

Question 28 (8 marks)

Some students were given a large container of hot water and three identical cans, except that one was painted white, one blue and one black.

They were asked to design and conduct an experiment to see how the colour of the can affected the rate at which water it contained cooled down.

- (a) The table shows one student's equipment list.

Complete the last row of the table to show the other piece of equipment needed to collect results for the experiment and its reason for use.

<i>Equipment</i>	<i>Reason for use</i>
• Cans	• To hold hot water
• Beaker	• To measure volume of water
• Large container	• To store hot water
• Stopwatch	• To measure time
•	•

- (b) One of the pieces of equipment used in the student's experiment should have been replaced by a different piece.

- (i) Which piece should be replaced and what should it be replaced by?

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- (ii) Explain your answer.

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- (c) Except for colour, the cans are identical. Name ONE other factor that would need to be controlled in this experiment.

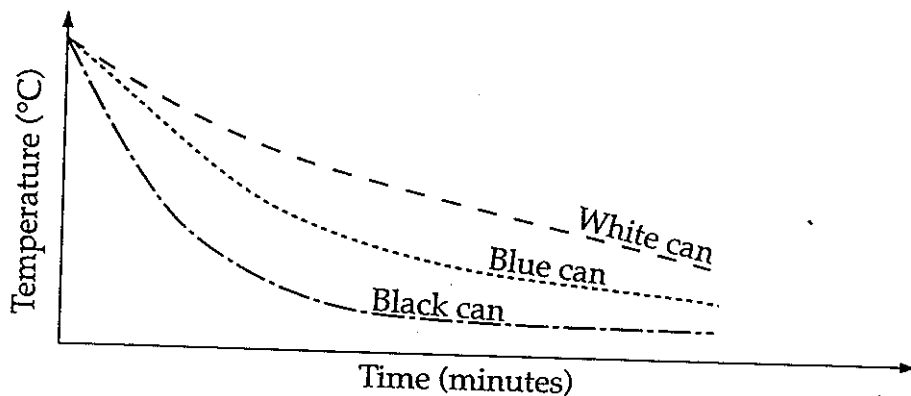
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- (d) Name the variable being tested.

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Question 28 (Continued)

(e) The graph shows the results of the student's experiment.



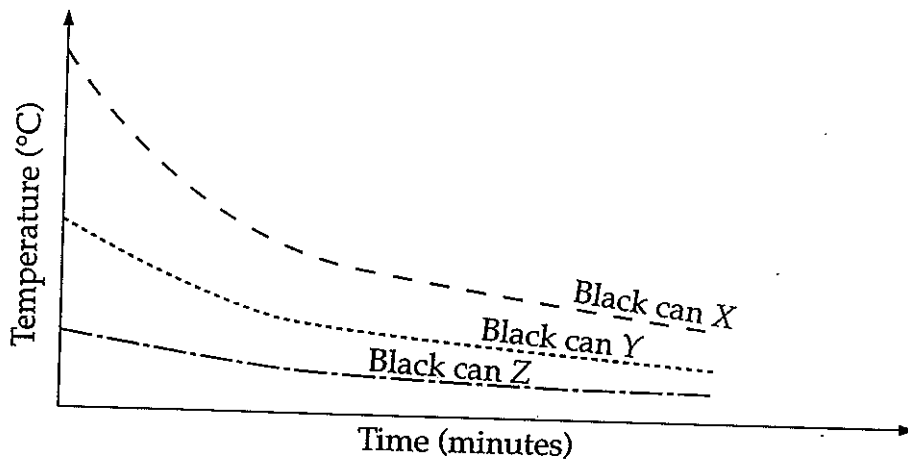
Write a conclusion for the experiment.

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(f) The experiment was repeated using three identical black cans X, Y and Z.



(i) What was the aim of the experiment?

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(ii) What do these results show?

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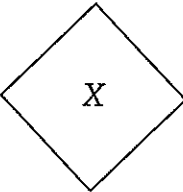
Question 29 (5 marks)

The information in the table below and the incomplete flowchart on page 25 relate to six chemicals (A–F) found in a farm shed.

