

Week 26

IGCSE Biology

Homework bundle for this week

本周作业合集

exercises.lol

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19. Organisms and their environment

Starter Quiz · 课前小测

IGCSE Biology

Name: _____ Score: _____

1. The original source of energy for almost all ecosystems is the:

- ☐ Sun
- ☐ soil
- ☐ wind
- ☐ water

2. In a food chain, the arrows show the direction of:

- ☐ energy flow (from food to eater)
- ☐ energy flow (from eater to food)
- ☐ water movement
- ☐ oxygen flow

3. A trophic level is:

- ☐ a feeding stage in a food chain
- ☐ a type of producer
- ☐ a decomposer
- ☐ a habitat

4. Which process removes carbon dioxide from the air?

- ☐ photosynthesis
- ☐ respiration
- ☐ combustion
- ☐ decomposition

5. Why can't plants use nitrogen gas from the air directly?

- ☐ it is unreactive
- ☐ it is poisonous
- ☐ there is too little of it
- ☐ it is too heavy

6. Roughly what percentage of energy is passed to the next trophic level?

7. Which are limiting factors on a population? (Select all that apply.)

- ☐ food supply
- ☐ space
- ☐ predators
- ☐ sunlight on the Moon

Tick every correct option.

8. How is energy lost between trophic levels? (Select all that apply.)

- ☐ heat from respiration
- ☐ movement
- ☐ undigested waste
- ☐ photosynthesis

Tick every correct option.

9. Energy flows through an ecosystem and is lost, rather than being recycled.

- ☐ True
- ☐ False

10. Decomposers break down dead matter and recycle nutrients.

- ☐ True
- ☐ False

19. Organisms and their environment

Answers · 答案

IGCSE Biology

1. Sun

Producers capture the Sun's energy.

2. energy flow (from food to eater)

Arrows point from the eaten to the eater.

3. a feeding stage in a food chain

Each feeding stage is a trophic level.

4. photosynthesis

Photosynthesis fixes CO₂ into glucose.

5. it is unreactive

N₂ is unreactive; it must be turned into nitrates.

6. 10

About 10% is passed on; the rest is lost.

7. food supply; space; predators

Food, space and predators limit growth.

8. heat from respiration; movement; undigested waste

Photosynthesis captures energy; the others lose it.

9. True

Energy must be resupplied by the Sun; only nutrients cycle.

10. True

Bacteria and fungi recycle nutrients back to the soil.

19.1 Energy flow

Name: _____ Class: _____ Date: _____

Total: 26 marks

KEY WORDS energy 能量 • trophic levels 营养级 • energy flow 能量流动 • respiration 呼吸作用
• excretory products 排泄物

Objective

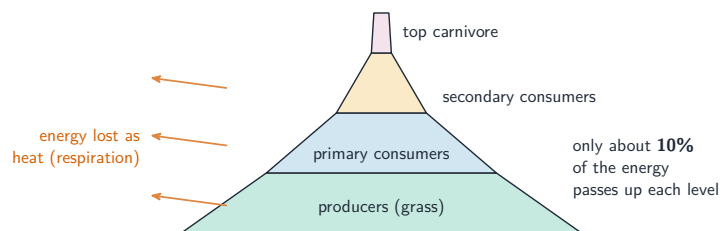
Build the skills to answer exam questions on **energy flow** 能量流动 — the Sun as the source, **trophic levels** 营养级, energy loss, and pyramids.

You must be able to:

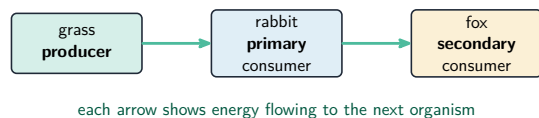
- describe how energy enters and flows through a food chain
- explain why only ~10% of energy passes up each level
- interpret pyramids of numbers, biomass and energy

1 Worked examples

■ Energy loss



Energy enters from the Sun, flows one way, and is lost as heat at each level (~10% passes up)



Energy flows along a food chain

- the rest is lost as heat (respiration), in movement and in waste.

- so chains have fewer than ~5 levels; eating plants directly wastes less energy.

■ Where the energy comes from, and where it goes

Almost all energy in an ecosystem starts as **light energy from the Sun**, captured by producers in **photosynthesis** 光合作用 and stored as chemical energy in glucose. That is why producers are always the first trophic level.

The losses at each transfer, which the exam wants named:

- **respiration** 呼吸作用 — the largest loss, released as **heat** to the surroundings;
- **undigested material** passed out in **faeces** 粪便;
- **excretory products** 排泄物 such as urea, which still contain chemical energy;
- parts of the organism that are **not eaten** — bones, roots, fur.

