

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.
- The maximum mark for this examination paper is **[30 marks]**.

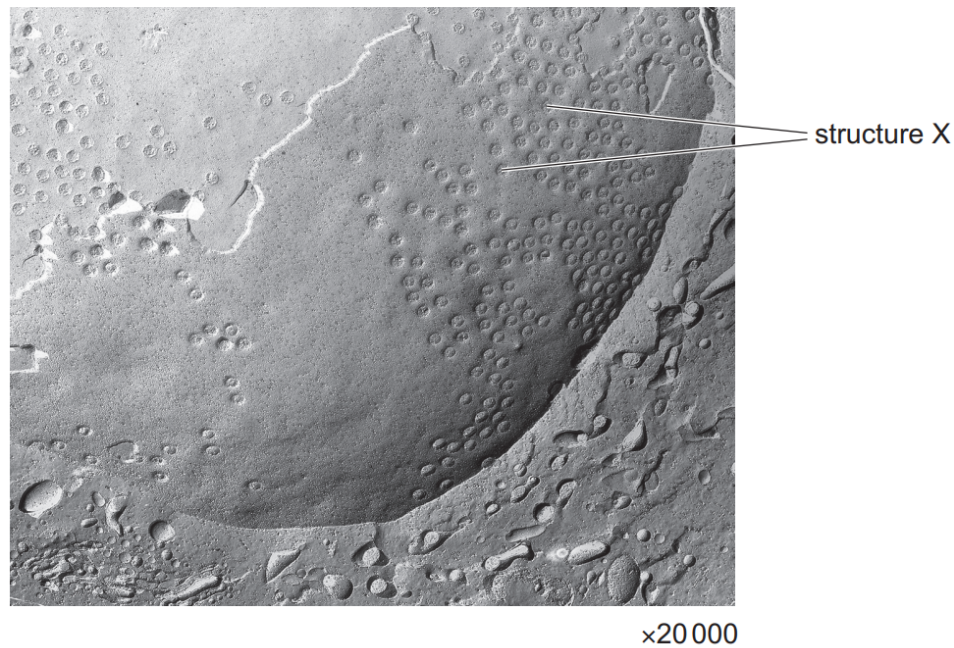
18 pages

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.

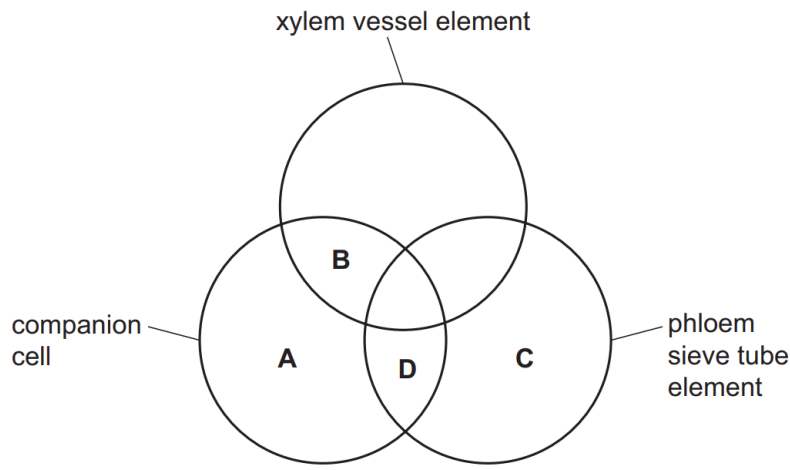
4. The electron micrograph shows a freeze-fractured onion root cell membrane in which numerous rounded particles (one labelled X) are scattered across the fractured face.



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.

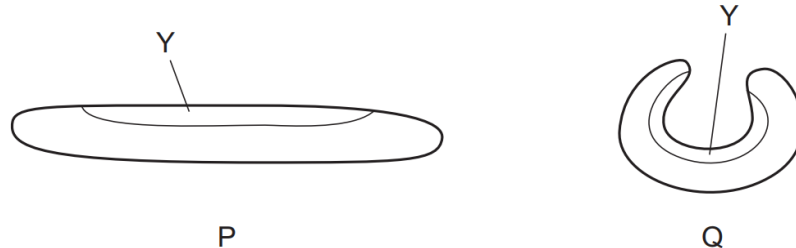
6. The Venn diagram compares organelle contents of a xylem vessel element, a companion cell and a phloem sieve-tube element. Letters A–D mark regions of overlap.



