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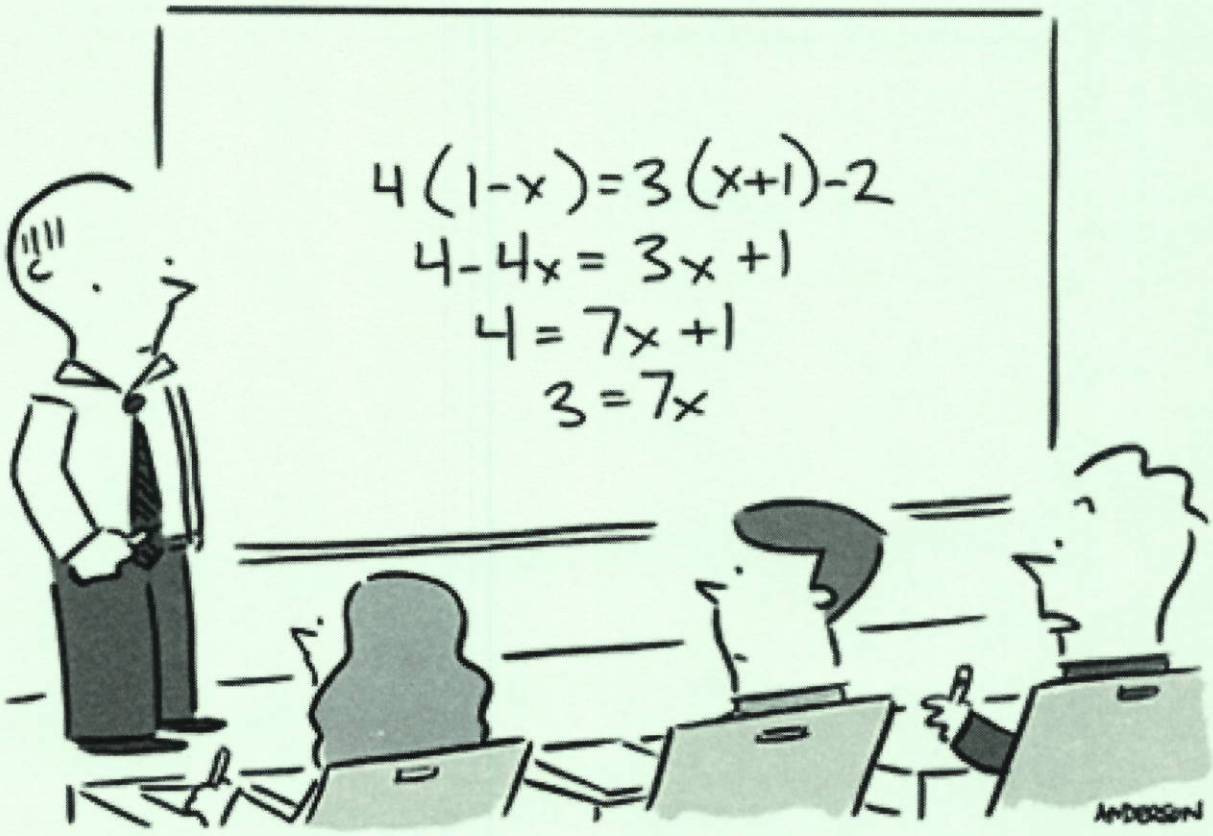
Name: Mrs Manners

Tutor Group: _____ Tutor: _____



"Wouldn't it be more efficient to just find who's complicating equations and ask them to stop?"

***Mrs Manners* (2018)**

What is a Linear Equation?

An equation is a mathematical statement with a left hand side (LHS), a right hand side (RHS) and an equal sign (=). For a **linear** equation, power of the letter (variable) is 1.

$$5a - 1 = 9$$

We can solve an equation by inspection. This means trying to find a number that makes the equation true. We can then check our answer to see if it is correct.

Check:

LHS
$= 5a - 1$
$= 5 \times 2 - 1$
$= 9$

RHS
$= 9$

LHS = RHS
$\therefore a = 2$

Example:

Linear Equation	LHS	=	RHS
$5p - 3 = 20$	$5p - 3$	=	20
$\frac{2x+1}{7} = 3$	$\frac{2x+1}{7}$	=	3
$\frac{4q}{9} - 1 = 6$	$\frac{4q}{9} - 1$	=	6

Example: Circle which of the following are linear equations.

$2a$	$2a + 1$	$2a + 1 = 5$	$a = 5$	5
$10x = 20$	$x - 5 = 3$	$7x$	$2a^2 = 8$	$= 8$
$y^3 = 1$	$7y - 2$	$1 - 8y = 3$	$6y = 12$	$\frac{y}{2} = 1$

Example: Solve the following equations by inspection.

a) $x + 3 = 10$ $x = 7$

b) $5x = 20$ $x = 4$

c) $\frac{x}{3} = 6$ $x = 18$

d) $x - 12 = 2$ $x = 14$

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

f) $\frac{x}{7} = 3$ $x = 21$

g) $3x + 2 = 11$ $x = 3$

h) $x - 10 = 0$ $x = 10$

i) $6x = 18$ $x = 3$

j) $\frac{x}{2} = 11$ $x = 22$

Inverse Operations

What are Inverse Operations?

