ExamFitter

examfitter.com · Free AP Chemistry quizzes, revision notes and worksheets

Topic 3.7: Solutions and Mixtures

Worksheet · AP Chemistry

UNIT 3 · PROPERTIES OF SUBSTANCES AND MIXTURES

On ExamFitter.com: Topic 3.7 Revision Notes · Topic 3.7 Quiz · Previous Worksheet: Topic 3.6 · Next Worksheet: Topic 3.8 · Unit 3: All Topics · AP Chemistry Home

How to Use This Worksheet

Work through the sections in order. Section A checks the vocabulary of mixtures and the particulate picture of a solution, Section B builds fluency with molarity, ion counting, dilution and mixing, and Section C combines them in exam style.

Keep two questions separate throughout: how much solute is present, and in what form it is present. Almost every error in this topic comes from answering one when the question asked the other.

Convert every volume to litres before using M = n ÷ V, unless both volumes in a dilution equation use the same unit.

Show every step of your working. In this topic the method is where the marks are: converting the volume, counting the ions each formula unit releases, and tracking the moles through a dilution or a mix.

Do not look at the answer key until you have attempted every question. The key gives full working, so compare your reasoning, not just the answer.

© 2026 ExamFitter.com · Free AP Chemistry worksheets

Section A: Recall and Concepts

A1. (a) Define the terms solute and solvent.

(b) A mixture is made from 30 mL of methanol and 70 mL of water. State which substance is the solvent, and the rule that decides it.

(c) State the property that lets a mixture's composition vary while the composition of a pure compound cannot vary.

(d) Brass is a uniform mixture of copper and zinc. State the classification of brass as a mixture, and the phase in which it exists.

A2. (a) Sodium chloride dissolves in water. Write the equation for the process, and name the species present in the finished solution.

(b) Describe how water molecules orient themselves around a dissolved Na^+ ion, and state what holds them in that arrangement.

(c) State how the orientation changes around a dissolved Cl^- ion.

(d) A 0.50 M sucrose solution and a 0.50 M NaCl solution are tested with a conductivity meter. State which one conducts, and explain the difference at the particulate level.

(e) A particulate drawing shows solute particles spread evenly through the solvent, each one completely surrounded by solvent particles. State the kind of mixture the drawing represents.

A3. (a) Define molarity, stating exactly which volume appears in the definition.

(b) A flask of solution is warmed from 20 °C to 40 °C. State what happens to its molarity, and why.

(c) State what happens to the mass percent of the same solution on warming, and why the two measures behave differently.

© 2026 ExamFitter.com · Free AP Chemistry worksheets

(d) Samples are drawn from the top and from the bottom of a thoroughly mixed solution. State how their molarities compare, and name the property of solutions that guarantees it.

A4. A solution of Na_2SO_4 has a molarity of 0.10 M.

(a) State the concentration of Na^+ ions.

(b) State the concentration of SO_4^{2-} ions.

(c) State the total concentration of dissolved particles.

(d) Explain why a 0.10 M $CaCl_2$ solution conducts better than a 0.10 M NaCl solution, even though the two stated molarities are equal.

A5. (a) State what quantity stays constant when a solution is diluted, and the two quantities that change.

(b) Describe the change at the particulate level when pure water is added to a solution in a beaker.

(c) A student preparing a standard solution adds water past the calibration mark of the volumetric flask. State the effect on the molarity, with the reason.

(d) A blue $Cu(NO_3)_2$ solution is diluted with pure water. State what happens to the colour, and what the change signals about the solution.

Section B: Core Practice

B1. A solution contains 0.350 mol of NH_4Cl dissolved in enough water to make 700.0 mL of solution. Calculate the molarity of the solution.

© 2026 ExamFitter.com · Free AP Chemistry worksheets

B2. Calculate the mass of KOH (molar mass 56.11 g/mol) needed to prepare 250.0 mL of a 0.400 M solution.

B3. A student measures out 150.0 mL of a 0.250 M $AgNO_3$ solution.

