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EDEXCEL COMBINED SCIENCE BIOLOGY: QUESTIONS BY TOPIC

Ecosystems and Material Cycles (9)

Combined Science Biology (Higher) Topic 9

7 questions · 73 marks · Mark schemes included

Pearson Edexcel Combined Science (9-1) Biology 1SC0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.
Click any row below to jump straight to that question.
On every question page, click ANSWER in the top-right corner to jump to its mark scheme.
Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION		SOURCE	MARKS	PAGE
1.	Q1	Paper 2 November 2021	9	4
2.	Q3	Paper 2 June 2022	9	7
3.	Q2	Paper 2 June 2025	9	9
4.	Q3	Paper 2 June 2024	10	13
5.	Q4	Paper 1 June 2023	11	16
6.	Q6	Paper 2 June 2023	12	20
7.	Q6	Paper 2 June 2022	13	23



QUESTIONS

7 questions · 73 marks · lowest tariff first



9-MARK QUESTIONS

3 questions in this booklet



- 1 Figure 1 shows an area of woodland with some small plants growing in the ground between the trees.



small plants

(Source: © Maksym Holovinov/Shutterstock)

Figure 1

- (a) Name a group of organisms that break down the dead leaves and release mineral ions into the soil.

(1)

- (b) The mineral ions are absorbed from the soil into the roots of plants.

Describe how these mineral ions are transported from the roots to the leaves of the plants.

(2)

- (c) A scientist recorded the mean light intensity and the mean number of small plants per m^2 for six 25 m^2 areas of the woodland.

Figure 2 shows the results.

area of woodland	mean light intensity in lux	mean number of small plants per m^2
A	1500	2.7
B	1300	1.6
C	1000	1.1
D	800	0.6
E	550	0.3
F	350	0.1

Figure 2

- (i) Explain the effect of light intensity on the number of small plants per m^2 .

(2)

.....

.....

.....

.....

- (ii) State **one** variable the scientist should have controlled to make sure the light intensity measurements could be compared.

(1)

.....

.....



- (d) The scientist selects an area near the edge of the woodland where many stinging nettles are growing.

This area is partly shaded by the trees.

Describe how the scientist should use a belt transect to investigate how light intensity affects the growth of stinging nettles.

(3)

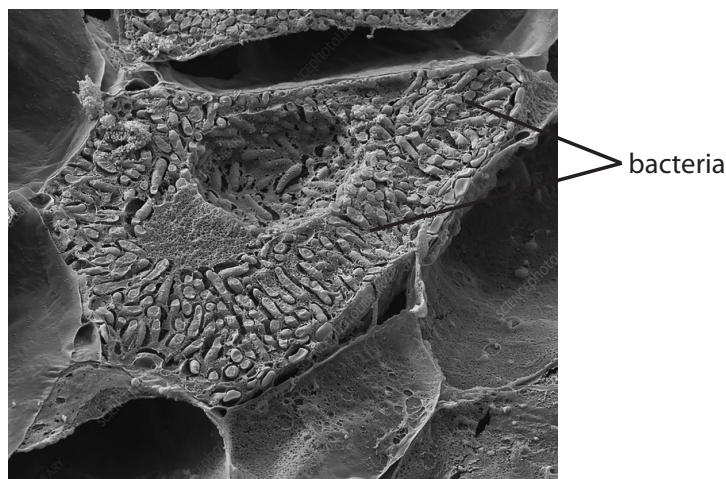
(Total for Question 1 = 9 marks)



- 3 (a) Figure 4 shows a cross-section of a root nodule on a leguminous plant.

Bacteria in the root nodule provide the leguminous plant with nitrogen compounds.

The leguminous plant provides the bacteria with sugars.



(Source: © Nigel Downer / Science Photo Library)

Figure 4

- (i) Which term describes the relationship between this leguminous plant and the bacteria?

(1)

- ☐ **A** parasitism
- ☐ **B** indigenous
- ☐ **C** biodiversity
- ☐ **D** mutualism

- (ii) The width of this root nodule is 7.5 mm.

