1.23 Ecosystems, Adaptation and Feeding Relationships: 1-hour Pack

AQA 8464 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Give one biotic factor, other than predation, that could cause the population of wild rabbits in a field to decrease. Explain how this factor could reduce the rabbit population.

(Total for Question 1 is 2 marks)

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2 The table shows estimated snowshoe hare and Canada lynx population sizes, in the same area of forest, over a 10-year period.

Year 1: hares 20000, lynx 800
Year 2: hares 55000, lynx 1200
Year 3: hares 90000, lynx 3000
Year 4: hares 60000, lynx 4500
Year 5: hares 25000, lynx 3500
Year 6: hares 15000, lynx 1500
Year 7: hares 30000, lynx 900
Year 8: hares 65000, lynx 1400
Year 9: hares 95000, lynx 3200
Year 10: hares 55000, lynx 4200

(a) Describe the relationship shown between the changes in the hare population and the changes in the lynx population. **(2)**

(b) Explain why changes in the population of Canada lynx lag behind changes in the population of snowshoe hares. **(6)**

(Total for Question 2 is 8 marks)

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3 Aaliyah wanted to compare the abundance of creeping buttercup plants in a sunny, open part of the school field with a shaded part underneath a large oak tree. She used a quadrat measuring 1 m x 1 m.

(a) Describe how Aaliyah should use the quadrat to collect random samples of creeping buttercup in each part of the field. **(3)**

(b) In the sunny area, Aaliyah counted the number of creeping buttercup plants in 10 quadrats. Her results were: 8, 12, 6, 10, 14, 8, 10, 8, 12, 12. Calculate the mean number of creeping buttercup plants per quadrat. **(2)**

.....

(c) The area of the sunny part of the field is 250 m^2. Estimate the total population of creeping buttercup plants in this part of the field. **(3)**

.....

(d) Explain why using randomly generated coordinates to position the quadrats, rather than Aaliyah choosing positions by eye, gives a more valid estimate of the buttercup population. **(2)**

(Total for Question 3 is 10 marks)

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4 Callum thought that light intensity affected where white clover grew in a field bordered by a tall, dense hedge. He wanted to investigate how the percentage cover of white clover changed with distance from the hedge.

(a) Name the sampling technique Callum should use to investigate how the percentage cover of white clover changes with distance from the hedge. **(1)**

(b) Describe how Callum could use this technique, together with a light meter, to collect suitable data. **(4)**

(c) At one point along the transect, a quadrat was divided into 100 equal squares. White clover was present in 37 of these squares. Calculate the percentage cover of clover at this point. **(2)**

(d) Callum's results showed that the percentage cover of white clover was much lower close to the hedge than in the open field. Use your knowledge of photosynthesis to suggest an explanation for this pattern. **(3)**

(Total for Question 4 is 10 marks)

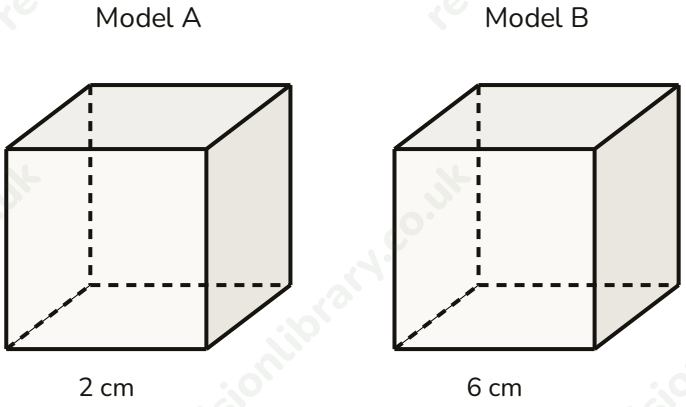
5 Polar bears live in the Arctic, where air temperatures can fall below -30 C. Explain how two structural adaptations help polar bears to survive these cold conditions.

(Total for Question 5 is 4 marks)

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6 Amelia is comparing how body size affects heat loss in cold climates, using two cube-shaped models to represent two animals of different size. Model A has sides of length 2 cm. Model B has sides of length 6 cm.

Diagram NOT accurately drawn



(a) Calculate the surface area and the volume of model A (sides of 2 cm). **(2)**

.....

(b) Calculate the surface-area-to-volume ratio of model A, giving your answer in the form n : 1. **(1)**

.....

(c) Calculate the surface-area-to-volume ratio of model B (sides of 6 cm), giving your answer in the form n : 1. **(2)**

.....

