2021 ASSESSMENT MATERIALS

GCSE
CHEMISTRY

Chemistry Test 4: Organic chemistry and Chemistry of the atmosphere (Higher)

Total number of marks: 38

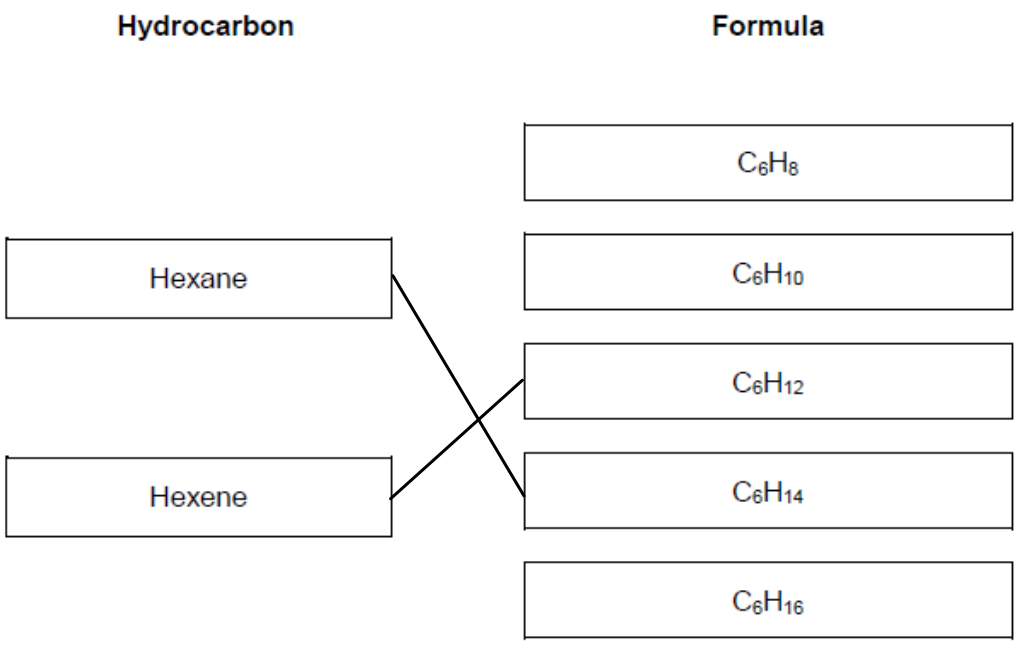
0 3 This question is about hydrocarbons.

Hexane and hexene are hydrocarbons containing six carbon atoms in each molecule.

Hexane is an alkane and hexene is an alkene.

0 3 . 1 Draw **one** line from each hydrocarbon to the formula of that hydrocarbon.

[2 marks]



0 3 . 2 Bromine water is added to hexane and to hexene.

What would be observed when bromine water is added to hexane and to hexene?

[2 marks]

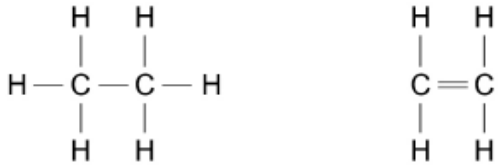
Hexane no change

Hexene the bromine water is decolourised

0 3 . 3 Ethane is an alkane and ethene is an alkene.

Figure 1 shows the displayed structural formulae of ethane and of ethene.

Figure 1



Ethane **Ethene**

Compare ethane with ethene.

You should refer to:

- their structure and bonding
- their reactions.

[6 marks]

Both ethane and ethene contain 2 carbon atoms, but ethane contains 2 more hydrogen atoms than ethene. Ethane also has one more covalent bond than ethene. Ethene has a double covalent bond between the carbon atoms whereas ethane has a single covalent bond between the carbon atoms. Both undergo combustion reactions to form carbon dioxide and water, but ethane forms more water molecules than ethene. Ethene also undergoes addition reactions with halides (e.g. bromine) whereas ethane does not. This is because the double bond is much more electron rich than the single bond.

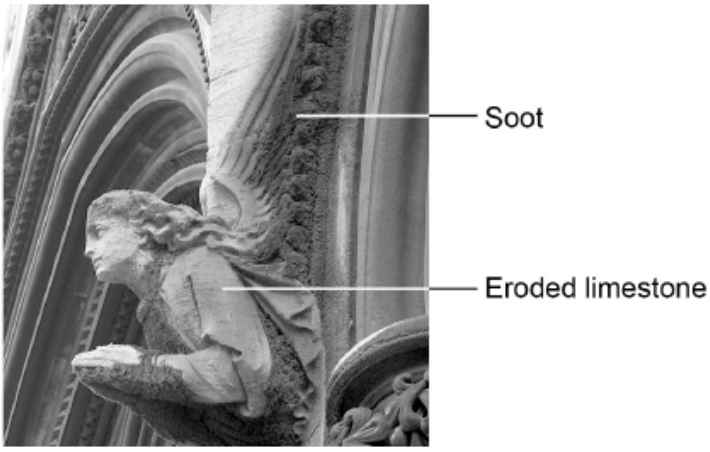
0 6 This question is about atmospheric pollution.

