



GCSE – **NEW**

3445U20-1A



**APPLIED SCIENCE (Double Award)**  
**UNIT 2: Space, Health and Life**

**Pre-Release Article for use in the following examinations on  
FRIDAY, 16 JUNE 2017 – MORNING:**

GCSE Applied Science (D/A) Unit 2 Foundation Tier (3445U20-1)

GCSE Applied Science (D/A) Unit 2 Higher Tier (3445UB0-1)

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## Contributors to the greenhouse effect

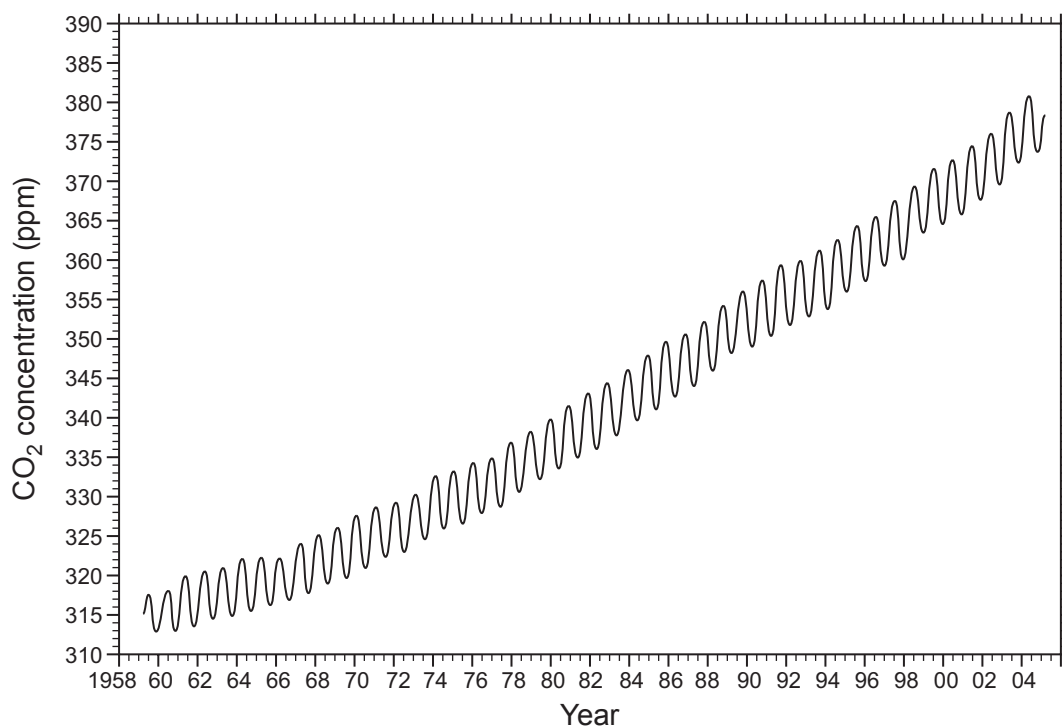
The main greenhouse gases emitted by human activities in the UK over time are shown in **Table 1**.

**Table 1: UK greenhouse gas emission trends by gas, 1990-2014 in MegatonnesCO<sub>2</sub>eq (MtCO<sub>2</sub>eq)**

	1990	1995	2000	2005	2010	2013	2014
net CO <sub>2</sub> emissions	592.8	557.1	554.3	554.1	495.8	463.3	422.0
methane	137.0	130.4	114.4	92.1	66.2	55.8	53.5
nitrous oxide	49.4	40.0	29.6	25.6	22.5	21.4	21.9
hydrofluorocarbons (HFC)	14.4	19.1	9.8	13.1	16.6	16.0	16.3
perfluorocarbons	1.7	0.6	0.6	0.4	0.3	0.3	0.3
sulfur hexafluoride	1.3	1.3	1.8	1.1	0.7	0.5	0.5
<b>Total greenhouse gases</b>	<b>796.6</b>	<b>748.5</b>	<b>710.6</b>	<b>686.3</b>	<b>602.1</b>	<b>557.3</b>	<b>514.4</b>

**Graph 1** shows seasonal CO<sub>2</sub> concentrations measured in Mauna Loa between 1958 and 2004. Each year there is a peak in November and a dip in May.

**Graph 1: Monthly average carbon dioxide concentration at Mauna Loa Observatory, Hawaii.**



On some websites it is claimed that the contribution of water vapour to the greenhouse effect is often ignored. **Table 2** was constructed from data published by the U.S. Department of Energy. It does not include water vapour. It refers to global atmospheric concentrations in the year 2000.

