Ecosystems, Succession and Productivity (Topic 5): Edexcel SNAB A Level Biology Exam Questions by Topic

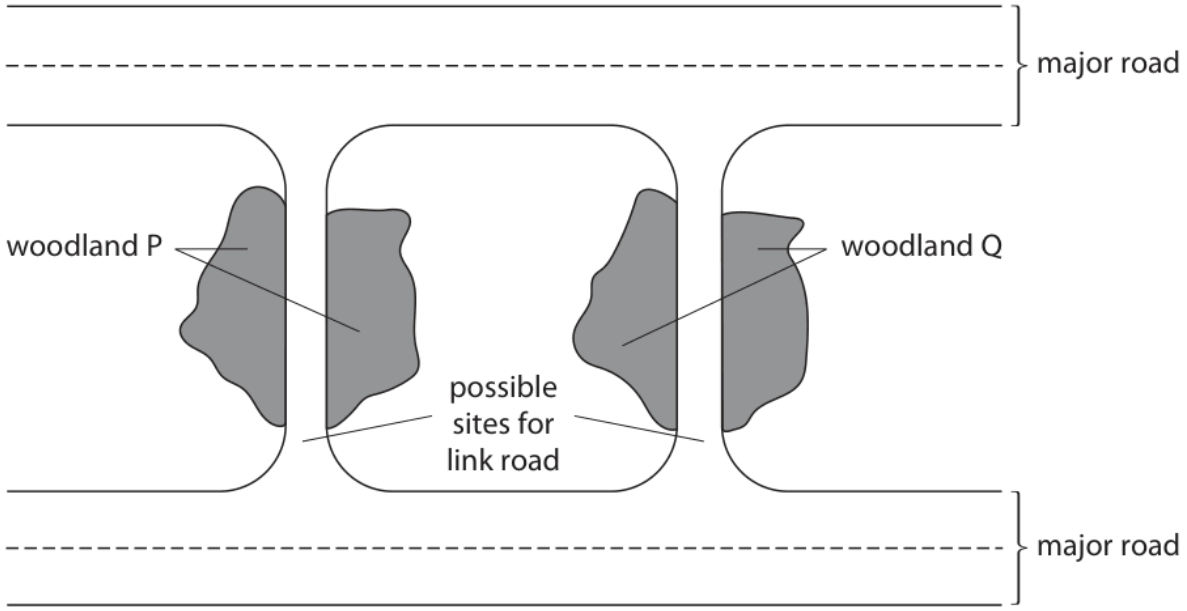
20 questions · 45 marks · about 54 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 1 · November 2021 · Q5(b)(i) · 1 mark

(b) Habitats can be destroyed by road building.

A link road is planned to connect two major roads.

The diagram shows the two possible sites for the link road and two woodland habitats.



(i) State what is meant by the term habitat.

(1)

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.....

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Question 2 · A level Paper 3 · October 2020 · Q3(b)(i) · 1 mark

(b) Photosynthesis contributes to the productivity of ecosystems.

(i) State what is meant by the term ecosystem.

(1)

Question 3 · A level Paper 3 · November 2021 · Q5(a)(i) · 2 marks

5 Forests are important habitats.

(a) The effect of cutting down trees on the number of bird species observed in two different forest habitats was investigated.

(i) Give two biotic factors, other than cutting down trees, that could affect the number of bird species observed in a forest.

(2)

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Question 4 · A level Paper 1 · October 2020 · Q7(c) · 4 marks

(c) In a study of two woodlands, 11 species of plant were found in a deciduous woodland and 4 different species in a coniferous woodland.

The table shows the other data recorded in this study.

Factor	Deciduous woodland	Coniferous woodland
Mean light intensity 10 cm above soil level / lux	1075	543
Mean pH of soil	7	5
Mean air temperature 10 cm above soil level / °C	18	18
Mean soil moisture content (%)	45	47

Assess the reasons for the differences in the number of species between these two types of woodland.

(4)

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4 The earthworm, (*Lumbricus terrestris*), feeds on dead organic matter found in soil.



Soil pH is one of the abiotic factors that affects the population size of earthworms.

The populations of earthworms in fields with either acidic soil or alkaline soil have been investigated.

The results of this investigation are summarised in the table.