About **10%** of the energy at one level is passed on. That single figure explains three separate exam answers: why a pyramid of biomass narrows upwards, why food chains rarely exceed four or five levels, and why feeding people on crops supports more people than feeding them on meat — a shorter chain wastes fewer transfers.

Worked example. Producers hold 150 000 kJ; the primary consumers hold 14 000 kJ; the secondary consumers hold 1 200 kJ. Find the efficiency of each transfer.

1. Producers → primary: $\frac{14\,000}{150\,000} \times 100 = 9.3\%$.
2. Primary → secondary: $\frac{1\,200}{14\,000} \times 100 = 8.6\%$.
3. Both are close to the usual 10%, and the small difference is normal variation in how much is respired and excreted.

△ Always divide by the level **below**, and give the unit as a percentage. Dividing the wrong way round gives a number over 100, which should tell you at once that the calculation is upside down.

2 Practice

2.1 State the main source of energy for almost all food chains. [1]

2.2 State the form in which most energy is lost at each trophic level. [1]

2.3 Name three ways in which energy is lost between one trophic level and the next. [3]

2.4 Explain why a pyramid of biomass is usually narrower at the top. [2]

2.5 Explain why feeding a population on crops supports more people than feeding it on beef. [2]

3 Exam-style questions

3.1 Roughly what percentage of energy passes from one trophic level to the next? [1]

- A 1%
- B 10%
- C 50%
- D 90%

3.2 Energy is lost along a food chain.

(a) Explain why food chains usually have fewer than five trophic levels. [2]

(b) Explain why it is more efficient for people to eat crop plants than meat. [2]

3.3 A grassland food chain is: grass → cattle → humans. The grass contains 2 400 000 kJ, the cattle 180 000 kJ and the humans 9 000 kJ.

(a) Calculate the percentage of energy transferred from the grass to the cattle. [2]

(b) Calculate the percentage of energy transferred from the cattle to the humans. [2]

(c) Explain why so much energy is lost at each transfer, naming three losses. [3]

(d) Suggest, with a reason, how the same area of grassland could support more people.[3]

(e) Explain why this food chain could not support a fourth trophic level. [2]

Solutions

2.1 the Sun.

2.2 as heat (from respiration).

2.3 Any three of: heat lost from respiration; undigested material lost in faeces; excretory products such as urea; parts not eaten, such as bones or roots.

2.4 Only about 10% of the energy at each level is passed on to the next, so there is less energy available and therefore less biomass can be supported at each higher level.

2.5 Eating crops is a chain with one transfer instead of two; each transfer loses about 90% of the energy, so a shorter chain wastes less and supports more people from the same land.

3.1 B. About 10% passes up each level.

3.2 (a) energy is lost at each level, so after a few levels too little is left to support another.
(b) eating plants directly is one trophic level; eating meat adds a level, where energy is lost, so it is less efficient.

3.3 (a) $\frac{180\,000}{2\,400\,000} \times 100 = 7.5\%$.

(b) $\frac{9\,000}{180\,000} \times 100 = 5.0\%$.

(c) Any three, one mark each: energy is released as heat during respiration; energy is lost in undigested material in faeces; energy is lost in excretory products such as urea; parts of the organism, such as bones, are not eaten.

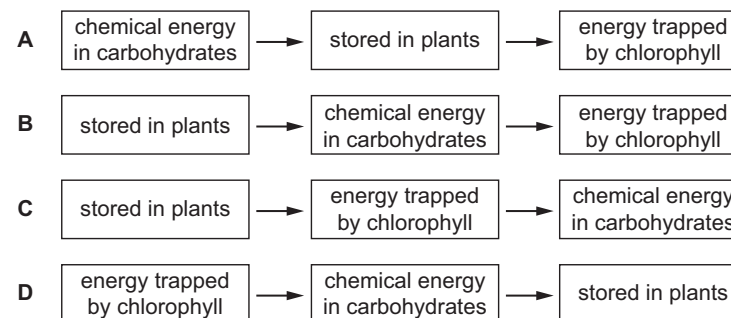
(d) Grow crops for people to eat directly instead of grazing cattle; this removes one transfer from the chain; about 90% of the energy is lost at each transfer, so far more of the grassland's energy reaches people.

(e) Only 9 000 kJ reaches the humans, and about 90% of that would be lost again; the roughly 900 kJ remaining is too little to support a population at a fourth level.

Name: _____

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32 Which flowchart shows how energy is transferred from the Sun to an organism?



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35 Which unit could be used for the measurements needed to construct a pyramid of energy?

- A kJ per g per m²
- B kJ per kg per year
- C kJ per m² per year
- D kJ per kg

4 Steppe ecosystems are large areas of grasslands found in central Asia.

(a) Fig. 4.1 is a food web from a steppe ecosystem.

