Week 7: Systems Applications & Inequalities

Student: SA
Tutor: Rachel Eglash

October 22, 2025

Session 7.1
Systems Word Problems Mixture, Motion, Break-Even

Quick Reference: Problem Type Formulas

Mixture Problems

Key Formula: $(\text{concentration}_1)(\text{volume}_1) + (\text{concentration}_2)(\text{volume}_2) = (\text{concentration}_{\text{final}})(\text{volume}_{\text{final}})$

Two Equations Needed:

1. Total volume equation
2. Total substance (acid, alcohol, etc.) equation

Motion Problems

Key Formula: distance = rate $\times$ time $\quad (d = rt)$

Two Equations Needed:

1. Total distance equation (add if opposite directions, subtract if same direction)
2. Distance equations for each object: $d_1 = r_1 t$ and $d_2 = r_2 t$

Break-Even Problems

Key Formula: Total Cost = Total Revenue

Two Equations Needed:

1. Cost: $C = \text{Fixed Costs} + (\text{variable cost per item})(x)$
2. Revenue: $R = (\text{price per item})(x)$
3. Set them equal: $C = R$

Homework 7.1: Systems Word Problems

Instructions

: For each problem,

1. Define your variables with units
2. Write your system of equations
3. Solve using any method
4. Check your answer for reasonableness

Homework Problem 1: Mixture Problem

A pharmacist needs to prepare 200 mL of a 15 mg/mL alcohol solution.

She has solution "A", which is a 10 mg/mL solution.

She has solution "B", which is a 25 mg/mL solution.

How much of each should she mix?

Variables:
A = number of mL of 10 mg/mL solution
B = number of mL of 25 mg/mL solution

Understanding Check:

Total alcohol needed = 200 mL $\times$ 15 mg/mL = _____ mg

System:

1. Equation for total mL: _____

2. Expression for mg from solution A: _____

3. Expression for mg from solution B: _____

4. Equation for total mg: _____

Solution:

A = _____ mL

B = _____ mL

Check Your Answer:

Does $A + B = 200$? _____

Does the total alcohol equal 3000 mg? _____

Homework Problem 2: Motion Problem

Two trains leave the same station at the same time.

They travel in opposite directions.

Train A travels at 75 mph.

Train B travels at 65 mph.

After how many hours will they be 420 miles apart?

Variables:
t = time in hours
A = distance traveled by train A in miles
B = distance traveled by train B in miles

Understanding Check:

Combined speed = _____ + _____ = _____ mph

System:

1. Equation for total distance: _____

2. Equation for train A distance: _____

3. Equation for train B distance: _____

Solution:

t = _____ hours

Check Your Answer:

Train A distance: _____ miles

Train B distance: _____ miles

Total: _____ miles (should equal 420)

Homework Problem 3: Break-Even Problem

A bakery makes cakes.

Fixed costs are $1500 per month,
and each cake costs $20 to produce.

Each cake sells for $45.

How many cakes must be sold to break even?

Variables:
x = number of cakes
C = total cost in dollars
R = total revenue in dollars

Understanding Check:

Profit per cake = _____ - _____ = _____

System:

1. Equation for total cost: $C =$ _____

2. Equation for total revenue: $R =$ _____

3. Break even means: ____$C = R$____

Solution:

$x =$ _____ cakes

Check Your Answer:

Total cost: _____

Total revenue: _____

Are they equal? _____

Homework Problem 4: Mixture Problem Challenge

A coffee shop mixes two types of beans.

Premium beans cost \$12 per pound.
Regular beans cost \$8 per pound.

The shop wants to make 50 pounds of a blend.

The blend should cost \$9.60 per pound.

How many pounds of each type should be used?

Variables:
p = pounds of premium beans
r = pounds of regular beans

Understanding Check:
Total cost of blend = 50 pounds $\times$ \$9.60 per pound = _____
This problem is like a mixture problem, but with **cost** instead of concentration!

System:
1. Equation for total pounds: _____

2. Expression for cost from premium beans: _____

3. Expression for cost from regular beans: _____

4. Equation for total cost: _____

Solution:

p = _____ pounds

r = _____ pounds

Check Your Answer:
Does $p + r = 50$? _____

Does the total cost equal \$480? _____

Makes sense: Should use more regular beans (cheaper) than premium beans? _____