Energy and Ecosystems: AQA A Level Biology Exam Questions by Topic

15 questions · 33 marks · about 43 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · June 2022 · Q01.1 · 2 marks

0 1 . 1 In the following passage the numbered spaces can be filled with biological terms.

During photosynthesis, plants produce ____(1)____ compounds which contain carbon, such as carbohydrates, lipids and proteins. Most of the sugars synthesised by plants are used by the plant in ____(2)____. The rest are used to make other groups of biological molecules. These biological molecules form the biomass of the plants. Biomass can be measured in terms of mass of ____(3)____ per given area per given time. The chemical energy store in dry biomass can be estimated using ____(4)____.

Write the correct biological term beside each number below, that matches the space in the passage.

[2 marks]

(1) _____

(2) _____

(3) _____

(4) _____

Question 2 · A level Paper 2 · June 2025 · Q03.1 · 2 marks

0 3 . 1 A student determined the dry mass of lettuce leaves. The equipment used was an oven and a weighing balance.

Describe how the student could use this equipment to determine the dry mass of lettuce leaves.

[2 marks]

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Question 3 · information from earlier in the question

0 4 Freshwater marshes have one of the highest rates of gross primary production (*GPP*) and net primary production (*NPP*) of all ecosystems.

Carbon use efficiency (*CUE*) is the ratio of *NPP:GPP*. Freshwater marshes have a high *CUE*.

Question 3 · A level Paper 3 · November 2021 · Q04.3 · 2 marks

A student investigated the growth rate of a freshwater marsh plant.

The growth rate (R) of a plant can be determined using this equation.

$$R = \frac{(\ln W_2 - \ln W_1)}{t}$$

Where
ln = natural logarithm
t = duration of the investigation in days
W_1 = plant biomass at the start of the investigation
W_2 = plant biomass at the end of the investigation

The student used the equation above; however, she substituted height for biomass. This was because she did not want to destroy the plants to measure their biomass.

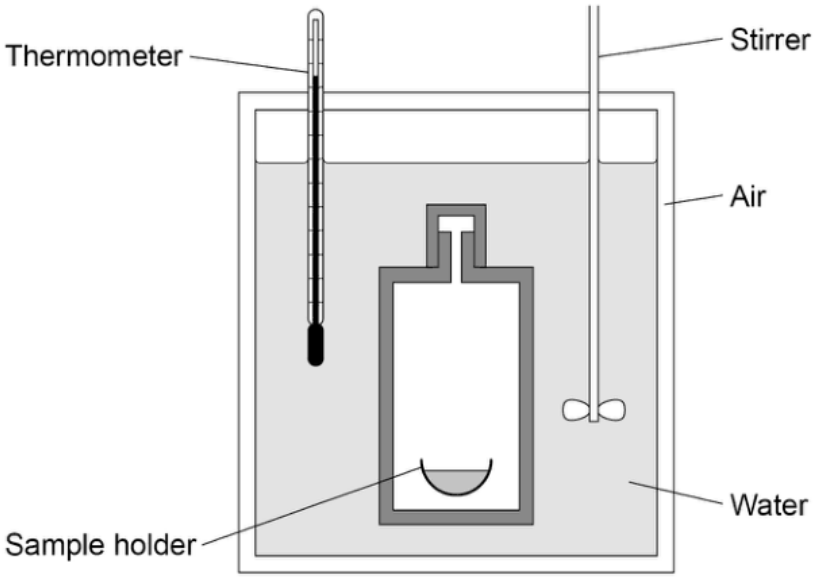
0 4 . 3 State the assumption the student has made **and** suggest why this assumption might **not** be valid.

[2 marks]

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0 3 **Figure 2** shows one type of calorimeter.

Figure 2



A calorimeter can be used to determine the chemical energy store of biomass.
A known mass of biomass is fully combusted in a calorimeter. The heat energy released from this combustion increases the temperature of the water in the calorimeter. The increase in the temperature of a known volume of water is recorded.

