Unit 4 · Ecology

HARDER PRACTICE QUESTIONS

Full marks 52

Write your answers on separate paper. Show your working.

1 Spot the error [2]

In the chain rice → grasshopper → frog → snake, the rice stores 6,000 kJ. Bikash wrote: "The snake is at level 4, so $E = 6{,}000 \times (0.1)^4 = 0.6$ kJ." Find his mistake and give the right answer.

2 Which can't be real? [4]

Anju copied these sets of figures (made-up), producers first, into her notebook. Name the shape of each pyramid. Which one can't be real, and why?

Set	Measured	Producers	Primary consumers	Secondary consumers
P	number	1	3,000	40
Q	g/m^2	5	30	not measured
R	kJ/m^2 per year	5,000	700	60
S	kJ/m^2 per year	800	1,200	100

3 Read the measurements [4]

At Silver Springs, the levels took in 87,100, 14,100, 1,600 and 88 kJ per square meter in a year.

i. Find the transfer efficiency of each of the three steps.
ii. What percentage of the producers' energy reached the top level?
iii. What would the ten percent law have predicted for the top level?
iv. Not one step was 10%. Why does the law still come out so close here?

4 Start from the top [3]

The snakes in a marsh, at level 4, take in 30 kJ. The plants catch 1.5% of the sunlight falling on them (made-up figures). Use the ten percent law to find how much sunlight is needed.

5 Estimate it [3]

Suppose a tiger eats about 3,000 kg of deer in a year, and a hectare of grassland gives the deer about 5,000 kg of grass in a year (made-up round figures). Treat mass like energy in the ten percent law. About how much land do Nepal's 429 tigers need? 100 hectares is 1 km^2.

6 Maize or chicken? [3]

A field's maize holds 3,000,000 kJ, and a person needs 10,000 kJ a day (made-up round figures). Find how many days of food for one person the field gives if:

i. all the maize is eaten by people;
ii. all of it is fed to chickens, and people eat the chickens;
iii. half is eaten by people and half fed to chickens.

7 Trace an atom [5]

A nitrogen atom in the air enters a lentil plant, then a person who eats the lentils. It leaves in the person's urine, and in the end returns to the air from a flooded field. Trace it, naming each step and the organisms that carry it out.

8 Predict, then explain [3]

Write your prediction first, then explain it.

Yubraj spreads the same fertilizer on two fields. One is well-aired, the other stays flooded for weeks. Which field loses more of its nitrate to the air? What happens to the making of new nitrate in that field?

9 Which explanation fits the evidence? [4]

The usual equation is $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$. Rabin says: "$6O_2$ has 12 oxygen atoms and $6H_2O$ has only 6, so half of the oxygen gas must come from CO_2."

i. In 1941, algae were given water made with heavy oxygen atoms. What would Rabin predict for the oxygen gas, and what would "all from water" predict?
ii. The heavy oxygen came out as the gas. Which idea does that fit?
iii. Write the equation that lets all of it come from water, and check the oxygen atoms on its two sides.

10 Design a fair test [4]

Manisha wants to test whether lentils grown after rice lessen the next rice crop's need for urea. Plan a fair test: what she changes, what she keeps the same, what she measures, and how she makes the result more reliable.

11 What if? [3]

Suppose all the denitrifying bacteria on Earth died out, and everything else went on as now. What would happen, slowly, to the nitrogen in the air, and in the soil and water? Why would that be a change to the cycle rather than just one lost step?

12 Draw [3]

In the English Channel, the phytoplankton weighed about 4 g/m^2 and the zooplankton about 21 g/m^2. Draw this pyramid of biomass, using 1 cm for 5 g/m^2. Beside it, sketch the shape of the pyramid of energy of the same two levels.

13 Read the numbers [3]

The carbon dioxide in the air was about 280 ppm before 1800 and 427 ppm in 2025.

i. Write 427 ppm as a percentage of the air.
ii. By what percentage has it risen?
iii. You breathe out carbon dioxide all day. Why isn't that a cause of the rise, while burning coal is?

14 Think [3]

Suppose the phytoplankton in the English Channel are replaced every 3 days, keeping 4 g/m^2 there at any moment (a made-up time, in line with "a few days").

i. How much do they grow in a year?
ii. Treating mass like energy, about how much new zooplankton can this make in a year?
iii. How does this answer the question "How can 4 g of food feed 21 g of animals?"

15 Correct the misconceptions [3]

The paragraph has three mistakes. Write each mistake and correct it.

> Tenzin wrote: “Decomposers recycle energy back to plants, so ecosystems can go on without much sunlight. Nitrification brings new nitrogen in from the air. The oxygen given off in photosynthesis comes from carbon dioxide.”

16 Make your own [2]

Make up a problem on a food chain of Nepal with at least four levels that can be solved by the ten percent law, and solve it.