Sample	Earthworms in field with acidic soil		Earthworms in field with alkaline soil	
	Number per square metre	Mass per square metre / g m^{-2}	Number per square metre	Mass per square metre / g m^{-2}
1	80	184	723	1 164
2	59	110	1 613	1 968
3	106	253	354	439
4	31	70	728	961
5	121	238	214	233
6	75	139	874	1 739
7	97	149	668	1 096
8	138	309	121	213
9	63	95	791	1 455
10	63	84	497	736
Total	833	1 631	6 583	10 004

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Question 6 · A level Paper 1 · June 2024 · Q7(a)(ii) · 2 marks

(ii) In the wild, several species of deer can live in the same area.

Explain why these deer can live in the same area.

(2)

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Question 7 · A level Paper 3 · June 2024 · Q1(a) · 1 mark

1 One of the first plant species to colonise some habitats is thale cress (*Arabidopsis thaliana*).

The plant hormone IAA (auxin) is produced in the growing tips of plants such as thale cress.



(Source: Nigel Cattlin / Alamy Stock Photo)

(a) State what is meant by the term **colonisation of a habitat**.

(1)

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Question 8 · A level Paper 3 · June 2025 · Q1(a)(i) · 2 marks

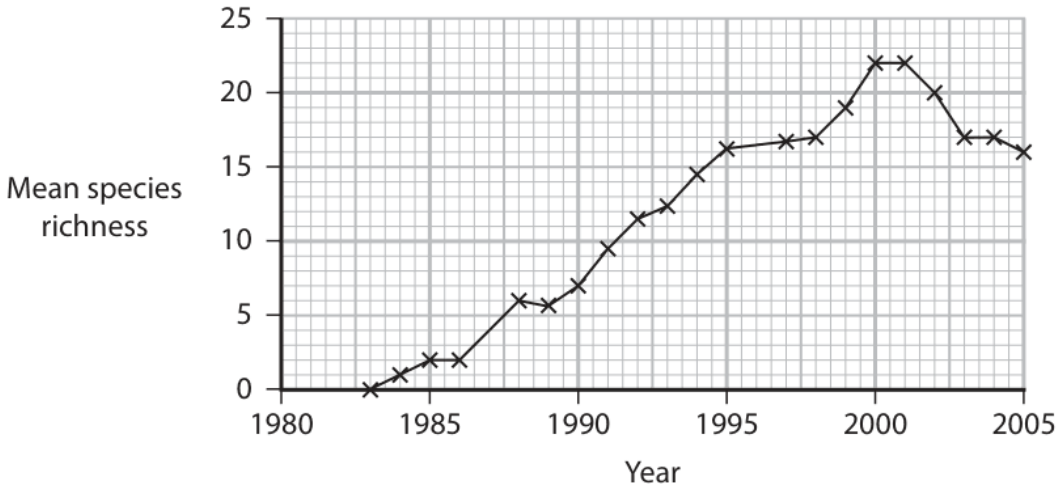
1 In 1980, a volcano erupted in Washington State, USA.

Ash from the volcano covered surrounding vegetation, killing all the plants.

Succession has been investigated on one of the sides of the volcano.

(a) In one study, species richness on the side of the volcano was measured.

The graph shows the change in mean species richness from 1983 to 2005.

