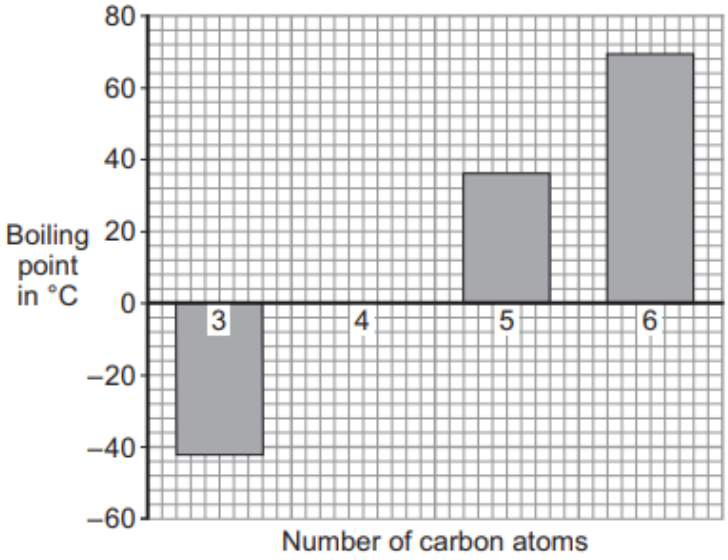
HYDROCARBONS 4

Q1. This question is about alkanes with 3, 4, 5 or 6 carbon atoms in their molecules.

The table shows the boiling points of these four alkanes.

Number of carbon atoms in a molecule of the alkane	3	4	5	6
Boiling point in °C	–42	0	36	69

The data in the table can also be shown in the diagram below.



(a) The diagram shows the data as a . . .

1 bar chart.

2 line graph.

3 pie chart.

4 scattergram.

(1 mark)

(b) The alkane with the highest boiling point has . . .

1 3 carbon atoms.

2 4 carbon atoms.

3 5 carbon atoms.

4 6 carbon atoms.

(1 mark)

(c) The alkane with 4 carbon atoms does not seem to be shown on the diagram.

This is because . . .

1 this is an anomalous result.

2 this alkane contains only hydrogen.

3 the boiling point of this alkane is 0 °C.

4 this alkane has the lowest boiling point.

(1 mark)

(d) The data shows that as the number of carbon atoms . . .

1 increases, the boiling point decreases.

2 decreases, the boiling point decreases.

3 increases, the boiling point stays the same.

4 decreases, the boiling point stays the same.

(1 mark)

Q2. This question is about crude oil and some of the alkanes that it contains. The table shows information about four of the fractions obtained from the distillation of crude oil.

Fraction	Boiling point in °C	Number of carbon atoms in the molecules of the alkanes in the fraction
Gases	Lower than 25	1–4
Petrol	25–60	4–11
Naphtha	60–180	7–14
Kerosene	180–222	11–15

(a) Which of the following is the likely boiling point for the alkane with twelve hydrogen atoms?

1 -16 °C

2 36 °C

3 76 °C

4 186 °C

(1 mark)

(b) Which of the following statements about the distillation of crude oil is correct?

1 It produces more alkanes than were in the original mixture.

2 It will not use up the world's fuel supplies.

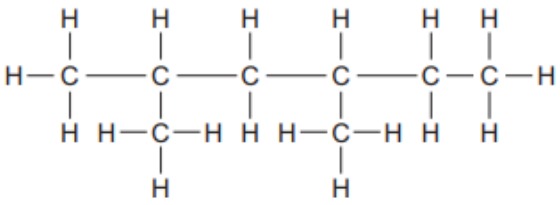
3 It will contribute to global warming.

4 It is a continuous process that could go on for ever.

(1 mark)

(c) Which of the following hydrocarbons would give the same number of molecules of carbon dioxide on complete combustion as octane C_8H_{18}?

1



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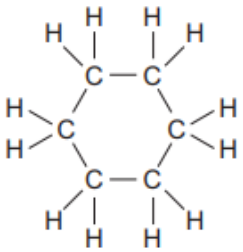

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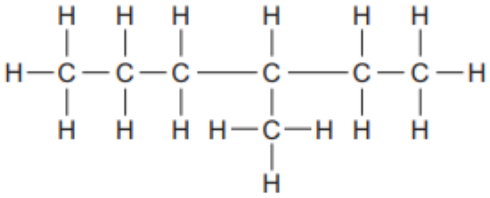

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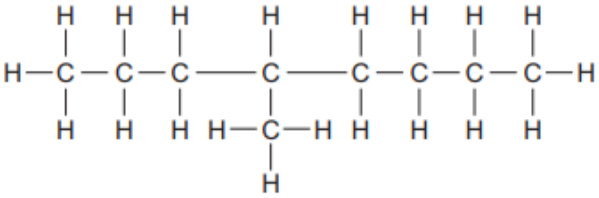


(1 mark)

(d) Hexane is the sixth member of the alkanes.

Which of the following could not be calculated from this information about its position in the alkane series?

