Biology
Standard level
Paper 1

IB Biology SL prediction paper 1

45 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
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- The maximum mark for this examination paper is **[30 marks]**.

18 pages

1. Which feature is characteristic of a mature human red blood cell?

    A.   Contains a nucleus and many mitochondria.

    B.   Has a biconcave shape that increases surface-area-to-volume ratio.

    C.   Possesses a thick cellulose cell wall for rigidity.

    D.   Stores sap in a large central vacuole.

2. Which property of water enables pond skaters (Gerridae) to stand on its surface?

    A.   High specific heat capacity.

    B.   Cohesion producing surface tension.

    C.   Universal solvent ability.

    D.   Maximum density at 4 °C.

3. Two related plant species are compared. Species X grows in temperate woodland; species Y grows in arid desert. Which trait combination is most likely an adaptation of species Y?

    A.   Large leaf surface area; stomata open mainly in daylight.

    B.   Small leaf surface area; thick, waxy cuticle.

    C.   High chloroplast density; thin epidermis.

   D.   Stomata concentrated on upper epidermis; thin cuticle.

TutorChase

4. The electron micrograph shows a freeze-fractured onion root cell membrane in which numerous rounded particles (one labelled X) are scattered across the fractured face.

structure X

×20 000
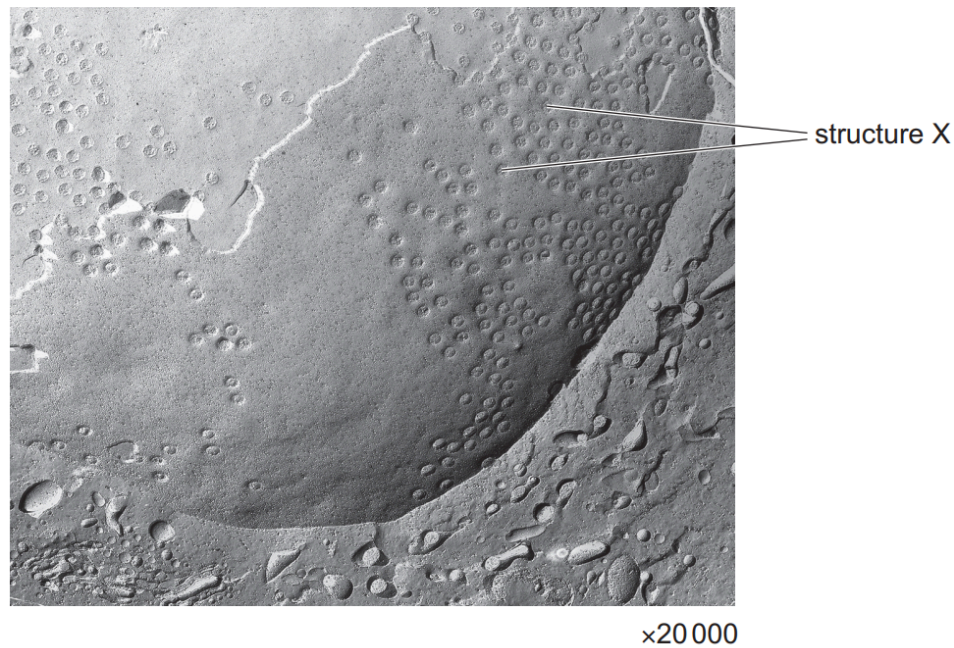
What is structure X and where is it located?