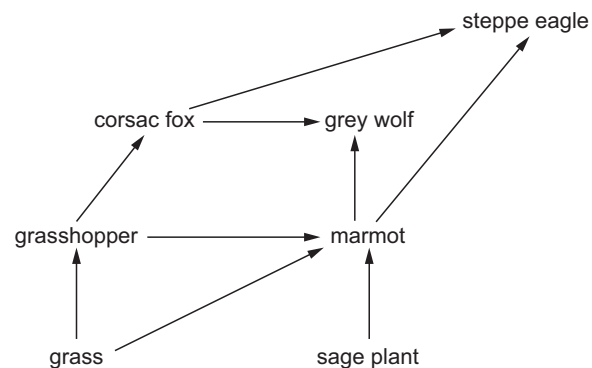


Fig. 4.1

(i) State the name of **one** primary consumer from Fig. 4.1.

..... [1]

(ii) Use the information in Fig. 4.1 to construct **one** food chain with four trophic levels that includes the steppe eagle.

[1]

(iii) There are fewer grey wolves than marmots in this ecosystem.

Explain why the population size of organisms decreases from one trophic level to the next trophic level in this ecosystem.

.....

 [2]

(b) Fig. 4.2 is a photograph of a wild horse. Przewalski's horse is a type of wild horse that nearly became extinct.



Fig. 4.2

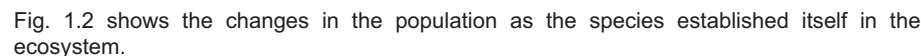
After a captive breeding programme, they have been successfully reintroduced to the steppe ecosystem.

The captive breeding programme started with 12 wild horses.

(i) Explain the risks to a species of a captive breeding programme that uses such a small number of individuals.

.....

 [3]



34 The food chain shows how energy is transferred to a human.

lettuce → snails → duck → human

Where did the energy in the lettuce come from?

- A** snails
- B** soil
- C** the Sun
- D** water

19.2 Food chains and food webs

Name: _____ Class: _____ Date: _____ **Total: 25 marks**

KEY WORDS food web 食物网 • trophic level 营养级 • consumer 消费者 • food chain 食物链
• ecosystem 生态系统

Objective

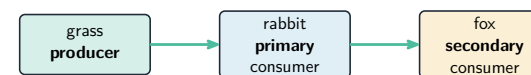
Build the skills to answer exam questions on **food chains and food webs** 食物链与食物网 — the terms, reading a web, and human impact.

You must be able to:

- define producer, consumer, herbivore, carnivore, decomposer
- read a food chain/web and the direction of energy flow
- explain the effect of overharvesting and introduced species

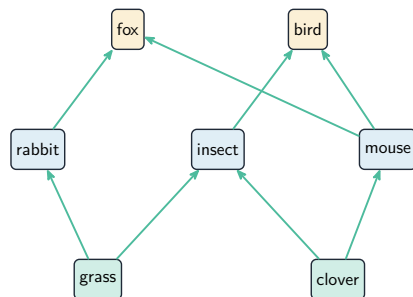
1 Worked examples

■ Food chains and webs



each arrow shows energy flowing to the next organism

Arrows show energy flow; a chain starts with a producer



A food web is several food chains linked together

- **producer:** makes its own food; **consumer:** feeds on others; **decomposer:** feeds on dead matter.

■ Reading a food web, and why the pyramid narrows

An **ecosystem** 生态系统 is all the organisms in an area together with the non-living parts they interact with. A **food chain** 食物链 shows the transfer of energy from one organism to the next; the **arrows point in the direction the energy travels**, that is from the organism eaten to the organism eating it. A **food web** 食物网 is several interlinked chains.

The trophic levels 营养级: a **producer** 生产者 makes its own food by photosynthesis; a **primary consumer** eats the producer (a herbivore); a **secondary consumer** eats the primary consumer; a **tertiary consumer** eats the secondary. A **decomposer** 分解者 breaks down dead organisms and waste, releasing the mineral ions back into the soil.

Why a pyramid of biomass narrows upwards, and why chains are short.

Only about **10%** of the energy at one trophic level reaches the next. The rest is lost as heat from **respiration**, in **undigested material in faeces**, and in **excretory products** such as urea; not all of an organism is eaten either. After four or five levels there is too little energy left to support another population.

Worked example. Producers hold 20 000 kJ and the secondary consumers 180 kJ. Calculate the percentage transferred, and explain the loss.

1. $\frac{180}{20\,000} \times 100 = 0.9\%$.
2. Two transfers have taken place, each losing about 90%.
3. The losses are respiration as heat, faeces and excretion, plus the parts never eaten.

