Efficiency of biomass transfer

Worked solutions

GCSE science calculations

This topic online

1 In a meadow, the biomass of the grasses and wild flowers is 2000 g/m^2. The biomass of the grasshoppers and other primary consumers is 180 g/m^2.

Calculate the efficiency of biomass transfer from the producers to the primary consumers. (2 marks)

Efficiency = higher level ÷ lower level x 100

$$\text{efficiency} = \frac{180}{2000} \times 100$$

9%

2 In a woodland, the biomass of the beetles is 450 kg. The beetles are eaten by shrews. The biomass of the shrews is 36 kg.

Calculate the efficiency of biomass transfer from the beetles to the shrews. (2 marks)

Efficiency = higher level ÷ lower level x 100

$$\text{efficiency} = \frac{36}{450} \times 100$$

8%

3 On a farm, a field of grass has a biomass of 2400 kg. The rabbits that feed on the grass have a biomass of 300 kg.

Calculate the percentage of the biomass that is **lost** between the grass and the rabbits. (3 marks)

Biomass lost = lower level - higher level

$$\text{lost} = 2400 - 300 = 2100 \text{ kg}$$

Percentage lost = lost ÷ lower level x 100

$$\text{percentage} = \frac{2100}{2400} \times 100$$

87.5%

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4 In a reservoir, the biomass of the phytoplankton is 3.5 tonnes. The biomass of the zooplankton that feed on them is 280 kg.

1 tonne = 1000 kg

Calculate the efficiency of biomass transfer from the phytoplankton to the zooplankton. (3 marks)

Convert tonnes to kg: 1 tonne = 1000 kg

3.5 tonnes = 3.5 × 1000 = 3500 kg

Efficiency = higher level ÷ lower level × 100

$$\text{efficiency} = \frac{280}{3500} \times 100$$

8%

5 In an oak tree, the caterpillars have a total biomass of 1.4 kg. The blue tits that eat the caterpillars have a total biomass of 84 g.

Calculate the efficiency of biomass transfer from the caterpillars to the blue tits. (3 marks)

Convert kg to g: 1 kg = 1000 g

1.4 kg = 1.4 × 1000 = 1400 g

Efficiency = higher level ÷ lower level × 100

$$\text{efficiency} = \frac{84}{1400} \times 100$$

6%

6 The table gives the biomass at each trophic level in a rock pool.

Trophic level	Biomass in g/m^2
Producers (seaweed)	5000
Primary consumers (limpets)	400
Secondary consumers (crabs)	30
Tertiary consumers (fish)	2

Calculate the efficiency of biomass transfer from the primary consumers to the secondary consumers. (2 marks)

Primary consumers = 400, secondary consumers = 30

Efficiency = higher level ÷ lower level × 100

$$\text{efficiency} = \frac{30}{400} \times 100$$

7.5%

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7 The producers in a pond have a biomass of 6500 kg. The efficiency of biomass transfer to the primary consumers is 10%.

Calculate the biomass of the primary consumers. (2 marks)

Efficiency = higher level ÷ lower level x 100

$$10 = \frac{B}{6500} \times 100$$

Rearrange: B = efficiency ÷ 100 x lower level

$$B = 0.10 \times 6500$$

650 kg

8 On a hillside, the foxes have a biomass of 54 kg. The efficiency of biomass transfer from the rabbits to the foxes is 12%.

Calculate the biomass of the rabbits. (3 marks)

Efficiency = higher level ÷ lower level x 100

$$12 = \frac{54}{B} \times 100$$

12% as a decimal is 0.12

$$0.12 = 54 \div B$$

Rearrange: B = 54 ÷ 0.12

$$B = 54 \div 0.12$$

450 kg

9 In a garden, the biomass of the ladybirds is 900 g. The efficiency of biomass transfer from the aphids to the ladybirds is 7.5%.

Calculate the biomass of the aphids in kg. (3 marks)

Efficiency = higher level ÷ lower level x 100

$$7.5 = \frac{900}{B} \times 100$$

7.5% as a decimal is 0.075

$$B = 900 \div 0.075$$

$$B = 12\,000 \text{ g}$$

Convert g to kg: 1 kg = 1000 g

$$B = 12\,000 \div 1000$$

12 kg

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10 A food chain on a Scottish moor is:

heather → red grouse → golden eagles

- The biomass of the heather is 40 000 kg.
- The efficiency of biomass transfer from heather to grouse is 10%.
- The efficiency of biomass transfer from grouse to eagles is 15%.

Calculate the biomass of the golden eagles. Show your working. (3 marks)

Higher level = efficiency ÷ 100 x lower level

Heather to grouse

grouse = 0.10 x 40 000

grouse = 4000 kg

Grouse to eagles

eagles = 0.15 x 4000

600 kg

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11 Naomi compares the transfer of biomass from producers to primary consumers in two places.

Place	Biomass of producers	Biomass of primary consumers
Lake	2.3 tonnes	170 kg
Hedgerow	860 kg	74 kg

1 tonne = 1000 kg

a. Calculate the efficiency of biomass transfer in the lake. Give your answer to 2 significant figures.

b. Calculate the efficiency of biomass transfer in the hedgerow. Give your answer to 2 significant figures.

c. Which place has the more efficient transfer?

Show your working.

(5 marks)

a)

Convert tonnes to kg: 1 tonne = 1000 kg

2.3 tonnes = 2.3 × 1000 = 2300 kg

Efficiency = higher level ÷ lower level × 100

$$\text{efficiency} = \frac{170}{2300} \times 100$$

efficiency = 7.391...%

7.4%

b)

$$\text{efficiency} = \frac{74}{860} \times 100$$

efficiency = 8.604...%

8.6%

c)

8.6% > 7.4%

hedgerow

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12 The table gives the biomass at each trophic level on one hectare of farmland.

Trophic level	Biomass in kg
Producers (wheat)	18 000
Primary consumers (insects, slugs and snails)	1500
Secondary consumers (spiders and ground beetles)	95
Tertiary consumers (shrews and small birds)	6

a. Calculate the efficiency of biomass transfer from the producers to the primary consumers. Give your answer to 2 significant figures.

b. Calculate the biomass lost between the primary consumers and the secondary consumers. Give your answer in tonnes.

1 tonne = 1000 kg

Show your working.

(4 marks)

a)

Efficiency = higher level ÷ lower level × 100

$$\text{efficiency} = \frac{1500}{18\,000} \times 100$$

$$\text{efficiency} = 8.333...\%$$

8.3%

b)

Primary consumers = 1500 kg, secondary consumers = 95 kg

Lost = 1500 − 95 = 1405 kg

Convert kg to tonnes: 1 tonne = 1000 kg

Lost = 1405 ÷ 1000

1.405 tonnes

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