

Solving Equations: Starters

Starter 1: Missing Numbers & Expressions

Q4

21						
?	?	?	?	?	?	?

Grid for Q10

×	2x	3
4		

1. $\frac{2}{5} = \underline{\hspace{2cm}}$

2. 3^{-2}

3. 0.2^{-1}

4. What number multiplied by 7 makes 21?

5. What number plus 8 makes 3?

6. What number multiplied by 1.2 makes 60?

7. How many £1.50 tickets can £12 buy?

Simplify the expressions below:

8. $3a + 5b - a + 2b$

9. $2a \times 3a^4$

10. Expand $4(2x + 3)$ using the grid.

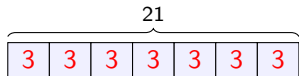
11. Expand and simplify $3(x + 2) - 2(x - 1)$.

12. Find $5 - 3x$ when $x = -2$.

13. (Challenge) Think of a number, double it and add 6. Halve the result, then subtract the number you started with. Show with algebra that you always get 3.

Starter 1: Missing Numbers & Expressions

Q4



Grid for Q10

×	2x	3
4	8x	12

1. $\frac{2}{5} = 40\%$ 2. $3^{-2} = \frac{1}{9}$ 3. $0.2^{-1} = \left(\frac{1}{5}\right)^{-1} = 5$

4. What number multiplied by 7 makes 21? 3

5. What number plus 8 makes 3? -5

6. What number multiplied by 1.2 makes 60?

$$\frac{60}{1.2} = \frac{600}{12} = 50$$

7. How many £1.50 tickets can £12 buy?

$$\frac{12}{1.5} = \frac{120}{15} = 8$$

Simplify the expressions below:

8. $3a + 5b - a + 2b$

$$2a + 7b$$

9. $2a \times 3a^4$ $6a^5$

10. Expand $4(2x + 3)$ using the grid. $8x + 12$

11. Expand and simplify $3(x + 2) - 2(x - 1)$.

$$3x + 6 - 2x + 2 = x + 8$$

12. Find $5 - 3x$ when $x = -2$. $5 - 3 \times (-2) = 11$

13. (Challenge) Think of a number, double it and add

6. Halve the result, then subtract the number you started with. Show with algebra that you always

$$\text{get } 3. \quad \frac{2x+6}{2} - x = x + 3 - x = 3$$

Starter 2: One- & Two-Step Equations

Working for Q4

$$4x - 7 = 29$$

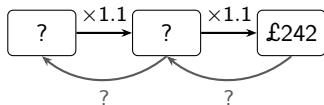
$$+7 \quad +7$$

$$4x = \underline{\quad}$$

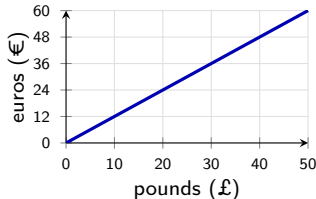
$$\div 4 \quad \div 4$$

$$x = \underline{\quad}$$

£? at 10% compound interest



Conversion graph



1. $\frac{3}{8} = \underline{\quad}\%$ 2. 2^{-3} 3. 0.5^{-2}

4. I think of a number x , multiply it by 4 and subtract 7 to get 29. Write an equation, then complete the working on the left.
Solve each equation.

5. $3x + 5 = 26$

6. $7 - 2x = 15$

7. Complete the sentence: a reduction by 20% leaves 80% of the original amount. To find the amount after the reduction we multiply the original by $\underline{\quad}$.
8. A price falls by 20% to £36. Solve an equation to find the original price, £ p .

9. Complete the flow chart. How much was invested?

10. Use the graph to change €36 into pounds. Check by solving $1.2x = 36$.

11. (Challenge) Solve $2^{x+4} = \frac{1}{8}$.

Starter 2: One- & Two-Step Equations

Working for Q4

$$4x - 7 = 29$$

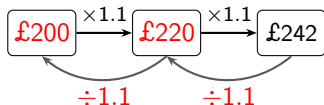
$$+7 \quad +7$$

$$4x = 36$$

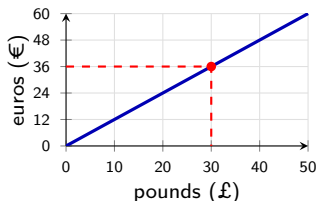
$$\div 4 \quad \div 4$$

$$x = 9$$

£? at 10% compound interest



Conversion graph



1. $\frac{3}{8} = 37.5\%$ 2. $2^{-3} = \frac{1}{8}$ 3. $0.5^{-2} = \left(\frac{1}{2}\right)^{-2} = 2^2 = 4$

4. I think of a number x , multiply it by 4 and subtract 7 to get 29. Write an equation, then complete the working on the left. $4x - 7 = 29$
Solve each equation.