Give the width in μm .

(1)

..... μm

(b) Figure 5 shows part of the nitrogen cycle.

dead animals and plants $\xrightarrow{\text{X}}$ ammonia $\xrightarrow{\text{Y}}$ nitrates

Figure 5

(i) Identify the types of microorganism involved in process X and process Y.

(2)

X.....

Y.....

(ii) Explain how crop rotation increases nitrate levels in the soil.

(3)

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(iii) Explain why increased nitrate levels in the soil improve crop yield.

(2)

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(Total for Question 3 = 9 marks)



2 (a) In 2018, all the plants were removed from the soil in a 1000 m² area.

A wall was built around this area to keep people out.

In 2019, three species of plants were recorded growing in this area.

Two of these species were indigenous.

(i) State what is meant by the term 'indigenous'.

(1)

(ii) Name **one** piece of equipment that could be used to sample the number of indigenous plants in this area.

(1)

(b) The area was surveyed every year and the number of plants of each species (A to H) was estimated.

Figure 5 shows the results.

estimated number of each plant species found in the survey								
year	A	B	C	D	E	F	G	H
2018	—	—	—	—	—	—	—	—
2019	491	23	66	—	—	—	—	—
2020	664	48	186	1	8	—	—	—
2021	470	25	283	3	6	7	1	—
2022	120	41	354	7	4	11	7	—
2023	44	39	421	21	6	11	9	8

Figure 5

- (i) State the trend shown by the data in Figure 5 for plant species C from 2019 to 2023.

(1)

- (ii) A scientist suggested that the decrease in the number of plants of species B in 2021 was caused by competition from one of the other species of plant.

Which species is most likely to have out-competed species B in 2021?

(1)

- ☐ **A** species A
- ☐ **B** species C
- ☐ **C** species D
- ☐ **D** species H

- (iii) Explain **one** way that this species could have out-competed species B.

(2)

- (iv) Give **one** way that species H could have moved into the area.

(1)



(c) Plants also need water to grow.

Explain how water is absorbed into the plant.

(2)

(Total for Question 2 = 9 marks)

10-MARK QUESTIONS

1 question in this booklet



(iii) Mistletoe is a parasite that grows on some trees.

Figure 4 shows a tree with mistletoe growing on it.



(Source: © NagyDodo/Shutterstock)

Figure 4

Describe the feeding relationship between the mistletoe and the tree.

(2)

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(b) Nitrate fertilisers are used in the garden.

Explain why nitrate fertilisers are used in gardens.

(2)

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(Total for Question 3 = 10 marks)

11-MARK QUESTIONS

1 question in this booklet



- 4 (a) In the 19th century the destruction of wetland habitats caused the extinction of the bittern in the UK.

Figure 5 shows a bittern.



(Source: © Ildiko Laskay/Shutterstock)

Figure 5

Restoration of the habitats has led to the birds returning to the UK.

Male bitterns make a loud booming sound.

This allows the numbers of male bitterns to be counted.

In 1997, 11 males were counted and this increased to 221 males in 2021.

- (i) Calculate the percentage increase in the number of males from 1997 to 2021.

(3)

.....%

The bitterns are difficult to see in the reeds of the wetland habitat.

- (ii) Give **one** benefit of this to the bittern.

(1)

.....

.....

.....

- (iii) There is some concern that the bitterns in the UK are all closely related. This could make them susceptible to extinction.

Explain, using your knowledge of natural selection, why being closely related could make the bitterns susceptible to extinction.

(3)

- (b) Describe how selective breeding can be used to produce a large population of animals that are not closely related.

(2)



(c) Sex determination in birds is different from humans.

Males are homozygous Z and females are heterozygous ZW.

Complete the Punnett square to show how sex is determined in birds.

(2)

		male	
female			

(Total for Question 4 = 11 marks)

12-MARK QUESTIONS

1 question in this booklet



- 6 Figure 9 shows a photomicrograph of two stomata in a leaf.

