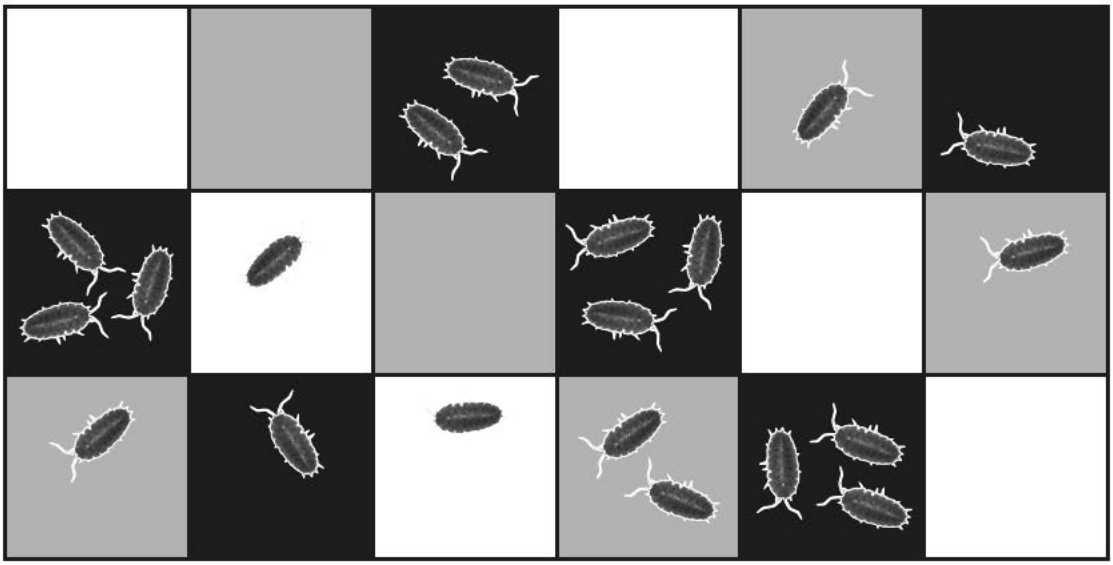
1 Woodlice are small animals that live in and under rotting wood.

20 woodlice were taken from a pile of logs in a forest and placed in the centre of a tray.

The tray had black, dark grey and white squares painted on the bottom.

The diagram shows where the woodlice were 30 minutes later.

Key:  = woodlice



(a) Calculate the percentage of woodlice found on the black squares.

(2)

answer = ...%

(b) The woodlice move quickly on the light squares and slow down on the dark squares.

All woodlice show this behaviour.

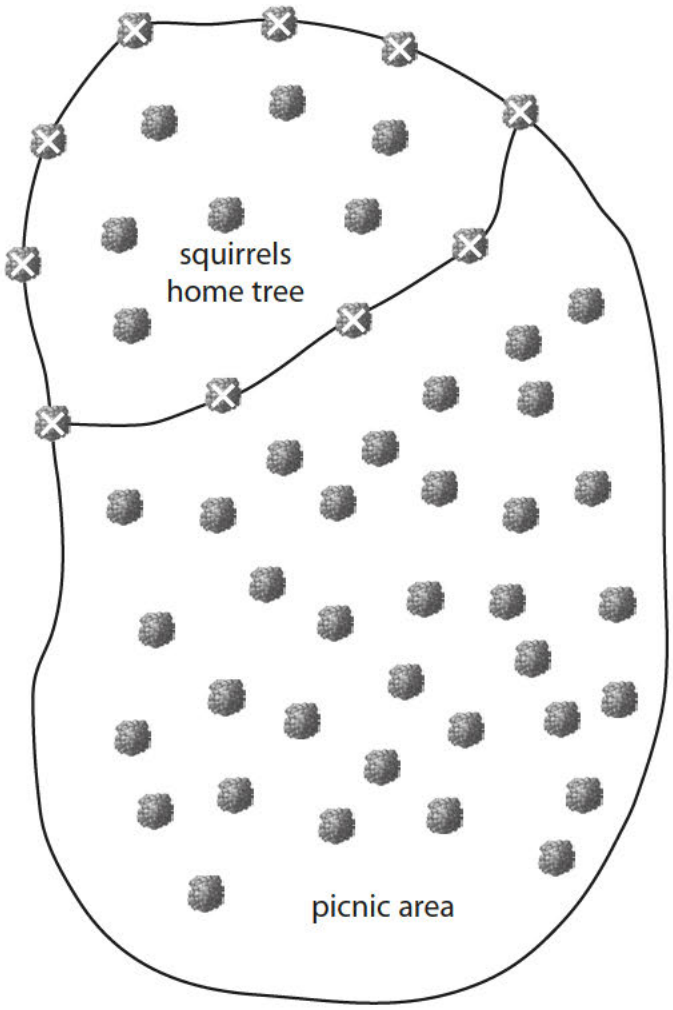
State the term used to describe this type of behaviour.