5. $3x + 5 = 26$ 6. $7 - 2x = 15$
 $3x = 21, \quad x = 7$ $-2x = 8, \quad x = -4$

7. Complete the sentence: a reduction by 20% leaves 80% of the original amount. To find the amount after the reduction we multiply the original by 0.8.

8. A price falls by 20% to £36. Solve an equation to find the original price, £ p . $0.8p = 36$,
 $p = \frac{36}{0.8} = \frac{360}{8} = 45$

9. Complete the flow chart. How much was invested?
 $\frac{242}{1.1} = \frac{2420}{11} = 220, \quad \frac{2200}{11} = 200$

10. Use the graph to change €36 into pounds. Check by solving $1.2x = 36$. **£30**; $x = \frac{360}{12} = 30$

11. (Challenge) Solve $2^{x+4} = \frac{1}{8}$. $2^{x+4} = 2^{-3}$,
 $x + 4 = -3, \quad x = -7$

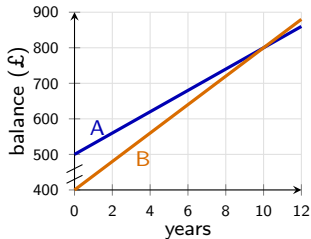
Starter 3: Unknowns on Both Sides

Bar model for Q3

x	x	x	x	3
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x	x	15
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Graph for Q6 and Q7



1. What is 0.45 as a fraction? 2. Simplify $3x^{-2} \times 4x^5$

3. Use the bar model to solve $4x + 3 = 2x + 15$.

Solve each equation below:

4. $7x - 4 = 3x + 24$ 5. $6(x - 2) = 2x + 8$

6. A has £500 at 6% and B has £400 at 10% simple interest a year. Write each balance after n years.

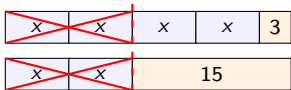
7. When are the balances equal? Solve an equation, then check on the graph.

8. Solve $7^{3x} = 7^{x+8}$ 9. What is £250 in euros, at €1.16 per £1

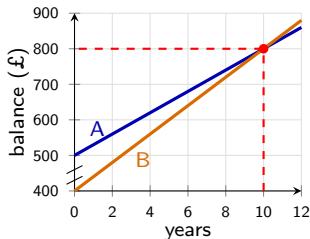
10. (Challenge) $x = 0.\dot{7}$. Use $10x - x$ to write x as a fraction.

Starter 3: Unknowns on Both Sides

Bar model for Q3



Graph for Q6 and Q7



- What is 0.45 as a fraction? $\frac{45}{100} = \frac{9}{20}$
- Simplify $3x^{-2} \times 4x^5$
 $12x^3$
- Use the bar model to solve $4x + 3 = 2x + 15$. Take $2x$ from both sides: $2x + 3 = 15$, $x = 6$
Solve each equation below:
 - $7x - 4 = 3x + 24$
 $4x - 4 = 24$, $x = 7$
 - $6(x - 2) = 2x + 8$
 $6x - 12 = 2x + 8$,
 $x = 5$
- A has £500 at 6% and B has £400 at 10% simple interest a year. Write each balance after n years.
A: $500 + 30n$, B: $400 + 40n$
- When are the balances equal? Solve an equation, then check on the graph.
 $500 + 30n = 400 + 40n$, $100 = 10n$, $n = 10$
- Solve $7^{3x} = 7^{x+8}$
 $3x = x + 8$, $x = 4$
- What is £250 in euros, at €1.16 per £1
€290
- (Challenge) $x = 0.\dot{7}$. Use $10x - x$ to write x as a fraction. $10x = 7.\dot{7}$, $9x = 7$, $x = \frac{7}{9}$

Starter 4: Unknown in the Denominator

Bread rolls

Pack	Rolls	Price	Per roll
A	4	£1.60	—
B	6	£2.10	—
C	n	£3.60	30p

Working for Q5

$$\begin{array}{l} \frac{12}{x} = 3 \\ \times x \quad \times x \\ 12 = \underline{\quad} \\ \div 3 \quad \div 3 \\ \underline{\quad} = x \end{array}$$

The bill for Q8

£80 plus 5%

£12	
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1. $\frac{7}{20} = \underline{\quad}\%$

2. 0.4^{-2}

3. Complete the table. Which is the better buy, A or B?

4. Solve an equation to find n for pack C.

Solve each equation.

