Linear Equations (unknowns on both sides)

Starter

1. **(Review of last lesson)** Convert these units to the ones stated:
   (a) 0.056 m³ to cm³ (b) 290000 mm² to m²

Working: (a) To convert from **m** to **cm** we **multiply** by 100.
So to convert from **m³** to **cm³** we **multiply** by 100^3.

$$\therefore 0.056 \text{ m}^3 \equiv 0.056 \times 100^3 \text{ cm}^3$$
$$= 0.056 \times 1000000 \text{ cm}^3$$
$$= 56000 \text{ cm}^3$$

(b) To convert from **mm** to **cm** we **divide** by 10.
So to convert from **mm** to **m** we **divide** by 1000.
So to convert from **mm²** to **m²** we **divide** by 1000^2.

$$\therefore 290000 \text{ mm}^2 \equiv 290000 \div 1000^2 \text{ m}^2$$
$$= 290000 \div 1000000 \text{ m}^2$$
$$= 0.29 \text{ mm}^2$$

2. **(Review of previous material)**
   Solve: (a) $x - 9 = 15$ (b) $7x = 56$

Working: (a)
$$x - 9 = 15$$
$$x = 15 + 9$$
$$x = 24$$

(b)
$$7x = 56$$
$$x = \frac{56}{7}$$
$$x = 8$$

N.B. The middle step could be missed out in each of these questions.

3. **(Review of previous material)** Solve the equation $2x - 7 = 15$.
   Hint: Decide whether to deal with the -7 or the 2 first.

Working:
$$2x - 7 = 15$$
$$2x = 15 + 7$$ ***when rearranging, addition before division***
$$2x = 22$$
$$x = \frac{22}{2}$$
$$x = 11$$

N.B. You can miss out the lines in orange if you feel confident.

4. **(Review of previous material)**
   Evaluate: (a) $3 + 5 \times 4$ (b) $9 - 6 \div 2$

Working: (a)
$$3 + 5 \times 4 = 3 + 20$$ ***multiplication before addition***
$$= 23$$

(b)
$$9 - 6 \div 2 = 9 - 3$$ ***division before subtraction***
$$= 6$$

E.g. 1 Solve $3x + 8 = 20$

Working: Opposite operation method ("do the same to both sides")
Do we deal with the $\times 3$ ***or the*** $+8$ ***first?***
Using SADMIB, we deal with $+8$ ***first.***
We do the opposite operation to $+8$ ***to both sides.***

$$3x + 8 = 20 \quad \xrightarrow{-8} \quad 3x = 12$$

$20 - 8 = 12$

We do the opposite operation to $\times 3$ **to both sides.**

$$x = 4 \quad \xrightarrow{\div 3}$$

N.B. Annotate in a circle each step that you take with the opposite operation.
Always have the '=' symbols in a column, one above the other.

Balancing method
Using SADMIB, we deal with $+8$ ***first.***

$$3x + 8 = 20$$

Subtract 8 ***from both sides*** $\quad 3x + 8 - 8 = 20 - 8$

$$3x = 12$$

Divide both side by 3 $\quad \frac{3}{3}x = \frac{12}{3}$

$$x = 4$$

N.B. The steps in orange do not need to be shown.
Always have the '=' symbols in a column, one above the other.
The final answer should always have the unknown on the LHS i.e. $x = 3$, not $3 = x$

E.g. 2 Solve $4d - 7 = 17$

Working:
Solving: subtraction before multiplication
Add 7 ***to both sides***
Divide both sides by 4

$$4d - 7 = 17$$
$$4d = 24$$
$$d = 6$$

E.g. 3 Solve: (a) $3x + 7 + 2x - 1 = 26$ (b) $7p - 8 - 4p + 3p = 34$

Working: (a)

$$3x + 7 + 2x - 1 = 26$$

Collect like terms

$$5x + 6 = 26$$

Addition before multiplication
Subtract 6 ***from both sides***

$$5x = 20$$

Divide both sides by 5

$$x = 4$$

(b)

$$7p - 8 - 4p + 3p = 34$$

Collect like terms

$$6p - 8 = 34$$

Subtraction before multiplication
Add 8 ***to both sides***

$$6p = 42$$

Divide both sides by 6

$$p = 7$$

Unknowns on both sides

E.g. Working with a peer, solve $7x + 6 = 3x + 42$

Working:

	$7x + 6 = 3x + 42$
Collate the x's onto one side	$4x + 6 = 42$
Collate the numbers onto the other side	$4x = 36$
Divide both sides by 4	$x = 9$

E.g. 4 Solve:

(a) $9x = 2x - 56$

(b) $11n - 8 = 5n + 34$

(c) $5p - 7 = 9p + 17$

(d) $5x - 31 = 14x + 41$

(e) $2p + 13 = 52 - 8p$

(f) $91 - 8y = 16 - 23y$

Working:

(a)

	$9x = 2x - 56$
Collate the x's onto one side	$7x = -56$
Divide both sides by 7	$x = -8$

(b)

	$11n - 8 = 5n + 34$
Collate the n's onto one side	$6n - 8 = 34$
Collate the numbers onto the other side	$6n = 42$
Divide both sides by 6	$x = 7$

(c)

	$5p - 7 = 9p + 17$
Collate the p's onto one side	$-7 = 4p + 17$
Collate the numbers onto the other side	$-24 = 4p$
Divide both sides by 4	$-6 = p$
Put the unknown on the LHS	$p = -6$

(d)

	$5x - 31 = 14x + 41$
Collate the x's onto one side	$-31 = 9x + 41$
Collate the numbers onto the other side	$-72 = 9x$
Divide both sides by 9	$-8 = x$
Put the unknown on the LHS	$x = -8$

(e)

	$2p + 13 = 52 - 8p$
Collate the p's onto one side	$10p + 13 = 52$
Collate the numbers onto the other side	$10p = 39$
Divide both sides by 10	$p = 3.9$

(f)

	$91 - 8y = 16 - 23y$
Collate the y's onto one side	$91 + 15y = 16$
Collate the numbers onto the other side	$15y = -75$
Divide both sides by 15	$y = 5$

E.g. 5 An equilateral triangle has sides of length $7x + 8$, $2x + 25$ and $2x + 25$. Find the value of x

Working: Equilateral triangle — all sides are the same length

$$7x + 8 = 2x + 25$$

Collate the x's onto one side

$$5x + 8 = 25$$

Collate the numbers onto the other side

$$5x = 17$$

Divide both sides by 5

$$x = \frac{17}{5} = 3.4$$

Video: Solving linear equations

Video: Linear equations - unknown on both sides

Solutions to Starter and E.g.s

Exercise

CIMT 8B p17 Ex 12.4 Qu 3a-d (unknown on both sides)