**Write your name, centre number and candidate number in the boxes below.**

| Surname | Other names |
|---|---|
| | |

Centre number | | | | | |

Candidate number | | | | |

**STEM** | Exam Builder

# Organisms and their environment

Time allowed: 1 hour 25 minutes

**Subject code** **0610**

# Biology

## Questions from Paper 3 and Paper 4

**You must have:** a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

**/ 90**

### Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

### Information

- This paper has 10 questions worth 90 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

### Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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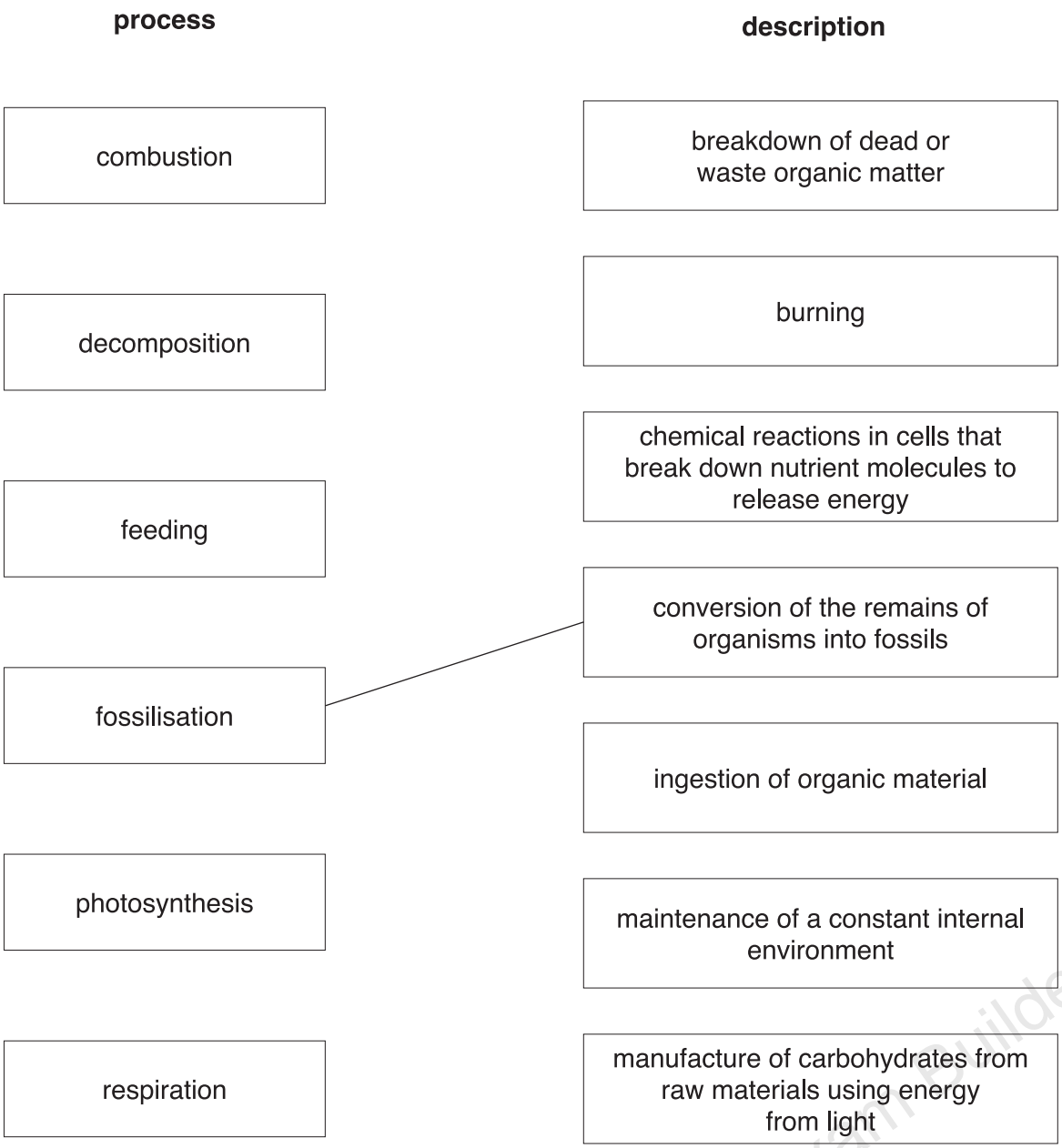
Print at 100% (Actual size) so diagrams keep their real measurements.

**1** The boxes on the left contain the names of processes from the carbon cycle.

The boxes on the right contain some descriptions of processes.

Draw **one** straight line from each process to link the process to its description.

An example has been done for you.




[5]

[Total: 5]

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Carbon, nitrogen and water cycles Click for more variations

| | | | |
|---|---|---|---|
| 1 | combustion → burning<br>decomposition → breakdown...<br>feeding → ingestion of...<br>fossilisation → conversion of remains...<br>photosynthesis → manufacture...<br>respiration → chemical reactions...<br>maintenance of...<br>;;;;; | 5 | |