Inverse Operations are operations that undo one another, eg. $+4, -4$ or $\times 5, \div 5$.

Operation	$+$	$-$	$\times$	$\div$
Inverse Operation	$-$	$+$	$\div$	$\times$

We can use inverse operations to solve equations:

One step equations:

$x + 3 = 11$ $-3 \quad -3$ $x = 8$	$x - 5 = 17$ $+5 \quad +5$ $x = 22$
$5 \times \frac{x}{5} = 10 \times 5$ $x = 50$	$\frac{0.4a}{0.4} = \frac{6}{0.4}$ $a = 15$
$\frac{-12x}{-12} = \frac{6}{-12}$ $x = -\frac{1}{2}$	$1.5 \times \frac{g}{1.5} = 10 \times 1.5$ $g = 15$
$\frac{-2}{3}a = 8$ $\times -\frac{2}{3} \quad \times -\frac{2}{3}$ $a = -12$	$n - 10 = -22$ $+10 \quad +10$ $n = -12$
$-b = 5$ $\times -1 \quad \times -1$ $b = -5$	$-f = 0.5$ $\times -1 \quad \times -1$ $f = -0.5$

8.3 Advancing with solving one-step equations

Solve each equation for the unknown variable.

1. $m + 5 = 20$

$-5 \quad -5$

$m = 15$

2. $f - 3 = 11$

$+3 \quad +3$

$f = 14$

3. $11a = 99$

$\frac{11a}{11} = \frac{99}{11}$

$a = 9$

4. $\frac{g}{5} = 12$ $\times 5$

$g = 60$

5. $h - 19 = 23$

$+19 \quad +19$

$h = 42$

6. $u + 100 = 1\,000$

$-100 \quad -100$

$u = 900$

7. $0.5w = 5$

$\frac{0.5w}{0.5} = \frac{5}{0.5}$

$w = 10$

8. $\frac{c}{7} = 9$ $\times 7$

$c = 63$

9. $j - 15 = 8.5$

$+15 \quad +15$

$j = 23.5$

10. $v - 70 = 18$

$+70 \quad +70$

$v = 88$

11. $12k = 60$

$\frac{12k}{12} = \frac{60}{12}$

$k = 5$

12. $\frac{p}{4.5} = 10$ $\times 4.5$

$p = 45$

8.4 Advancing with solving one-step equations with directed number

Solve each equation for the unknown variable.

1. $m + 7 = -40$

$-7 \quad -7$

$m = -47$

2. $f - 10 = -33$

$+10 \quad +10$

$f = -23$

3. $\frac{6a}{6} = \frac{-54}{6}$

$a = -9$

4. $\frac{n}{9} \times 9 = -8 \times 9$

$n = -72$

5. $y - 12 = -50$

$+12 \quad +12$

$y = -38$

6. $k + 100 = -1\,000$

$-100 \quad -100$

$k = -1100$

7. $\frac{-4w}{-4} = \frac{-32}{-4}$

$w = 8$

8. $\frac{5 \times c}{5} = -2.4 \times 5$

$c = -12$

9. $j - 23 = -7.5$

$+23 \quad +23$

$j = 15.5$

10. $v + 80 = 12$

$-80 \quad -80$

$v = -68$

11. $\frac{-0.1k}{-0.1} = \frac{-20}{-0.1}$

$k = 200$

12. $\frac{3.5 \times p}{3.5} = -20 \times 3.5$

$p = -70$

Ex 10-01
Q1 – 4 (2 columns)
Q 5 – 6

Two step equations:

Method 1:

$3 \times \frac{4x}{3} = 16 \times 3$

$\frac{4x}{4} = \frac{48}{4}$

$x = 12$

Method 2:

$\frac{4x}{3} = 16$

$\left(\frac{4}{3}\right) \quad \left(\frac{4}{3}\right)$

$x = 12$

Method 1:

$11 \times \frac{-3g}{11} = 2 \times 11$

$\frac{-3g}{-3} = \frac{22}{-3}$

$g = -\frac{22}{3}$

Method 2:

$\frac{-3g}{11} = 2$

$\left(-\frac{3}{11}\right) \quad \left(-\frac{3}{11}\right)$

$g = -\frac{22}{3}$

Method 1:

$1 - 5q = 46$

$-1 \quad -1$

$\frac{-5q}{-5} = \frac{45}{-5}$

$q = 9$

Method 2:

$1 - 5q = 46$

$+5q \quad +5q$

$1 = 46 + 5q$

$-46 \quad -46$

$\frac{-45}{5} = \frac{5q}{5}$

$q = -9$

Method 1:

$5 - 2d = 19$

$-5 \quad -5$

$\frac{-2d}{-2} = \frac{14}{-2}$

$d = -7$

Method 2:

$5 - 2d = 19$

$+2d \quad +2d$

$5 = 19 + 2d$

$-19 \quad -19$

$\frac{-14}{2} = \frac{2d}{2}$

$d = -7$

These two equations look the same but are different:

The fraction bar is underneath both terms in the numerator. The 3 is NOT free to move. Move the 5 first.

