Year 11 Integrated Science

Task 6

Refining Rocket Fuel with Distillation

Name:		**Score:**	**/24**
Date:			

The move to greener fuel sources is progressing in an attempt to mitigate the damage to the environment due to an enhanced greenhouse effect. One of the main contributors to the enhanced greenhouse effect is the burning of fossil fuels as our primary source of energy.

Ethanol has been suggested as a sustainable fuel source in the future because it can be produced easily through the fermentation of sugars through yeast. The products of this reaction are an ethanol and water mixture. This reaction can produce ethanol at a maximum concentration of 15% ethanol by volume but a much higher concentration of ethanol is required for use as a fuel. For this reason, we need to separate the mixture and purify the ethanol.

Distillation is an extremely useful technique that is used to purify and separate liquid–liquid and liquid–solid mixtures. There are two common types of distillation – simple and fractional distillation. Simple distillation is used to separate the components of a liquid-liquid mixture if the boiling points of the liquids are very different (70°C). If the boiling points of the liquids are closer together, then fractional distillation should be used.

Our experiment involves separating a mixture of ethanol and water. The boiling points of these two liquids are 78°C and 100°C respectively. We are limited in the equipment we have available to us and will use simple distillation to extract ethanol to use as a fuel source.

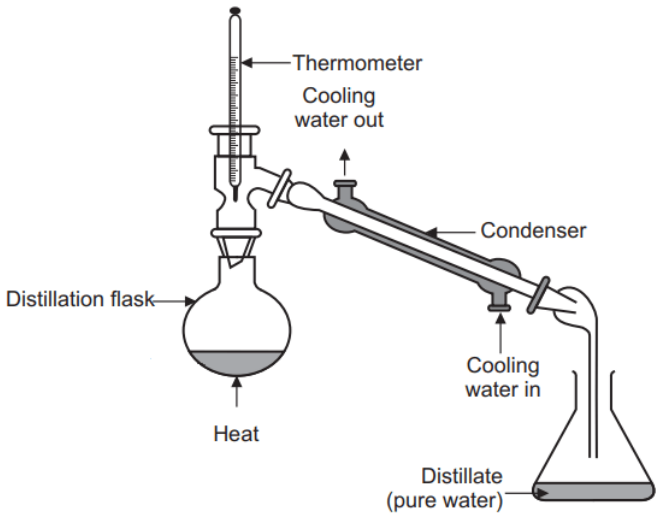


Figure 1: Apparatus

The following method was used:

i) The equipment was set up as per Figure 1.

ii) 100mL of impure mixture was added into the distilling flask and the rubber stopper and thermometer was placed on top.

iii) The ethanol-water mixture was slowly heated to the 78°C.

iv) The temperature of the ethanol-water mixture and the number of drops of distillate were recorded every two minutes.

Table of Results

Time (minutes)	Temperature of mixture (°C)	Drops of distillate
0	45	0
2	58	0
4	64	1
6	69	2
8	73	4
10	78	6
12	78	8
14	78	13
16	78	14
18	78	16
20	78	18
22	78	12
24	78	6
26	82	3
28	85	1

