Math Virtual Learning

HS/Essential Math II

April 28, 2020

High School/Essentials of Algebra Course 2
Lesson: April 22, 2020(U5L7 Solving Equations One Chunk at a Time)

Objective/Learning Target:

Solve equations using properties of operations & the logic of preserving equality - solving systems.

MENTAL MATHEMATICS

PURPOSE

Repeating what one has done before can feel stagnating, or it can be a chance to develop & notice one's competence. The utility of challenge in multiplying by 5 warrants an extra day.

Mental Math * Activity 10: Multiplying by 5

Multiply each yellow number by 5, next slide answer key.

22	
2.4	
4.8	
30	
16	

7.2	
21	
4.1	
9.2	
84	

2.6	
4.7	
26	
50	
6.4	

32	
14	
18	
58	
9.2	

Mental Math * Activity 10: Multiplying by 5

22	110
2.4	12
4.8	24
30	150
16	80

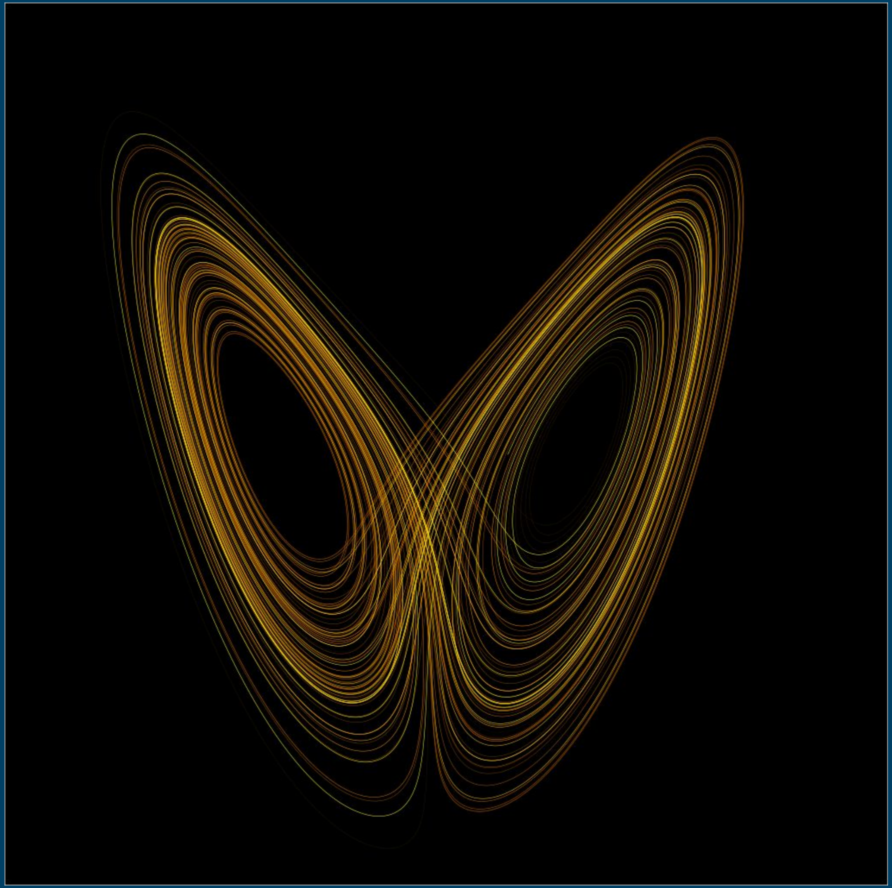
7.2	36
21	105
4.1	20.5
9.2	46
84	420

2.6	13
4.7	23.5
26	130
50	250
6.4	32

32	160
14	70
18	90
58	290
9.2	46

Unit 5 Lesson 8:

Solving with Systems



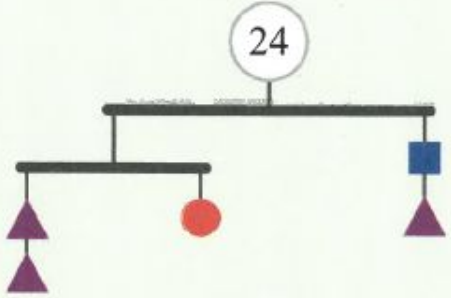
IMPORTANT STUFF

A **system of equations** is a set of equations that all use the same set of variables. Solving a system of equations means finding one value for each of the variables in a way that makes all of the equations true simultaneously. For example, this system has the solution $c = 6$, $t = 3$, and $q = 9$:

$$3t + c + q = 24$$
$$2t + c = 12$$
$$c = 2t$$

Solving a system of equations is a lot like solving a mobile puzzle. In fact, this system of equations matches the mobile in problem 1. Can you see where each equation appears in the mobile?

(1)



● = ______ ▲ = ______ ■ = ______

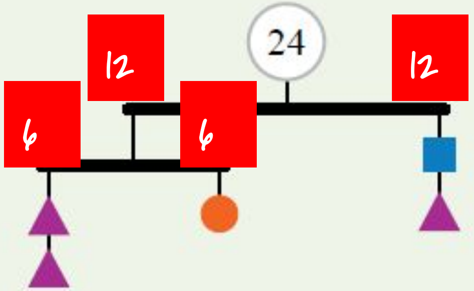
Use the mobile and the key to write an algebraic equation for each description below.