$$\frac{x+3}{5} = 10$$

$5 \times$ ... $\times 5$

$x + 3 = 50$

$-3 \quad -3$

$x = 47$

The fraction bar is underneath one term in the numerator. The other term is free to move.

$$\frac{x}{5} + 3 = 10$$

$-3 \quad -3$

$5 \times \frac{x}{5} = 7 \times 5$

$x = 35$

$$\frac{k}{11} - 7 = 3$$

$+7 \quad +7$

$11 \times \frac{k}{11} = 10 \times 11$

$k = 110$

$$\frac{k-7}{11} = 3$$

$\times 11$

$k - 7 = 33$

$+7 \quad +7$

$k = 40$

$$\frac{c-9}{2} = 1.5$$

$\times 2$

$c - 9 = 3$

$+9 \quad +9$

$c = 12$

$$\frac{c}{2} - 9 = 1.5$$

$+9 \quad +9$

$2 \times \frac{c}{2} = 10.5 \times 2$

$c = 21$

$$\frac{u+10}{5} = -2$$

$\times 5$

$u + 10 = -10$

$-10 \quad -10$

$u = -20$

$$\frac{u}{5} + 10 = -2$$

$-10 \quad -10$

$5 \times \frac{u}{5} = -12 \times 5$

$u = -60$

You do:

$2x + 9 = 16$ $-9 \quad -9$ $\frac{2x}{2} = \frac{7}{2}$ $x = 3.5$	$20 - 7a = 6$ $-20 \quad -20$ $-7a = -$
$5p - 13 = 55$ $+13 \quad +13$ $\frac{5p}{5} = \frac{68}{5}$ $p = \frac{68}{5}$	$7 - 3n = 70$ $-7 \quad -7$ $\frac{-3n}{-3} = \frac{63}{-3}$ $n = -21$
$4 \times \frac{d+15}{4} = 6 \times 4$ $d + 15 = 24$ $-15 \quad -15$ $d = 9$	$\frac{d}{4} + 15 = 6$ $-15 \quad -15$ $4 \times \frac{d}{4} = -9 \times 4$ $d = -36$
$7 \times \frac{-5a}{7} = 3 \times 7$ $\frac{-5a}{-5} = \frac{21}{-5}$ $a = -\frac{21}{5}$	$1 + \frac{g}{2} = -5$ $-1 \quad -1$ $2 \times \frac{g}{2} = -6 \times 2$ $g = -12$

8.5 Advancing with solving two-step equations

Solve each equation for the unknown variable.

1. $5q + 3 = 58$

$\frac{5q}{5} = \frac{55}{5}$

$q = 11$

2. $20a + 15 = 45$

$\frac{20a}{20} = \frac{30}{20}$

$a = \frac{3}{2}$

3. $13g = 7g + 54$

$-7g \quad -7g$

$\frac{6g}{6} = \frac{54}{6}$

$g = 9$

4. $12m = 9m - 15$

$-9m \quad -9m$

$\frac{3m}{3} = \frac{-15}{3}$

$m = -5$

5. $\frac{\overset{3}{\times} 4y}{3} = 8 \overset{\times 3}{}$

$\frac{4y}{4} = \frac{24}{4}$

$y = 6$

6. $\frac{\overset{19}{\times} 2y}{19} = 4 \times 19$

$\frac{2y}{2} = \frac{76}{2}$

$y = 38$

7. $3f + 9f = 60$

$\frac{12f}{12} = \frac{60}{12}$

$f = 5$

8. $11e - 4e = 42$

$\frac{7e}{7} = \frac{42}{7}$

$e = 6$

9. $20q + 5 = 20$

$-5 \quad -5$

$\frac{20q}{20} = \frac{15}{20}$

$q = \frac{3}{4}$

10. $5u = 8u - 63$

$-8u \quad -8u$

$\frac{-3u}{-3} = \frac{-63}{-3}$

$u = 21$

Equations and formulae

Topic 3: Two-step equations

QUESTION 1 Solve the following two-step equations.

a $2x + 1 = 3$

$x = 1$

b $18 = 3x - 6$

$x = 8$

c $10 = 5y - 15$

$y = 5$

d $\frac{5m}{3} = 10$

$m = 6$

e $\frac{x-3}{4} = 5$

$x = 23$

f $2a + 9 = 19$

$a = 5$

g $\frac{x}{2} - 1 = 7$

$x = 16$

h $3x + 5 = 11$

$x = 2$

i $\frac{a-2}{7} = 3$

$a - 2 = 21$

$a = 23$

j $8x - 7 = 33$

$x = 5$

k $5x + 3 = 28$

$x = 5$

l $6t - 3 = 39$

$t = 7$

m $7y - 5 = 9$

$y = 2$

n $\frac{m}{3} - 4 = 6$

$m = 30$

o $2k + 3 = 21$

$k = 9$

QUESTION 2 Solve the following equations.

a $3x - 3 = 9$

$x = 4$

b $\frac{m}{2} + 6 = 9$

$m = 6$

c $\frac{x-5}{7} = 4$

$x = 33$

d $\frac{x-2}{6} = 8$

$x = 50$

e $5x - 9 = 26$

$x = 7$

f $\frac{5m}{6} = 10$

$m = 12$

g $10 - 2m = 0$

$m = 5$

h $3y - 9 = 21$

$y = 10$

i $7y + 4 = -3$

$y = -1$

j $2x + 8 = 14$

$x = 3$

k $8x - 7 = 17$

$x = 3$

l $9x - 7 = 56$

$x = 7$

m $3a - 2.3 = 7$

$3a = 9.3$

$a = 3.1$

n $6a - 1\frac{1}{2} = 4\frac{1}{2}$

$a = 1$

o $8b + 0.3 = 2.7$

$8b = 2.4$

$b = 0.3$

Three step equations:

There are no like terms on either side.

