2.5 The Earth and its Atmosphere: 1-hour Pack

Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A factory releases 1200 kg of CO_2 every week. If a nearby project plants trees that absorb 50 kg of CO_2 each per year, how many trees are needed to absorb all of the CO_2 the factory releases in one year (52 weeks)? Assume tree uptake is constant and ignore other sinks.

(2)

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2 The table shows average atmospheric carbon dioxide concentration (parts per million, ppm) measured at a remote site over three years.

Year: 2018, 2019, 2020

CO_2 concentration (ppm): 405.0, 408.2, 412.5

(a) Calculate the increase in ppm from 2018 to 2020. **(1)**

.....

(b) Calculate the average yearly increase over the two-year period (give your answer to one decimal place). **(2)**

.....

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3 A sealed 2.0 L bottle contains air weighing 2.8 g at room temperature. Calculate the density of the air in g/L and in kg/m^3. (1 L = 0.001 m^3). Give both answers with correct units.

(a) Density in g per L. **(1)**

(b) Density in kg per m^3. **(2)**

4 Explain how condensation in the atmosphere leads to cloud formation. Include what happens to water vapour and any key steps.

(3)

5 Name the two main gases in Earth's atmosphere by percentage of volume.

(1)

6 Complete the sentence. Carbon dioxide is important in the atmosphere because it absorbs and helps to trap thermal energy from the Sun. Give three other reasons why carbon dioxide is important on Earth.

(3)

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7 A student measures the percentage of oxygen in a sealed container before and after placing a small lit candle inside until the flame goes out. Before the candle the oxygen level is 21.0%. After it goes out the oxygen level is 19.2%.

(a) Calculate the percentage of oxygen used. **(2)**

.....

(b) Suggest two reasons the measurement might not be perfectly accurate. **(2)**

.....

.....

8 State what is meant by the greenhouse effect in one sentence.

(2)

9 Kwame investigates how adding water to a jar of soil affects the release of carbon dioxide from the soil over one hour. He keeps the soil mass the same and measures CO_2 with a sensor every 15 minutes. Identify the independent variable, the dependent variable and two control variables Kwame should keep the same.

(3)

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10 Human activities have changed the composition of the atmosphere over the last 200 years. Evaluate the statement: "Reducing the use of fossil fuels is the most effective way to slow down harmful changes in the atmosphere." In your answer, consider at least two human activities that change atmospheric composition and give reasons for and against the statement before reaching a conclusion.

(6)

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11 Quickfire: the gases in today's atmosphere. Choose the correct answer for each question.

(a) Which gas makes up approximately 78% of the Earth's atmosphere today? **(1)**

- [ ] A) Oxygen
- [ ] B) Nitrogen
- [ ] C) Carbon dioxide
- [ ] D) Argon

(b) Which gas makes up approximately 21% of the Earth's atmosphere today? **(1)**

- [ ] A) Nitrogen
- [ ] B) Argon
- [ ] C) Oxygen
- [ ] D) Carbon dioxide

(c) Approximately what percentage of today's atmosphere is carbon dioxide? **(1)**

- [ ] A) 21%
- [ ] B) 4%
- [ ] C) 0.04%
- [ ] D) 78%

(d) Which noble gas makes up just under 1% of today's atmosphere? **(1)**

- [ ] A) Helium
- [ ] B) Neon
- [ ] C) Argon
- [ ] D) Krypton

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12 The table shows the approximate composition of today's atmosphere (dry air). Complete the table.

Gas	Approximate percentage by volume
Nitrogen	(a)
Oxygen	21%
Argon	(b)
Carbon dioxide	(c)
(d)	*trace amount*

(a) State the approximate percentage of nitrogen in today's atmosphere. **(1)**

(b) State the approximate percentage of argon in today's atmosphere. **(1)**

(c) State the approximate percentage of carbon dioxide in today's atmosphere. **(1)**

(d) Name one other gas present in today's atmosphere in trace amounts (other than argon or carbon dioxide). **(1)**

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13 Quickfire true or false: for each statement about the Earth's atmosphere, state whether it is True or False.

