Solving Linear Equations - Age Problems

Objective: Solve age problems by creating and solving a linear equation.

An application of linear equations is what are called age problems. When we are solving age problems we generally will be comparing the age of two people both now and in the future (or past). Using the clues given in the problem we will be working to find their current age. There can be a lot of information in these problems and we can easily get lost in all the information. To help us organize and solve our problem we will fill out a three by three table for each problem. An example of the basic structure of the table is below

	Age Now	Change
Person 1		
Person 2		

Table 1. Structure of Age Table

Normally where we see "Person 1" and "Person 2" we will use the name of the person we are talking about. We will use this table to set up the following example.

Example 1.

Adam is 20 years younger than Brian. In two years Brian will be twice as old as Adam. How old are they now?

	Age Now	$+2$
Adam		
Brian		

We use Adam and Brian for our persons
We use $+2$ for change because the second phrase is two years in the future

	Age Now	$+2$
Adam	$x - 20$	
Brain	x	

Consider the "Now" part, **Adam is 20 years youger than Brian**. We are given information about Adam, not Brian. So Brian is x now. To show Adam is 20 years younger we subtract 20, Adam is $x - 20$.

	Age Now	$+2$
Adam	$x - 20$	$x - 20 + 2$
Brian	x	$x + 2$

Now the $+2$ column is filled in. This is done by adding 2 to both Adam's and Brian's now column as shown in the table.

	Age Now	$+2$
Adam	$x - 20$	$x - 18$
Brian	x	$x + 2$

Combine like terms in Adam's future age: $-20 + 2$
This table is now filled out and we are ready to try and solve.

$$B = 2A$$

Our equation comes from the future statement:
Brian will be twice as old as Adam. This means the younger, Adam, needs to be multiplied by 2.

$$(x+2) = 2(x-18)$$

Replace B and A with the information in their future cells, Adam (A) is replaced with $x - 18$ and Brian (B) is replaced with $(x+2)$ This is the equation to solve!

$$x + 2 = 2x - 36$$ Distribute through parenthesis

$$\underline{-\boldsymbol{x} \qquad -\boldsymbol{x}}$$ Subtract x from both sides to get variable on one side

$$2 = x - 36$$ Need to clear the -36

$$\underline{+\,\boldsymbol{36} \qquad +\,\boldsymbol{36}}$$ Add 36 to both sides

$$38 = x$$ Our solution for x

	Age now
Adam	$38 - 20 = 18$
Brian	38

The first column will help us answer the question. Replace the $x's$ with 38 and simplify.
Adam is 18 and Brian is 38

Solving age problems can be summarized in the following five steps. These five steps are guidelines to help organize the problem we are trying to solve.

1. Fill in the now column. The person we know nothing about is x.

2. Fill in the future/past collumn by adding/subtracting the change to the now column.

3. Make an equation for the relationship in the future. This is independent of the table.

4. Replace variables in equation with information in future cells of table

5. Solve the equation for x, use the solution to answer the question

These five steps can be seen illustrated in the following example.

Example 2.

Carmen is 12 years older than David. Five years ago the sum of their ages was 28. How old are they now?

	Age Now	-5
Carmen		
David		

Five years ago is -5 in the change column.

	Age Now	-5
Carmen	$x + 12$	
David	x	

Carmen is 12 years older than David. We don$'t$ know about David so he is x, Carmen then is $x + 12$

	Age Now	-5
Carmen	$x + 12$	$x + 12 - 5$
David	x	$x - 5$

Subtract 5 from now column to get the change

	Age Now	-5
Carmen	$x+12$	$x+7$
David	x	$x-5$

Simplify by combining like terms $12-5$
Our table is ready!

$$C+D=28$$ The sum of their ages will be 29. So we add C and D

$$(x+7)+(x-5)=28$$ Replace C and D with the change cells.

$$x+7+x-5=28$$ Remove parenthesis

$$2x+2=28$$ Combine like terms $x+x$ and $7-5$

$$\underline{-2\quad-2}$$ Subtract 2 from both sides

$$2x=26$$ Notice x is multiplied by 2

$$\overline{2\quad\ 2}$$ Divide both sides by 2

$$x=13$$ Our solution for x

	Age Now
Caremen	$13+12=25$
David	13

Replace x with 13 to answer the question
Carmen is 25 and David is 13

Sometimes we are given the sum of their ages right now. These problems can be tricky. In this case we will write the sum above the now column and make the first person's age now x. The second person will then turn into the subtraction problem total $-x$. This is shown in the next example.

