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# HL Paper 1

In a pond, two species of fish feed on insects and worms. The insects feed on the green plants that live in the water. What constitutes a population in this ecosystem?

- A. All the living organisms
- B. All the animals
- C. All the fish
- D. All the fish of one species

## Markscheme

D

## Examiners report

N/A

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What contributes to rising atmospheric concentrations of carbon dioxide and increases in average global temperature?

- A. An increase in the shorter wavelength radiation emitted by Earth
- B. An increase in longer wavelength radiation emitted by Earth
- C. An increase in the combustion of fossilized organic matter
- D. The depletion of ozone in the stratosphere

## Markscheme

C

## Examiners report

[N/A]

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Which represents a correct food chain from this web?

- A. stickleback → midge larva → unicellular algae
- B. ciliates → *Daphnia* → stickleback → dragonfly nymph
- C. diatom → midge larva → caddisfly larva → stickleback
- D. filamentous algae → mayfly nymph → leech → stickleback

# Markscheme

C

## Examiners report

This proved to be a very easy question with more than 90% of the candidates answering it correctly. A small proportion were not aware that the arrows in a food chain indicate the direction of energy flow, not what feeds on what. Inevitably this question was a poor discriminator as both weaker and stronger candidates were able to answer it correctly.

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How is peat formed?

- A. From methanogenic archaeans under anaerobic and acidic conditions in deep sea vents
- B. From partially decomposed organic matter under anaerobic and acidic conditions in waterlogged soils
- C. From porous limestone under high pressure, aerobic and alkaline conditions in ocean beds
- D. From bituminous coal under high pressure, anaerobic and acidic conditions below ground

# Markscheme

B

## Examiners report

[N/A]

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Which hypothesis is supported by evidence from ecological research?

- A. Decomposers are the final stage in the food chain.
- B. Producers depend upon consumers more than on decomposers.
- C. Decomposers help to recycle energy from food chains.
- D. Producers use nutrients that decomposers help to recycle.

# Markscheme

D

## Examiners report

Some comments mention this question is tricky, especially in the use of the term "stage" of food chain. This did not seem to confuse candidates, as only a few answered A. This answer is not correct, as tertiary or quaternary consumers are the final stage of the food chain.

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Human activity leading to the emission of greenhouse gases may be a cause of global warming.

According to the precautionary principle, what should be done about greenhouse gas emission?

- A. Analyse historical records from monitoring stations to see the trends in carbon dioxide emissions
- B. Obtain more evidence by carrying out research on greenhouse gas emission
- C. Take measures to lower greenhouse gas emission without further evidence
- D. Develop strategies for coping with higher global temperatures

## Markscheme

C

## Examiners report

Some teachers found this question confusing and it is true that the precautionary principle is not the easiest. The teacher's notes indicate that in this context the precautionary principle dictates that if the effects of a human-induced change would be very large, those responsible for the change must prove that it will not do harm before proceeding. In this question proceeding would be continuing to emit greenhouse gases. Answer B implies that emissions should continue until there is evidence of harm, so it does not follow the precautionary principle. The expected answer is C, which states that measures should be taken to reduce emissions before waiting for further evidence of harm to be produced.

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Which of the following is a consequence of global temperature rise on arctic ecosystems?

- A. Increased rates of decomposition of detritus trapped in permafrost
- B. Decrease of geographical range of habitats for temperate species
- C. Decrease of pest species and increase of permafrost species
- D. Increase of geographical range of habitats for permafrost species

## Markscheme

A

## Examiners report

N/A

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Global warming caused by the enhanced greenhouse effect is likely to have major consequences for arctic ecosystems. Which of the following are likely to occur in the arctic if the Earth's surface temperature rises?

- I. Decreased rates of decomposition of detritus
  - II. Increased range of predators from temperate regions
  - III. Increase in numbers of pest species and pathogens
- A. I and II only  
B. I and III only  
C. II and III only  
D. I, II and III

## Markscheme

C

## Examiners report

N/A

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What best describes the mode of nutrition of a heterotroph?