Figure 3 shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.

Figure 3



0 6 . 1 Explain why soot is formed when some fossil fuels are burned.

[2 marks]

Soot is carbon by itself, so when some fossil fuels are burned some compounds don't completely react with oxygen and unburned hydrocarbons remain.

0 6 . 2 Fossil fuels are burned in car engines.

Explain how reducing the amount of sulfur in fossil fuels reduces the erosion of limestone.

[4 marks]

when compounds containing sulfur are burned, the sulfur reacts with oxygen to form sulfur dioxide which reacts with water to form sulfuric acid (H_2SO_4), which is acid rain. Reducing the amount of sulfur in fossil fuels would reduce the amount of acid rain formed.

0 6 . 3 Oxides of nitrogen are atmospheric pollutants which are formed in car engines.

Explain why oxides of nitrogen are formed in car engines.

[2 marks]

Oxygen and nitrogen react at very high temperatures in car engines (much higher temperatures than usual).

0 6 This question is about polymers.

0 6 . 1 Name the monomer used to form poly(chloroethene).

[1 mark]

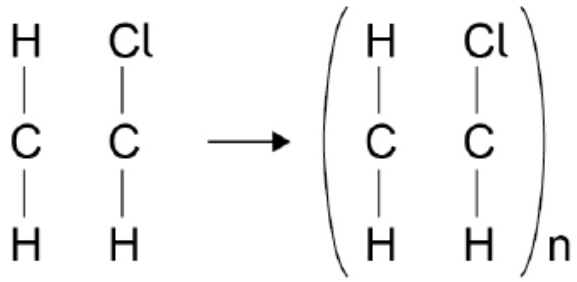
chloroethene

0 6 . 2 **Figure 8** shows the equation for the formation of poly(chloroethene).

Complete **Figure 8**.

[3 marks]

Figure 8



0 6 . 3 Poly(chloroethene) is the only product.

What type of polymer is poly(chloroethene)?

[1 mark]

addition polymer

Ethanediol reacts with butanedioic acid to produce a polyester and a small molecule.

0 6 . 4 **Figure 9** shows the structural formula of ethanediol.

Figure 9

$HO–CH_2–CH_2–OH$

Name the functional group present in ethanediol.

[1 mark]

Hydroxyl group (-OH)

0 6 . 5 **Figure 10** shows the structural formula of butanedioic acid.

Figure 10

$HOOC–CH_2–CH_2–COOH$

Which formula represents the carboxylic acid functional group?

[1 mark]

Tick **one** box.

$–CH_2–$ ☐

$–CH_2–CH_2–$ ☐

$–CH_2–COOH$ ☐

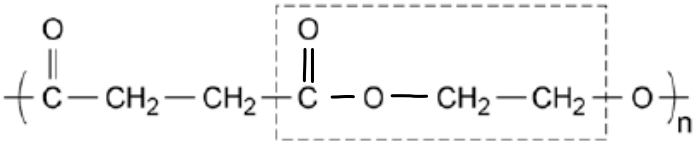
$–COOH$ ☑

0 6 . 6 **Figure 11** shows part of the structure of the polyester.

Complete the box in **Figure 11**.

[2 marks]

Figure 11



0 6 . 7 Name the small molecule produced when ethanediol reacts with butanedioic acid.

[1 mark]

water

Starch, proteins and DNA are naturally occurring polymers.

0 6 . 8 Name the monomers from which starch and proteins are produced.

[2 marks]

Starch sugars

Proteins amino acids

0 6 . 9 Describe the structure of DNA.

[2 marks]

double helix structure made up of many nucleotide monomer units with hydrogen bonds between the complementary bases.

each nucleotide consists of a phosphate group, a deoxyribose sugar and a nitrogenous base (A, T, C, G).

0 8 Titan is a moon of the planet Saturn.

Table 3 shows the percentages of the gases in the atmosphere of Titan.

Table 3

Gas	Percentage of gas in atmosphere (%)
Nitrogen	98.4
Methane	1.4
Other gases	0.2

0 8 . 1 Some scientists think that living organisms could have evolved on Titan.

Explain why these organisms could **not** have evolved in the same way that life is thought to have evolved on Earth.

Use **Table 3**.

[3 marks]

The atmosphere of Titan is comprised of mostly nitrogen (98.4%) and a small bit of methane, which would not have been suitable for the evolution of photosynthesising plants (which need carbon dioxide for photosynthesis) and animals (which need oxygen produced from photosynthesis to respire).

0 8 . 2 Saturn has other moons.

The other moons of Saturn have no atmosphere.

Titan is warmer than the other moons of Saturn because its atmosphere contains the greenhouse gas methane.

Explain how this greenhouse gas keeps Titan warmer than the other moons of Saturn.

[3 marks]

The presence of greenhouse gases in Titan's atmosphere means the greenhouse effect takes place similarly to how it does on Earth:

Methane acts as a greenhouse gas by letting through long infrared radiation from the sun to Titan's surface, but then absorbing some of the short infrared radiation reflected from Titan's surface, therefore warming Titan.

The other moons do not absorb the infrared radiation hitting their surface.