(a) "Today's atmosphere contains a much higher percentage of oxygen than the Earth's very early atmosphere." **(1)**

- ☐ True
- ☐ False

(b) "Carbon dioxide makes up about 21% of today's atmosphere." **(1)**

- ☐ True
- ☐ False

(c) "The greenhouse effect is a natural process that keeps the Earth warm enough to support life." **(1)**

- ☐ True
- ☐ False

(d) "Burning fossil fuels releases carbon that has been stored underground for millions of years back into the atmosphere as carbon dioxide." **(1)**

- ☐ True
- ☐ False

(e) "Nitrogen is classed as a significant greenhouse gas because it strongly absorbs infrared radiation." **(1)**

- ☐ True
- ☐ False

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14 The greenhouse effect is essential for life on Earth. Define what is meant by the term 'greenhouse effect'.

(3)

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15 The Earth's atmosphere has changed enormously since the Earth formed about 4.6 billion years ago.

(a) State two gases thought to have made up most of the Earth's early atmosphere. **(2)**

(b) Name the process, linked to activity inside the Earth, that released these gases to form the early atmosphere. **(1)**

(c) Explain how the oceans are thought to have formed from this early atmosphere. **(1)**

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16 Scientists drill deep into ice sheets in Antarctica and Greenland to remove long cylinders of ice called ice cores. Explain how scientists can use ice cores to estimate both the atmospheric carbon dioxide concentration and the temperature of the atmosphere from thousands of years ago.

(3)

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Mark scheme · 2.5 The Earth and its Atmosphere: 1-hour Pack

Question 1

convert weekly release to annual: 1200 kg x 52 = 62400 kg	M1
divide by 50 -> 1248 trees cao	A1

Answer: **1248 trees**

Question 2

(a) 412.5 - 405.0 = 7.5 ppm cao	B1

(a) Answer: **7.5 ppm**

(b) method: 7.5 / 2	M1
(b) 3.8 ppm per year cao	A1

(b) Answer: **3.8 ppm per year**

Question 3

(a) 2.8 g / 2.0 L = 1.4 g/L cao	B1

(a) Answer: **1.4 g/L**

(b) convert 1.4 g/L to kg/m^3: 1.4 g/L = 1.4 kg/m^3 or show conversion via 1.4 g/L -> 1.4 g per 0.001 m^3	M1
(b) 1.4 g/L = 1.4 kg/m^3 (since 1 g/L = 1 kg/m^3) cao	A1

(b) Answer: **1.4 kg/m^3**

Question 4

water vapour cools as air rises or moves to cooler regions	M1
vapour condenses into tiny water droplets on condensation nuclei (dust or salt)	M1
these droplets cluster to form visible clouds	A1

Answer: **Water vapour cools as air rises, causing the vapour to condense onto dust or salt particles; many tiny droplets form and cluster together to make visible clouds.**

Question 5

nitrogen and oxygen cao	B1

Answer: **Nitrogen and oxygen**

Question 6

used by plants for photosynthesis	B1
produced by respiration/combustion (accept either as a reason for cycling)	B1
dissolves in oceans and affects acidity/part of carbon cycle	B1

Answer: **It is used by plants for photosynthesis; it is produced by respiration and burning fuels; it dissolves in oceans and affects acidity.**

Question 7

(a) subtraction 21.0 - 19.2	M1
(a) 1.8% cao	A1

(a) Answer: **1.8%**

(b) sensor calibration drift or sensor not accurate	B1
(b) some oxygen dissolved in water or escaped or flame did not consume uniformly (any reasonable experimental error)	B1

(b) Answer: **Possible sensor inaccuracy or oxygen loss to the environment such as dissolving into water or leaking.**

Question 8

greenhouse gases trap heat/thermal energy radiated from Earth leading to warming of the surface	B1
must mention trapping or absorbing outgoing infrared or warming effect	B1

Answer: **Greenhouse gases absorb and trap infrared radiation from Earth, causing the surface to be warmer than it would be otherwise.**

Question 9

independent variable = volume/amount of water added to the soil	B1
dependent variable = concentration or amount of carbon dioxide measured (eg CO_2 reading)	B1
two control variables = keep soil mass the same and keep temperature constant (accept eg same soil type and same temperature or same container and same measurement interval)	B1

Answer: **Independent variable: amount of water added. Dependent variable: CO_2 concentration measured. Controls: soil mass kept the same and temperature kept constant (also same soil type and same measurement times).**

