# Answers Global Systems

## Year 10 Science Chapter 7

**p159**

**1** The four Earth spheres are: the biosphere, the hydrosphere, the atmosphere, the lihosphere.

**2** The **biosphere** includes all of the living organisms on Earth.

**3** Three abiotic (non living) factors are temperature, soil, rainfall.

**4** The biosphere is divided into **biomes**. A biome is a large geographical area containing organisms that are distinct from the organisms in other biomes.

**5** Without the biosphere the Earth would be lifeless. Human life is dependent on the other organisms in the biosphere.

**6** The **hydrosphere** is the total mass of water found on Earth.

**7** The three states of water are solid, liquid, and gas.

**8** The hydrosphere is an important habitat for a large majority of organisms.

**9** The oceans of the hydrosphere are a major contributor to the composition of the atmosphere.

**p161**

**1** Four of the Earth global systems are lithosphere, biosphere, atmosphere, hydrosphere.

**2** The Earth's **atmosphere** is the layer of gases surrounding the Earth.

**3** The atmosphere supports life through:

- The carbon dioxide in the atmosphere is a key ingredient in photosynthesis - providing food in the form of glucose to photosynthesising organisms.
- The oxygen in the atmosphere is used by organisms for respiration - the production of energy for life.
- The atmosphere absorbs and protects organisms from harmful ultraviolet radiation from the Sun.
- The atmosphere warms the Earth by holding the heat from the Sun and reduces the variation from day's heat to the night's cold - the greenhouse effect.

**4** The **lithosphere** is the solid outer layer of the surface of the Earth. The lithosphere, with an average 80 km depth, includes the continents and the sea floor.

**5** Examples of interactions between the lithosphere and other systems:

- Loose soil can increase the sediments in streams (Lithosphere and hydrosphere interaction).
- Soil erosion can reduce vegetation growth (Lithosphere, hydrosphere, biosphere interaction).

**6** Can you provide two examples of interactions between the lithosphere and?

**a)** the atmosphere: Erupting volcanoes. Gases passing from the lithosphere to the atmosphere.

**b)** the biosphere: Organisms using the lithosphere as a habitat. Plants obtaining nutrients from the lithosphere.

## p163

**1** The phosphorous cycle.

- Weathering washes the phosphate ions, such as $PO_4^{3-}$, from rocks into the soil and water.
- Plants absorb the phophate ions from the soil and water. The plants use the phosphorous for cell development and energy production.
- The phosphorous then becomes available to the other organisms in the food chain.
- The phosphorous is returned to the soil and water when organisms die. Sedimentation places the phosphorous back into rocks.

**2** **Phosphorous** (P) is an essential nutrient for organisms. Phosphorous is vital to cell development and many cell processes such as the production of energy.

**3** The **water cycle**, also known as the hydrologic cycle, describes the movement of water above, on, and below the surface of the Earth.

**4** All life on Earth depends on the continuous movement of the water cycle.

**5** Run-off from fertilised vegetable crops increases the amount of phosphorous in the water. Increased phosphorous increasesd algal growth and reduces the oxygen and sunlight in the water.

**6** The Sun powers the water cycle.

## p165

**1** The nitrogen cycle.

- Bacteria convert nitrogen in the atmosphere to nitrogen compounds in the ground and in water.
- Lightning converts atmospheric nitrogen into nitrogen compounds.
- Microbes absorb the nitrogen compounds into their cells.
- Consumers absorb nitrogen compounds as they eat microbes and other consumers.
- Microorganisms convert nitrogen compounds into nitrogen gas.

**2** **Nitrogen** (N) is an essential nutrient for organisms. Nitrogen is used to make proteins and nucleic acids. Nitrogen is also a component of chlorophyll which is essential for photosynthesis. The nitrogen cycle is a vital part of every ecosystem.

**3** Nitrogen-fixing bacteria make nitrogen gas available to organisms by converting nonreactive nitrogen gas to ammonium and nitrate compounds.