2 Fig. 9.1 shows a food web.

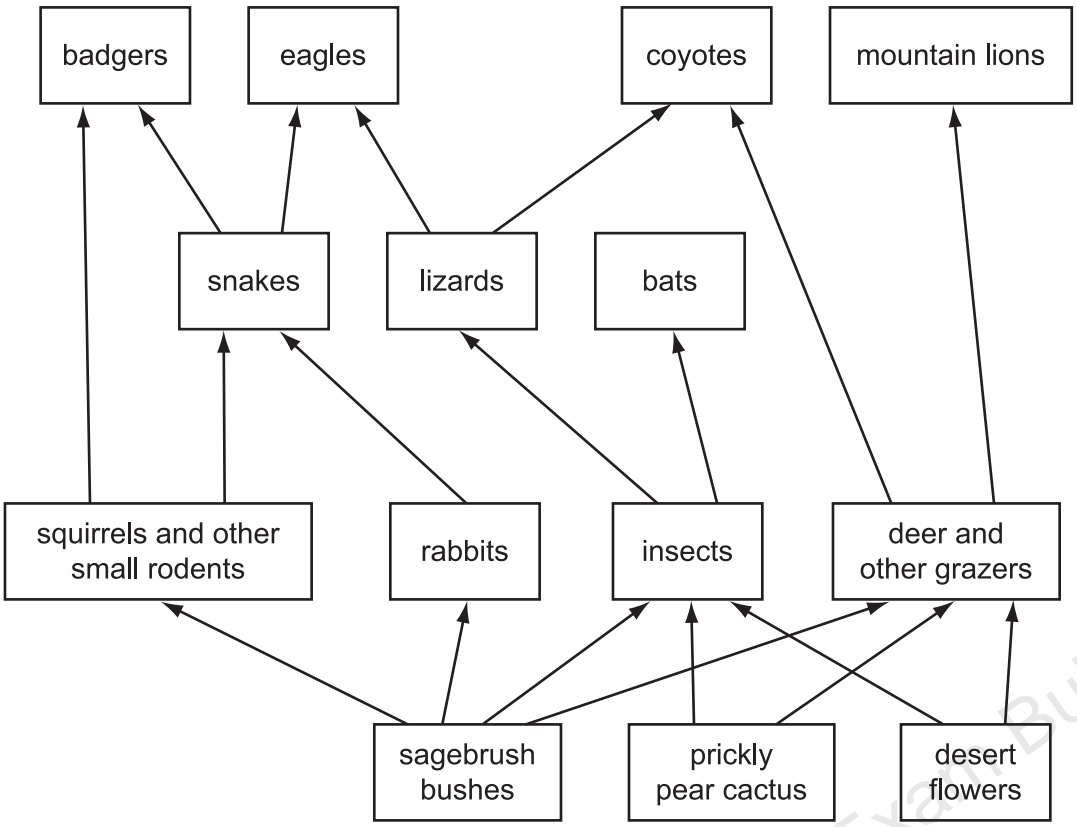



**Fig. 9.1**

**(a)** Explain the difference between a food web and a food chain.

.....

.....

.....

..... [2]

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**(b)** From the food web name:

**(i)** a carnivore; .....

**(ii)** a producer; .....

**(iii)** a consumer from the 2nd trophic level. ..... [3]

**(c)** In some regions, mountain lions have been hunted and face extinction.

Suggest how the coyotes might be affected if the mountain lion became extinct.

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

Food chains, food webs and energy flow Click for more variations

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| | | | |
|---|---|---|---|
| 2 **(a)** | food chain shows energy transfer from one organism to next organism;<br><br>food web shows energy transfer through an ecosystem; | [2] | A – only one organism at each (trophic) level<br><br>A – can have more than one organism at (trophic) levels<br>A – food web is a network of linked food chains |
| **(b)** | **(i)** snake / lizard / bat / badger / eagle / coyote / mountain lion; | | |
| | **(ii)** producer – sage brush / prickly pear (cactus) / (desert) flowers; | | A – bushes, cactus |
| | **(iii)** rabbit / insects / deer (and other grazers) / squirrel (and other small rodents); | [3] | |
| **(c)** | (no mountain lions / extinction) leads to increase in numbers of deer (and other grazers);<br><br>more food for coyotes;<br><br>leads to increase in numbers of coyotes; | [3] | A – alternative routes that lead from mountain lion to coyotes via deer, producers, insects, lizards, etc.<br><br>A – less competition for food |
| | | **[Total: 8]** | |

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**3** **(a)** The boxes on the left show two terms.

The boxes on the right show the descriptions of some terms.

Draw **one** line to link each term to its description.

Draw **two** lines.

| term | description |
| --- | --- |
| | a group of organisms that can reproduce to produce fertile offspring |
| | all of the populations of different species in an ecosystem |
| community | |
| | an organism that gets its energy by feeding on other organisms |
| | a group of organisms of one species, living in the same area, at the same time |
| population | |
| | the position of an organism in a food chain, food web or ecological pyramid |
| | a unit containing the different species of organisms and their environment, interacting together |

[2]

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**(b)** The growth of bacteria in a flask containing nutrients was monitored for six hours.

The number of **live** bacteria per $cm^3$ was estimated every 30 minutes.

Fig. 6.1 shows the results.

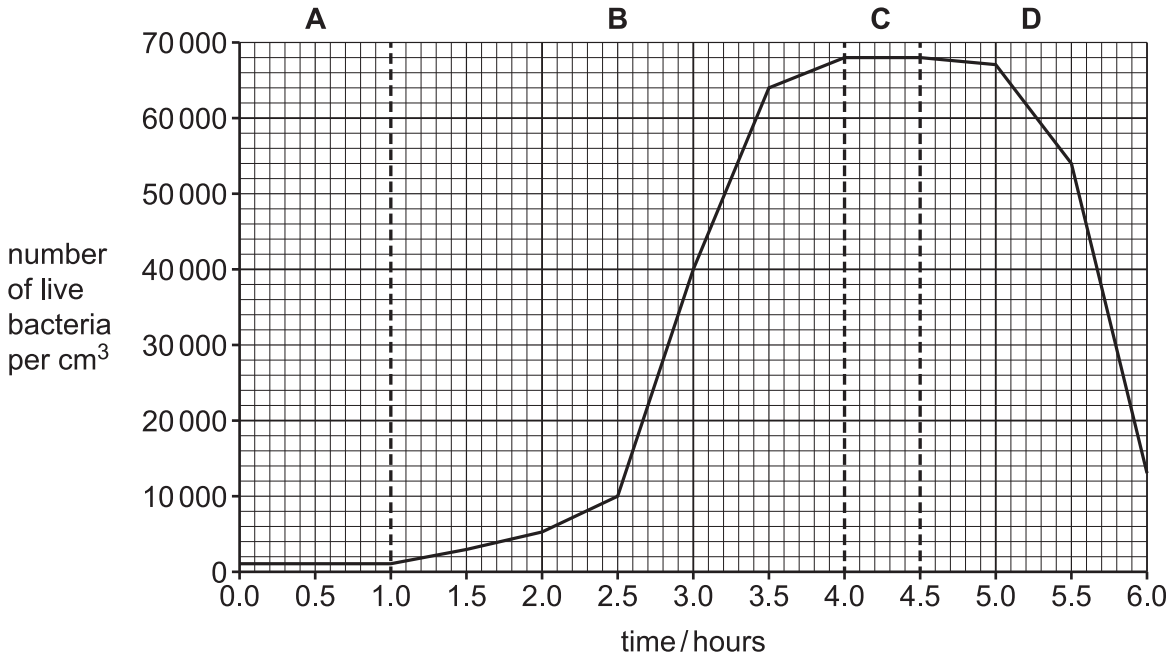



**Fig. 6.1**

**(i)** The data in the graph has been divided into four phases: **A**, **B**, **C** and **D**.

The list shows the names of the four phases.

**death** **exponential** **lag** **stationary**

Use the words from the list to identify phases **A**, **B**, **C** and **D** shown in Fig. 6.1.

**A** .....

**B** .....

**C** .....

**D** .....

[2]

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**(ii)** Complete the sentences using the data shown in Fig. 6.1 and your knowledge.

The number of live bacteria in phase **A** remained at .....

per $cm^3$.

In phase **B** the number of live bacteria doubled between 2.0 hours and

..... hours.

The maximum number of live bacteria occurred in phase ..... .

In phase ..... the number of live bacteria decreased because the bacteria did not have enough ..... .