A. Peripheral protein loosely attached to the cytoplasmic surface of the membrane.

B. Glycolipid exposed on the external face of the membrane.

C. Integral (trans-membrane) protein embedded within the phospholipid bilayer.

D. Phospholipid head group revealed by the fracture plane.

5. In ecology, a species' niche is best defined as:

A. Only the physical space it occupies.

B. Its trophic level in a food chain.

C. The role it plays plus the abiotic and biotic conditions it requires.

D. The total biomass of the species in an ecosystem.

6. The Venn diagram compares organelle contents of a xylem vessel element, a companion cell and a phloem sieve-tube element. Letters A–D mark regions of overlap.
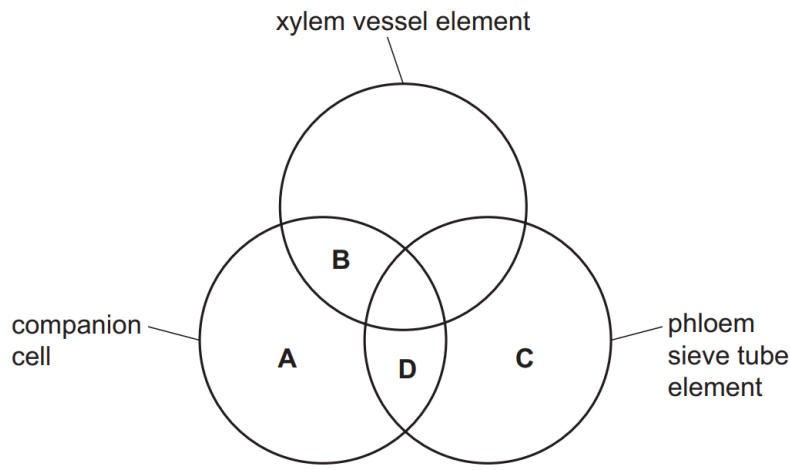
Which letter represents cells that contain cytoplasm with both mitochondria and a nucleus?

A.   A.

B.   B.

C.   C.

D.   D.

7. In aerobic respiration of a eukaryotic cell, most ATP is produced:

A.   In the cytosol during glycolysis.

B.   In the mitochondrial matrix during the link reaction.

C.   On the cristae by oxidative phosphorylation.

D.   In the nucleus during transcription.

8. Which pigment in chloroplasts absorbs mainly red and blue wavelengths of visible light to drive photosynthesis?

    A.   Anthocyanin.

    B.   β-carotene.

    C.   Xanthophyll.

    D.   Chlorophyll a.

9. The outlines show a xerophytic leaf after 45 minutes in two environmental conditions, P and Q. In Q the leaf blades have rolled inwards around the lower surface (region Y).
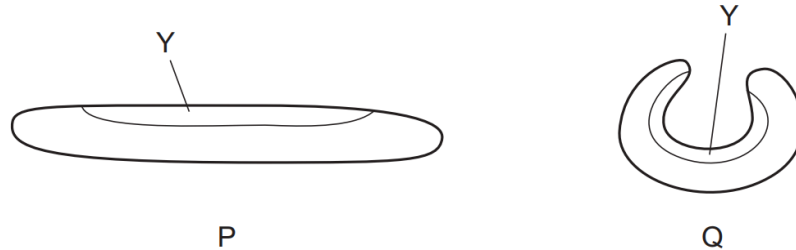

Which change in abiotic condition from P to Q most likely caused the rolling, and what advantage does this confer?