**4** Carbon is removed from the atmosphere through photosynthesis and absorption by the oceans. Carbon is returned to the atmosphere through respiration and the burning of fossil fuels.

**5** **Carbon** (C) is essential for life. Carbon is a major component of many life sustaining compounds. Examples are carbohydrates, proteins, fats, vitamins, DNA.

**6** Write word equations and symbolic equations for:

**a)** photosynthesis. carbon dioxide + water → glucose + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

**b)** absorption of carbon dioxide by the oceans. carbon dioxide + water → carbonic acid

$CO_2 + H_2O \rightarrow H_2CO_3$

**c)** respiration. Glucose + oxygen → carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

**d)** burning of fossil fuels. Carbon + oxygen → carbon dioxide

$C + O_2 \rightarrow CO_2$

**7** Carbon dioxide is removed from the atmosphere through photosynthesis and absorption by the oceans. Carbon dioxide is returned to the atmosphere through respiration and the burning of fossil fuels.

**p167**

**1** The **greenhouse effect** is the process by which the reflected radiation energy from the Earth is trapped by the greenhouse gases in the atmosphere.

**2** The greenhouse effect warms the Earth by holding the heat from the Sun and reduces the variation from day's heat to the night's cold. It has been estimated that without the greenhouse effect, Earth's average surface temperature of 15°C would be −18°C.

**3** The greenhouse gases, that trap the radiation energy reflected from the Earth's surface, are water vapour, carbon dioxide, methane, and ozone.

**4** A greenhouse is similar to the greenhouse effect by trapping radiation energy within the greenhouse. The glass allows the entry of radiation energy and prevents loss of heat through convection by preventing air movement.

**5** A greenhouse, or glasshouse, is different to the greenhouse effect in that glass traps the radiation energy rather than gases?

**6** The amount of carbon dioxide in the atmosphere may be increasing through the excessive burning of fossil fuels.

**7** Comment on the following statement:

Carbon dioxide and water are both greenhouse gases. Increasing carbon dioxide will increase the Earth's temperature, which will increase the water vapour, which will further increase the Earth's temperature.

**p169**

**1** The oceans cover almost 75% of the Earth's surface and act as massive heat sinks. The movement of the oceans play a major role in distributing heat, and cold, throughout the Earth. The oceans are also a major source of water vapour for the atmosphere. As a result, the currents of the oceans have a major influence on Earth's weather and climate.

**2** The ocean currents also have a major influence on the biosphere. For example, ocean currents from polar regions provide a large source of food for fish in the form of plankton.

**3** Ocean currents are driven by:

- the wind.
- the rotation of the Earth.
- temperature differences.
- differences in salt concentrations.
- the gravitational pull of the Sun and the moon.
- the lithosphere (coastlines, deep ocean trenches, marine mountain ranges, etc).

**4** The lithosphere shapes the path of the ocean currents through coastlines, deep ocean trenches, and marine mountains similar to the way mountains shape the path of a river in the valley between the mountains.

**5** The **surface currents**, driven by winds, transfer heat from the tropics to the polar regions. For example, the Gulf Stream carries warm water to Northern Europe. Norther Europe is thus much warmer than other countries at the same latitude.

**6** **Deep ocean currents** are driven by temperature and density differences. Cold dense salt water sinks and warm salt water rises. The deep ocean currents are large bodies of water that move slowly under the surface of the ocean.

**7** Northern Europe much warmer than other countries at the same latitude because the gulf stream carries warm water from the tropics to northern Europe.

**p171**

**1** **Global warming** refers to the increase in the average temperature of the Earth's surface. The average surface temperature has increased by 0.74 ± 0.18°C over the period 1906-2005.

**2** The contribution to global warming of each of the following heat sources:

**a) Volcanic eruptions**. Volcanoes can emit vast amounts of carbon dioxide, a greenhouse gas. It is estimated that humans produce 150 times more carbon dioxide than do volcanoes. Volcanoes also emit large amounts of dust, ash, and sulphur compounds which lower the surface temperature of the Earth by reducing solar radiation.