0 3 . 1 Other than the thermometer, explain how **two** features of the calorimeter shown in **Figure 2** would enable a valid measurement of the total heat energy released.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

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Question 5 · A level Paper 2 · November 2020 · Q03.3 · 2 marks

Plants and algae produce fuels called biofuels. Scientists have used *Chlorella* to produce biofuel. *Chlorella* is a genus of single-celled photosynthetic alga. *Chlorella* can be grown in open ponds and fermenters.

0 3 . 3 In natural ecosystems, most of the light falling on producers is **not** used in photosynthesis.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 6 · A level Paper 2 · June 2025 · Q03.3 · 2 marks

0 3 . 3 Biomass can be measured as the dry mass of tissue per given area. Some crop plants are grown in large greenhouses (glasshouses) where optimum growing conditions can be maintained.

Growing crop plants at higher temperatures than their optimum temperature can decrease their biomass.

Use your knowledge of net primary production to explain why.

[2 marks]

_____

_____

_____

_____

_____

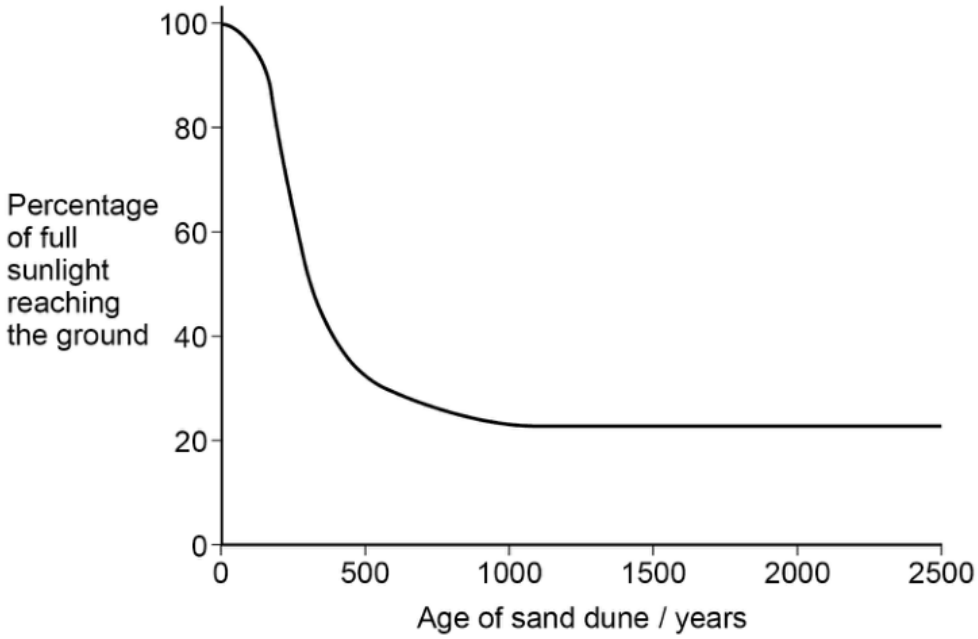
_____

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Question 7 · information from earlier in the question

The scientists also investigated how the proportion of sunlight reaching the ground changed during succession. Some of the results the scientists obtained are shown in **Figure 6**.

Figure 6



Question 7 · A level Paper 2 · June 2018 · Q04.4 · 2 marks

0 4 . 4 Using evidence from **Figure 6**, what can you conclude about the net primary productivity (NPP) in the sand dunes that are older than 1000 years?

Explain your answer.

[2 marks]

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Question 8 · A level Paper 3 · November 2021 · Q04.1 · 2 marks

0 4 Freshwater marshes have one of the highest rates of gross primary production (*GPP*) and net primary production (*NPP*) of all ecosystems.

Carbon use efficiency (*CUE*) is the ratio of *NPP:GPP*. Freshwater marshes have a high *CUE*.

0 4 . 1 Use your knowledge of *NPP* to explain why freshwater marshes have a high *CUE* **and** the advantage of this.