- A. It ingests only non-living organic matter.  
B. It obtains organic molecules from other organisms.  
C. It synthesizes its organic molecules from inorganic substances.  
D. It produces its organic molecules from chemical reactions using light.

## Markscheme

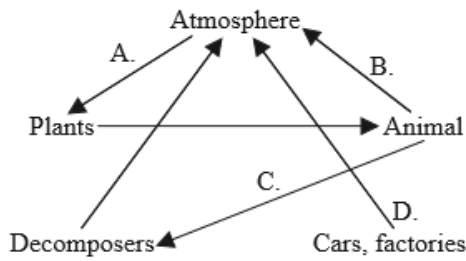
B

## Examiners report

N/A

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The diagram is a representation of a carbon cycle. Which arrow will reduce the greenhouse effect?



# Markscheme

A

# Examiners report

N/A

What is a community composed of?

- A. Habitats
- B. Populations
- C. Abiotic factors
- D. Biotic and abiotic factors

# Markscheme

B

# Examiners report

N/A

The statement is about the role of some bacteria in ecosystems.

“Bacteria play an important role in recycling nutrients in ecosystems. They live on organic wastes and dead organisms and digest their molecules. They then absorb some of these molecules for their own metabolism, and the rest is used by other organisms.”

What is the mode of nutrition of these bacteria?

- A. They are autotrophs.
- B. They are consumers.
- C. They are saprotrophs.
- D. They are detritivores.

# Markscheme

C

# Examiners report

N/A

Which term best defines a group of populations living and interacting with each other in an area?

- A. Ecology
- B. Community
- C. Species
- D. Ecosystem

# Markscheme

B

# Examiners report

N/A

The fungus *Calocera viscosa* obtains its nutrients from decaying conifer trees. Which pair of terms describes *C. viscosa*’s nutrition?

A.	autotroph	herbivore
B.	autotroph	saprotroph
C.	heterotroph	herbivore
D.	heterotroph	saprotroph

# Markscheme

D

# Examiners report

N/A

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What is an example of the precautionary principle?

- A. Avoiding cigarettes as they increase the chances of lung cancer
- B. Reducing carbon dioxide emissions as they may cause global warming
- C. Avoiding strong sunlight as it increases the chances of skin cancer
- D. Reducing cod fishing to increase fish stocks

## Markscheme

B

# Examiners report

Question 16 raised some interesting issues about the nature of science. The expected answer was B. The IB programme uses global warming as an example of the precautionary principle, because anthropogenic carbon dioxide emissions are not yet proven to be the cause of the enhanced greenhouse effect but we should not wait for this proof before responding. It could be argued that in A, C and D we do not have proof of causation so again the precautionary principle could be invoked but the evidence of causation in each case is very strong –arguably stronger than with the cause of enhanced global warming.

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Slime moulds (*Acridiomyxota*) are prototists. They feed on decaying organic matter, bacteria and protozoa.

Which of the terms describes their nutrition?

- I. Detritivore
  - II. Autotroph
  - III. Heterotroph
- 
- A. I only
  - B. I and II only
  - C. I and III only
  - D. I, II and III

## Markscheme

C

# Examiners report

Although some teachers complained that the term protoctist is not present in the syllabus, the candidates did not seem to have any problems understanding the question. This question had a high discrimination index, showing that the good candidates answered it correctly and the weaker candidates incorrectly.

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What is the mode of nutrition of midge larva?

- A. Autotroph
- B. Detritivore
- C. Heterotroph
- D. Saprotroph

## Markscheme

C

## Examiners report

Nearly four fifths of candidates answered this question correctly, showing good understanding of the nutrition terms used.

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Two populations of the same fish species were fed different diets to investigate the effect of differing nutrition on their growth. What is an appropriate method to determine the significance of a resulting difference?

- A. Calculate the mean for each population
- B. Calculate the standard deviation for each population
- C. Graph the results
- D. Perform a *t*-test

## Markscheme

D

## Examiners report

[N/A]

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What is the best definition of the greenhouse effect in the Earth’s atmosphere?