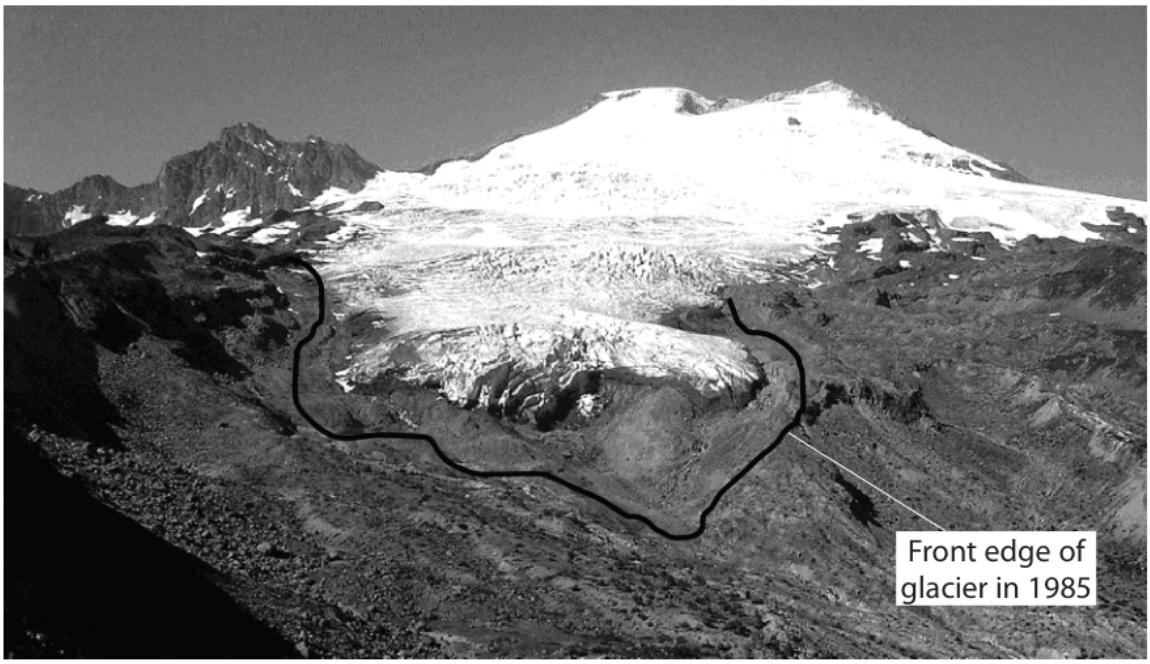


(i) State what is meant by the term **succession**.

(2)

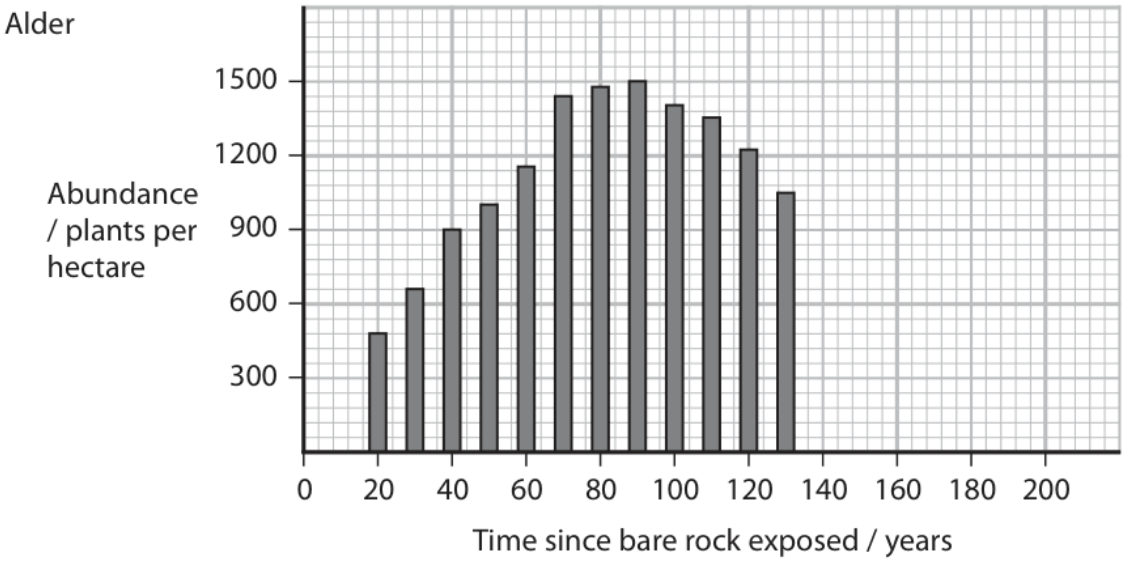
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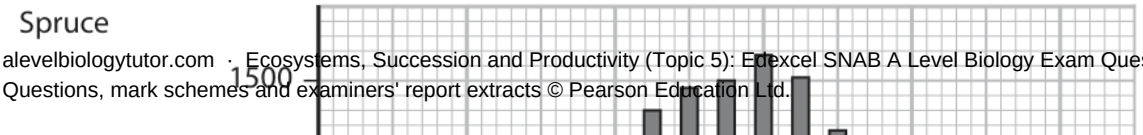
6 The photograph shows a glacier at the top of a mountain.
Glaciers in many areas of the world are retreating (reducing in size).
The line on the photograph shows the position of the front edge of the glacier in 1985.