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Question 10

Level 1 Basic points about human activities and one relevant effect on the atmosphere. Limited reasoning and a simple or unsupported conclusion if present. **1-2**

Level 2 Clear description of at least two human activities that change the atmosphere and some balanced reasoning for and against the statement. A partially supported conclusion is given. **3-4**

Level 3 Detailed evaluation showing understanding of how activities (for example burning fossil fuels, deforestation, agriculture) alter atmospheric gases, well balanced weighing of arguments for and against reducing fossil fuel use, and a justified conclusion with suggestions of other effective measures where appropriate. **5-6**

Indicative content:

- Human activities that change composition: burning fossil fuels increases CO_2; deforestation reduces CO_2 uptake; intensive agriculture releases methane and nitrous oxide; industry and transport emit pollutants and particulates.
- Arguments for reducing fossil fuel use: directly reduces CO_2 emissions which drive global warming; reduces air pollutants that harm health; large-scale impact if adopted widely.
- Arguments against it being the only solution: other gases like methane and nitrous oxide are significant and come from agriculture and waste; existing emissions already in atmosphere; need for adaptation and carbon sinks; economic and practical barriers.
- Possible other measures: restoring forests, reducing methane from agriculture, improving energy efficiency, developing carbon capture, policy and lifestyle changes.
- Expected conclusion: reducing fossil fuels is very important but most effective as part of a suite of measures; best answers weigh evidence and propose combined strategies.

Question 11

(a) B - nitrogen **B1**

(a) Answer: **B (nitrogen)**

(b) C - oxygen **B1**

(b) Answer: **C (oxygen)**

(c) C - 0.04% **B1**

(c) Answer: **C (0.04%)**

(d) C - argon **B1**

(d) Answer: **C (argon)**

Question 12

(a) 78% (accept 77-79%) **B1**

(a) Answer: **78%**

(b) 0.9% (accept 0.8-1%) **B1**

(b) Answer: **0.9%**

(c) 0.04% (accept 0.03-0.05%) **B1**

(c) Answer: **0.04%**

(d) any one from: neon, helium, methane, water vapour, hydrogen, krypton (oe) **B1**

(d) Answer: **e.g. water vapour**

Question 13

(a) True **B1**

(a) Answer: **True**

(b) False **B1**

(b) Answer: **False**

(c) True **B1**

(c) Answer: **True**

(d) True **B1**

(d) Answer: **True**

(e) False **B1**

(e) Answer: **False**

Question 14

the Sun's (shortwave) radiation passes through the atmosphere and warms the Earth's surface **B1**

the warmed surface radiates (longwave) infrared radiation **B1**

greenhouse gases (e.g. carbon dioxide, methane, water vapour) absorb this infrared radiation and re-radiate it in all directions, including back towards the Earth, keeping the surface warmer than it would otherwise be **B1**

Answer: **The greenhouse effect is the natural warming of the Earth caused by greenhouse gases absorbing infrared radiation emitted by the warmed surface and re-radiating it back towards the surface, trapping heat in the atmosphere.**

Question 15

(a) carbon dioxide **B1**

(a) water vapour (accept nitrogen as an alternative to either mark) **B1**

(a) Answer: **Carbon dioxide and water vapour**

(b) volcanic activity / volcanoes (outgassing) **B1**

(b) Answer: **Volcanic activity**

(c) as the Earth cooled, water vapour in the atmosphere condensed to form liquid water, which collected to form the oceans **B1**

(c) Answer: **Water vapour condensed as the Earth cooled and collected to form the oceans.**

Question 16

as snow fell and compacted into ice over thousands of years, tiny bubbles of the atmosphere at that time became trapped and sealed inside the ice **B1**

scientists can analyse the trapped air in these bubbles at different depths to directly measure the CO_2 concentration of the atmosphere when that layer formed, with deeper ice being older **B1**

the ratio of oxygen isotopes in the ice itself changes depending on the temperature at the time the ice formed, so scientists use this ratio to estimate past temperatures **B1**

Answer: **Trapped air bubbles in the ice directly record past atmospheric CO_2 concentration, while the ratio of oxygen isotopes in the ice itself is used to estimate the temperature at the time each layer formed.**

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