Like terms on the same side must be simplified

$3x + 4 = x - 8$

$-x \quad -x$

$2x + 4 = -8$

$-4 \quad -4$

$\frac{2x}{2} = \frac{-12}{2}$

$x = -6$

$3x + 4 + x - 8 = 26$

$2x - 4 = 26$

$+4 \quad +4$

$\frac{2x}{2} = \frac{30}{2}$

$x = 15$

$2y + 3 - 9y - 11 = 69$

$-7y - 8 = 69$

$+8 \quad +8$

$\frac{-7y}{-7} = \frac{77}{-7}$

$y = -11$

$2y + 3 = 9y - 11$

$-9y \quad -9y$

$-7y + 3 = -11$

$-3 \quad -3$

$\frac{-7y}{-7} = \frac{-14}{-7}$

$y = 2$

The fraction bar is under both terms. Move the denominator first.

$7 \times \frac{2m - 12}{7} = 4 \times 7$

$2m - 12 = 28$

$+12 \quad +12$

$\frac{2m}{2} = \frac{40}{2}$

$m = 20$

The fraction bar is under only one term. The other term (−12) is free to move.

$\frac{2m}{7} - 12 = 4$

$+12 \quad +12$

$7 \times \frac{2m}{7} = 16 \times 7$

$\frac{2m}{2} = \frac{112}{2}$

$m = 56$

$416 \times 7 = 112$

$3 - \frac{4w}{5} = 11$

$-3 \quad -3$

$5 \times -\frac{4w}{5} = 8 \times 5$

$-4w = 40$

$\frac{-4w}{-4} = \frac{40}{-4}$

$w = -10$

$5 \times \frac{3 - 4w}{5} = 11 \times 5$

$3 - 4w = 55$

$-3 \quad -3$

$-4w = 52$

$\frac{-4w}{-4} = \frac{52}{-4}$

$w = -13$

$5x - 11 - 9x + 15 = 24$

$-4x + 4 = 24$

$-4 \quad -4$

$\frac{-4x}{-4} = \frac{20}{-4}$

$x = -5$

$5x - 11 = 9x - 15$

$-9x \quad -9x$

$-4x - 11 = -15$

$+11 \quad +11$

$\frac{-4x}{-4} = \frac{-4}{-4}$

$x = 1$

$6 \times \frac{2 - 9a}{6} = 1 \times 6$

$2 - 9a = 6$

$-2 \quad -2$

$\frac{-9a}{-9} = \frac{4}{-9}$

$a = -\frac{4}{9}$

$4 \times \frac{20 - p}{4} = 10 \times 4$

$20 - p = 40$

$-20 \quad -20$

$\frac{-p}{-1} = \frac{20}{-1}$

$p = -20$

8.6 Advancing with solving three-step equations

Solve each equation for the unknown variable.

1. $11a + 5 = 3a + 45$

$a = 5$

2. $7q - 4 = q + 50$

$q = 9$

3. $3m - 2 = 5m + 42$

$m = -22$

4. $4u - 3 = 13u - 30$

$u = 3$

5. $\frac{3y - 4}{5} = 7$

$y = 13$

6. $\frac{5f + 10}{6} = 5$

$f = 4$

7. $\frac{3h}{4} + 8 = 20$

$h = 16$

8. $\frac{3r}{7} + 4 = 13$

$r = 21$

9. $\frac{4 - 2c}{8} = 3$

$c = -10$

10. $\frac{12 - 4d}{9} = 12$

$12 - 4d = 108$

$-4d = +96$

$d = -24$

$4\overline{)96}$ 24

Equations and formulae

Topic 4: Three-step equations

QUESTION 1 Solve the following three-step equations.

a $4x + 9 = 3x - 12$

$x = -21$

b $2x - 7 = x - 3$

$x = 4$

c $6t - 10 = 4t + 12$

$2t = 22$

$t = 11$

d $11m - 6 = 7m + 14$

$4m = 20$

$m = 5$

e $9m - 3 = 7m + 9$

$2m = 12$

$m = 6$

f $4a - 3 = 3a + 9$

$a = 12$

g $10y - 6 = 5y + 19$

$5y = 25$

$y = 5$

h $6x - 4 = 2x + 16$

$4x = 20$

$x = 5$

i $7y - 3 = 4y + 15$

$3y = 18$

$y = 6$

j $5x - 1 = 6x - 9$

$8 = x$

k $3a + 5 = 21 - a$

$4a = 16$

$a = 4$

l $12p - 3 = 7p + 32$

$5p = 35$

$p = 7$

m $6m - 7 = 4m + 13$

$2m = 20$

$m = 10$

n $2y - 1 = y + 9$

$y = 10$

o $4 + m = 16 - 3m$

$4m = 12$

$m = 3$

QUESTION 2 Solve the following equations.