**b) Increased solar activity**. Measurements of the Sun over the last forty years suggest that the Sun hasn't increased its energy production.

**c) The Earth orbiting closer to the Sun**. The Earth's present orbiting trend suggests a slight cooling rather than a warming.

**d) Increase in the amount of greenhouse gases**. There is considerable evidence to suggest that the amount of carbon dioxide in the atmosphere has increased over the last 250 years and is at its highest level for the last four million years.

**3** The enormous oceans act as the Earth's heat sink and absorb 90% of the heat energy trapped by the greenhouse effect. The ocean currents transport the heat energy throughout the Earth. A small increase in ocean temperature represents a massive increase in heat energy.

**p173**

**1** **Weather effects**. Global warming has affected patterns of rainfall with generally reduced rain in the subtropics and increased rain in the subpolar latitudes and some equatorial areas. Essentially the drier areas are becoming drier and the wetter areas are becoming wetter. The increased energy in the weather systems is expected to produce stronger storms.

**2** **Ocean effects**. Ocean temperatures have risen. Sea levels have risen. The acidity of the oceans have increased as the oceans absorb more carbon dioxide.

**3** **Cryosphere effects**. Global warming has affected areas of snow and ice. The Artic sea ice has declined. Alpine glaciers have retreated. Snow cover has reduced in the Northern Hemisphere. The South American ice caps are to be gone by 2100.

**4** **Marine life**. The increased acidity of the oceans is expected to affect numerous species of marine life. The increase in carbonic acid reduces the ability of organisms to produce shells or skeletons (eg., corals, planktons, snails, etc).

**5** **Food supply effects**. Global warming is expected to increase the frequency and the severity of droughts for extensive areas of agricultural land. Droughts significantly reduce agricultural production. Migration of pests, to a more suitable environment, is expected to impact negatively on agricultural production. Ecosystems are changing. While some organisms will thrive, other organisms will suffer. Populations of organisms, dependent upon cold habitats, are declining.

**6** Explain how each of the following may be useful biological indicators of global warming:

**a)** The patterns of migratory birds would be expected to change, such as earlier migrations, as air temperature increases.

**b)** The populations of cold water fish would be expected to decrease in areas where the water temperature increases.

**c)** Shifts in the flowering times of plants, such as earlier sping flowering, would be expected to be an indicator of global warming.

## p174

**1** **Biodiversity** is the measure of the variety of organisms. Biodiversity varies considerably throughout Earth.

**2** Indicate a habitat where biodiversity is expected to be low: Ice sheet habitats.

**3** Indicate a habitat where biodiversity is expected to be high: Coastal marine habitats.

**4** Indicate three threats to biodiversity:

- **Increasing human population**. The increasing human population is the greatest threat to biodiversity.
- **Global warming**. Examples are coral bleaching due to increasing temperatures, acidification of the sea reducing the ability of organisms to form shells and skeletons.
- **Habitat destruction**. An example is the widespread reduction of tropical forests.
- **Introduced invasive species**. Introduced invasive species displace native species from their habitat.

**5** Comment on the speed of recovery of biodiversity after a mass extinction event.

## p175

**1** **Earth system science** is a the study of Earth as an integrated system. Earth system science uses a combination of biology, physics, mathematics, chemistry, geology, and applied sciences to analyse the interactions between the atmosphere, hydrosphere, lithosphere, and the biosphere.

**2** The four major systems of the Earth are the atmosphere, hydrosphere, lithosphere, and the biosphere.

**3**

| | Atmosphere | Hydrosphere | Lithosphere | Biosphere |
|---|---|---|---|---|
| **Atmosphere** | Thunder storms | *Evaporation* Water vapour from the oceans/lakes rises into the air | *Volcanic eruptions* Eruptions add carbon dioxide and soot particles to the atmosphere | *Respiration* Breathing in oxygen and breathing out carbon dioxide |
| **Hydrosphere** | | | *Erosion* Rivers, floods washing away soil and rocks | *Droughts* Lack of water causing loss of life |
| **Lithosphere** | | | | *Burning fossil* fuels Global warming |
| **Biosphere** | | | | |

A partly completed matrix showing a few examples of interactions among pairs of Earth's systems.