Key: ● = *c* ▲ = *t* ■ = *q*

(2) The shapes on the two left strings balance the shapes on the right string.

$2t + c =$

(3) All of the shapes on the mobile together weigh 24 units.

① 

● = 6 ▲ = 3 ■ = 9

Use the mobile and the key to write an algebraic equation for each description below.

Key: ● = c ▲ = t ■ = q

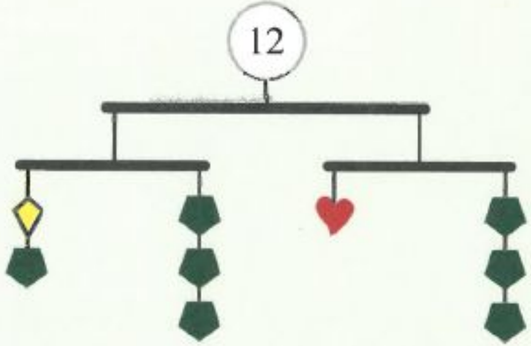
② The shapes on the two left strings balance the shapes on the right string.

$2t + c = q + t$

③ All of the shapes on the mobile together weigh 24 units.

$3t + c + q = 24$

④



= ______ = ______ = ______

Again, use the mobile and the key to write an algebraic equation for each description below.

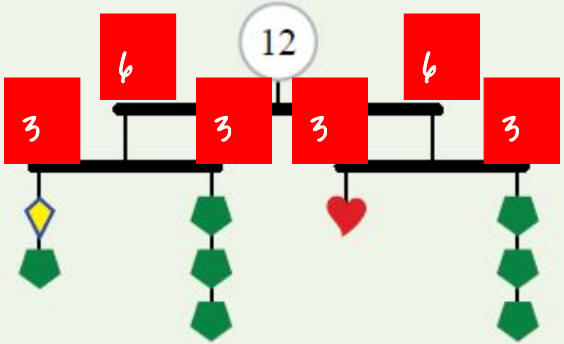
Key: = h = k = p

⑤ All of the shapes hanging from the left beam balance all of the shapes on the right beam.

⑥ On the right beam, the shapes on the left string balance the shapes on the right string.

$h =$

4



♥ = 3 ◊ = 2 ⬟ = 1

Again, use the mobile and the key to write an algebraic equation for each description below.

Key: ♥ = *h* ◊ = *k* ⬟ = *p*

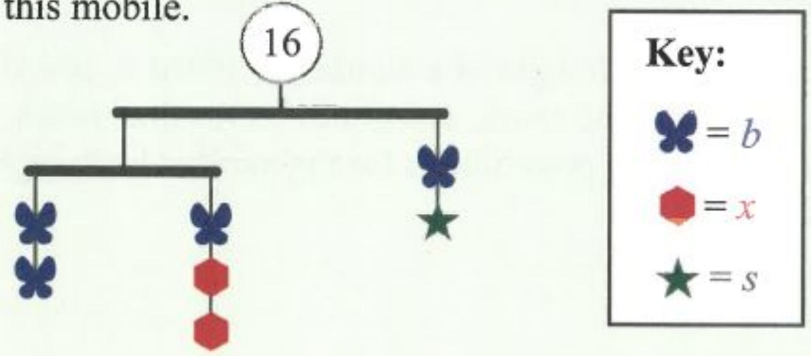
5 All of the shapes hanging from the left beam balance all of the shapes on the right beam.

$k + 4p = h + 3p$

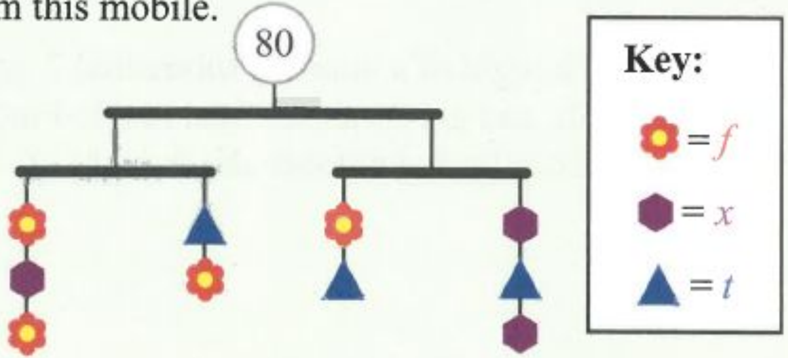
6 On the right beam, the shapes on the left string balance the shapes on the right string.

$h = 3p$

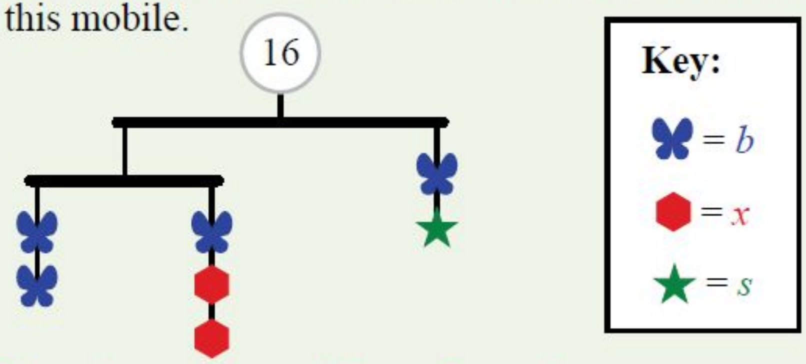
⑦ Write *two* different equations that can be written from this mobile.



