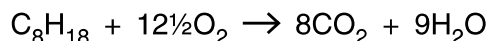


Answer **all** the questions.

- 1 Crude oil is a source of hydrocarbons which can be used as fuels or for processing into petrochemicals.

Octane, C<sub>8</sub>H<sub>18</sub>, is one of the alkanes present in petrol.

Carbon dioxide is formed during the complete combustion of octane.



- (a) What is the general formula for an alkane?

..... [1]

- (b) Carbon monoxide, CO, is formed during the incomplete combustion of octane.

- (i) Write an equation for the incomplete combustion of octane, forming carbon monoxide and water.

..... [1]

- (ii) Why does incomplete combustion sometimes take place?

.....  
..... [1]

- (c) In cars fitted with a catalytic converter, two toxic gases, CO and NO, react together to form two non-toxic gases.

- (i) Write an equation for the reaction between CO and NO in a catalytic converter.

..... [1]

- (ii) Outline the stages that take place in a catalytic converter to allow CO to react with NO.

.....  
.....  
.....  
.....  
.....  
..... [3]

- (d) Oil companies process hydrocarbons, such as octane, into branched and cyclic hydrocarbons that promote efficient combustion in petrol.

Draw the skeletal formulae of a branched hydrocarbon and a cyclic hydrocarbon, each containing eight carbon atoms.

[2]

- (e) Some scientists believe that increased  $\text{CO}_2$  levels arising from the combustion of hydrocarbons lead to global warming because  $\text{CO}_2$  is a greenhouse gas. Carbon capture and storage, CCS, is being developed as a method for removing  $\text{CO}_2$  produced by combustion.

- (i) Different gases have different contributions to global warming.

State **two** factors that affect the contribution of a greenhouse gas to global warming.

.....  
.....  
.....  
..... [2]

- (ii) Outline **two** methods that could be developed to achieve carbon capture and storage, CCS.

.....  
.....  
.....  
.....  
..... [2]

[Total: 13]

- 7 There is much international concern that an increase in atmospheric concentrations of carbon dioxide and methane may lead to global warming and climate change.

**(a)** Carbon dioxide and methane are both greenhouse gases.

- (i) What type of radiation is absorbed by methane molecules and what effect does this radiation have on these molecules?

..... [2]

- (ii) Some scientists are more concerned about carbon dioxide as a greenhouse gas than methane.

Suggest why.

.....

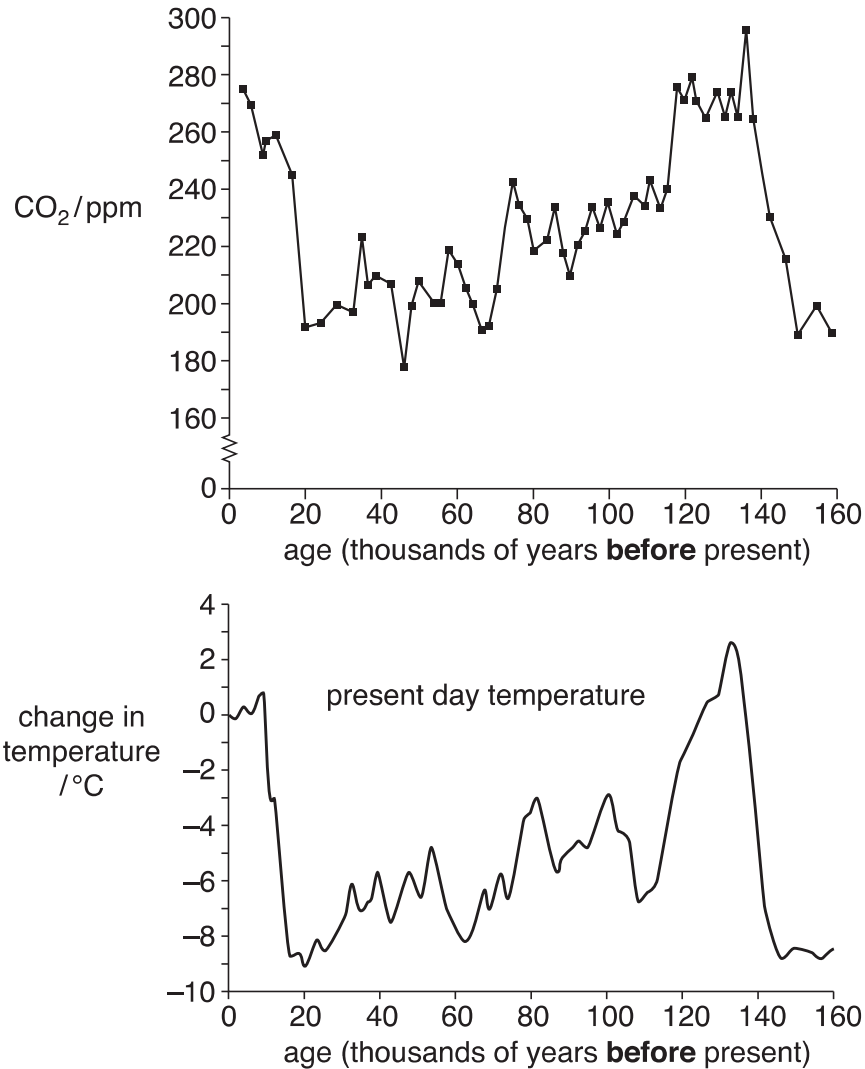
..... [1]

- (b)** Describe ways that research chemists are trying to minimise climate change resulting from global warming caused by the release of greenhouse gases.

..... [5]

- (c) Research scientists working in the Antarctic have measured the concentration of carbon dioxide in the ice. This study has allowed the scientists to estimate the atmospheric concentration of carbon dioxide over many thousands of years.

The graphs below show these atmospheric concentrations and the corresponding average surface temperature.



Do the graphs provide reliable evidence that an increase in atmospheric carbon dioxide concentration will result in global warming?

Explain your answer.

.....

.....

.....

.....

.....

..... [2]

[Total: 10]

END OF QUESTION PAPER