Word Problems with Linear Equations

Theory + 30 practice questions (10 easy · 10 medium · 5 medium-hard · 5 hard) with full step-by-step solutions. For Pre-Algebra and Algebra I students at SOMATH — the School of Math on the Upper West Side of NYC.

How to use this packet

Work each question on scratch paper first, then check the solution at the back. Every solution follows the same 5-step recipe: Read · Name · Translate · Solve · Check. The goal is not to memorize the answer — it is to memorize the translation.

The 5-step recipe

1. Read. Read the problem twice. Underline the numbers and circle the question.

2. Name. Write "Let x = ..." in a full sentence. Name every unknown.

3. Translate. "is" → =, "more than" → +, "less than" → −, "of" → ×.

4. Solve. Isolate the variable. Show every line.

5. Check. Plug the answer back into the original words, not the equation.

Practice Questions

Work these first. Full solutions start on the solutions page.

Section 1 · Easy (Questions 1–10)

Question 1 · Easy

A number plus 7 equals 23. Find the number.

Question 2 · Easy

Twice a number is 46. Find the number.

Question 3 · Easy

Five times a number, minus 4, equals 41. Find the number.

Question 4 · Easy

A number divided by 3 gives 12. Find the number.

Question 5 · Easy

Ana has some stickers. Her friend gives her 15 more, and now she has 42. How many stickers did Ana start with?

Question 6 · Easy

A pencil costs $2. Lucas buys some pencils and spends a total of $18. How many pencils did he buy?

Question 7 · Easy

A number, when increased by 8 and then doubled, equals 30. Find the number.

Question 8 · Easy

Three times a number equals 20 more than the number itself. Find the number.

Question 9 · Easy

The sum of two consecutive integers is 47. Find the smaller integer.

Question 10 · Easy

A taxi charges a $3 flat fee plus $2 per mile. A ride costs $17 total. How many miles was the ride?

Section 2 · Medium (Questions 11–20)

Question 11 · Medium

The sum of three consecutive integers is 72. Find the three integers.

Question 12 · Medium

A father is currently 4 times as old as his son. In 5 years, the father will be 3 times as old as his son. How old is each now?

Question 13 · Medium

One number is 8 more than another. Their sum is 54. Find both numbers.

Question 14 · Medium

A rectangle's length is 3 more than twice its width. The perimeter is 36. Find the width and length.

Question 15 · Medium

Marta buys 3 notebooks and 2 pens for $19. A notebook costs $3 more than a pen. What is the price of a pen?

Question 16 · Medium

Train A leaves the station going 60 mph. One hour later, Train B leaves the same station going 75 mph in the same direction on a parallel track. How many hours (after B leaves) until B catches up with A?

Question 17 · Medium

A phone plan charges $20 per month plus $0.10 per minute. Last month's bill was $47. How many minutes were used?

Question 18 · Medium

The sum of two numbers is 40. Three times the larger equals five times the smaller. Find the numbers.

Question 19 · Medium

Gym A charges a $40 sign-up fee plus $30 per month. Gym B charges $50 per month with no sign-up fee. After how many months do the two plans cost the same?

Question 20 · Medium

A ferry crosses a river in 30 minutes going with the current and 45 minutes against. The ferry's speed in still water is 12 mph. Find the speed of the current.

Section 3 · Medium–Hard (Questions 21–25)

Question 21 · Medium–Hard

Two pipes together fill a tank in 6 hours. Pipe A alone fills it in 10 hours. How long does pipe B alone take?

Question 22 · Medium–Hard

You have 40 kg of an alloy that is 25% copper. How many kilograms of pure copper must you add to make the alloy 40% copper?

Question 23 · Medium–Hard

A car and a bus leave the same station at the same time, going in opposite directions. The car goes 65 mph and the bus goes 55 mph. After how many hours are they 480 miles apart?

Question 24 · Medium–Hard

A boat travels 24 km downstream in 2 hours and 24 km upstream in 3 hours. Find the boat's speed in still water and the speed of the current.

Question 25 · Medium–Hard

The sum of the digits of a two-digit number is 12. When the digits are reversed, the new number is 18 more than the original. Find the original number.

Section 4 · Hard (Questions 26–30)

Question 26 · Hard

A boy has $4.50 in nickels and dimes. He has 3 more dimes than nickels. How many of each coin does he have?