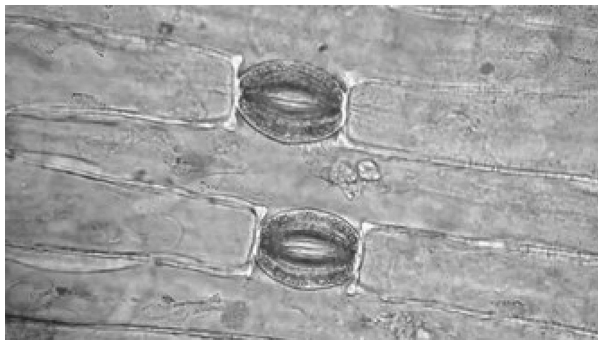


Figure 9

- (a) (i) The length of one guard cell in this image is 6 mm.

Convert the length of this guard cell into micrometres (μm).

(1)

- (ii) The image has been magnified 150 $\times$.

Calculate the actual size of the guard cell.

Give your answer in standard form in mm.

(3)

..... mm

- (b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2)

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* (c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.

(6)

(Total for Question 6 = 12 marks)



13-MARK QUESTIONS

1 question in this booklet



- 6 (a) Scientists use a technique called mark and recapture to estimate animal populations in a habitat.

A sample of the population is captured and a harmless mark is added to each animal.

These animals are released and after a period of time the population is sampled again.

This second sample includes some recaptured animals that have marks on them.

The population can be estimated using this equation

$$\text{population size} = \frac{\text{number marked in the first sample} \times \text{size of the second sample}}{\text{number recaptured in the second sample}}$$

A scientist used this technique to determine the change in the population size of snails in a pond from March to July.

Figure 9 shows the results.

month	number marked in the first sample	size of the second sample	number of recaptured animals	population size
March	18	22	8	50
July	12	18	10	

Figure 9

- (i) Using data from Figure 9, calculate the difference in the population size from March to July.

(3)

Difference in the population size

(ii) State **two** factors the scientist should control when sampling the habitat in March and July.

(2)

1

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2

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(b) This pond is affected by eutrophication.

Explain **one** possible cause of eutrophication.

(2)

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*(c) Reforestation has a beneficial effect on air composition and biodiversity.

Animal conservation projects can also have a beneficial effect on biodiversity.

Explain the beneficial effects of reforestation and animal conservation projects.

(6)

(Total for Question 6 = 13 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional guidance	Mark
1(a)	Any one from: bacteria / fungi / decomposers / prokaryotes	accept microorganisms accept named decomposing organisms e.g. worms	(1) A01 1

Question Number	Answer	Additional guidance	Mark
1(b)	A description including two from: • (dissolved) in water (1) • diffusion through the root (1) • (so water moves) through the xylem (1) • by transpiration (stream) (1) • into leaves by diffusion (1)	accept active transport through the plant reject phloem accept evaporated from the leaves	(2) A02 1

Question Number	Answer	Additional guidance	Mark
1(c) (i)	An explanation linking: • as light intensity decreases the number of (small) plants (per m²) decreases (1) • because the (small) plants will not be able to photosynthesise enough (1)	accept reverse argument	(2) A03 1ab

Question Number	Answer	Additional guidance	Mark
1(c) (ii)	Any one from: • same time of day (1) • same meter (1) • same position(s) in area / measure the same size area (1) • same person makes the readings (1) • meter held vertically each time (1)	accept other valid variables that should be controlled	(1) A03 1ab

Question Number	Answer	Additional guidance	Mark
1(d)	A description including three from: • place a quadrat along a {rope / tape} measure (1) • tape measure to measure along the transect (1) • measure light intensity at different distances (from the wood) (1) • measure the stinging nettles {along the transect / at different light intensities} (1) • way of measuring growth of stinging nettles (in the quadrats) (1)	reject quadrant accept good descriptions of quadrats – e.g. ½ metre wire square accept use a light meter/lux meter accept named examples – e.g. {height / mass/ dry mass / number of leaves / number of plants}	(3) AO3 3a