Example 3.

The sum of the ages of Nicole and Kristin is 32. In two years Nicole will be three times as old as Kristin. How old are they now?

	Age Now	$+2$
Nicole	x	
Kristen	$32-x$	

32 (above Age Now)

The change is $+2$ for two years in the future
The total is placed above Age Now
The first person is x. The second becomes $32-x$

	Age Now	$+2$
Nicole	x	$x+2$
Kristen	$32-x$	$32-x+2$

Add 2 to each cell fill in the change column

	Age Now	$+2$
Nicole	x	$x+2$
Kristen	$32-x$	$34-x$

Combine like terms $32+2$, our table is done!

$$N=3K$$ Nicole is three times as old as Kristin.

$$(x+2)=3(34-x)$$ Replace variables with information in change cells

$$x+2=102-3x$$ Distribute through parenthesis

$$\underline{+3x\qquad\quad+3x}$$ Add $3x$ to both sides so variable is only on one side

$$4x+2=102$$ Solve the two $-$ step equation

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$$-\,\mathbf{2} \quad -\,\mathbf{2} \qquad \text{Subtract 2 from both sides}$$
$$4x = 100 \qquad \text{The variable is multiplied by 4}$$
$$\overline{\quad \mathbf{4} \quad \mathbf{4} \quad} \qquad \text{Divide both sides by 4}$$
$$x = 25 \qquad \text{Our solution for } x$$

	Age Now
Nicole	25
Kristen	$32 - 25 = 7$

Plug 25 in for x in the now column
Nicole is 25 and Kristin is 7

A slight variation on age problems is to ask not how old the people are, but rather ask how long until we have some relationship about their ages. In this case we alter our table slightly. In the change column because we don't know the time to add or subtract we will use a variable, t, and add or subtract this from the now column. This is shown in the next example.

Example 4.

Louis is 26 years old. Her daughter is 4 years old. In how many years will Louis be double her daughter's age?

	Age Now	$+t$
Louis	26	
Daughter	4	

As we are given their ages now, these numbers go into the table. The change is unknown, so we write $+t$ for the change

	Age Now	$+t$
Louis	26	$26+t$
Daughter	4	$4+t$

Fill in the change column by adding t to each person's age. Our table is now complete.

$$L = 2D \qquad \text{Louis will be double her daughter}$$
$$(26 + t) = 2(4 + t) \qquad \text{Replace variables with information in change cells}$$
$$26 + t = 8 + 2t \qquad \text{Distribute through parenthesis}$$
$$\underline{-\,\boldsymbol{t} \qquad -\,\boldsymbol{t}} \qquad \text{Subtract } t \text{ from both sides}$$
$$26 = 8 + t \qquad \text{Now we have an 8 added to the } t$$
$$\underline{-\,\mathbf{8} - \mathbf{8}} \qquad \text{Subtract 8 from both sides}$$
$$18 = t \qquad \text{In 18 years she will be double her daughter's age}$$

Age problems have several steps to them. However, if we take the time to work through each of the steps carefully, keeping the information organized, the problems can be solved quite nicely.

World View Note: The oldest man in the world was Shigechiyo Izumi from Japan who lived to be 120 years, 237 days. However, his exact age has been disputed.

1.9 Practice - Age Problems

1. A boy is 10 years older than his brother. In 4 years he will be twice as old as his brother. Find the present age of each.

2. A father is 4 times as old as his son. In 20 years the father will be twice as old as his son. Find the present age of each.

3. Pat is 20 years older than his son James. In two years Pat will be twice as old as James. How old are they now?

4. Diane is 23 years older than her daughter Amy. In 6 years Diane will be twice as old as Amy. How old are they now?

5. Fred is 4 years older than Barney. Five years ago the sum of their ages was 48. How old are they now?

6. John is four times as old as Martha. Five years ago the sum of their ages was 50. How old are they now?

7. Tim is 5 years older than JoAnn. Six years from now the sum of their ages will be 79. How old are they now?

8. Jack is twice as old as Lacy. In three years the sum of their ages will be 54. How old are they now?

9. The sum of the ages of John and Mary is 32. Four years ago, John was twice as old as Mary. Find the present age of each.

10. The sum of the ages of a father and son is 56. Four years ago the father was 3 times as old as the son. Find the present age of each.