Do **not** refer to abiotic factors in your answer.

[2 marks]

Explanation _____

Advantage _____

Question 9 · A level Paper 3 · June 2022 · Q05.5 · 2 marks

0 5 . 5 Mature leaves from slow-growing, shade-tolerant plants produce poisonous chemicals that are a defence against being eaten by herbivores.

Suggest how this benefits slow-growing, shade-tolerant plants.

[2 marks]

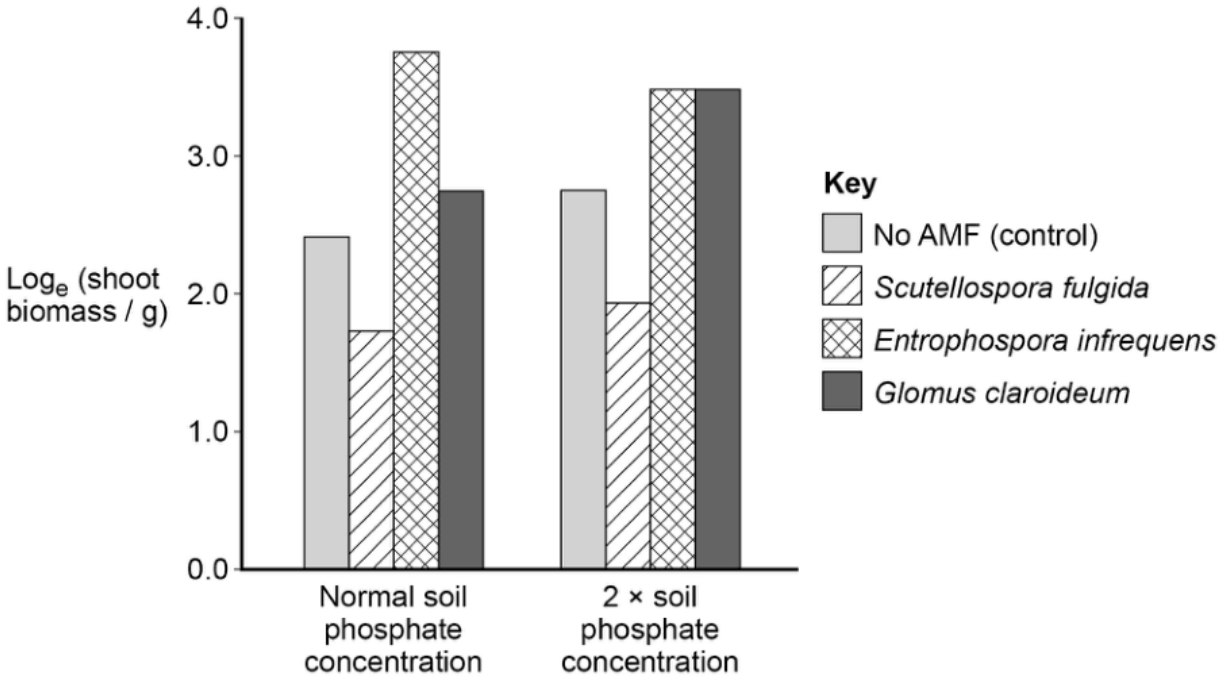
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0 5 . 3 Scientists investigated the effects of different AMF species on the productivity of the plant community of a prairie grassland ecosystem when growing in/on soil containing different phosphate concentrations.

The scientists set up identical plots of prairie grassland soil containing seeds of the plant species found in the ecosystem. The scientists added different AMF species and different concentrations of phosphate to particular plots. Control plots without AMF species were also set up. After 20 weeks the scientists determined the shoot biomass for each plot.

The results the scientists obtained are shown in **Figure 5**.

Figure 5



Explain why an increase in shoot biomass can be taken as a measurement of **net** primary productivity.

[2 marks]

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Question 11 · A level Paper 2 · June 2017 · Q05.4 · 4 marks

0 5 . 4 Using the data from **Figure 5**, evaluate the effect on plant productivity of adding AMF species and adding phosphate to the soil.