(Total for question 1 = 9 marks)

Question Number	Answer	Mark
3 (a)(i)	D mutualism The only correct answer is D <i>A is not correct because it is not parasitism</i> <i>B is not correct because it is not indigenous</i> <i>C is not correct because it is not biodiversity</i>	(1) AO1

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	7500 (µm)	accept 7.5×10^3 reject 7.5×10^{-3}	(1) AO1 1

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	X – decomposers Y – nitrifying (bacteria)	accept fungi / decomposing bacteria accept named nitrifying bacteria reject denitrifying bacteria / nitrogen-fixing bacteria	(2) AO1 1

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation linking three from: • leguminous crops planted (1) • that have nitrogen-fixing bacteria (1) • in root (nodules) (1) • which fix nitrogen (gas) (1)	accept named leguminous crops accept use nitrogen from the air / use atmospheric nitrogen / make ammonia ignore produce nitrates	(3) AO1

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	An explanation linking: • nitrates are needed to make {protein / amino acids} (1) • which are needed for growth (1)	accept for DNA / genetic material	(2) AO1

(Total marks for question 3 = 9 marks)

Question number	Answer	Mark
2(a)(i)	native (species) / (species) from the country of origin	(1)

Question number	Answer	Additional guidance	Mark
2(a)(ii)	quadrat / stated size of square area	accept {belt / line} transect / a grid	(1)

Question number	Answer	Mark
2(b)(i)	increases / goes up / rises	(1)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	The only correct answer is B species C A is incorrect because Species A is decreasing so will not out-compete C is incorrect because species D has only increased by 2 so will not out-compete B D is incorrect because species H is not present so will not out-compete species B		(1)

Question number	Answer	Additional guidance	Mark
2(b)(iii)	An explanation linking: - taller / bigger / had larger leaves / had larger roots (1) (got more) water / minerals / nutrients / light / photosynthesis (1)	ORA accept grows / reproduces / takes up more space / higher population accept named minerals accept disease / eaten by animals (1)	(2)

Question number	Answer	Mark
2(b)(iv)	(seeds) blown in by the wind / (seeds) brought in by animals / {roots / shoots} growing under the wall	(1)

Question number	Answer	Additional guidance	Mark
2(c)	An explanation including two from: • through the root (hair cells) (1) • by osmosis (1) • across the {semi / partially} permeable membrane (1) • from a high water concentration to a low water concentration (1)	accept down a concentration gradient / from high water potential to low water potential	(2)

Total for Question 2 = 9 marks

Question number	Answer	Additional guidance	Mark
3(a)(i)	A plan including three from: • use a quadrat (1) • use a random number generator (to decide the areas to sample) / use random co-ordinates (1) • (use a key) to identify the plants (1) • count the number of plant species (1)	ignore belt transect accept square / grid ignore sample the number of plant species	(3) AO3 3a

Question number	Answer	Additional guidance	Mark
3(a)(ii)	Any three from: • measure the temperature with a thermometer (1) • measure the light levels using a {lux / light} meter (1) • measure the levels of water in the soil using a water {meter / sensor / wet - dry mass of soil sample} (1) • rainfall using a {measuring cylinder / beaker} (1) • humidity using a humidity {meter / sensor} (1) • depth of the soil using a ruler (1)	accept heat for temperature accept photometer / phone app / light sensor accept data logger accept datalogger accept hygrometer accept	(3) AO1 2

Question number	Answer	Additional guidance	Mark
3(a)(iii)	A description including two from: - the tree is the host (1) - the mistletoe gains {nutrients / water} from the tree (1) - the tree is damaged by the mistletoe (1)	accept any indication of harm including killing the tree	(2) AO1 1

Question number	Answer	Additional guidance	Mark
3(b)	An explanation including: (fertilisers are used) to increase {growth / repair} of plants (1) (because nitrates are needed) to make proteins (1)	accept DNA / amino acids for proteins	(2) AO1 1