Bare rock is exposed as the glacier retreats. Two hundred years ago, bare rock was exposed after a glacier retreated. A study has been made of the long-term changes in vegetation on that area of rock after the retreat of the glacier.

The graphs show the abundance of three species of tree since the bare rock was exposed as the glacier retreated. The abundance of each species was measured every ten years for 200 years.





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Question 10 · A level Paper 1 · October 2020 · Q6(b) · 3 marks

(b) Explain what happened to the bare rock to allow the growth of these trees.

(3)

Question 11 · A level Paper 1 · June 2018 · Q9(a)(ii) · 2 marks

(ii) The gross primary productivity (GPP) for one mature tropical rainforest was found to be 24 800 kJ m^{-2} $year^{-1}$. It was estimated that 65% of GPP was used in respiration.

Calculate the energy transferred to the next trophic level.

(2)

..... kJ m^{-2} $year^{-1}$

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Question 12 · A level Paper 3 · October 2020 · Q3(b)(ii) · 2 marks

(ii) The table shows information about two types of ecosystem.

Ecosystem	Gross productivity / g m^{-2} day^{-1}	Net productivity / g m^{-2} day^{-1}	Percentage of gross productivity used in respiration (%)	Total surface area of Earth occupied / km^2
Tropical rainforest	16.7	5.5	67.1	510×10^6
Salt marsh	10.5		34.3	5.5×10^4

Calculate the net productivity of the salt marsh ecosystem.

(2)

..... g m^{-2} day^{-1}

Question 13 · A level Paper 3 · June 2024 · Q4(b)(i) · 1 mark

(b) Phytoplankton are photosynthetic unicellular microorganisms.

Phytoplankton are primary producers in aquatic ecosystems.

(i) State the relationship between gross primary productivity and net primary productivity.

(1)

.....

.....

.....

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Question 14 · A level Paper 1 · November 2021 · Q1(c) · 2 marks

(c) Net primary productivity (NPP) is a measure of the increase in biomass of a plant.

Explain why respiration affects the production of biomass.

(2)

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.....

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.....

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.....

Question 15 · A level Paper 1 · June 2017 · Q5(b)(i) · 3 marks

(b) Scientists measured the productivity of two types of forest and recorded the mass of carbon taken up per square metre per year (gC m^{-2} y^{-1}).

The table shows data on the mean net primary productivity (NPP) and mean gross primary productivity (GPP) of these two types of forest.

Type of forest	Mean NPP / gC m^{-2} y^{-1}	Mean GPP / gC m^{-2} y^{-1}	Ratio of NPP to GPP
Boreal	322	1013	0.32
Temperate deciduous	1301	2165	0.60

(i) Calculate the percentage increase in mass of carbon released due to respiration by temperate deciduous forests compared with that by boreal forests.

(3)

.....%

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Question 16 · A level Paper 1 · June 2017 · Q5(b)(ii) · 3 marks

(ii) The ratio of net primary productivity to gross primary productivity is a measure of the ability of forests to transfer carbon from the atmosphere into biomass.