Question 27 · Hard

A chemist has a 30% acid solution and a 60% acid solution. How many liters of each are needed to make 30 liters of a 50% acid solution?

Question 28 · Hard

A train leaves NYC at 8:00 am going 50 mph. Another train leaves NYC 90 minutes later going 65 mph on the same track in the same direction. At what time does the second train catch the first?

Question 29 · Hard

A rectangle has perimeter 42. Its length is 3 more than twice its width. Find the area of the rectangle.

Question 30 · Hard

A tank is filled by pipe A alone in 12 hours and by pipe B alone in 15 hours. Both pipes are opened together for 4 hours, and then pipe A is shut off. How long does pipe B alone take to finish filling the tank?

Solutions

Full step-by-step reasoning for every question.

Question 1 · Easy

A number plus 7 equals 23. Find the number.

Answer: x = 16

Step 2 · Name. Let x **= the number.**

Step 3 · Translate. "A number plus 7 equals 23" → $x + 7 = 23$.

Step 4 · Solve. Subtract 7 from both sides: $x = 23 - 7 = 16$.

Step 5 · Check. $16 + 7 = 23$. ✓

Question 2 · Easy

Twice a number is 46. Find the number.

Answer: x = 23

Translate: "Twice a number is 46" → $2x = 46$.

Solve: divide both sides by 2 → $x = 23$.

Check: $2 \cdot 23 = 46$. ✓

Question 3 · Easy

Five times a number, minus 4, equals 41. Find the number.

Answer: x = 9

Translate: $5x - 4 = 41$.

Solve: add 4 → $5x = 45$**; divide by 5 →** $x = 9$.

Check: $5(9) - 4 = 45 - 4 = 41$. ✓

Question 4 · Easy

A number divided by 3 gives 12. Find the number.

Answer: x = 36

Translate: $x/3 = 12$.

Solve: multiply both sides by 3 → $x = 36$.

Question 5 · Easy

Ana has some stickers. Her friend gives her 15 more, and now she has 42. How many stickers did Ana start with?

Answer: x = 27 stickers

Name: Let x **= starting stickers.**

Translate: starting + 15 = 42 → $x + 15 = 42$.

Solve: $x = 42 - 15 = 27$.

Question 6 · Easy

A pencil costs $2. Lucas buys some pencils and spends a total of $18. How many pencils did he buy?

Answer: x = 9 pencils

Translate: price × quantity = total → $2x = 18$.

Solve: $x = 9$.

Question 7 · Easy

A number, when increased by 8 and then doubled, equals 30. Find the number.

Answer: x = 7

Translate: "increased by 8" → $(x + 8)$**; "then doubled" →** $2(x + 8) = 30$.

Solve: divide both sides by 2 → $x + 8 = 15$**; subtract 8 →** $x = 7$.

Check: $2(7 + 8) = 2(15) = 30$. ✓

Question 8 · Easy

Three times a number equals 20 more than the number itself. Find the number.

Answer: x = 10

Translate: $3x = x + 20$.

Solve: subtract x **from both sides →** $2x = 20$**; divide by 2 →** $x = 10$.

Question 9 · Easy

The sum of two consecutive integers is 47. Find the smaller integer.

Answer: x = 23 (integers are 23 and 24)

Name: Let x = smaller integer, so the next one is $x + 1$.

Translate: $x + (x + 1) = 47$, i.e. $2x + 1 = 47$.

Solve: $2x = 46$, so $x = 23$. The two integers are 23 and 24.

Question 10 · Easy

A taxi charges a $3 flat fee plus $2 per mile. A ride costs $17 total. How many miles was the ride?

Answer: x = 7 miles

Translate: flat fee + (rate)(miles) = total → $3 + 2x = 17$.

Solve: subtract 3 → $2x = 14$; divide by 2 → $x = 7$.

Question 11 · Medium

The sum of three consecutive integers is 72. Find the three integers.

Answer: 23, 24, 25

Name: Let x = smallest, then $x + 1$ and $x + 2$ are the next two.

Translate: $x + (x + 1) + (x + 2) = 72$, so $3x + 3 = 72$.

Solve: $3x = 69$, so $x = 23$. The three integers are 23, 24, 25.

Question 12 · Medium

A father is currently 4 times as old as his son. In 5 years, the father will be 3 times as old as his son. How old is each now?

