Environmental Studies
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Climate Change? A Comprehension Exercise

From 2007, the comprehension question on AQA A2 exams will alternate between the two A2 papers. Comprehension questions are usually the worst - answered questions on the papers and many students find answering them difficult. The secret is to practice.

This Factsheet will:

- *Analyse student responses to a Comprehension on climate change*
- *Suggest ways in which students can improve their performance on this type of question*

Read the following account and answer the questions that follow.

Are we changing the climate? - Comprehension exercise

Greenhouse gases (GHGs) include carbon dioxide, methane, CFCs, nitrous oxides and tropospheric ozone. Humans are increasing the concentrations of greenhouse gases and this is increasing the efficiency with which the atmosphere absorbs outgoing terrestrial radiation.

But the greenhouse effect is natural and essential and has operated in the Earth's atmosphere for billions of years due to naturally-occurring GHGs. In preindustrial times, the natural concentration of carbon dioxide (CO_2) ranged from about 190 parts per million (ppm) to 280 ppm. - and the temperature of the earth's oceans and atmosphere varied similarly. In turn, these affected circulation and weather patterns.

CO_2 concentrations have increased by 31% since 1750. The present CO_2 concentration - 370ppm - is the highest that it has been for 420,000 years and probably the highest for the last 20 million years! The sources of this extra CO_2 are fossil fuel burning and land-use change.

Carbon dioxide has been estimated to be responsible for over half the enhanced greenhouse effect in the past, and is likely to remain so in the future. Many scientists believe that we need to reduce our emissions of CO_2 immediately and that, because there are many alternatives to fossil fuels and energy conservation makes good economic sense, we should be concentrating on this gas.

However, although we have identified several other important GHGs, their relative importance and, in some cases, their net effect on climate, is uncertain *(Fig. 1)*.

Fig. 1 Climate Change Factors

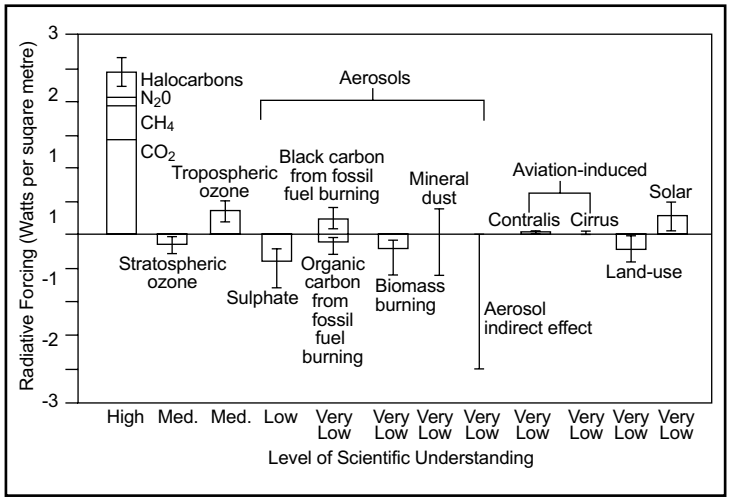
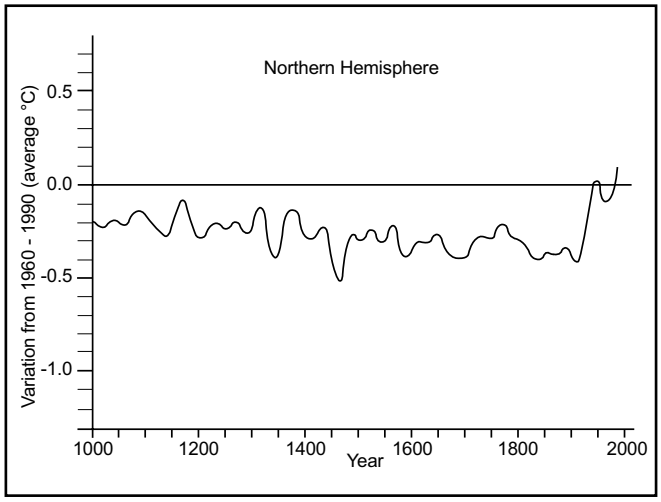


Fig. 2 Variation in Earth's surface temperature (past 1000 years)



Aerosols are particles and very small droplets of natural and human origin that occur in the atmosphere. Aerosols in the lower atmosphere resulting from combustion of fossil fuels, biomass burning and other sources have led to a small cooling effect. Locally, this can more than offset the warming due to GHGs. However, anthropogenic aerosols do not stay around in the atmosphere as long as GHGs such as carbon dioxide, methane and nitrous oxide, hence their cooling effects may be temporary.

The global mean surface temperature has increased by about 0.6°C over the 20th century - the greatest increase of any century during the past 1000 years *(Fig. 2)*.

