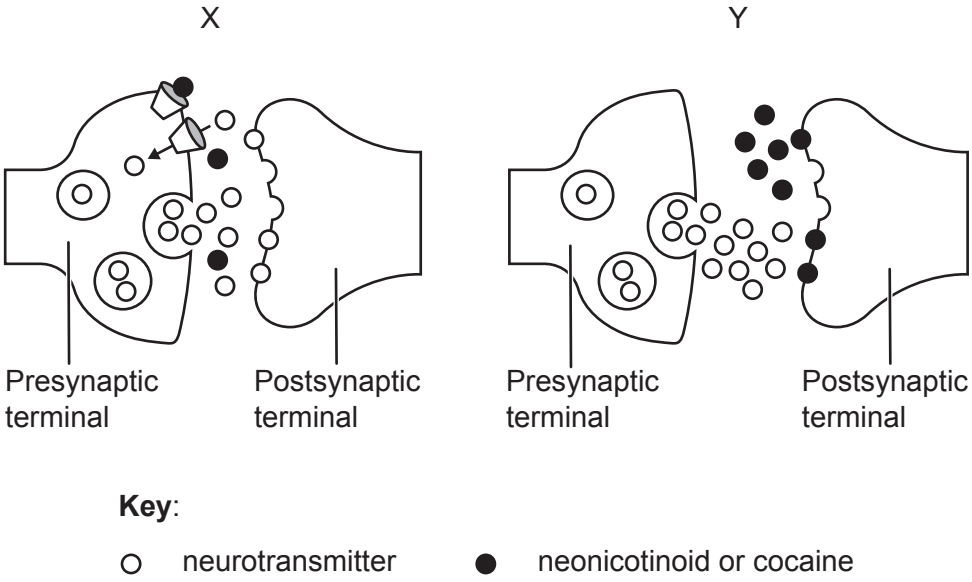
C.



D.



**18.** Diagrams X and Y show the possible action on synaptic transmission of two exogenous chemicals.




**Key**:

○ neurotransmitter ● neonicotinoid or cocaine

Cocaine and neonicotinoids have different modes of action. Which statement identifies the correct mode of action of one of these chemicals?

A. Y shows cocaine because it prevents binding of the neurotransmitter to the postsynaptic membrane.

B. X shows neonicotinoid because it is taken up by the presynaptic terminal.

C. Y shows neonicotinoid because it binds to the neurotransmitter.

D. X shows cocaine because the neurotransmitter cannot be taken up by the presynaptic terminal.

**19.** Which characteristic is shared by all tumours?

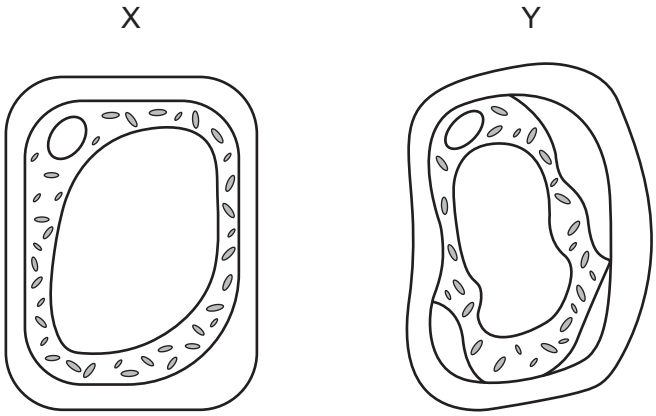
A. Cells metastasize from the primary tumour

B. They result from mutations

C. Spherical in shape

D. Malignancy

**20.** Two plant cells are shown as they appear in different solutions X and Y.




What happens to water and pressure potential inside the cell if it is moved from solution X to solution Y?

| | Water potential | Pressure potential |
|---|---|---|
| A. | does not change | decreases |
| B. | decreases | decreases |
| C. | does not change | increases |
| D. | increases | increases |

**21.** The salamander genus *Ensatina* from California, USA, has evolved several different forms, depending on location. Two such forms are shown.

What determines if these forms are members of the same species?