Answer: son is 10, father is 40

Name: Let x = son's current age. Father is $4x$.

Translate (in 5 years): son will be $x + 5$, father will be $4x + 5$, and father = 3 · son:

$$4x + 5 = 3(x + 5)$$

Solve: $4x + 5 = 3x + 15$ → subtract $3x$ from both sides → $x + 5 = 15$ → $x = 10$. So father is $4(10) = 40$.

Check: in 5 years son is 15, father is 45, and $45 = 3 \cdot 15$. ✓

Question 13 · Medium

One number is 8 more than another. Their sum is 54. Find both numbers.

Answer: 23 and 31

Name: Let x **= smaller number; the larger is** $x + 8$.

Translate: $x + (x + 8) = 54$.

Solve: $2x + 8 = 54 \rightarrow 2x = 46 \rightarrow x = 23$. **Larger =** $23 + 8 = 31$.

Question 14 · Medium

A rectangle's length is 3 more than twice its width. The perimeter is 36. Find the width and length.

Answer: width = 5, length = 13

Name: Let w **= width. Length =** $2w + 3$.

Translate: perimeter = 2(length + width) → $2(w + 2w + 3) = 36$.

Solve: $2(3w + 3) = 36 \rightarrow 6w + 6 = 36 \rightarrow 6w = 30 \rightarrow w = 5$. **Length =** $2(5) + 3 = 13$.

Check: perimeter = $2(13 + 5) = 36$. ✔

Question 15 · Medium

Marta buys 3 notebooks and 2 pens for $19. A notebook costs $3 more than a pen. What is the price of a pen?

Answer: pen = $2, notebook = $5

Name: Let x **= price of a pen. Notebook =** $x + 3$.

Translate: $3(x + 3) + 2x = 19$.

Solve: $3x + 9 + 2x = 19 \rightarrow 5x = 10 \rightarrow x = 2$. **Notebook = $5.**

Check: $3(5) + 2(2) = 15 + 4 = 19$. ✔

Question 16 · Medium

Train A leaves the station going 60 mph. One hour later, Train B leaves the same station going 75 mph in the same direction on a parallel track. How many hours (after B leaves) until B catches up with A?

Answer: 4 hours after B leaves

Name: Let t = time (in hours) after B leaves. Then A has been traveling $t + 1$ hours.

Translate: when B catches A, they have gone the same distance:

$$60(t + 1) = 75t$$

Solve: $60t + 60 = 75t$ → $60 = 15t$ → $t = 4$ **hours.**

Check: A traveled $60(5) = 300$ **miles; B traveled** $75(4) = 300$ **miles.** ✓

Question 17 · Medium

A phone plan charges $20 per month plus $0.10 per minute. Last month's bill was $47. How many minutes were used?

Answer: 270 minutes

Translate: fixed + (rate)(minutes) = total → $20 + 0.10x = 47$.

Solve: subtract 20 → $0.10x = 27$**; divide by 0.10 →** $x = 270$.

Question 18 · Medium

The sum of two numbers is 40. Three times the larger equals five times the smaller. Find the numbers.

Answer: smaller = 15, larger = 25

Name: Let x = smaller; then larger = $40 - x$.

Translate: $3(40 - x) = 5x$.

Solve: $120 - 3x = 5x$ → $120 = 8x$ → $x = 15$**. Larger =** 25.

Check: $3(25) = 75$ **and** $5(15) = 75$. ✓

Question 19 · Medium

Gym A charges a $40 sign-up fee plus $30 per month. Gym B charges $50 per month with no sign-up fee. After how many months do the two plans cost the same?

Answer: 2 months (both cost $100 at that point)

Name: Let `m` = months.

Translate: `40 + 30m = 50m`.

Solve: `40 = 20m` → `m = 2`.

Interpretation: at exactly 2 months the two plans cost the same. After that, Gym A is cheaper (Gym A adds $30/month vs. Gym B $50/month).

Question 20 · Medium

A ferry crosses a river in 30 minutes going with the current and 45 minutes against. The ferry's speed in still water is 12 mph. Find the speed of the current.

Answer: current = 2.4 mph (12/5)

Name: Let `c` = speed of the current, in mph. Downstream speed = `12 + c`; upstream speed = `12 − c`. The distance across the river is the same both ways.