△ **Removing one species affects the whole web.** Say which population rises and which falls, and give the reason: if the rabbits go, the foxes that ate them fall because their food supply is reduced, the grass increases because nothing grazes it, and any other prey of the fox falls because the foxes now eat more of it.

2 Practice

2.1 Define a producer. [1]

2.2 State what the arrows in a food chain show. [1]

2.3 State what the 10% figure refers to in a food chain, and name two ways the other 90% is lost. [3]

2.4 Name the trophic level of a fox in the chain grass → rabbit → fox, and of the grass. [2]

2.5 Explain why food chains rarely have more than five trophic levels. [2]

3 Exam-style questions

3.1 In the chain grass → rabbit → fox, the rabbit is a: [1]

- A producer
- B primary consumer
- C secondary consumer
- D decomposer

3.2 A food web links several chains.

(a) Explain what could happen to the other organisms if all the rabbits were removed.[2]

(b) State one way humans can damage a food web. [1]

3.3 A food web in a garden contains: lettuce → slug → thrush → hawk, and lettuce → caterpillar → thrush.

(a) Name the producer, and name one secondary consumer. [2]

(b) State what the arrows in the web represent. [1]

(c) All the slugs are removed by a gardener. Explain the effect on the caterpillar population and on the hawk population. [4]

(d) The lettuces contain 48 000 kJ of energy and the thrushes 290 kJ. Calculate the percentage of energy that reaches the thrushes. [2]

(e) Explain why the answer to (d) is so small. [3]

Solutions

2.1 an organism that makes its own food (usually by photosynthesis).

2.2 the direction of energy flow (from one organism to the next).

2.3 The proportion of energy passed on from one trophic level to the next; any two of: lost as heat from respiration; lost in undigested material in faeces; lost in excretory products such as urea.

2.4 The fox is a secondary consumer; the grass is a producer.

2.5 Only about 10% of the energy passes to each next level, so after four or five levels there is too little energy left to support another population.

3.1 B. The rabbit eats the producer, so it is a primary consumer.

3.2 (a) animals that ate rabbits (e.g. foxes) would have less food and may decrease; plants the rabbits ate may increase.

(b) overharvesting (e.g. overfishing) or introducing a foreign species.

3.3 (a) The producer is the lettuce; a secondary consumer is the thrush.

(b) The direction in which energy is transferred, from the organism eaten to the organism eating it.

(c) The caterpillar population rises, because the slugs no longer compete with them for lettuce and the thrushes have fewer prey species so more lettuce is left. The hawk population falls, or stays about the same, because the thrushes it feeds on have lost one of their food sources, so there are fewer thrushes to eat.

(d) $\frac{290}{48\,000} \times 100 = 0.60\%$.

(e) Energy is lost at each of the two transfers; it is lost as heat from respiration, in undigested material in faeces and in excretory products; not all of each organism is eaten, so only a small fraction of the energy reaches the thrushes.

Name: _____

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33 Which statements about a food chain are correct?

- 1 Between trophic level 1 and trophic level 2, energy is passed from a herbivore to a carnivore.
- 2 Between trophic level 2 and trophic level 3, energy is passed from a primary consumer to a secondary consumer.
- 3 Between trophic level 3 and trophic level 4, energy is passed from a secondary consumer to a tertiary consumer.

A 1 and 3

B 1 only

C 2 and 3

D 2 only

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38 In which trophic level are herbivores found?

A primary consumers

B quaternary consumers

C secondary consumers

D tertiary consumers

4 Steppe ecosystems are large areas of grasslands found in central Asia.

(a) Fig. 4.1 is a food web from a steppe ecosystem.

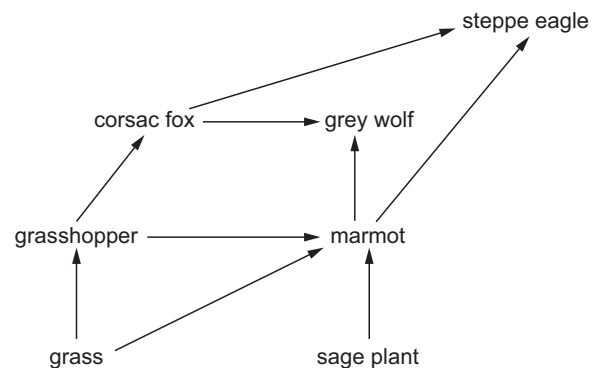


Fig. 4.1

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(ii) Use the information in Fig. 4.1 to construct **one** food chain with four trophic levels that includes the steppe eagle.

[1]

(iii) There are fewer grey wolves than marmots in this ecosystem.