    A.   Lower air humidity; rolling traps moist air to reduce transpiration.

    B.   Higher light intensity; rolling exposes more chloroplasts for photosynthesis.

    C.   Lower atmospheric CO_2; rolling enlarges internal air spaces for gas exchange.

    D.   Higher temperature; rolling increases leaf surface area for heat dissipation.

10. The competitive exclusion principle states that:

    A.   Two species can coexist indefinitely if they share the same fundamental niche.

    B.   Two species with identical niches cannot stably coexist in the same habitat.

    C.   Predators always have lower biomass than their prey.

    D.   Maximum biodiversity occurs when resources are unlimited.

11. In **semiconservative** DNA replication, each daughter double helix contains:

    A.   two parental (template) strands.

    B.   two newly synthesised strands.

    C.   one parental strand and one newly synthesised strand.

    D.   one DNA strand and one complementary RNA strand.

12. Which nitrogenous base pairs with adenine in a DNA double helix?

    A.   Uracil.

    B.   Thymine.

    C.   Cytosine.

    D.   Guanine.

13. The figure shows the mean mass of tomatoes produced in four greenhouses (P–S). Seedlings either had or lacked the mycorrhizal fungus *Glomus intraradices* and were grown with water shortage or no water shortage.
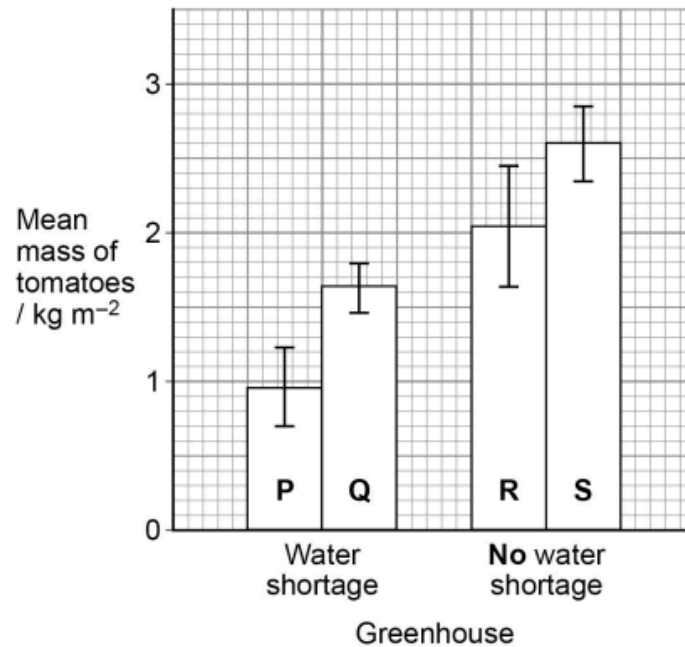
Which explanation based on water potential best accounts for the higher yield in greenhouse Q compared with P?

A. Mycorrhizal hyphae lower the water potential inside root cells, maintaining a gradient that drives osmosis from the dry soil into the plant.

B. The fungus blocks xylem vessels, slowing transpiration and conserving water in leaves.

C. The fungus raises leaf solute concentration, decreasing transpiration pull and water loss.

D. Mycorrhiza raises the soil water potential, reducing the gradient for water uptake by roots.

14. A woodland snail population was surveyed before and after clear-felling of trees:

Shell pattern	Before (n = 500)	After (n = 500)
Banded	100	280
Unbanded	400	220

Which explanation best accounts for the observed change in shell-pattern frequencies?

A. Genetic drift due to a population bottleneck.

B. Directional natural selection favouring banded shells for camouflage in the new, more open habitat.

C. Founder effect following immigration of unbanded snails.

D. Increased mutation rate generating more banded alleles.

15. A tRNA anticodon is 3′-UAC-5′. Which mRNA codon does it recognise?

A. 5′-AUG-3′.

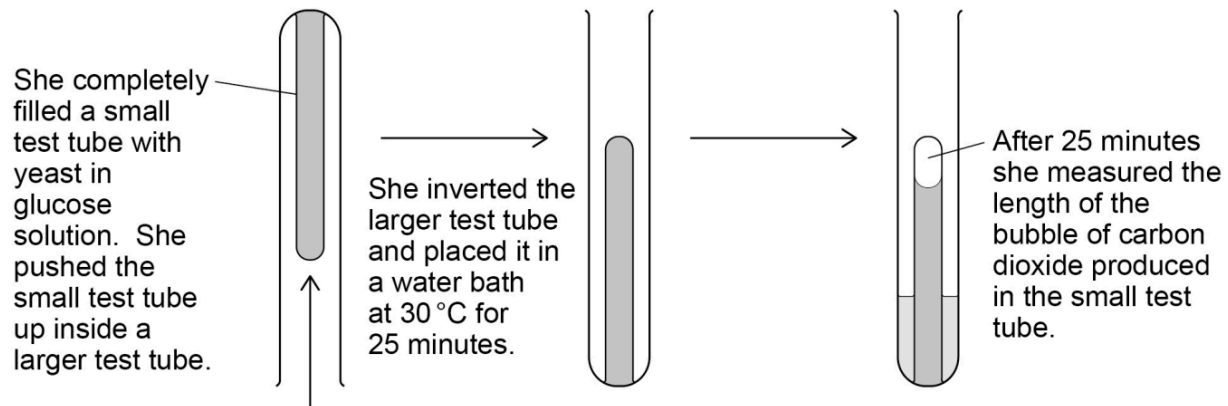B. 5′-UAC-3′.

C. 5′-CAU-3′.

D. 5′-GUA-3′.

16. Beak-depth data (mean ± SD, mm) for a finch population on an island dominated by large, hard seeds:

Year	Mean beak depth (mm)	Standard deviation (mm)
1	9.4	± 0.6
5	9.9	± 0.5
10	10.3	± 0.4

Which evolutionary mechanism is **most consistent** with the trend shown?

A. Gene flow from a mainland population with smaller beaks.

B. Stabilising selection around an intermediate optimum.

C. Disruptive selection produces two distinct beak-size morphs.

D. Directional selection favouring birds with deeper beaks.

17. Which change is most likely to increase the rate of an enzyme-catalysed reaction that is operating below its temperature optimum?