[5]

[Total: 9]

Populations Click for more variations

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| | | | |
|---|---|---|---|
| 3(a) | term / description<br>a group of organisms that can reproduce to produce fertile offspring<br>community → all of the populations of different species in an ecosystem<br>an organism that gets its energy by feeding on other organisms<br>population → group of organisms of one species, living in the same area, at the same time<br>the position of an organism in a food chain, food web or ecological pyramid<br>unit containing the different species of organisms and their environment, interacting together | 2 | **R** each additional line |
| 3(b)(i) | **A** lag<br>**B** exponential<br>**C** stationary<br>**D** death ;; | 2 | all correct = 2 marks<br>any 1 correct = 1 mark |
| 3(b)(ii) | 1000 ;<br>2.5 ;<br>**C** ;<br>**D** ;<br>(named) nutrients / oxygen ; | 5 | |

**4** Fig. 5.1 shows a food web.

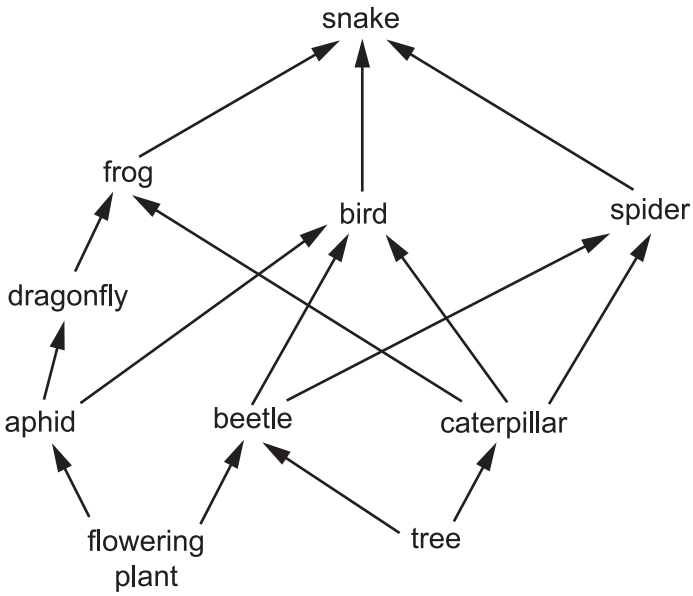



**Fig. 5.1**

**(a) (i)** Complete Table 5.1 using the information in Fig. 5.1.

One has been done for you.

**Table 5.1**

| | number shown in Fig. 5.1 |
|---|---|
| producers | 2 |
| herbivores | |
| primary consumers | |
| carnivores | |

[3]

**(ii)** State the name of **one** organism in Fig. 5.1 which obtains its energy from eating three different organisms.

..... [1]

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**(b)** A disease killed most of the snakes in the food web in Fig. 5.1.

Complete the sentences by circling the correct words **in bold**.

The first one has been done for you.

The population of snakes **increases / (decreases) / stays the same** .

The population of spiders **increases / decreases / stays the same** because there is less **predation / food / competition** .

The population of caterpillars **increases / decreases / stays the same** because there is more **predation / food / competition** .

[2]

**(c)** Decomposers are not shown in the food web in Fig. 5.1.

Complete the definition of the term decomposer.

A decomposer is an organism that gets its ..... from dead or waste ..... material.

[2]

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**(d)** Fig. 5.2 shows a food chain.




**Fig. 5.2**

Table 5.2 shows the number of organisms in this food chain and some of the information needed to draw a pyramid of numbers.

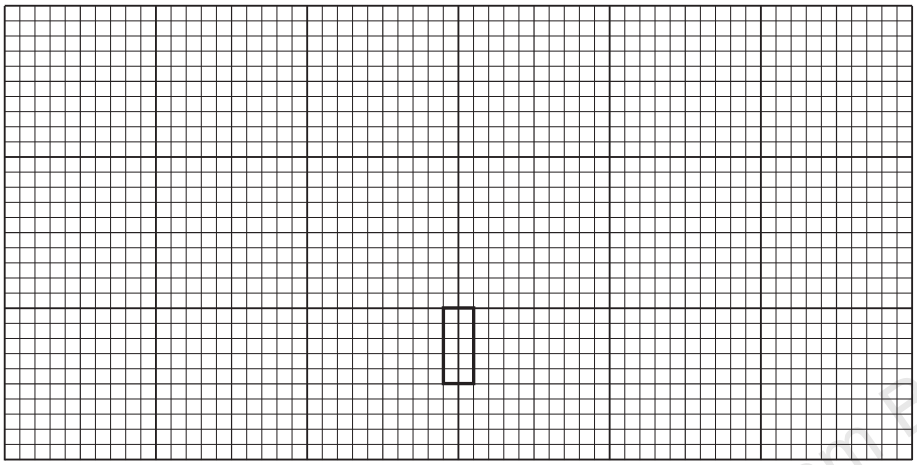
**Table 5.2**

| organism | number of organisms | width of bar in pyramid / mm |
|---|---|---|
| bird | 2 | |
| caterpillar | 20 | 80 |
| cabbage | 1 | 4 |

**(i)** Complete Table 5.2 by calculating the missing value and writing it in the table. [1]

**(ii)** Complete the pyramid of numbers on the grid for the food chain shown in Fig. 5.2 using the information in Table 5.2. The bar for the cabbage has been done for you.

Label the organisms on the pyramid of numbers.



[3]

[Total: 12]

Food chains, food webs and energy flow Click for more variations
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| | | | |
|---|---|---|---|
| **4**(a)(i) | <table><tr><th>organism</th><th>number</th></tr><tr><td>producers</td><td>2</td></tr><tr><td>herbivores</td><td>3 ;</td></tr><tr><td>primary consumers</td><td>3 ;</td></tr><tr><td>carnivores</td><td>5 ;</td></tr></table> | **3** | |
| **4**(a)(ii) | bird / snake ; | **1** | |
| **4**(b) | increases **and** predation ;<br>decreases **and** predation ; | **2** | one mark for each correct sentence |
| **4**(c) | energy ;<br>organic ; | **2** | |
| **4**(d)(i) | 8 ; | **1** | |
| **4**(d)(ii) | correct order – caterpillar above cabbage and bird above caterpillar ;<br><br>correct block width – caterpillar 40 small square wide and bird 4 small squares wide ;<br><br>three correct name labels that match the block size ; | **3** | ecf from 5(d)(i) for bird |

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5 **(a)** The flow chart in Fig. 6.1 shows one pathway of nitrogen as it travels through the nitrogen cycle.

Complete the flow chart in Fig. 6.1.