5. $\frac{12}{x} = 3$

6. $\frac{35}{x-2} = 5$

7. $3 + \frac{18}{x} = 9$

8. A £80 bill has 5% service added, and is split equally at £12 each. Solve an equation to find the number of people, p .

9. Solve $5x^{-1} = 20$.

10. (Challenge) Solve $\frac{50}{x+2} = 0.8^{-2}$.

Starter 4: Unknown in the Denominator

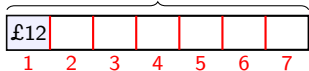
Bread rolls

Pack	Rolls	Price	Per roll
A	4	£1.60	40p
B	6	£2.10	35p
C	n	£3.60	30p

Working for Q5

$$\begin{aligned}\frac{12}{x} &= 3 \\ \times x & \quad \times x \\ 12 &= 3x \\ \div 3 & \quad \div 3 \\ 4 &= x\end{aligned}$$

The bill for Q8
£80 plus 5%



$$1. \quad \frac{7}{20} = 35\%$$

$$2. \quad 0.4^{-2} = \left(\frac{2}{5}\right)^{-2} = \left(\frac{5}{2}\right)^2 = \frac{25}{4}$$

3. Complete the table. Which is the better buy, A or B? **B**

4. Solve an equation to find n for pack C. $\frac{360}{n} = 30$,
 $360 = 30n$, $n = 12$

Solve each equation.

$$5. \quad \frac{12}{x} = 3 \\ x = 4$$

$$6. \quad \frac{35}{x-2} = 5 \\ 35 = 5(x-2), \\ x = 9$$

$$7. \quad 3 + \frac{18}{x} = 9 \\ \frac{18}{x} = 6, \\ x = 3$$

8. A £80 bill has 5% service added, and is split equally at £12 each. Solve an equation to find the number of people, p . $\frac{84}{p} = 12$, $84 = 12p$,
 $p = 7$

9. Solve $5x^{-1} = 20$. $\frac{5}{x} = 20$, $5 = 20x$, $x = \frac{1}{4}$

10. (Challenge) Solve $\frac{50}{x+2} = 0.8^{-2}$.

$$\left(\frac{4}{5}\right)^{-2} = \frac{25}{16}, \quad 800 = 25(x+2), \quad x = 30$$

Starter 5: Equations with Fractions

Working for Q3

$$\frac{x+2}{3} = 5$$

$$\frac{\quad}{\quad} = \frac{\quad}{\quad}$$
$$x + 2 = \quad$$

$$\frac{\quad}{\quad} = \frac{\quad}{\quad}$$
$$x = \quad$$

1. $\frac{1}{3} + \frac{1}{4}$

Solve each equation.

3. $\frac{x+2}{3} = 5$

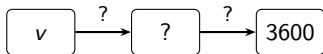
5. $\frac{x}{3} + \frac{x}{4} = 14$

2. $\left(\frac{3}{4}\right)^{-2}$

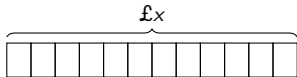
4. $\frac{2x-1}{5} = 3$

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

A car's value in £, over 2 years



Sam's money



7. A car loses 25% of its value each year. Complete the flow chart, then solve an equation for v .
8. Sam has £ x . He spends $\frac{1}{3}$ on a game and $\frac{1}{4}$ on food, leaving £15. Shade the bar, then solve an equation for x .
9. Solve $\left(\frac{2}{3}\right)^x = \frac{9}{4}$.
10. (Challenge) £3 buys x rolls and £4 buys $x + 4$ rolls, at the same price per roll. Find x .