A. Have similar appearance

B. Populations mix freely

C. Produce fertile offspring

D. Can interbreed

**22.** What is one application of DNA barcoding?

A. Selective breeding

B. Preserving an endangered species

C. Analysing environmental DNA

D. Sequencing a genome

**23.** What is a role of one of the structures at a synovial joint such as the hip?

A. Ligaments attach muscle to bone.

B. Tendons transmit force of contraction to bone.

C. Cartilage holds bones together at the joint.

D. Muscles stretch and contract to move bones.

**24.** What is a reason that veins have relatively thin walls compared to arteries?

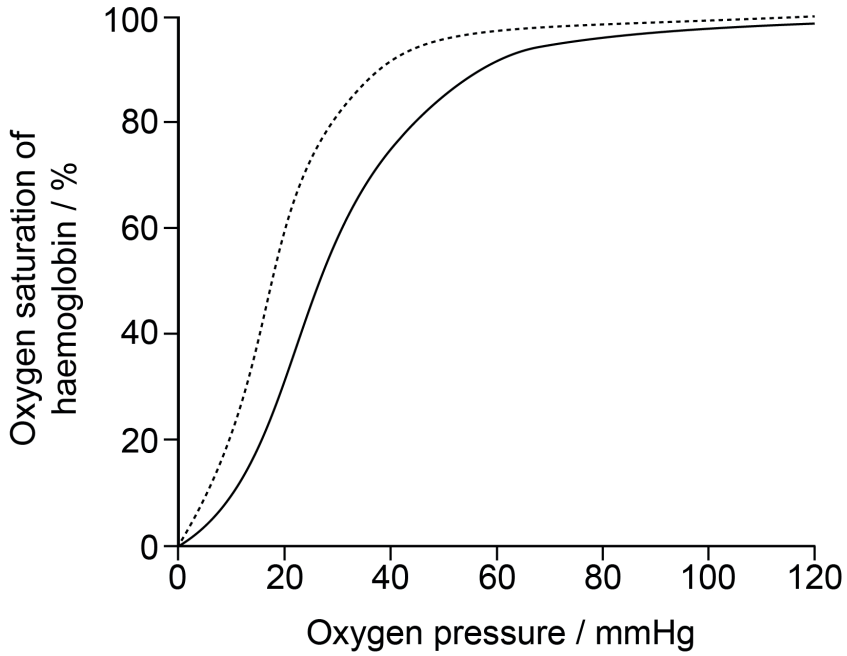
A. Allows muscle contraction to assist in blood flow

B. Prevents a blood clot forming

C. Allows exchange of materials with tissue fluid

D. Easier attachment of semilunar valves

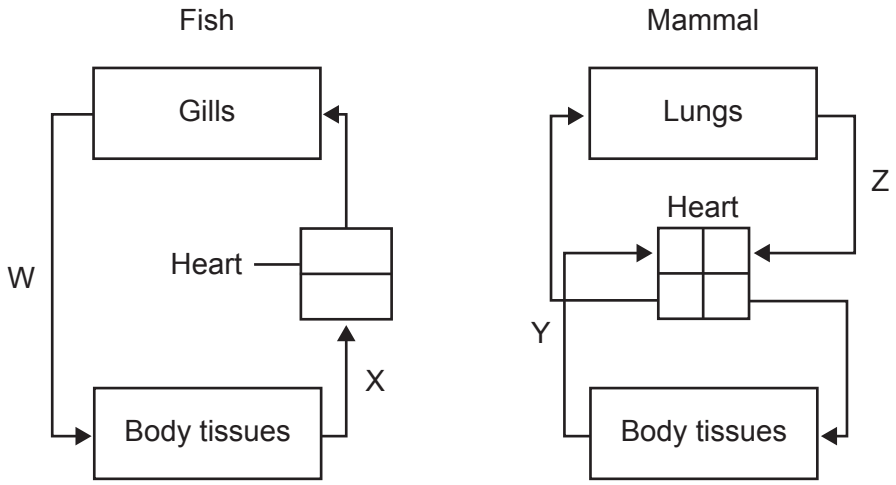
**25.** Two oxygen dissociation curves in an adult human are shown.




