



K16 Variation, Classification and Adaptation

AQA AQA KS3 Science - Biology · Calculator allowed · about 80 minutes

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

1 Quickfire: circle the correct letter for each question.

(a) Differences between individuals of the same species are called: **(1)**

- ☐ A) adaptation
- ☐ B) variation
- ☐ C) classification
- ☐ D) reproduction

(b) Which of these characteristics shows continuous variation? **(1)**

- ☐ A) blood group
- ☐ B) height
- ☐ C) ability to roll your tongue
- ☐ D) whether an earlobe is attached or free

(c) Differences between two different species, such as a dog and a cat, are mainly the result of: **(1)**

- ☐ A) environment only
- ☐ B) different genes
- ☐ C) random chance only
- ☐ D) different adaptations only

(d) A characteristic such as body mass, which is affected by both genes and by diet and exercise, shows: **(1)**

- ☐ A) continuous variation
- ☐ B) discontinuous variation
- ☐ C) no variation
- ☐ D) classification

2 State two causes of variation between individuals of the same species.

(2)

3 Classify each characteristic below as an example of continuous or discontinuous variation.

(a) Height of a student. (1)

(b) Blood group (A, B, AB or O). (1)

(c) Hand span (distance from thumb tip to little finger tip when the hand is stretched out). (1)

(d) Ability to roll your tongue into a U-shape (can or cannot). (1)

(e) Foot length. (1)

(f) Whether an earlobe is attached to the side of the head or hangs free. (1)

4 Living things are sorted into smaller and smaller groups using the classification hierarchy: Kingdom, _____, _____, Order, _____, Genus, Species.

(3)

5 Living things can be sorted into five kingdoms.

(3)

- 6** Scientists use the binomial naming system to give every species a unique two-part Latin name, for example *Homo sapiens* for humans.

(3)

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- 7** Use this classification key to identify each small animal described below. 1. If the animal has 6 legs, go to statement 2. If it does not have 6 legs, go to statement 3. 2. If the animal has wings, it is a ladybird. If it does not have wings, it is an ant. 3. If the animal has a hard shell on its back, it is a snail. If it does not have a hard shell, it is a spider.

(a) Animal 1 has 8 legs and no hard shell. (1)

(b) Animal 2 has 6 legs and wings. (1)

(c) Animal 3 has 6 legs and no wings. (1)

(d) Animal 4 does not have 6 legs and has a hard shell on its back. (1)

8 Adaptations can be structural (a body part), behavioural (a way an animal acts) or functional (something that happens inside the body). Classify each adaptation below.

- (a) A polar bear has a thick layer of fur and fat. (1)
- (b) A camel stores fat in its hump, which releases water and energy when broken down. (1)
- (c) Some birds migrate to warmer countries in winter. (1)
- (d) A cactus has sharp spines instead of broad leaves. (1)
- (e) A hedgehog hibernates during the coldest months. (1)
- (f) Some Arctic fish produce a natural antifreeze protein in their blood. (1)

9 Some organisms, called extremophiles, live in environments that would kill most other living things.

(2)

10 A camel living in a hot desert has large, flat feet and stores fat in a single hump on its back.

(a) Explain how the camel's large, flat feet help it survive in the desert. (2)

(b) Explain how storing fat in a hump helps the camel survive long periods without food or water. (2)

11 Cheetahs hunt gazelles. Over many generations, both cheetahs and gazelles have become faster runners.

(3)

12 A UK farm removes several hedgerows to make its fields larger for machinery. Ecologists notice that the local population of yellowhammers, a hedge-nesting bird, falls sharply over the following five years.

(4)

13 Grey squirrels were introduced to the UK and compete with the native red squirrel for the same food and habitat. In one woodland, the red squirrel population was 800 in the year before grey squirrels arrived. Five years after grey squirrels arrived, the red squirrel population had fallen to 240.

(a) Calculate the percentage decrease in the red squirrel population over the five years. (3)

(b) Suggest the main reason for this decrease. (1)

14 A class investigates camouflage. They scatter 50 small paper 'prey' shapes, some green and some red, onto a green playing field. Volunteer 'predators' have 60 seconds to spot and collect as many shapes as they can.

(3)

15 Peppered moths exist in a pale form and a dark ('melanic') form, caused by different gene variants. Before industrial pollution, tree trunks in a wood were pale and covered in lichen. After nearby factories blackened the tree trunks with soot, the proportion of dark moths in the wood increased greatly over the next few decades.

(3)

16 Vertebrates (animals with a backbone) are sorted into five groups: fish, amphibians, reptiles, birds and mammals. Use the clues to identify the group of each animal described.

