

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE
A173/01**

**TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A/FURTHER ADDITIONAL
SCIENCE A**

Module C7 (Foundation Tier)

WEDNESDAY 17 JUNE 2015: Morning

DURATION: 1 hour

plus your additional time allowance

MODIFIED ENLARGED 24pt

Candidate forename						Candidate surname				
Centre number						Candidate number				

**Candidates answer on the Question Paper.
A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:
A copy of the Periodic Table**

**OTHER MATERIALS REQUIRED:
Pencil
Ruler (cm/mm)**

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.

Use black ink. HB pencil may be used for graphs and diagrams only.

Answer ALL the questions.

Read each question carefully. Make sure you know what you have to do before starting your answer.

Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

The quality of written communication is assessed in questions marked with a pencil ().

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 60.

Any blank pages are indicated.

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Answer ALL the questions.

- 1 Large amounts of nitrogen gas in the air are turned into nitrogen compounds every year.
This is called ‘fixing’ the nitrogen.
It happens by different routes.**

The table shows how much nitrogen is fixed every year by each route.

Route for fixing nitrogen	Amount of nitrogen fixed in million tonnes per year
burning fuels	20
making chemicals in industry	50
lightning in thunderstorms	10
growing crops on farms	90
trees growing	50
plankton in the sea	35

- (a) Which route fixes the most nitrogen in a year?**

_____ **[1]**

- (b) One of these routes is the Haber process for making ammonia.**

Use the table to suggest how much nitrogen is fixed each year by the Haber process.

_____ **million tonnes [1]**

- (c) In the Haber process, nitrogen and hydrogen react.
Ammonia is the only substance made.**

Write a word equation for this reaction.

_____ **[1]**

- (d) The hydrogen needed for the Haber process is made in a separate reaction.**

Which TWO substances are needed for this reaction?

Put a tick (✓) in the box next to the correct answer.

hydrogen and steam

☐

natural gas and steam

☐

nitrogen and steam

☐

water and steam

☐

[1]

- (e) The UK makes 3000 tonnes of ammonia every day.
For every tonne of ammonia, 1.6 tonnes of carbon dioxide are made.
Half of this carbon dioxide can be captured.**

How much carbon dioxide can be captured each day?

_____ tonnes [2]

- (f) Most of the ammonia is used to make fertilisers.
Fertilisers are very useful, but can cause pollution.**

Suggest why fertilisers are useful and how they might cause pollution.

[2]

- (g) Nitrogen is also fixed by some plants.
They use bacteria in their roots.
These bacteria need different conditions from the Haber process.

Finish the sentences about the conditions for bacteria to fix nitrogen in plants.

Put ticks (✓) in the boxes next to the correct terms.

The bacteria work best at

high temperature	
room temperature	
low temperature	

and

high pressure.	
room pressure.	
low pressure.	

The bacteria use

acids	
alkalis	
enzymes	
iron	

as the catalyst.

[3]

- (h) The table shows some chemicals which are manufactured.
Chemicals such as ammonia are made on a large scale.
Some other chemicals are made on a small scale.

Put ticks (✓) in the boxes to complete the table.

CHEMICAL	LARGE SCALE	SMALL SCALE
food additives		
phosphoric acid		
sodium hydroxide		
fragrances for perfumes		

[2]

[TOTAL: 13]

- 2 Some 'green' buses use biodiesel which is a fuel that has been made from waste fats and cooking oil.
The fats and oils are esters.**

(a) Most oils are made by plants.

How do plants use the oils that they make?

Put a tick (✓) in the box next to the correct answer.

to give them energy

☐

to make them slippery

☐

to make them taste nasty

☐

to make them float in water

☐

[1]

(b) Most fats are made by animals.

The esters in animal fats are different from the esters in plant oils.

What is the difference between these esters?

Use words from the list to complete the sentence.

glycerol

saturated

fatty acid

unsaturated

Animal fats have mostly _____ molecules

and oils have mostly _____ molecules.

[2]

(c) A catalyst is used to turn the fats and oils into biodiesel. The usual catalyst is hot concentrated sodium hydroxide.

Scientists are investigating a new catalyst. The new catalyst is called an enzyme.