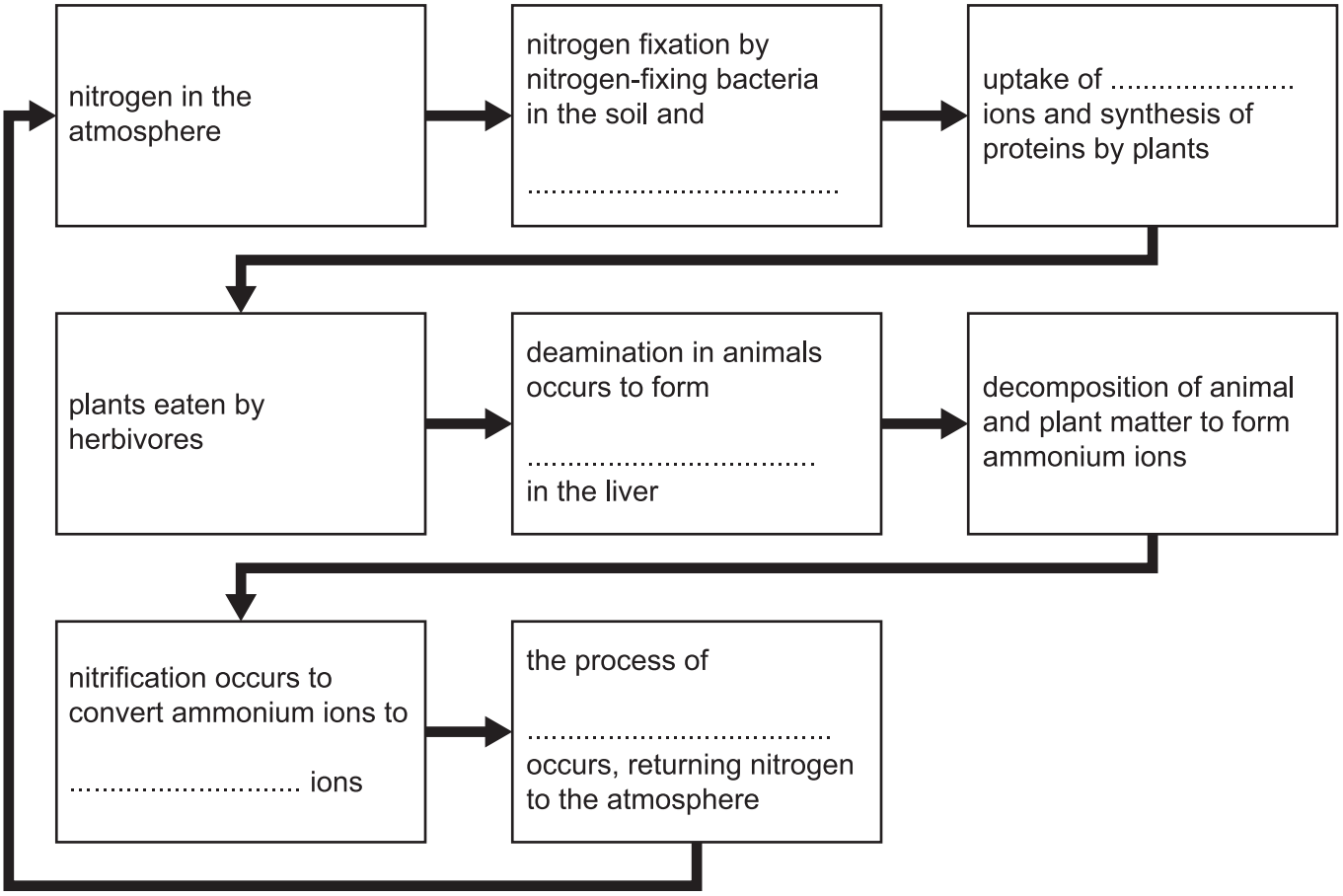



**Fig. 6.1**

[5]

**(b)** State the names of **two** processes that occur in both the carbon and nitrogen cycles.

1 .....

2 .....

[2]

**(c)** State the principal source of energy input to biological systems.

..... [1]

[Total: 8]

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Carbon, nitrogen and water cycles Click for more variations

| | | | |
|---|---|---|---|
| 5(a) | lightning / root nodules ;<br>nitrate ;<br>urea ;<br>nitrate ;<br>denitrification ; | **5** | |
| 5(b) | *any two from:*<br>decomposition / decay ;<br>feeding ;<br>excretion ;<br>AVP ; | **2** | **A** in any order |
| 5(c) | (the) Sun ; | **1** | |

**6** Many biologists study populations of organisms in their natural habitats.

**(a)** Define the term *population*.

.....

.....

.....

..... [2]

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**(b)** A 10-year study was carried out to investigate the relationship between voles and owls. Voles are small mouse-like mammals and owls are carnivorous birds.

The results are shown in Fig. 6.1 and Fig. 6.2.

