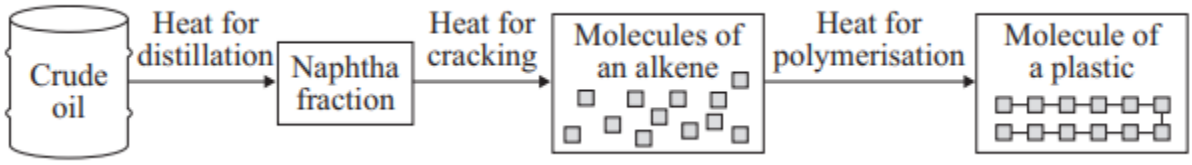
SEPARATION TECHNIQUES 2

Q1. To make a plastic, such as poly(ethene), from crude oil involves many processes.



(a) Describe how crude oil is separated into fractions.

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(2 marks)

(b) The table shows some information about four of the fractions from crude oil that are used as fuels.

Fraction	Boiling point in °C	Number of carbon atoms found in the molecules
Gasoline (petrol)	20–200	5–10
Kerosene (paraffin)	180–260	10–16
Diesel	260–340	14–20
Fuel oil	370–600	20–70

Use the information in the table to help you to answer these questions.

(i) How can you tell that each of the fractions is a mixture?

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_____

(1 mark)

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

_____

_____

(1 mark)

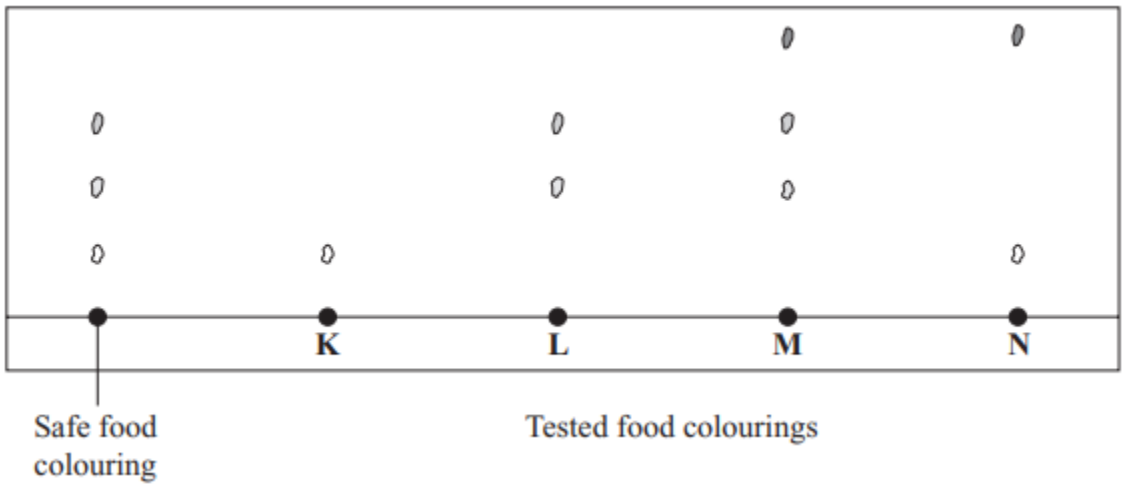
Q2. This information was taken from a label on a packet of crisps.

Main ingredients:
Potatoes, vegetable oil, Worcester sauce flavour, colourings, flavourings, salt.

Nutritional information (per 100 g):

Energy	2040 kJ
Protein	6.5 g
Carbohydrate	55 g
of which sugars	3 g
Fat	27 g
of which saturates	9 g
unsaturates	18 g
Fibre	4.5 g
Sodium	1.2 g

The crisp manufacturer had to remove these crisps from sale because they contained Worcester sauce flavour. The Worcester sauce flavour was found to contain the artificial colouring called Sudan 1, which is known to cause cancer. The diagram shows how the dyes in the colourings were detected and identified.