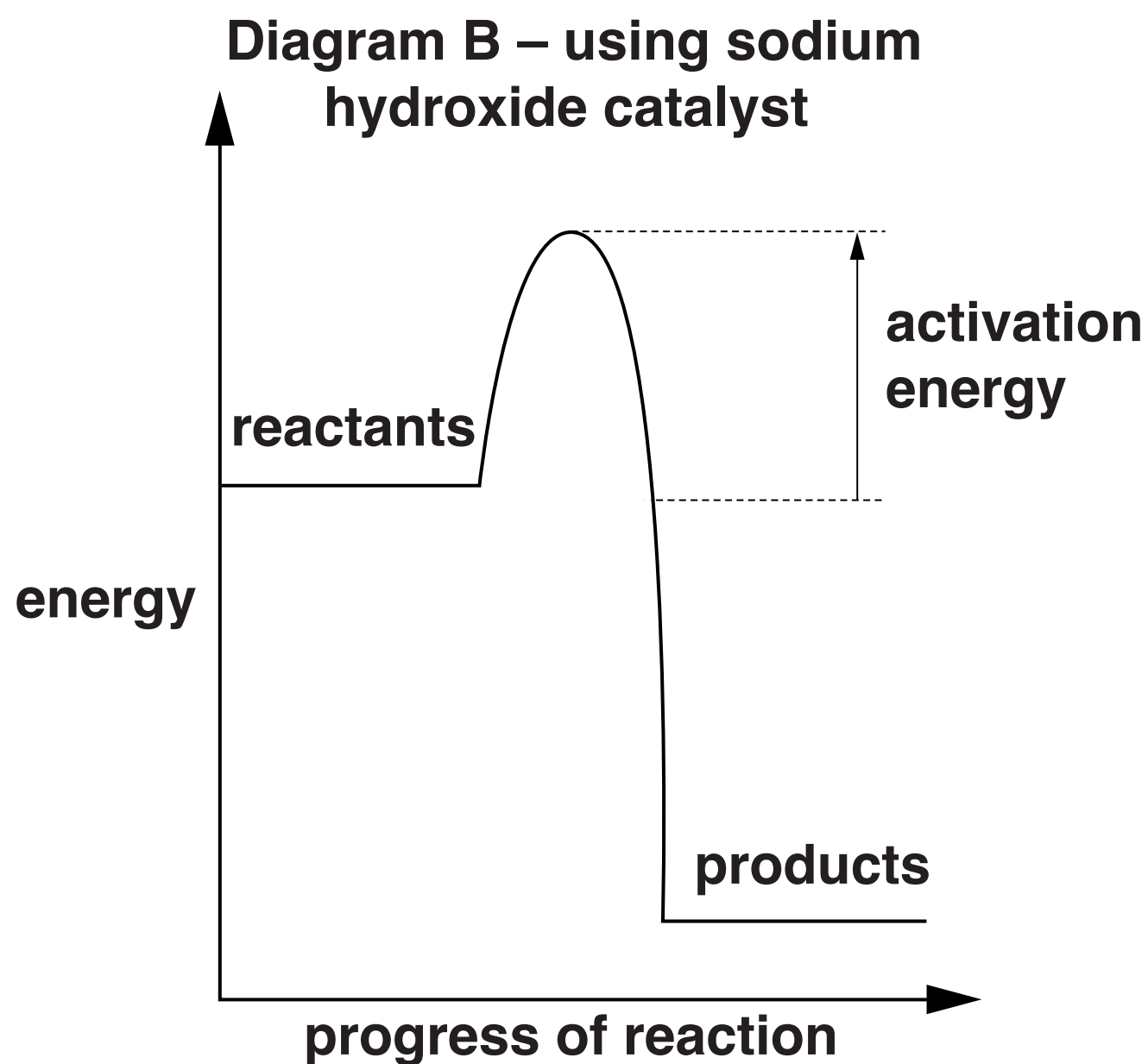
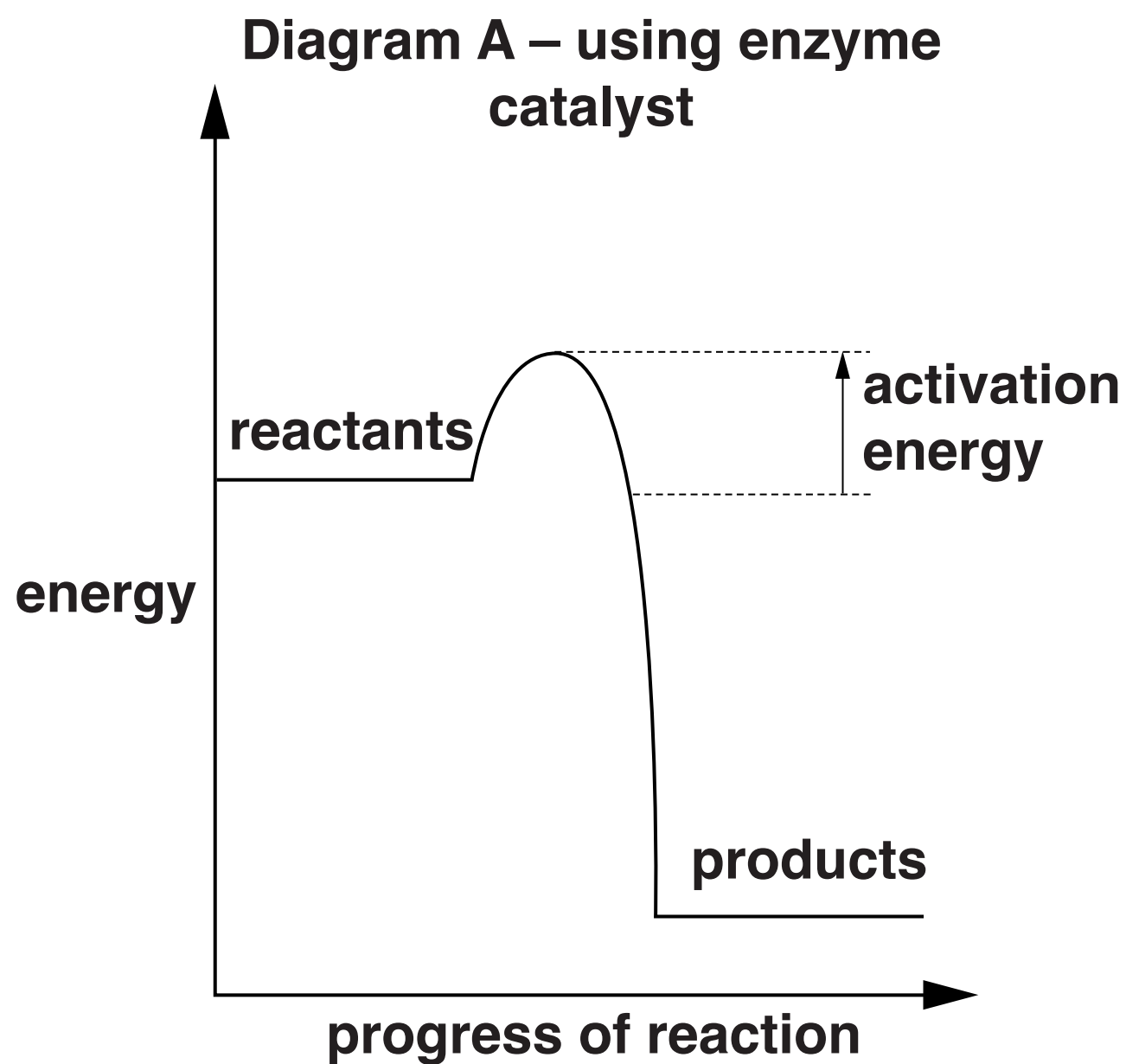
Here is some information about both catalysts.