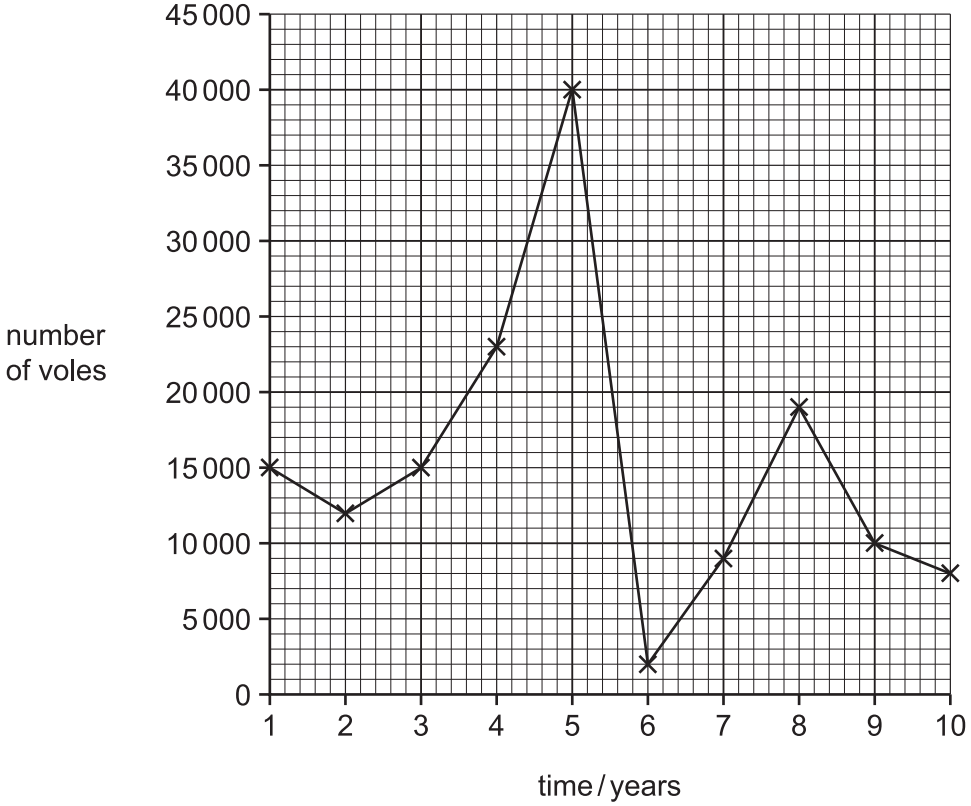



**Fig. 6.1**

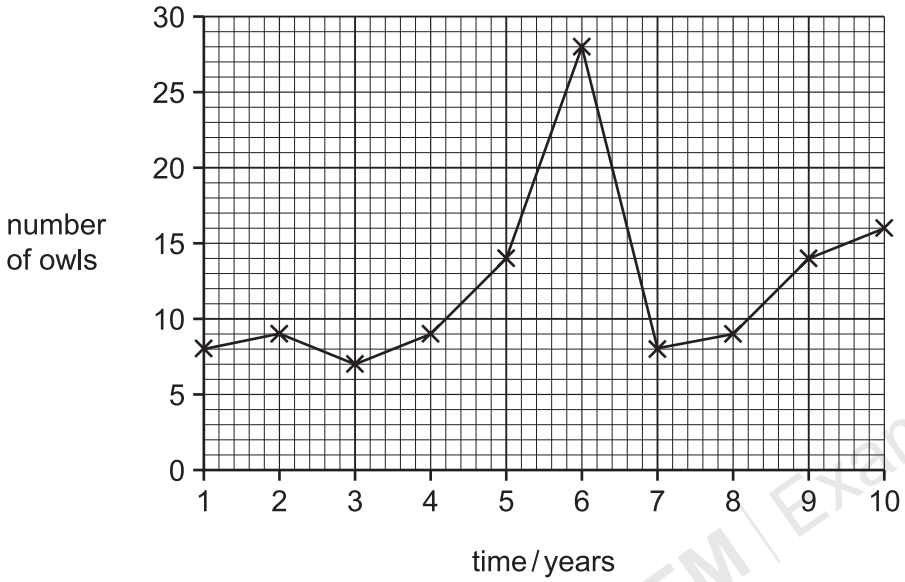



**Fig. 6.2**

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**(i)** Suggest **three** reasons for the decrease in the population of voles between years 5 and 6.

1 .....

.....

2 .....

.....

3 .....

..... [3]

**(ii)** State the evidence from Fig. 6.1 and Fig. 6.2 that supports the idea that voles form a large part of the food eaten by owls.

.....

.....

.....

.....

.....

..... [2]

**[Total: 7]**

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| | | | |
|---|---|---|---|
| **6 (a)** | group of organisms of the <u>same species</u> ;<br><br>in the same area / at the same time ; | [2] | **A** 'of a kind' / <u>a</u> species<br><br>**A** same habitat / ecosystem / community |
| **(b) (i)** | greater predation by owls / more predators / more owls;<br>lack of food / starvation / more competition for food ;<br>adverse (named) weather condition (s) ;<br>disease / sickness / illness;<br>emigration ;<br>AVP ; habitat destruction | max [3] | **R** climate change |
| **(ii)** | **1** owl population increases, after / AW, vole population increases ;<br>**2** owl population crashes (in year 7) ;<br>**3** immediately after crash in vole population ;<br>**4** vole population crashes / decreases (in year 6) ;<br>**5** when there are most owls ;<br>**6** if owls ate (much) other prey there would not be a close relationship / AW ;<br>**7** ref to numbers of owls from the graph ; | max [2] | **if MP1 and MP2** not given accept the idea that 'owl population follows changes in vole population' if answer does not refer to the increase or decrease |
| | | **[Total:7]** | |

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7 The human population is growing rapidly. This is increasing the pressure on the world food supply.

**(a)** Name the rapid growth phase of any population of organisms.

..... [1]

In Canada farmers are breeding fish in large nets because the wild stocks of fish are decreasing. Fig. 6.1 is a diagram of a salmon fish farm in the ocean. The salmon only eat the food provided by the worker.

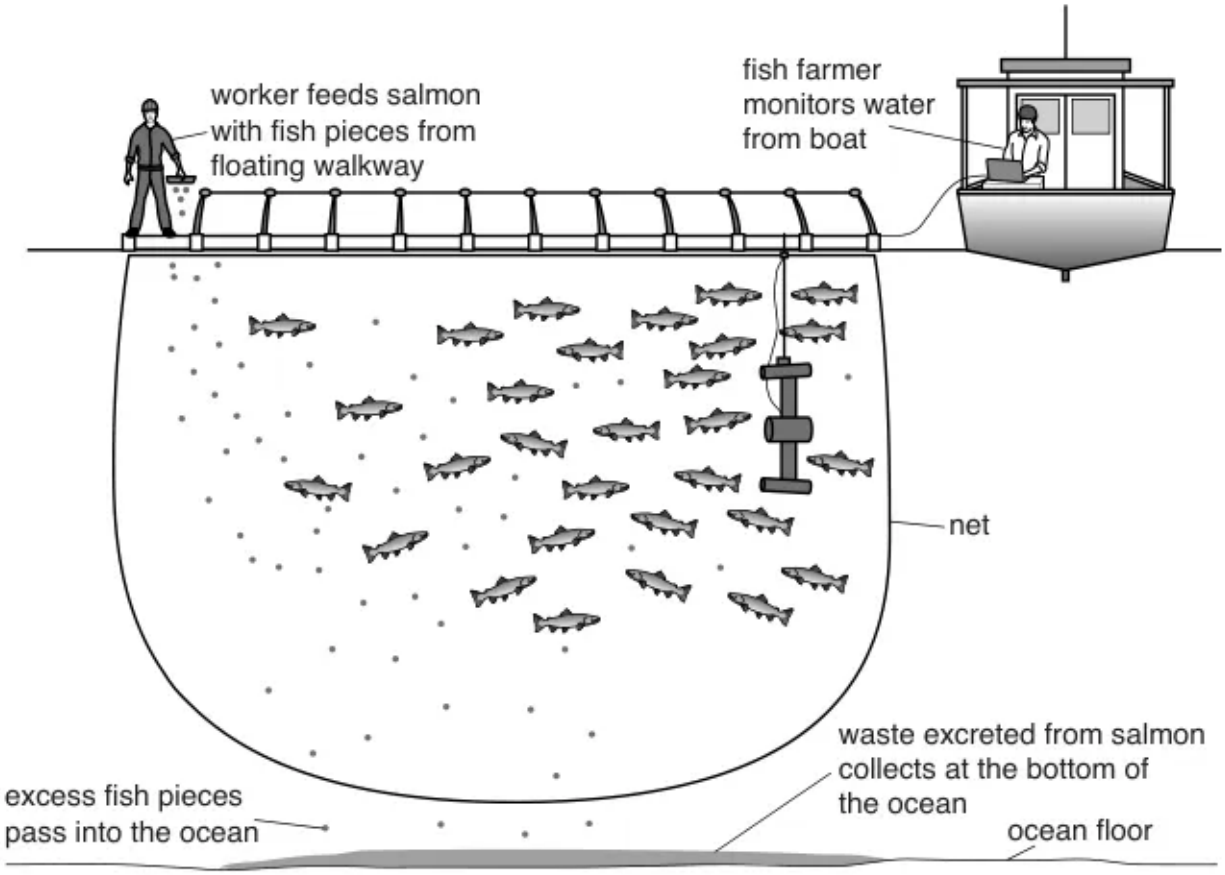



**Fig. 6.1**

**(b)** Explain the effects of the excess fish pieces and waste excreted from the salmon on the environment.

.....

