Question 2 **(20 marks)**

(a) Use the diagram to explain how the element carbon is recycled. (4 marks)

Description	Marks
Explanation includes:	
Carbon enters the atmosphere as carbon dioxide from respiration and/or combustion (burning)	1
Carbon dioxide is absorbed by producers (plants) for photosynthesis	1
Animals feed on the plants and the carbon compounds move along the food chain	1
The dead organisms (animals and plants) are broken down decomposers in the ground. The carbon in these is released as carbon dioxide to the atmosphere	1
Total	**4**

Answer could include:

Carbon enters the atmosphere as carbon dioxide from respiration from the polar bears and burning materials in the urban development
Carbon dioxide is absorbed by plants to make carbohydrates in photosynthesis.
Fish and other animals feed on the plants. Polar bears eat the fish. Thus passing the carbon compounds along the food chain
The dead organisms (dead animals and plants) and polar bear waste are broken down by decomposers in the soil permafrost. The carbon in these is returned to the atmosphere as carbon dioxide.

(b) Explain why the carbon cycle is considered a biogeochemical cycle. (3 marks)

Description	Marks
Explains what a biogeochemical cycle is	3
Outlines what biogeochemical cycle is	2
States a fact about biogeochemical cycling	1
Total	**3**

Answer could include:

- a biogeochemical cycle or cycling of substances is a pathway by which a chemical substance moves through both biotic and abiotic components of the Earth. Carbon is an element that cycles in this manner
- a cycle is a series of change which comes back to the starting point and which can be repeated. Elements such as carbon, chemical compounds, and other forms of matter are passed from one organism to another and from one part of the biosphere to another through biogeochemical cycles
- the term 'biogeochemical' tells us that biological, geological and chemical factors are all involved. The circulation of chemical nutrients like carbon, oxygen, nitrogen, phosphorus, calcium, and water etc. through the biological and physical world are known as biogeochemical cycles.

(d) With climate change Arctic sea ice has declined (melting into the ocean) and carbon dioxide levels have increased. Explain how the changes to these two abiotic factors affect the survival of coldwater fish that live in the Arctic region. (4 marks)

Description	Marks
Explanation includes:	
Melting ice increases water temperature	1
Carbon dioxide level will change the pH on the water	1
Outlines that coldwater fish will react to this change (e.g. move location, die)	2
States some valid information that coldwater fish survival will be will be impacted on	1
Total	**4**

Answer could include:

Climate change has caused the sea ice to melt. This water will be at a higher temperature that the ocean, hence water temperature will increase. The carbon dioxide from the atmosphere will dissolve into the water and lower the pH of the water.
These changes will impact on the coldwater fish as their environment will change. The fish may move their location. Warmwater fish may now come into their environment and compete for food source. Change in pH levels may affect their reproduction. Any of these will impact on their survival.

Accept other relevant answers.