- A. A naturally occurring effect by which shorter wavelength radiation is trapped
- B. A naturally occurring effect by which longer wavelength radiation is trapped
- C. An effect of pollution by which shorter wavelength radiation is trapped
- D. An effect of pollution by which longer wavelength radiation is trapped

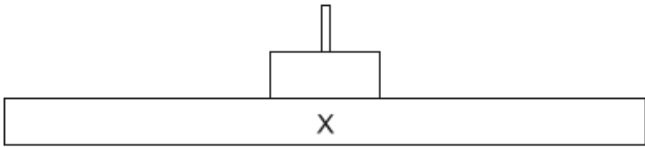
## Markscheme

B

## Examiners report

This was answered correctly by only a third of candidates, and the distribution of wrong answers revealed two popular misconceptions. The first is that the greenhouse effect is caused by pollution, when the teacher’s notes for assessment statement 5.2.3 state that it is a natural phenomenon that is merely enhanced by the emissions of greenhouse gases. The second misconception was that it is shorter wave radiation that is trapped in the atmosphere. The same teacher's note states that students should be aware that it is longer wave radiation that is trapped.

The diagram represents a pyramid of energy.



What level does the letter X represent?

- A. Light
- B. Primary consumers
- C. Abiotic environment
- D. Producers

## Markscheme

D

## Examiners report

N/A

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What are the units of a pyramid of energy?

- A.  $\text{kJ m}^{-2} \text{yr}^{-1}$
- B.  $\text{kJ m}^{-1} \text{yr}^{-1}$
- C.  $\text{J m}^{-3} \text{s}^{-1}$
- D.  $\text{J m}^2 \text{s}^{-1}$

## Markscheme

A

## Examiners report

There are some complaints in the G2s about asking questions where candidates need to memorize data. I do not believe this is the case, as if a candidate understands that a pyramid of energy is showing energy per unit of surface in a period of time, the only possible answers are A and D. A candidate ought to know that the unit of time cannot be a second, so the only possible answer is A. Most candidates did have this answer right, but many were going for B.

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Which are characteristics of a species?

- I. The potential to interbreed to produce fertile offspring
- II. The formation of a population with members of the same species within a community
- III. The overproduction of offspring

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

## Markscheme

A

## Examiners report

This was a highly criticized question. Many teachers believed that D was the correct answer. The fact is that not all species overproduce offspring. There are many species in danger of extinction (for example, the Giant Panda) and it is clear that these species are not over-reproducing themselves.

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What contributes to the enhanced greenhouse effect?

- A. Ozone from violent thunderstorms
- B. Carbon particles in diesel engine exhaust
- C. Methane from agricultural sources
- D. Carbon dioxide from active volcanoes around the world

## Markscheme

C

## Examiners report

Most candidates were able to realize that methane from agriculture is a greater contributor to the greenhouse effect than carbon dioxide from volcanoes. Some candidates did believe it was the carbon particles from engines, failing to realize this is not a gas.

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What favours the production of peat?

- I. Presence of organic matter
  - II. Anaerobic conditions
  - III. Acidic conditions
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

## Markscheme

D

## Examiners report

[N/A]

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Methanogens produce methane gas. What is this gas converted to in the atmosphere?

- A. Carbon dioxide and oxygen
- B. Ethanol and carbon dioxide
- C. Carbon monoxide and ozone

D. Carbon dioxide and water

Markscheme

D

Examiners report

[N/A]

The scarlet cup fungus (*Sarcoscypha coccinea*) obtains its nutrition from decaying wood by releasing digestive enzymes into the wood and absorbing the digested products.

Which of the following terms describe(s) the fungus?

