

Telling pure substances from mixtures

Grade 7 science (Year 8 · Class 7) · Worksheet answers

Use these answers to check your work only after attempting every problem. The reasoning matters as much as the final result, so read each step and compare it with your own. Final answers are shown in bold.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS1-2

Problem 1 Pure or mixture

1. **Pure substance.**
2. **Mixture** (water and dissolved salts).
3. **Pure substance.**
4. **Mixture** (copper and zinc).
5. **Mixture** (nitrogen, oxygen and other gases).

Problem 2 True or false

1. **True.**
2. **False.** Spring water contains dissolved salts, so it is a mixture.
3. **False.** The properties of a mixture depend on how much of each substance it has.

Problem 3 Fixed points of water

1. **0 °C.**
2. **100 °C.**
3. The boiling point rises above 100 °C: **it increases.**

Problem 4 Reading particle boxes

1. Box C has three different kinds of particles mixed: **C.**
2. Box B has only one kind of joined pair: **B**, because the pairs are all identical.
3. Box A has one kind of single particle: **A.**

Problem 5 Colour test results

1. It shows that **water is present.**
2. Strips 2 and 3.
3. The liquid on strip 1 contains no water, so **strip 1 stays blue.**

Problem 6 Residue on a watch glass

1. **The tap water glass.**
2. The ring is the dissolved solids (mainly salts) left behind when the water evaporates.
3. Distilled water left nothing, so **distilled water is closer to pure.**

Problem 7 Name the solid

1. A sharp melting point shows the sample is **pure**.
2. 133 °C matches urea in the table: **urea**.
3. He would have seen it start to melt at a lower temperature and melt over a wide range.

Problem 8 Melting ranges

1. X: $61.5 - 61.0 = 0.5$ °C. Y: $64 - 55 = 9$ °C. Z: $80.5 - 80.0 = 0.5$ °C. **0.5 °C, 9 °C and 0.5 °C.**
2. **Sample Y.**
3. A wide melting range means the particles are not all the same, so sample Y is a mixture.

Problem 9 Ethanol and water

1. Ethanol has the lower boiling point, so **ethanol boils off first**.
2. The vapour is rich in ethanol, so the liquid left becomes richer in water, and the boiling temperature rises. **The reading keeps rising as the mixture changes.**
3. In a pure liquid all the particles escape at one temperature, so **the reading stays fixed**.

Problem 10 Salty soup

1. **No, it is not pure water.**
2. Pure water boils at 100 °C at sea level; 103 °C is higher, because dissolved salt raises the boiling point.
3. Dissolved salt lowers the freezing point, so it would freeze **below 0 °C**.

Problem 11 Gold jewellery

1. $22 \div 24 = 0.9167$: **91.7 %**.
2. $15.0 \text{ g} \times 22 \div 24 =$ **13.75 g of gold**.
3. $15.0 \text{ g} - 13.75 \text{ g} =$ **1.25 g of other metals**.

Problem 12 Samples P and Q

1. P is flat at **52 °C**.
2. Q melts between 44 °C (2 min) and 51 °C (6 min): **44 °C to 51 °C**, a range of 7 °C.
3. **P is purer**, because it melts at one sharp temperature and Q starts melting at a lower temperature and over a wide range.

Problem 13 Spot the error

1. 'Spring water' contains dissolved minerals, so it is not a pure substance.
2. The paper test only shows that water is present, not that it is pure.
3. **Spring water is a mixture; to test its purity measure its boiling and freezing**

points.

Problem 14 Water test limits

1. It shows that **water is present** in the juice.
2. Orange juice also contains water, so the powder turns blue even though the juice is a mixture of water, sugar and acids.
3. **Measure the boiling point** (it must be 100 °C at normal pressure), or the freezing point (0 °C).

Problem 15 Brass bells

1. Brass contains two metals, copper and zinc, that are mixed together in a chosen proportion, so it is a mixture.
2. $250 \text{ g} \times 0.65 = \mathbf{162.5 \text{ g of copper.}}$
3. $250 \text{ g} - 162.5 \text{ g} = \mathbf{87.5 \text{ g of zinc.}}$

Problem 16 Which liquid boils?

1. 78 °C matches ethanol and the reading is steady: **ethanol**.
2. The second liquid does not boil at one fixed temperature but over 79 °C to 96 °C: **it is a mixture**.
3. As the lower-boiling substance leaves first, the liquid left contains more of the higher-boiling substance, so the boiling temperature rises.
4. The range begins near ethanol and ends below 100 °C, so it could be **ethanol mixed with water**.

Problem 17 Reading a bottle label

1. $340 \text{ mg/L} \times 1.5 \text{ L} = 510 \text{ mg} = \mathbf{0.51 \text{ g.}}$
2. $200 \text{ mL} = 0.200 \text{ L}$. $340 \text{ mg/L} \times 0.200 \text{ L} = \mathbf{68 \text{ mg.}}$
3. It contains water and dissolved solids, so it is a mixture.
4. After distillation the water would leave less or no residue on evaporation and would boil at 100 °C: **boiling point and residue measurements**.

Problem 18 Impurity and melting point

1. $44.0 - 41.5 = 2.5$; $44.0 - 39.0 = 5.0$; $44.0 - 35.2 = 8.8$. **2.5 °C, 5.0 °C and 8.8 °C.**
2. The melting point falls as the amount of impurity increases, but the fall for 20% (8.8 °C) is less than four times the fall for 5% (10 °C).
3. Halfway between 39.0 °C and 35.2 °C: $(39.0 + 35.2) \div 2 = \mathbf{37.1 \text{ °C.}}$

Problem 19 Plan a purity test

1. Evaporate equal volumes (say 20 mL) of each water on identical clean watch glasses over

the same hot water bath and compare the residues. Keep volume, heating, time and glass type constant.

2. Heat each sample and record the boiling point with a thermometer.

3. Distilled water: little or no residue and boils at 100 °C. Tap water: a visible residue and a boiling point slightly above 100 °C. **Distilled water is purer.**

4. Each test has uncertainty, and a thermometer or a residue might be too small to see, so two independent measurements give more confidence.

Problem 20 Rock salt purity

1. $4.00 \text{ g} - 0.16 \text{ g} = \mathbf{3.84 \text{ g}}$.

2. $3.84 \div 4.00 \times 100 = \mathbf{96.0 \%}$.

3. $250 \text{ g} \times 0.960 = \mathbf{240 \text{ g}}$.

4. Rock salt contains salt plus sand and other material, so it is a mixture.