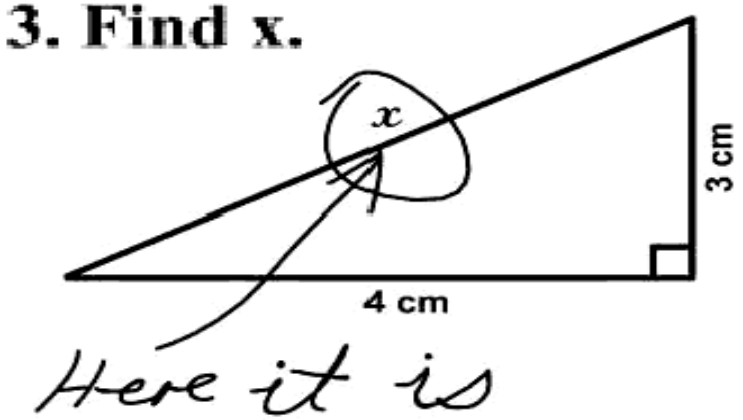
# S4 National 5 Maths Notes

Here is an actual answer from a maths exam.




# Equations & Inequations

## Previous Knowledge

**Ex1**

$2x = 6$ (divide both sides by 2)
$x = 3$

**Ex2**

$5a = -15$ (divide both sides by 5)
$a = -3$

**Ex3**

$-3x = 9$ (divide both sides by -3)
$x = -3$

**Ex4**

$-7w = -28$ (divide both sides by -7)
$w = 4$

Sometimes it is ok to expect a fraction as a solution:

**Ex5**

$-6 = -4a$
$\frac{-6}{-4} = a$
$\frac{3}{2} = a$

**Ex6**

$-10 = 4m$
$\frac{-10}{4} = m$
$-\frac{5}{2} = m$

**Ex7**

$6x - 2 = 1$
$-2 \quad -2$
$6x = -1$
$x = -\frac{1}{2}$

**Ex8**

$7x + 2 = x$
$-7x \quad -7x$
$2 = -6x$
$-\frac{2}{6} = x$
$-\frac{1}{3} = x$

Multiplying out Brackets: Multiply each term inside the bracket by the letter or number outside the bracket.

**Ex9**

Expand $2(x - 4)$

$2(x - 4)$
$= 2x - 8$

**Ex10**

Expand $-2(3s - 11)$

$-2(3s - 11)$
$= -6s + 22$

**Ex11**

Expand $x(3x - y)$

$x(3x - y)$
$= 3x^2 - xy$

**Ex12**

Expand & Simplify $2x + 2(3x - 1)$

$2x + 2(3x - 1)$
$= 2x + 6x - 2$
$= 8x - 2$

**Ex13**

Expand & Simplify $4m - 2(m + 1)$

$4m - 2(m + 1)$
$= 4m - 2m - 2$
$= 2m - 2$

Multiplying out Pairs of Brackets:

**Ex14**

Expand $(x-2)(x+3)$

Use **FOIL**:

$= x^2 + 3x - 2x - 6$

$= x^2 + x - 6$

**F**: Firsts $= x \times x = x^2$

**O**: Outsides $= x \times 3 = 3x$

**I**: Insides $= -2 \times x = -2x$

**L**: Lasts $= -2 \times 3 = -6$

**Ex15**

Expand $(y-2)(2y+1)$

$= 2y^2 + y - 4y - 2$

$= 2y^2 - 3y - 2$

Expanding Squared Brackets:

**Ex16**

Expand $(m-5)^2$

**Step 1** – Square the first term – $m^2$

**Step 2** – Multiply the two terms together and double it – $m \times -5 = -5m \times 2 = -10m$

**Step 3** – Square the last term - **25**

$(m-5)^2 = m^2 - 10m + 25$

**Ex17**

Expand & Simplify $2x - (5-x)^2$

$$\begin{aligned} 2x - (5-x)^2 &= 2x - (25 - 10x + x^2) \\ &= 2x - 25 + 10x - x^2 \\ &= -x^2 + 12x - 25 \end{aligned}$$

## Exercise0

1. Solve for x:

(a) $8w = -32$ (b) $-n = 16$ (c) $-5f = -25$ (d) $-7a = -3$
(e) $14 = -4n$ (f) $4w + 1 = -3$

2. Multiply out and simplify where possible:

(a) $-7(2 - y)$ (b) $9 + 2(k - 3)$ (c) $5n - 3(n - 1)$ (d) $(2w - 1)(w - 3)$
(e) $3(m - 1)^2$ (f) $5 - (x - 1)^2$ (g) $(n + 1)^2 - (n - 1)^2$ (h) $(3m + 4)^2 - (2m - 3)^2$

## Equation Solving

### Ex1

Solve $y + 3 = 5y + 11$

$$y + 3 = 5y + 11$$
$$-3 \qquad\quad -3$$
$$y = 5y + 8$$
$$-5y \qquad -5y$$
$$-4y = 8$$
$$y = \frac{8}{-4}$$
$$\underline{\underline{y = -2}}$$

### Ex2

Solve $4x - 5(2x - 1) = 2(1 - x)$

$$4x - 10x + 5 = 2 - 2x$$
$$-6x + 5 = 2 - 2x$$
$$+2x \quad -5 \quad -5 \quad +2x$$
$$-4x = -3$$
$$x = \frac{-3}{-4}$$
$$\underline{\underline{x = \frac{3}{4}}}$$