(d) Using your answers to (b) and (c), explain which model represents an animal that is better adapted to surviving in a cold climate. **(1)**

.....

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(Total for Question 6 is 6 marks)

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7 Camels store fat in a hump on their back, rather than as a layer spread evenly under the skin like many other mammals. Suggest why storing fat in this way is an advantage for camels living in hot desert conditions.

(Total for Question 7 is 2 marks)

8 Callum records the number of dandelion plants in ten 0.5 m by 0.5 m quadrats placed randomly across a school field with a total area of 2400 m^2. The total number of dandelions counted across all ten quadrats is 65.

(a) Calculate the mean number of dandelions per quadrat. **(1)**

(b) Each quadrat has an area of 0.25 m^2. Use your answer to (a) to estimate the total number of dandelions growing across the whole 2400 m^2 field. Show your working. **(3)**

(Total for Question 8 is 4 marks)

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Mark scheme · 1.23 Ecosystems, Adaptation and Feeding Relationships: 1-hour Pack

Question 1

a suitable biotic factor named, e.g. a new disease/pathogen spreading through the population, or increased competition (with other rabbits or another herbivore species) for food **B1**

a linked explanation, e.g. disease increases the death rate/reduces reproduction in the population; or competition means less food is available per rabbit, reducing survival and reproduction rates, oe **B1**

Answer: For example, a new disease spreading through the population (a biotic factor) could increase the death rate and reduce the rabbits' ability to reproduce, lowering the population.

Question 2

(a) both populations rise and fall in a repeating (cyclical) pattern over the 10 years **B1**

(a) the changes in the lynx population follow the same pattern as the hare population, but lag behind by about a year (e.g. hares peak in year 3, but lynx peak in year 4) **B1**

(a) Answer: Both populations show a repeating, cyclical rise-and-fall pattern, with the lynx population's changes lagging around a year behind the same changes in the hare population.

(b) **L3** A clear, logically sequenced explanation of the full predator-prey cycle, correctly linking food availability to changes in the lynx population and explaining the time lag in both the rise and the fall of lynx numbers. **5-6**

(b) **L2** The explanation links food availability to changes in the lynx population and refers to a time lag, but the chain of reasoning is incomplete or not fully sequenced (e.g. only the rise, or only the fall, is explained fully). **3-4**

(b) **L1** Basic, largely isolated statements are made about the link between hares and lynx (e.g. 'lynx eat hares'), with little or no reference to a time lag or mechanism. **1-2**

(b) **L0** No relevant content. **0**

(b) Indicative content:

- When the hare population is high, there is a large amount of food available for the lynx.
- This greater food supply allows lynx to survive better and have more energy/resources for reproduction, so the lynx population begins to increase.
- It takes time for lynx to breed and for young lynx to grow, so the increase in the lynx population happens (lags) after the increase in the hare population.
- As the lynx population increases, more hares are eaten (predation pressure increases), so the hare population starts to decrease.
- With fewer hares available, there is less food for the lynx, so the lynx population also starts to decrease, again after a delay.
- With fewer lynx, predation pressure on the hares reduces, allowing the hare population to increase again, and the cycle repeats.

(b) Answer: Levels of response question - no single correct answer; credit a clear, logically sequenced explanation covering how hare numbers affect lynx food supply and breeding success, and how the resulting change in lynx numbers (after a delay) then affects hare numbers through predation, completing the cycle. See indicative content.

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Question 3

(a) mark out a grid across each study area, e.g. by laying two tape measures at right angles, to create a set of coordinates **B1**

(a) use a random number generator (or random number table) to generate pairs of coordinates **B1**

(a) place the quadrat at each randomly generated coordinate and count/record the number of buttercup plants inside it, repeating for a suitably large number of quadrats (e.g. at least 10) in each area, oe **B1**

(a) Answer: Mark out a grid of coordinates across each area, use a random number generator to pick coordinate pairs, then place the quadrat at each randomly chosen point and count the buttercups inside, repeating for at least 10 quadrats in each area.

(b) total = 100 (sum of the 10 counts), divided by 10 **M1**

(b) 10.0 (buttercups per quadrat) cao **A1**

(b) Answer: 10.0 creeping buttercup plants per quadrat.

(c) number of 1 m^2 quadrats needed to cover the whole area = 250 / 1 (= 250), ft from (b) **M1**

(c) population estimate = mean count per quadrat x number of quadrats **M1**

(c) 2500 creeping buttercup plants, allow ecf from the student's mean in part (b) **A1**

(c) Answer: Approximately 2500 creeping buttercup plants.