**Table 2**

greenhouse gas	concentration in the atmosphere (parts per billion (ppb))				
	pre-industrial baseline	natural additions	man-made additions	total	percent of total (%)
carbon dioxide	288 000	68 520	11 880	368 400	99.438
methane	848	577	320	1 745	0.471
nitrous oxide	285	12	15	312	0.084
CFC's	25	0	2	27	0.007
Total	289 158	69 109	12 217	370 484	100.000

Using corrections for the **greenhouse contribution** of each gas gives a more meaningful comparison of greenhouse gases, based on the conversion:

$$\text{greenhouse contribution} = (\text{concentration in the atmosphere}) \times (\text{multiplier})$$

**Table 3: Contribution of some greenhouse gases to greenhouse effect**

greenhouse gas	multiplier
carbon dioxide	1
methane	21
nitrous oxide	310

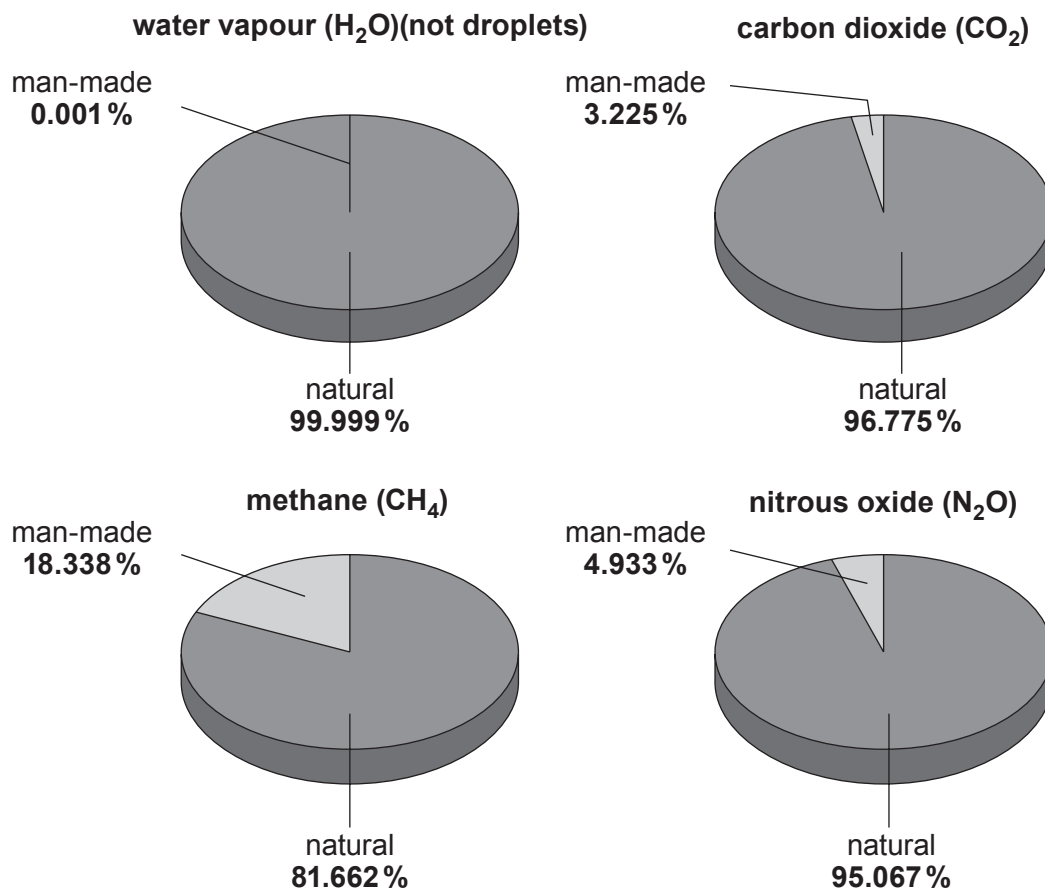
**Table 4** shows what happens when the effect of water vapour is factored in.

**Table 4**

greenhouse gas	% of total	% of total including <b>water vapour</b>
<b>water vapour</b>		<b>95.00</b>
carbon dioxide	72.40	<b>3.62</b>
methane	7.10	<b>0.36</b>
nitrous oxide	19.00	<b>0.95</b>
CFC's (and other misc. gases)	1.40	<b>0.07</b>
total	100.00	<b>100.00</b>