- I. Autotroph
  - II. Heterotroph
  - III. Saprotroph
- A. III only  
B. II and III only  
C. I and III only  
D. I, II and III

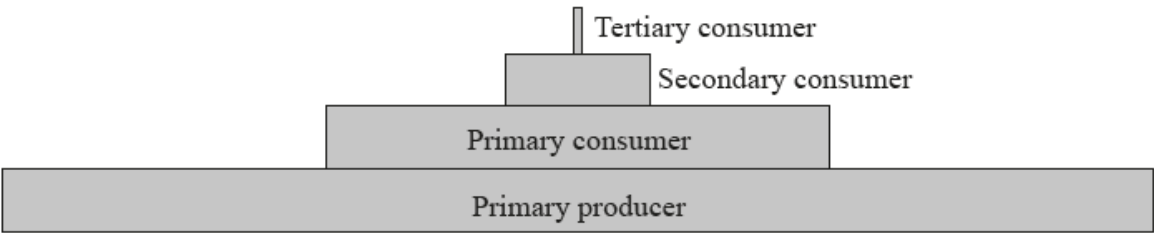
Markscheme

B

Examiners report

N/A

The following shows an energy pyramid.



How is energy lost between the trophic levels?

- A. photosynthesis, birth of an organism and digestion

- B. respiration, death of an organism and egestion
- C. recycling of nutrients, death of an organism and egestion
- D. respiration, birth of an organism and digestion

## Markscheme

B

## Examiners report

[N/A]

How is energy passed from one trophic level to the next?

- I. Food
  - II. Light
  - III. Heat
- A. I only  
B. I and II only  
C. II and III only  
D. I, II and III

## Markscheme

A

## Examiners report

[N/A]

The image shows a transect through a stream and a field.



- Which calculation would test for the association between two species of plants from quadrat data from section A and section B of the field?
- A. Correlation coefficient
  - B. Random numbers sampling
  - C. Standard deviation
  - D. Chi-squared

# Markscheme

D

## Examiners report

[N/A]

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What is a consequence of a global temperature rise on arctic ecosystems?

- A. Decrease in CO<sub>2</sub> released from decomposing detritus
- B. Increase in the greenhouse effect
- C. Decrease in ocean level
- D. Increase in pest species

# Markscheme

D

## Examiners report

There were some issues in this question regarding the possibility that answer B is also correct. Although many candidates did go for B, D is a better answer as what is asked for is the consequence, not the cause for the greenhouse effect.

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Which of the following are greenhouse gases?

- I. Oxides of nitrogen
- II. Carbon dioxide
- III. Methane

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

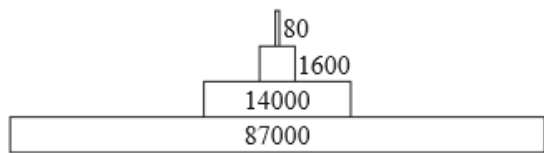
# Markscheme

D

## Examiners report

While the majority of candidates chose the correct answer D, many candidates also choose the wrong answer C. This meant they did not know that oxides of nitrogen are also greenhouse gases. This is in section 5.2.3 of the syllabus.

The diagram shows a pyramid of energy for a wetland environment. What units would be appropriate for the values shown?



- A.  $\text{kg yr}^{-1}$
- B.  $\text{kJ m}^{-2} \text{yr}^{-1}$
- C.  $\text{J m}^{-2}$
- D.  $\text{mg dry mass m}^{-3}$