(a) Calculate the moles of $AgNO_3$ in the sample.

(b) Calculate the number of Ag^+ ions in the sample. Use Avogadro's constant, 6.022×10^{23} mol^{-1}.

(c) State the concentration of NO_3^- ions in the solution.

B4. A solution of $Al_2(SO_4)_3$ has a molarity of 0.250 M.

(a) State the concentration of Al^{3+} ions.

(b) State the concentration of SO_4^{2-} ions.

(c) State the total concentration of ions.

(d) Calculate the total moles of ions in 200.0 mL of the solution.

B5. What volume of a 6.00 M stock solution must be measured out to prepare 500.0 mL of a 0.750 M solution? State also the assumption about the solute that the calculation makes.

B6. A 200.0 mL portion of 0.300 M NaOH is mixed with a 300.0 mL portion of 0.500 M NaOH. Calculate the molarity of the mixture, and state why it does not sit halfway between the two starting molarities.

© 2026 ExamFitter.com · Free AP Chemistry worksheets

Section C: Exam Style

C1. A solution is prepared by dissolving 11.7 g of NaCl (molar mass 58.44 g/mol) in water and making the volume up to 500.0 mL.

(a) Calculate the molarity of the solution.

(b) State the concentration of Na^+ ions and of Cl^- ions.

(c) Calculate the total moles of ions in the flask.

(d) A 100.0 mL portion of the solution is taken and diluted to 250.0 mL. Calculate the new molarity.

(e) A second solution contains sucrose at the same molarity and in the same volume. State how its count of solute particles compares with the NaCl solution's, and explain why only one of the two solutions conducts electricity.

C2. Four solutions are each 0.100 M: glucose ($C_6H_{12}O_6$), $NaNO_3$, $MgCl_2$ and $AlCl_3$.

(a) Calculate the total concentration of dissolved particles in each solution.

(b) Rank the four solutions by electrical conductivity, justifying the ranking.

(c) State which solution has the highest concentration of Cl^- ions, and calculate the moles of Cl^- in 50.0 mL of it.

(d) Equal volumes of the $NaNO_3$ solution and the $MgCl_2$ solution are mixed. State the concentration of each ion in the mixture, and the total ion concentration.

(e) The $AlCl_3$ solution is then diluted by adding an equal volume of pure water. State the new concentration of Al^{3+} ions and of Cl^- ions.

© 2026 ExamFitter.com · Free AP Chemistry worksheets

C3. An aqueous NaOH solution is 20.0% NaOH by mass and has a density of 1.22 g/mL. The molar mass of NaOH is 40.00 g/mol.

(a) Explain why the density must be known before the molarity can be calculated.

(b) Calculate the molarity, taking a basis of 100.0 g of solution.

(c) Calculate the volume of this solution that contains 0.250 mol of NaOH.

(d) State whether the molarity found in (b) would change if the solution were warmed, and whether the mass percent would change.

© 2026 ExamFitter.com · Free AP Chemistry worksheets

Answer Key

A1. (a) The solute is the substance that dissolves; the solvent is the substance it dissolves in, the component that does the dissolving. (b) Water is the solvent. The rule: in a mixture of two liquids, the solvent is the component present in the greater amount, and 70 mL of water exceeds 30 mL of methanol. (c) A mixture's components are physically combined, so they can be present in any proportions; a compound's elements are chemically joined in a fixed ratio set by its formula, the law of definite proportions, so its composition is fixed. (d) Brass is a solid solution: a homogeneous mixture existing in the solid phase.

A2. (a) $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$. The solution contains separate, mobile Na^+ and Cl^- ions, each surrounded by water molecules; no intact NaCl units remain. (b) The oxygen ends of the water molecules point inward, toward the Na^+ ion. Oxygen carries the partial negative charge of the polar water molecule, and the ion-dipole attraction between that end and the positive ion holds the shell in place. (c) Around Cl^- the shell turns around: the hydrogen ends, carrying the partial positive charge, point inward toward the negative ion. (d) The NaCl solution conducts; the sucrose solution does not. Conductivity requires mobile charged particles. Dissolved NaCl supplies free ions that can move and carry charge, while sucrose disperses as intact neutral molecules, which cannot carry a current however many of them there are. (e) A homogeneous solution. The even spread of the solute particles, each fully surrounded by solvent, is the particulate picture of a true solution.