Explain why the population size of organisms decreases from one trophic level to the next trophic level in this ecosystem.

.....

 [2]

(b) Fig. 4.2 is a photograph of a wild horse. Przewalski's horse is a type of wild horse that nearly became extinct.



Fig. 4.2

After a captive breeding programme, they have been successfully reintroduced to the steppe ecosystem.

The captive breeding programme started with 12 wild horses.

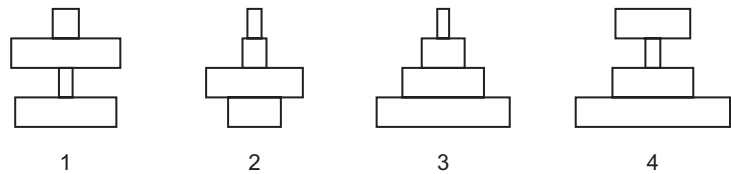
(i) Explain the risks to a species of a captive breeding programme that uses such a small number of individuals.

.....

 [3]

36 In a food chain, zebras are large mammals that eat grass. The zebras have many insects living on them which suck their blood. Birds eat the insects.

The diagrams show some biological pyramids.



Which row identifies the types of pyramids for this food chain?

	pyramid of energy	pyramid of numbers
A	4	2
B	3	2
C	3	1
D	4	1

36 Which organisms can be sources of energy for decomposers?

	producers	herbivores	carnivores	
A	✓	✓	✓	key ✓ = yes ✗ = no
B	✓	✗	✗	
C	✗	✓	✓	
D	✗	✗	✗	

19.3 Nutrient cycles

KEY WORDS nitrogen cycle 氮循环 • nitrogen fixation 固氮作用 • nitrate ions 硝酸根离子
• nitrification 硝化作用 • ammonium ions 铵离子

Objective

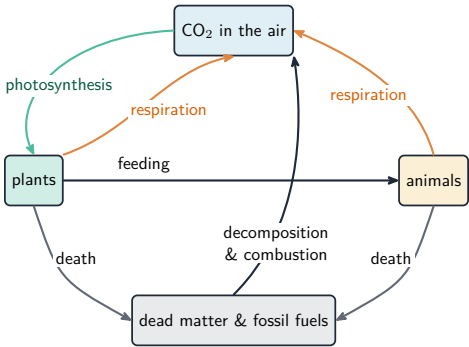
Build the skills to answer exam questions on **nutrient cycles** 营养循环 — the **carbon cycle** 碳循环 and the **nitrogen cycle** 氮循环.

You must be able to:

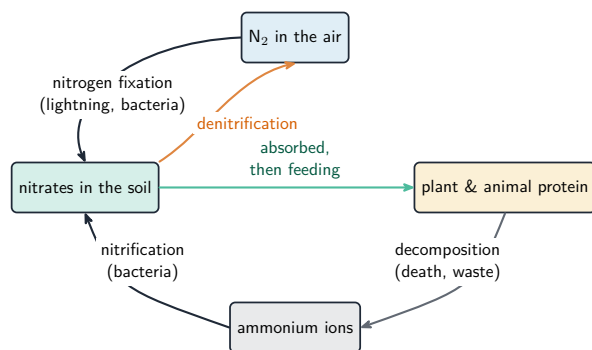
- describe the carbon cycle (photosynthesis, respiration, combustion, decay)
- describe the nitrogen cycle and the roles of microorganisms
- contrast nutrient recycling with one-way energy flow

1 Worked examples

Carbon and nitrogen cycles



Photosynthesis removes CO₂; respiration, combustion and decay return it



Microorganisms: decomposition, nitrification, nitrogen fixation, denitrification

2 Practice

2.1 Name the process that removes carbon dioxide from the air, and name one process that returns it. [2]

2.2 Name two processes that return carbon dioxide to the air. [2]

3 Exam-style questions

3.1 In the nitrogen cycle, bacteria that turn ammonium ions into nitrate ions carry out: [1]

- A nitrogen fixation
- B nitrification
- C denitrification
- D decomposition

3.2 The carbon cycle keeps carbon moving.

(a) Describe how carbon passes from a plant to a consumer. [1]

(b) Explain how burning fossil fuels affects the carbon cycle. [2]

Solutions

2.1 photosynthesis; respiration, combustion of fossil fuels or decomposition.

2.2 respiration; combustion (burning).

3.1 B. Turning ammonium into nitrate is nitrification.

3.2 (a) the consumer eats the plant (feeding).

(b) it releases carbon dioxide into the air, adding to the amount in the atmosphere.