[4 marks]

Question 12 · A level Paper 2 · June 2023 · Q07.3 · 3 marks

0 7 . 3 Give **three** reasons for the low efficiency of energy transfer from secondary consumers to tertiary consumers in an ecosystem.

[3 marks]

1

2

3

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Question 13 · A level Paper 2 · June 2022 · Q02.4 · 2 marks

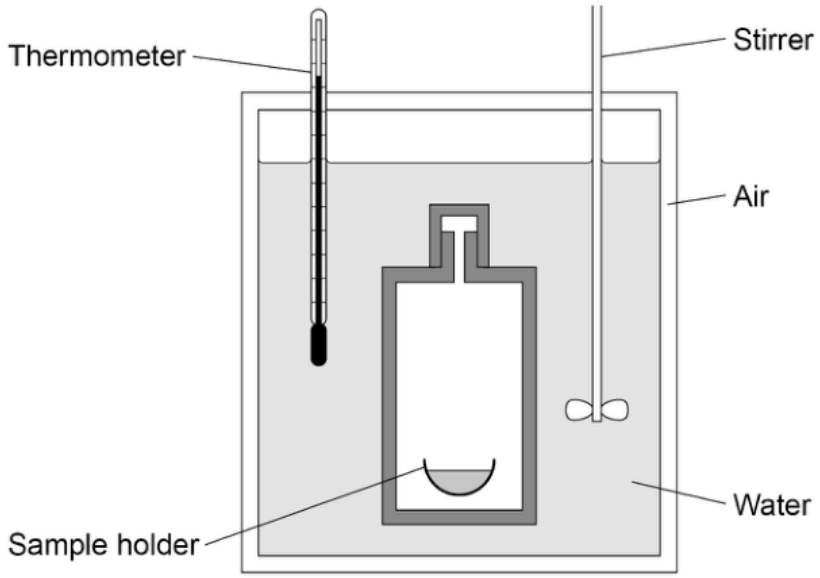
0 2 . 4 Farming cattle for humans to eat is less efficient than farming crops because of energy transfer.
Explain why.

[2 marks]

Question 14 · information from earlier in the question

0 3 **Figure 2** shows one type of calorimeter.

Figure 2



A calorimeter can be used to determine the chemical energy store of biomass.
A known mass of biomass is fully combusted in a calorimeter. The heat energy released from this combustion increases the temperature of the water in the calorimeter. The increase in the temperature of a known volume of water is recorded.

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Question 14 · A level Paper 2 · November 2020 · Q03.2 · 2 marks

0 3 . 2 A 2 g sample of biomass was fully combusted in a calorimeter.

The volume of water in the calorimeter was 100 cm^3

The increase in temperature recorded was 15.7 °C

4.18 J of energy are needed to increase the temperature of 1 cm^3 of water by 1 °C

Use this information to calculate the heat energy released in kJ per g of biomass.

Show your working.

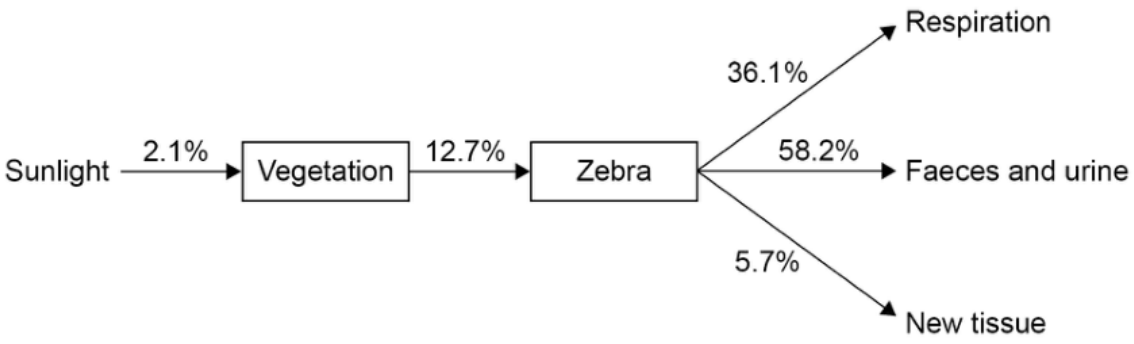
[2 marks]

Answer _____ kJg^{-1}

Question 15 · information from earlier in the question

Figure 1 shows percentages of energy transferred from sunlight to a zebra in a grassland ecosystem.