(i) What is the name of the process that is used to detect and identify the dyes in colourings?

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(1 mark)

(ii) Which food colouring, K, L, M or N, is made up of a single dye?

_____

(1 mark)

(iii) Which of the food colourings K, L, M and N are safe to use?

_____

(1 mark)

(iv) Explain how you can tell that each of the five food colourings is different.

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_____

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_____

(2 marks)

Q3. The nutrition label is from a pack of smoked salmon.

Typical values	Per 100 g	Per 50 g portion
Energy kJ	695	350
kcal	165	85
Protein g	22.3	11.2
Carbohydrate g	3.2	1.6
of which sugars g	0.1	0.05
Fat g	7.1	3.6
of which saturates g	1.7	0.9
monounsaturates g	2.5	1.3
polyunsaturates g	2.4	1.2
Fibre g	0.5	0.3
Sodium g	1.30	0.70
Equivalent as salt g	3.2	1.6

Guideline Daily Amounts Recommended by nutrition professionals for average adults			
	Per 50 g portion	Woman	Man
Calories	85	2000	2500
Fat g	3.6	70	95
Salt g	1.6	6	6

Some farmed salmon have a coloured additive in the food that they are given. This is a permitted additive that improves the colour of the fish meat.

A sample of the colour is extracted from a salmon. Explain how paper chromatography could be used to confirm that this is the permitted additive.

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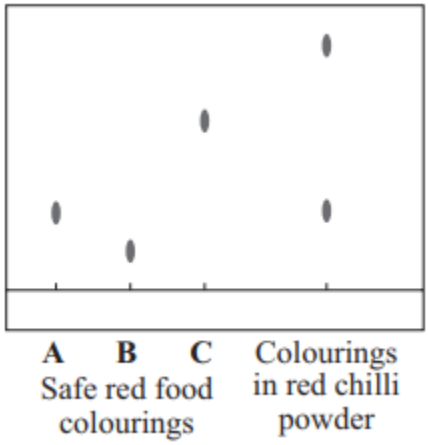
(3 marks)

Q4. Additives in some crisps include red chilli powder.

Sudan 1 is a bright red dye and is thought to cause cancer. In 2005, it was used to add more colour to a large batch of chilli powder. This batch of chilli powder was used by many food companies. The contaminated foods were removed from sale and destroyed.

A crisp manufacturer tested its chilli powder to check that it did not contain Sudan 1. The result of the test is shown below.



Explain how this test needs to be modified to show that the chilli powder does not contain Sudan 1.

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(2 marks)

Q5. Read the article.

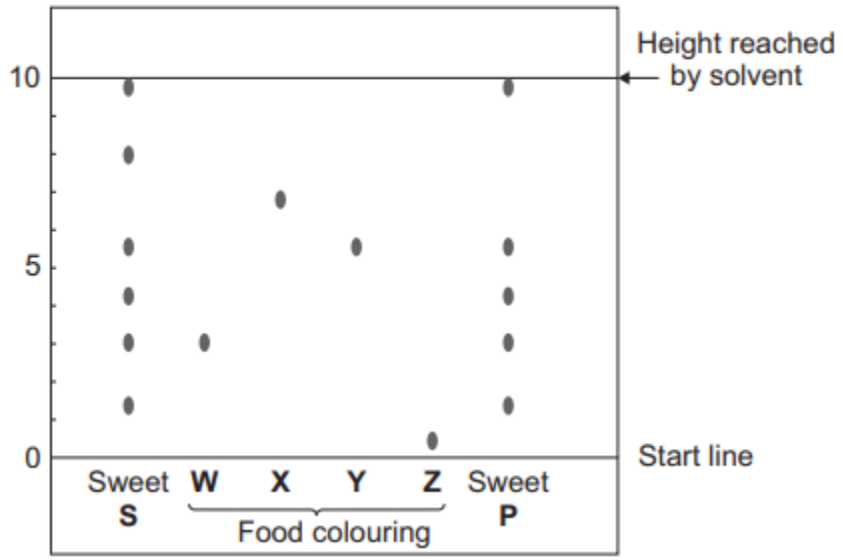
Problem food colourings

Scientists say they have evidence that some food colourings cause hyperactive behaviour in young children.