1 its chemical formula

2 the number of water molecules produced by burning one molecule of hexane

3 the number of bonds in one molecule of hexane

4 the number of carbon monoxide molecules produced by the incomplete combustion of one molecule of hexane

(1 mark)

Q3. The table shows some information about four alkanes, A, B, C and D.

	Name of alkane	Formula of alkane	Melting point in °C	Boiling point in °C	Amount of oxygen, in cm^3, needed to completely burn 100 cm^3 of the alkane
A	Methane	CH_4	–182	–164	200
B	Ethane	C_2H_6	–183	–89	350
C	Propane	C_3H_8	–190	–42	500
D	Butane	C_4H_{10}	–138	–1	650

Match alkanes, A, B, C and D, with the numbers 1– 4 in the table below.

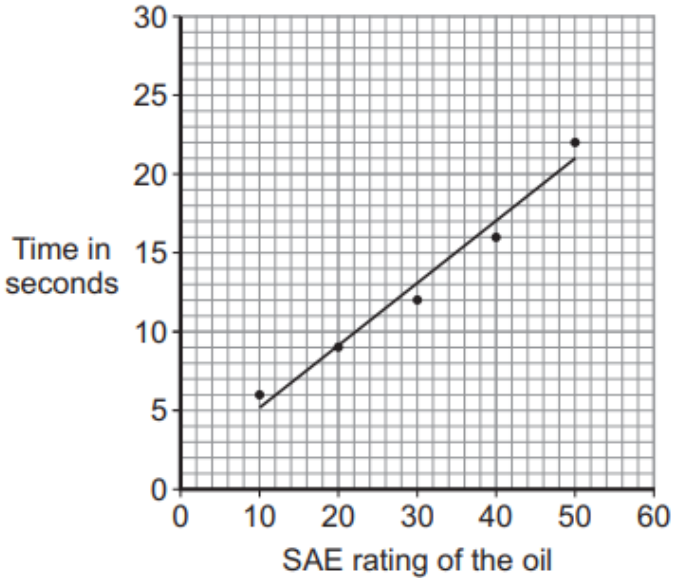
1	This alkane has the lowest melting point.
2	This alkane has the smallest molecules.
3	The boiling point of this alkane is similar to the melting point of ice.
4	10 cm^3 of this alkane requires 35 cm^3 of oxygen to burn completely.

(4 marks)

Q4. This question is about the viscosity of engine oils. Viscosity is a measure of how easily a liquid will flow. The less viscous a liquid is, the more easily it will flow. The viscosities of engine oils are given a rating by the Society of Automotive Engineers (SAE rating). A student investigated the viscosity of oils with different SAE ratings. She poured a fixed volume of an oil of SAE 10 into a funnel with a narrow spout and started a stopwatch. She measured how long it took for all of the oil to flow out of the funnel. She repeated the experiment with four different oils.

Here are her results.

SAE rating	Time in seconds
10	6
20	9
30	12
40	16
50	22



(a) The experiment shows that . . .

1 an SAE 15 oil would take 15 seconds to flow through the funnel.

2 the SAE 40 oil takes twice as long to flow through the funnel as SAE 20 oil.

3 all five oils have a similar viscosity.

4 viscosity increases as the SAE rating increases.

(1 mark)

(b) The reliability of the results could be improved . . .

1 by using a larger funnel.

2 by repeating each test.

3 by using a smaller volume of oil.

4 by using oils with lower SAE ratings.

(1 mark)

(c) Three months later, the student did the same experiment in the same laboratory, using samples of the same oils.

She found that all the oils took longer to flow through the funnel. This could be because . . .

1 long oil molecules break into shorter ones when they are stored.

2 the laboratory was at a lower temperature.

3 she had used a funnel with a wider spout.

4 she started the stopwatch only when the oil started to drip out.

(1 mark)

(d) The student was unsure about the trend shown by the line of best fit through her points. This is because . . .

1 a curve passing through all the points is always better than a straight line.

2 the points on her graph were plotted incorrectly.