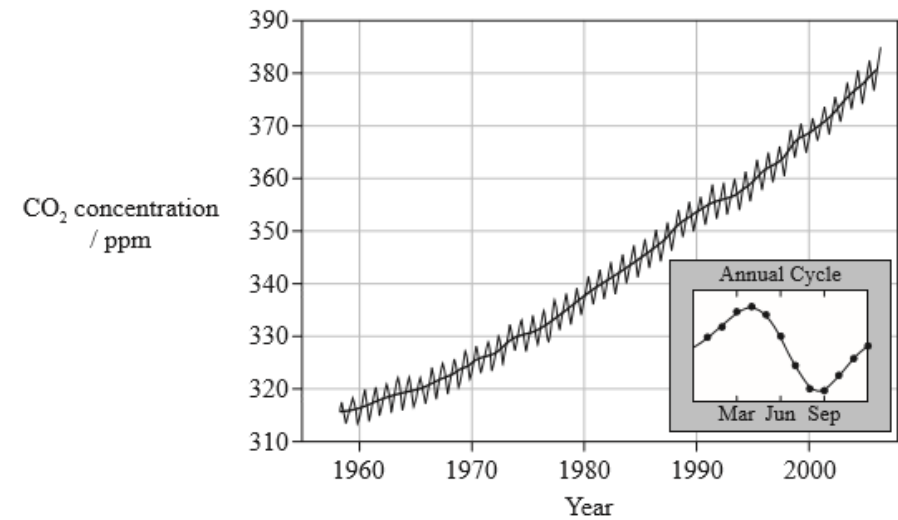
Markscheme

B

Examiners report

A relatively low discrimination index for this question suggests that some of the stronger candidates were unaware that pyramids of energy are showing energy flow, which must be over a period of time. The time period conventionally is one year, so the answer was B.

The following graph refers to questions 19 and 20. It shows variation in the concentration of CO<sub>2</sub> in the atmosphere as measured at Mauna Loa in Hawai'i. The small inset graph shows the variations in CO<sub>2</sub> during a one year period.



[Source: adapted from Dr P Tans, NOAA Earth System Research Laboratory]

Why does the amount of CO<sub>2</sub> fall between April and August?

- A. Seasonal increase in the rate of photosynthesis in northern hemisphere forests
- B. Seasonal decrease in the rate of photosynthesis in northern hemisphere forests
- C. Seasonal decrease in the rate of fossil fuel consumption
- D. Seasonal increase in the amount of CO<sub>2</sub> taken up by the oceans

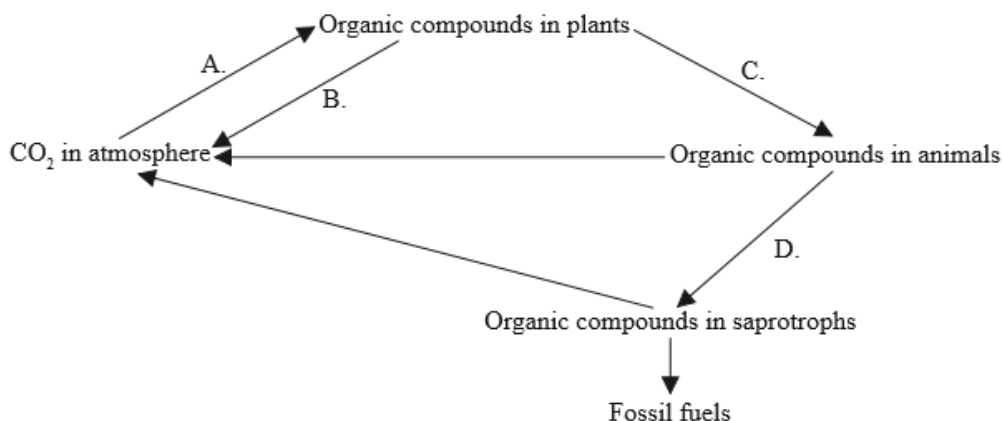
## Markscheme

A

## Examiners report

Assessment statement 5.2.2 says to analyze the changes in concentration of atmospheric carbon dioxide using historical records. This means candidates should have used the data provided, or data of a very similar nature. Most candidates found the questions easy. Although in question 20 other options might seem correct, answer A was the most correct.

The diagram shows the carbon cycle. Which letter indicates respiration?



## Markscheme

B

## Examiners report

It would have been clearer if the term cell respiration had been used rather than respiration in this question. However this did not affect the answer that candidates should have chosen and the question was effective.



In ecosystems the amount of energy that passes from one trophic level to the next is called the conversion efficiency. What is the average conversion efficiency from primary to secondary consumers in most ecosystems?

A. 1 %  
B. 10 %  
C. 50 %  
D. 90 %

Markscheme

B

Examiners report

N/A

The table shows the monthly CO<sub>2</sub> concentrations in mg L<sup>−1</sup> taken at two monitoring stations.

Month Station	Jul 2011	Aug 2011	Sept 2011	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012
Cape Grim, Australia	388	389	389	389	389	389	389	389	389	389	389	390
Mauna Loa, Hawaii, USA	392	390	389	389	390	392	393	394	394	396	397	396

[Source: © International Baccalaureate Organization 2015]

What is directly indicated by the data?

