

Solving Equations: Starters

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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.

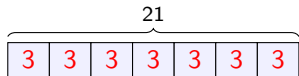
11. Expand and simplify $3(x + 2) - 2(x - 1)$.

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

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

$$2a + 7b$$

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

Worked Solution: Starter 1, Question 1

Question: $\frac{2}{5} = ?$ as a percentage.

Worked Solution: Starter 1, Question 1

Question: $\frac{2}{5} = ?$ as a percentage.

Solution:

$$\frac{2}{5} = \frac{2 \times 20}{5 \times 20} = \frac{40}{100} = 40\%.$$

Multiply numerator and denominator by 20 to make the denominator 100.

Worked Solution: Starter 1, Question 2

Question: $3^{-2} = ?$

Worked Solution: Starter 1, Question 2

Question: $3^{-2} = ?$

Solution:

$$3^{-2} = \frac{1}{3^2} = \frac{1}{9}.$$

A negative index means take the reciprocal.

Worked Solution: Starter 1, Question 3

Question: $0.2^{-1} = ?$

Worked Solution: Starter 1, Question 3

Question: $0.2^{-1} = ?$

Solution:

$$0.2 = \frac{2}{10} = \frac{1}{5}, \quad \text{so} \quad 0.2^{-1} = \left(\frac{1}{5}\right)^{-1} = 5.$$

Write the decimal as a fraction, then flip it.

Worked Solution: Starter 1, Question 4

Question: What number multiplied by 7 makes 21?

Worked Solution: Starter 1, Question 4

Question: What number multiplied by 7 makes 21?

Solution: Let the number be x . Then

$$7x = 21.$$

Divide both sides by 7:

$$x = \frac{21}{7} = 3.$$

So the number is 3.

Worked Solution: Starter 1, Question 5

Question: What number plus 8 makes 3?

Worked Solution: Starter 1, Question 5

Question: What number plus 8 makes 3?

Solution: Let the number be x . Then

$$x + 8 = 3.$$

Subtract 8 from both sides:

$$x = 3 - 8 = -5.$$

So the number is -5 .

Worked Solution: Starter 1, Question 6

Question: What number multiplied by 1.2 makes 60?

Worked Solution: Starter 1, Question 6

Question: What number multiplied by 1.2 makes 60?

Solution: Let the number be x . Then

$$1.2x = 60.$$

Divide both sides by 1.2:

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

So the number is 50.

Worked Solution: Starter 1, Question 7

Question: How many £1.50 tickets can £12 buy?

Worked Solution: Starter 1, Question 7

Question: How many £1.50 tickets can £12 buy?

Solution: Let n be the number of tickets. Then

$$1.5n = 12.$$

Divide both sides by 1.5:

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

So 8 tickets can be bought.

Worked Solution: Starter 1, Question 8

Question: Simplify $3a + 5b - a + 2b$.

Worked Solution: Starter 1, Question 8

Question: Simplify $3a + 5b - a + 2b$.

Solution: Collect like terms:

$$3a - a = 2a, \quad 5b + 2b = 7b.$$

So the simplified expression is

$$2a + 7b.$$

Worked Solution: Starter 1, Question 9

Question: Simplify $2a \times 3a^4$.

Worked Solution: Starter 1, Question 9

Question: Simplify $2a \times 3a^4$.

Solution: Multiply the coefficients and the powers of a :

$$2a \times 3a^4 = (2 \times 3) \times (a^1 \times a^4) = 6a^{1+4} = 6a^5.$$

Worked Solution: Starter 1, Question 10

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

Worked Solution: Starter 1, Question 10

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

Solution: Using the grid:

$$4 \times 2x = 8x, \quad 4 \times 3 = 12.$$

So

$$4(2x + 3) = 8x + 12.$$

Worked Solution: Starter 1, Question 11

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

Worked Solution: Starter 1, Question 11

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

Solution: Expand each bracket:

$$3(x + 2) = 3x + 6, \quad -2(x - 1) = -2x + 2.$$

Add the results:

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

Worked Solution: Starter 1, Question 12

Question: Find $5 - 3x$ when $x = -2$.

Worked Solution: Starter 1, Question 12

Question: Find $5 - 3x$ when $x = -2$.

Solution: Substitute $x = -2$:

$$5 - 3(-2) = 5 + 6 = 11.$$

Worked Solution: Starter 1, Question 13

Question: (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.

Worked Solution: Starter 1, Question 13

Question: (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.

Solution: Let the starting number be x .

Double it: $2x$, add 6 : $2x + 6$.

Halve the result:

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

Subtract the original number:

$$(x + 3) - x = 3.$$

So the final result is always 3.