FEATURES OF ENZYME	FEATURES OF HOT CONCENTRATED SODIUM HYDROXIDE
needs gentle heating	needs strong heating
easy to remove from the reaction mixture	dissolves in reaction mixture
speeds up this reaction only	speeds up other reactions which produce waste material
expensive	very cheap

Identify the ADVANTAGES and DISADVANTAGES of using the enzyme, and explain which catalyst is best.

[6]

(d) Scientists draw energy level diagrams for the reactions.



Give ONE similarity and ONE difference between the changes shown in these diagrams.

[2]

(e) The formula of one substance in biodiesel is $C_{19}H_{38}O_2$.

Biodiesel burns completely if there is plenty of air.

Suggest the TWO substances which are produced.

_____ and _____ [2]

[TOTAL: 13]

3 Fred investigates ethanoic acid.

(a) The formula of ethanoic acid is CH_3COOH .

(i) How many different elements are there in CH_3COOH ?

_____ **[1]**

(ii) How many atoms of carbon are there in the formula CH_3COOH ?

_____ **[1]**

(iii) Which part of the formula shows you that CH_3COOH is a carboxylic acid?

Put a **ring** around the correct answer.

CH_3

CO

OH

COOH

[1]

(iv) This acid is a weak acid. What does this mean?

Put a tick (✓) in the box next to the correct answer.

Its formula contains carbon, hydrogen and oxygen.

☐

It is more dilute than acids such as hydrochloric acid.

☐

It is less reactive than acids such as hydrochloric acid.

☐

It is more runny than acids such as hydrochloric acid.

☐

[1]

(v) Fred compares solutions of this weak acid with a strong acid of the same concentration.

How do the pH values of the two solutions compare?

Put a tick (✓) in the box next to the correct answer.

The weak acid has a higher pH.

☐

The weak acid has the same pH.

☐

The weak acid has a lower pH.

☐

The weak acid has a much lower pH.

☐

[1]

(b) Fred reacts the acid with ethanol to make an ester.

(i) Which of these is a property of esters?

Put a tick (✓) in the box next to the correct answer.

They are all solids.

☐

They give off purple fumes.

☐

They have distinctive smells.

☐

They have a distinctive colour.

☐

[1]

(ii) The equation for the reaction is

ethanoic acid + ethanol \rightleftharpoons ester + water

What does the symbol \rightleftharpoons tell you?

Put a tick (✓) in the box next to the correct answer.

The reaction is fast.

☐

The reaction is reversible.

☐

The reaction is exothermic.

☐

The reaction is hard to control.

☐

[1]

(iii) This type of reaction can reach equilibrium.

What happens when it is at equilibrium?

Put a tick (✓) in the box next to the correct answer.

Only reactants are present.

☐

Only products are present.

