

Exam-style question: Emission scenarios

Introduction

This activity is in the style of a Unit 3 exam question.

Note that this activity, while being in the style of an exam question, has not been subject to the careful evaluation and revision of questions undertaken by AQA during the preparation of operational exam papers.

Paste in dotted answer lines under each of the parts of the question if you want your students to answer the question in writing as in an examination. Allow at least 2 lines for each part of the question and not less than one line per mark.

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The mark scheme assumes that credit will be given for valid answers even where these are not stated in the scheme. The mark scheme shows which science explanations (SEs) and ideas about how science works (HSW) are being tested. As in the scheme of work, the code letters are those found in sections 3.5 and 3.6 of the specification.

Questions with answers and a suggested mark scheme

(a) Explain, using a labelled diagram, how increasing levels of carbon dioxide in the atmosphere lead to a rise in the global mean temperature of the Earth.

Diagram showing:

- *shorter (UV) wavelength radiation from the Sun passing through the atmosphere to the surface of the earth*
- *the Earth re-radiation at longer (IR) wavelengths*
- *the atmosphere absorbing longer wavelengths*
- *warmer atmosphere radiating energy back to the surface of the Earth*
- *incoming radiation > outgoing radiation*

(any 3 for 1 mark each) (SE Nb, Nc, Nd, Ne)

(b) (i) Why is it important for climate modellers to have good data about past climates?

Scientists test their computer models by seeing how accurately they can account for changes in data from past climates

(1 mark) (HSW Df)

(ii) The diagram shows a smooth rise in the carbon dioxide concentration from 1900 to 2000 whereas there are sharp fluctuations in the rising graph for global mean temperature. Suggest an explanation for the appearance of the historical temperature graph.

The answer can include:

- *the trend of the mean is for the temperature to rise as greenhouse gas concentrations rise*
- *the intensity of the radiation reaching the Earth from the Sun varies with the activity of the Sun itself and the pattern of the Earth's orbit round the Sun*
- *variations on Earth such as degree of cloud cover, wind patterns and volcanic eruptions cause fluctuations in the climate*

(any 2 for 1 mark each)

(c) (i) In scenario X, what is the predicted rise in global mean temperature by 2100, above the 1980-2000 mean?

- *3.2 (allow 3.0 – 3.5) °C rise*
- *± 1 (allow 0.9 – 1.1) °C*

(1 mark each) (HSW Ad, Ag)

(ii) Suggest two reasons why, in scenario X, the predicted concentration of carbon dioxide keeps rising after 2050 even though carbon dioxide emissions from fossil fuels are falling.

- *Carbon dioxide remains in the atmosphere for many years*
- *Fossil fuels are not the only source of carbon dioxide*
- *The rising temperature can disrupt ecosystems and slow down natural processes that remove carbon dioxide from the air.*

(Any 2 for 1 mark each) (SE Ma, Mb, Mc, Md)

(iii) In all the scenarios there is much more uncertainty in the 2100 predictions of temperature than in the levels of carbon dioxide. Suggest one factor, other than the concentration of carbon dioxide, that might also influence the temperature and explain how it contributes to the uncertainty.

Possible examples:

- *clouds – uncertainty about cloud levels and whether they are part of a positive or negative feedback*
- *concentrations of other greenhouse gases (including water vapour) – uncertainties about the impact of global warming on emissions of other greenhouse gases such as the release of methane from sediments or rising levels of water vapour in the air*
- *reflection of radiation by snow and ice – rate of melting of ice caps and glaciers determines how quickly the albedo of glacial regions changes*

(any appropriate factor – 1 mark, explanation – 1 mark)

(iv) Name one major environment problem that would occur if the predictions from scenario Y take place and account for your choice.

Credit the justification for an appropriate problem such as:

- *rising sea level*
- *desertification*
- *extreme weather events*
- *melting ice caps and/or glaciers*
- *damage to ecosystems.*

(1 mark for justification matched to stated problem)

(d) The level of carbon dioxide emissions from fossil fuels is largely under human control. Which of the three scenarios do you think is most likely? Explain why you have chosen this scenario.

A good, well argued answer will relate points made to the shape of the graphs in the scenario chosen. Some points that might be included in the answers:

- *other likely human impacts on the environment*
- *availability and cost of fossil fuels*
- *competing political responses to the predictions of scientists*
- *international agreements and the likelihood that they will be adhered to*
- *carbon trading and its possible limitations*
- *new low-carbon technologies*
- *changes in developing economies*
- *feedbacks in the climate system*

Good, well argued answer: 5 – 6 marks

Competent but limited answer: 3 – 4 marks

*Poor answer: 1 – 2 marks
(HSW Db, Fa, Hb, He)*

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This activity is in the style of a question that you might find in a Unit 3 exam paper for this course. You are expected to apply what you have learnt in the course to answer questions set in a context which may be unfamiliar. Study the information at the start of the question carefully before you start to answer the questions.

