01 Experimental Chemistry

Set A **Answer key**

A From the lesson

7 MARKS

1 **B** burette [1]

A burette measures to the nearest 0.05 cm^3, so it can measure 25.15 cm^3.

A A beaker is not used for accurate measurement.

C A measuring cylinder measures to the nearest 0.5 cm^3.

D A pipette measures one fixed volume, such as 25.0 cm^3.

2 **D** 273 K [1]

Pure water freezes at 0 °C and temperature in K = temperature in °C + 273.

3 **(a)** Water displacement *or* upward delivery. [1]

(b) Calcium oxide (quicklime). [1]

Gas Y reacts with acids, so it cannot be dried with concentrated sulfuric acid.

4 Remove the insoluble solid Z from the three other substances by filtration. [1]

From the two immiscible layers, use a separating funnel to run off liquid X, the lower layer.

Separate solid Y from its solution in W by evaporation *or* crystallisation. [1] [1]

B Practice

29 MARKS

5 **D** A yellow solid that melts at 60 °C. [1]

A pure substance has a fixed, sharp melting point.

6 **B** 104 °C [1]

Dissolved salt raises the boiling point of water a little, so the boiling point is just above 100 °C.

7 **A** melting point −39 °C and boiling point 357 °C [1]

B A boiling point of −3 °C is below 25 °C, so mercury would be a gas.

C A boiling point of 20 °C is below 25 °C, so mercury would be a gas.

D A melting point of 30 °C is above 25 °C, so mercury would be a solid.

8 **B** Add methylbenzene and stir, then filter, then add the residue to water and stir, and then filter this mixture. [1]

Methylbenzene dissolves R only, so the residue is P and Q. Water then dissolves Q only, so the final residue is pure P.

9 **B** to act as a drying agent [1]

Concentrated sulfuric acid absorbs water, so it dries the gases.

10 **C** measuring cylinder [1]

11 **C** less dense than air [1]

The apparatus is upward delivery, so gas X must be less dense than air. There is not enough information to deduce its solubility in water.

12 **A** set-up A [1]

Solid Y is insoluble in ethanol, so filtration separates them easily: Y is the residue and ethanol is the filtrate. The boiling points are distractors.

13 **D** 0.538 [1]

R_f of B = $\frac{7}{13}$ = 0.538

14 **A** 100 °C and a colourless distillate [1]

Only water boils off, so the thermometer at the side arm reads its boiling point, 100 °C, and the distillate is pure, colourless water.

15 **(a)** The black dye is impure because there is more than one spot on the chromatogram. [1]

(b) Determine the boiling point *or* freezing point of the black dye. [1]

If it boils or freezes at a fixed temperature, it is pure. *or* If it boils or freezes over a range of temperatures, it is not pure. [1]

(c) Dye B is insoluble in the solvent (ethanol). [1]

(d) Dye A [1]

Distance moved by A = 4.0 − 1.5 = 2.5 cm and distance moved by the solvent front = 7.0 − 1.5 = 5.5 cm. R_f = 2.5 ÷ 5.5 = 0.45 [1]

16 **(i)**

Fractional distillation [1]

Distillation alone is not accepted.

(ii)

The components have different boiling points. [1]

(iii)

No. The components are miscible (they mix). [1]

17 **(a)**

All the dyes must have different solubilities in the same solvent (the mixture of water and ethanol). [1]

(b)

The R_f value of the yellow dye in pure water (0% ethanol) is zero, so the yellow dye is insoluble in pure water. [1]

The R_f value of the red dye in pure ethanol (100% ethanol) is zero, so the red dye is insoluble in pure ethanol. [1]

The black dye would not be completely separated into its components if either pure water or pure ethanol were used. [1]

(c)

Percentage of ethanol = $\frac{32}{200} \times 100\% = 16\%$ [1]

So the R_f value of the blue dye is 0.72. [1]

(d)(i)

No, the student cannot conclude that the black dye is pure. [1]

The R_f values of the blue, red and yellow dyes are all 0.4 when the solvent is 80% ethanol, so the three dyes give only one spot. [1]

(ii)

The start line must be drawn in pencil. [1]

The level of the solvent must be below the start line. [1]