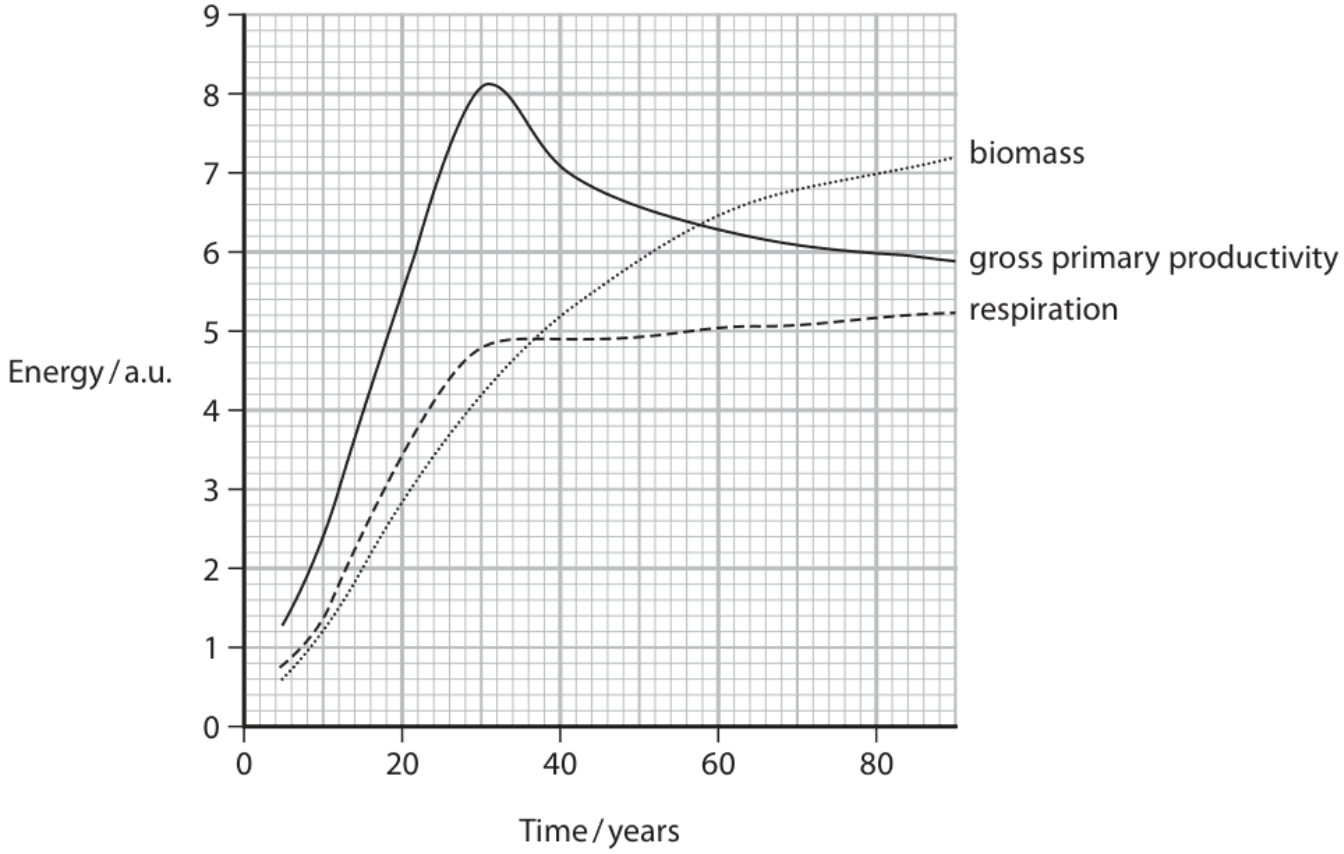
Scientists concluded that temperate deciduous forests would reduce levels of carbon dioxide in the atmosphere more than boreal forests.

Justify this conclusion.

(3)

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(b) The graph shows the changes in biomass, gross primary productivity and the energy used in respiration during succession from grassland to mature forest.



(i) Add shading to the graph to show the area that represents net primary productivity.

(1)

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Question 18 · A level Paper 3 · June 2022 · Q3(b)(iii) · 3 marks

(iii) Deduce the effect of succession on the level of carbon dioxide in the atmosphere.

(3)

Question 19 · A level Paper 1 · June 2019 · Q2(a)(ii) · 1 mark

(ii) The table gives details of energy transfers at the different trophic levels.

Trophic level	Energy fixed as biomass / kJ m^{-2} yr^{-1}	Transfer efficiency (%)
Producers	31 874	
Primary consumers	4615	14.5
Secondary consumers	464	
Tertiary consumers	21	4.5

Calculate the efficiency of energy transfer between primary consumers and secondary consumers.

(1)

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4 The photographs show two large marine animals, the great white shark and the humpback whale.



(Source: Sergey Uryadnikov/Shutterstock)

