Preparing and purifying an organic liquid

AQA 7404/7405 · AS content

Show your working where needed. Check the worked answers when you finish.

Name _____ Date _____

1. Choose an apparatus arrangement

A reaction must be heated for 30 minutes and the starting liquid is volatile. Explain how an upright condenser lets the student keep the mixture hot for that time without losing much starting liquid.

2. Check a thermometer reading

A student sets up simple distillation but puts the thermometer bulb into the boiling liquid. Where should the bulb sit? Explain why the new position gives a more useful reading for identifying the fraction.

3. Check the water connections

A water-cooled condenser is fitted for distillation. Which connector takes in cold water and which lets it out? Explain the direction.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-organic-preparation-and-purification

Preparing and purifying an organic liquid

AQA 7404/7405 · AS content

4. Decide which layer to collect

A mixture forms two immiscible layers. The organic layer has density 0.81 g cm^{-3}, and the aqueous layer has density 1.04 g cm^{-3}. The product is in the organic layer. Explain which layer to keep and how to collect it without mixing the layers.

5. Explain the use of a solid

After separating the bulk aqueous layer, a student adds anhydrous magnesium sulfate to the organic layer and later removes the solid. Explain why the salt is used.

6. Interpret the collected fraction

At the same pressure, a pure reference liquid boils at 81 °C. A student collects a fraction from 72 °C to 86 °C. What does this broad range suggest, and what follow-up would improve the evidence?

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-organic-preparation-and-purification

Preparing and purifying an organic liquid

AQA 7404/7405 · AS content

7. Calculate a preparation yield

A student heats 10.0 g cyclohexanol ($C_6H_{12}O$) with an acid catalyst and isolates 5.74 g cyclohexene (C_6H_{10}). Water is the other product. Write a balanced equation and calculate the percentage yield. Use A_r values C = 12.0, H = 1.0 and O = 16.0.

8. Check a recorded yield

The reaction can give a maximum of 4.60 g pure organic product. A student records collecting 5.08 g of liquid. Calculate the apparent percentage yield. Give one plausible reason for the result and a suitable check.

9. Extra challenge · Plan the collection and judge the yield

A student oxidises 9.00 g of propan-1-ol to propanal, then collects 5.22 g of the aldehyde. The M_r values of propan-1-ol and propanal are 60.0 and 58.0.

Describe how to collect propanal during the reaction and avoid producing mainly propanoic acid. Calculate the percentage yield and explain why it may differ from the percentage of alcohol that reacted.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-organic-preparation-and-purification

Worked answers

Preparing and purifying an organic liquid · AQA 7404/7405 · AS content

1. Choose an apparatus arrangement

Vapours from the heated mixture cool in the condenser. They condense and flow back into the flask, so the mixture can be heated while reducing loss of volatile material.

2. Check a thermometer reading

Put the bulb at the entrance to the side arm so it sits in the vapour passing towards the condenser. It measures the temperature of the vapour being collected.

3. Check the water connections

Water enters at the lower connector and leaves at the upper one. Feeding water in from the bottom keeps the jacket full and allows air to escape through the upper outlet.

4. Decide which layer to collect

The organic layer is on top because it is less dense. Use a separating funnel. Run off the lower aqueous layer through the tap, then collect the organic layer separately.

5. Explain the use of a solid

Anhydrous magnesium sulfate takes up traces of water by forming hydrated solid. Removing the solid leaves the organic liquid with less water.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-organic-preparation-and-purification

Worked answers

Preparing and purifying an organic liquid · AQA 7404/7405 · AS content

6. Interpret the collected fraction

A wide range is consistent with more than one volatile substance in the fraction. Redistil and collect the narrow fraction around 81 °C at the same pressure.

Check a second piece of evidence, for example an IR spectrum against a suitable reference. A narrow boiling range alone cannot establish identity or purity.

7. Calculate a preparation yield

$C_6H_{12}O \rightarrow C_6H_{10} + H_2O$. The equation gives a 1:1 mole ratio. The amount of cyclohexanol is 10.0 ÷ 100.0 = 0.100 mol.

The theoretical mass of cyclohexene is 0.100 × 82.0 = 8.20 g. Percentage yield = 5.74 ÷ 8.20 × 100 = 70.0%.

8. Check a recorded yield

5.08 ÷ 4.60 × 100 = 110% to three significant figures. The mass cannot all be pure product.

The sample may contain water. Dry it with an appropriate anhydrous salt, remove the salt and reweigh in a tared container. Residual solvent or an incorrect tare are other possibilities.

9. Extra challenge · Plan the collection and judge the yield

Use acidified potassium dichromate(VI) with controlled addition to the alcohol and distil the volatile propanal as it forms. Removing it from the hot oxidising mixture reduces further oxidation to the acid.

The alcohol amount is 9.00 ÷ 60.0 = 0.150 mol. The 1:1 ratio gives 8.70 g propanal as the theoretical mass. Yield = 5.22 ÷ 8.70 × 100 = 60.0%.

Alcohol can react to give another product, or some propanal may be lost during collection or transfer. The isolated yield alone does not give the fraction of alcohol that reacted.

Scan to try fresh questions online

Try a core or harder question. Use clues and worked answers.

chemistryhelp.co.uk/worksheets/aqa-organic-preparation-and-purification