4.1 Organisms and feeding relationships

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

Objective

Build the skills to answer exam questions on **organisms in the environment and feeding relationships** : populations, communities and ecosystems, quadrats, abiotic and biotic factors, food chains and webs, pyramids and energy transfer.

You must be able to:

- use the terms population, community, habitat and ecosystem
- estimate a population size from quadrat results
- explain why energy is lost between trophic levels
- plan a fair quadrat survey

1 Key knowledge and worked examples

Ecology

idea	rule
population / community	all the organisms of one species in an area / all the populations in an area
habitat / ecosystem	the place where an organism lives / a community and its physical surroundings
population estimate	mean number per quadrat × (area of the field ÷ area of one quadrat)
trophic levels	producer → primary consumer → secondary consumer → tertiary consumer
energy efficiency	energy passed to the next level ÷ energy in this level ×100

Worked example 1: population estimate. A mean of 4 daisies is found per 0.25 m^2 quadrat in a 200 m^2 lawn. Estimate the population.

1. Known: mean 4; quadrat 0.25 m^2; lawn 200 m^2.
2. Rule: mean × (area ÷ quadrat area).
3. Numbers: $4 \times (200 \div 0.25) = 4 \times 800$.
4. Result: 3200 **daisies**.

Worked example 2: energy efficiency. Producers hold 2000 kJ; primary consumers get 150 kJ. Find the efficiency.

1. Known: 150 out of 2000 kJ.
2. Rule: passed on ÷ in level ×100.
3. Numbers: $150 \div 2000 \times 100$.
4. Result: 7.5%.

Answer shapes: for energy loss, name where the energy goes: respiration, heat, waste, parts not eaten.

2 Practice

2.1 Name **one** abiotic factor and **one** biotic factor that could affect the number of daisies in a field. [2]

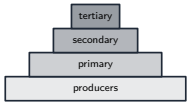


2.2 In the food chain grass → rabbit → fox, name the primary consumer and give the trophic level of the fox. [2]



3 Exam-style questions

3.1 The pyramid of energy shows that only about 10% of energy passes from one trophic level to the next. Explain why. [3]



3.2 Students count plantain plants in ten 0.25 m^2 quadrats in two areas of the school field: area A, away from a path, and area B, next to the path. Area A is 400 m^2. The results are shown.

(a) Calculate the mean number of plantains per quadrat in area A. [2]



quadrat	1	2	3	4	5	6	7	8	9	10
A	6	8	5	7	9	4	6	8	7	10
B	2	1	3	0	2	1	2	3	1	0

(b) Estimate the number of plantains in area A. [3]

(c) Suggest and explain **two** reasons why there are fewer plantains in area B. [3]

(d) Describe how the students should use quadrats to compare the two areas fairly. [6]

Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

- abiotic: light, soil water, temperature, soil pH or minerals
- biotic: grazing animals, competition from grass, disease

2.2

- primary consumer: rabbit
- the fox is a secondary consumer (trophic level 3)

3.1

Any three (1 mark each):

- energy is used in respiration and lost as heat
- some parts are not eaten, e.g. roots or bones
- some food is not digested and is lost in faeces
- energy is lost in waste such as urine

3.2

(a) $70 \div 10 = \mathbf{7}$

(b) $400 \div 0.25 = 1600$ quadrats; $7 \times 1600 = \mathbf{11\,200}$

(c) any two reasons with an explanation: trampling damages leaves, so less photosynthesis; trampled soil is compacted, so roots get less water and air; explanation linked to growth or survival

(d) points to include:

- use the same size of quadrat in both areas (K)
- place quadrats at random, e.g. using random numbers as coordinates on a grid (K)
- use the same number of quadrats in each area, at least ten (App)
- decide a rule for plants partly inside the quadrat, and use it each time (App)
- calculate the mean per quadrat for each area and compare (An)
- also measure abiotic factors, e.g. soil compaction or light, to help explain the difference (An)

Levels: **5–6** a full, logical answer with correct biology and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.

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