Figure 1



Questions, mark schemes and examiners' report extracts © AQA.

Question 15 · A level Paper 2 · June 2019 · Q01.3 · 2 marks

0 1 . 3 In this ecosystem the net productivity of the vegetation is 24 525 kJ m^{-2} $year^{-1}$

Use this information and **Figure 1** to calculate the energy stored in new tissues of the zebra in kJ m^{-2} $year^{-1}$

[2 marks]

Answer = _____ kJ m^{-2} $year^{-1}$

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Mark schemes

Question 1 · A level Paper 2 · June 2022 · Q01.1 · 2 marks

01.1	1. Organic 2. Respiration 3. Carbon 4. Calorimetry;;	2 (2 x AO1)	4 correct = **2 marks** 2–3 correct = **1 mark** 0–1correct = **0 marks** 2. Ignore aerobic/anaerobic. 3. Accept cells/tissue(s)/plant(s)/animal(s)/organism(s)/ NPP/ living material/biological molecules. 3. Ignore biomass/biological materials/organic matter and reference to 'dry'. 4. Accept calorimeter but reject colorimeter. 4. Accept phonetic spellings.

Question 2 · A level Paper 2 · June 2025 · Q03.1 · 2 marks

03.1	1. Heat and (then) weigh; 2. (Until) mass is constant;	2 (2 x AO3)	Accept 'heat until sample remains the same mass' for 2 marks 1. Accept any specified temperature for 'heat' 1. Ignore length of time heated 1. Reject 'burn' 2. Accept weight for mass

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04.3	1. Assumed that height is (directly) proportional to biomass; 2. (Plants may put biomass into) other named aspect of growth (other than height) **OR** Height does not include the roots **OR** Some increase in height results from water gain;

2	1. Accept descriptions of 'is proportional to', eg correlates to, is equivalent to 2. Examples of other named aspects of growth could include root growth, flower/seed/fruit formation, lateral growth, wider leaves

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Question 4 · A level Paper 2 · November 2020 · Q03.1 · 2 marks

03.1	1. Stirrer distributes heat (energy); 2. Insulation/space/air reduces loss/gain of heat **OR** Insulation/space/air reduces conduction/convection; 3. Water has high (specific) heat capacity;	2 max

1. Accept stirrer ensures equal/even temperature or prevents build up of 'hot spots'.

2. Reject vacuum.

Question 5 · A level Paper 2 · November 2020 · Q03.3 · 2 marks

03.3	1. (Light is) reflected; 2. (Light is) wrong wavelength; 3. (Light) misses chlorophyll/ chloroplasts/photosynthetic tissue; 4. CO_2 concentration or temperature is a limiting factor.	2 max

1. Light is not absorbed on its own is not enough.

2. Accept frequency for wavelength.

2. Accept reference to absorbing specified wavelengths/frequencies.

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Question 6 · A level Paper 2 · June 2025 · Q03.3 · 2 marks

03.3	1. Net primary production = gross primary production minus respiratory losses **OR** NPP = GPP – R; 2. (At higher temperature) photosynthesis/GPP decreases **OR** (At higher temperature) respiration increases **OR** (At higher temperature) enzymes for photosynthesis denature;	2 (1 x AO1, 1 x AO2)