What is the explanation for the shift of the dissociation curve to the right-hand curve?

| | Carbon dioxide | Affinity of haemoglobin for oxygen |
|---|---|---|
| A. | dissociates from haemoglobin | increases |
| B. | dissociates from haemoglobin | decreases |
| C. | associates with haemoglobin | increases |
| D. | associates with haemoglobin | decreases |

**26.** The diagrams show blood circulation in a fish and a mammal.




Which two labels represent deoxygenated blood with the lowest pressure in each animal?

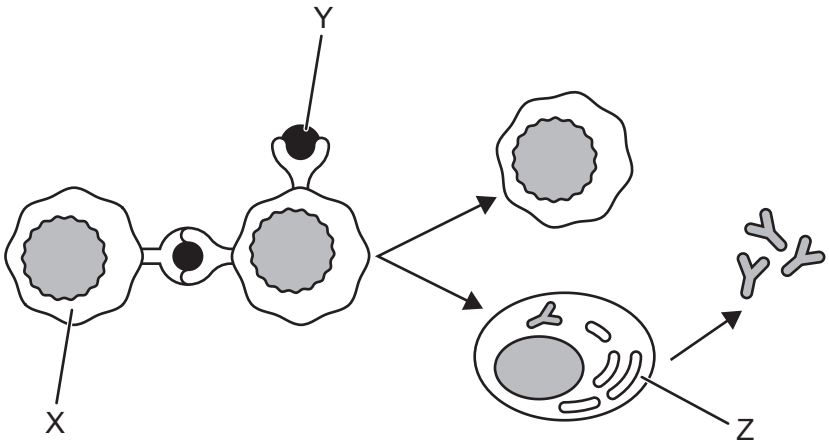
A. W and Z

B. X and Y

C. W and Y

D. X and Z

**27.** The diagram shows stages in an immune response.




What is represented by labels X, Y and Z?

| | X | Y | Z |
|---|---|---|---|
| A. | helper T-cell | antibody | plasma cell |
| B. | B-cell | antigen | memory B-cell |
| C. | helper T-cell | antigen | plasma cell |
| D. | B-cell | antibody | memory B-cell |

**28.** What is a reason for the ineffectiveness of antibiotics against viruses?

A. Viruses have genes for antibiotic resistance.

B. Viruses do not have cell membranes.

C. Antibiotics are only effective against archaea.

D. Antibiotics target metabolic processes.

**29.** What correctly describes the action of auxin in phototropism?

A. Auxin efflux carriers actively transport auxin in and out of cells.

B. Auxin promotes hydrogen ion secretion into the cytoplasm.

C. Auxin efflux carriers are positioned in the plasma membrane on one side of the cell.

D. Auxin breaks beta-glucose links in the cell wall.

**30.** What happens during fertilization in humans?

A. The nuclear membranes of sperm and egg break down.

B. The sperm enters the egg.

C. The chromosomes undergo joint meiosis.

D. Mitochondria in the zygote come from sperm and egg.

**31.** When white flowers of the species *Mirabilis jalapa* are fertilized by pollen from red flowers, the resulting plants produce pink flowers. What is the pattern of inheritance and the reason for this?

| | **Inheritance** | **Reason** |
|---|---|---|
| A. | incomplete dominance | offspring show both parental phenotypes |
| B. | codominance | offspring show both parental phenotypes |
| C. | incomplete dominance | offspring show a blended phenotype of the parents' |
| D. | codominance | offspring show a blended phenotype of the parents' |