.....

.....

.....

.....

.....

..... [3]

**(c)** State the lowest possible trophic level of the salmon shown in Fig. 6.1.

..... [1]

**(d)** Other farmers grow seaweed. Salmon farming is a less energy efficient way of producing food for humans than seaweed farming.

Explain why.

.....

.....

.....

.....

.....

.....

..... [3]

**[Total: 8]**

Pollution and climate change Click for more variations

| | | | | | |
|---|---|---|---|---|---|
| 7 | **(a)** | | log / exponential (phase) ; | [1] | |
| | **(b)** | **1**<br>**2**<br>**3**<br>**4**<br>**5** | decomposition of waste ;<br>by bacteria / microorganisms ;<br>reduces oxygen available ;<br>eutrophication / algal bloom ;<br>results in death of (aquatic) plants and animals ; | max [3] | **ignore** pollution / contamination unqualified |
| | **(c)** | | secondary consumer / third trophic level ; | [1] | |
| | **(d)** | **1**<br>**2**<br>**3**<br>**4**<br>**5**<br>**6**<br>**7**<br>**8** | seaweed at a lower trophic level (than salmon) ; **ora**<br>energy is lost, between / within, trophic levels / along food chain ;<br>reference to 10% energy transfer / **ora** ;<br>(energy lost in) respiration / heat / (named) metabolic process ;<br>(energy lost in) movement / muscle contraction ;<br>reference to (more) material that is, inedible / not digestible (in longer food chains) ;<br>(energy lost in) excretion / urine ;<br>*idea that* less fuel required to farm seaweed / AW ; | max [3] | **A** seaweed are producers / first trophic level |
| | | | | **[Total: 8]** | |

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**8** *Daphnia* is a small arthropod animal found in freshwater. The population of *Daphnia* in a lake in Oregon (in the northern temperate region) was sampled at regular intervals between March and November in 2006 and 2007. During 2006 there were very few *Daphnia* in any of the samples. At the end of that year fish were removed from the lake.

- The population of *Daphnia* in March, April and May 2007 was 1 animal per $m^3$ of water sampled.
- The population then increased exponentially to 100 000 per $m^3$ at the beginning of July.
- By the end of August the population had decreased to 10 000 per $m^3$ and the population remained at this number until the end of November.

**(a)** Sketch a line on Fig. 6.1 to show the population of *Daphnia* from March to the end of November 2007. [3]

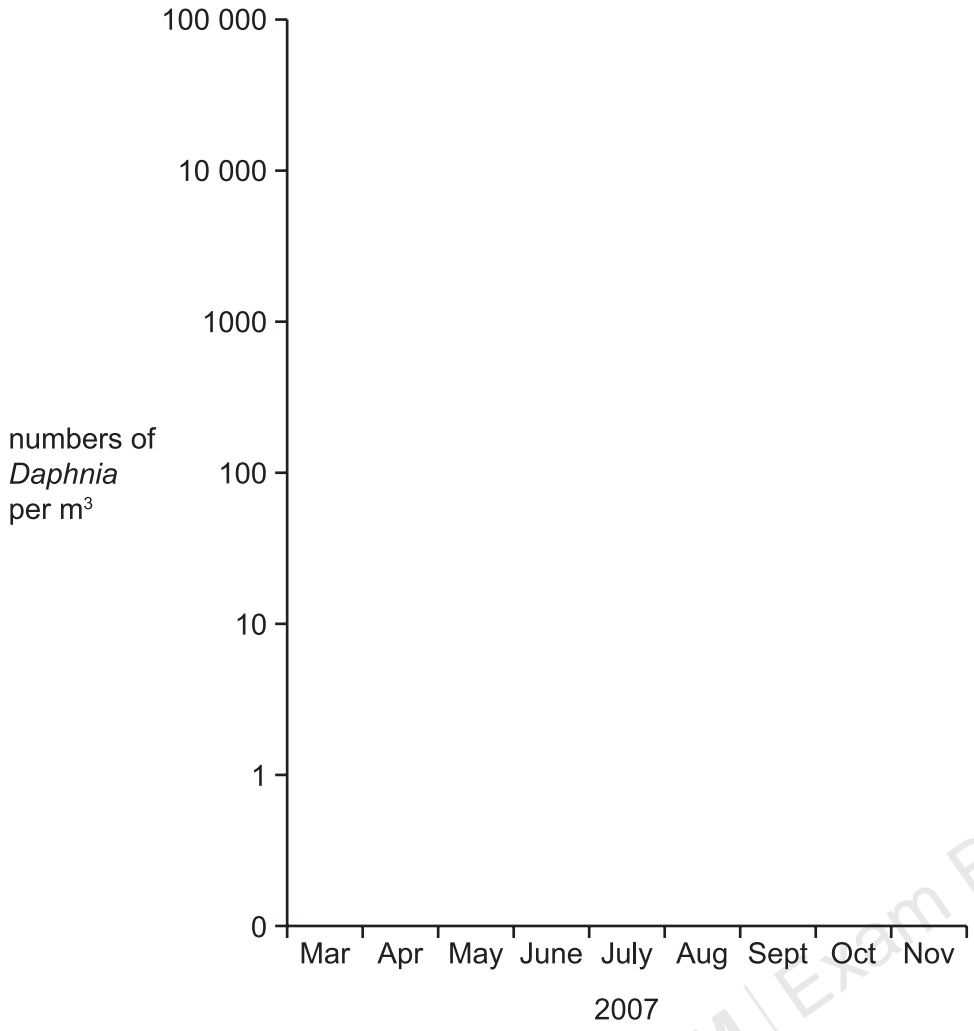



**Fig. 6.1**

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**(b)** Suggest why there were very few *Daphnia* present in the lake in 2006.

[2]

**(c)** Explain the changes in the population of *Daphnia* in 2007.

[4]

[Total: 9]

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| | | | | |
|---|---|---|---|---|
| 8 **(a)** | | line at 1 until end of May ;<br>exponential increase from June to 100 000 at beginning of July ;<br>**A** a straight line<br>decrease at end of August to around 10 000 ;<br>remains about 10 000 until beginning of November ; | [max 3] | if points are plotted, but no line or block graph used = max 1 |
| **(b)** | | eaten by, predator / fish ;<br>not enough food ;<br>too cold ;<br>pollution ;<br>AVP ; | [max 2] | **A** eutrophication |
| **(c)** | **1**<br><br><br>**2**<br>**3**<br><br><br>**4**<br>**5**<br>**6**<br><br><br>**7**<br>**8**<br>**9**<br>**10**<br>**11**<br>**12** | *accept ref. to* limiting factor(s) *once in the answer* ;<br><br>*lag phase* (*March April May*)<br>slow reproduction rate / BR = DR ;<br>no food / too cold / AW ;<br><br>*exponential / log, phase (June)*<br>reproduction rate increases / BR > DR ;<br>increase in temperature ;<br>food available ;<br><br>*steady / stationary / AW, phase* (*September October November*)<br>reproduction rate slows / BR = DR ;<br>decline phase ;<br>(reached) carrying capacity / AW ;<br>DR > BR ;<br>predation ;<br>less food / competition for food; | [max 4] | **I** refs. to numbers and descriptions rather than explanations<br><br>for MP2 – 12 must be clear which period of the graph or phase is being described |

| | |
|---|---|
| **[Total: 9]** | |

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**9** Fig. 2.1 shows the flow of energy through a natural ecosystem that is **not** used by humans at any of the trophic levels.