<i>Chemical</i>	<i>Substance</i>	<i>Description</i>
A	Fertiliser	<ul style="list-style-type: none">• white solid• dissolves in water• reacts with sodium hydroxide
B	Snail bait	<ul style="list-style-type: none">• blue solid• dissolves in water• reacts with sodium hydroxide
C	Methylated spirits	<ul style="list-style-type: none">• clear liquid• dissolves in water• does not react with sodium hydroxide
D	Petrol	<ul style="list-style-type: none">• yellowy liquid• does not dissolve in water• does not react with sodium hydroxide
E	Acid	<ul style="list-style-type: none">• clear liquid• dissolves in water• reacts with sodium hydroxide
F	Washing soda	<ul style="list-style-type: none">• white solid• dissolves in water• does not react with sodium hydroxide

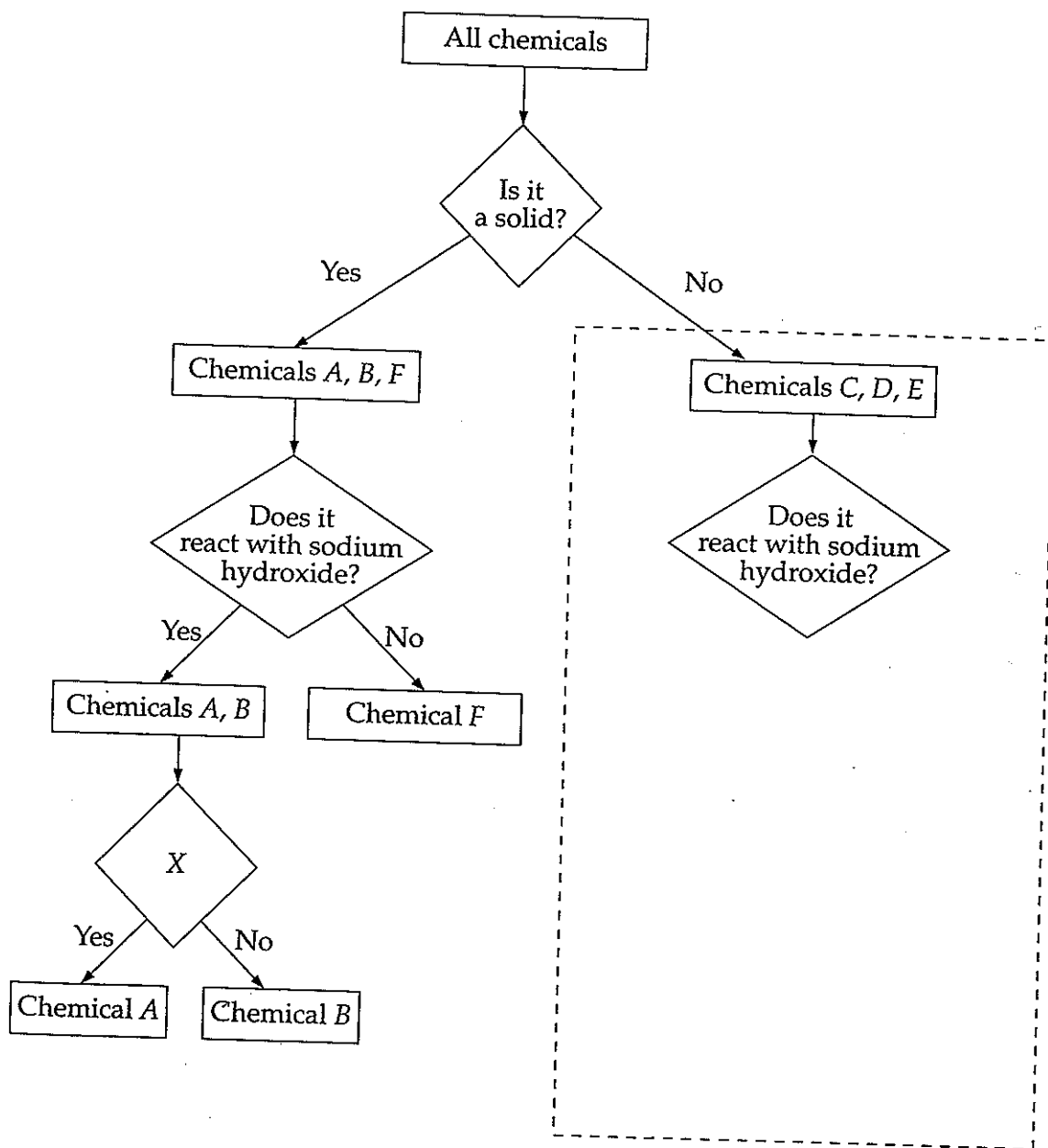
- (a) According to the information in the table, what chemical would you use to distinguish between methylated spirits and acid?
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Question 29 (Continued)

(b) What question should be asked in  on the flowchart?