A3. (a) Molarity is the moles of solute per litre of solution: $M = n \div V$. The volume is the total volume of the finished solution, not the volume of solvent used to prepare it. (b) The molarity falls slightly. Warming expands the liquid, so the same number of moles occupies a larger volume, and the moles per litre drop. (c) The mass percent is unchanged: neither the mass of solute nor the mass of solution changes with temperature. The two measures differ because molarity is built on volume, which depends on temperature, while mass percent is built on masses alone. (d) The molarities are identical. A solution is homogeneous: the solute is dispersed uniformly throughout the solvent, so the concentration is the same at every point in the sample.

A4. (a) 0.20 M. Each formula unit releases two Na^+ ions, so $[Na^+] = 2 \times 0.10 = 0.20$ M. (b) 0.10 M. Each formula unit releases one SO_4^{2-} ion. (c) 0.30 M: 0.20 + 0.10. (d) Conductivity counts mobile ions, not formula units. The 0.10 M NaCl solution holds 0.20 M of ions in total, while the 0.10 M $CaCl_2$ solution holds 0.30 M (0.10 M Ca^{2+} and 0.20 M Cl^-). At the same stated molarity, the $CaCl_2$ solution has half as many charge carriers again per litre, so it conducts better. The stated molarity counts formula units; conductivity counts what each unit releases.

A5. (a) The moles, and so the mass, of solute stay constant. The volume increases and the molarity decreases. (b) The solute particles are unchanged in number; they become more widely spaced as the added solvent fills the space between them. (c) The molarity is lower than intended. The moles

© 2026 ExamFitter.com · Free AP Chemistry worksheets

of solute are unchanged, but they are spread through a volume larger than the mark specifies, and M = n ÷ V falls. (d) The blue colour becomes paler. The intensity of the colour follows the concentration of the coloured Cu^{2+} ions, so the fading signals that dilution has lowered the concentration.

B1. Convert the volume: 700.0 mL = 0.7000 L. M = n ÷ V = 0.350 ÷ 0.7000 = 0.500 M.

B2. n = M × V = 0.400 × 0.2500 = 0.100 mol of KOH. Mass = n × molar mass = 0.100 × 56.11 = 5.61 g.

B3. (a) n = M × V = 0.250 × 0.1500 = 0.0375 mol of $AgNO_3$. (b) Each formula unit releases one Ag^+ ion, so the sample holds 0.0375 mol of Ag^+. Number of ions = 0.0375 × 6.022 × 10^{23} = 2.26 × 10^{22} ions. (c) Each $AgNO_3$ formula unit releases one NO_3^- ion, so $[NO_3^-]$ = 0.250 M, identical to the Ag^+ concentration.

B4. (a) Each formula unit releases two Al^{3+} ions: $[Al^{3+}]$ = 2 × 0.250 = 0.500 M. (b) Each formula unit releases three SO_4^{2-} ions: $[SO_4^{2-}]$ = 3 × 0.250 = 0.750 M. (c) Total ion concentration = 0.500 + 0.750 = 1.25 M. (d) Moles of ions = 1.25 × 0.2000 = 0.250 mol.

B5. $M_1V_1 = M_2V_2$, so V_1 = (0.750 × 500.0) ÷ 6.00 = 62.5 mL of stock. The calculation assumes the amount of solute is unchanged by the transfer and the dilution: every mole measured out in the stock ends up in the finished solution, and none is added or lost.

