**A. Fuels: Crude oil, hydrocarbons and fractional distillation**

1. What is the formula of an alkane with eight hydrogens? Draw its structural formula. (2)

 ***C3H8 [1]***

  [1]

1. Describe what crude oil is. (4)

 ***Any four from -***

***Crude oil is a finite resource [1]; containing mixture [1] of hydrocarbons [1]; fossil fuel [1]***

1. Give the name and formulae for the first two alkanes in the homologous series. (2)

 ***Methane CH4 [1]***

 ***Ethane C2H6 [1]***

1. Name three of the fractions separated in fractional distillation. (3)

 ***Any three from:***

***Petrol, diesel oil, kerosene, heavy fuel oil, liquefied petroleum gases (LPG) [3]***

1. Explain how fractional distillation separates these fractions. (4)

***Fractions evaporate [1] at different boiling points [1] these condense [1] at different points in the column [1]***

1. Hydrocarbons in crude oil vary in their size. Describe how increasing molecular size of hydrocarbons alters the boiling point, viscosity and flammability of hydrocarbons. (3)

***Increasing size, increases boiling point [1], increases viscosity [1] and decreases flammability [1]***

1. Explain what is meant by the term ‘homologous series’. Give examples using alkanes. (5)

***Any 5 from:***

***Have same general formula [1] CnH2n+2 [1], differ by CH2 in molecular formulae from neighbouring compounds [1] any two examples e.g. CH4 and C2H6 [1], show gradual variation in boiling points [1], have similar chemical properties [1]***

**B. Fuels: Combustion and pollution**

1. Describe what happens to the carbon and hydrogen atoms in a hydrocarbon during combustion. (3)

***Bonds between carbon and hydrogens break [1] bonds between carbons and carbons break [1] both carbon and hydrogen are then oxidised [1] forming carbon dioxide and water [1]***

1. Write the balanced symbol equation for the complete combustion of pentane gas C5H12 (3)

***C5H12 (g) + 8O2 (g) 5CO2 (g) + 6H2O (g)***

***Correct formulae [1]***

***Correct balancing [1]***

***Correct state symbols [1] / allow (l) for water as the state symbol***

1. **Extended response question:**

Carbon monoxide, sulfur dioxide and particulates may be produced from the combustion of fossil fuels. Describe and explain how each of these pollutants are produced. (6)

***Carbon reacts with oxygen to make carbon monoxide [1] there is a lack of oxygen [1]***

 ***Sulfur is present in small amounts in fossil fuels [1] it reacts with oxygen to make sulfur dioxide [1]***

 ***Particulates are solid particles [1] and unburnt hydrocarbons [1]***

1. Describe the problems caused by carbon monoxide, sulfur dioxide and particulates in the atmosphere. (3)

***Carbon monoxide is toxic/poisonous [1]***

***Sulfur dioxide cause respiratory problems/acid rain [1]***

***Particulates cause global dimming/health problems in humans [1]***

1. Hydrogen fuel cells are used on space craft to produce electricity. Give an advantage and a disadvantage of using hydrogen fuel cells on a space craft. (2)

***One advantage – no pollution/ water can be drunk by astronauts [1]***

***One disadvantage – hydrogen fuel takes a lot of space/explosive [1]***

1. Incomplete combustion of hydrocarbons can form carbon monoxide and soot. Explain why these are produced and the issues associated with carbon monoxide. (4)

***Carbon reacts with oxygen to make carbon monoxide [1] there is a lack of oxygen [1], soot is unreacted carbon [1], carbon monoxide is a toxic gas [1]***

**C. Fuels: Cracking**

1. The cracking of hydrocarbons can make alkanes and one other type of chemical. Name this chemical and describe a chemical test that could be used to identify between this chemical and the alkane. Give the positive test result as part of your answer. (3)

***Alkene [1] add bromine water [1] orange/brown to colourless [1]***

1. A scientist carried out an experiment to crack a hydrocarbon; here is the symbol equation for the reaction. The chemical that was cracked was C12H26 . One of the products was C2H4., what is the formula of the other product? (2)

***C10 [1] H22 [1]***

1. Explain why cracking is necessary. (4)

***Crude oil contains large hydrocarbons [1] do not flow easily/ difficult to ignite [1], often shortage of short chain useful hydrocarbons e.g. petrol [1], cracking used to break large hydrocarbons down into smaller more useful hydrocarbons [1]***

**D. Earth’s early atmosphere and changes in atmospheric gases**

1. Why is it difficult to predict the gases in the Earth’s early atmosphere? (2)

***4.6 billion years ago [1] limited evidence [1]***

1. **Extended response question:**

In the first billion years of the Earth’s atmosphere the main gases were carbon dioxide and water vapour.

Explain how these gases were released into the atmosphere and how they were removed from the Earth’s early atmosphere. (6)

***Volcanoes produced these gases [1]***

***Water vapour condensed [1] to form the oceans [1]***

***Carbon dioxide dissolved in the oceans [1] carbonates were precipitated [1] producing sediments [1]***

***Do not allow photosynthesis here.***

1. Which organisms produced oxygen in the early atmosphere? (2)

***Algae [1] plants [1]***

1. Write the balanced symbol equation for photosynthesis. (3)

***6CO2 + 6H20  C6H12O6 + 6O2***

***reactants [1] products [1] balancing [1]***

1. **Extended response question:**

Describe and explain how the amount of carbon dioxide in the atmosphere has decreased over the last 2.7 billion years. (6)

***Algae and plants [1] removed carbon dioxide by photosynthesis [1]***

***Formation of fossil fuels [1] trapped carbon [1]***

***Formation of sedimentary rock [1] trapped carbon in calcium carbonate [1]***

**E. The greenhouse effect and climate change; composition of today’s atmosphere**

1. Name two greenhouse gases. (2)

 ***Any two carbon dioxide/methane/water vapour***

1. Describe the greenhouse effect in terms of the wavelength of radiation and its interaction with matter. (4)

***Shorter wavelength visible light [1] is absorbed by the Earth [1] emitted as longer wavelength [1] absorbed by greenhouse gases [1]***

1. For each gas, name one way in which human activities increase the amount of carbon dioxide and methane in the atmosphere. (2)

 ***Carbon dioxide – burning fossil fuels/deforestation [1]***

 ***Methane – farming of livestock/landfills [1]***

1. Describe two potential effects of global climate change. (2)

***Any two from flooding/rising sea level/droughts/ice caps melting/desertification [2]***

1. The majority of the Earth’s atmosphere consist of two gases. Name these two gases and state the proportion of the atmosphere they inhabit. (4)

***Nitrogen [1] 80% [1]***

***Oxygen [1] 20% [1]***

1. Name two other gases in the Earth’s atmosphere. (2)

***Any two from carbon dioxide/water vapour/any named noble gas [2]***