(Total for question 3 = 10 marks)

Question number	Answer	Additional guidance	Mark
4(a)(i)	subtraction $221 - 11$ or 210 (1) calculation $210 \div 11 \times 100$ (1) evaluation 1909 (%)	award full marks for the correct answer without workings accept ecf from incorrect subtraction or no subtraction accept 1909.1 accept answer to any number of decimal places correctly rounded accept 19.09 for 2 marks	(3)

Question number	Answer	Additional guidance	Mark
4(a)(ii)	increased survival rate / hidden from predators / hidden from prey	accept camouflaged / increased chance of getting food	(1)

Question number	Answer	Additional guidance	Mark
4(a)(iii)	An explanation linking three from: - all genetically similar / there is less variation (1) - if there is a selection pressure (1) - they will {be susceptible / die} (due to the selection pressure) / no survival of the fittest (1) - fewer birds will be able to reproduce (1) - the species cannot evolve (1)	accept decreased gene pool / similar {DNA / genes / alleles} accept examples of selection pressure e.g. disease / change in the environment accept affected for susceptible accept it's less likely there will be adapted bitterns to survive accept fewer offspring are produced	(3)

Question number	Answer	Additional guidance	Mark
4(b)	An answer including two of the following: • breed animals who are {not genetically similar / genetically different} (1) • repeat the process over many generations (1)	animals with different characteristics accept this occurs over several generations accept prevent the animals inbreeding (1)	(2)

Question number	Answer	Additional guidance	Mark											
4(c)	male <table><tr><td></td><td>Z</td><td>Z</td></tr><tr><td>female</td><td>Z</td><td>ZZ</td><td>ZZ</td></tr><tr><td></td><td>W</td><td>ZW</td><td>ZW</td></tr></table> correct parental genotypes (1) correct offspring genotypes (1) <td> ecf for incorrect parental genotype if Z and W used. Accept WZ </td> <td>(2)</td>		Z	Z	female	Z	ZZ	ZZ		W	ZW	ZW	ecf for incorrect parental genotype if Z and W used. Accept WZ	(2)
	Z	Z												
female	Z	ZZ	ZZ											
	W	ZW	ZW											

(Total for question 4 = 11 marks)

Question number	Answer	Mark
6(a)(i)	6000 μm 6×10^3 6.0×10^3 Reject 6×10^{-3}	(1)

Question number	Answer	Additional guidance	Mark
6(a)(ii)	$6 \div 150$ (1) 0.04 (mm) (1) 4.0×10^{-2} (mm)	accept 4×10^{-2} for full marks	(3)

Question number	Answer	Additional guidance	Mark
6(b)	A description linking the following: (denitrifying bacteria) convert nitrates (1) - back into (atmospheric) nitrogen (1)	accept nitrites	(2)

Question number	Indicative content	Mark
*6(c)	AO1 Biotic Plants • During photosynthesis plants take in carbon dioxide from the atmosphere • During respiration plants release carbon dioxide into the atmosphere • Plants store carbon compounds e.g. glucose • Carbon is transferred to animals when they are eaten Animals • Animals release carbon dioxide when they respire • Animals ingest carbon compounds e.g. glucose when they eat plants or animals Decomposers • Decomposers release carbon dioxide during respiration • Decomposers break things down Abiotic • Burning fossil fuels releases carbon dioxide or carbon (particulates) into the atmosphere • The oceans can absorb carbon dioxide • Carbon can be stored in carbonate rocks • Erosion of carbonate rocks releases carbon dioxide • Volcanoes releasing carbon dioxide	(6)

Level	Mark	Indicative content
	0	No rewardable material.
Level 1	1–2	• a simple description one way in which carbon is cycled • linked to a process involved
Level 2	3–4	• A detailed description of how carbon is cycled in the biotic or abiotic environment or a simple description of how carbon is cycled in each environment • Linked to two different processes involved
Level 3	5–6	• A detailed description of how carbon is cycled in the biotic and abiotic environment including the role of plants, animals and decomposers • Linked to the processes of respiration and photosynthesis and an abiotic process