A. Raising pH far above the optimum.

B. Increasing temperature from 25 °C to 37 °C.

C. Adding a competitive inhibitor.

D. Halving the substrate concentration.

18. The diagram shows an investigation in which a student incubates yeast in different sugar solutions. After 25 minutes at 30 °C she measures the length of the carbon-dioxide bubble formed at the top of the inverted, liquid-filled inner tube.

She completely filled a small test tube with yeast in glucose solution. She pushed the small test tube up inside a larger test tube.

She inverted the larger test tube and placed it in a water bath at 30 °C for 25 minutes.

After 25 minutes she measured the length of the bubble of carbon dioxide produced in the small test tube.

When comparing the effect of different sugars on respiration, which of the following is the **dependent variable**?

A. Temperature of the water bath.

B. Type of sugar provided to the yeast.

C. Length of the carbon-dioxide bubble after 25 minutes.

D. Volume of yeast suspension placed in the tube.

**19.** Potato cylinders were incubated for 24 h in sucrose solutions:

Sucrose / mol dm⁻³	0.0	0.2	0.4	0.6	0.8
% mass change	+12	+6	0	−7	−12

If a 0.4 mol dm⁻³ solution has a solute potential (ψ_s) of −950 kPa, what is the approximate solute potential of the potato tissue?

A. −300 kPa.

B. −650 kPa.

C. −1200 kPa.

D. −950 kPa.

Turn over

20. The graph shows the total number of species assessed by the IUCN each year from 2000 – 2020 (solid line) and the number classed as threatened (dashed line).
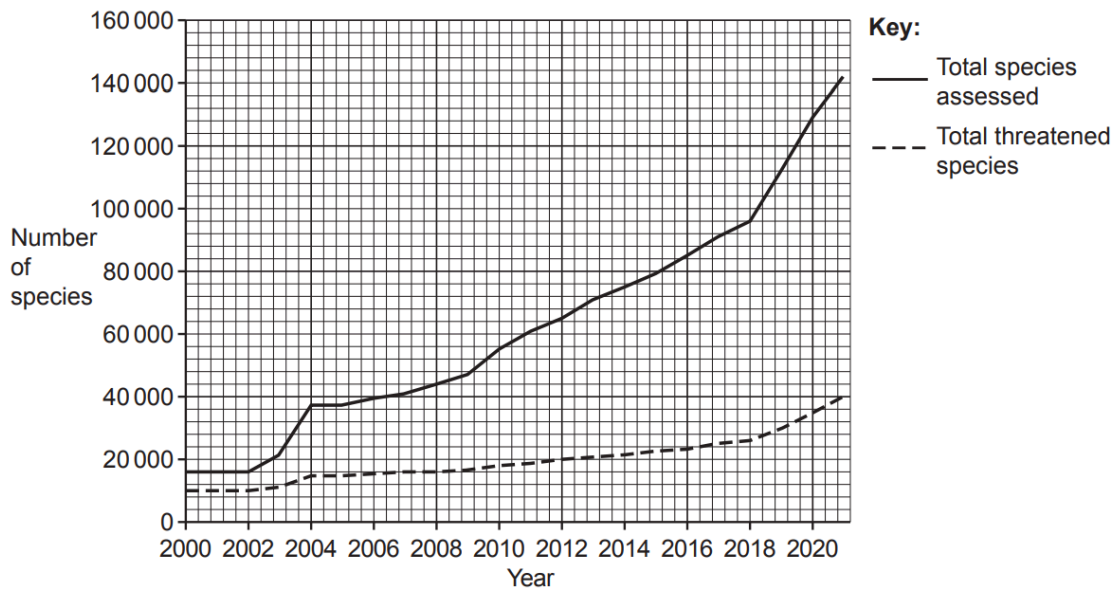

Which evidence from the graph most strongly supports the view that a biodiversity crisis is intensifying?