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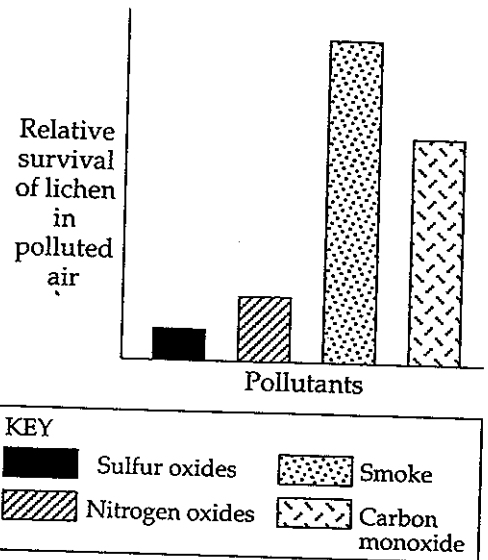
(c) Complete the flowchart below to identify chemicals C, D and E, by drawing and writing appropriate information inside the space indicated on the diagram.



Question 30 (4 marks)

The table and graph show some information about air pollution.

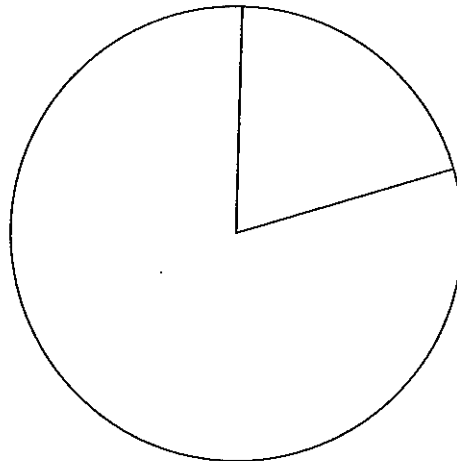
Pollutants	SOURCE OF POLLUTANTS		
	Power stations (%)	Road traffic (%)	Other sources (%)
Sulfur oxides	70	2	28
Nitrogen oxides	30	50	20
Smoke	25	25	50
Carbon monoxide	1	90	9



- (a) Half of all smoke pollution comes from sources other than power stations and road traffic. Name ONE other major source of smoke pollution.
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- (b) Use data from the table to complete the sector (pie) graph for the percentage of nitrogen oxides produced by each source.

Label each sector of the graph.



- (c) Lichens are organisms that grow on rocks, trees and buildings. Very few lichens live near power stations, but they are often found alongside roads. Suggest the MAIN reason for this low occurrence near power stations.
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QUESTION 28. (7 marks)

Modern society depends heavily on metals. More than 60 metals are extracted from the earth and used. Each metal has its own properties which include strength, hardness, conduction of electricity and heat, resistance to corrosion, density, and chemical activity.

Some metals are used more than others. This depends on the properties of the metal and how much it costs. The cost depends on how abundant the metal is and how easily we can mine and refine the ore. The more chemically active a metal is, the faster it will corrode and the harder it is to extract from its ore.

Even though new reserves of metal ores are being found, supplies must eventually run out. There are two important ways we are trying to solve this problem:

- recycling
- using substitute materials.

The table shows information about some metals.

<i>Metal</i>	<i>Atomic symbol</i>	<i>World production (thousands of tonnes per year)</i>	<i>Density (g mL⁻¹)</i>	<i>Chemical activity</i>	<i>Estimated time known reserves will last (years)</i>
magnesium	Mg	300	1.7	Most active ↑ Least active	500+
aluminium	Al	15 700	2.7		260
zinc	Zn	9 000	7.1		150
chromium	Cr	6 000	7.1		100
iron	Fe	750 000	7.9		200
tin	Sn	800	7.3		100
lead	Pb	5 000	11.3		150
copper	Cu	12 000	8.9		40
silver	Ag	10	10.5		150
gold	Au	2	19.3		25

QUESTION 28. (Continued)

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;

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(ii) explain an advantage of making a car out of gold.

