

M.2 Pure Substances, Mixtures & Separation

Practice Worksheet — name: _____ date: _____

FORMULAS FOR THIS TOPIC

$$\text{RETENTION FACTOR } R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

SECTION A — MULTIPLE CHOICE

A1. Which technique separates salt from a salt-and-sand mixture after adding water and filtering?

- (A) Chromatography
- (B) Distillation
- (C) Evaporation and crystallisation
- (D) Magnetic separation

A2. A liquid melts between 52 °C and 58 °C. This tells you the liquid is:

- (A) A pure compound
- (B) A pure element
- (C) A mixture
- (D) An alloy

A3. In paper chromatography, a dye spot moves 4.0 cm while the solvent front moves 8.0 cm. The R_f value is:

- (A) 0.25
- (B) 0.50
- (C) 2.0
- (D) 4.0

SECTION B — SHORT ANSWER

B1. Explain how fractional distillation separates ethanol (b.p. 78 °C) from water (b.p. 100 °C). [4 marks]

B2. Describe how you would identify whether a black ink contains a single dye or several. [3 marks]

B3. Classify each as element, compound or mixture: air, carbon dioxide, copper, sea water. [2 marks]

ANSWER KEY

For worked explanations, interactive practice and more free resources, visit www.newtonine.com

Section A

A1: Evaporation and crystallisation — Water dissolves the salt but not the sand; filtration removes the sand; then gently evaporating the filtrate leaves salt crystals behind. Each step exploits a different physical property — solubility, particle size, and volatility.

A2: A mixture — Pure substances have sharp melting points (a single temperature). A melting range spread over several degrees is the fingerprint of a mixture — the classic purity test.

A3: 0.50 — $R_f = 4.0/8.0 = 0.50$. R_f values are always between 0 and 1 (the spot cannot outrun the solvent) — a quick sanity check for calculations.

Section B

B1: The mixture is heated; ethanol, with the lower boiling point, evaporates preferentially. The fractionating column stays cooler towards the top, so water vapour condenses and falls back while ethanol vapour passes over. The ethanol vapour is then cooled in the condenser and collected as liquid. Separation works because the two liquids have different boiling points.

B2: Spot the ink on a pencil start-line on chromatography paper, stand the paper in a shallow solvent below the line, and let the solvent rise. If the ink separates into more than one spot at different heights, it contains several dyes; a single spot suggests one dye. Comparing R_f values with known dyes identifies them.

B3: Air — mixture (of gases); carbon dioxide — compound (C and O chemically bonded); copper — element; sea water — mixture (water plus dissolved salts).