(Total for question 6 = 12 marks)



Question Number	Answer	Additional Guidance	Mark
6(a)(i)	substitution $(12 \times 18 \div 10) = 21.6$ (1) whole organism (1) $= 21 / 22$ $(50 - 21 / 22) = 28 / 29$	award full marks for correct answer with no working e.c.f. from incorrect substitution using data from the table e.c.f. from incorrect whole organism award two marks for 28.4 or 27.9 or 22 or 21 without working	(3) AO2

Question Number	Answer	Mark
6(a)(ii)	Any two from: • sample at the (same) time of day (1) • sample for the (same) length of time (1) • use the (same) equipment / techniques (1) • (same) time period between first and second sample (1) • (same) marking process (1) • do not harm organisms when sampling (1)	(2) AO2

Question Number	Answer	Additional Guidance	Mark
6(b)	An explanation linking two from: - leaching / run off / fertilisers / dead organic matter (1) (causes) a build up of nitrates / nitrates in the water (1)	accept {sewage / mineral ions} accept phosphates ignore nutrients	(2) AO1

Question number	Indicative content	Mark
6 *(c)	AO1 6 marks Reforestation - reforestation is planting of trees - trees take up water from the soil - prevents erosion and reduces flooding - trees can be used for renewable resources - provides habitats - increases the rate of photosynthesis - removes carbon dioxide and releases oxygen - reduces greenhouse gases / global warming - provides a source of medicines / food for consumers Animal conservation - increase numbers of endangered species / prevent extinction - through controlled breeding programmes / reduction in poaching / maintaining habitats - generating income to fund conservation projects through zoos / animal parks / ecotourism - improves the number of animals / range of species - maintains the food web - maintains genetic diversity - allows re-introduction of animals into the wild	(6)

Level	Mark	Descriptor
	0	no rewardable material.
Level 1	1-2	- demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. - presents an explanation with some structure and coherence.
Level 2	3-4	- demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and /or developed. - presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5-6	- demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. - presents an explanation that has a well-developed structure which is clear, coherent and logical.

Additional Guidance

Level 1	1-2	- A brief explanation of either the benefits of reforestation OR animal conservation projects. - The response refers to changes in atmospheric gases OR photosynthesis OR HOW animal conservation improves biodiversity
Level 2	3-4	- A brief explanation of the benefits of reforestation AND animal conservation projects - The response refers to changes a named atmospheric gas OR photosynthesis OR HOW animal conservation improves biodiversity
Level 3	5-6	- A detailed explanation on the benefits of reforestation and animal conservation projects - The response refers to changes in both named atmospheric gases AND HOW animal conservation improves biodiversity including why endangered species are preserved or the impact on food webs

Level	Marks	Possible responses
Level 1	1	Animal conservation protects endangered species / reforestation provides habitats for animals
	2	Reforestation is planting trees which take in carbon dioxide / reforestation provides habitats for animals and reduces greenhouse gases
Level 2	3	Animal conservation protects endangered species and reforestation provides habitats for animals / Animal conservation protects endangered species from hunting. Reforestation is the planting of trees which provides habitats for animals.
	4	Animal conservation protects endangered species so the numbers increase and reforestation is the planting of trees. The trees take in carbon dioxide and provide habitats for animals
Level 3	5	Animal conservation protects endangered species so the numbers increase by protecting them from hunting and maintaining habitats. Reforestation is the planting of trees. The trees take in carbon dioxide and provide habitats and food source for animals.
	6	Animal conservation protects endangered species so the numbers increase by protecting them from hunting and maintaining habitats. Reforestation is the planting of trees. The trees release oxygen and take in carbon dioxide. They also provide habitats and food source for animals.

(Total for question 6 = 13 marks)