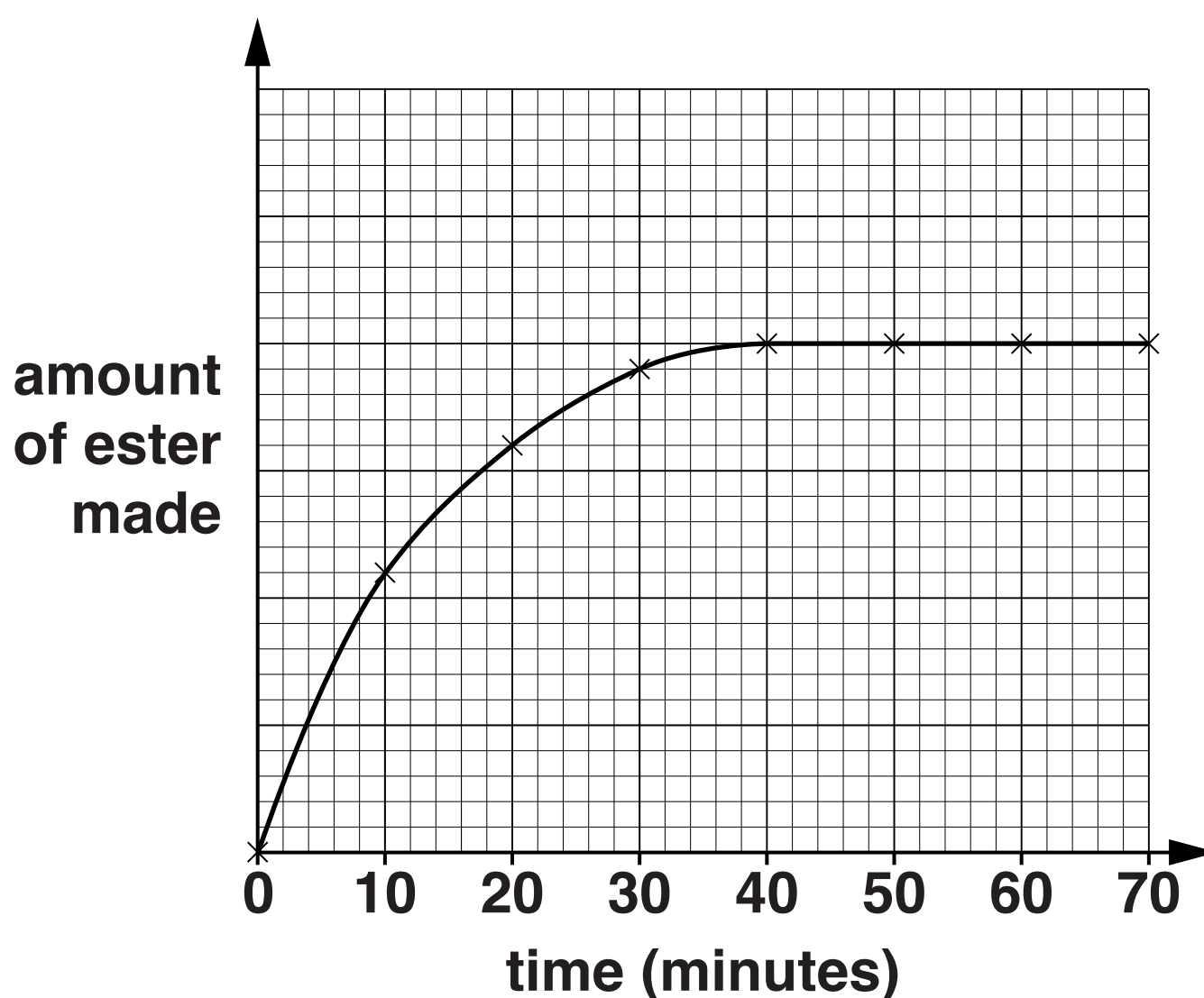
☐

Reactants and products are both present.

☐

[1]

(iv) Fred measures the amount of ester made in the reaction to see how it changes with time.



Use the graph to describe how the amount of ester changes.

[3]

(c) Fred needs to calculate the relative formula mass of ethanol to work out the overall yield of the reaction.

Calculate the relative formula mass of ethanol, C₂H₅OH.

In your answer, use the relative atomic masses from the Periodic Table.

_____ [1]

[TOTAL: 12]

4 When chemical engineers design an industrial process, they make it as sustainable as possible.
One of the things that they consider is the energy changes during the chemical reaction.

(a) During a reaction, chemical bonds are broken and new bonds are made.

Put ticks (✓) in the boxes to complete these sentences.

When chemical bonds are broken, energy is

taken in	
given out	
not needed	

.

When chemical bonds are made, energy is

taken in	
given out	
not needed	

.

If more energy is taken in than is given out the reaction is

endothermic	
exothermic	

.

Some energy is usually needed to start the reaction.

This energy is the

activation energy	
green energy	
geothermal energy	
energy output	

.

[3]

(b) The industrial processes are more likely to be sustainable if:

renewable chemicals are used

there are few by-products.

Explain what 'RENEWABLE' and 'BY-PRODUCTS' mean, and how they affect the sustainability of the process.