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).

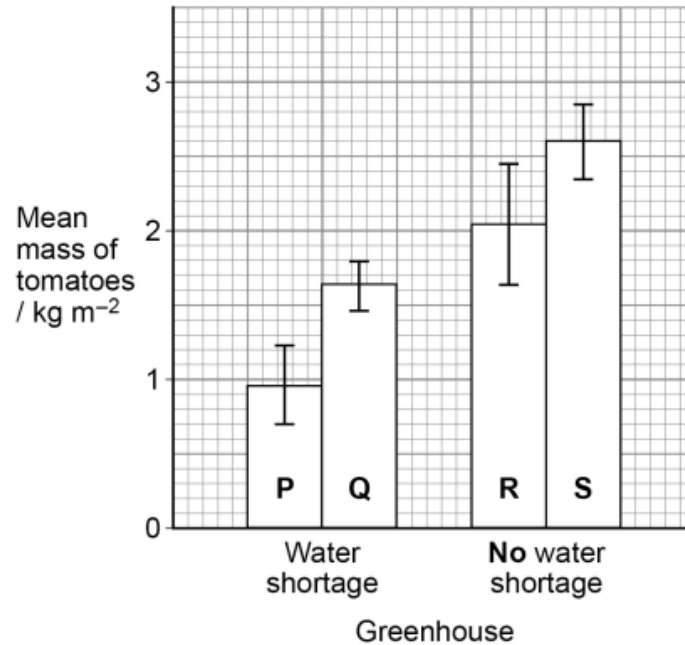


Which change in abiotic condition from P to Q most likely caused the rolling, and what advantage does this confer?

- 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'.

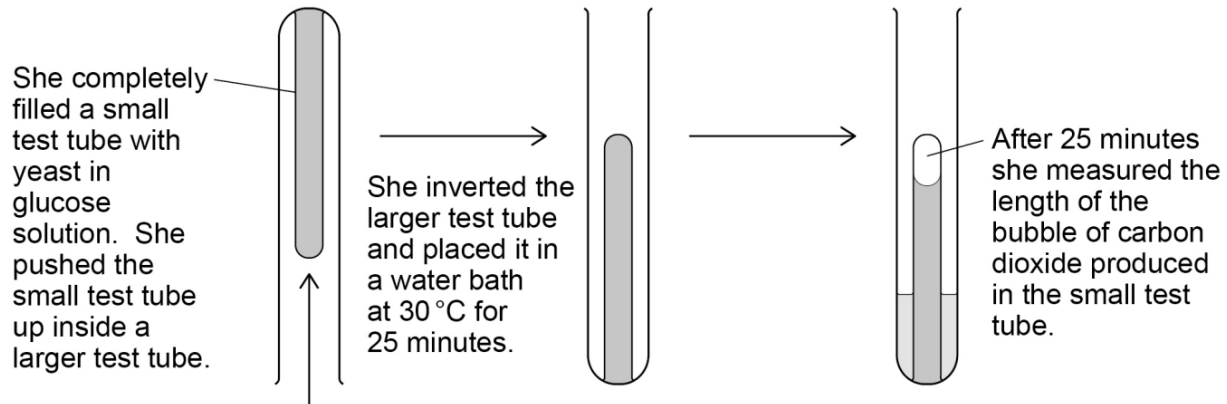
16. Beak-depth data (mean $\pm$ SD, mm) for a finch population on an island dominated by large, hard seeds:

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.