B6. Moles from the first portion: 0.300 × 0.2000 = 0.0600 mol. Moles from the second: 0.500 × 0.3000 = 0.150 mol. Total = 0.210 mol in 0.2000 + 0.3000 = 0.5000 L. M = 0.210 ÷ 0.5000 = 0.420 M. It is not the 0.400 M halfway value, because the portions are unequal: the larger portion is the more concentrated one and supplies 0.150 of the 0.210 mol, pulling the result toward 0.500 M. A simple average works only for equal volumes. Note that 0.420 M lies closer to 0.500 M than to 0.300 M, exactly as the larger share of moles requires.

C1. (a) n = 11.7 ÷ 58.44 = 0.200 mol of NaCl. M = 0.200 ÷ 0.5000 = 0.400 M. (b) NaCl dissociates into one Na^+ and one Cl^- per formula unit, so $[Na^+]$ = 0.400 M and $[Cl^-]$ = 0.400 M. (c) Total ion concentration = 0.400 + 0.400 = 0.800 M, so total moles of ions = 0.800 × 0.5000 = 0.400 mol. (d) M_2 = (0.400 × 100.0) ÷ 250.0 = 0.160 M. (e) The sucrose solution holds the same amount of solute particles, 0.200 mol, but they are whole molecules; the NaCl solution holds twice as many particles, 0.400 mol of ions. Only the NaCl solution conducts, because its particles are charged and mobile, while neutral sucrose molecules cannot carry a current.

C2. (a) Glucose disperses as molecules: 0.100 M of particles. $NaNO_3$ gives 0.100 M Na^+ and 0.100 M NO_3^-: 0.200 M in total. $MgCl_2$ gives 0.100 M Mg^{2+} and 0.200 M Cl^-: 0.300 M in total. $AlCl_3$ gives 0.100 M Al^{3+} and 0.300 M Cl^-: 0.400 M in total. (b) $AlCl_3$ highest, then $MgCl_2$, then $NaNO_3$, then glucose, which does not conduct. Conductivity rises with the total concentration of mobile ions, and glucose releases no ions at all. (c) The $AlCl_3$ solution, with $[Cl^-]$ = 3 × 0.100 = 0.300 M. Moles of Cl^- in 50.0 mL = 0.300 × 0.0500 = 0.0150 mol. (d) Mixing equal volumes doubles the volume each solute occupies, so every concentration from the two starting solutions halves: $[Na^+]$ = 0.0500 M, $[NO_3^-]$ = 0.0500 M, $[Mg^{2+}]$ = 0.0500 M, and $[Cl^-]$ = 0.100 M. Total ion concentration = 0.0500 + 0.0500 + 0.0500 + 0.100 =

© 2026 ExamFitter.com · Free AP Chemistry worksheets

0.250 M, the average of the two starting totals, 0.200 M and 0.300 M, as it must be when moles and volumes both simply add. (e) Adding an equal volume of water doubles the volume the $AlCl_3$ occupies, so both ion concentrations halve: $[Al^{3+}]$ = 0.0500 M and $[Cl^-]$ = 0.150 M.

C3. (a) Mass percent connects masses: grams of solute per 100 g of solution. Molarity needs moles per litre, and a litre is a volume. Only the density connects the mass of a sample of solution to the volume that sample occupies, so without it the volume in the definition cannot be reached. (b) Basis 100.0 g of solution: it contains 20.0 g of NaOH, which is 20.0 ÷ 40.00 = 0.500 mol. The volume of the sample is 100.0 ÷ 1.22 = 81.97 mL = 0.08197 L. M = 0.500 ÷ 0.08197 = 6.10 M. (c) V = n ÷ M = 0.250 ÷ 6.10 = 0.0410 L, which is 41.0 mL. (d) The molarity would fall slightly on warming, because the solution expands and the same moles fill more litres. The mass percent would not change, because no mass changes when the temperature changes.

Continue Revising

Topic 3.7 Revision Notes

Topic 3.7 Quiz

Previous Worksheet: Topic 3.6

Next Worksheet: Topic 3.8

Unit 3: All Topics

AP Chemistry Home

© 2026 ExamFitter.com · Free AP Chemistry worksheets