A. CO<sub>2</sub> concentration in the atmosphere varies from place to place.  
B. Cape Grim is less affected by global warming than Mauna Loa.  
C. CO<sub>2</sub> creates a greenhouse effect at both locations.  
D. The standard deviation for Cape Grim is higher than standard deviation for Mauna Loa.

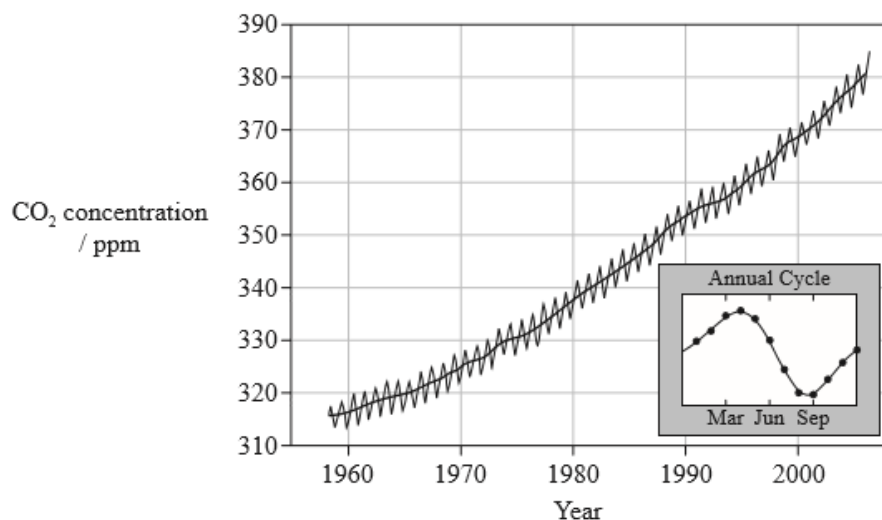
Markscheme

A

Examiners report

This question had too much data to analyse for a multiple-choice question. Capable candidates however were able to answer this question well.

The following graph refers to questions 19 and 20. It shows variation in the concentration of CO<sub>2</sub> in the atmosphere as measured at Mauna Loa in Hawai'i. The small inset graph shows the variations in CO<sub>2</sub> during a one year period.



[Source: adapted from Dr P Tans, NOAA Earth System Research Laboratory]

What is the main cause of the increase in CO<sub>2</sub> levels from 1960 to 2000?

- A. Burning fossil fuels
- B. Destruction of the ozone layer
- C. Increases in ultraviolet light penetrating the Earth's atmosphere
- D. Reforestation

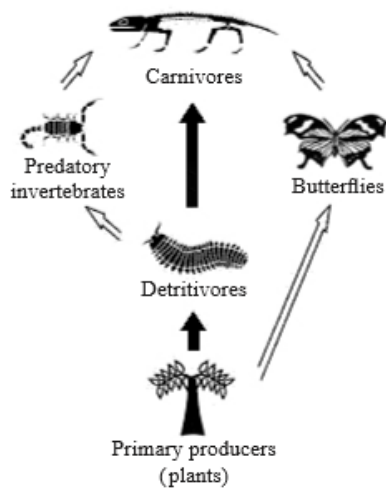
## Markscheme

A

## Examiners report

Assessment statement 5.2.2 says to analyze the changes in concentration of atmospheric carbon dioxide using historical records. This means candidates should have used the data provided, or data of a very similar nature. Most candidates found the questions easy.

This question refers to the following food web.



[Adapted with permission from <http://jogginsfossilcliffs.net/cliffs/biodiversity/>]

The energy passing from the detritivores to the predatory invertebrates in this food web is  $14\,000\text{ kJ m}^{-2}\text{ year}^{-1}$ . Approximately how much energy (in  $\text{kJ m}^{-2}\text{ year}^{-1}$ ) passes from the predatory invertebrates to the carnivores?