Translate: distance = rate · time, in hours (30 min = 1/2 hr, 45 min = 3/4 hr):

```
(12 + c) · (1/2) = (12 − c) · (3/4)
```

Solve: multiply both sides by 4 → `2(12 + c) = 3(12 − c)` → `24 + 2c = 36 − 3c` → `5c = 12` → `c = 12/5 = 2.4` **mph.**

Question 21 · Medium–Hard

Two pipes together fill a tank in 6 hours. Pipe A alone fills it in 10 hours. How long does pipe B alone take?

Answer: 15 hours

Idea · work rates add. If pipe A fills in 10 hours, its rate is 1/10 of the tank per hour. Similarly, pipe B's rate is `1/b` per hour. Together, in one hour they fill `1/10 + 1/b` of the tank. Together they fill the whole tank in 6 hours, so their combined rate is `1/6` per hour.

Translate:

```
1/10 + 1/b = 1/6
```

Solve: `1/b = 1/6 − 1/10 = 5/30 − 3/30 = 2/30 = 1/15`, **so** `b = 15` **hours.**

Question 22 · Medium–Hard

You have 40 kg of an alloy that is 25% copper. How many kilograms of pure copper must you add to make the alloy 40% copper?

Answer: 10 kg

Idea: track the copper only. Initial copper mass = $0.25 \cdot 40 = 10$ **kg. If we add** x **kg of pure copper, total mass becomes** $40 + x$ **and total copper becomes** $10 + x$**.**

Translate: new percentage = 40%, so

$$(10 + x) / (40 + x) = 0.40$$

Solve: multiply both sides by $(40 + x)$ → $10 + x = 0.40(40 + x) = 16 + 0.40x$ → $0.60x = 6$ → $x = 10$ **kg.**

Check: new copper = 20 kg, new total = 50 kg, and $20/50 = 0.40$**.** ✓

Question 23 · Medium–Hard

A car and a bus leave the same station at the same time, going in opposite directions. The car goes 65 mph and the bus goes 55 mph. After how many hours are they 480 miles apart?

Answer: 4 hours

Idea: when two objects move in opposite directions, their separation increases at a rate equal to the sum of their speeds.

Translate: $65t + 55t = 480$**.**

Solve: $120t = 480$ → $t = 4$ **hours.**

Question 24 · Medium–Hard

A boat travels 24 km downstream in 2 hours and 24 km upstream in 3 hours. Find the boat's speed in still water and the speed of the current.

Answer: boat = 10 km/h, current = 2 km/h

Name: Let b **= boat speed in still water,** c **= current speed.**

Translate: downstream, effective speed = $b + c$**. From** $d = rt$**:** $24 = (b + c)(2)$**, so** $b + c = 12$**. Upstream:** $24 = (b - c)(3)$**, so** $b - c = 8$**.**

Solve the system: add the two equations to eliminate c**:**

$$(b + c) + (b - c) = 12 + 8$$
$$2b = 20$$
$$b = 10$$

Then $c = 12 - 10 = 2$**.**

Question 25 · Medium–Hard

The sum of the digits of a two-digit number is 12. When the digits are reversed, the new number is 18 more than the original. Find the original number.

Answer: 57

Name: Let t = tens digit, u = units digit. Then the original number is $10t + u$ and the reversed number is $10u + t$.

Translate: sum of digits: $t + u = 12$. Reversed exceeds original by 18: $(10u + t) - (10t + u) = 18$ → $9u - 9t = 18$ → $u - t = 2$.

Solve the system: add: $(t + u) + (u - t) = 12 + 2$ → $2u = 14$ → $u = 7$, so $t = 5$. Original number = $10(5) + 7 = 57$.

Check: reversed = 75, and $75 - 57 = 18$. ✓

Question 26 · Hard

A boy has $4.50 in nickels and dimes. He has 3 more dimes than nickels. How many of each coin does he have?

Answer: 28 nickels, 31 dimes

Idea · coin problems: total value = value-per-coin × number of coins, summed over all coin types.

Name: Let n = number of nickels. Dimes = $n + 3$. Convert everything to dollars: nickel = $0.05, dime = $0.10.

Translate: $0.05n + 0.10(n + 3) = 4.50$.

Solve:

```
0.05n + 0.10n + 0.30 = 4.50
0.15n = 4.20
n = 28
```

Dimes = $28 + 3 = 31$.