Most scientists now believe that most of the warming observed over the last 50 years has been caused by human activity. The globally average surface temperature is projected to increase by 1.4 to 5.8°C over the period 1990 to and global mean sea level is projected to rise by 9 to 88 cm between 1990 and 2100. This is due primarily to thermal expansion and loss of mass from glaciers and ice caps. Worryingly, surface temperatures and sea levels are expected to continue to rise for hundreds of years even after stabilisation of GHGs, and even if this was at present levels.

Questions

(a) What is meant by the term greenhouse gas? *(2)*

(b) Outline:
(i) how atmospheric CO_2 concentrations can affect circulation and weather patterns *(lines 4-5)* *(3)*
(ii) land use change can increase atmospheric CO_2 concentrations *(line 7)* *(2)*

(c) Explain what is meant by the phrase "their net effect on climate, is uncertain". *(lines11-14 and Fig. 1)* *(3)*

(d) Suggest:

(i) reasons for the trend shown in *Fig. 2* since the 1840s. *(2)*

(ii) surface temperatures and sea levels are expected to continue to rise for hundreds of years. *(lines 22-23)* *(2)*

How to do well

1. Start by reading through the whole passage.
2. Before answering a question part, make notes of the key words you are going to use on the actual exam paper.
3. Never copy part or whole sentences from the passage
4. Remember, most but not all of the answers are in the passage – you have to find and expand upon the key points
5. If a question is worth 3 marks, make 4 or 5 points (assume one or more of them will be wrong/ irrelevant etc)

Student responses

The Markscheme is in the right hand corner of this page. Try marking these responses using the Markscheme before you read what they actually got. This will help you to think like an examiner (Sorry, but some of you guys will end up as teachers and examiners, so you might as well start now).

(a) What is meant by the term **greenhouse gas**? *(2)*

"Carbon dioxide, methane etc are greenhouse gases. They trap heat and warm up the earth"……..

Student score: 1 mark for the named GHG. "Trap heat" is too vague at A2. "earth" = soil. Be precise, refer to the lower atmosphere/ troposphere.

b) Outline:
(i) how atmospheric CO_2 concentrations can affect circulation and weather patterns. *(lines 4-5)* *(3)*

"As it gets hotter, it rains more in some places and less in others. Also, as the greenhouse effect kicks in, there will be more storms and hurricanes and tsunamis. Circulation will speed up."

Student score: 0 marks. The student has completely missed the point. You need to know that air moves from a region of high pressure to one of lower pressure and that ocean currents are influenced by air temperatures

(ii) land use change can increase atmospheric CO_2 concentrations. *(line 7)* *(2)*

"Deforestation kills trees, so photosynthesis is less. With less trees, there is less photosynthesis so less CO_2 is absorbed."

Student score: 1 mark. They got Mark Point (MP)1 but said it twice. You must make more, different points than there are marks available.

(c) Explain what is meant by the phrase "their net effect on climate, is uncertain". *(lines 11-14 and Fig. 1)* *(3)*

"It means we aren't certain what effect they'll have. Our level of scientific understanding is poor. Scientists disagree."

Student score: 1 mark for MP4. Although the student has tried to come up with 3 different points, in reality, they have ignored the references given in the Question. The Figure clearly shows that aerosols have both a warming and a cooling effect.

(d) Suggest:

(i) reasons for the trend shown in *Fig. 2* since the 1840s. *(2)*

"The industrial revolution meant we were using lots of coal a fossil fuel. It gives off CO_2 when burned. Also cars, aeroplanes, etc, factories, have been developed, again, all using coal and oil. Deforestation has also occurred, stopping CO_2 being absorbed."

Student score: 2 marks. A good answer with more points than marks available

(ii) surface temperatures and sea levels are expected to continue to rise for hundreds of years. *(lines 22-23)* *(2)*

"We can't just stop releasing CO_2.We are dependent on fossil fuels for our way of life. The developing countries also want cars, factories etc and a better way of life - it all takes fuel, so carbon dioxide levels will continue to go up for a long time yet."

Student score: 0 marks. The student has not read around the excerpt. The Question refers you to *Lines 22* and *23*. *Line 33* tells us that levels will rise even if we stabilise GHGs at their present level. So clearly, something else is needed. Here, the examiner is asking you to think around the topic.

Markscheme

(a) named gas;
absorbs outgoing/longwave/infrared radiation;
therefore heats up (lower) atmosphere; *max 2*

(b) (i) CO_2 = GHG so warms atmosphere;
Which warms ocean;
Ocean currents/air movements generated by temperature differences;
(ii) deforestation removes C sink/reduces photosynthesis;
urbanisation/industrialisation means increased fossil fuel use/ heating/transport;
ploughing/ soil disturbance releases CO_2; *max 2*

(c) Some GHGs e.g. aerosols can have both a cooling and warming effect;
Net effect refers to overall effect (at any time);
Ref to different atmospheric life times;
Ref to level of scientific understanding; *max 3*

(d) (i) industrial revolution;
burning of fossil fuels;
transport developments;
population growth; *max 2*

(ii) residence times of some gases;
new GHGs;
positive feedback; *max 2*

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