### Ex3

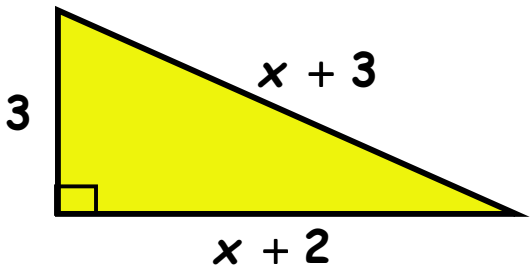
Solve $x^2 - 3 = (x + 2)(x - 1)$

$$x^2 - 3 = x^2 - x + 2x - 2$$

$$x^2 - 3 = x^2 + x - 2$$
$$-x^2 \qquad -x^2$$
$$-3 = x - 2$$
$$+2 \qquad +2$$
$$\underline{\underline{-1 = x}}$$

**Ex4**

Find the lengths of the sides of this triangle:




Using Pythagoras Theorem:

$$(x+3)^2 = (x+2)^2 + 3^2$$
$$x^2 + 6x + 9 = x^2 + 4x + 4 + 9$$
$$x^2 + 6x + 9 = x^2 + 4x + 13$$
$$-x^2 \quad -4x \quad -9 \qquad -x^2 \quad -4x \quad -9$$
$$2x = 4$$
$$x = 2$$

Sides are 3, 4 and 5

**Equations With Fractions**

When we have a single fraction equal to another single fraction we can cross multiply:

**Ex1**

Solve: $\frac{y}{5} = \frac{1}{3}$

$$y \times 3 = 1 \times 5$$
$$3y = 5$$
$$y = \frac{5}{3}$$

When we can't cross multiply we get rid of the fraction by multiplying both sides by the denominator of the fraction:

**Ex2**

Solve: $m = \frac{7}{3}(m+2)$

$$3 \times m = 3 \times \frac{7}{3}(m+2)$$
$$3m = \frac{21}{3}(m+2)$$
$$3m = 7(m+2)$$
$$3m = 7m + 14$$
$$-7m \quad -7m$$
$$-4m = 14$$
$$m = -\frac{14}{4}$$
$$m = -\frac{7}{2}$$

**Ex3**

Solve: $x - 2 = \frac{3}{4}x$

$$4 \times (x-2) = 4 \times \frac{3}{4}x$$
$$4(x-2) = \frac{12}{4}x$$
$$4(x-2) = 3x$$
$$4x - 8 = 3x$$
$$-3x \quad +8 \qquad -3x \quad +8$$
$$x = 8$$

## More Equations With Fractions: Using the LCM (Lowest Common Multiple)

Sometimes equations have more than one fraction with different denominators. In these cases we use the same method but multiply by the Lowest Common Multiple (L.C.M) of the denominators.

**Ex1**

Solve: $\frac{x}{4}-\frac{x}{6}=3$

The L.C.M of 4 & 6 is 12

$$\frac{12x}{4}-\frac{12x}{6}=12\times 3$$
$$3x-2x=36$$
$$x=36$$

**Ex2**

Solve: $\frac{y-1}{2}-\frac{y+1}{3}=2$

The L.C.M of 2 & 3 is 6

$$\frac{6(y-1)}{2}-\frac{6(y+1)}{3}=6\times 2$$
$$3(y-1)-2(y+1)=12$$
$$3y-3-2y-2=12$$
$$y-5=12$$
$$+5\quad +5$$
$$y=17$$

**Ex3**

Solve: $\frac{1}{2}(x+8)=3+\frac{1}{4}(x-12)$

The L.C.M of 2 & 4 is 8

$$\frac{4}{2}(x+8)=12+\frac{4}{4}(x-12)$$
$$2(x+8)=12+1(x-12)$$
$$2x+16=12+x-12$$
$$2x+16=x$$
$$-x\quad -16\quad -x\quad -16$$
$$x=-16$$

## Solving Inequalities (Inequations)

An inequality is similar to an equation but with the = replaced by $<$, $>$, $\geq$, or $\leq$

They are solved in the same way as equations with two differences.

1) The letter is always brought to the left hand side
2) If we have a negative number times the letter at the end of the working when we divide by the negative we must change the sign round.

**Ex1**

Solve: $5x + 2 \leq -3$

$$5x + 2 \leq -3$$
$$-2 \quad -2$$
$$5x \leq -5$$
$$x \leq -1$$

**Ex2**

Solve: $8 - 3m < 2$

$$8 - 3m < 2$$
$$-8 \qquad -8$$
$$-3m < -6$$
$$m > 2$$

Sometimes you are given values from which the answer must come:

**Ex3**

Solve: $2m + 5 > 0$ where the solutions come from $\{-3, -2, -1, 0, 1, 2, 3\}$

$$2m + 5 > 0$$
$$-5 \quad -5$$
$$2m > -5$$
$$m > -\frac{5}{2}$$

The solutions are $m = -2, -1, 0, 1, 2, 3$

**Ex4**

Solve: $5(x - 1) - 8x \geq -11$

$$5x - 5 - 8x \geq -11$$
$$-3x - 5 \geq -11$$
$$+5 \quad +5$$
$$-3x \geq -6$$
$$x \leq 2$$