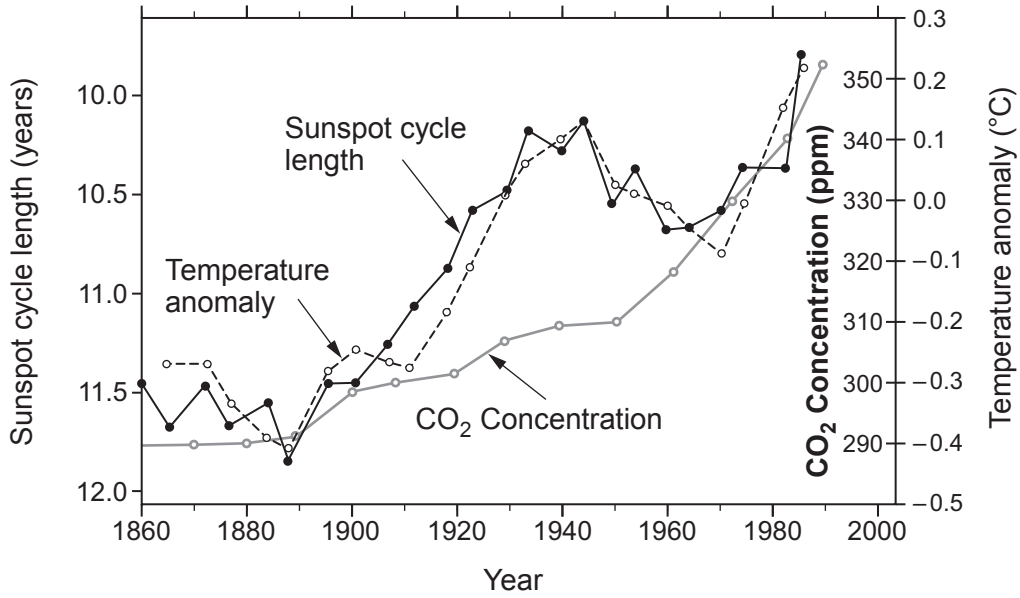
Other websites compare the human contribution to the greenhouse effect with natural contributions. The pie charts below show how much of each greenhouse gas is **natural** and how much is **man-made**.

**Chart 1**

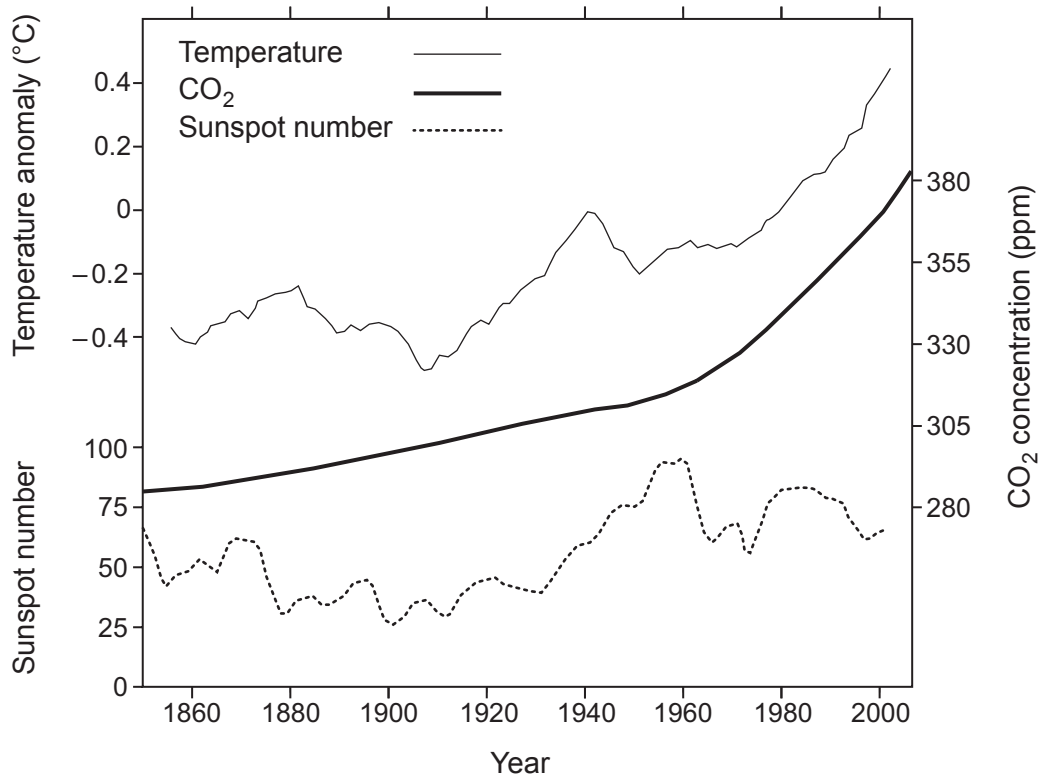


Some websites claim that global temperature depends on the activity of the Sun. The graphs below are taken from two different websites. The temperature anomaly refers to variations in air temperature.

**Graph 2**



**Graph 3**



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