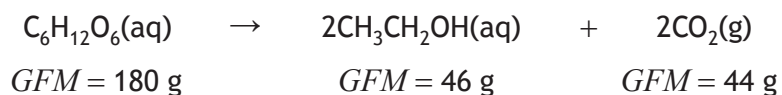


5. Gin is made by flavouring a mixture of ethanol and water with plant extracts.

- (a) (i) The mixture of ethanol and water is made by fermentation followed by distillation.

In fermentation, enzymes in yeast convert glucose, $C_6H_{12}O_6$, into ethanol and carbon dioxide.

The equation for fermentation is shown.



- (A) A 50.0 cm^3 sample of glucose solution contained 5.79 g of glucose.

Calculate the volume, in litres, of carbon dioxide gas that would be produced if 16 litres of this glucose solution was fermented.

3

Take the volume of 1 mole of carbon dioxide gas to be 24 litres.

- (B) Calculate the atom economy for the production of ethanol.

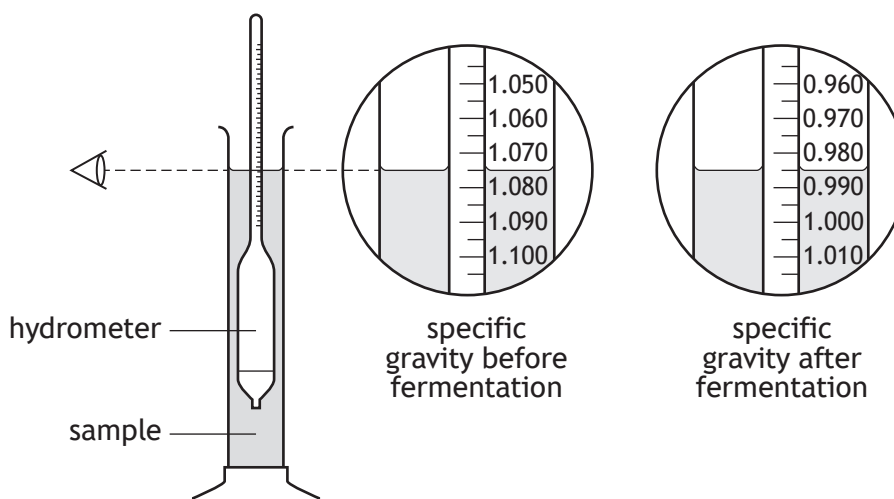
2



5. (a) (continued)

- (ii) The percentage of alcohol by volume can be calculated by measuring the specific gravity of samples taken before and after fermentation.

The specific gravity is measured using a hydrometer. The level of the sample on the hydrometer scale, read at eye level, is the specific gravity.



The % alcohol by volume can be calculated using the formula

$$\% \text{ alcohol by volume} = \left(\frac{\text{change in specific gravity}}{0.7362} \right) \times 100$$

Calculate the % alcohol by volume for this sample.

2

[Turn over

5. (continued)

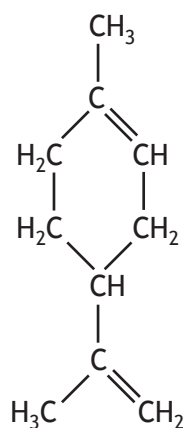
- (b) Plant material is used to flavour the ethanol and water mixture. The mixture is then distilled.

- (i) The first fraction from the distillation contains toxic methanol and propan-2-one and is discarded.

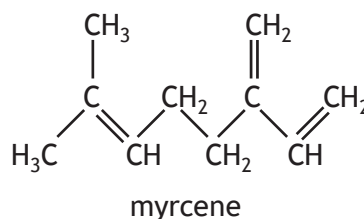
Describe a chemical test, with the expected result for **both** compounds, that could be used to distinguish between methanol and propan-2-one.

2

- (ii) The second fraction from the distillation is collected for bottling as gin. Some of the plant compounds that give gin its flavour are shown.



limonene



geranyl acetate

- (A) Name the class of compounds to which unsaturated hydrocarbons such as limonene and myrcene belong.

1

- (B) Circle an isoprene unit on the limonene structure above.

1

(An additional structure, if required, can be found on *page 40*.)



5. (b) (ii) (continued)

(C) Geranyl acetate can undergo hydrolysis to produce an alcohol and another product.

Name the other product.

1

(c) Gin is often mixed with tonic water before drinking. Tonic water contains quinine, a bitter tasting compound. Historically quinine was used to treat malaria.

To treat malaria an intake of 10.0 mg of quinine per kilogram of body weight is required every 8 hours.

Calculate the mass of quinine required by a 70 kg adult in one day.

2

[Turn over