(1)

.....

(c) A pair of squirrels in a forest were studied for four months.

The map shows part of the forest including the area where the squirrels lived.



(i) The squirrels were observed to urinate regularly on particular trees.

The trees on which they urinated are marked on the map with an X.

Explain how this behaviour benefits the squirrels.

(3)

(ii) The squirrels being studied ran away from people. Other squirrels that lived by the picnic area did not run away.

A scientist suggested that the squirrels near the picnic area had become used to people because the people did not harm them.

Complete the sentence by putting a cross (☒) in the box next to your answer.

This type of behaviour is called

(1)

- ☒ **A** classical conditioning
- ☒ **B** habituation
- ☒ **C** imprinting
- ☒ **D** courtship

(iii) Another scientist suggested that the squirrels that lived near the picnic area were showing operant conditioning.

Describe what is meant by the term operant conditioning.

(3)

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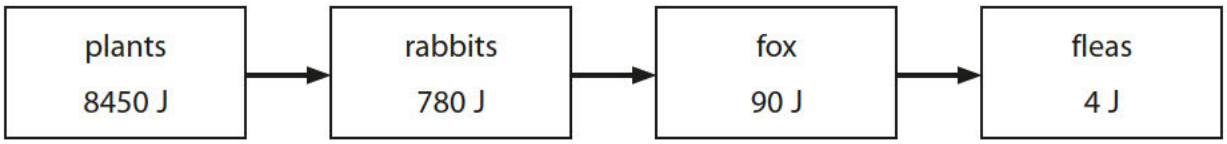
(Total for Question 1 = 10 marks)

2 Scientists can show the relationships between organisms in a variety of ways.

This food chain shows the energy content at each trophic level.



(a) (i) Calculate the percentage of energy that is transferred from the rabbits to the fox.

(2)

answer = ...%

(ii) State **two** ways in which energy can be lost between the trophic levels of the rabbit and the fox.

(2)

1 .....

.....

2 .....

.....

(b) Suggest how a farmer rearing chickens could limit energy loss from the chickens.

(2)

.....

.....

.....

.....

(c) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Fleas are parasites that feed on foxes.

Another example of parasites are

(1)

- ☐ **A** cleaner fish
- ☐ **B** lichens
- ☐ **C** mistletoe
- ☐ **D** oxpeckers

(ii) Peas and beans are known as legumes.
They form a mutualistic relationship with the bacteria in their roots.

Explain the importance of this mutualistic relationship to the legumes.

(3)

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(Total for Question 2 = 10 marks)

3 Tropical fish excrete ammonia, which is an alkali.

The pH level of water in a tropical fish tank needs to be maintained between 6.6 and 7.4 for the fish to survive.

This is the optimum pH range for the bacteria that are responsible for the conversion of ammonia into nitrites and then nitrates.

Nitrosomonas bacteria convert ammonia into nitrites.

Nitrobacter bacteria convert nitrites into nitrates.

(a) (i) *Nitrosomonas* bacteria are an example of

(1)

☒ **A** nitrogen fixing bacteria

☒ **B** nitrifying bacteria

☒ **C** denitrifying bacteria

☒ **D** *Helicobacter* bacteria

(ii) Explain why *Nitrosomonas* and *Nitrobacter* bacteria are needed in tropical fish tanks.

(2)

An aquatic plant in the fish tank had a concentration of nitrates higher than the water in the fish tank.

(iii) Explain how this aquatic plant can uptake nitrates from the water in the fish tank.

(2)

Leguminous plants have nodules on their roots that have colonies of nitrogen-fixing bacteria.

Clover is a leguminous plant.

(b) Describe how a quadrat could be used to sample the population of clover in a 500 m^2 field.

(3)

The nitrogen-fixing bacteria provide nitrates for the plants and release any excess into the soil.

(c) Explain how leguminous plants such as clover could be used to reduce the amount of artificial fertilisers.

(4)

(Total for Question 3 = 12 marks)

4 The food chain shows the energy transferred between organisms.

	7760 kJ		620 kJ		50 kJ	
oak tree	⟶	caterpillars	⟶	blue tits	⟶	sparrowhawk

(a) (i) The oak tree is the producer in the food chain.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The oak tree obtains energy

(1)

☒ **A** autotrophically

☒ **B** heterotrophically

☒ **C** parasitically

☒ **D** saprophytically

(ii) The energy available in the oak tree that could be transferred to the caterpillars was 97 000.

Calculate the percentage loss of energy between the oak tree and the caterpillars.

(3)

.....%

(iii) Suggest how energy is lost between trophic levels in this food chain.

(2)

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.....

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.....

*(b) The survival of some organisms may depend on mutualism.

Explain, using **three** examples, how some organisms benefit from mutualism.

(6)

(Total for Question 4 = 12 marks)