Name: _____

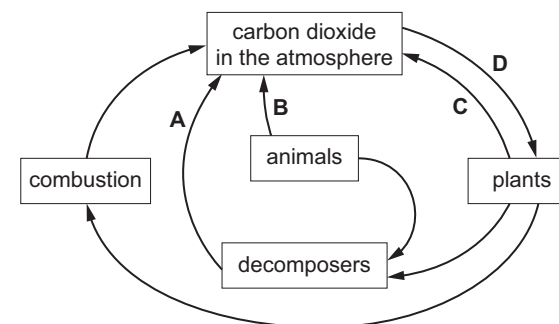
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34 Which process in the nitrogen cycle is involved in the breakdown of amino acids in living organisms?

- A deamination
- B decomposition
- C denitrification
- D digestion

35 The diagram shows part of the carbon cycle.

Which arrow represents photosynthesis?



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36 Which process needs microorganisms to break down protein to produce ammonium ions?

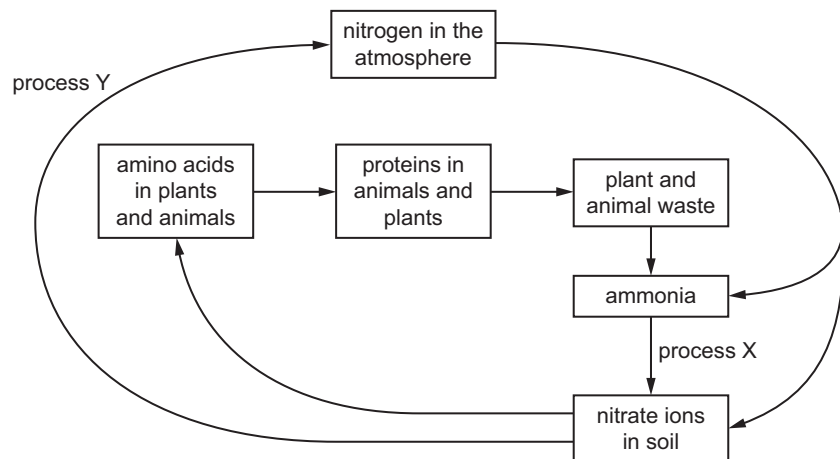
- A decomposition
- B denitrification
- C nitrification
- D nitrogen fixation

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35 Which process removes carbon dioxide from the atmosphere?

- A combustion
- B decomposition
- C photosynthesis
- D respiration

36 The diagram shows part of the nitrogen cycle.



What are the names of process X and process Y?

	X	Y
A	deamination	denitrification
B	nitrogen fixation	deamination
C	nitrogen fixation	nitrification
D	nitrification	denitrification

3 Fig. 3.1 is a diagram of the nitrogen cycle.

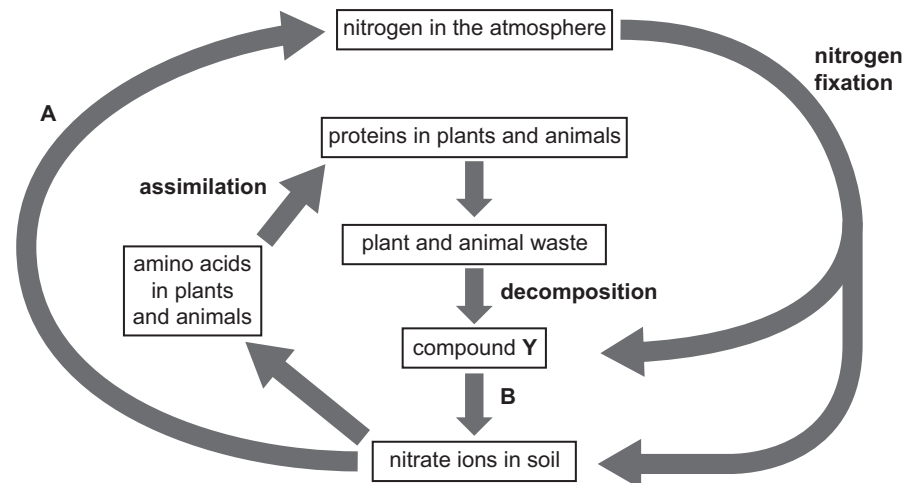


Fig. 3.1

(a) (i) State the names of processes A and B in Fig. 3.1.

A [2]
 B

(ii) State **two** ways that nitrogen fixation can occur.

1 [2]
 2

(iii) State the name of compound Y in Fig. 3.1.

..... [1]

(iv) State the name of an organ in animals, where assimilation **and** deamination of amino acids occurs.

..... [1]

(v) Describe the process of deamination.

.....

.....

.....

.....

..... [2]

(b) Complete the sentences about pollution of the air by writing the appropriate words or phrases in the spaces provided.