**4** Provide two examples of a process that involves all four major systems.

Thunderstorms (Involves moisture from the hydrosphere evaporating into the atmosphere. Water vapour condensing on soot particles from the lithosphere. Moisture breathed out from plants and animals in the biosphere).

Erosion (High evaporation rates from the hydrosphere, producing large amounts of moisture in the atmosphere, producing rain and washing soil and rocks from the surface of the lithosphere. Erosion causing loss of habitat for organisms in the biosphere).

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**2** The **biosphere** includes all of the living organisms on Earth.

**3** Three abiotic (non living) factors are temperature, soil, rainfall.

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**9** The oceans of the hydrosphere are a major contributor to the composition of the atmosphere.**10** List four of the Earth global systems.

**10** Four of the Earth global systems are lithosphere, biosphere, atmosphere, hydrosphere.

**11** The Earth's **atmosphere** is the layer of gases surrounding the Earth.

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- The carbon dioxide in the atmosphere is a key ingredient in photosynthesis - providing food in the form of glucose to photosynthesising organisms.
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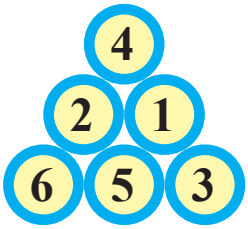
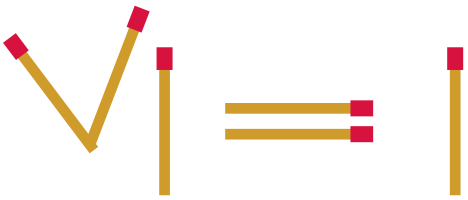



**2** There are two solutions.


**3**




**square root of 1 = 1**

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**p183**

**1** b) **2** a) **3** a) **4** a)

**p184**

**1** **a)** Australia
**b)** India
**c)** The amounts of carbon dioxide emissions would significantly increase

**2** The following compares humans and grazing livestock, in Australia, in terms of tonnes of carbon dioxide per year:

Humans = 24 million×16.9 tonnes/year = 406 million tonnes $CO_2$ per year

Cattle = 30 million×70 kg×22÷1000kg/year = 46 million tonnes $CO_2$ per year

Sheep = 75 million×7 kg×22÷1000kg/year = 12 million tonnes $CO_2$ per year

Kangaroos = 60 million×7 kg×22÷1000kg/year = 9 million tonnes $CO_2$ per year

Assuming the above data, humans emit considerably larger amounts of carbon dioxide than any of the grazing livestock. Human emissions of carbon dioxide may even be more than all of the grazing livestock combined.

**3** **a)** As the temperature increases from 0°C to 5°C the volume of water decreases.
As the temperature increases from 5°C to 20°C the volume of water increases.
**b)** As the temperature increases, the volume of the oceans would be expected to increase and thus increase the sea levels.
**c)** Golbal warming would be expected to increase sea levels and the ocean volumes increase. Global warming would also be expected to reduce ice at the polar caps also adding to the increase in sea levels

**4** **a)** 9 troughs, ice ages, appear to have happened in the last 800 thousand years.
**b)** As the temperature decreased approaching an ice age, carbon dioxide solubility in the oceans increased reducing the amount of atmospheric carbon dioxide. As the temperature increased coming out of an ice age, the solubility of carbon dioxide decreased increasing the amount of atmospheric carbon dioxide.
**c)** At the current time, per the graph, the amount of atmospheric carbon dioxide is way above the global temperature. The rest of the graph has a close matching between the global temperature and the global atmospheric carbon dioxide.