- (a) Animal A has moist, permeable skin, lives in water as a young animal (breathing through gills) and on land as an adult (breathing with lungs). (1)
- (b) Animal B has dry, scaly, waterproof skin and lays soft-shelled eggs on land. (1)
- (c) Animal C has feathers, a beak, and lays hard-shelled eggs. (1)
- (d) Animal D has fur, feeds its young on milk, and controls its own body temperature. (1)
- (e) Animal E has wet scales, breathes using gills for its whole life, and lays soft eggs in water. (1)

17 State the definition of a species.

(1)

18 The Arctic fox lives in the very cold Arctic tundra. It has thick white-grey fur that turns brown in summer, small rounded ears, a short muzzle, and fur-covered paws. Explain how these adaptations help the Arctic fox survive in its environment, and predict what might happen to Arctic fox populations if the Arctic climate continues to warm.

(6)

Mark scheme · K16 Variation, Classification and Adaptation

Question 1

- (a) **B1** B (variation) cao
- (a) Answer: **B) variation**
- (b) **B1** B (height) cao
- (b) Answer: **B) height**
- (c) **B1** B (different genes) cao
- (c) Answer: **B) different genes**
- (d) **B1** A (continuous variation) cao
- (d) Answer: **A) continuous variation**

Question 2

- **B1** genetic variation (differences in genes inherited from parents)
- **B1** environmental variation (differences caused by surroundings, diet, lifestyle etc.), oe
- Answer: **Genetic variation (inherited differences) and environmental variation (differences caused by surroundings or lifestyle).**

Question 3

- (a) **B1** continuous cao
- (a) Answer: **Continuous**
- (b) **B1** discontinuous cao
- (b) Answer: **Discontinuous**
- (c) **B1** continuous cao
- (c) Answer: **Continuous**
- (d) **B1** discontinuous cao
- (d) Answer: **Discontinuous**
- (e) **B1** continuous cao
- (e) Answer: **Continuous**
- (f) **B1** discontinuous cao
- (f) Answer: **Discontinuous**

Question 4

- **B1** Phylum
- **B1** Class
- **B1** Family, all in the correct positions
- Answer: **Kingdom, Phylum, Class, Order, Family, Genus, Species.**

Question 5

- **B1** any one of: animals, plants, fungi, protists (protocista), bacteria (monera)
- **B1** a second correct kingdom from the list above
- **B1** a third correct kingdom from the list above
- Answer: **Any three of: animals, plants, fungi, protists, bacteria (monera).**

Question 6

- **B1** the first part of the name (e.g. Homo) is the genus, written with a capital letter
- **B1** the second part of the name (e.g. sapiens) is the species, written with a lower case letter
- **B1** the whole name is written in italics (or underlined by hand), oe
- Answer: **The first word (capitalised) is the genus and the second word (lower case) is the species; the full name is written in italics or underlined.**

Question 7

- (a) **B1** spider cao
- (a) Answer: **Spider**
- (b) **B1** ladybird cao
- (b) Answer: **Ladybird**
- (c) **B1** ant cao
- (c) Answer: **Ant**
- (d) **B1** snail cao
- (d) Answer: **Snail**

Question 8

- (a) **B1** structural cao
- (a) Answer: **Structural**
- (b) **B1** functional cao
- (b) Answer: **Functional**
- (c) **B1** behavioural cao
- (c) Answer: **Behavioural**
- (d) **B1** structural cao
- (d) Answer: **Structural**
- (e) **B1** behavioural cao
- (e) Answer: **Behavioural**
- (f) **B1** functional cao
- (f) Answer: **Functional**

Question 9

- **B1** names a suitable extreme environment, e.g. hot springs/deep-sea vents (very high temperature) or very salty lakes
- **B1** names a matching organism or adaptation, e.g. heat-tolerant bacteria that can survive very high temperatures, oe
- Answer: **Bacteria living in hot springs or deep-sea vents can survive extremely high temperatures that would kill most other organisms.**

Question 10

- (a) **B1** large flat feet spread the camel's weight over a bigger area
- (a) **B1** so the camel is less likely to sink into soft sand, allowing it to walk more easily to find food and water, oe
- (a) Answer: **Large, flat feet spread the camel's weight over a bigger area, stopping it sinking into soft sand.**
- (b) **B1** the fat stored in the hump can be broken down (respired) to release energy when food is scarce
- (b) **B1** breaking down this fat also releases water, helping the camel survive when water is scarce, oe
- (b) Answer: **The fat in the hump can be broken down to release energy, and this process also releases water, helping the camel survive when food and water are scarce.**