⑧ Write *three* different equations that can be written from this mobile.



(7) Write *two* different equations that can be written from this mobile.

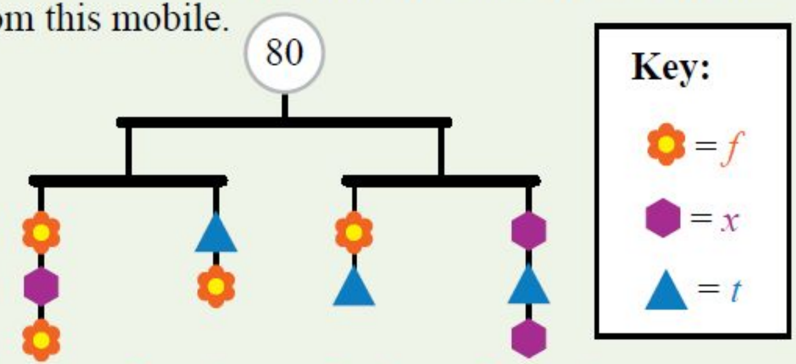


$2b = b + 2x$ $3b + 2x = b + s$

$b = 2x$ $3b = s$

(Many possible responses. Examples shown.)

(8) Write *three* different equations that can be written from this mobile.



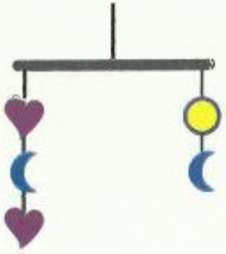
$2f + x = f + t$ $f + t = 2x + t$

$f + x = t$ $f = 2x$

$3f + x + t = 2x + f + 2t$

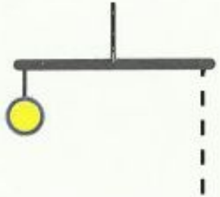
⑨ This mobile balances.

This mobile balances, too.



Key: ○ = *c* ♥ = *h* ☾ = *m*

ⓐ Draw the right number of *hearts* to make this balance.



ⓑ Draw the right number of *hearts* to make this balance.

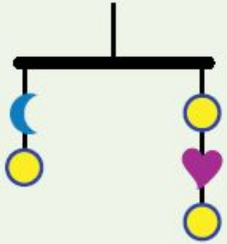
ⓒ Draw the right number of *circles* to make this balance.

ⓓ How many hearts will balance ☾ + ○ ?

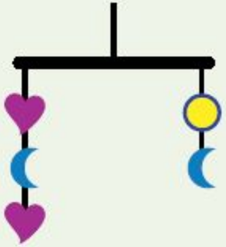
ⓔ If ☾ + ○ = 10, what do each of the shapes weigh?

♥ = ___ ○ = ___ ☾ = ___

(9) This mobile balances.

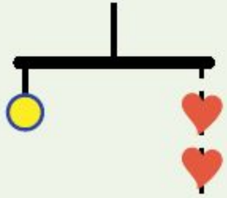


This mobile balances, too.

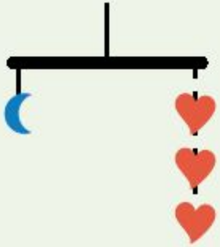


Key: = c = h = m

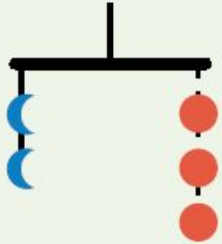
(a) Draw the right number of *hearts* to make this balance.



(b) Draw the right number of *hearts* to make this balance.



(c) Draw the right number of *circles* to make this balance.



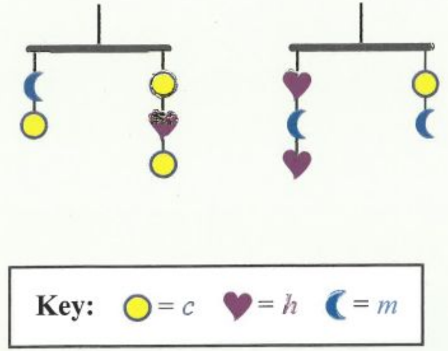
(d) How many hearts will balance + ? 5

(e) If + = 10, what do each of the shapes weigh?

= 2 = 4 = 6

This mobile balances.

This mobile balances, too.



There are many good ways to solve the mobile problem and many good ways to solve the system of equations. For example, you might recognize that these two equations both have a side that says "*m* + *c*."

⑩ From the first mobile we get:

$$m + c = 2c + \_\_\_\_$$

⑪ From the second mobile we get:

$$2h + m = \_\_\_\_\_\_$$

⑫ Combining our equations we get:

$$2c + \_\_\_ = 2h + \_\_\_$$

⑬ We can rewrite this as:

$$2c = \_\_\_\_\_\_$$

When you see a system of equations, remember the kind of thinking you use to solve mobile puzzles. Look for expressions that you can substitute in other places that might be helpful, and if you find a dead end, back up and try something else.

