Energy Transfer through ecosystems

Question Paper 1

Level	A Level
Subject	Biology
Exam Board	Edexcel
Topic	Nature of Ecosystems
Sub Topic	Energy transfer through ecosystems
Booklet	Question Paper 1

Time Allowed: **52 minutes**

Score: **/43**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Gross primary productivity (GPP) is affected by temperature and precipitation, which includes rain and snow.

The table below shows the mean annual temperature range and mean annual precipitation range in some ecosystems. The table also shows the GPP range in these ecosystems.

Ecosystem	Mean annual temperature range / °C	Mean annual precipitation range / cm	GPP range / kJ m^{-2} $year^{-1}$
Tropical rainforest	20 to 28	240 to 440	24 500 to 29 000
Temperate forest	1 to 20	50 to 240	15 000 to 27 000
Temperate grassland	–8 to 20	20 to 130	1 700 to 11 000
Tundra	–14 to –8	10 to 110	850 to 2 500

(a) Explain the meaning of the term **gross primary productivity (GPP)**.

(2)

(b) Using the information in the table, describe and explain the effects of temperature and precipitation on GPP.

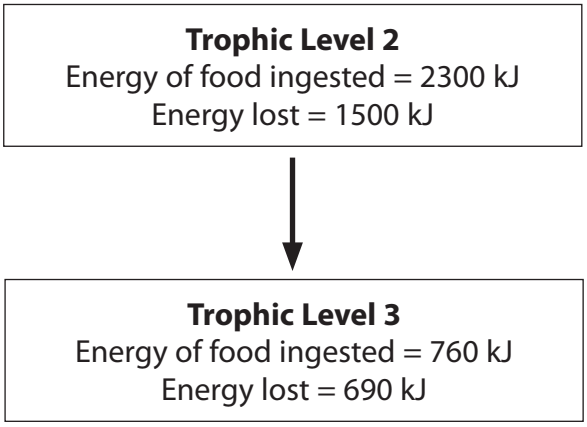
(5)

(c) A desert has a mean annual temperature range of –8 °C to 20 °C and a mean annual precipitation range of 0 to 20 cm.

Suggest a range for the GPP in this desert. Give reasons for your answer.

(3)

(d) The diagram below shows the flow of energy in part of an ecosystem.



Calculate the percentage of energy from trophic level 2 that would be available for trophic level 4.

(3)

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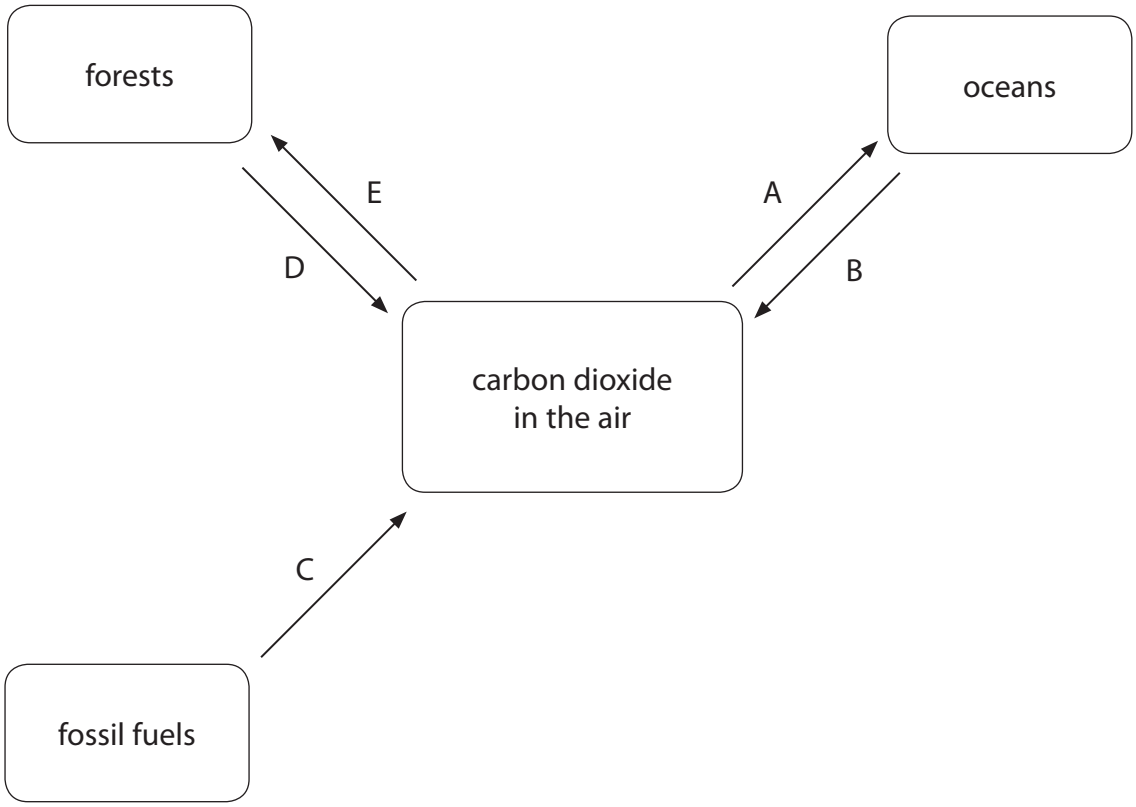
(Total for Question 1 = 13 marks)