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(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

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(c) Use the information given, or your knowledge, to answer the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your answer.

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(ii) Suggest one reason why most of the copper we use is recycled.

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(iii) Suggest one reason why less than half of the iron we use is recycled.

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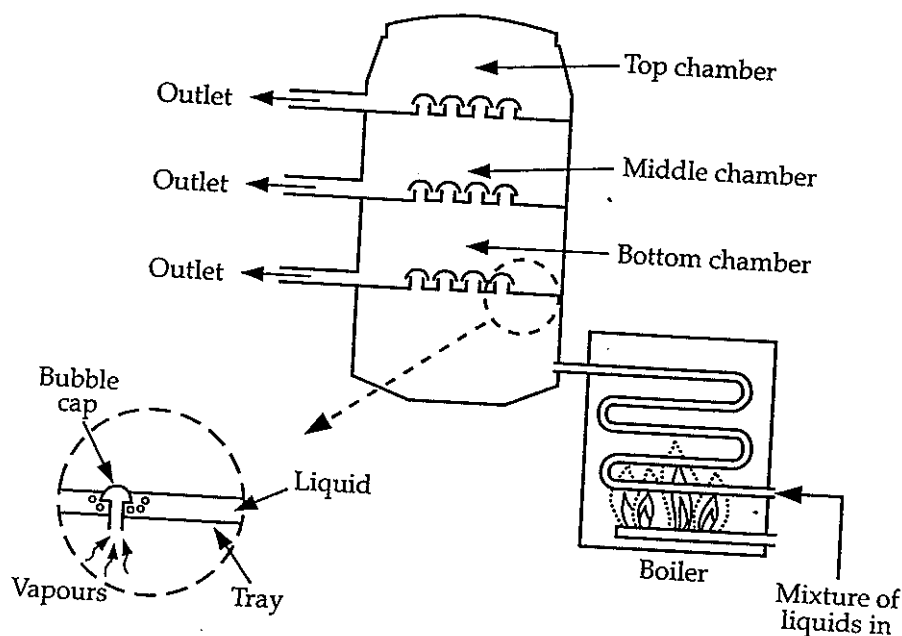
(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.

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QUESTION 29. (9 marks)

Fractional distillation is used to separate mixtures of liquids of different boiling points. The diagram shows a simple distillation column.



The mixture is added to the boiler and heated. Vapours formed pass into the column at the bottom where it is hottest. The vapours rise up the column passing from chamber to chamber through the bubble caps. The vapour condenses when it reaches a chamber where the temperature is lower than its boiling point. Liquids of different boiling points collect in different trays and are drawn off through the outlets.

A mixture of liquids *P*, *Q* and *R* is added to the boiler.

The boiling points of *P*, *Q* and *R* and the amount of each collected after one litre of mixture had been distilled are shown in the table.

Liquid	Boiling point (°C)	Amount collected (mL)
<i>P</i>	85	410
<i>Q</i>	54	240
<i>R</i>	67	350

QUESTION 29. (Continued)

- (a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

Chamber	Vapour
Top	
Middle	
Bottom	

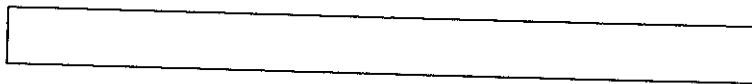
- (ii) What is the maximum temperature in the middle chamber for the column to work correctly?

.....°C

Explain your answer.

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- (iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order *P*, then *Q*, then *R*.



- (b) Is fractional distillation a physical or chemical change?

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Justify your answer.