Check: value = $28(0.05) + 31(0.10) = 1.40 + 3.10 = 4.50$. ✓

Question 27 · Hard

A chemist has a 30% acid solution and a 60% acid solution. How many liters of each are needed to make 30 liters of a 50% acid solution?

Answer: 10 L of 30% and 20 L of 60%

Idea · mixture problems: track the pure substance (acid, in this case). The total acid in the mixture equals the sum of the acid in each component.

Name: Let x **= liters of 30% solution. Then liters of 60% =** $30 - x$**.**

Translate: acid in mixture = acid in solution 1 + acid in solution 2:

$$0.30x + 0.60(30 - x) = 0.50(30)$$
$$0.30x + 18 - 0.60x = 15$$
$$-0.30x = -3$$
$$x = 10$$

So 10 L of 30% + 20 L of 60%.

Check: acid = $0.30(10) + 0.60(20) = 3 + 12 = 15$ **L. And** $15/30 = 0.50$**.** ✔

Question 28 · Hard

A train leaves NYC at 8:00 am going 50 mph. Another train leaves NYC 90 minutes later going 65 mph on the same track in the same direction. At what time does the second train catch the first?

Answer: 2:30 pm (6.5 hours after 8:00 am)

Name: Let t **= hours after 8:00 am. Then train 1 has traveled** $50t$ **miles. Train 2 started at** $t = 1.5$**, so at time** t **it has traveled** $65(t - 1.5)$ **miles.**

Translate: catch-up means equal distances:

$$50t = 65(t - 1.5)$$

Solve: $50t = 65t - 97.5$ **→** $97.5 = 15t$ **→** $t = 6.5$ **hours.**

Convert to time: 8:00 am + 6.5 hours = 2:30 pm.

Question 29 · Hard

A rectangle has perimeter 42. Its length is 3 more than twice its width. Find the area of the rectangle.

Answer: width = 6, length = 15, area = 90

Name: Let w **= width. Length =** $2w + 3$**.**

Translate: perimeter = $2(\text{length} + \text{width}) = 42$**, so** $\text{length} + \text{width} = 21$**, i.e.** $(2w + 3) + w = 21$**.**

Solve: $3w + 3 = 21$ **→** $3w = 18$ **→** $w = 6$**. Length =** $2(6) + 3 = 15$**.**

Area: $6 \cdot 15 = 90$**.**

Question 30 · Hard

A tank is filled by pipe A alone in 12 hours and by pipe B alone in 15 hours. Both pipes are opened together for 4 hours, and then pipe A is shut off. How long does pipe B alone take to finish filling the tank?

Answer: 6 more hours for B alone

Idea · work in stages. Compute how much of the tank is filled in the first 4 hours (both pipes on), subtract from 1, then divide by B's rate.

Stage 1 (both on, 4 hours): combined rate = `1/12 + 1/15 = 5/60 + 4/60 = 9/60 = 3/20` **of the tank per hour. In 4 hours:** `4 · 3/20 = 12/20 = 3/5` **of the tank is filled. Remaining:** `1 − 3/5 = 2/5`.

Stage 2 (B alone): B's rate is `1/15` **per hour. Time to fill remaining** `2/5`**:**

```
(1/15) · t = 2/5
t = (2/5)(15) = 6 hours
```

Answer Key Summary

All 30 answers at a glance.

#	Level	Answer
1	Easy	x = 16
2	Easy	x = 23
3	Easy	x = 9
4	Easy	x = 36
5	Easy	27 stickers
6	Easy	9 pencils
7	Easy	x = 7
8	Easy	x = 10
9	Easy	23, 24
10	Easy	7 miles
11	Medium	23, 24, 25
12	Medium	Son 10, Father 40
13	Medium	23 and 31
14	Medium	Width 5, Length 13
15	Medium	Pen $2, Notebook $5
16	Medium	4 hours after B leaves
17	Medium	270 minutes
18	Medium	15 and 25
19	Medium	2 months
20	Medium	2.4 mph
21	Medium-Hard	15 hours
22	Medium-Hard	10 kg
23	Medium-Hard	4 hours
24	Medium-Hard	Boat 10 km/h, Current 2 km/h
25	Medium-Hard	57
26	Hard	28 nickels, 31 dimes
27	Hard	10 L of 30%, 20 L of 60%

#	Level	Answer
28	Hard	2:30 pm
29	Hard	Area = 90
30	Hard	6 more hours

About SOMATH

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