A.   The absolute number of threatened species rises roughly four-fold over the period.

B.   The proportion of assessed species that are threatened falls after 2005.

C.   The total number of species assessed increases at a constant linear rate.

D.   The rate of species assessment slows after 2018.

21. In human males, spermatogenesis primarily occurs in the:

A.   Epididymis.

B.   Seminiferous tubules of the testes.

C.   Prostate gland.

D.   Vas deferens.

22. Which action is an example of **ex situ** conservation?

A. Designating a coral reef as a marine protected area.

B. Restoring native plant species in a degraded grassland.

C. Legislating to ban clear-cutting of rainforests.

D. Breeding endangered frogs in a zoo programme.

23. Why does ice float on liquid water?

A. Covalent O–H bonds become stronger at 0 °C.

B. Hydrogen bonds pack molecules closer together in ice.

C. Crystalline lattice makes solid water less dense than liquid water.

D. High latent heat of fusion prevents freezing below 4 °C.

24. The graph displays the absorption spectra of chlorophyll a, chlorophyll b and carotenoids across wavelengths of visible light.
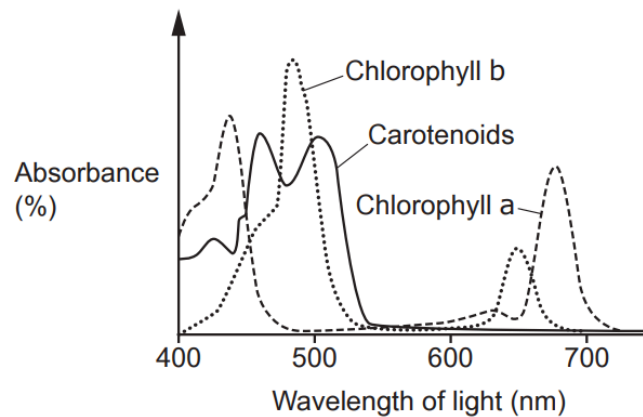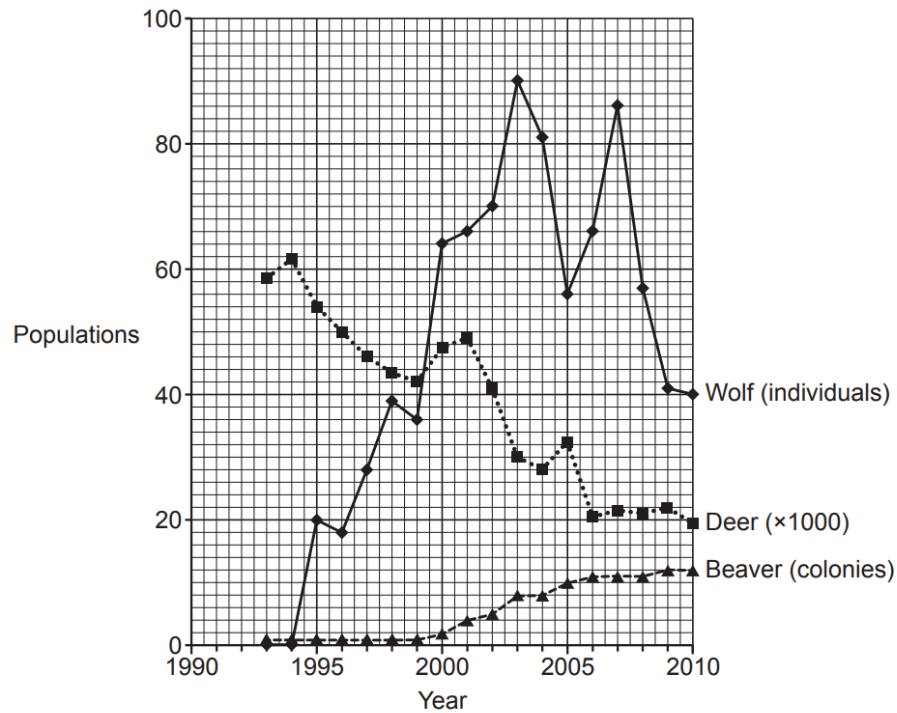

Which colour of light would be **least effective** for photosynthesis in a plant containing only these pigments?

A.   Violet ($\approx$ 410 nm).

B.   Blue-green ($\approx$ 495 nm).

C.   Orange ($\approx$ 620 nm).

D.   Green-yellow ($\approx$ 550 nm).

Turn over

25.   The graph tracks grey wolf numbers, deer numbers (× 1000) and beaver colonies in an
   ecosystem between 1990 – 2010; wolves were reintroduced in 1993.

Which observation best illustrates density-dependent regulation by the predator?

A.   Deer numbers fall sharply after wolf numbers climb and recover when wolf
      numbers decline.

B.   Beaver colonies rise steadily despite large fluctuations in wolf numbers.

C.   Wolf numbers peak twice between 2000 and 2008.

D.   Deer numbers fall before wolves were reintroduced.

26. In a mark–release–recapture study, 80 beetles were marked on day 1. On day 3, 100 beetles were captured, of which 20 were marked. Using the Lincoln–Petersen method, estimate population size and identify a key assumption.