These food colourings are added to some sweets.

W, X, Y and Z are food colourings that may cause hyperactive behaviour in young children.

A scientist used chromatography to see if these food colourings were used in two sweets, S and P. The results are shown on the chromatogram.



(a) Food colourings, such as W, X, Y and Z, are added to some sweets. Suggest one reason why.

_____

_____

(1 mark)

(b)

$$\text{In chromatography, the } R_f \text{ value} = \frac{\text{distance moved by the colouring}}{\text{distance moved by the solvent}}$$

Use the scale on the chromatogram to help you to answer this question. Which food colouring, W, X, Y or Z, has an R_f value of 0.7? ☐

(1 mark)

(c) From the chromatogram, what conclusions can the scientist make about the colourings in sweets S and P?

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(3 marks)

Q6. Known crude oil reserves are being used up rapidly. Crude oil is used to produce many useful fuels, such as petrol. One way to conserve crude oil reserves would be to increase the production of bio-fuels. Ethanol can be produced for use as a bio-fuel. Cars can be powered by ethanol or ethanol–petrol mixtures. Sugar cane can be fermented to give a mixture of water (boiling point 100 °C) and ethanol (boiling point 78 °C).

How can ethanol be separated from water?

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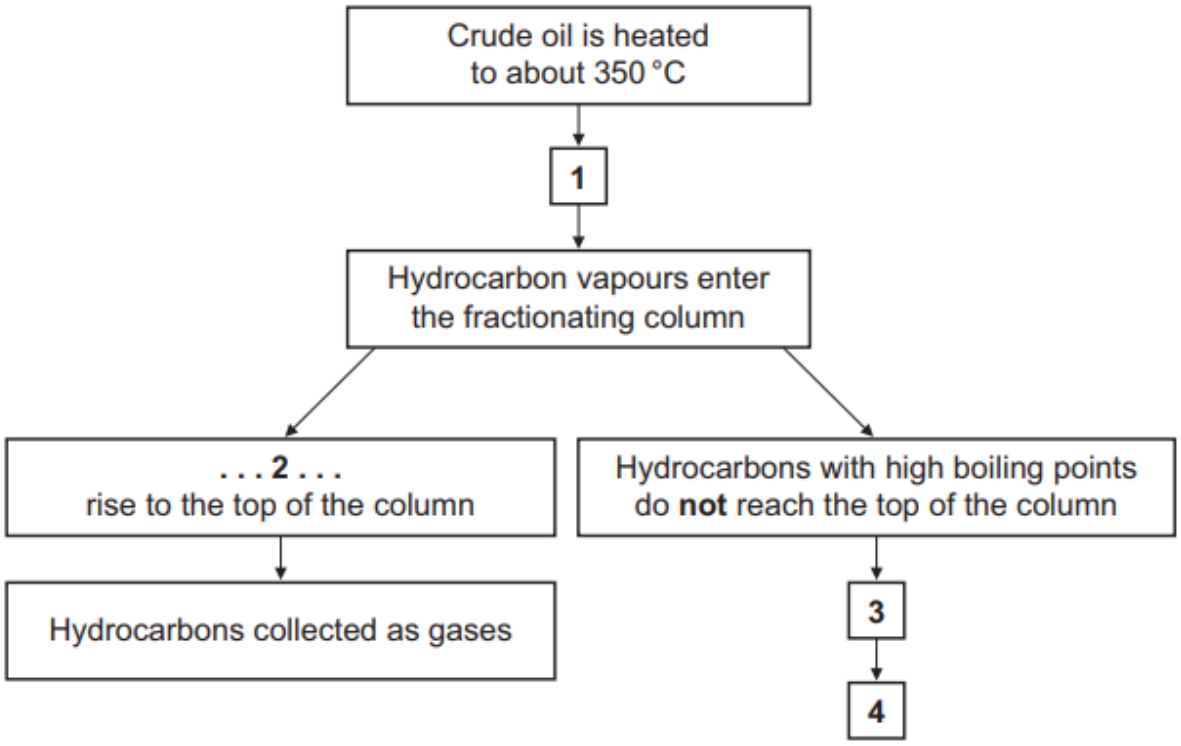
(1 mark)