(10) From the first mobile we get:

$m + c = 2c + \underline{h}$

There are many good ways to solve the mobile problem and many good ways to solve the system of equations. For example, you might recognize that these two equations both have a side that says "*m* + *c*."

(11) From the second mobile we get:

$2h + m = \underline{c + m}$

(12) Combining our equations we get:

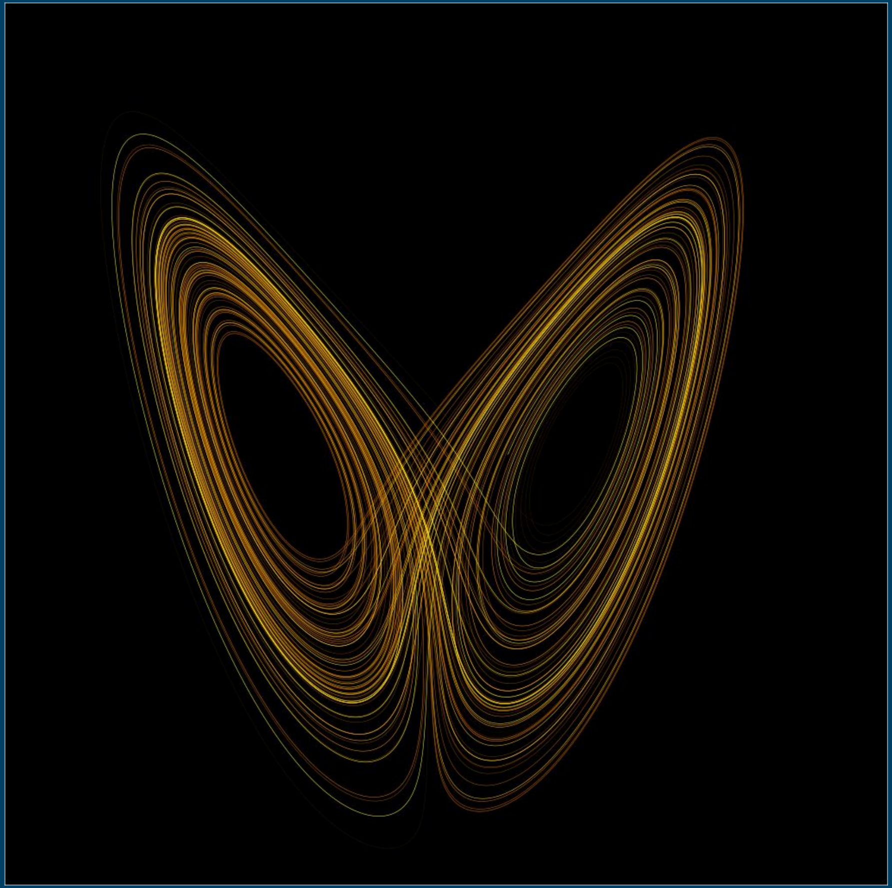
$2c + \underline{h} = 2h + \underline{m}$

(13) We can rewrite this as:

$2c = \underline{h + m}$

When you see a system of equations, remember the kind of thinking you use to solve mobile puzzles. Look for expressions that you can substitute in other places that might be helpful, and if you find a dead end, back up and try something else.

Stuff to Make You Think…



(20) What could ⬡, ★, ⬟, ▲, and ✿ be if all the shapes are *different* single-digit numbers (0-9)?

⬡ $\cdot$ ★ = ★

⬡ + ⬡ = ★

⬡ + ★ = ⬟

⬟ + ⬟ = ▲

⬟ $\cdot$ ⬟ = ✿

⬡ = ______

★ = ______

⬟ = ______

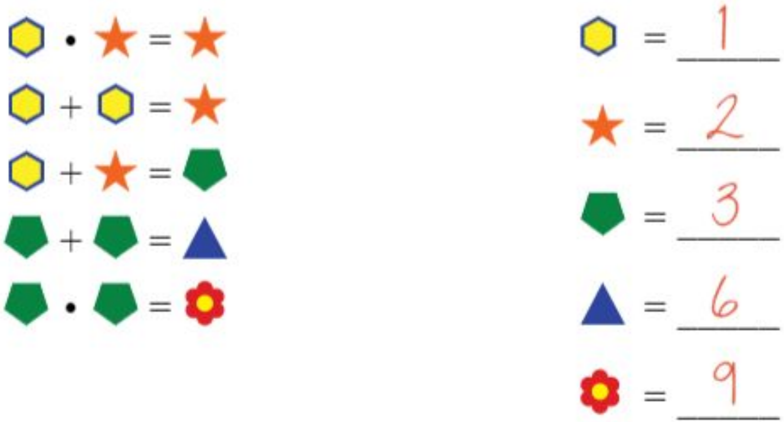
▲ = ______

✿ = ______

(21) MysteryGrid **5, 6, 7, 8**

42, •		40, •	
5 **5**	21, +		
56, •	30, •		48, •
	35, •		

⑳ What could  be if all the shapes are *different* single-digit numbers (0-9)?