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:

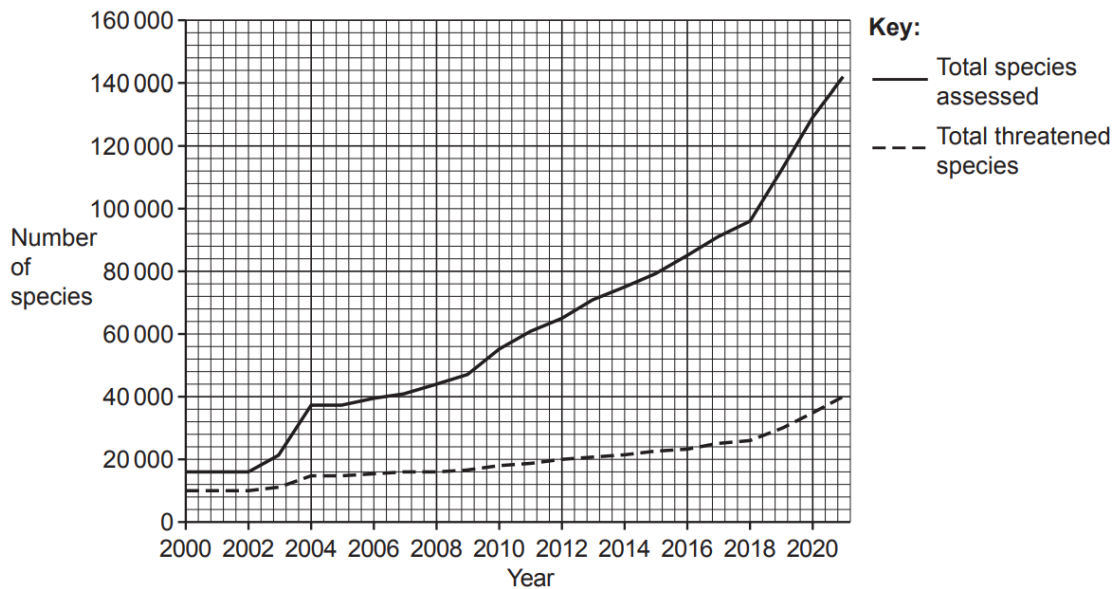
Sucrose / mol dm⁻³	0.0	0.2	0.4	0.6	0.8
% mass change	+12	+6	0	–7	–12

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).

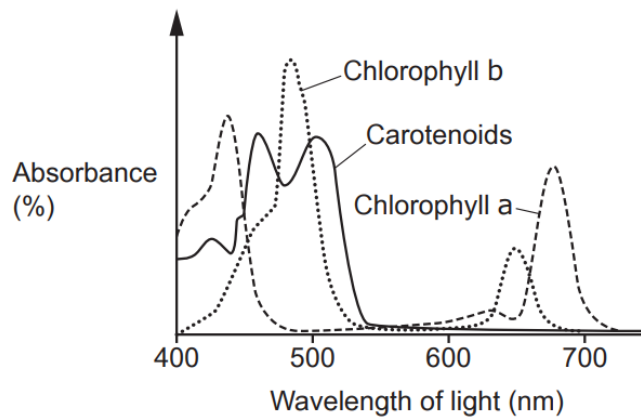


Which evidence from the graph most strongly supports the view that a biodiversity crisis is intensifying?

- 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.

