2.28 The Atmosphere: Evolution and Greenhouse Gases: Test Pack

AQA 8464 · Calculator allowed · about 35 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Name one gas that is a major greenhouse gas today and contributes to warming of the atmosphere.

(Total for Question 1 is 1 mark)

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2 Early in Earth history the composition of the atmosphere was very different from today.

(a) Give two gases that were likely abundant in the early atmosphere but are much less abundant today. **(2)**

(Total for Question 2 is 2 marks)

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3 Fossil fuels release carbon dioxide when burned. Write the word equation for the complete combustion of methane.

(Total for Question 3 is 2 marks)

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4 Explain how greenhouse gases cause the greenhouse effect in the atmosphere.

(a) Give one statement of how energy from the Sun interacts with Earth and one statement of how greenhouse gases then warm the atmosphere. **(3)**

(Total for Question 4 is 3 marks)

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5 A sample of air contains 0.012 moles of carbon dioxide in a 2.00 L container at room temperature. Calculate the concentration in mol per litre (mol L-1).

(a) Calculate the concentration of CO_2 in mol L-1. Give your answer to three significant figures. **(3)**

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(Total for Question 5 is 3 marks)

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6 Sulfur dioxide can be removed from flue gases by reacting with calcium oxide in a scrubber. The reaction is $SO_2 + CaO \rightarrow CaSO_3$.

(a) Calculate the mass of CaO needed to remove 64.0 g of SO_2, assuming complete reaction. Mr: SO_2 = 64.0, CaO = 56.0. Show your working. **(3)**

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(b) State one limitation of assuming complete reaction when designing a scrubber. **(1)**

(Total for Question 6 is 4 marks)

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7 A simplified data set shows atmospheric CO_2 readings at two sites over five years. Site A: 395, 397, 400, 402, 405 ppm. Site B: 396, 398, 399, 401, 403 ppm.

(a) Calculate the average rate of increase in ppm per year at Site A over the five year period. Show your working. **(2)**

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(b) State which site shows a more consistent year-to-year increase and give one reason from the data to support your answer. **(1)**

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(Total for Question 7 is 3 marks)

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8 Required practical style: investigating the effect of dissolved carbon dioxide on the pH of water using universal indicator.

(a) Describe a simple experimental method to show that bubbling CO_2 into water makes it more acidic. Include the key control variable that must be kept constant. **(2)**

(b) State one improvement to make the results more reliable. **(1)**

(Total for Question 8 is 3 marks)

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9 A scientist measures CO_2 concentration as 400.0 ppm with an uncertainty of plus or minus 0.5 ppm.

(a) Write the measured value including its uncertainty. **(1)**

(b) If two measurements are 400.0 ppm ± 0.5 ppm and 400.6 ppm ± 0.5 ppm, state whether these agree within experimental uncertainty and justify your answer briefly. **(2)**

(Total for Question 9 is 3 marks)

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Mark scheme · 2.28 The Atmosphere: Evolution and Greenhouse Gases: Test Pack

Question 1

carbon dioxide (CO_2) or methane (CH_4) or water vapour or nitrous oxide (N_2O), accept any one **B1**

Answer: Carbon dioxide (CO_2).

Question 2

(a) any one from: carbon dioxide, water vapour (H_2O), methane, ammonia **B1**

(a) any other one from the same list **B1**

(a) Answer: Any two from: carbon dioxide; water vapour; methane; ammonia.

Question 3

methane + oxygen -> carbon dioxide + water **B1**

equation must represent complete combustion with CO_2 and H_2O as products **B1**

Answer: Methane + oxygen -> carbon dioxide + water

Question 4

(a) shortwave radiation from the Sun reaches Earth and is absorbed by the surface (statement of incoming energy) **B1**

(a) Earth emits longwave infrared radiation back towards space (statement of outgoing energy) **B1**

(a) greenhouse gases absorb and re-emit some of the outgoing infrared, causing warming of the lower atmosphere (mechanism) **B1**

(a) Answer: Sunlight is absorbed at the surface; the Earth emits longwave infrared; greenhouse gases absorb and re-emit some infrared, trapping heat and warming the lower atmosphere.

Question 5

(a) substitutes concentration = moles / volume: 0.012 / 2.00 **M1**

(a) 0.00600 mol L-1 cao **A1**

(a) unit stated as mol L-1 or mol per litre **B1**

(a) Answer: 0.00600 mol L-1

Question 6

(a) calculate moles of SO_2: 64.0 / 64.0 = 1.00 mol **M1**

(a) use 1:1 stoichiometry so moles CaO = 1.00 **M1**

(a) mass of CaO = 1.00 x 56.0 = 56.0 g cao **A1**

(a) Answer: 56.0 g

(b) reaction may be incomplete, some SO_2 may pass through; impurities; mass transfer limitations **B1**

(b) Answer: In reality the reaction may be incomplete so some SO_2 will remain; this affects the amount of CaO required.

Question 7

(a) calculate change: 405 - 395 = 10 ppm and divide by number of years 4 (intervals) **M1**

(a) 2.50 ppm per year cao **A1**

(a) Answer: 2.50 ppm per year

(b) Site A is more consistent because its yearly changes are mostly +2 or +3 ppm while Site B has a year with +1 ppm (399 from 398) showing more variability, or vice versa with explanation **B1**

(b) Answer: Site A is more consistent; its increases are steady (e.g. mainly +2 to +3 ppm) whereas Site B includes a smaller step of +1 ppm, showing more variability.

Question 8

(a) bubble CO_2 through a sample of distilled water containing universal indicator using a syringe or tube and a source of CO_2 **M1**

(a) observe the indicator change colour to show lower pH; control variable: keep volume of water and temperature constant (one required) **A1**

(a) Answer: Bubble CO_2 through a measured volume of distilled water containing indicator; observe the indicator turning towards acidic colours. Keep the volume of water and temperature constant.

(b) repeat the experiment and calculate a mean or use a pH probe for continuous pH measurement **B1**

(b) Answer: Repeat the experiment and take the mean pH, or use a pH probe for more precise readings.

Question 9

(a) 400.0 ppm ± 0.5 ppm **B1**

(a) Answer: 400.0 ppm ± 0.5 ppm

(b) recognises overlapping ranges: first range 399.5 to 400.5, second range 400.1 to 401.1 **M1**

(b) they overlap (400.1 to 400.5) so the measurements agree within uncertainty **A1**

(b) Answer: They agree because ranges 399.5 to 400.5 and 400.1 to 401.1 overlap (400.1 to 400.5).

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