



Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. fossils
2. paleontology
3. sedimentary
4. homologous
5. analogous
6. vestigial
7. connecting links
8. mutagen

K • 4

Each carries 0.5 mark.

2 Label the diagram

- | | | |
|---|--|-------|
| 1. lungfish (Protopterus) | 4. platypus hair and milk, but lays eggs | K • 3 |
| 2. Archaeopteryx feathers, but teeth, clawed wings, bony tail | 5. Birds | |
| 3. Amphibians | 6. Mammals | |
| | | |

Each carries 0.5 mark.

3 Multiple choice

- i. a. Charles Darwin

K • 1

Darwin (with Wallace) proposed natural selection. Lamarck proposed the inheritance of acquired characters, de Vries the mutation theory, and Mendel the laws of heredity.

- ii. a. sedimentary

K • 1

Fossils form when remains are buried in layers of mud and sand, which become sedimentary rock. Igneous and volcanic rocks form from melted rock, which destroys remains; heat and pressure in metamorphic rock usually destroy them too.

- iii. a. our hand and the foreleg of a horse

U • 1

Our hand and a horse's foreleg have the same bones (humerus, radius, ulna, carpals, metacarpals, phalanges) but do different jobs. An elephant's tusk is a tooth, not a limb. Our ear and a rabbit's, or our canines and a dog's, share an origin too, but they do the same job; the answer expected is the pair where the same bones do different jobs.

- iv. b. giraffes with slightly longer necks survived hard times better and passed this variation on

U • 1

In Darwin's theory the variation is there first: necks already differ. Nature then selects the ones that survive. The first option is Lamarck's explanation, which fails because stretched necks are not inherited.

- v. a. homologous: both are built on the same bone plan

A • 1

This is a famous puzzle. As forelimbs, both have a humerus, radius, ulna and hand bones, so they are homologous. As wings, they evolved separately (the bird's from feathers, the bat's from skin between fingers), so as wings they are analogous.

4 Very short answers

- a. MARKING SCHEME

K • 1

✓ Archaeopteryx.



- b. MARKING SCHEME K · 1
✓ Carbon dating (radioactive dating).
- c. MARKING SCHEME U · 1
✓ No, because it is an acquired character, which is not inherited.

5 Short answers

- a. MARKING SCHEME U · 2
✓ Fossils are the actual remains of organisms that lived millions of years ago, in rock layers whose age can be measured.
✓ The oldest (lowest) layers hold only simple organisms and the younger (upper) layers more and more complex ones, in the order evolution predicts.
- b. MARKING SCHEME U · 2
✓ Food, space and shelter are limited, so the young must struggle with each other, with other species and with the environment.
✓ Only those with variations best suited to the environment survive and reproduce; most die before they can breed, so the numbers stay roughly the same.
- c. MARKING SCHEME U · 2
✓ Any one difference, e.g. homologous organs have the same basic structure and origin; analogous organs have a different structure and origin.
✓ Any second difference, e.g. homologous organs do different jobs, analogous organs the same job; or examples: human arm and horse's foreleg against the wings of an insect and a bird.
- d. MARKING SCHEME K · 2
✓ Any two, e.g. it is a sudden change in the genes or chromosomes; it brings a new character not seen in the parents; it is discontinuous.
✓ Any two more, e.g. it is inherited if it is in the egg or sperm; it is caused by radiation, chemicals or copying errors; most mutations are recessive and harmful or neutral.

6 Long answers

- a. ANSWER U · 4
Darwin's theory of natural selection (On the Origin of Species, 1859) has five points:
1. **Enormous fertility:** organisms produce far more young than can survive; numbers would grow geometrically, yet populations stay roughly constant.
 2. **Struggle for existence:** the young compete for limited food, space and mates, and struggle against enemies and the environment.
 3. **Variation and heredity:** individuals differ, and many variations are inherited.
 4. **Natural selection:** those with variations best suited to the environment survive and reproduce (survival of the fittest); the others die out.
 5. **Origin of new species:** favorable variations add up over many generations, until the descendants form a new species.

MARKING SCHEME

- ✓ Enormous fertility: organisms produce far more young than can survive, yet their numbers stay roughly the same.
- ✓ Struggle for existence: the young compete for limited food, space and mates, and struggle against enemies and the environment.
- ✓ Variation and heredity, and natural selection: individuals differ; those whose inherited variations suit the environment best survive and reproduce (survival of the fittest).
- ✓ Origin of new species: favorable variations add up over many generations until the descendants form a new species.



1. **Fossils:** older rock layers hold simpler organisms; e.g. ammonites, Archaeopteryx.
2. **Comparative anatomy:** homologous organs (human arm, horse's foreleg, bat's wing, whale's flipper: same bones, different jobs) show common ancestry; analogous organs (wings of insects and birds) show similar solutions in different groups.
3. **Vestigial organs:** the human appendix, coccyx and ear muscles work in other animals and in our ancestors.
4. **Connecting links:** the platypus (reptiles–mammals), Archaeopteryx (reptiles–birds) and lungfish (fish–amphibians) have features of two groups.
5. **Embryos:** the early embryos of fish, salamanders, tortoises, chickens and humans look alike, with tails and pharyngeal pouches.

MARKING SCHEME

- ✓ Fossils: older rock layers hold simpler organisms (e.g. ammonites, Archaeopteryx).
- ✓ Comparative anatomy: homologous organs (human arm, horse's foreleg, bat's wing, whale's flipper) show a common ancestor; or vestigial organs (appendix, coccyx, ear muscles) that work in other animals.
- ✓ Connecting links: the platypus (reptiles and mammals), Archaeopteryx (reptiles and birds) or the lungfish (fish and amphibians).
- ✓ Embryos: the early embryos of fish, tortoises, chickens and humans look alike, with tails and pharyngeal pouches.

7 Think**ANSWER**

HA · 2

If the course is stopped early, the bacteria that happen to resist the medicine best are the ones left alive. They multiply and pass on their resistance, so the next time the medicine may not work: antibiotic-resistant bacteria evolve by natural selection. Finishing the course kills them too.

MARKING SCHEME

- ✓ Bacteria vary, and a few happen to resist the antibiotic better; if the course is stopped early, these are the ones that survive.
- ✓ They multiply and pass on their resistance, so the medicine stops working (resistant bacteria evolve); finishing the course kills these too.

8 Activity: Variation in your family (Activity 4.1)

(not marked)

WHAT STUDENTS SHOULD FIND

Hair type, skin color, eye color and features such as six fingers are blastogenic (genetic) and can be inherited; a sudden unusual feature that runs in a family began as a mutation. A scar or a skill is somatogenic (acquired) and is not passed on. Height is both: it depends on the genes, but better food also makes children taller than their grandparents (environmental variation), and that part is not inherited.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	17	13	1	2	33