Starter 2: One- & Two-Step Equations

Working for Q4

$$4x - 7 = 29$$

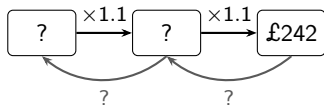
$$+7 \quad +7$$

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

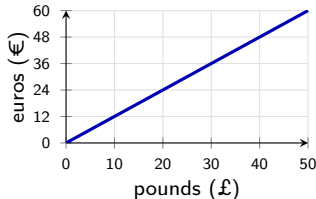
$$\div 4 \quad \div 4$$

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

£? 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

$$4x - 7 = 29$$

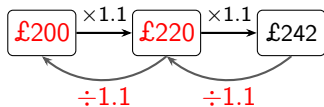
$$+7 \quad +7$$

$$4x = 36$$

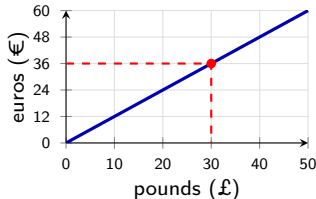
$$\div 4 \quad \div 4$$

$$x = 9$$

£? 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 $2^{x+4} = \frac{1}{8}$. $2^{x+4} = 2^{-3}$,
 $x + 4 = -3, \quad x = -7$

Worked Solution: Starter 2, Question 1

Question: $\frac{3}{8} = ?\%$

Worked Solution: Starter 2, Question 1

Question: $\frac{3}{8} = ?\%$

Solution:

$$\frac{3}{8} = 0.375 = 37.5\%.$$

Or multiply by 100:

$$\frac{3}{8} \times 100 = \frac{300}{8} = 37.5.$$

So $\frac{3}{8} = 37.5\%$.

Worked Solution: Starter 2, Question 2

Question: $2^{-3} = ?$

Worked Solution: Starter 2, Question 2

Question: $2^{-3} = ?$

Solution:

$$2^{-3} = \frac{1}{2^3} = \frac{1}{8}.$$

Worked Solution: Starter 2, Question 3

Question: $0.5^{-2} = ?$

Worked Solution: Starter 2, Question 3

Question: $0.5^{-2} = ?$

Solution:

$$0.5 = \frac{1}{2}, \quad \text{so} \quad 0.5^{-2} = \left(\frac{1}{2}\right)^{-2} = 2^2 = 4.$$

Worked Solution: Starter 2, Question 4

Question: 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.

Worked Solution: Starter 2, Question 4

Question: 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.

Solution: The equation is

$$4x - 7 = 29.$$

Add 7 to both sides:

$$4x = 36.$$

Divide both sides by 4:

$$x = 9.$$

Worked Solution: Starter 2, Question 5

Question: Solve $3x + 5 = 26$.

Worked Solution: Starter 2, Question 5

Question: Solve $3x + 5 = 26$.

Solution:

$$3x + 5 = 26.$$

Subtract 5:

$$3x = 21.$$

Divide by 3:

$$x = 7.$$

Worked Solution: Starter 2, Question 6

Question: Solve $7 - 2x = 15$.

Worked Solution: Starter 2, Question 6

Question: Solve $7 - 2x = 15$.

Solution:

$$7 - 2x = 15.$$

Subtract 7:

$$-2x = 8.$$

Divide by -2 :

$$x = -4.$$

Worked Solution: Starter 2, Question 7

Question: 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 ____.

Worked Solution: Starter 2, Question 7

Question: 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.

Solution: The multiplier is

$$1 - 0.20 = 0.80 = 0.8.$$

So we multiply the original by 0.8.

Worked Solution: Starter 2, Question 8

Question: A price falls by 20% to £36. Solve an equation to find the original price, £ p .

Worked Solution: Starter 2, Question 8

Question: A price falls by 20% to £36. Solve an equation to find the original price, £ p .

Solution: After a 20% reduction, the price is 80% of the original. So

$$0.8p = 36.$$

Divide both sides by 0.8:

$$p = \frac{36}{0.8} = \frac{360}{8} = 45.$$

So the original price was £45.

Worked Solution: Starter 2, Question 9

Question: Complete the flow chart. How much was invested?

Worked Solution: Starter 2, Question 9

Question: Complete the flow chart. How much was invested?

Solution: The flow chart shows an amount multiplied by 1.1 twice to get £242. Work backwards:

$$242 \div 1.1 = \frac{242}{1.1} = \frac{2420}{11} = 220,$$

$$220 \div 1.1 = \frac{220}{1.1} = \frac{2200}{11} = 200.$$

So £200 was invested.

Worked Solution: Starter 2, Question 10

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

Worked Solution: Starter 2, Question 10

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

Solution: From the graph, €36 corresponds to £30. Check:

$$1.2x = 36 \Rightarrow x = \frac{36}{1.2} = \frac{360}{12} = 30.$$

So €36 is £30.

Worked Solution: Starter 2, Question 11

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

Worked Solution: Starter 2, Question 11

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

Solution: Write $\frac{1}{8} = 2^{-3}$. Then

$$2^{x+4} = 2^{-3}.$$

Since the bases are the same, equate the exponents:

$$x + 4 = -3.$$

Subtract 4:

$$x = -7.$$

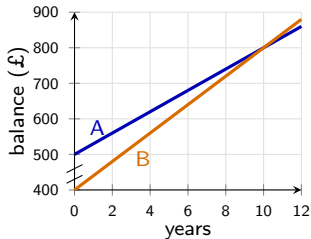
Starter 3: Unknowns on Both Sides

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.