The unit of energy flow is kJ per $m^2$ per year.

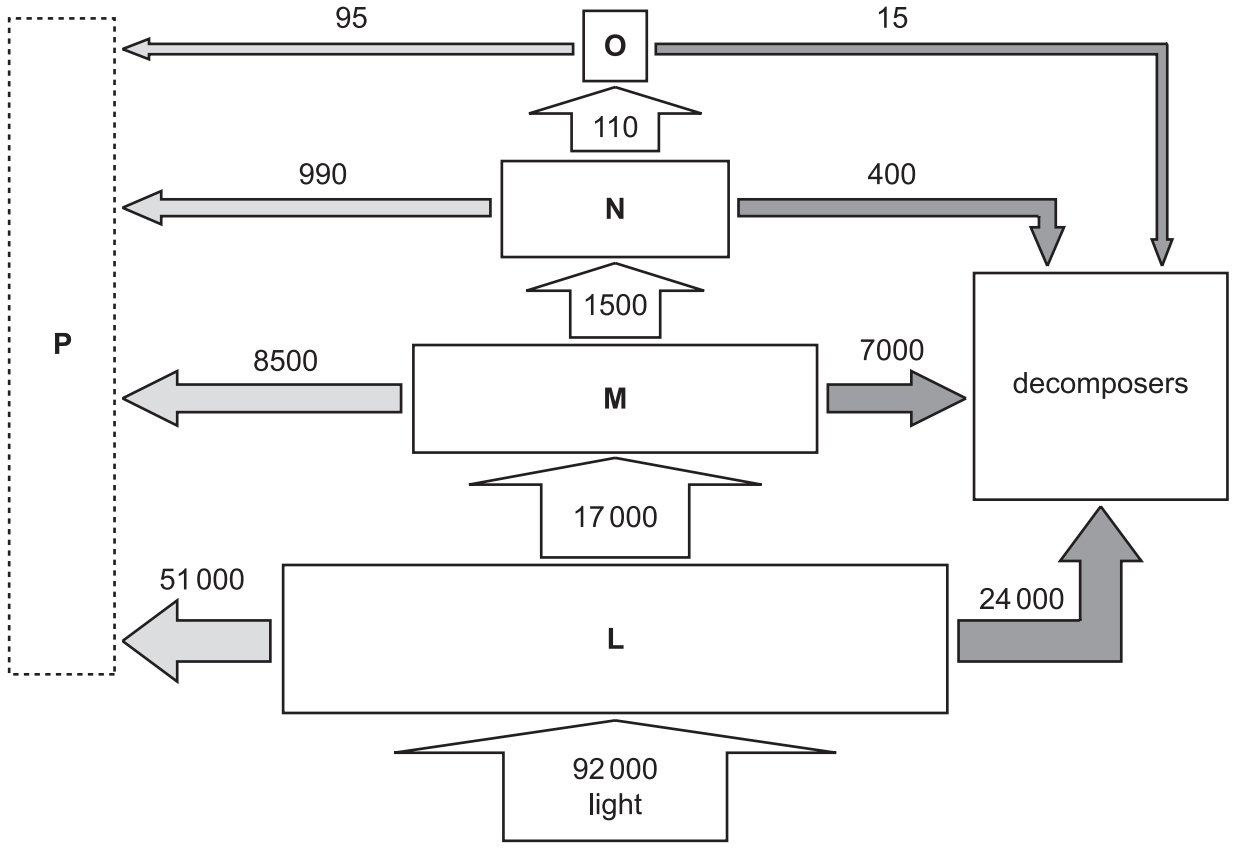



**Fig. 2.1**

**(a)** The letters **L** to **O** represent the different trophic levels in the ecosystem.

**(i)** Name the first and third trophic levels, **L** and **N**.

**L** .....

**N** ..... [2]

**(ii)** Suggest what is shown by the relative sizes of the boxes, **L** to **O**, in the energy flow diagram in Fig. 2.1.

..... [1]

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**(iii)** There are no predators in the ecosystem feeding on the animals in trophic level **O**.

Suggest **and** explain why there are no predators in the ecosystem feeding on the animals in trophic level **O**.

.....

.....

.....

.....

.....

..... [3]

**(iv)** **P** in Fig. 2.1 does **not** represent any organisms.

Explain what **P** represents in the energy flow diagram.

.....

.....

.....

..... [2]

**(b)** People who live near this ecosystem **would like** to use some of the organisms at trophic level **M** for food.

Suggest **and** explain what might happen to the ecosystem if the people took too many of the organisms at trophic level **M**.

.....

.....

.....

.....

.....

.....

.....

..... [3]

**[Total: 11]**

Food chains, food webs and energy flow Click for more variations

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| | | | | |
|---|---|---|---|---|
| 9 (a) (i) | | **L** = (primary) producer(s) **;**<br>**N** = secondary consumer(s) **;** | [2] | **ignore** (green) plant<br>**ignore** carnivore |
| (ii) | | energy, of / at, each trophic level **;**<br>**A** shows that energy, decreases / is lost (at each trophic level)<br>e.g. '**L** has more energy than **M**' | [1] | **R** biomass / numbers<br>**R** 'production of energy'<br>**ignore** energy passed on – shown by the arrows not the boxes |
| (iii) | | *idea that* | | |
| | **1** | no, energy left **;** | | |
| | **2** | use figures from Fig. 2.1 to show that all energy to **O** is already | | |
| | **3** | little / not enough, energy available from eating, tertiary consumers / **O** / AW **;** | | **A** 'needing to eat a lot to get enough energy' |
| | **4** | loss of (90%) energy, at / between, each trophic level / AW **;** | | MP4 *no need to use the term trophic level if idea is implied* |
| | **5** | would be very small population of predators of **O** **;** | | |
| | **6** | (population of) predators of **O** unlikely to survive **;** | | |
| | **7** | AVP **;** e.g. *idea that* difficult to be a predator of **O** because **O** is likely to be 'large and fierce' | [max 3] | |

| | | | | |
|---|---|---|---|---|
| (iv) | **1** | loss of energy (from, each / all, trophic level(s)) **;** | | |
| | **2** | (by) <u>respiration</u> **;** | | |
| | **3** | (to the) environment / atmosphere / surroundings **;** | | |
| | **4** | as, heat / thermal energy **;** | [max 2] | *accept once only* |
| (b) | | *M is the herbivore* | | **ignore** any changes to decomposers / recycling<br>**A** the argument that more primary consumers will migrate into the ecosystem<br>**ignore** predators / organisms unqualified |
| | **1** | more (biomass of / energy in), producers / **L** **;** | | |
| | **2** | as fewer / no, herbivores / primary consumers / predators (to eat **L**) / **M** **;** | | |
| | **3** | fewer / extinction of, carnivores / secondary consumers / **N** **;** | | |
| | **4** | fewer / extinction of, tertiary consumers / **O** **;** | | |
| | **5** | as less, food / energy **;** | | |
| | **6** | more competition **;** | [max 3] | |

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**10** **(a)** Fig. 1.1 shows a pyramid of energy for an ecosystem.

