

GCSE Combined Science: Trilogy

Worksheet: Adaptations

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Adaptations

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

Organisms have adaptations that help them survive in the conditions where they normally live. Adaptations can be structural, behavioural or functional.

Table 1

Adaptation	Type of adaptation
A desert rodent produces a very small volume of very concentrated urine	
An Arctic fox has thick white fur in winter	
A desert lizard hides in a burrow during the hottest part of the day	

0 1 . 1

Complete Table 1.
Write **structural**, **behavioural** or **functional** in each box.

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[3 marks]

0 1 . 2

Some organisms live in environments with a very high temperature, pressure or salt concentration.

What name is given to these organisms?

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.....

[1 mark]

0 1 . 3

Give **one** place where bacteria that are extremophiles live.

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.....

[1 mark]

0 2

Organisms have adaptations that enable them to survive in the conditions in which they normally live.

0 2 . 1

Which is a behavioural adaptation?

Tick (✓) **one** box.

A hedgehog hibernates during the winter.

☐

A polar bear has a thick layer of fat.

☐

A cactus stores water in its stem.

☐

A desert rat produces very concentrated urine.

☐

[1 mark]

0 2 . 2

Which is a functional adaptation?

Tick (✓) **one** box.

A camel has long eyelashes.

☐

An Antarctic fish makes antifreeze proteins in its blood.

☐

Penguins huddle together in cold weather.

☐

A cactus has spines instead of leaves.

☐

[1 mark]

0 2 . 3

Bacteria that live near deep-sea vents are extremophiles.
Give **two** extreme conditions that these bacteria are adapted to.

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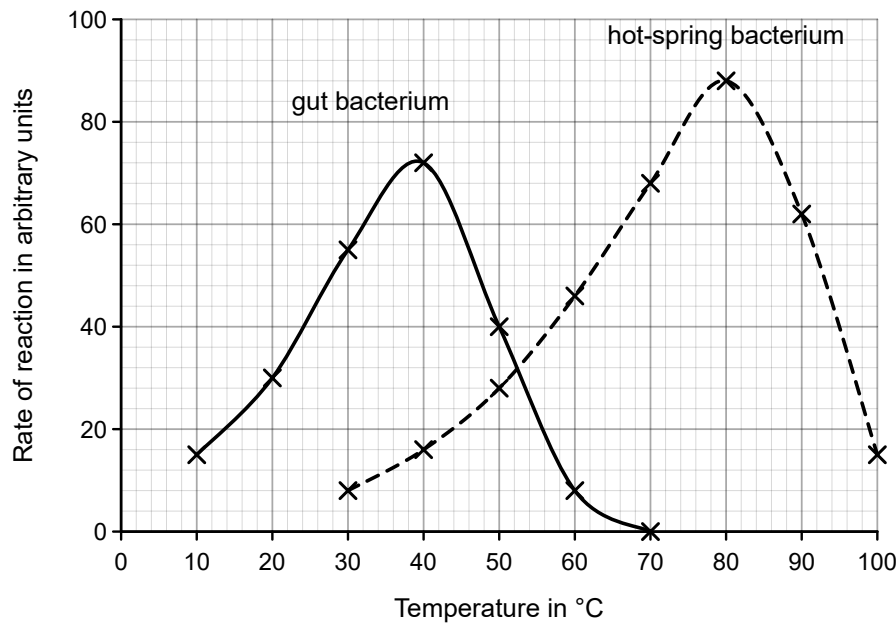
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[2 marks]

0 3

Some bacteria live in hot springs where the water is at 80 °C. Scientists extracted an enzyme from these bacteria and a similar enzyme from bacteria that live in the human gut. They measured the rate of reaction of each enzyme at different temperatures. Figure 1 shows the results.

Figure 1



0 3 . 1

Give the optimum temperature of the enzyme from the hot-spring bacteria.

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Optimum temperature = °C

[1 mark]

0 3 . 2

Explain why the enzyme from the gut bacteria has a very low rate of reaction at 60 °C.

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[3 marks]

0 3 . 3

The hot-spring bacteria are extremophiles.
Explain how their enzymes are an adaptation to their environment.

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[2 marks]

0 3 . 4

Suggest why the hot-spring bacteria could not grow well in the human gut.

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[1 mark]

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0 4

A student modelled a mouse and a rabbit as spheres. The model of a mouse had a radius of 2 cm. The model of a rabbit had a radius of 6 cm.

For a sphere with radius r : surface area = $4\pi r^2$ and volume = $\frac{4}{3} \times \pi r^3$.

0 4 . 1

Calculate the surface area to volume ratio of the model of a mouse.

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Ratio = : 1

[2 marks]

0 4 . 2

The surface area to volume ratio of the model of a rabbit is 0.5 : 1.
Use the ratios to explain why a mouse loses heat faster, for its size, than a rabbit.

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[2 marks]

0 4 . 3

Suggest **one** way in which a mouse is adapted to reduce heat loss.

.....