㉑ MysteryGrid **5, 6, 7, 8**

42, • 6	7	40, • 8	5
5 5	21, + 8	6	7
56, • 7	30, • 6	5	48, • 8
8	35, • 5	7	6

(22) $3x = z$ $x =$ ____

$4y = z$ $y =$ ____

$xy = z$ $z =$ ____

(23) $3c = b$ $a =$ ____

$a + 1 = b$ $b =$ ____

$2c + 2 = a$ $c =$ ____

(22) $3x = z$

$4y = z$

$xy = z$

Use substitution property to solve for x and y then solve for z

$x = \underline{4}$

$y = \underline{3}$

$z = \underline{12}$

(23) $3c = b$

$a + 1 = b$

$2c + 2 = a$

Use substitution property to solve for b, then c

$a = \underline{8}$

$b = \underline{9}$

$c = \underline{3}$

#22. Since xy = z it is true by substitution 3x = xy, then solving for x, y = 3
Since xy = z it is true by substitution 4y = xy, then solving for y, x =4
Substituting x = 4 and y = 3 into xy = z then z = 12

#23. Since a = 2c +2, substitute for a into a + 1 = b to get 2c+2+1 = b or 2c+3 = b
Now substitute for b into 3c = b to get 3c = 2c + 3, then solving for c, c = 3
Substitute c = 3 into 3c = b to get b = 9
Substitute c = 3 into 2c +2 = a, to get 8
OR substitute b =9 into a + 1 = b , to get a = 8

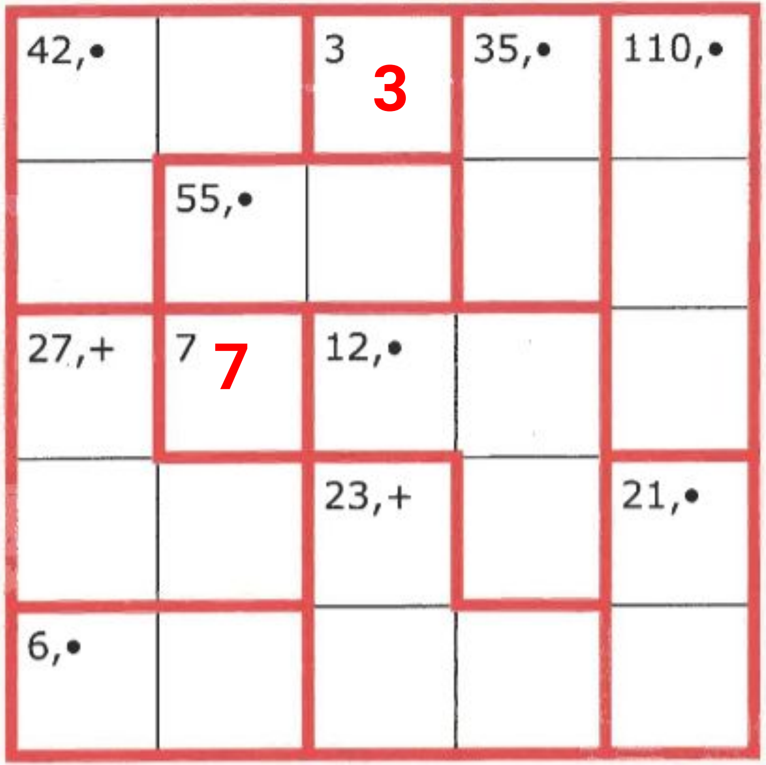
(24)

$r + s = t$ $\qquad$ $r =$ ____

$rs - 1 = t$ $\qquad$ $s =$ ____

$2s = t + 1$ $\qquad$ $t =$ ____

(25) MysteryGrid **2, 3, 5, 7, 11**



(24) $r + s = t$ $r =$ 2

$rs - 1 = t$ $s =$ 3

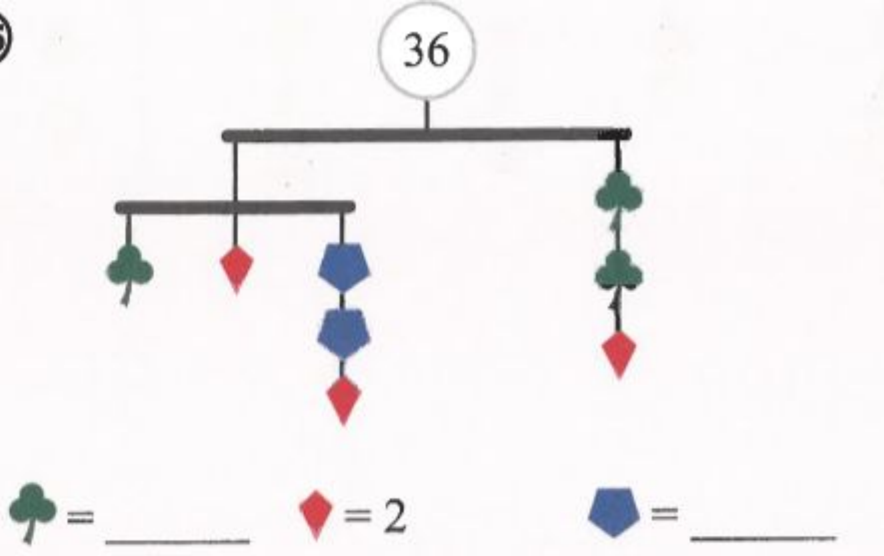
$2s = t + 1$ $t =$ 5

- **Substitute second equation into third equation and solve for r, so 2s = rs - 1 +1, and dividing by s, r = 2**
- **Since first equation and second equation are both equal to t, r + s = rs -1 then substitute r = 2 to get 2 + s = 2s - 1 and solve for s to get s = 3**
- **Substitute s = 3 into 2s = t + 1, to get t = 5**