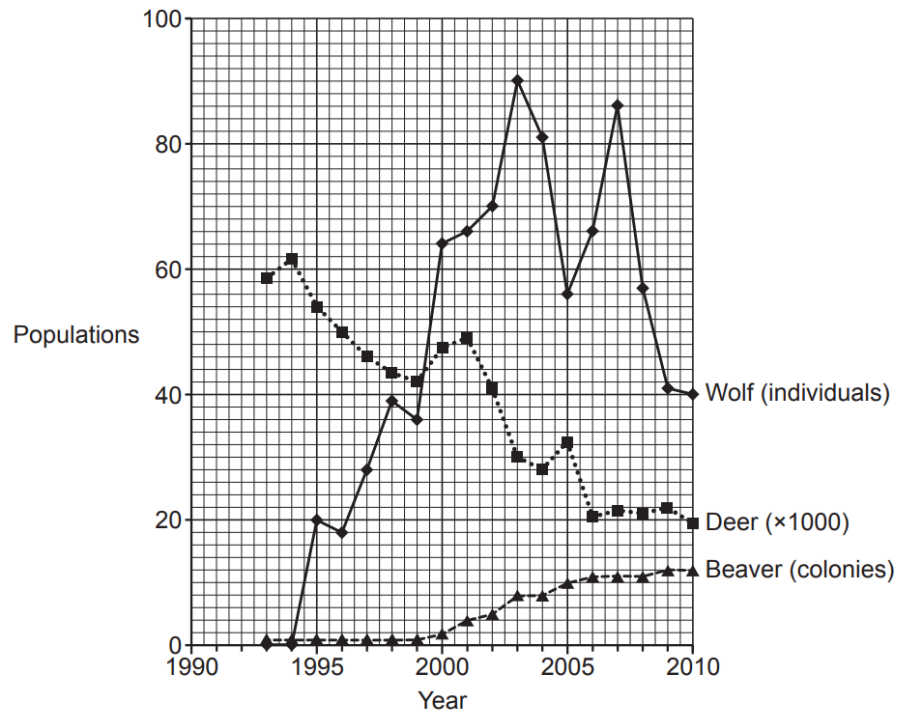


Which colour of light would be **least effective** for photosynthesis in a plant containing only these pigments?

- A. Violet (≈ 410 nm).
- B. Blue-green (≈ 495 nm).
- C. Orange (≈ 620 nm).
- D. Green-yellow (≈ 550 nm).

Turn over

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



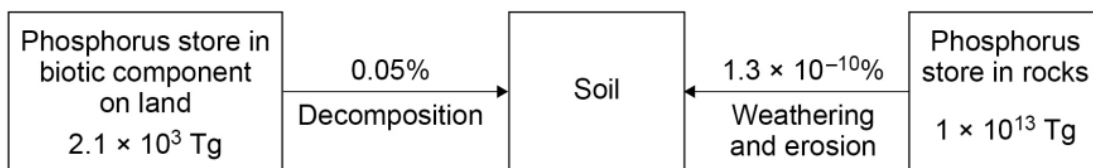
Which observation best illustrates density-dependent regulation by the predator?

- 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.



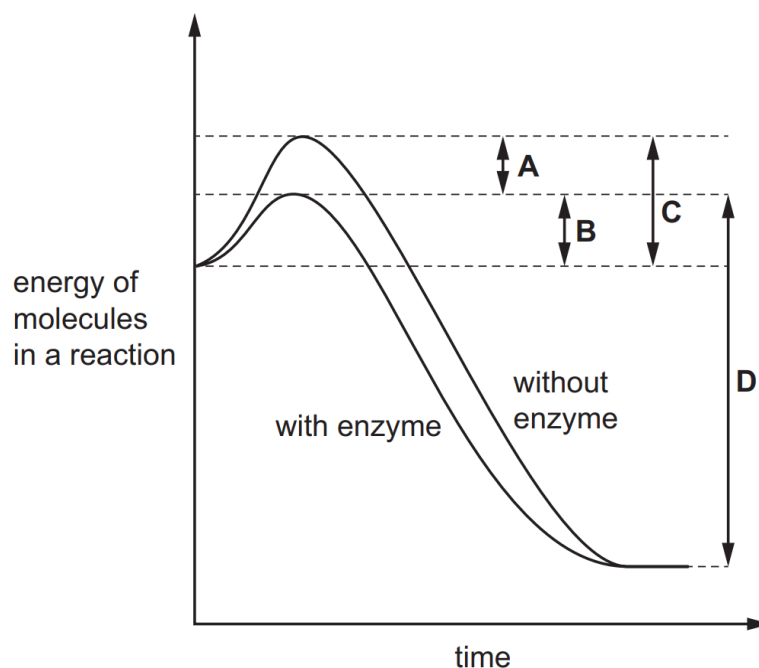
One teragram (Tg) is 1×10^{12} grams.

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.

Turn over

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

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

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.