Q7. The flow chart shows stages in the fractional distillation of crude oil.



Match statements, A, B, C and D, with the numbers 1– 4 in the flow chart.

A Hydrocarbons turn to vapour

B Hydrocarbons cool

C Hydrocarbons with low boiling points

D Hydrocarbons condense to form liquids

(4 marks)

Q8. This question is about fractional distillation of crude oil.

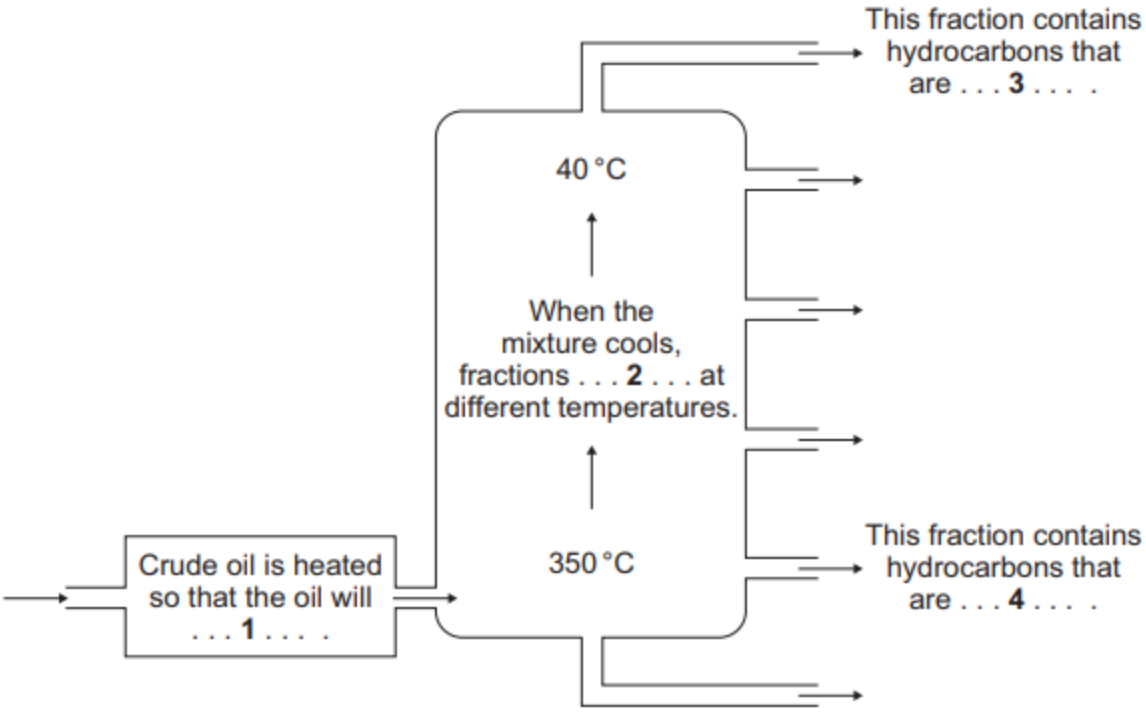
Match words, A, B, C and D, with the numbers 1– 4 in the sentences on the diagram.

A condense

B vaporise

C viscous

D volatile



(4 marks)

Total marks (28)