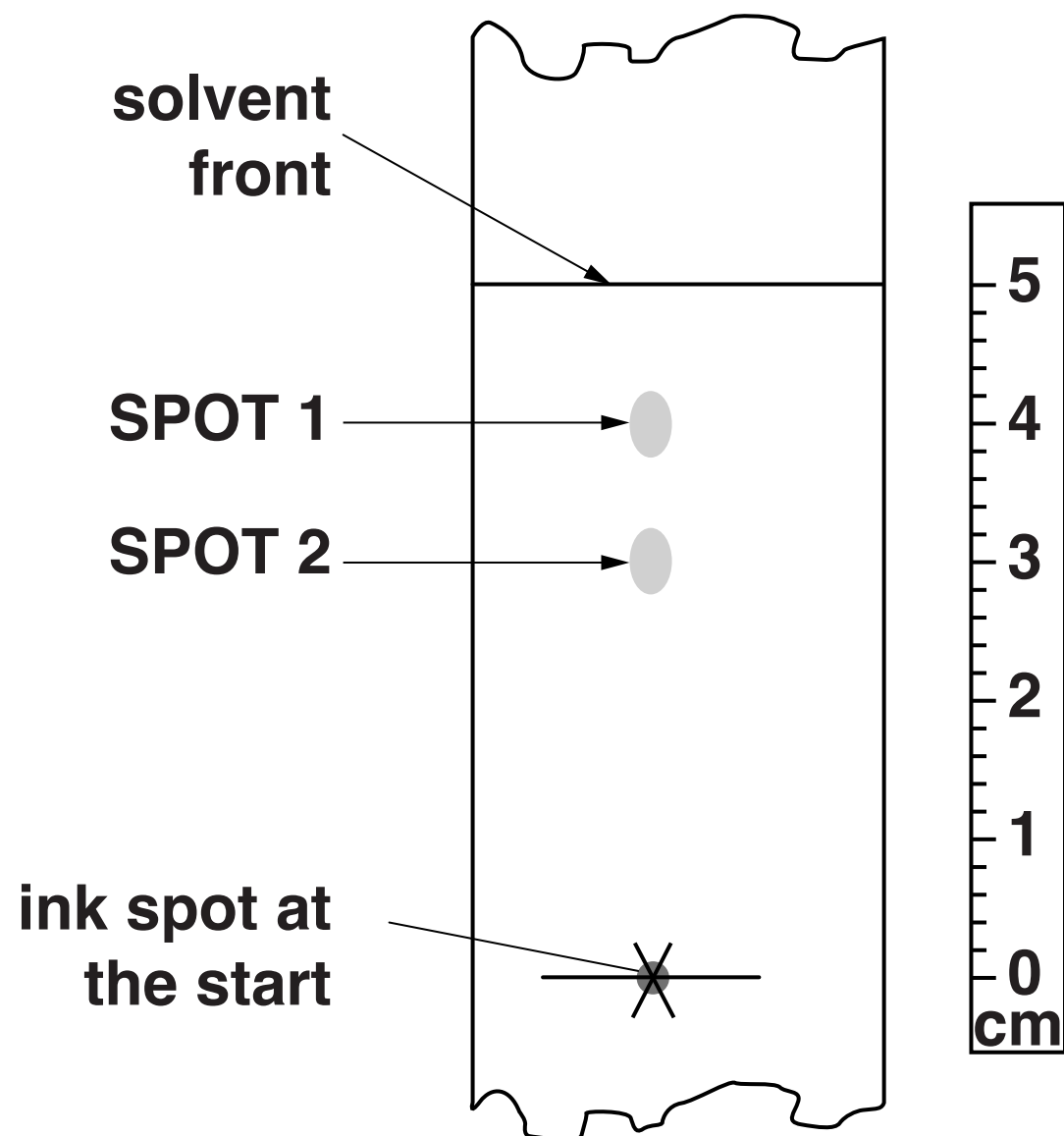
The quality of written communication will be assessed in your answer.

[6]

[TOTAL: 9]

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- 5 Ben uses paper chromatography to analyse the ink from his pen.
He puts the bottom of the paper in water and leaves it for a few hours.
The diagram shows his result.



- (a) Explain why there are two spots, and why SPOT 1 is higher than SPOT 2.**



The quality of written communication will be assessed in your answer.

[illegible]

- (b) Use this formula to calculate the *Rf* value for SPOT 1.**

$$Rf = \frac{\text{distance travelled by spot}}{\text{distance travelled by solvent}}$$

Show your working.

***Rf* for SPOT 1 = _____ [2]**

**(c) Sometimes when scientists do chromatography they have to use locating agents.
Explain why.**

[2]

**(d) A factory makes ink. The ink is made continuously throughout the day.
Chromatography is used to test samples of the ink.**

Jane says ‘Take 10 samples at 9 am and 10 samples at 1pm.’

Mike says ‘Take a sample every hour.’

Explain who has the best approach.

[3]

[TOTAL: 13]

END OF QUESTION PAPER