What to bring to class:
Ask students to bring PM 4A and 5A.

## 4.2 – Identities, Properties, Rules

Algebraic Identities are equations which are true no matter which numbers their letters represent.

$$3x + 8x + 5 - 2 = 11x + 3$$

Teaching Sequence: Ex: Commutative Prop

1) Principle – we can add in either order
2) Examples – $3 + 5 = 5 + 3$ etc
3) Precise Statements – $a + b = b + a$ for whole #'s a + b.

– without algebra we cannot say exactly what we want to.

say: algebra is sometimes needed as a language to talk about arithmetic; necessary teacher knowledge.

Arithmetic Properties: For any whole numbers a, b, c

1) Commutative ⟹ $a + b = b + a$ or $ab = ba$
2) Associative $a + (b + c) = (a + b) + c$ or $a(bc) = (ab)c$
   (1) & (2) any order property, but no precise way to say
3) Distributive $a(b + c) = ab + ac$
4) Additive & Multiplicative Identities: $a + 0 = a$
   $a \cdot 1 = a$

These are still statements about numbers!

Arithmetic Properties are foundational identities:
* describe basic ways numbers behave
* all other identities can be derived from them.

From Arithmetic Prop get:

1) <u>Rules</u> = identities so simple & useful that they are worth memorizing.

say: "Rule" means "without exception" not "prescribed law"

Ex: $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$ "invert & multiply" (ch 6)

$(-a)(-b) = ab$ (ch 8)

2) <u>Others</u> – not worth memorizing

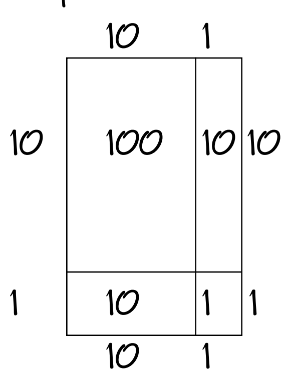
Ex:
$$
\begin{aligned}
6k(5x+3) + 2kx &= 30kx + 18k + 2kx && \text{DP} \\
&= 30kx + 2kx + 18k && \text{Comm} \\
&= (30+2)kx + 18k && \text{DP} \\
&= 32kx + 18k
\end{aligned}
$$

In prealgebra identities are obtained from:

* Models
* Examples $\frac{a}{b} \div \frac{c}{d} = \frac{ad}{bc} \longleftrightarrow \frac{1}{3} \div \frac{4}{7} = \frac{7}{3 \cdot 4}$ (try it! / generalize it.)
* derived from properties.

<u>Ex:</u> $(a+b)^2$

<u>Step 1</u>: Find $11^2 = (10+1)^2$




$11^2 = (10+1)^2 = 100 + 2 \cdot 10 + 1 = 121$

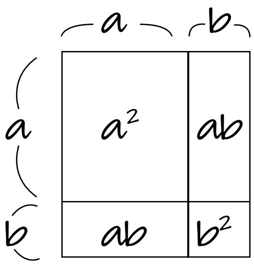
Similarly:

$21^2 = (20+1)^2 = 400 + 2 \cdot 20 + 1 = 441$

$41^2 = 1600 + 2 \cdot 40 + 1 = 1681$

$61^2 =$ ____.

Step 2: Find $(a+b)(a+b)$




$(a+b)(a+b) = (a+b)\,a + (a+b)\,b$ DP

$= a^2 + ba + ab + b^2$ DP

$= a^2 + 2ab + b^2$ CP

agree!

Mental Math

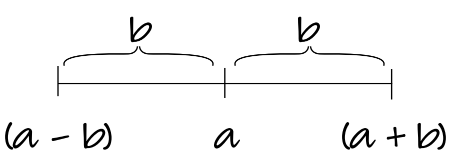
$(32)^2 = (30+2)^2 = 900 + 2\cdot 60 + 4 = 1024$

$(24)^2 = 400 + 2\cdot 80 + 16 = 576$

students try 30 sec.

Ex 2: $(a+b)(a-b) = a^2 - b^2$

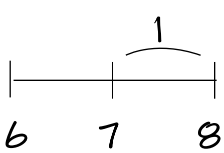
Mental Math use: Given $a+b$ & $a-b$




average = a

distance from average = b

Ex:




$6 \times 8 = 7^2 - 1^2 = 49 - 1 = 48$

average of 6 & 8 (7); distance from average (1)

$9 \times 7 = 8^2 - 1^2 = 63$

$8 \times 12 = 10^2 - 2^2 = 96$

$14 \times 16 = 15^2 - 1^2 = 225 - 1 = 224$

$38 \times 42 = 40^2 - 2^2 = 1600 - 4 = 1596$

$13 \times 17 = 15^2 - 2^2 = 221$

Special case of "double distributive property"

Ex: $(a + b)(c + d) = (a + b)c + (a + b)d$ DP

$= ac + bc + ad + bd$ DP

Do not use "FOIL" (say: first, outer, inner, last)

Does not generalize $(a + b + c)(x + y) = ?$

Students should learn Distributive Property!

HW Read 4.2, Do HW #17