QUESTIONS

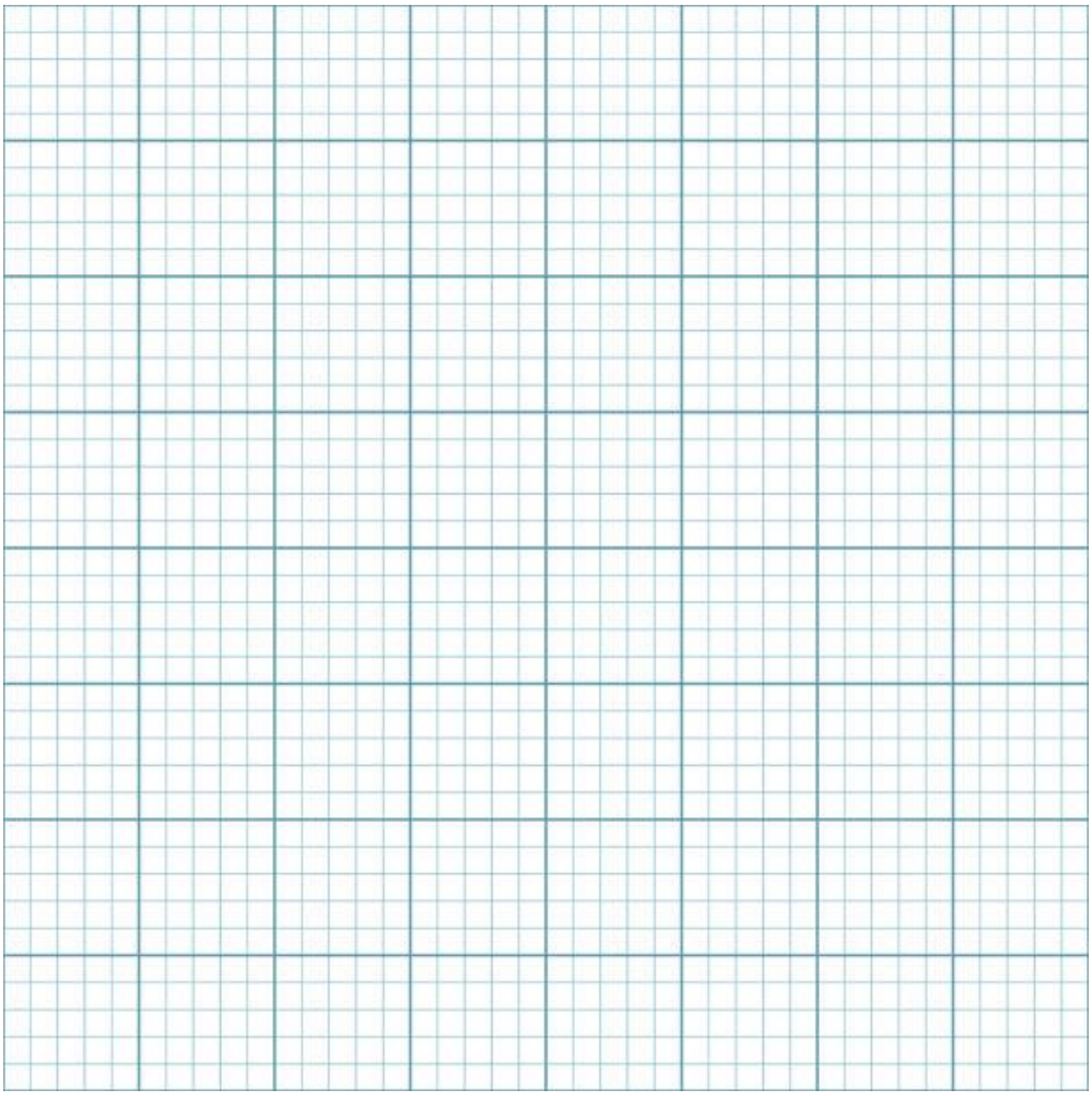
1) What is the aim of the experiment? (1 mark)

2) Describe the relationship between **temperature** and **drops of distillate.** (1 mark)

3) Why did the drops of distillate go down towards the end of the experiment? (1 mark)

4) Explain why the ethanol/water mixture stayed at 78^{o}C for majority of the experiment. (2 marks)

5) Create a graph of **time** and **temperature** using the data you have collected. (5 marks)



6) Give two reasons why a water bath was used for this experiment instead of a Bunsen burner. (2 marks)

a)

b)

7) Describe the process of distillation and explain why we can use the separation technique to purify our ethanol and water mixture. (4 marks)

8) Do you think that this distillation method was effective in separating ethanol and water? Explain with reference to the boiling points of ethanol and water. (2 marks)

9) How could the separation effectiveness be increased? (1 mark)

10) Explain why the following separation processes would **not** be suitable for separating ethanol and water. Note that the densities of ethanol and water are very similar. (3 marks)

a) Filtering

b) Decantation

c) Magnetic separation

11) Explain some distillate was produced when the ethanol-water mixture was below the boiling point of ethanol. (2 marks)