**32.** What is a reason for the changes in blood flow during exercise?

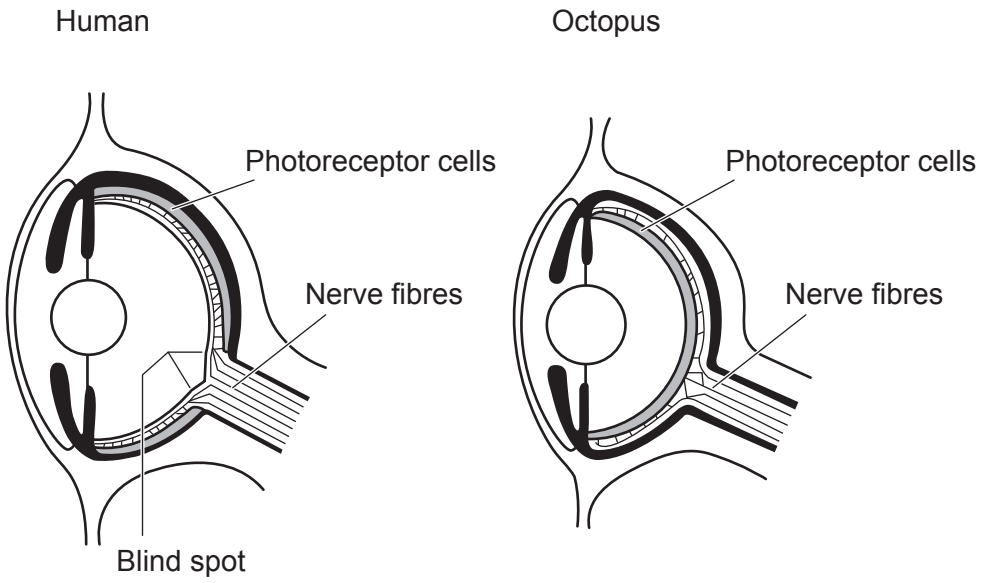
A. Increased blood flow to the kidneys removes waste products from exercise.

B. Blood flow to the brain decreases so that blood is diverted to the kidneys.

C. Increased blood flow to the skin removes heat.

D. Increased blood flow to the digestive system provides more glucose to muscles.

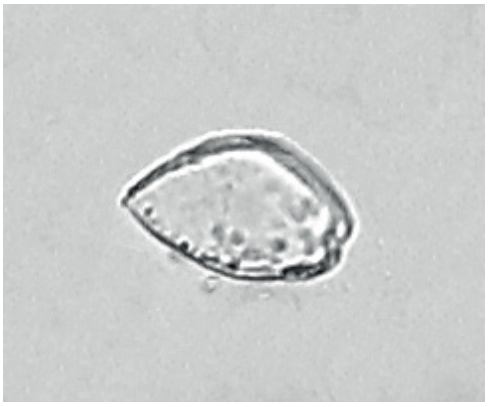
**33.** Human and octopus eyes have a similar structure and function but humans and octopuses have a different evolutionary origin.




What explains the similar structure of these eyes?

| | Type of evolution | Relationship of structures |
|---|---|---|
| A. | convergent | analogous |
| B. | convergent | homologous |
| C. | divergent | homologous |
| D. | divergent | analogous |

**34.** The image shows *Prorocentrum*, a coastal dinoflagellate that obtains energy from sunlight and from other organisms.



What best describes the mode of nutrition of *Prorocentrum*?