Great white shark

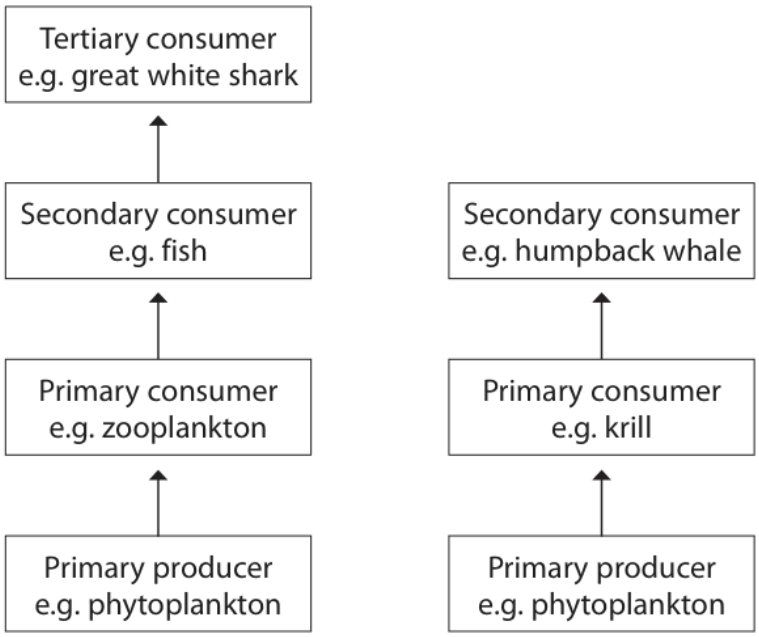


(Source: Mircea Costina / Alamy Stock Photo)

Humpback whale

A typical adult great white shark has a mass of approximately 600 kg.
Adult humpback whales have a mass of approximately 140 000 kg.

The diagram shows the trophic levels for two marine communities, one that includes the great white shark and one that includes the humpback whale.



(a) Explain why an area of ocean can support a greater biomass of humpback whales than of great white sharks.

(3)

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Mark schemes

Question 1 · A level Paper 1 · November 2021 · Q5(b)(i) · 1 mark

Question Number	Answer	Additional Guidance	Mark
5 (b)(i)	A answer that makes reference to the following: • the area inhabited by a particular { species / organism } (1)		**(1)**

Question 2 · A level Paper 3 · October 2020 · Q3(b)(i) · 1 mark

Question number	Answer	Additional guidance	Mark
3(b)(i)	An answer that makes reference to the following: • organisms and {non-living components / abiotic factors} (1)		**(1)**

Question 3 · A level Paper 3 · November 2021 · Q5(a)(i) · 2 marks

Question number	Answer
5(a)(i)	An answer that makes reference to two of the following: • food availability (1) • interspecific competition (1) • predation (1) • disease (1)

Additional guidance	Mark
IGNORE time of year / availability of resources ALLOW grazing / migration IGNORE competition unqualified or competition between birds	Choose an item (2)

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Question 4 · A level Paper 1 · October 2020 · Q7(c) · 4 marks

Question Number	Answer
7(c)	An answer that makes reference to four of the following points • (difference in number of species) not due to temperature and soil moisture content as they are the {same/similar} in the two woodlands (1) • the light intensity is the most likely reason for the greater number of species as it is higher in the deciduous woodland (1) • description of the effect of light intensity on plant growth (1) • the pH of the soil in the coniferous woodland is acidic so this may also reduce the number of species found (1) • only plant species considered and not other organisms (1)

Additional guidance	Mark
e.g. high light intensity allows a greater rate of photosynthesis / more photosynthesis or plants need to be adapted to low light intensities	**(4)**

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Question 5 · A level Paper 3 · June 2019 · Q4(a) · 4 marks

Question Number	Answer
4(a)	An answer the makes reference to four of the following: • in alkaline soil the number of worms is greater (1) • in alkaline soil the (total) mass of worms is greater (1) • in alkaline soil the mass of individual earthworms is less (1) • earthworms reproduce more in alkaline soil (1) • in alkaline soil earthworms are smaller due to greater competition (for resources) (1)

Additional guidance	Mark
ALLOW mean mass of ALLOW converse arguments for each point ALLOW higher pH for alkaline soil an earthworm is 1.96g in acidic soil and 1.52g in alkaline soil	**(4)**

Question 6 · A level Paper 1 · June 2024 · Q7(a)(ii) · 2 marks

Question Number	**Answer**
7(a)(ii)	An explanation that makes reference to the following • (each species) occupies a different niche (1) • therefore there is no competition (between species of deer) for { food /space /territory } (1)

Additional guidance	**Mark**
ALLOW no competition for resources	(2)

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Question 7 · A level Paper 3 · June 2024 · Q1(a) · 1 mark

Question number	Answer
1(a)	An answer that makes reference to the following: • when a species {moves / spreads / grows} into a new area (1)

