

# HYDROCARBONS 2

**Q1.** Rapeseed oil can be used for cooking.

A label on a bottle of rapeseed oil stated:

Rapeseed oil is healthy because it is

- low in saturated fat
- high in poly-unsaturated fat.

Two students investigated if the statement was true. They found the following information about four oils.

|                                 | Rapeseed oil | Sunflower oil | Olive oil | Corn oil |
|---------------------------------|--------------|---------------|-----------|----------|
| <b>Saturated fat (%)</b>        | 6.6          | 12.0          | 14.3      | 14.4     |
| <b>Mono-unsaturated fat (%)</b> | 59.3         | 20.5          | 73.0      | 29.9     |
| <b>Poly-unsaturated fat (%)</b> | 29.3         | 63.3          | 8.2       | 51.3     |
| <b>Melting point (°C)</b>       | 5            | -18           | -12       | -15      |

**(a)** Does this information support the two claims made on the label? Explain your answers.

**(i)** 'Rapeseed oil is low in saturated fat.'

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(1 mark)

**(ii)** 'Rapeseed oil is high in poly-unsaturated fat.'

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(1 mark)

**(b)** Rapeseed oil contains unsaturated fats. How could the students test the oil to show that it contained unsaturated fats?

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(2 marks)

Rapeseed oil can be hardened by reacting it with hydrogen.

**(c)** What would happen to the melting point of rapeseed oil if it was hardened?

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(1 mark)

**Q2.** Ethene is produced by cracking the hydrocarbons in the naphtha fraction.

**(i)** Balance the symbol equation for this reaction.



(1 mark)

**(ii)** Describe how cracking is carried out.

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(2 marks)

**Q3.** Fuels are substances that release energy.

**(i)** Name the reaction that releases energy from a fuel such as gasoline (petrol).

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(1 mark)

(ii) Describe how fuel oil is broken down into smaller, more useful molecules such as gasoline (petrol).

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(2 marks)

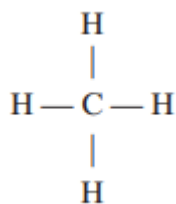
**Q4.**

(a) The table gives the name and formula for each of the first three alkanes. Complete the table to show the formula of butane.

| Name of alkane | Formula                       |
|----------------|-------------------------------|
| Methane        | CH <sub>4</sub>               |
| Ethane         | C <sub>2</sub> H <sub>6</sub> |
| Propane        | C <sub>3</sub> H <sub>8</sub> |
| Butane         |                               |

(1 mark)

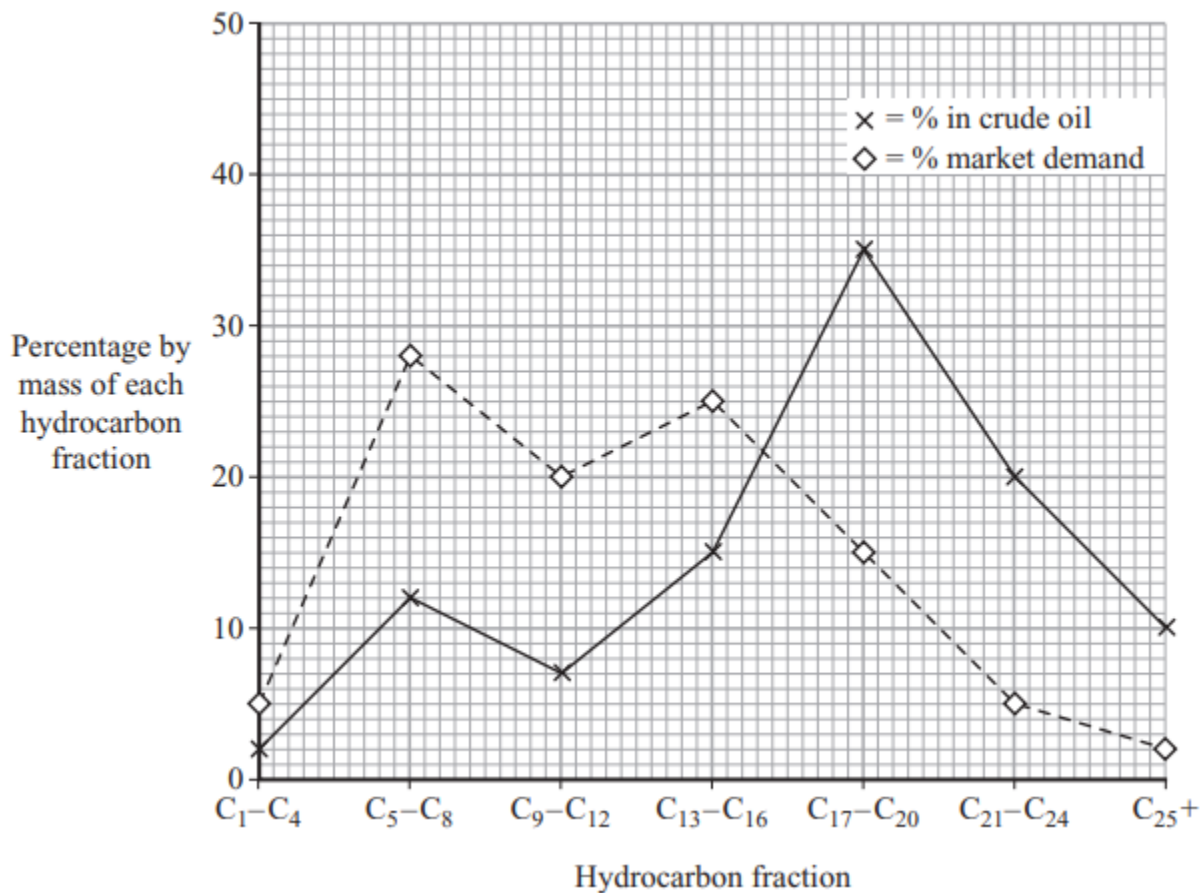
(b) The structural formula of methane, CH<sub>4</sub>, is:



Draw the structural formula of propane, C<sub>3</sub>H<sub>8</sub>

(1 mark)

(c) The relative amounts of and the market demand for some hydrocarbons from the fractional distillation of crude oil are shown in the graph.



(i) Why is the market demand for the C<sub>5</sub>-C<sub>8</sub> fraction higher than the market demand for the C<sub>21</sub>-C<sub>24</sub> fraction?

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(1 mark)

(ii) Cracking is used to break down large hydrocarbon molecules into smaller hydrocarbon molecules.

Complete the symbol equation by writing in the formula of the other hydrocarbon.



(1 mark)

(iii) The  $C_5$ – $C_8$  fraction has low supply and high market demand. Suggest three ways in which the oil industry could overcome this problem.

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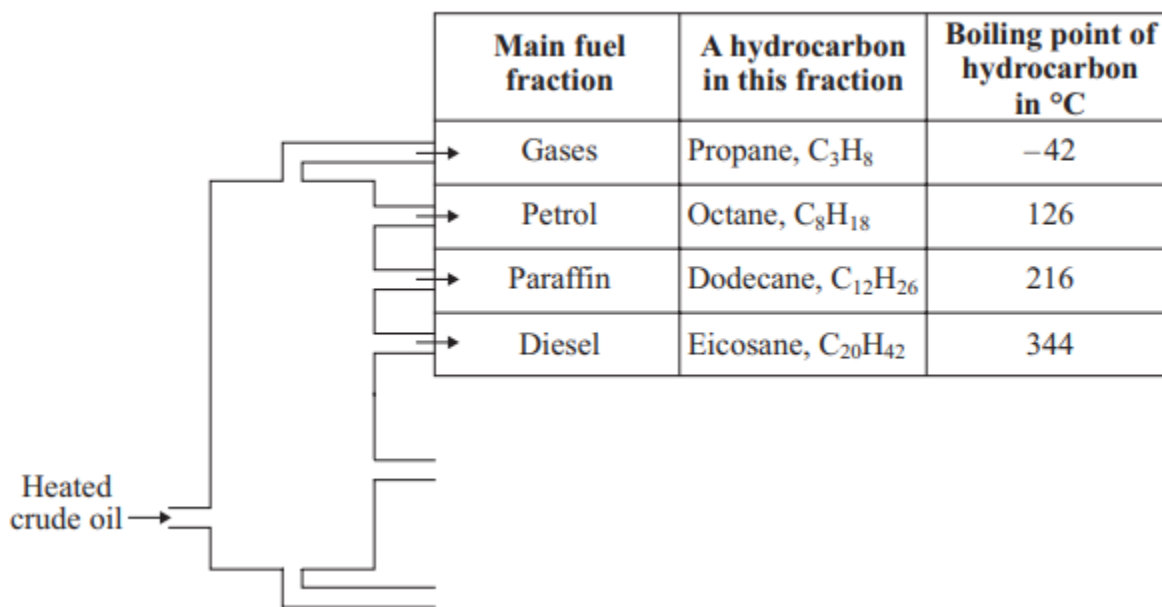
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(3 marks)

**Q5.** Crude oil is a resource from which fuels can be separated.

(a) The name of the main fuel fractions and one of the hydrocarbons in each fraction are shown in the table.