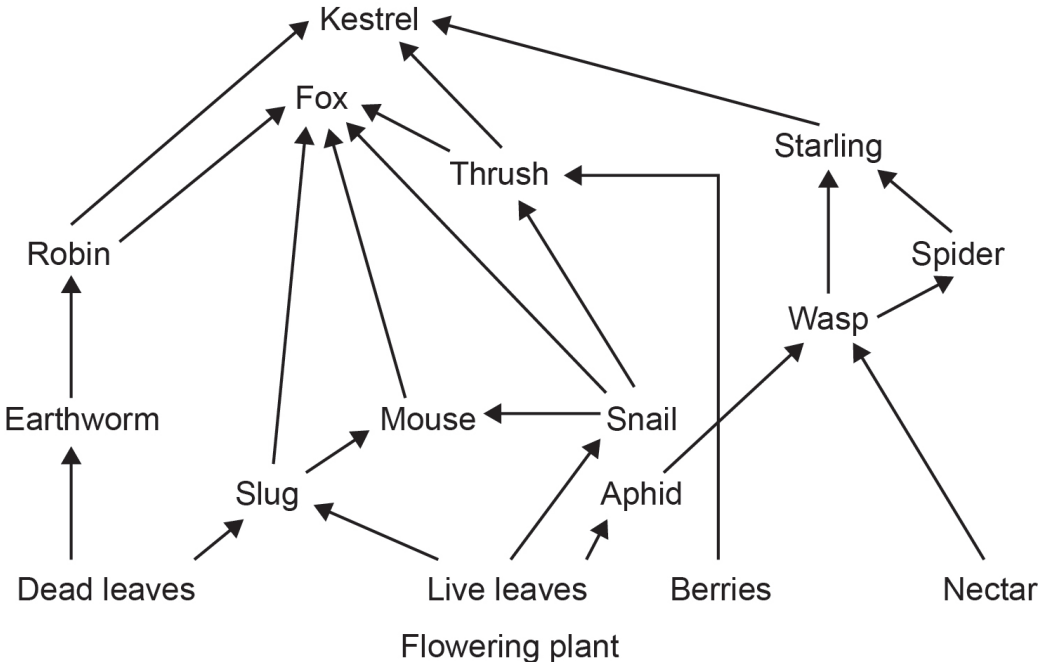
A. Mixotrophic

B. Autotrophic

C. Holozoic

D. Heterotrophic

**35.** A terrestrial food web is shown.




How many species in the food web are **only** primary consumers?

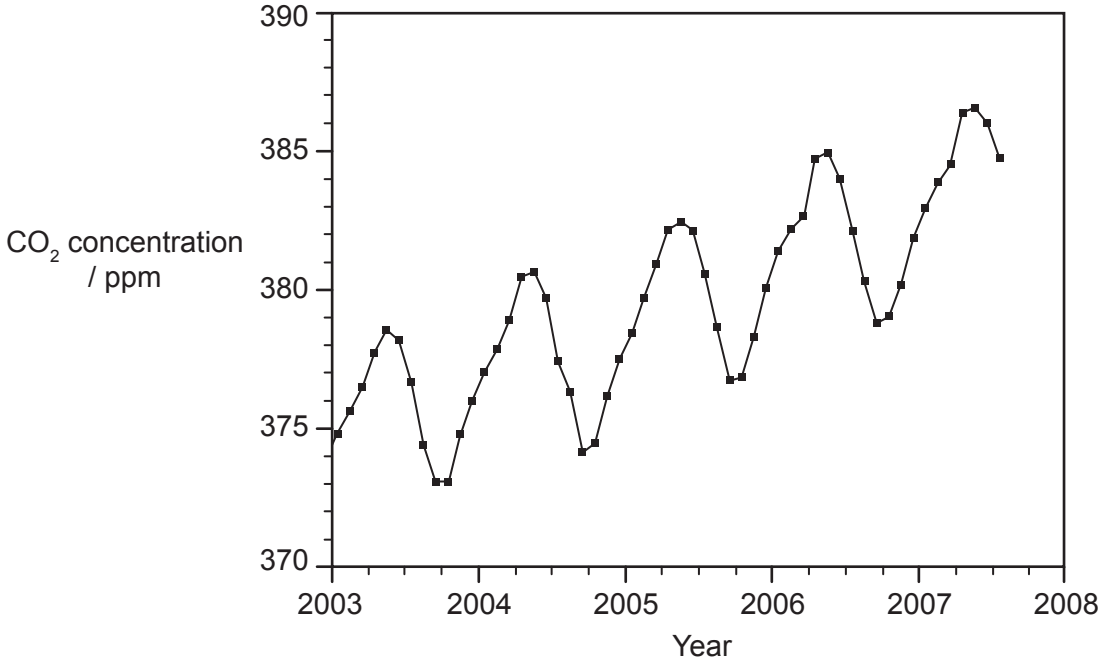
A. 3

B. 4

C. 5

D. 6

**36.** The graph shows data collected at Mauna Loa, USA, for monthly mean carbon dioxide concentration.




What causes the decreases in monthly mean carbon dioxide concentration each year?

A. Combustion increases.

B. Respiration increases.

C. Decomposition increases.

D. Photosynthesis increases.

**37.** John Endler experimented on populations of guppies (*Poecilia reticulata*) with different colouration. A male guppy fish is shown with large spots, which makes the fish more attractive to females, but more visible to predators.