Question 11

- **B1** faster gazelles are more likely to escape cheetahs and survive to reproduce, passing on genes for speed
- **B1** faster cheetahs are more likely to catch enough gazelles to survive and reproduce, passing on genes for speed
- **B1** over many generations this increases average speed in both populations, oe
- Answer: **Faster gazelles are more likely to escape and survive to reproduce, and faster cheetahs are more likely to catch food and survive to reproduce; over many generations both populations become faster as these genes are passed on.**

Question 12

- **B1** hedgerows provide nesting sites, so fewer hedgerows means fewer safe places to breed
- **B1** hedgerows also provide seeds, berries and insects to eat, so removing them reduces the food supply
- **B1** with less shelter, more chicks/eggs may be lost to predators or bad weather
- **B1** overall, fewer birds survive and breed successfully, so the population decreases, oe
- **Answer: Removing hedgerows destroys nesting sites and reduces the supply of seeds, berries and insects, and removes shelter from predators. With less food, fewer safe nest sites and more predation, fewer yellowhammers survive and breed, so the population falls.**

Question 13

- (a) **M1** decrease = $800 - 240 = 560$
- (a) **M1** $(560 / 800) \times 100$
- (a) **A1** = 70% decrease cao
- (a) **Answer: 70% decrease**
- (b) **B1** competition with grey squirrels for the same food and habitat, so fewer resources are available for red squirrels, oe
- (b) **Answer: Competition with grey squirrels for the same limited food and habitat means fewer resources are available for red squirrels.**

Question 14

- **B1** independent variable: colour of the paper prey shape (green or red)
- **B1** dependent variable: number of that colour of shape found/collected
- **B1** a control variable: e.g. searching time (60 s for everyone), number of predators, area searched, or number of shapes scattered, oe
- **Answer: Independent variable: colour of prey shape. Dependent variable: number of shapes of that colour found. Control variable: searching time (60 s for everyone).**

Question 15

- **B1** both pale and dark moths already existed in the population because of natural genetic variation
- **B1** on blackened trunks, dark moths are better camouflaged from birds, so pale moths are more often seen and eaten
- **B1** more dark moths survive to reproduce and pass on the gene for the dark colour, so the proportion of dark moths increases over generations, oe
- **Answer: Genetic variation meant both forms already existed. Once trunks were blackened, dark moths were better camouflaged and survived predation better than pale moths, so more dark moths reproduced and passed on their genes, increasing the proportion of dark moths over time.**

Question 16

- (a) **B1** amphibian cao
- (a) **Answer: Amphibian**
- (b) **B1** reptile cao
- (b) **Answer: Reptile**
- (c) **B1** bird cao
- (c) **Answer: Bird**
- (d) **B1** mammal cao
- (d) **Answer: Mammal**
- (e) **B1** fish cao
- (e) **Answer: Fish**

Question 17

- **B1** a group of organisms that can breed (interbreed) together to produce fertile offspring, oe
- **Answer: A group of organisms that can breed together to produce fertile offspring.**

Question 18

- **Level 1** (1-2): Simple, isolated statements identifying one or two adaptations, e.g. thick fur keeps it warm, with little or no explanation and no prediction about climate change.
- **Level 2** (3-4): Several adaptations are correctly explained (structural and/or behavioural, e.g. fur, ear size, camouflage), with some reference to survival, and a simple prediction about the effect of warming that lacks detail or reasoning.
- **Level 3** (5-6): A clear, well-linked explanation of multiple adaptations (insulation, reduced heat loss from small ears/short muzzle, seasonal camouflage) showing how each aids survival, together with a well-reasoned prediction of population decline or range shift linked to loss of camouflage and/or increased competition as the climate warms.
- **Indicative content:**
 - Thick fur (and fur-covered paws) traps a layer of insulating air, reducing heat loss from the body in extreme cold - a structural adaptation.
 - Small, rounded ears and a short muzzle reduce the surface area from which body heat can be lost, helping the fox conserve heat (structural adaptation, linked to lower surface area to volume ratio).
 - Fur that turns from white-grey in winter to brown in summer gives camouflage against snow or bare tundra, making the fox harder for prey to detect and less visible to predators (structural/seasonal adaptation).
 - Foxes may also den underground or reduce activity in the harshest weather, a behavioural adaptation that further reduces heat loss and energy use.
 - Prediction: if the Arctic warms, snow cover lasts for a shorter part of the year, so the fox's white winter coat may be mismatched with a snow-free background for longer periods, making it more visible to predators and less successful at hunting.
 - A warmer climate may also let the larger, more dominant red fox move further north, increasing competition for food and space with Arctic foxes.
 - Both effects (poorer camouflage and competition) would be expected to reduce Arctic fox survival, breeding success and population size over time, or force populations further north.