Additional guidance	Mark
ALLOW to immigrate into a (new) area ALLOW any term that indicates an area e.g. environment / habitat ALLOW other terms in place of species e.g. plant / animal / organism ALLOW pioneer species being first to live in an area IGNORE dominant species in an area / species outcompeting other species in an area	(1)

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Question 8 · A level Paper 3 · June 2025 · Q1(a)(i) · 2 marks

Question number	Answer
1(a)(i)	An answer that makes reference to two of the following: • change in species (of plants and animals) (1) • taking place over time (1) • leading to a climax community (1)

Additional guidance	Mark
ALLOW change in community IGNORE organisms	(2)

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Question 9 · A level Paper 1 · October 2020 · Q6(a) · 4 marks

Question Number	Answer
6(a)	A answer that makes reference to four of the following • succession has occurred (1) • alder and spruce were the first species of tree to colonise (1) • slowest increase in abundance was spruce (1) • (interspecific) competition occurs between the three species (1) • example of resources competed for (1)

Additional guidance	Mark
IGNORE primary or secondary ALLOW either alder or spruce ALLOW description of increase and decrease of abundance of each species over time ALLOW spruce and hemlock compete with alder / hemlock competes with spruce and alder e.g. water, mineral ions, light, etc.	**(4)**

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Question 10 · A level Paper 1 · October 2020 · Q6(b) · 3 marks

Question Number	Answer
6(b)	An explanation that makes reference to the following • the bare rock was colonised by pioneer species (1) • (these pioneer species) break up the rock (1) • dead plants add {humus / organic matter} (as they decompose) (1) • (eventually trees will be able to grow) as the soil { becomes deeper / can retain more water } (1)

Additional guidance	Mark
ALLOW algae or lichen	**(3)**

Question 11 · A level Paper 1 · June 2018 · Q9(a)(ii) · 2 marks

Question Number	Answer
9(a)(ii)	• correct percentage transferred (1) • correct answer (1)

Additional Guidance	Mark
<u>Example of calculation</u> 35 % / 0.35 = 8680 (kJ m^{-2} yr^{-1}) Correct answer without working gains full marks	**(2)**

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Question 12 · A level Paper 3 · October 2020 · Q3(b)(ii) · 2 marks

Question number	Answer
3(b)(ii)	Choose an item. • correct value for respiration (1) • respiration value calculated subtracted from gross productivity value (1)

Additional guidance	Mark
Example of calculation 10.5 x (34.3 ÷ 100) = 3.6 10.5 – 3.6 = 6.9 (g m^{-2} day^{-1}) Correct answer with no working gains full marks	**(2)**

Question 13 · A level Paper 3 · June 2024 · Q4(b)(i) · 1 mark

Question number	Answer
4(b)(i)	An answer that makes reference to the following: • GPP = NPP + R / NPP = GPP – R (1)

Additional guidance	Mark
ALLOW description in words	(1)

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Question 14 · A level Paper 1 · November 2021 · Q1(c) · 2 marks

Question Number	Answer
1(c)	An explanation that makes reference to two of the following: • GPP – R = NPP (1) • {organic molecules / glucose} used in respiration to provide energy (1) • because the more {organic molecules / glucose } used in respiration, the less is available for the production of biomass (1)

Additional guidance	Mark
ALLOW word equation or rearranged equation ALLOW more respiration results in less biomass	**(2)**

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Question 15 · A level Paper 1 · June 2017 · Q5(b)(i) · 3 marks

Question Number	Answer
5(b)(i)	• correct values for carbon released by boreal forest and deciduous forest respiration (1) • correct use of values to calculate percentage increase (1) • correct answer (1)

Additional Guidance	Mark
Example of calculation 1013 – 322 = 691 (Boreal) 2165 – 1301 = 864 (Deciduous) = 173 ÷ 691 deciduous release 25% (25.04%) more than boreal Correct answer with no working gains full marks	3

