2.6 Separating Mixtures and Solutions: 30-minute Pack

Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A student is given a mixture composed of 10 g of sugar, 10 g of sand and 20 g of an oily liquid that does not mix with water. The student plans to separate and weigh each component. The student follows these steps and records the mass obtained for each component at the end: 1) Add 50 g of water, stir and allow to settle. 2) Use a separating funnel and drain the lower aqueous layer into a beaker, leaving the oily layer in the funnel. 3) Filter the aqueous layer to remove any sand and then evaporate the water to obtain sugar crystals. The student reports the following masses after drying: oily liquid 19.0 g, sand 9.2 g, sugar 9.0 g. Use the data to answer the parts.

(a) Calculate the total mass recovered by the student and compare it to the original total mass of the mixture. Show your working and state the difference in grams. **(4)**

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(b) Suggest six plausible reasons, related to technique or apparatus, that could explain the loss of 2.8 g during the separation and collection. Give brief explanations for each reason. **(6)**

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(c) The teacher suggests an improved method to reduce loss: rinse the separating funnel and filter paper with small amounts of solvent or water and include the rinsings with the correct fraction, and dry samples thoroughly before weighing. Explain how rinsing and careful drying would reduce the mass loss or measurement error. Give two separate points. **(6)**

2 Describe how you would obtain dry salt crystals from the salt solution left after filtration. Give three steps in order.

(3)

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3 A student performs simple distillation to separate pure water from seawater. Describe two differences between evaporation and simple distillation in how they separate mixtures.

(4)

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4 A student tests solubility by adding 20 g of a solid to 100 g of water at 20°C. After stirring, 5 g of solid remains undissolved. Calculate the solubility of the solid in g per 100 g water at 20°C.

(4)

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Mark scheme · 2.6 Separating Mixtures and Solutions: 30-minute Pack

Question 1

(a) correct addition of recovered masses 19.0 + 9.2 + 9.0 = 37.2 g	M1
(a) correct statement of original total mass 10 + 10 + 20 = 40 g	M1
(a) calculate difference 40 - 37.2 = 2.8 g cao	A1
(a) state that recovered mass is 37.2 g which is 2.8 g less than original	A1

(a) Answer: **Total recovered 37.2 g; original mass 40 g; difference 2.8 g (less recovered).**

(b) loss could be due to incomplete transfer of oily liquid from separating funnel (eg some left on walls), with brief explanation	M1
(b) loss of sugar during filtration or crystallisation (eg some sugar remained dissolved in water or stuck to filter paper), with brief explanation	M1
(b) sand lost during transfers or stuck to glassware, with brief explanation	M1
(b) evaporation losses when drying crystals (splashing or carry-over) or incomplete drying leading to underestimation, with brief explanation	M1
(b) weighing error such as balance not tared or sample not cooled before weighing, with brief explanation	M1
(b) contamination or mixture of layers causing some mass to be unassigned, with brief explanation	M1

(b) Answer: **Possible causes: oily liquid left on funnel walls; some sugar remained dissolved or stuck to filter paper; sand lost during transfers; evaporation losses or incomplete drying; balance or weighing procedure errors; or contamination between layers.**

(c) rinsing recovers material stuck to glassware or filter paper and returns it to the correct fraction	M1
(c) explain that rinsing increases recovered mass because residues are washed into the correct container instead of being left behind	A1
(c) careful drying ensures that water or solvent is removed before weighing	M1
(c) explain that drying avoids measuring extra mass from solvent or underestimating mass when wet, improving accuracy	A1
(c) mention practical step such as using a warm oven or desiccator or leaving to dry to constant mass	M1
(c) link to how this reduces random or systematic error in the final mass measurement	A1

(c) Answer: **Rinsing washes residues from the funnel and filter paper into the correct collection vessel so less sample is left behind, increasing recovered mass. Careful drying removes water or solvent so the measured mass is of the substance only; drying to constant mass avoids systematic under- or overestimation.**

Question 2

evaporate or gently heat the salt solution to remove most of the water / concentrate the solution	M1
leave to cool or allow remaining water to evaporate so crystals form	M1
mention collecting, scraping or drying the crystals (eg remove and dry crystals) cao	A1

Answer: **Gently heat the salt solution to evaporate water until crystals start to form; then leave to cool and dry and collect the dry salt crystals**

Question 3

evaporation removes solvent by heating until solvent evaporates leaving solute behind	M1
simple distillation collects vapour which is then cooled and condensed into a separate container	M1
state that evaporation does not collect the liquid while distillation does (collects liquid) cao	A1
state that distillation gives a purer collected liquid because vapour is condensed leaving non-volatile impurities behind or mention control of temperature cao	A1

Answer: **Evaporation turns water into vapour and leaves the salt behind without collecting the water; simple distillation condenses the vapour to collect pure water in another container, giving a purer collected liquid.**

Question 4

correct subtraction to find dissolved amount 20 - 5 = 15 g	M1
recognise solubility is dissolved mass per 100 g water	M1
15 g per 100 g water cao	A1
unit stated as g per 100 g water or g/100 g, cao	B1

Answer: **15 g per 100 g water**

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