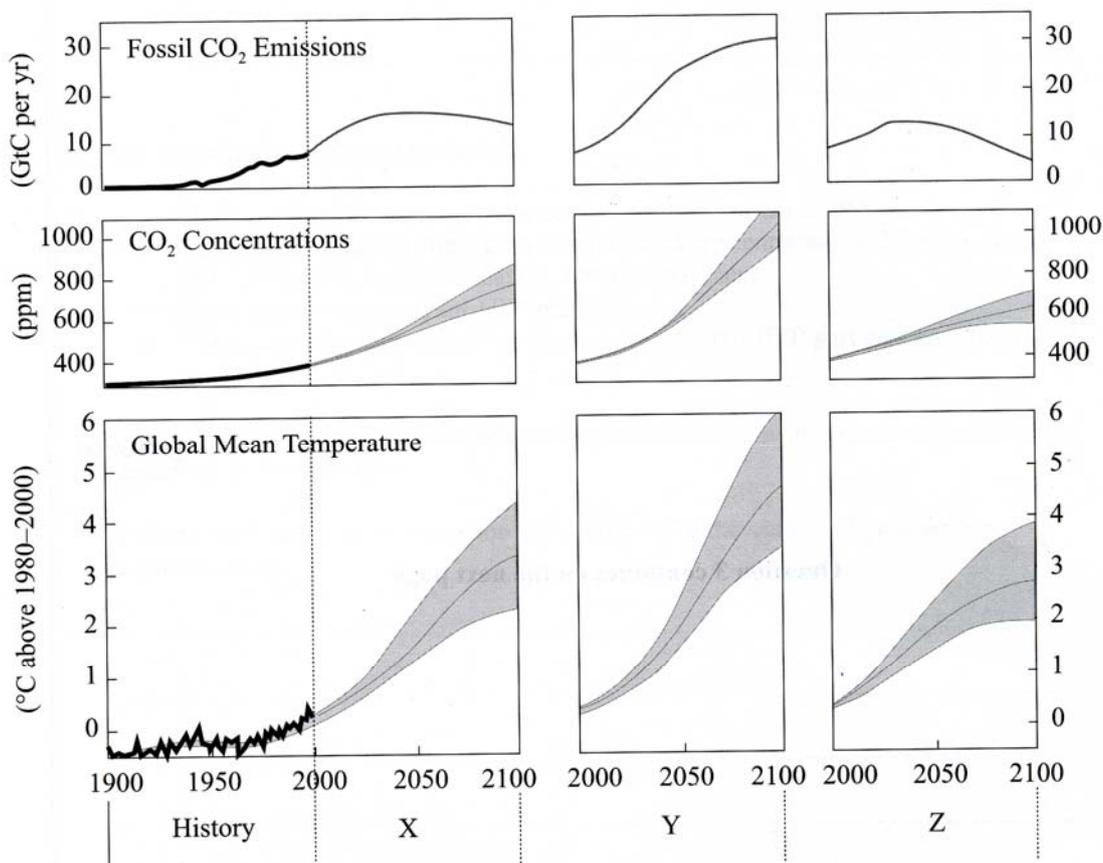
Question

Scientists use computer models to predict future mean global temperatures for different levels of carbon dioxide in the atmosphere.

- (a) Explain, using a labelled diagram, how increasing levels of carbon dioxide in the atmosphere lead to a rise in the global mean temperature of the Earth.

(3 marks)

Scientists develop scenarios based on different predictions of future emissions of carbon dioxide in the atmosphere. The scientists feed the data on which these scenarios are based into computer models. The diagram shows the results of computer modelling for three scenarios X, Y and Z. The shaded regions represent the uncertainty in the predictions. On the left, the darker lines on the diagram show the known values up to the year 2000.



- (b) (i) Why is it important for climate modellers to have good data about past climates? (1 mark)
- (ii) The diagram shows a smooth rise in the carbon dioxide concentration from 1900 to 2000 whereas there are sharp fluctuations in the rising graph for global mean temperature. Suggest an explanation for the appearance of the historical temperature graph. (2 marks)
- (c) (i) In scenario X, what is the predicted rise in global mean temperature by 2100, above the 1980-2000 mean?
Show this change as:°C rise \pm °C (2 marks)
- (ii) Suggest two reasons why, in scenario X, the predicted concentration of carbon dioxide keeps rising after 2050 even though carbon dioxide emissions from fossil fuels are falling. (2 marks)
- (iii) In all the scenarios there is much more uncertainty in the 2100 predictions of temperature than in the levels of carbon dioxide. Suggest one factor, other than the concentration of carbon dioxide, that might also influence the temperature and justify your choice. (2 marks)
- (iv) Name one major environment problem that would occur if the predictions from scenario Y take place and account for your choice. (1 mark)
- (d) The level of carbon dioxide emissions from fossil fuels is largely under human control. Which of the three scenarios do you think is most likely? Explain why you have chosen this scenario. (6 marks)