(d) choosing positions by eye could introduce bias, e.g. Aaliyah might unconsciously choose areas that look like they have more (or fewer) buttercups **B1**

(d) random positioning means every part of the area has an equal chance of being sampled, so the sample is more likely to be representative of the whole area, giving a more valid estimate, oe **B1**

(d) Answer: Choosing quadrat positions by eye could introduce bias, for example by unconsciously picking areas with more or fewer buttercups; random coordinates give every part of the area an equal chance of being sampled, so the estimate is more likely to be representative and valid.

Question 4

(a) a belt transect (accept 'transect') **B1**

(a) Answer: A belt transect.

(b) lay a tape measure (or string) in a straight line from the hedge out into the open field **B1**

(b) starting at the hedge, place a quadrat at regular intervals along the tape (e.g. every 2 m) **B1**

(b) at each point, record the percentage cover of white clover within the quadrat, e.g. using a quadrat with a grid of numbered squares to help estimate cover **B1**

(b) at each of the same points, measure and record the light intensity using a light meter/data logger, held at the same height and angle each time, oe **B1**

(b) Answer: Lay a tape measure in a straight line from the hedge into the field, and place a quadrat at regular intervals (e.g. every 2 m) along it. At each point, record the percentage cover of clover using a gridded quadrat, and measure light intensity with a light meter held at the same height and angle each time.

(c) (37/100) x 100, oe **M1**

(c) 37% cao **A1**

(c) Answer: 37%

(d) close to the hedge, the tall hedge blocks/shades light, so light intensity is lower there than further into the open field **B1**

(d) light is needed, along with carbon dioxide and water, for photosynthesis, so a lower light intensity limits the rate of photosynthesis near the hedge **B1**

(d) this means white clover near the hedge produces less glucose for growth, so fewer/smaller clover plants survive there, giving a lower percentage cover than in the open field, where higher light intensity allows a faster rate of photosynthesis and more growth, oe **B1**

(d) Answer: Close to the hedge, shading reduces light intensity, which limits the rate of photosynthesis; with less glucose produced for growth, fewer clover plants can survive there, giving lower percentage cover than further into the open field, where light intensity (and so photosynthesis and growth) is greater.

Question 5

adaptation 1 named: a thick layer of fat (blubber) under the skin **B1**

explanation: the blubber acts as an insulating layer, reducing the rate of heat loss from the body, oe **B1**

adaptation 2 named: a compact, rounded body shape with small ears (a relatively small surface area) **B1**

explanation: this gives a small surface area to volume ratio, which reduces the rate of heat loss from the body, oe **B1**

Answer: A thick layer of blubber under the skin insulates the body and reduces heat loss; a compact, rounded body with small ears gives a small surface area to volume ratio, which also reduces heat loss.

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Question 6

(a) surface area = 6 x (2 x 2) = 24 cm^2 **M1**

(a) volume = 2 x 2 x 2 = 8 cm^3 **A1**

(a) Answer: Surface area = 24 cm^2; volume = 8 cm^3

(b) 3 : 1 (24 / 8 = 3), ecf from part (a) **B1**

(b) Answer: 3 : 1

(c) surface area = 6 x (6 x 6) = 216 cm^2 and volume = 6 x 6 x 6 = 216 cm^3 **M1**

(c) 1 : 1 (216 / 216 = 1) cao **A1**

(c) Answer: 1 : 1

(d) model B (the larger animal), because it has a smaller surface-area-to-volume ratio, so it loses proportionally less heat energy from its body surface relative to the heat it generates/stores in its volume, so it can maintain its body temperature more easily in the cold, oe **B1**

(d) Answer: Model B, because its lower surface-area-to-volume ratio (1:1, compared with 3:1) means it loses relatively less heat through its surface, so it retains body heat more easily in a cold climate.

Question 7

if fat were spread evenly under the skin, it would act as an insulating layer over the whole body, trapping heat inside **B1**

storing the fat in one place (the hump) leaves the rest of the body without this insulating layer, so heat can be lost more easily through the skin, helping the camel avoid overheating, oe **B1**

Answer: If fat were spread under the skin it would insulate the whole body and trap heat in; keeping it in a hump leaves the rest of the skin free to lose heat easily, helping the camel avoid overheating in the desert heat.

Question 8

(a) 6.5 (65 / 10) cao **B1**

(a) Answer: 6.5 dandelions per quadrat

(b) calculates mean density: 6.5 / 0.25 = 26 dandelions per m^2 **M1**

(b) substitutes: 26 x 2400 **M1**

(b) 62400 dandelions cao **A1**

(b) Answer: 62400 dandelions

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