- A. 140
- B. 1400
- C. 14 000
- D. 140 000

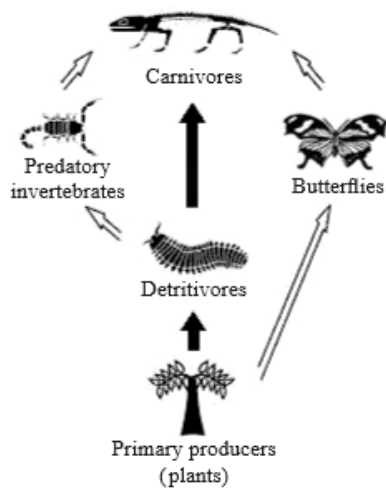
## Markscheme

B

## Examiners report

N/A

This question refers to the following food web.



[Adapted with permission from <http://jogginsfossilcliffs.net/cliffs/biodiversity/>]

To which trophic level do the butterflies belong?

- A. Producers
- B. Primary consumers
- C. Secondary consumers
- D. Tertiary consumers

## Markscheme

B

## Examiners report

N/A

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The image shows a female Golden Orb-weaving spider (*Nephila plumipes*). They can grow as large as 4 cm and build webs strong enough to trap small birds for food.



[Source: adapted from [www.cli.nsw.edu.au](http://www.cli.nsw.edu.au)]

Which of the following describe(s) this spider?

- I. Primary consumer
- II. Heterotroph
- III. Arthropod
- A. I only
- B. I and II only
- C. II and III only
- D. I, II and III

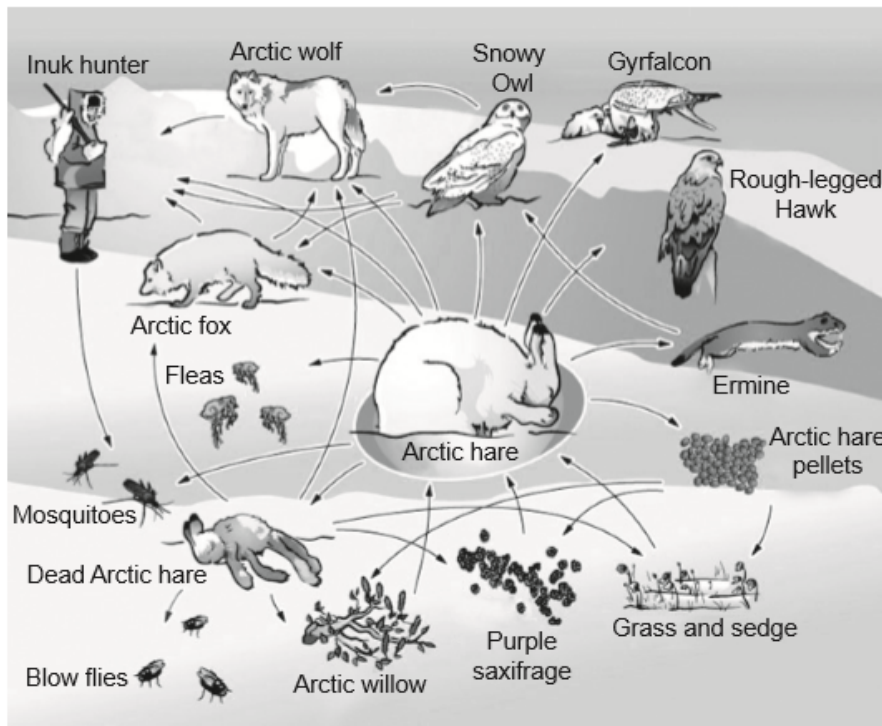
Markscheme

C

Examiners report

[N/A]

The image shows an Arctic food web.



[Source: Ukaliq, the Arctic Hare (<http://nature.ca/ukaliq/>) © Canadian Museum of Nature]

What is the role of the Arctic hare?

- A. Detritivore
- B. Primary consumer
- C. Secondary consumer
- D. Saprotroph

## Markscheme

B

## Examiners report

Although the diagram of the food web was probably not the best, the question was clear to most candidates.