Methane is a pollutant gas that contributes to the enhanced
and climate change. Methane is released into the atmosphere from cattle and from the
farming of crops.

..... is a gas that is absorbed by trees in the process
of This gas is released into the atmosphere by the
..... of fossil fuels, where it also contributes to climate change. [5]

(c) Explain the process of eutrophication in aquatic ecosystems.

.....

.....

.....

.....

.....

.....

.....

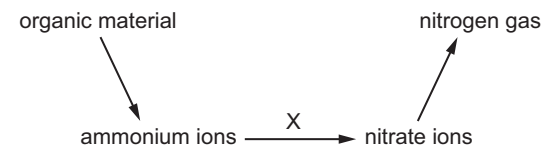
.....

.....

..... [6]

[Total:19]

37 The diagram shows part of the nitrogen cycle.



What is the process labelled X in the diagram?

- A decomposition
- B denitrification
- C nitrification
- D nitrogen fixation

37 Which process in the nitrogen cycle can be caused by lightning and bacteria?

- A deamination
- B denitrification
- C nitrification
- D nitrogen fixation

35 The processes listed affect the concentration of carbon dioxide in the atmosphere.

- 1 increased deforestation
- 2 increased tree planting
- 3 decreased fossil fuel combustion
- 4 increased fossil fuel combustion

Which processes increase the concentration of carbon dioxide in the atmosphere?

- A 1 and 3 B 1 and 4 C 2 and 3 D 2 and 4

19.4 Populations

KEY WORDS population 种群 • resources 资源 • death phase 死亡期 • competition 竞争
• stationary phase 稳定期

Objective

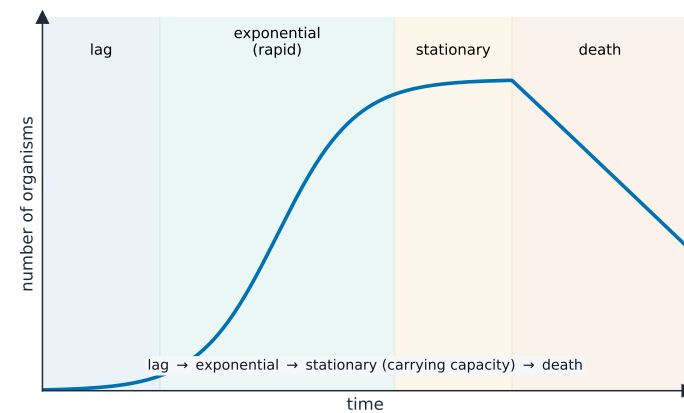
Build the skills to answer exam questions on **populations** 种群 — the terms, and the **S-shaped growth curve** S 形增长曲线.

You must be able to:

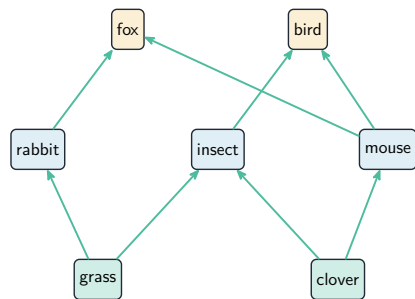
- define population, community and ecosystem
- describe the factors that affect population growth
- name and explain the phases of the S-shaped growth curve

1 Worked examples

■ Population growth



Four phases: lag (slow), exponential (fast), stationary (births $\approx$ deaths), death (numbers fall)



Populations interact in a food web

- **population:** one species, one area, one time.
- growth depends on food, competition, predation and disease.

2 Practice

2.1 Define a population. [1]

2.2 Name the phase of fastest growth. [1]

3 Exam-style questions

3.1 In the stationary phase of population growth: [1]

- **A** the population is growing fastest
- **B** births roughly equal deaths
- **C** the population is dying out
- **D** there are no organisms

3.2 A population grows in a place with limited resources.

(a) State two factors that limit population growth. [2]

(b) Explain why the population enters a death phase. [2]

Solutions

2.1 a group of organisms of one species, living in the same area at the same time.

2.2 the exponential (log) phase.

3.1 B. In the stationary phase births roughly equal deaths.

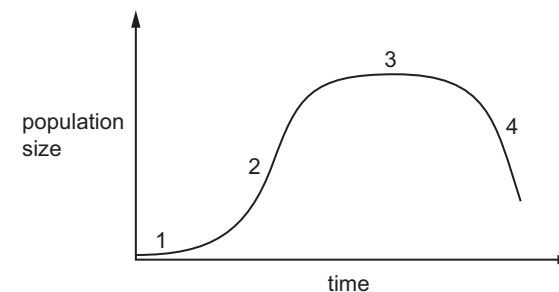
3.2 (a) any two of: food supply; competition; predation; disease.