11. The sum of the ages of a china plate and a glass plate is 16 years. Four years ago the china plate was three times the age of the glass plate. Find the

present age of each plate.

12. The sum of the ages of a wood plaque and a bronze plaque is 20 years. Four years ago, the bronze plaque was one-half the age of the wood plaque. Find the present age of each plaque.

13. A is now 34 years old, and B is 4 years old. In how many years will A be twice as old as B?

14. A man's age is 36 and that of his daughter is 3 years. In how many years will the man be 4 times as old as his daughter?

15. An Oriental rug is 52 years old and a Persian rug is 16 years old. How many years ago was the Oriental rug four times as old as the Persian Rug?

16. A log cabin quilt is 24 years old and a friendship quilt is 6 years old. In how may years will the log cabin quilt be three times as old as the friendship quilt?

17. The age of the older of two boys is twice that of the younger; 5 years ago it was three times that of the younger. Find the age of each.

18. A pitcher is 30 years old, and a vase is 22 years old. How many years ago was the pitcher twice as old as the vase?

19. Marge is twice as old as Consuelo. The sum of their ages seven years ago was 13. How old are they now?

20. The sum of Jason and Mandy's age is 35. Ten years ago Jason was double Mandy's age. How old are they now?

21. A silver coin is 28 years older than a bronze coin. In 6 years, the silver coin will be twice as old as the bronze coin. Find the present age of each coin.

22. A sofa is 12 years old and a table is 36 years old. In how many years will the table be twice as old as the sofa?

23. A limestone statue is 56 years older than a marble statue. In 12 years, the limestone will be three times as old as the marble statue. Find the present age of the statues.

24. A pewter bowl is 8 years old, and a silver bowl is 22 years old. In how many years will the silver bowl be twice the age of the pewter bowl?

25. Brandon is 9 years older than Ronda. In four years the sum of their ages will be 91. How old are they now?

26. A kerosene lamp is 95 years old, and an electric lamp is 55 years old. How

many years ago was the kerosene lamp twice the age of the electric lamp?

27. A father is three times as old as his son, and his daughter is 3 years younger than the son. If the sum of their ages 3 years ago was 63 years, find the present age of the father.

28. The sum of Clyde and Wendy's age is 64. In four years, Wendy will be three times as old as Clyde. How old are they now?

29. The sum of the ages of two ships is 12 years. Two years ago, the age of the older ship was three times the age of the newer ship. Find the present age of each ship.

30. Chelsea's age is double Daniel's age. Eight years ago the sum of their ages was 32. How old are they now?

31. Ann is eighteen years older than her son. One year ago, she was three times as old as her son. How old are they now?

32. The sum of the ages of Kristen and Ben is 32. Four years ago Kristen was twice as old as Ben. How old are they both now?

33. A mosaic is 74 years older than the engraving. Thirty years ago, the mosaic was three times as old as the engraving. Find the present age of each.

34. The sum of the ages of Elli and Dan is 56. Four years ago Elli was 3 times as old as Dan. How old are they now?

35. A wool tapestry is 32 years older than a linen tapestry. Twenty years ago, the wool tapestry was twice as old as the linen tapestry. Find the present age of each.

36. Carolyn's age is triple her daughter's age. In eight years the sum of their ages will be 72. How old are they now?

37. Nicole is 26 years old. Emma is 2 years old. In how many years will Nicole be triple Emma's age?

38. The sum of the ages of two children is 16 years. Four years ago, the age of the older child was three times the age of the younger child. Find the present age of each child.

39. Mike is 4 years older than Ron. In two years, the sum of their ages will be 84. How old are they now?

40. A marble bust is 25 years old, and a terra-cotta bust is 85 years old. In how many years will the terra-cotta bust be three times as old as the marble bust?

Answers - Age Problems

1) 6, 16	15) 4	29) 8, 4
2) 10, 40	16) 3	30) 16, 32
3) 18, 38	17) 10, 20	31) 10, 28
4) 17, 40	18) 14	
5) 27, 31	19) 9, 18	32) 12,20
6) 12, 48	20) 15, 20	33) 141, 67
7) 31, 36	21) 50, 22	34) 16, 40
8) 16, 32	22) 12	35) 84, 52
9) 12, 20	23) 72, 16	36) 14, 42
10) 40, 16	24) 6	37) 10
11) 10, 6	25) 37, 46	
12) 12, 8	26) 15	38) 10, 6
13) 26	27) 45	39) 38, 42
14) 8	28) 14, 54	40) 5