2 The diagram below shows part of the carbon cycle. The processes A, B, C, D and E, transfer carbon.



(a) Explain how carbon dioxide is removed from the air into the oceans by process A.

(2)

(b) Suggest how carbon dioxide is returned to the air from the oceans by process B.

(1)

(c) Place a cross ☒ in the box next to the gases produced by process C.

(1)

- ☒ **A** carbon dioxide and methane
- ☒ **B** carbon dioxide and water vapour
- ☒ **C** carbon dioxide, methane and water vapour
- ☒ **D** carbon dioxide, oxygen and water vapour

(d) Describe the role of bacteria in process D in the diagram.

(3)

(e) Place a cross ☒ in the box next to the reaction in process E that uses carbon dioxide.

(1)

- ☒ **A** light-dependent reaction
- ☒ **B** light-independent reaction
- ☒ **C** photolysis
- ☒ **D** photophosphorylation

(f) The table below shows how much carbon is being transferred by each of the processes in the diagram.

Process	A	B	C	D	E
Mass of carbon transferred / au	338	332	23	444	450

(i) Calculate how much more carbon is entering the air than is leaving it.

Show your working.

(2)

Answer .....

(ii) Suggest why more carbon is entering the air than is leaving it.

(3)

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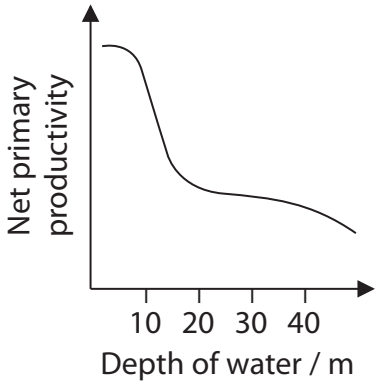
(Total for Question 2 = 13 marks)

3 The graph below shows how the depth of water in a freshwater lake affects the net primary productivity (NPP).



(a) Place a cross ☒ in the box next to the units that should appear on the *y*-axis of this graph.

(1)

☒ **A** kg

☒ **B** kJ m^{-1}

☒ **C** kJ m^{-2} $year^{-1}$

☒ **D** kg m^{-1} $year^{-1}$

(b) Place a cross ☒ in the box next to the equation that describes the relationship between NPP, gross primary productivity (GPP) and respiration (R).

(1)

☒ **A** GPP = R – NPP

☒ **B** NPP = GPP – R

☒ **C** NPP = GPP + R

☒ **D** R = GPP + NPP

(c) Suggest an explanation for the effect of depth of water on the NPP in this freshwater lake.

(4)

(Total for Question 3 = 6 marks)

4 Bacteria are involved in the decomposition of organic matter.

(a) Place a cross ☒ in the box next to the type of chemical reaction that takes place in decomposition.

(1)

☒ **A** condensation

☒ **B** esterification

☒ **C** hydrolysis

☒ **D** polymerisation

(b) An investigation was carried out to study the rate of decomposition of leaves from ash trees and beech trees.

Five piles of each type of leaf were placed outside on the ground and each pile was covered with a heavy bucket. Each pile of leaves had a mass of 10 grams.

Every few weeks, one pile of each type of leaf was removed and weighed.

The table below shows the results of this investigation.

Time after falling from the tree / weeks	Mass of pile of ash leaves / g	Mass of pile of beech leaves / g
0	10.0	10.0
4	4.9	9.1
8	2.0	8.4
16	1.1	6.0
32	1.2	2.8
64	0.8	2.4

(i) Place a cross ☒ in the box next to the reason for using five piles of ash leaves in this investigation.

(1)

☒ **A** to calculate a mean

☒ **B** to give a range of values for the independent variable

☒ **C** to make the investigation valid

☒ **D** to produce reliable data

(ii) A student made the following conclusions from these results.

Decomposition of beech leaves is faster than ash leaves.

Bacteria are needed for the decomposition of beech and ash leaves.

There is a correlation between decomposition and time.

Place a cross ☒ in the box next to the number of correct conclusions made by this student.

(1)

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(iii) Explain why there is a decrease in mass of the leaves.

(4)

(iv) Suggest what effect an increase in temperature would have on the rate of decomposition of these leaves. Give an explanation for your answer.

(4)

(Total for Question 4 = 11 marks)