(25) MysteryGrid **2, 3, 5, 7, 11**

42,• 7	2	3 3	35,• 5	110,• 11
3	55,• 5	11	7	2
27,+ 11	7 7	12,• 2	3	5
5	11	23,+ 7	2	21,• 3
6,• 2	3	5	11	7

(26)

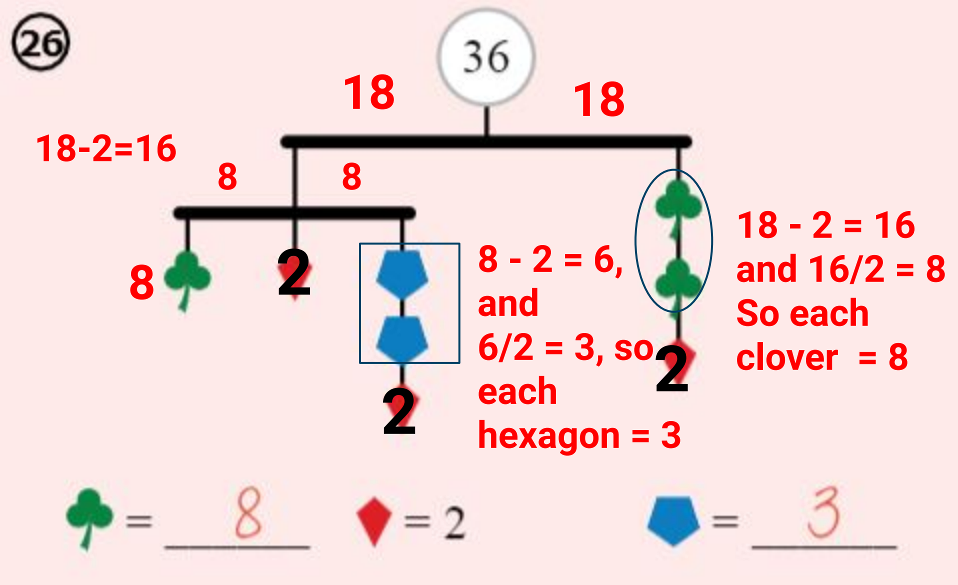


(27)

Who Am I?

- $t \geq u$
- The sum of my digits is 11.
- The product of my digits is 18.

t	u



27

Who Am I?

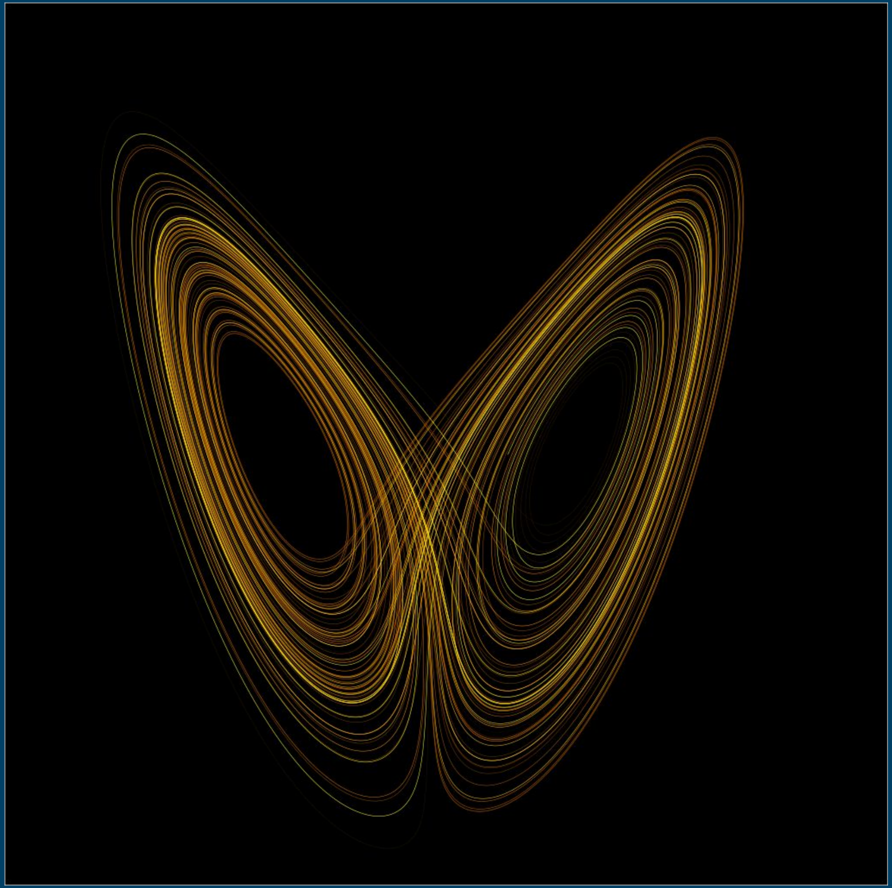
- $t \geq u$
- The sum of my digits is 11.
- The product of my digits is 18.

t	u
9	2

#27.

