Preparing and purifying an organic liquid

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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.

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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?

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7. Calculate a preparation yield

A student prepares 1-bromobutane from 7.40 g of butan-1-ol with other reagents in excess and isolates 9.59 g of 1-bromobutane. Use the 1:1 mole ratio and M_r values 74.0 and 137.0 to calculate the percentage yield.

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 · Recover a liquid after reflux

Butan-1-ol is heated with sodium bromide and sulfuric acid under reflux. After cooling, the crude distillate contains 1-bromobutane, water and some unreacted butan-1-ol. At the same pressure, pure 1-bromobutane boils at 101 °C and butan-1-ol at 118 °C. The product-rich layer has density 1.25 g cm^{-3} and the aqueous layer 1.03 g cm^{-3}.

Plan how to separate, dry and redistil the product. Identify the layer to keep, explain each step and give one way to check the purity of the collected product.

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