

1.10 Energy Flow and the 10% Rule

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS 10% rule 十分之一定律 • trophic levels 营养级 • producers 生产者
• ecosystem 生态系统

Objective

Build the skills to answer exam questions on **energy flow and the 10% rule**.

You must be able to:

- apply the **10% rule** 十分之一定律
- calculate energy at each trophic level
- explain why energy is lost between levels

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ The 10% rule

Only about **10%** of the energy at one trophic level is passed to the next. The other ~90% is lost as **heat** and used for the organism's own life processes (movement, respiration).

■ Calculating up the levels

Multiply by 0.1 at each step. Producers with 10 000 units → primary consumers 1000 → secondary 100 → tertiary 10.

■ Why energy is lost

Energy is used for respiration, movement, and heat, and not all of an organism is eaten or digested — so most energy never reaches the next level.

■ A worked calculation

If producers store 50 000 kcal, the secondary consumers receive $50\,000 \times 0.1 \times 0.1 = 500$ kcal.

2 Practice

Now apply the methods above.

2.1 What percentage of energy passes to the next trophic level? [1]

2.2 Producers have 8000 kcal. How much reaches the primary consumers? [1]

2.3 Where does the “lost” energy go? [1]

3 Exam-style questions

3.1 By the 10% rule, energy passed from producers to primary consumers is [1]

- **A** 1%
- **B** 10%
- **C** 90%
- **D** 100%

3.2 Producers in an ecosystem store $30\,000 \text{ kcal/m}^2/\text{yr}$.

(a) Calculate the energy reaching the tertiary consumers. [3]

(b) Explain why so little reaches this level. [1]

3.3 Explain why energy flow limits the number of trophic levels an ecosystem can support. [2]

Solutions

2.1 About 10%.

2.2 800 kcal.

2.3 Lost as heat and used in life processes (respiration, movement).

3.1 B — 10%.

3.2 (a) primary = 3000; secondary = 300; tertiary = 30 kcal/m²/yr. (b) About 90% of the energy is lost at each of the three transfers.

3.3 Because ~90% of energy is lost at each level, after a few levels there is too little energy left to support another, limiting the number of levels.