a $6x - 20 = 4x + 48$

$2x = 68$

$x = 34$

b $2x - 6 = 3 - x$

$3x = 9$

$x = 3$

c $6x - 2 = 3x - 6$

$3x = -4$

$x = -\frac{4}{3}$

d $7y - 14 = 5y + 20$

$2y = 34$

$y = 17$

e $2x - 14 = x - 12$

$x = 2$

f $5x + 17 = 3 - 4x$

$9x = -14$

$x = -\frac{14}{9}$

g $3m - 2 = 2m + 7$

$m = 9$

h $6x - 21 = 2x - 2$

$4x = 19$

$x = \frac{19}{4}$

i $3y + 1 = 2y + 7$

$y = 6$

j $6m + 7 = 7m + 10$

$-m = 3$

$m = -3$

k $2x + 3 = x - 9$

$x = -12$

l $4y - 3 = 2y + 11$

$2y = 14$

$y = 7$

Equations with brackets:

For equations with brackets, you sometimes need to e<u>xpand</u> the brackets FIRST.

Remember: $3(e + 2) =$ <u>$3e + 6$</u> and $3(e - 2) =$ <u>$3e - 6$</u> and $-3(e - 2) =$ <u>$-3e + 6$</u>

Method 1:

$3(e - 2) = 21$

$3e - 6 = 21$
$+6 \quad +6$
$\frac{3e}{3} = \frac{27}{3}$

$e = 9$

Method 2:

$\frac{3(e - 2)}{3} = \frac{21}{3}$

$e - 2 = 7$
$+2 \quad +2$

$e = 9$

Method 1:

$4(a + 5) = 11$

$4a + 20 = 11$
$-20 \quad -20$

$\frac{4a}{4} = \frac{-9}{4}$

$a = -\frac{9}{4}$

Method 2:

$\frac{4(a + 5)}{4} = \frac{11}{4}$

$a + 5 = \frac{11}{4}$
$-5 \quad -5$

$a = -\frac{9}{4}$

Two sets of brackets on one side

1. Expand the brackets
2. Collect like terms on the LHS

$8(n + 1) + 2(n + 5) = 40$

$8n + 8 + 2n + 10 = 40$

$10n + 18 = 40$
$-18 \quad -18$

$\frac{10n}{10} = \frac{22}{10}$

$n = 2.2$

Two sets of brackets on one side

1. Expand the brackets
2. Collect like terms on the LHS

$2(m - 7) + 6(m - 4) = 12$

$2m - 14 + 6m - 24 = 12$

$8m - 38 = 12$

$8m = 50$

$m = \frac{50}{8}$

$= 6.25$

Equations and formulae

Topic 5: Equations with grouping symbols

QUESTION 1 Solve the following equations.

a $3(x+4)=18$ $x=2$

b $2(m+1)=5$ $m=1\cdot5$

c $6(m-1)=24$ $m=5$

d $2(x+5)=18$ $x=4$

e $3(a-3)=10$ $a=6\frac{1}{3}$

f $4(n-3)=36$ $n=12$

g $5(2n-1)=25$ $n=3$

h $2(3p-1)=22$ $p=4$

i $5(2x+3)=45$ $x=3$

j $4(a-4)=8$ $a=6$

k $3(m+2)=m+14$ $m=4$

l $2(3x+2)=16$ $x=2$

QUESTION 2 Solve the following equations.

a $5(a+4)=4(a-3)$ $a=-32$

b $3(x-5)=2(x+4)$ $x=23$

c $4(y-3)=3(y+2)$ $y=18$

d $7(x-8)=6(x+2)$ $x=68$

e $8(3-x)=7(x-6)$ $x=\frac{22}{5}$

f $2(a+1)+a+3=0$ $a=\frac{-5}{3}$

g $3(x+7)+x+3=18$ $x=\frac{-3}{2}$

h $5(a+3)=4(a+9)$ $a=21$

i $3(3a-2)=4(4-a)$ $a=\frac{22}{13}$

j $2(a+1)-a+7=9$ $a=0$

k $3(a-3)-2a+9=15$ $a=15$

l $2(5a-10)-9a+6=0$ $a=14$

m $6(a+7)=5(a-3)$ $a=-57$

n $8(2a+7)=5(3a-8)$ $a=-96$

o $9(3a-4)=13(2a-1)$ $a=23$

Further Equations with Fractions

The easiest way to work with equations with fraction is to m_____ EVERY TERM by the c_____ d_____. Remember to cancel carefully.