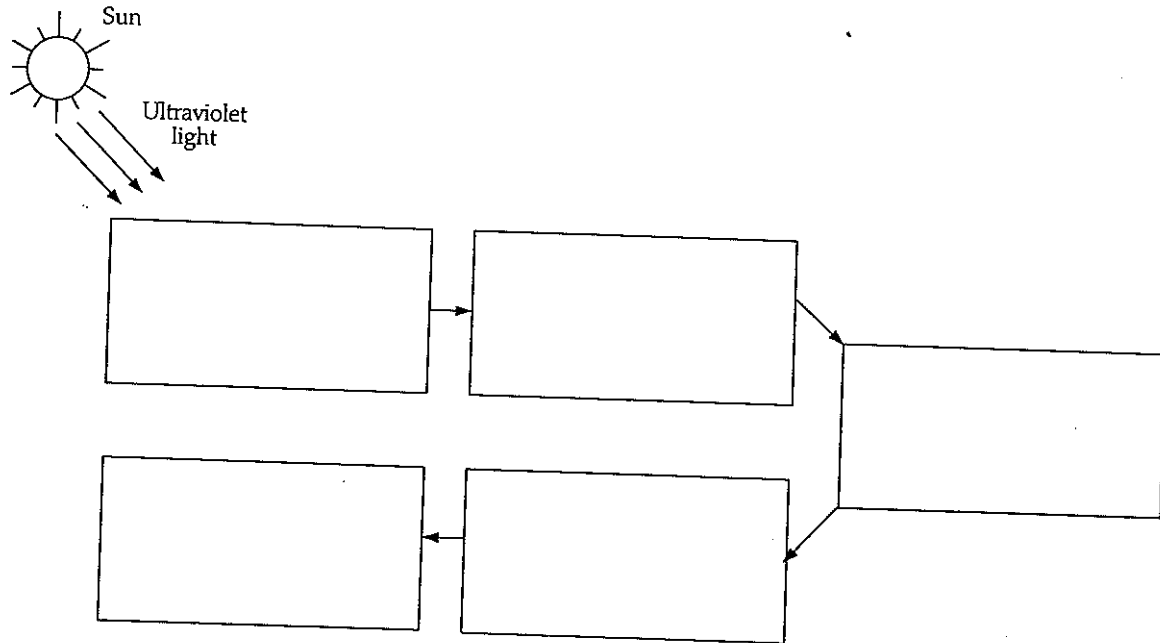
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QUESTION 26. (7 marks)

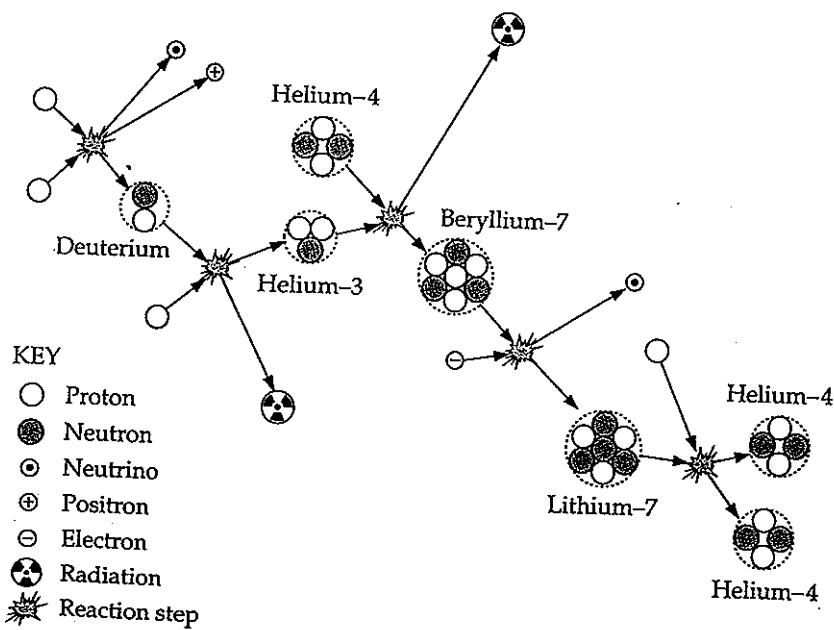
The Sun's Energy

The Sun is the source of energy for all living things at the Earth's surface. The first step in most food chains and cycles is the use of ultraviolet light from the Sun by plants in the process of photosynthesis. Plants produce sugars on which all other organisms ultimately depend.

a) Complete the diagram below representing a FOOD CHAIN.



The energy from the Sun is produced by a series of nuclear reactions. Part of the series of reactions is shown in the diagram below. It describes the five steps in the chain of reactions that produces helium-4 particles in the core of the Sun.



QUESTION 26. (Continued)

Refer to the diagram on the opposite page showing the chain of reactions.

(b) (i) What does a deuterium particle consist of?

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(ii) Describe the reactants and products in the third step in the chain of reactions.

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(iii) As part of a different chain of reactions occurring in the Sun, two helium-3 particles combine to form one helium-4 particle, two protons, and radiation. Using the same key, draw a diagram to represent this reaction.