(b) food runs out (or wastes build up / disease spreads), so deaths exceed births and numbers fall.

Name:

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36 The graph shows how the size of a population changes over time.

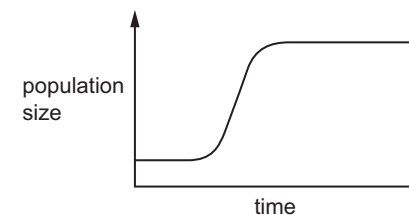


Which row identifies the phases of population growth?

	death phase	exponential phase	lag phase
A	3	1	4
B	3	2	1
C	4	1	3
D	4	2	1

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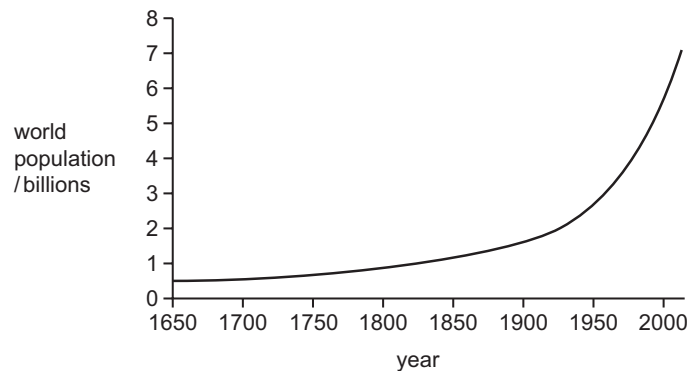
37 The graph shows part of a growth curve for a bacterial population.



What is **not** shown in the graph?

- A** the death phase
- B** the exponential phase
- C** the lag phase
- D** the stationary phase

37 The graph shows how the population of the world increased from 1650 until the present day.

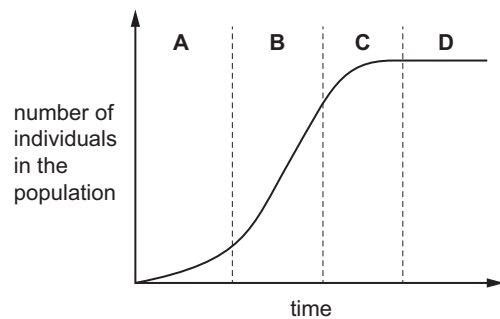


Which phases of a sigmoid curve of population growth are **not** shown on this graph?

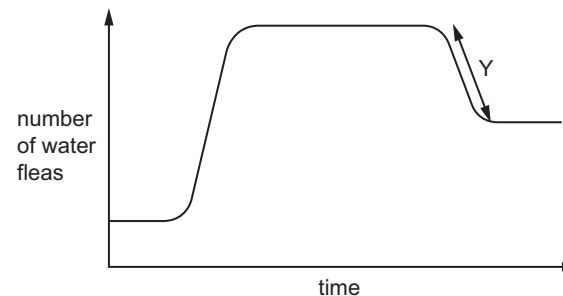
- A** death and lag
- B** exponential (log) and stationary
- C** lag and exponential (log)
- D** stationary and death

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37 Which letter represents the lag phase in the population graph shown?



38 The graph shows the number of water fleas in a newly-created pond.

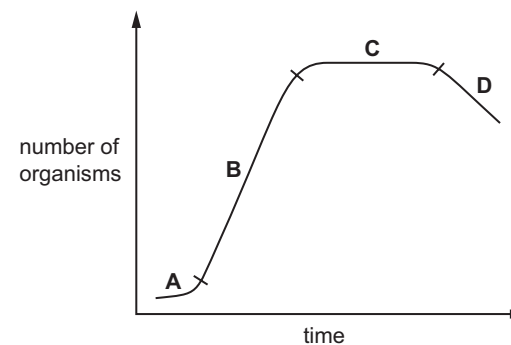


Which event could be responsible for the shape of the graph at Y?

- A** the addition of extra oxygenating plants to the pond
- B** an increase in the birth rate of the water fleas
- C** an increase in the food supply for the water fleas
- D** the addition of predators which feed on water fleas

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38 Which phase in the population growth curve shows when death rates are higher than birth rates?



37 A coral reef contains species such as stony corals, sponges, seahorses and whale sharks.

These species interact with each other and are affected by the temperature, salt concentration and oxygen concentration of the water.

Using all the information given, what is being described?

- A** community
- B** ecosystem
- C** food web
- D** population

38 What can cause an increase in the size of a rabbit population?

- A** an increase in a disease that affects rabbits
- B** an increase in available food for the rabbits
- C** an increase in pollution in the habitat of the rabbits
- D** an increase in predation of rabbits