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Student number

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Name _____

Date _____

Attempt/Time taken _____

GCSE BIOLOGY

Topic Paper: 7.4 Trophic levels in an ecosystem (biology only)
Part 1

Time allowed: 55 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

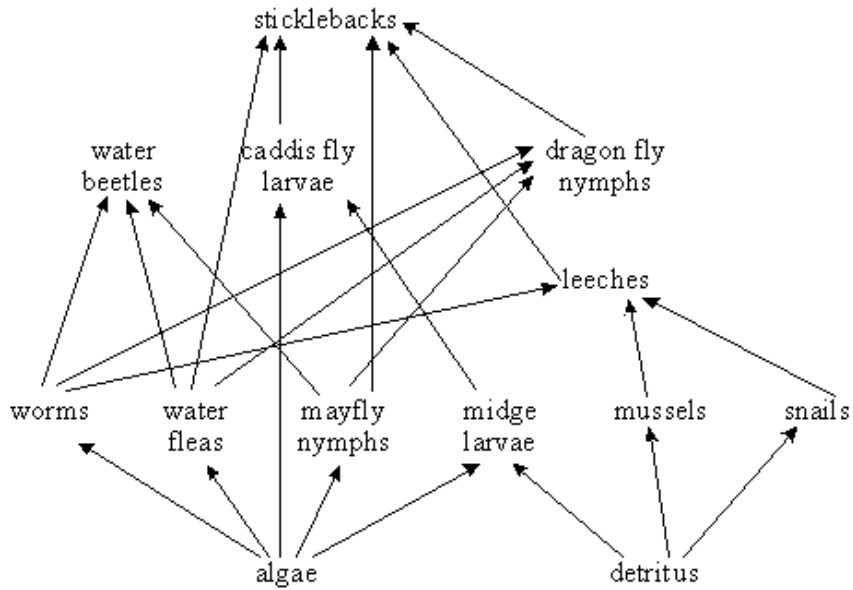
- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
 - is clear, logical, sensibly structured
 - fully meets the requirements of the question
 - shows that each separate point or step supports the overall answer.



51 Marks

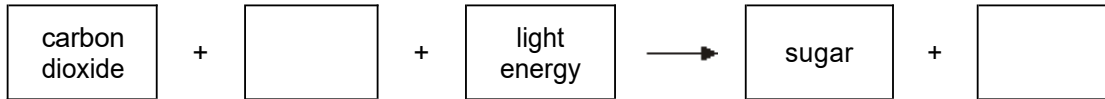


Q1. The diagram below shows a food web for some of the organisms which live in a pond.



You may need to use information from the food web to help you to answer the following questions.

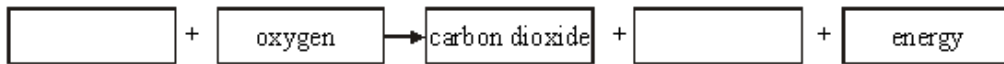
(a) The algae photosynthesise. Complete the equation for photosynthesis.



(2)



(a) Complete the equation for plant respiration.



(2)

(b) (i) Calculate the mass of carbon removed from the atmosphere each year. (*Show your working.*)

Answer billion tonnes

(1)

(ii) Calculate the percentage of this total which is removed by the photosynthesis of land plants. (*Show your working.*)

Answer %

(2)

(iii) Calculate the net gain of carbon by the atmosphere in one year. (*Show your working.*)

Answer billion tonnes

(2)

(Total 7 marks)

Q3. A gardener pulled up weeds and used them to start a compost heap. The compost heap soon became colonised by large numbers of earthworms and slugs. The gardener then noticed a hedgehog rooting through the compost heap, eating the earthworms and slugs. Every so often the hedgehog stopped to scratch itself. This was because it had large numbers of fleas which fed by sucking the hedgehog's blood.

(a) Use **only** information from the passage to answer the following.

Construct and label a pyramid of **biomass** for your food chain.

(2)



- (b) Gardeners put plant material onto compost heaps so that it will decay. They then put the decayed compost onto soil where they are growing their plants.

Give **three** conditions which are needed for plant material to decay rapidly.

1

2

3

(3)
(Total 5 marks)

Q4. The photographs show four different species of bird.

Great tit



© JensGade/iStock

Blue tit



© Marcobarone/iStock

Coal tit



© MikeLane45/iStock

Long-tailed tit



© Andrew Howe/iStock

The table gives information about the four species of bird in winter.