- The tens is larger than or equal to the units
- Tens + Units = 11, so options are 9 & 2, 8 & 3, 7 & 4, 6 & 5
- Tens times Units must equal 18, so the only option is the 9 & 2
- Since units is larger the number is 92

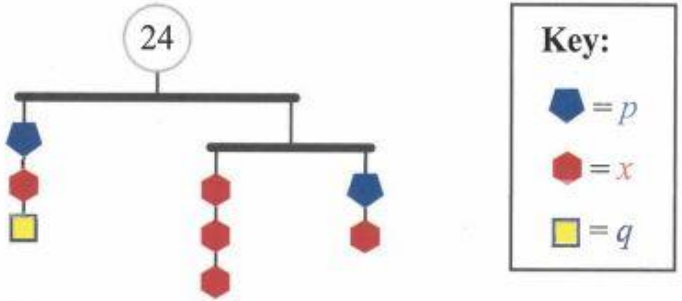
Additional Practice



Additional Practice 1

Additional Practice

A Write an equation to match each description.



(i) The shapes on the upper left string balance all the shapes on the two right strings.

$p + x + q =$

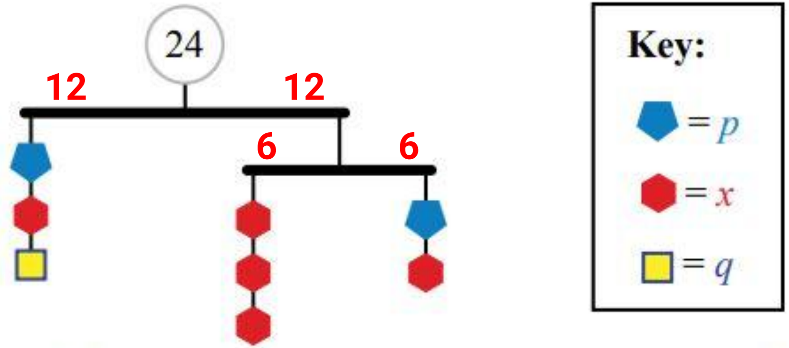
(ii) Together, all of the shapes hanging from the right two strings weigh 12 units.

Find the weights of the shapes in the mobile above.

B = ______ = ______ = ______

Additional Practice 1 Key

(A) Write an equation to match each description.



(i) The shapes on the upper left string balance all the shapes on the two right strings.

$p + x + q = 4x + p$

(ii) Together, all of the shapes hanging from the right two strings weigh 12 units.

$4x + p = 12$

Find the weights of the shapes in the mobile above.

(B) = 2 = 4 = 6

Work with what you know first. You know that 24/2=12, so the first divide HAS to be 12 on both sides

You also know that 12/2=6 so the second subdivide MUST be 6 to each side

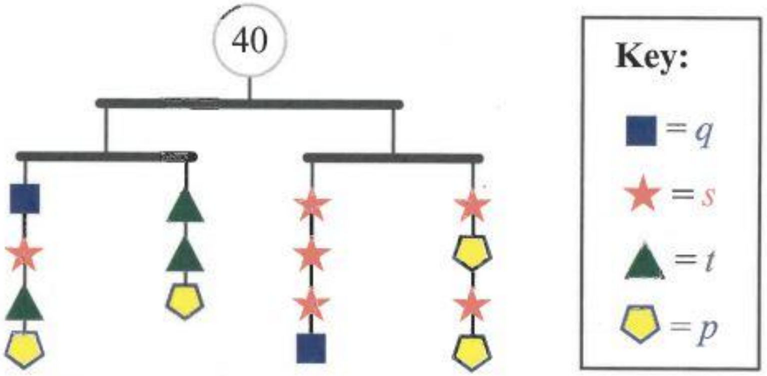
Go to the side that is all the same, the string that looks like a bunch of stop signs. 6/3=2, so x is worth 2

Right side: We know that 6-2 is 4, so p=4

Plug the numbers in on the left side and we find that 12-4 = 8 and 8-2=6 SO the square or q must be 6

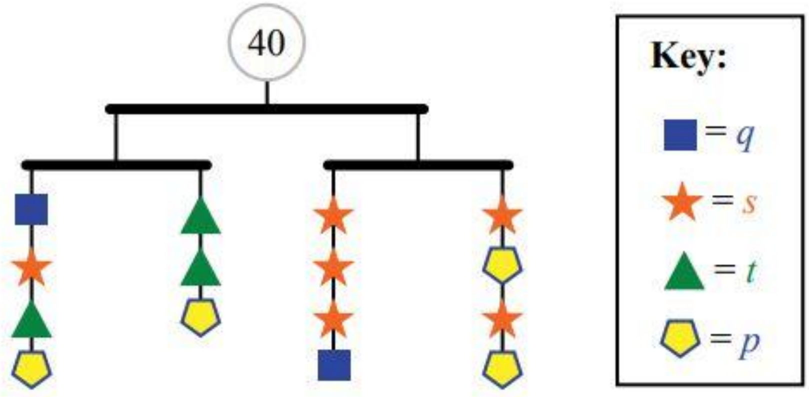
Additional Practice 2

Ⓒ Write *three* different equations using this mobile.



Additional Practice 2 Key

(c) Write *three* different equations using this mobile.