The table shows the male colouration of guppy fish and number of predators in three different ponds.

| | **Predator X** | **Predator Y** | **Male guppy colouration** |
|---|---|---|---|
| Pond 1 | 12 | 0 | Large colourful spots |
| Pond 2 | 15 | 0 | Medium colourful spots |
| Pond 3 | 5 | 17 | None/very small drab spots |

What can be concluded from the data?

A. There is a positive correlation between numbers of predator X and size of spots.

B. Predator Y has least influence on colouration.

C. There is a negative correlation between number of predators and size of spots.

D. There is no sexual selection.

**38.** Which action is part of the rewilding of ecosystems?

A. Applying fertilizer

B. Removal of apex predators

C. Reintroduction of keystone species

D. Restricting size for easier management

**39.** Which of these conditions is/are necessary for genotype frequencies to fit the Hardy–Weinberg equation?

I. Homozygous recessive phenotypes have lower survival.

II. Mating is random.

III. The population is small.

A. I only

B. II only

C. II and III only

D. I, II and III

**40.** Which action will decrease carbon sequestration?

A. Afforestation

B. Primary production

C. Deforestation

D. Rewetting peatlands

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**References:**


**1.** Malsam, L., 2020. *Macro of Gerris lacustris or common pond skater*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/macro-of-gerris-lacustris-or-common-pond-skater-royalty-free-image/1225103683?phrase=pond+skater&adppopup=true [Accessed 13 May 2024]. Source adapted.

**2.** Darekk2. https://commons.wikimedia.org/wiki/File:Nucleosome_organization.png. CC BY-SA 3.0. https://creativecommons.org/licenses/by-sa/3.0. Source adapted.

**4.** X: Keertana, A., n.d. [*Protein X*]. [online] Available at: https://simplemed.co.uk [Accessed 18 April 2024]. Reference redacted. Source adapted.

Y: Nevit Dilmen. https://commons.wikimedia.org/wiki/File:1K6F_Crystal_Structure_Of_The_Collagen_Triple_Helix_Model_Pro-_Pro-Gly103_04.png. CC BY-SA 3.0. http://creativecommons.org/licenses/by-sa/3.0/. Source adapted.

Z: AzaToth. https://commons.wikimedia.org/wiki/File:Myoglobin.png. Public domain.

**21.** Devitt, T.J., Baird, S.J.E. and Moritz, C., 2011. *Ensatina eschscholtzii ring species*. [image online] Available at: https://commons.wikimedia.org/wiki/File:Ensatina_eschscholtzii_ring_species.jpg [Accessed 18 April 2024]. Source adapted. This file is licensed under the Creative Commons Attribution 2.0 Generic license: https://creativecommons.org/licenses/by/2.0/deed.en.

**25.** Peter Southwood. https://commons.wikimedia.org/wiki/File:Oxygen-Haemoglobin_dissociation_curves.svg. Public domain. Source adapted.

**27.** VectorMine. 2018. https://www.gettyimages.co.uk/detail/illustration/cells-and-t-cells-schematic-diagram-vector-royalty-free-illustration/907993572?phrase=Vectormine%20immune%20response&adppopup=true. Source adapted.

**33.** Philcha, 2008. *Vertebrate n octopus eyes*. [image online] Available at: https://commons.wikimedia.org/wiki/File:Vertebrate_n_octopus_eyes.png [Accessed 23 April 2024]. Source adapted. Public domain.

**34.** Minami Himemiya. https://commons.wikimedia.org/wiki/File:Prorocentrum_micans.jpg. Licensed under CC BY-SA 3.0. https://creativecommons.org/licenses/by-sa/3.0.

**36.** NOAA Global Monitoring Laboratory, n.d. *NOAA In Situ Carbon Dioxide* ($CO_2$) *Measurements*. [online] Available at: https://gml.noaa.gov/obop/mlo/programs/esrl/co2/co2.html [Accessed 18 April 2024]. Source adapted.

**37.** Per Harald Olsen. https://commons.wikimedia.org/wiki/File:Guppy_pho_0048.jpg. Licensed under CC BY 3.0. https://creativecommons.org/licenses/by/3.0. Source adapted.


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