Starter 5: Equations with Fractions

Working for Q3

$$\frac{x+2}{3} = 5$$

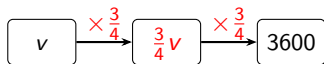
$$\times 3 \quad \times 3$$

$$x + 2 = 15$$

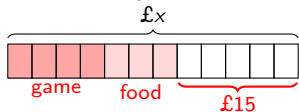
$$-2 \quad -2$$

$$x = 13$$

A car's value in £, over 2 years



Sam's money



5 parts are £15, so 1 part is £3

$$1. \quad \frac{1}{3} + \frac{1}{4} = \frac{7}{12}$$

Solve each equation.

$$3. \quad \frac{x+2}{3} = 5 \quad x = 13$$

$$2. \quad \left(\frac{3}{4}\right)^{-2} = \left(\frac{4}{3}\right)^2 = \frac{16}{9}$$

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

$$2x - 1 = 15, \quad x = 8$$

$$5. \quad \frac{x}{3} + \frac{x}{4} = 14$$

$$4x + 3x = 168,$$

$$x = 24$$

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

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

$$x = 5$$

7. A car loses 25% of its value each year. Complete the flow chart, then solve an equation for v .

$$\frac{9}{16}v = 3600, \quad 9v = 57600, \quad v = 6400$$

8. Sam has £ x . He spends $\frac{1}{3}$ on a game and $\frac{1}{4}$ on food, leaving £15. Shade the bar, then solve an equation for x .

$$x - \frac{x}{3} - \frac{x}{4} = 15, \quad \frac{5x}{12} = 15, \quad x = 36$$

9. Solve $\left(\frac{2}{3}\right)^x = \frac{9}{4}$. $\left(\frac{2}{3}\right)^{-2} = \frac{9}{4}$, so $x = -2$

10. (Challenge) £3 buys x rolls and £4 buys $x+4$ rolls, at the same price per roll. Find x . $\frac{3}{x} = \frac{4}{x+4}$,
 $3(x+4) = 4x, \quad x = 12$

Starter 6: Simultaneous Equations

Two receipts

2 coffees 3 cakes ----- Total £9.30	2 coffees 1 cake ----- Total £5.50
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£P at £/ simple interest a year

Years	2	5
Balance	£560	£650

Two bureaux de change

Airport: no fee, and €1.10 for every £1.

High Street: a £5 fee, then €1.20 for every £1 that is left.

1. 0.125 as a fraction
2. $2^{-1} + 2^{-2}$ as a percentage
3. Write each receipt as an equation, with c for a coffee and k for a cake. Subtract to find k and c .

Solve each pair of equations.

4. $x + y = 10$
 $x - y = 4$
5. $2x + 3y = 13$
 $x + y = 5$
6. Write two equations from the table, and solve them. Find the interest rate.
7. Write the euros, y , that each bureau gives for £ x . When are they equal?
8. (Challenge) Solve $2^x \times 2^y = 64$ and $3^x \div 3^y = \frac{1}{9}$.

Starter 6: Simultaneous Equations

Two receipts

2 coffees 3 cakes	2 coffees 1 cake
Total £9.30	Total £5.50

£P at £I simple interest a year

Years	2	5
Balance	£560	£650

Two bureaux de change

Airport: no fee, and €1.10 for every £1.

High Street: a £5 fee, then €1.20 for every £1 that is left.

1. 0.125 as a fraction $\frac{1}{8}$ 2. $2^{-1} + 2^{-2}$ as a percentage

$$\frac{1}{2} + \frac{1}{4} = 75\%$$

3. Write each receipt as an equation, with c for a coffee and k for a cake. Subtract to find k and c .
 $2c + 3k = 9.30$, $2c + k = 5.50$; $2k = 3.80$,
 $k = 1.90$, $c = 1.80$

Solve each pair of equations.

4. $x + y = 10$ $x = 7$, 5. $2x + 3y = 13$

$$x - y = 4$$

$$x + y = 5$$

$$y = 3$$

$$x = 2, \quad y = 3$$

6. Write two equations from the table, and solve them. Find the interest rate. $P + 2I = 560$,
 $P + 5I = 650$; $I = 30$, $P = 500$; 6%
7. Write the euros, y , that each bureau gives for £ x . When are they equal? $y = 1.1x$, $y = 1.2x - 6$;
 $0.1x = 6$, $x = \frac{6}{0.1} = \frac{60}{1} = 60$
8. (Challenge) Solve $2^x \times 2^y = 64$ and $3^x \div 3^y = \frac{1}{9}$.
 $x + y = 6$, $x - y = -2$; $x = 2$, $y = 4$