(Many possible responses. Examples shown.)

$q+s+t+p=2t+p$ $\quad$ $3s+q=2s+2p$

$q+s+t+p=10$ $\quad$ $3s+q=10$

$2t+p=10$ $\quad$ $2q+6s+3t+4p=40$

Additional Practice 3

In each problem, **write only the instruction that was performed last.** You can refer to the result of all the earlier instructions just by saying "the result."

45. $4 - \frac{k-3}{2}$

Subtract the result from ______________________

46. $7(m + 8)$

____

47. $10 - 4h$

____

48. $\frac{5(p+2)-1}{3}$

____

Additional Practice 3 Key

45. $4 - \frac{k-3}{2}$

Subtract the result from 4.

46. $7(m + 8)$

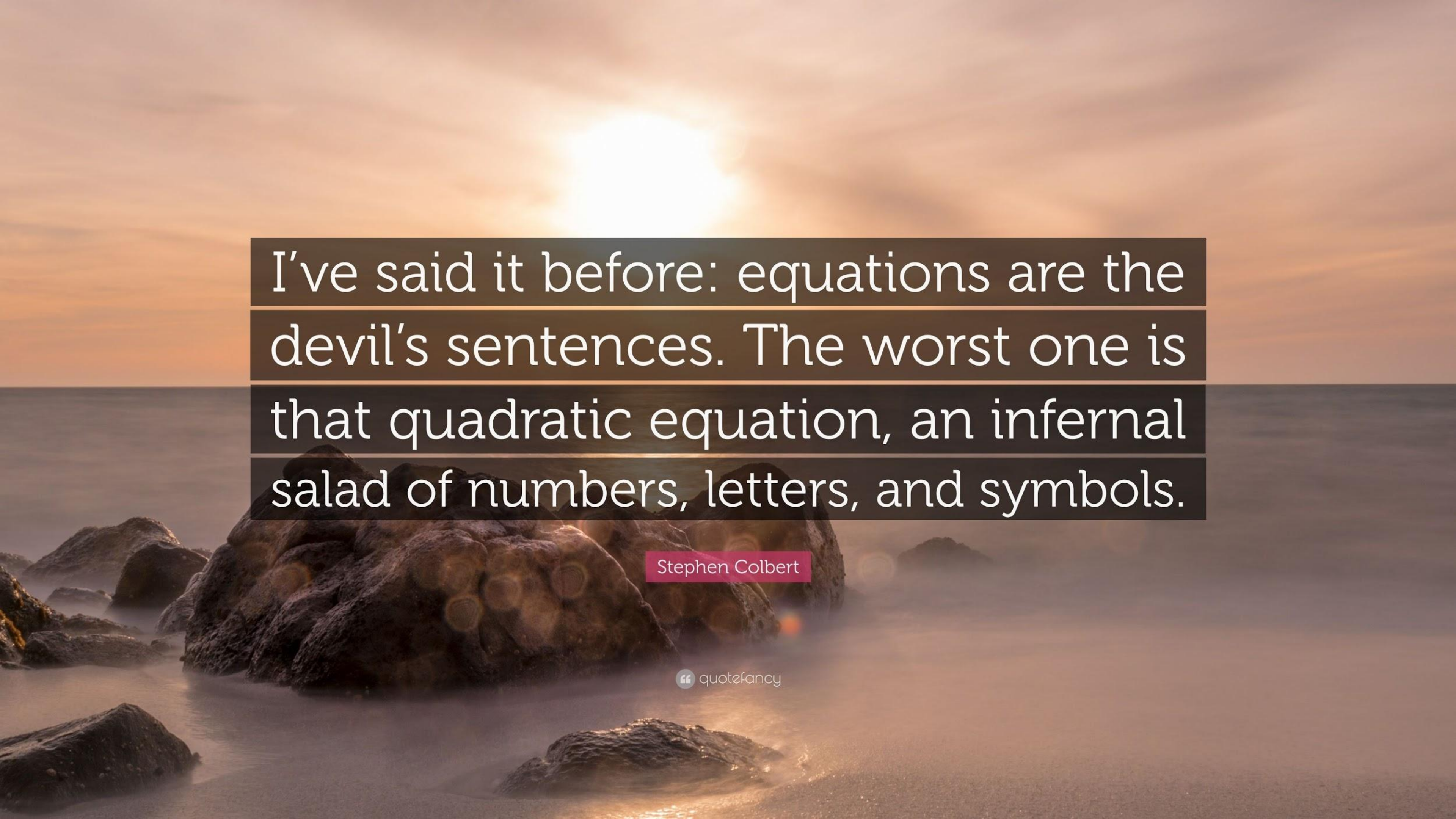
Multiply the result by 7.

47. $10 - 4h$

Subtract the result from 10.

48. $\frac{5(p+2)-1}{3}$

Divide the result by 3.


I’ve said it before: equations are the devil’s sentences. The worst one is that quadratic equation, an infernal salad of numbers, letters, and symbols.
Stephen Colbert
quotefancy

Additional Resources

Solve equations using properties of operations & the logic of preserving equality - solving systems.

CLICK THE LINKS for ADDITIONAL PRACTICE:

SolveMe Mobiles

Who Am I? Puzzles

Solve Me Mystery Grids