Bird species	Mean body mass in grams	Mean energy needed in kJ per day	Mean percentage of day spent feeding
Great tit	21	84.2	75
Blue tit	12	62.4	81
Coal tit	9	49.5	88
Long-tailed tit	7	42.0	92

(a) (i) Calculate the energy needed per day per gram of body mass for the blue tit.

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Answer = kJ per day per gram of body mass

(2)

(ii) Describe the trend for energy needed per day per gram of body mass for the four species of bird.

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(1)



(iii) Suggest an explanation for the trend you have described in part (a)(ii).

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(2)

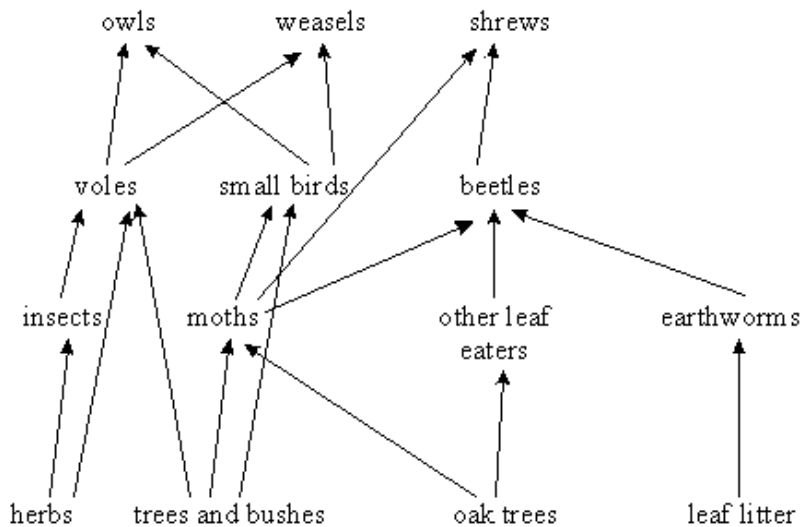
(b) Describe and explain the trend shown by the data for the time spent feeding in winter for the birds.

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(2)

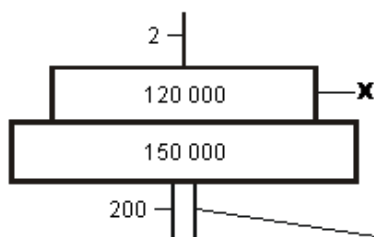
(Total 7 marks)

Q5. The diagram below shows a food web for a wood.

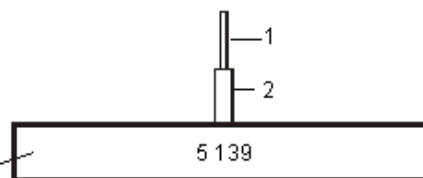


(a) The diagrams below show a pyramid of the numbers and a pyramid of the biomass for 0.1 hectare of this wood.

Pyramid of Numbers
numbers/0.1 hectare



Pyramid of Biomass
biomass (grams per square metre)





(i) Name **one** organism from the level labelled X.

.....

(1)

(ii) Explain, as fully as you can, why the level labelled Y is such a different width in the two pyramids.

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(3)

(b) Explain, as fully as you can, what eventually happens to energy from the sun which is captured by the plants in the wood.

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(10)

(Total 14 marks)



Q6. An oak wood contained the following:

200 oak trees

150 000 primary consumers

120 000 secondary consumers

(a) Draw and label a pyramid of biomass for **this** wood. (Your pyramid does **not** have to be drawn to scale.)

(2)

(b) A scientist estimated the total amount of energy flow through each level of the pyramid per year.

The results were:

Energy absorbed by oak trees 4 600 000 kJ per m² per year

Energy in sugar produced by trees 44 000 kJ per m² per year

Energy transferred to primary consumers 2 920 kJ per m² per year

Energy transferred to secondary consumers 700 kJ per m² per year

(i) Calculate the percentage of the energy absorbed by the trees that is transferred to sugar by photosynthesis. Show your working.

Answer %

(2)

(ii) Suggest **two** reasons why a large proportion of the energy is not transferred to sugar.

1

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2

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(2)



(iii) Give **three** reasons why some of the energy in the primary consumers is not passed on to the secondary consumers.