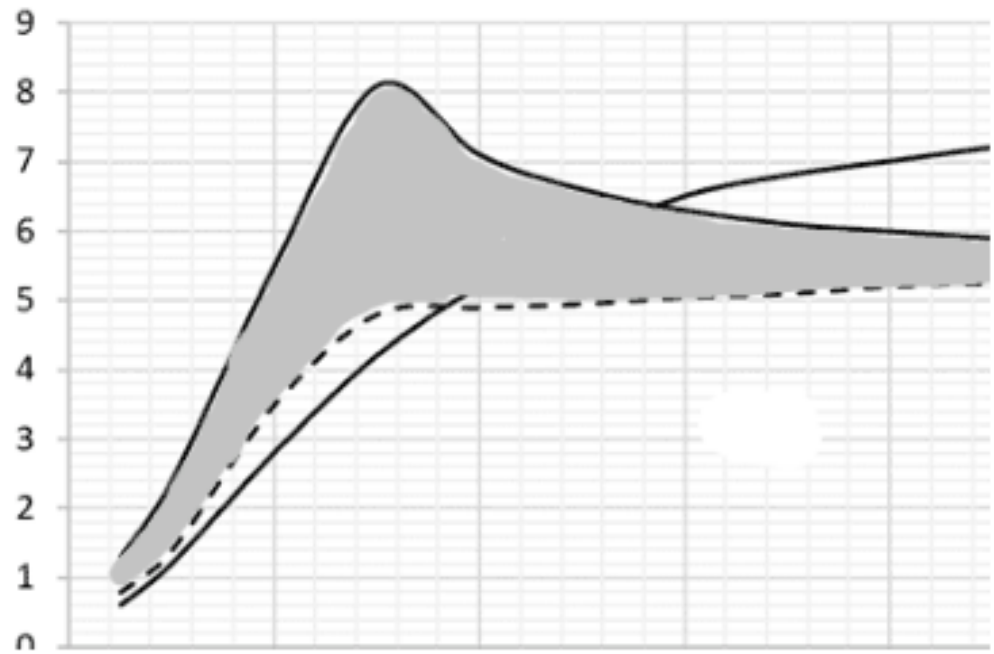
Question 16 · A level Paper 1 · June 2017 · Q5(b)(ii) · 3 marks

Question Number	Answer
5(b)(ii)	An answer that makes reference to the following: • the ratio of NPP to GPP is higher in deciduous forests (1) • NPP is higher / more of the carbon (fixed) is used to produce biomass (1) • (in deciduous forests) more carbon (dioxide) removed (by photosynthesis) than returned by respirat ion (1)

Additional Guidance	Mark
ALLOW converse for boreal forests for all points	3

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Question 17 · A level Paper 3 · June 2022 · Q3(b)(i) · 1 mark

Question number	Answer
3(b)(i)	Choose an item. 

Additional guidance	Mark
ALLOW solid or hatched shading Shading must be complete (e.g. not stop at biomass line)	(1)

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Question 18 · A level Paper 3 · June 2022 · Q3(b)(iii) · 3 marks

Question number	Answer
3(b)(iii)	An answer that makes reference to three of the following: • (the energy lost in) respiration {levels off / stops increasing} (1) • accumulation of (the energy incorporated into) biomass continues (1) • therefore, with succession more carbon dioxide is fixed (1) • reduces the amount of carbon dioxide (in the atmosphere) (1)

Additional guidance	Mark
ALLOW more carbon sinks ALLOW more photosynthesis to remove carbon dioxide ALLOW (with succession) carbon dioxide released from respiration is less than the carbon dioxide fixed (by RUBSCO)	(3)

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Question 19 · A level Paper 1 · June 2019 · Q2(a)(ii) · 1 mark

Question Number	Answer
2(a)(ii)	• calculation of energy fixed as biomass by secondary consumers as a percentage of the energy fixed by primary consumers

Additional guidance	Mark
<u>Example of calculation</u> (464 ÷ 4615) x 100 = 10.1 (same number of decimal places as other values in table)	**(1)**

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Question 20 · A level Paper 3 · June 2024 · Q4(a) · 3 marks

Question number	Answer
4(a)	An explanation that makes reference to the following: • fewer trophic levels in humpback whale (community) / whales are secondary consumers while sharks are tertiary consumers (1) • energy is lost at each trophic level / transfer of energy between trophic levels is inefficient (1) • therefore more energy is available (in the humpback whale) to be stored as biomass (1)

Additional guidance	Mark
ALLOW converse argument for shark ALLOW 4 trophic levels for shark and 3 for whale ALLOW description of how energy is lost between trophic levels e.g. each trophic level uses energy in respiration	Choose an item. (3)

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