(i) How does the number of carbon atoms in a hydrocarbon affect its boiling point?

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(1 mark)

(ii) Suggest the lowest temperature to which crude oil needs to be heated to vaporise all the hydrocarbons in the table.

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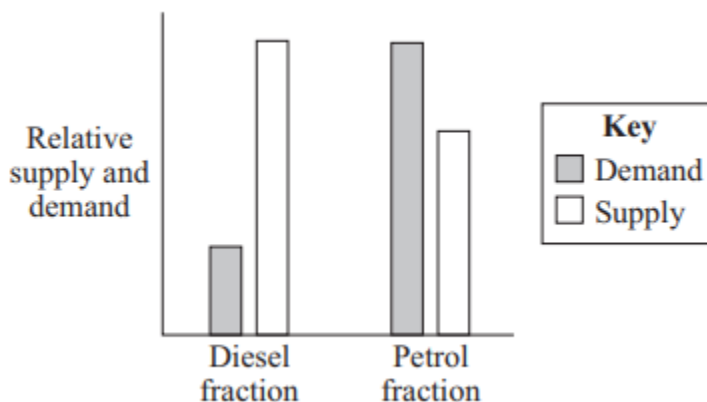
(1 mark)

(iii) Dodecane boils at 216 °C. At what temperature will dodecane gas condense to liquid?

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(1 mark)

(b) The bar chart shows the relative supply and demand for the petrol and diesel fractions.



(i) How does the relative supply and demand for petrol and diesel fractions cause problems for an oil company?

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(2 marks)

(ii) Suggest one way an oil company could solve these problems.

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(1 mark)

**Q6.** An advert for some crisps claims that they now contain only 30% saturated fat because they are cooked in sunflower oil. The crisp company used bromine water to compare percentage unsaturation of sunflower oil with four other vegetable oils, A, B, C and D.

| Oil              | Volume of bromine water added until the bromine colour just remains (cm <sup>3</sup> ) |        |        |         | Percentage unsaturation (%) |
|------------------|--|--------|--------|---------|-----------------------------|
|                  | Test 1   | Test 2 | Test 3 | Average |                             |
| <b>Sunflower</b> | 25.4   | 28.0   | 27.0   | 26.8    |                             |
| <b>A</b>         | 13.0   | 14.0   | 15.0   | 14.0    | 35                          |
| <b>B</b>         | 23.2   | 11.2   | 24.0   | 23.6    | 59                          |
| <b>C</b>         | 19.9   | 21.1   | 20.2   | 20.4    | 51                          |
| <b>D</b>         | 9.5  | 8.8    | 9.3    | 9.2     | 23                          |

(i) What is the range of percentage unsaturation for oils A, B, C and D?

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(1 mark)

(ii) The average for oil B is given as 23.6 cm<sup>3</sup>. Explain how this average has been calculated.

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(1 mark)

(iii) The results did not show that sunflower oil contains 30% saturated fat. Explain why. (You will need to calculate the percentage unsaturation of sunflower oil.)

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(2 marks)

**Q7.** Scientists state that unsaturated fats are healthier to eat than saturated fats.

The table shows some information about four fats.

| Fat | Fat content as a percentage (%) |           | Melting point in °C |
|-----|---------------------------------|-----------|---------------------|
|     | Unsaturated                     | Saturated |                     |
| A   | 80                              | 20        | -11                 |
| B   | 60                              | 40        | -5                  |
| C   | 30                              | 70        | +4                  |
| D   | 10                              | 90        | +63                 |

**(a)(i)** Which fat, A, B, C or D, has the lowest melting point?

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(1 mark)

**(ii)** Use the information in the table to describe the pattern between the percentage of unsaturated fat and the melting point.

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(1 mark)

**(iii)** Which fat, A, B, C or D, contains the smallest number of carbon carbon double bonds per gram?

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(1 mark)

**(b)** Fat A is reacted with hydrogen (hydrogenated). State one way in which the physical properties of Fat A are changed by this reaction.

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(1 mark)



(c) Tick (✓) one thing that scientists are not able to do.

| One thing that scientists are not able to do                          | Tick (✓) |
|---|----------|
| find out if a fat is unsaturated                                      |          |
| show that an unsaturated fat is healthier to eat than a saturated fat |          |
| stop people eating unhealthy fat                                      |          |
| change unsaturated fat to saturated fat                               |          |

(1 mark)

Total marks (33)