1

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2

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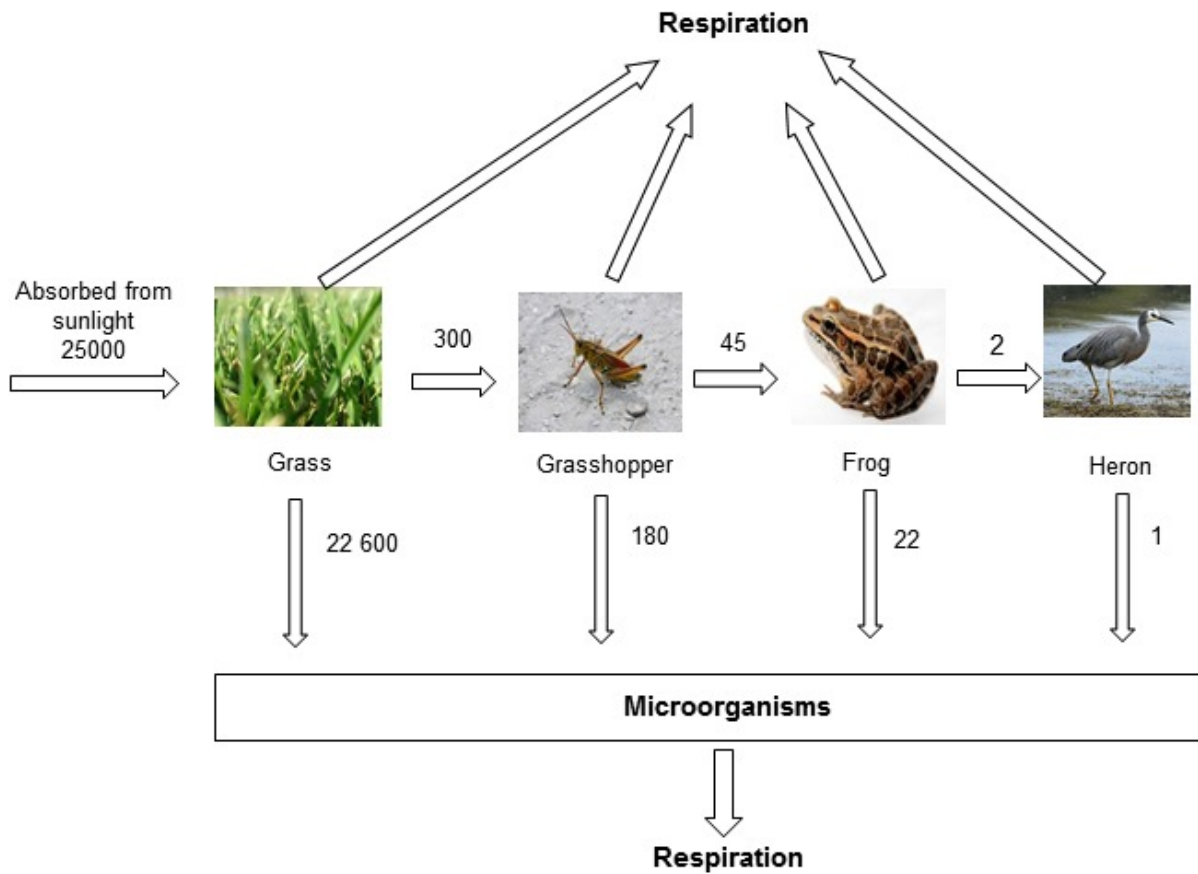
3

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(3)
(Total 9 marks)

Q7. The diagram shows the annual energy flow through 1 m² of a habitat.

The unit, in each case, is kJ per m² per year.



(a) Calculate the percentage of the energy absorbed by the grass from sunlight that is transferred to the frog.

Show clearly how you work out your answer.

.....

Answer %

(2)

(b) All of the energy the grass absorbs from the sun is eventually lost to the surroundings.

In what form is this energy lost?

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(1)

(c) Food chains are usually **not** more than five organisms long.

Explain why.

To gain full marks you must use data from the diagram.

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(2)

(d) In this habitat microorganisms help to recycle materials.

Explain how.

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(3)

(Total 8 marks)

Grass by Catarina Carvalho from Lisboa, Portugal (Flickr) [CC-BY-2.0], via Wikimedia Commons. Grasshopper by I, Daniel Schwen [GFDL, CC-BY-SA-3.0], via Wikimedia Commons. Frog by Brian Gratwicke (Pickere! Frog) [CC-BY-2.0], via Wikimedia Commons. Heron by Glen Fergus (Own work, Otago Peninsula, New Zealand) [CC-BY-SA-2.5], via Wikimedia Commons.