    A. 160; marks are not lost between samples.

    B. 200; population is closed (no immigration/emigration).

    C. 400; marked and unmarked beetles have equal capture probability.

    D. 800; marking increases predation risk.

27. The diagram shows masses of phosphorus in two stores and the percentage of each store transferred to soil annually.
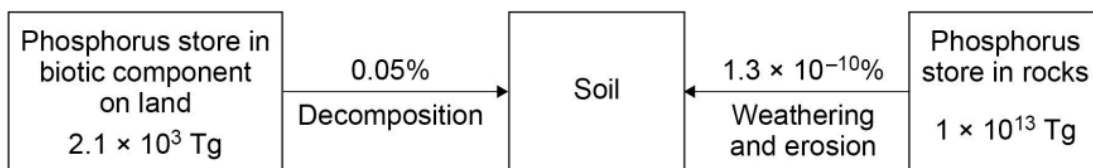

One teragram (Tg) is 1×10^{12} grams.

The supply of phosphorus to the soil is shown as a percentage of the total phosphorus mass of each store.

What is the approximate mass of phosphorus supplied to the soil each year by weathering of rocks?

    A. 0.13 Tg.

    B. 1.3 Tg.

    C. 13 Tg.

    D. 130 Tg.

28. The diagram below shows the course of an exergonic reaction with and without an enzyme; four vertical arrows (A–D) indicate different energy changes.
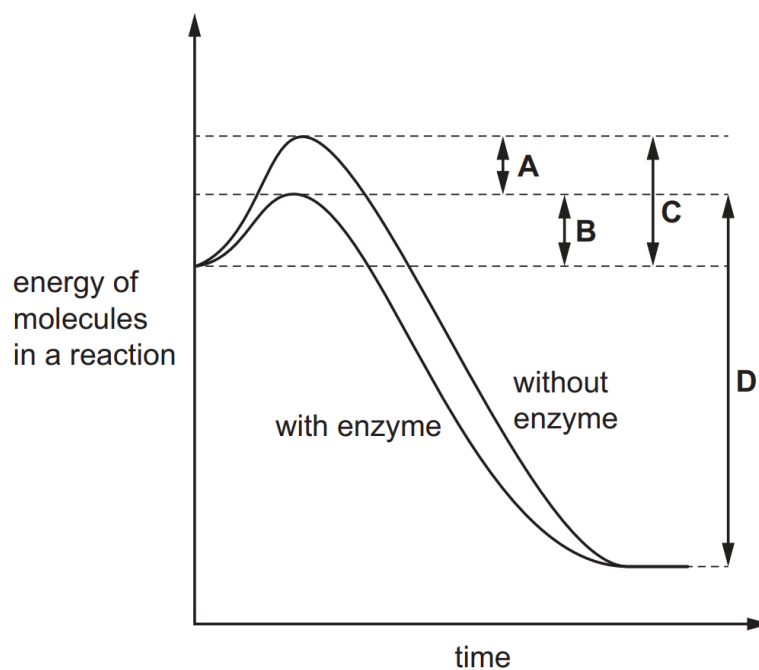
Which arrow represents the activation energy of the enzyme-catalysed reaction?

A. A.

B. B.

C. C.

D. D.

29. The table shows derived characters in five vertebrate groups:

Character	Lamprey	Shark	Salamander	Lizard	Kangaroo
Jaws	✗	✓	✓	✓	✓
Lungs	✗	✗	✓	✓	✓
Amniotic egg	✗	✗	✗	✓	✓
Hair	✗	✗	✗	✗	✓

Which cladogram best fits the principle of parsimony?

A. Lamprey diverges first, followed by shark, then salamander; lizard and kangaroo share the most recent ancestor.

B. Lamprey and shark are sister taxa; salamander diverges next; lizard and kangaroo diverge earliest

C. Kangaroo diverges first; lamprey diverges last.

D. Salamander and lamprey share a most recent common ancestor; shark diverges last.

30. The normal DNA triplet **GAA** on the coding strand of the β-globin gene specifies glutamic acid. A point mutation changes this triplet to **GTA**. Using the universal genetic code, how is this mutation best classified?

A. Silent (synonymous) substitution.

B. Missense (nonsynonymous) substitution.

C. Nonsense substitution.

D. Frameshift mutation.