1. Accept ‘is’ for = sign
1. Accept RL (respiratory losses) for R

1. Accept respiration for ‘respiratory losses’

2. Accept ‘respiratory losses’ for respiration

2. Reject enzymes for photosynthesis and respiration denature

2.Reject ‘more energy used in respiration’

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Question 7 · A level Paper 2 · June 2018 · Q04.4 · 2 marks

04.4	1.(NPP) remains constant; 2. GPP/photosynthesis **and** respiration constant; **OR** 3. (NPP) low/decreases; 4. Less light so less photosynthesis/GPP;

2	Mark in paired statements 1 and 2 **or** 3 and 4 2. Accept GPP/photosynthesis equals respiration 4. Reject no photosynthesis

Question 8 · A level Paper 3 · November 2021 · Q04.1 · 2 marks

04.1	1. Low respiration; 2. More growth/biomass/colonisation;	2	1. Accept less energy lost in respiration 2. Allow examples of more carbon-containing molecules eg glucose

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Question 9 · A level Paper 3 · June 2022 · Q05.5 · 2 marks

05.5	1. (In the shade, so) **less/slower rate of** photosynthesis; 2. (Slow-growing, so) would take a long time to replace (mature leaves) **OR** **Leaves** more likely to reach maturity **OR** **Leaves** take a long time to mature; 3. Plants can maintain (a large enough) surface area for photosynthesis **OR** Plants can absorb enough light;

2 max (2 x AO3)	1. Accept any named aspect of photosynthesis that uses light, eg LDR, photoionisation 2. Accept would take a long time to make cellulose or any other correct named compound

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Question 10 · A level Paper 2 · June 2017 · Q05.3 · 2 marks

05.3	1. Represents dry mass / mass of carbon; 2. Represents gross production minus respiratory losses;	2	2. Accept: NPP = GPP – R. 2. Accept: Chemical energy minus respiratory losses. 1 and 2. Chemical energy store minus respiratory losses = 2 marks.

Question 11 · A level Paper 2 · June 2017 · Q05.4 · 4 marks

05.4	1. For the control an increase in phosphate increases (plant) growth; 2. For *Entrophospora* an increase in phosphate reduces (plant) growth; 3. *Scutellospora* reduces (plant) growth (compared to control); 4. *Entrophospora and Glomus* increases (plant) growth(compared to control); 5. No SD/statistical test to determine significance; 6. Only 20 weeks of growth; 7. Underground/root growth not known;		
4 max			5. Accept: no error bars. 7. Accept: only shows shoot growth.

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Question 12 · A level Paper 2 · June 2023 · Q07.3 · 3 marks

07.3	1. Heat (loss) from respiration; 2. (Food) not digested **OR** Not all eaten; 3. Excretion;	3 (3 x AO1)	2. Accept faeces for not digested. 3. Accept urine/urea for excretion.

Question 13 · A level Paper 2 · June 2022 · Q02.4 · 2 marks

02.4	1. Energy lost between/at trophic/feeding levels; 2. Energy lost via respiration/excretion/faeces;	2 (2 x AO2)

1. Accept description of trophic levels e.g., food chain.

2. Accept energy lost via heat/metabolism/food not eaten/digested /muscle contraction/movement /maintaining temperature.

2. Reject energy used in respiration.

2. Reject energy produced/generated.

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Question 14 · A level Paper 2 · November 2020 · Q03.2 · 2 marks

03.2	3.28 / 3.3 ($kJ\ g^{-1}$) **= 2 marks;;** Incorrect answer but shows 328 / 33 (ignore any subsequent numbers and decimal point) **= 1 mark** **OR** Incorrect answer of 6.56 / 6.6 ($kJ\ g^{-1}$) (ignore any subsequent numbers) **= 1 mark;**	2

Question 15 · A level Paper 2 · June 2019 · Q01.3 · 2 marks

01.3	1. Answer of 180/178/177.5 = **2 marks**;; 2. Incorrect answer but shows use of numbers 57 **and** 127 (with decimal points in any position) within the calculation = **1 mark**;	2	1. Ignore any numbers following 177.5

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