



Evolution and speciation: practice questions

8 questions • 29 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 29

1 PAPER 1A STYLE

[1 mark]

Which observation is an example of evolution?

- A. ☐ A giraffe's neck lengthening during its life as it stretches for leaves
- B. ☐ An increase over many generations in the frequency of an allele for dark wing colour in a moth population
- C. ☐ A person developing larger muscles through regular weight training
- D. ☐ Plants of one variety growing taller when given more fertiliser

2

[5 marks]

Cytochrome c is a protein of 104 amino acids found in a wide range of organisms. The table shows the number of amino acid differences between human cytochrome c and that of other organisms (data for practice). (a) Identify the organism most closely related to humans, according to the data. [1] (b) Calculate the percentage of amino acids in horse cytochrome c that differ from human cytochrome c. [1] (c) Explain how the data provide evidence for evolution. [2] (d) Suggest why comparing the base sequences of the cytochrome c gene might show more differences than comparing the amino acid sequences. [1]

Amino acid differences from human cytochrome c (data for practice)	
Organism	Number of differences
Chimpanzee	0
Rhesus monkey	1
Dog	11
Horse	12
Chicken	13
Tuna	21
Yeast	44

[illegible]

3

[2 marks]

Kale, broccoli and cauliflower are all varieties of one species, *Brassica oleracea*, produced from wild cabbage by selective breeding. Outline how this provides evidence for evolution.

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4 PAPER 2A STYLE

[4 marks]

Distinguish between homologous structures and analogous structures, using one named example of each.

[illegible]

5 PAPER 2B STYLE

[6 marks]

Explain how a pre-existing species can split into two species, using the example of bonobos and common chimpanzees.

[illegible]

6 PAPER 1A STYLE

[1 mark]

HL only

Which statement describes adaptive radiation?

- A. ☐ Unrelated species evolve similar structures because they live in similar environments
- B. ☐ A species gradually changes over time without splitting
- C. ☐ Many species evolve rapidly from one ancestral species, each adapted to a different niche
- D. ☐ Two species hybridize and the hybrid doubles its chromosome number

HL only

Compare and contrast sympatric and allopatric speciation.

HL only

Explain how the alleles of different species are kept separate, and how hybridization can lead to abrupt speciation in plants such as *Persicaria*.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B; [1]

2. [5]

- (a) chimpanzee; [1]
- (b) $12 \div 104 \times 100 = 11.5\%$ / 11.5; [1] Accept 11.54 / 12 %
- (c) differences arise by mutation and accumulate over time after lineages split; [1]
- (c) fewer differences show more recent common ancestry, e.g. humans and chimpanzees / more differences show more distant ancestry, e.g. yeast; [1]
- (c) the same protein in all these organisms suggests a common origin / common ancestor; [1]
- (d) genetic code is degenerate / more than one codon codes for the same amino acid, so some base changes do not change the amino acid; [1] OWTTE
- max 5

3. [2]

- humans selected and bred plants with desired (heritable) traits over many generations; [1]
- large differences between varieties and from the wild species show heritable characteristics of a population can change; [1]
- change happened rapidly / in a short time, so natural selection over much longer periods could produce larger changes; [1]
- max 2

4. [4]

- homologous structures have the same basic structure / same arrangement of parts; [1]
- homologous structures are inherited from a common ancestor / have the same evolutionary origin, but may have different functions; [1]
- named homologous example, e.g. pentadactyl limbs of human arm, bat wing and whale flipper; [1]
- analogous structures have the same function but different evolutionary origins; [1]
- analogous structures result from convergent evolution / similar selection pressures on unrelated groups; [1]
- named analogous example, e.g. wings of birds and insects / eyes of octopus and vertebrates / fins of shark and dolphin; [1]
- max 4

5. [6]

- speciation is the splitting of a pre-existing species into two (or more); [1]
- a population becomes reproductively isolated / stops interbreeding; [1]
- so there is no gene flow between the populations; [1]
- geographical isolation is one cause / a barrier separates the populations; [1]
- ancestral Pan population separated by the Congo River, which the apes cannot cross; [1] Accept either the river forming or ancestral bonobos crossing it at low water.
- bonobos south of the river and common chimpanzees north of it; [1]
- differential selection / different selection pressures in each area favour different alleles; [1]
- e.g. gorillas compete for food north of the river but not south of it, OWTTE; [1]
- gene pools / allele frequencies diverge over many generations; [1]
- until the populations can no longer interbreed to produce fertile offspring / are separate species; [1]
- speciation increases the number of species; gradual change within one species is not speciation; [1]
- max 6

6. [1] HL only

C C; [1]

7. [4] HL only

- both require reproductive isolation / the end of gene flow between populations; [1]
- both involve divergence of gene pools / differential selection; [1]
- both produce new species that cannot interbreed (with the original); [1]
- allopatric speciation involves geographic isolation / populations in different areas; [1]
- sympatric speciation occurs in the same area / without a geographical barrier; [1]
- sympatric isolation is behavioural or temporal (or by polyploidy); [1]
- max 4. At least one similarity and one difference are needed for full marks.

8. [6] HL only

- courtship behaviour (often) prevents hybridization in animals; [1]
- courtship signals are species-specific so individuals only mate with their own species; [1]
- interspecific hybrids are often sterile, e.g. mule (horse × donkey); [1]
- mule has 63 chromosomes / an odd number, which cannot form homologous pairs in meiosis, so no viable gametes; [1]
- so alleles are not passed from one species' gene pool into the other; [1]
- in plants, a hybrid of two species is sterile as its chromosome sets are not homologous; [1]
- doubling of the chromosome number (polyploidy) gives every chromosome a partner; [1]
- the polyploid can carry out meiosis and is fertile; [1]
- crosses with either parent give sterile offspring (e.g. triploids), so the polyploid is reproductively isolated / a new species; [1]
- this happens in one generation / abruptly; [1]
- Persicaria contains many species formed by hybridization and polyploidy; [1]
- max 6