$6 \times \frac{2}{3}x + \frac{6\times1}{2}x = \frac{6\times1}{6}x + 3$ $\times 6$ 6

$4x + 3x = x + 18$

$7x = x + 18$

$-x \quad -x$

$\frac{6x}{6} = \frac{18}{6}$

$x = 3$

$\frac{6}{1}\times\frac{1}{2}(5y-2) + \frac{6}{1}\times 7 = \frac{6}{1}\times 5 + \frac{6\times2}{3}(9y+18)$

$3(5y-2) + 42 = 30 + 4(9y+18)$

$15y - 6 + 42 = 30 + 36y + 72$

$15y + 36 = 36y + 102$

$-36y \quad\quad -36y$

$-21y + 36 = 102$

$-36 \quad -36$

$\frac{-21y}{-21} = \frac{66}{-21}$

$y = -\frac{22}{7}$

$15 \times \frac{1}{3}m + \frac{15\times1}{5} = \frac{15\times1}{5}m - 1$ $\times 15$

$5m + 3 = 3m - 15$

$-3m \quad\quad -3m$

$2m + 3 = -15$

$-3 \quad -3$

$\frac{2m}{2} = \frac{-18}{2}$

$m = -9$

$3 \times 3x - \frac{3\times2}{3}(9x-2) = 0$ $\times 3$

$9x - 2(9x-2) = 0$

$9x - 18x + 4 = 0$

$-9x + 4 = 0$

$-4 \quad -4$

$\frac{-9x}{-9} = \frac{-4}{-9}$

$x = \frac{4}{9}$

$\frac{12}{1}\times\frac{k}{6} + \frac{12\times k}{4} = 5$ $\times 12$

$2k + 3k = 60$

$\frac{5k}{5} = \frac{60}{5}$

$k = 12$

$\frac{2}{1}6 \times \frac{2d}{3} + \frac{6}{1}\times\frac{d-4}{2} = 5$ $\times 6$

$4d + 3(d-4) = 30$

$4d + 3d - 12 = 30$

$7d - 12 = 30$

$+12 \quad +12$

$\frac{7d}{7} = \frac{42}{7}$

$d = 6$

You do:

Pt. 1 Practice…

1. $\frac{3}{4}x+1=\frac{7}{4}$

$3x+4=7$

$\frac{3x}{3}=\frac{3}{3}$

$x=1$

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

$x+21=3x-7$

$-x \quad -x$

$\frac{28}{2}=\frac{2x}{2}$

$x=14$

3. $\frac{5}{8}x=-\frac{15}{8}$

$\frac{5x}{5}=\frac{-15}{5}$

$x=-3$

4. $2x+\frac{9}{4}=3+\frac{1}{4}x$

$8x+9=12+x$

$-x \quad -x$

$7x+9=12$

$-9 \quad -9$

$7x=3$

$\frac{7x}{7}=\frac{3}{7}$

$x=\frac{3}{7}$

Pt. 2 Practice

1. $\frac{1}{2}x-8=\frac{7}{8}$ ①

$4x-64=7$

$+64 \quad +64$

$\frac{4x}{4}=\frac{71}{4}$

$x=\frac{71}{4}$

2. $\frac{5}{8}=\frac{3}{16}x$ ②

$\frac{10}{3}=\frac{3x}{3}$

$x=\frac{10}{3}$

3. $\frac{5}{8}+\frac{3}{4}x=\frac{1}{16}$ ③

$10+12x=1$

$-10 \quad -10$

$\frac{12x}{12}=\frac{-9}{12}$

$x=-\frac{3}{4}$

4. $\frac{2}{5}x+\frac{3}{7}=1-\frac{4}{7}x$

5. $\frac{x-8}{12}=\frac{15}{3}$

$x-8=60$

$+8 \quad +8$

$x=68$

6. $\frac{x-7}{4}=\frac{2x+3}{2}$ ⑥

$x-7=2(2x+3)$

$x-7=4x+6$

$-x \quad -x$

$-7=3x+6$

$-6 \quad -6$

$\frac{-13}{3}=\frac{3x}{3}$

$x=-\frac{13}{3}$

④ $14x+15=35-20x$

$+20x \quad +20x$

$34x+15=35$

$-15 \quad -15$

$\frac{34x}{34}=\frac{20}{34}$

$x=\frac{20}{34}=\frac{10}{17}$

Pt. 3 Practice…

1) $\frac{1}{4}(x+4)=10$

$4\times$ $\times 4$

$x+4=40$

$-4 \quad -4$

$x=36$

2) $\frac{3}{2}=\frac{1}{2}(10-x)$

$2\times$ $2\times$

$3=10-x$

$-10 \quad -10$

$-7=-x$

$-1 \quad -1$

$x=7$

3) $\frac{1}{5}(10x-10)=5x-17$

$5\times$ $5\times$

$10x-10=25x-85$

$-25x \quad -25x$

$-15x-10=-85$

$+10 \quad +10$

$\frac{-15x}{-15}=\frac{-75}{-15}$

$x=5$

4) $\frac{2}{3}(10x+6)=\frac{1}{3}(15x+12)$

$3\times$ $3\times$

$2(10x+6)=15x+12$

$20x+12=15x+12$

$-15x \quad -15x$

$5x+12=12$

$-12 \quad -12$

$\frac{5x}{5}=\frac{0}{5}$

$x=0$

Is $x = -1$ a solution of the following equation?

$$-x+17-8x=9-x$$

LHS
$= -x+17-8x$
$= -(-1)+17-8(-1)$
$= 1+17+8$
$= 26$

RHS
$= 9-x$
$= 9--1$
$= 10$

LHS $\neq$ RHS

$\therefore$ $x=-1$ is not a solution of the equation.