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[1 mark]

0 5

A student modelled a shrew and a hedgehog as spheres. The model of a shrew had a radius of 3 cm. The model of a hedgehog had a radius of 10 cm.

For a sphere with radius r : surface area = $4\pi r^2$ and volume = $\frac{4}{3} \times \pi r^3$.

0 5 . 1

Calculate the surface area to volume ratio of the model of a shrew.

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Ratio = : 1

[2 marks]

0 5 . 2

The surface area to volume ratio of the model of a hedgehog is 0.3 : 1.
Use the ratios to explain why a shrew loses heat faster, for its size, than a hedgehog.

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[2 marks]

0 5 . 3

Suggest **one** way in which a shrew is adapted to reduce heat loss.

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[1 mark]

0 6

Water lilies grow in ponds. Their roots are in the mud at the bottom of the pond, and their leaves float on the surface of the water. Table 2 compares the leaves of a water lily with the leaves of a typical land plant.

Table 2

Feature	Water lily leaf	Land plant leaf
Position of stomata	upper surface only	mostly on the lower surface
Waxy cuticle	thin	thick
Air spaces in the leaf and stem	very large	small
Size and shape	large, flat and round	smaller

0 6 . 1

Explain why the water lily has stomata only on the upper surface of its leaves.

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[2 marks]

0 6 . 2

Suggest why the water lily has only a thin waxy cuticle.

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[1 mark]

0 6 . 3

Suggest **two** functions of the large air spaces in the leaves and stem.

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[2 marks]

0 6 . 4

Suggest how the large, flat leaves help the water lily to compete with other water plants.

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[1 mark]



END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

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Question 1 (5 marks)

01.1 [3 marks]

Answer: Functional; structural; behavioural

- concentrated urine: functional (1)
 - thick white fur: structural (1)
 - hiding in a burrow: behavioural (1)
-

01.2 [1 mark]

Answer: Extremophiles

- extremophiles (1)
-

01.3 [1 mark]

- deep-sea (hydrothermal) vents (1)
- hot springs (1)
- very salty lakes (1)

Any 1 of the points above.

Question 2 (4 marks)

02.1 [1 mark]

Correct: A hedgehog hibernates during the winter.

02.2 [1 mark]

Correct: An Antarctic fish makes antifreeze proteins in its blood.

02.3 [2 marks]

- high temperature (1)
- high pressure (1)
- no light (1)
- high concentrations of dissolved chemicals / minerals (1)

Any 2 of the points above.

Question 3 (7 marks)

03.1 [1 mark]

Answer: 80 °C

- 80 (°C) (1)

03.2 [3 marks]

- the enzyme is denatured (1)
- the shape of the active site changes (1)
- the substrate no longer fits / binds to the active site (1)

03.3 [2 marks]

- they live in an extreme environment with a very high temperature (1)
- their enzymes are not denatured / work fastest at high temperatures, so reactions such as respiration can continue (1)

03.4 [1 mark]

- the gut temperature (37 °C) is too low: their enzymes work very slowly, so metabolism / respiration is too slow (1)

Question 4 (5 marks)

04.1 [2 marks]

Answer: 1.5 : 1

- surface area = 50.3 cm² and volume = 33.5 cm³ (1)
- 1.5 : 1 (1)

Notes: Allow answers that differ slightly because of rounding the surface area and volume.

04.2 [2 marks]

- the model of a mouse has the larger surface area to volume ratio (1)
- so it has more surface area through which heat is lost compared with the volume of body that produces heat by respiration (1)

04.3 [1 mark]

- thick fur, which traps air for insulation (1)
- a layer of fat under the skin (1)
- curling up / sheltering in a nest or burrow (1)

Any 1 of the points above.

Question 5 (5 marks)

05.1 [2 marks]

Answer: 1 : 1

- surface area = 113 cm^2 and volume = 113 cm^3 (1)
- 1 : 1 (1)

Notes: Allow answers that differ slightly because of rounding the surface area and volume.

05.2 [2 marks]

- the model of a shrew has the larger surface area to volume ratio (1)
- so it has more surface area through which heat is lost compared with the volume of body that produces heat by respiration (1)

05.3 [1 mark]

- thick fur, which traps air for insulation (1)
- a layer of fat under the skin (1)
- curling up / sheltering in a nest or burrow (1)

Any 1 of the points above.

Question 6 (6 marks)

06.1 [2 marks]

- the lower surface is in contact with water / only the upper surface is in contact with the air (1)
- stomata allow gas exchange with the air: carbon dioxide diffuses in for photosynthesis and oxygen diffuses out (1)

06.2 [1 mark]

- it does not need to reduce water loss, because it has plenty of water (1)

06.3 [2 marks]

- they help the leaves to float on the surface, in the light (1)
- they allow oxygen to diffuse down to the roots, which are in mud that contains little oxygen, for (aerobic) respiration (1)

Notes: Each mark must be for a different function.

06.4 [1 mark]

- they absorb more light for photosynthesis and shade the plants below them (1)
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