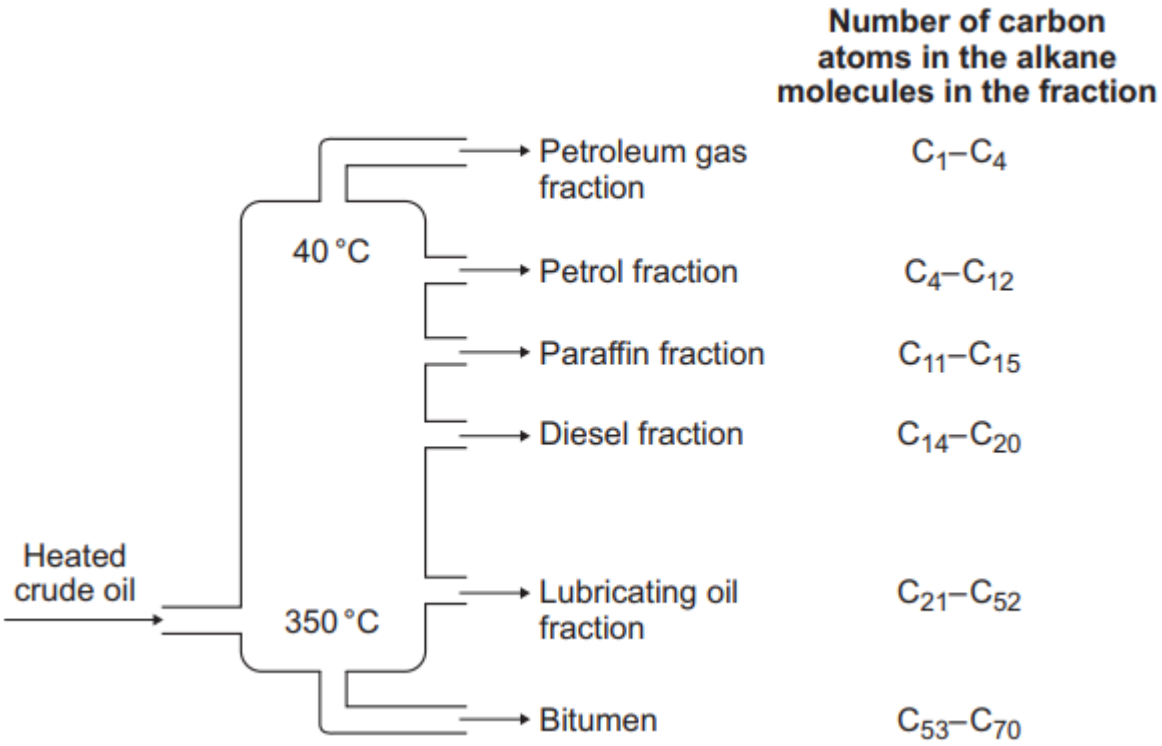
3 none of the points lies on the line.

4 she did not have enough oils to show whether the line should be curved or straight.

(1 mark)

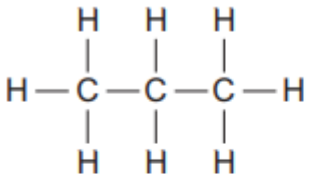
Q5. Crude oil can be separated into fractions.

Each fraction contains several alkanes.



(a) One of the alkanes in the petrol fraction can be represented by

1



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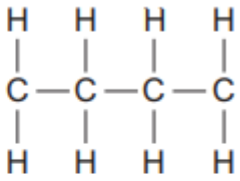

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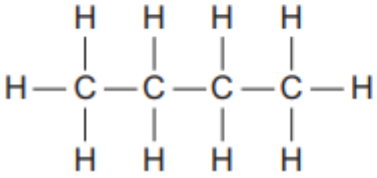

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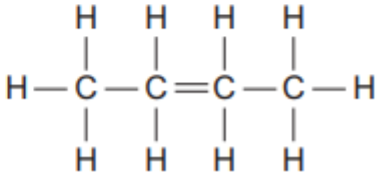

(1 mark)

(b) When compared with the alkanes in the petrol fraction, the alkanes in the lubricating oil fraction . . .

1 will be more difficult to ignite.

2 will burn with a cleaner flame.

3 will have lower boiling points.

4 will have smaller molecules.

(1 mark)

(c) The alkane called nonane has 20 hydrogen atoms in each molecule. In which fraction will it be mainly collected?

1 Petroleum gas fraction

2 Petrol fraction

3 Diesel fraction

4 Lubricating oil fraction

(1 mark)

(d) Which of these gases cannot be produced when a pure alkane burns?

1 carbon monoxide

2 carbon dioxide

3 sulfur dioxide

4 water vapour

(1 mark)

Q6. Petrol and diesel are the fuels used for most cars. Several companies are researching the use of hydrogen as a fuel for cars, instead of petrol or diesel.

Hydrogen can be used to power fuel cells. In a fuel cell, hydrogen is chemically combined with oxygen to generate electricity to run the car.

Hydrogen can be produced from natural gas or from water.

(a) There are several reasons why this research is being carried out.

Which of the following is not one of the reasons?

1 There could be a shortage of petrol and diesel in the future.

2 There is political pressure to increase the number of cars on the road.

3 Petrol and diesel are obtained from a non-renewable source.

4 There is political pressure to reduce carbon emissions.

(1 mark)

(b) One reason why there are only a few hydrogen-powered cars on the road is that . . .

1 the raw materials to make hydrogen are scarce.

2 only water is produced when hydrogen burns.

3 fuel cell technology has been difficult to develop.

4 hydrogen-powered cars are made by only a few companies.

(1 mark)

(c) The development of hydrogen as a fuel for cars could be delayed even further if . . .

1 new, large deposits of crude oil are discovered.

2 a safe way of storing hydrogen is found.

3 hydrogen can be made more cheaply.

4 global warming continues to be a concern.

(1 mark)

(d) The very rare and expensive metal called palladium is capable of storing many hundreds of times its own volume of hydrogen.

Which statement would be true if palladium was used in hydrogen-powered cars?

1 The increased demand for palladium would cause its price to fall.

2 Hydrogen that had been stored in palladium would have a lower density.

3 Hydrogen that had been stored in palladium would be hard to burn.

4 The cars would be safer than those that store hydrogen in pressurised cylinders

(1 mark)

Total marks (24)