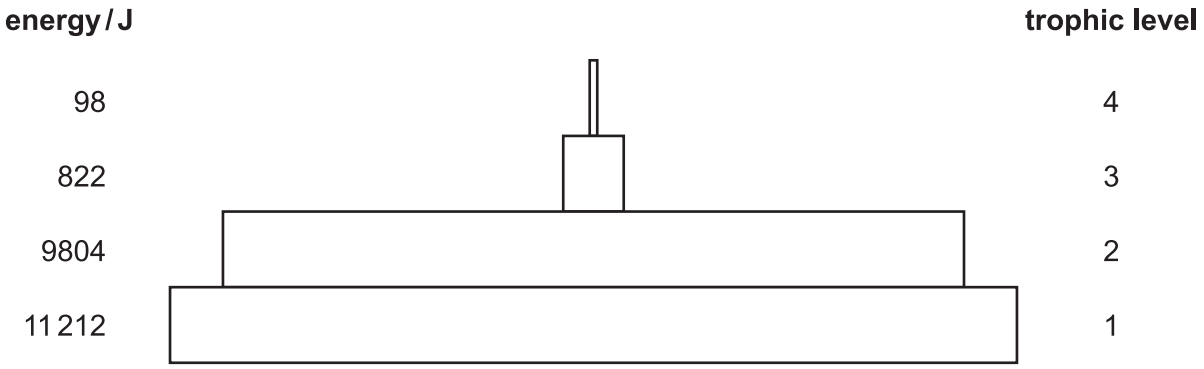



**Fig. 1.1**

**(i)** State where the organisms in trophic level 1 in Fig. 1.1 get their energy from.

..... [1]

**(ii)** Calculate the percentage of energy transferred between trophic levels 2 and 3 in Fig. 1.1.

Give your answer to **one** significant figure.

..... [2]

**(iii)** State **two** reasons why the energy decreases between trophic levels 1 and 4, as shown in Fig. 1.1.

1 .....

2 .....

[2]

**(iv)** Describe the advantages of representing food chains using a pyramid of energy compared with a pyramid of biomass.

.....

.....

.....

.....

..... [2]

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**(b)** A new species was introduced to an ecosystem.

Fig. 1.2 shows the changes in the population as the species established itself in the ecosystem.

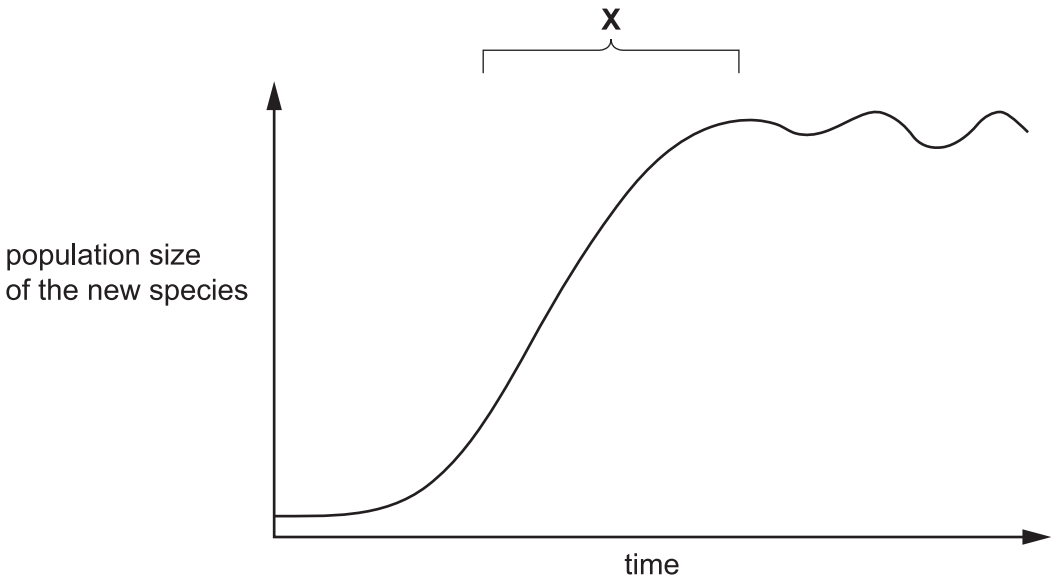



**Fig. 1.2**

**(i)** Complete the sentence to describe the term population.

A population is a group of organisms of one species living in the same ..... at the same ..... . [1]

**(ii)** Describe **and** explain the reasons for the shape of the graph at **X** in Fig. 1.2.

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..... [5]

[Total: 13]

Populations Click for more variations

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Reduced to 77% to fit the page (wider than A4).

| | | | |
|---|---|---|---|
| **10**(a)(i) | Sun ; | **1** | |
| **10**(a)(ii) | 8 ;; | **2** | MP1 correct calculation to any number of significant figures<br>MP2 correct rounding to one significant figure<br><br>**ecf** from previous step |
| **10**(a)(iii) | *any two from:*<br>(energy lost as) heat / respiration ;<br>(named other) metabolic processes ;<br>(energy lost in) movement / muscle contraction ;<br>not all of the organism is, eaten ;<br>not all of the organism is digested **or** (energy lost in) faeces / egestion ;<br>not every organism in that trophic level is eaten ; | **2** | |
| **10**(a)(iv) | *any two from:*<br>more <u>accurate</u> representation of energy, transfer / loss ;<br>*idea of* accounts for (different) rate of reproduction ;<br>*idea of* accounts for (different) life spans ;<br>*idea of* accounts for different, sizes / body composition, of organisms ;<br>*idea of* accounts for, time / seasonal variations ;<br>allows (better) comparisons between ecosystems ; | **2** | |
| **10**(b)(i) | area (at the same) time ; | **1** | |
| **10**(b)(ii) | *any five from:*<br>1 (population) increases and plateaus ;<br>2 birth rate exceeds mortality rate / AW ;<br>3 plenty of (named) resources / no competition for (named) resources / lack of predation ;<br>4 (then) slowing / decreasing rate, of population growth ;<br>5 (named) resources become limited / competition for resources / increased predation / (new) disease ;<br>6 birth rate and mortality rate become more equal ;<br>7 AVP ; | **5** | |

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