Is $y = -4$ a solution of the following equation?

$$2(3y+5)-6=3y-8$$

LHS
$= 2(3y+5)-6$
$= 2(3x-4+5)-6$
$= 2(-12+5)-6$
$= 2(-7)-6$
$= -14-6$
$= -20$

RHS
$= 3y-8$
$= 3(-4)-8$
$= -12-8$
$= -20$

LHS = RHS

$\therefore$ $y=-4$ is a solution of the equation

Is $r = 10$ a solution of the following equation?

$$7-2\left(\frac{1}{2}r-6\right)=r-1$$

LHS
$= 7-2\left(\frac{1}{2}r-6\right)$
$= 7-2\left(\frac{1}{2}\times 10-6\right)$
$= 7-2(5-6)$
$= 7-2(-1)$
$= 9$

RHS
$= r-1$
$= 10-1$
$= 9$

LHS = RHS

$\therefore$ $r=10$ is a solution of the equation

Is $n = 0$ a solution of the following equation?

$$-5-2(n-5)=-(n+3)$$

LHS
$= -5-2(n-5)$
$= -5-2(0-5)$
$= -5-2(-5)$
$= -5+10$
$= 5$

RHS
$= -(n+3)$
$= -(0+3)$
$= -3$

LHS $\neq$ RHS

$\therefore$ $n=0$ is not a solution of the equation

Is $z = 2$ a solution of the following equation?

$$3z+5=2z+7$$

LHS
$= 3z+5$
$= 3(2)+5$
$= 6+5$
$= 11$

RHS
$= 2z+7$
$= 2(2)+7$
$= 4+7$
$= 11$

LHS = RHS

$\therefore$ $z=2$ is a solution of the equation

Is $h = \frac{1}{3}$ a solution of the following equation?

$$4(3h-7)-3(h+2)=-1$$

LHS
$= 4(3h-7)-3(h+2)$
$= 4\left(3\times\frac{1}{3}-7\right)-3\left(\frac{1}{3}+2\right)$
$= 4(1-7)-3\left(\frac{7}{3}\right)$
$= 4(-6)-7$
$= -24-7$
$= -31$

RHS
$= -1$

LHS $\neq$ RHS

$\therefore$ $h=\frac{1}{3}$ is not a solution of the equation

Checking the solution of an Equation

Is x = -1 a solution of the following equation?

$$-5(4x-2)=-2(3+6x)$$

LHS
$= -5(4x-2)$
$= -5(4\times -1-2)$
$= -5(-4-2)$
$= -5(-6)$
$= 30$

RHS
$= -2(3+6x)$
$= -2(3+6\times -1)$
$= -2(3-6)$
$= -2\times -3$
$= 6$

LHS ≠ RHS
$x = -1$ is not a solution of the equation

Is $a = -2$ a solution of the following equation?

$$-\frac{1}{2}(10a-2)+3=14$$

LHS
$= -\frac{1}{2}(10a-2)+3$
$= -\frac{1}{2}(10\times -2-2)+3$
$= -\frac{1}{2}(-20-2)+3$
$= -\frac{1}{2}(-22)+3$
$= 11+3$
$= 14$

RHS
$= 14$

LHS = RHS
$a = -2$ is a solution of the equation

Is m = 10 a solution of the following equation?

$$5(2m+6)=-4(-5-2m)+3m$$

LHS
$=5(2m+6)$
$=5(2\times 10+6)$
$=5(26)$
$=130$

RHS
$=-4(-5-2m)+3m$
$=-4(-5-2\times 10)+3\times 10$
$=-4(-5-20)+30$
$=-4(-25)+30$
$=100+30$
$=130$

LHS = RHS
$\therefore m = 10$ is a solution of the equation

Is p = 0 a solution of the following equation?

$$-5p-8(1+7p)=-8$$

LHS
$=-5p-8(1+7p)$
$=-5\times 0-8(1+7\times 0)$
$=0-8(1)$
$=-8$

RHS
$=-8$

LHS = RHS
$\therefore p = 0$ is a solution of the equation

Is k = 6 a solution of the following equation?

$$-2=-(k-8)$$

LHS
$=-2$

RHS
$=-(k-8)$
$=-(6-8)$
$=-(-2)$
$=2$

LHS ≠ RHS
$\therefore k = 6$ is not a solution of the equation

Is $g = -13$ a solution of the following equation?

$$5g-25=3g-51$$

LHS
$=5g-25$
$=5(-13)-25$
$=-65-25$
$=-90$

RHS
$=3g-51$
$=3(-13)-51$
$=-39-51$
$=-90$

LHS = RHS
$\therefore g = -13$ is a solution of the equation

What is a Quadratic Equation

An equation has a LHS and a RHS joined by an = sign. With a linear equation, the highest power of the letter (variable) is 1 eg. $4x - 3 = 17$. With a quadratic equation, the highest power of the variable is 2 eg. $4x^2 = 100$.

Circle the quadratic equations below:

$3a - 5 = 10$	$3a^2 = 9$	$u = 3$	$u^2 = 100$
b^2	$b^2 = 4$	$b^3 = 8$	$b = 8$
$2 - n^2 = 18$	$2 - n = 18$	$n^2 = 16$	$3 + n^2 = 28$

Example:

$$x^2 = 4$$

What number squared equals 4?

$$(-2)^2 = 4 \quad \text{and} \quad (2)^2 = 4$$

You can square **two** numbers to get 4.

You can square 2 to get 4.

You can also square -2 to get 4.

Therefore, the equation $x^2 = 4$ has 2 solutions.

$x =$ -2 and $x =$ 2

Example:

$$x^2 = -25$$

What number squared equals –25?

$$(\quad)^2 = -25$$

Whenever you square a number the result is a positive number.

Therefore, the equation $x^2 = -25$ has no real solution.

There are 0 real numbers that you can square to get – 25.

Note:

1. For quadratic equations of the form $x^2 = c$ where c is positive, the equation will have 2 solutions.

Eg. $y^2 = 36$ Solutions: $y =$ 6 and $y =$ -6

2. For quadratic equations of the form $x^2 = c$ where c is negative, the equation will have no real solutions.

Eg. $a^2 = -81$ Solution: no real solutions

Set 1: Solve the following quadratic equations:

$x^2 = 9$ $x = 3, \quad x = -3$	$a^2 = 81$ $a = 9, \quad a = -9$
$m^2 = 1$ $m = 1, \quad m = -1$	$q^2 = 100$ $q = 10, \quad q = -10$

Set 2: Solve the following quadratic equations leaving your answer in exact surd form.

$d^2 = 8$ $d = \sqrt{8}, \quad d = -\sqrt{8}$	$u^2 = 12$ $u = \sqrt{12}, \quad u = -\sqrt{12}$
$c^2 = 22$ $c = \sqrt{22}, \quad c = -\sqrt{22}$	$p^2 = 5$ $p = \sqrt{5}, \quad p = -\sqrt{5}$

Set 3: Solve the following quadratic equations rounding your answer to one decimal place.

$h^2 = 7$ $h = \sqrt{7}$ $\quad h = -\sqrt{7}$ $=$ $\quad =$	$r^2 = 2$ $r = \sqrt{2}$ $\quad r = -\sqrt{2}$ $=$ $\quad =$
$t^2 = 20$ $t = \sqrt{20}$ $\quad t = -\sqrt{20}$ $=$ $\quad =$	$b^2 = 1000$ $b = \sqrt{1000}$ $\quad b = -\sqrt{1000}$ $=$ $\quad =$

Set 4: Solve the following quadratic equations .

$\frac{2m^2}{2} = \frac{32}{2}$ $m^2 = 16$ $m = 4, \quad m = -4$	$4q^2 - 100 = 0$ $4q^2 = 100$ $q^2 = 25$ $q = 5, \quad q = -5$
$3s^2 - 12 = 0$ $3s^2 = 12$ $s^2 = 4$ $s = 2, \quad s = -2$	$20b^2 - 20 = 0$ $20b^2 = 20$ $b^2 = 1$ $b = 1, \quad b = -1$

Set 5: Solve the following quadratic equations .

$4f^2 - 9 = 0$ $4f^2 = 9$ $f^2 = \frac{9}{4}$ $f = \sqrt{\frac{9}{4}} \quad f = -\sqrt{\frac{9}{4}}$ $= \frac{3}{2} \quad = -\frac{3}{2}$	$100d^2 - 81 = 0$ $100d^2 = 81$ $d^2 = \frac{81}{100}$ $d = \sqrt{\frac{81}{100}} \quad d = -\sqrt{\frac{81}{100}}$ $= \frac{9}{10} \quad = -\frac{9}{10}$

1. What is the difference between a linear and a quadratic equation?

Linear equation - the highest power of the variable is 1

Quadratic equation - the highest power of the variable in the equation is 2.

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2. Find the solutions to the variable in each of these equations. Leave the solutions in surd form if necessary, and state if each equation has one, two or no real solutions:

a $x^2 = 4$

$x = \pm 2$

b $2b^2 = 32$

$\frac{2b^2}{2} = \frac{32}{2}$

$b^2 = 16$

$b = \pm 4$

c $3b^2 - 75 = 0$

$\frac{3b^2}{3} = \frac{75}{3}$

$b^2 = 25$

$b = \pm 5$

d $6y^2 = 0$

$\frac{6y^2}{6} = \frac{0}{6}$

$y^2 = 0$

$y = 0$

e $4t^2 - 28 = 0$

$\frac{4t^2}{4} = \frac{28}{4}$

$t^2 = 7$

$t = \pm \sqrt{7}$

f $h^2 = -9$

no real solutions

g $2p^2 = -8$

$\frac{2p^2}{2} = \frac{-8}{2}$

$p^2 = -4$

no real solutions

h $8m^2 + 5 = 5$

$-5 \quad -5$

$\frac{8m^2}{8} = \frac{0}{8}$

$m^2 = 0$

$m = 0$

i $9x^2 - 16 = 0$

$+16 \quad +16$

$\frac{9x^2}{9} = \frac{16}{9}$

$x^2 = \frac{16}{9}$

$x = \pm \sqrt{\frac{16}{9}}$

$x = \pm \frac{4}{3}$

j $-3k^2 + 108 = 0$

$+3k^2 \quad +3k^2$

$\frac{108}{3} = \frac{3k^2}{3}$

$k^2 = 36$

$k = \pm 6$