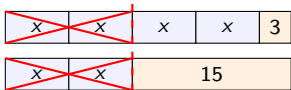
7. When are the balances equal? Solve an equation, then check on the graph.

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

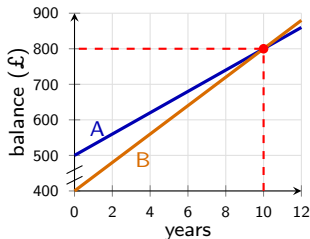
10. (Challenge) $x = 0.\dot{7}$. Use $10x - x$ to write x as a fraction.

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. $10x = 7.\dot{7}$, $9x = 7$, $x = \frac{7}{9}$

Worked Solution: Starter 3, Question 1

Question: What is 0.45 as a fraction?

Worked Solution: Starter 3, Question 1

Question: What is 0.45 as a fraction?

Solution:

$$0.45 = \frac{45}{100} = \frac{9}{20}.$$

Worked Solution: Starter 3, Question 2

Question: Simplify $3x^{-2} \times 4x^5$.

Worked Solution: Starter 3, Question 2

Question: Simplify $3x^{-2} \times 4x^5$.

Solution: Multiply coefficients and add indices:

$$3 \times 4 = 12, \quad x^{-2} \times x^5 = x^{-2+5} = x^3.$$

So

$$3x^{-2} \times 4x^5 = 12x^3.$$

Worked Solution: Starter 3, Question 3

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

Worked Solution: Starter 3, Question 3

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

Solution: From the bar model, take $2x$ from both sides:

$$4x + 3 - 2x = 2x + 15 - 2x \Rightarrow 2x + 3 = 15.$$

Subtract 3:

$$2x = 12.$$

Divide by 2:

$$x = 6.$$

Worked Solution: Starter 3, Question 4

Question: Solve $7x - 4 = 3x + 24$.

Worked Solution: Starter 3, Question 4

Question: Solve $7x - 4 = 3x + 24$.

Solution:

$$7x - 4 = 3x + 24.$$

Subtract $3x$ from both sides:

$$4x - 4 = 24.$$

Add 4:

$$4x = 28.$$

Divide by 4:

$$x = 7.$$

Worked Solution: Starter 3, Question 5

Question: Solve $6(x - 2) = 2x + 8$.

Worked Solution: Starter 3, Question 5

Question: Solve $6(x - 2) = 2x + 8$.

Solution: Expand the bracket:

$$6x - 12 = 2x + 8.$$

Subtract $2x$:

$$4x - 12 = 8.$$

Add 12:

$$4x = 20.$$

Divide by 4:

$$x = 5.$$

Worked Solution: Starter 3, Question 6

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

Worked Solution: Starter 3, Question 6

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

Solution: A earns $500 \times 0.06 = 30$ per year. So balance A is

$$500 + 30n.$$

B earns $400 \times 0.10 = 40$ per year. So balance B is

$$400 + 40n.$$

Worked Solution: Starter 3, Question 7

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

Worked Solution: Starter 3, Question 7

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

Solution: Set the balances equal:

$$500 + 30n = 400 + 40n.$$

Subtract 400:

$$100 + 30n = 40n.$$

Subtract $30n$:

$$100 = 10n.$$

Divide by 10:

$$n = 10.$$

At 10 years, both balances are £800, which matches the graph.

Worked Solution: Starter 3, Question 8

Question: Solve $7^{3x} = 7^{x+8}$.

Worked Solution: Starter 3, Question 8

Question: Solve $7^{3x} = 7^{x+8}$.

Solution: Bases are the same, so equate exponents:

$$3x = x + 8.$$

Subtract x :

$$2x = 8.$$

Divide by 2:

$$x = 4.$$

Worked Solution: Starter 3, Question 9

Question: What is £250 in euros, at €1.16 per £1?

Worked Solution: Starter 3, Question 9

Question: What is £250 in euros, at €1.16 per £1?

Solution: Multiply:

$$250 \times 1.16 = 250 \times (1 + 0.16) = 250 + 40 = 290.$$

So £250 is €290.

Worked Solution: Starter 3, Question 10

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

Worked Solution: Starter 3, Question 10

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

Solution: Let $x = 0.777\dots$. Then

$$10x = 7.777\dots$$

Subtract x :

$$10x - x = 7.777\dots - 0.777\dots = 7.$$

So

$$9x = 7 \Rightarrow x = \frac{7}{9}.$$

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

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

xx xx

12 =

$$\div 3 \quad \div 3$$

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

The bill for Q8

£80 plus 5%

£12	
-----	--

1. $\frac{7}{20} = \underline{\hspace{1cm}}\%$

2. 0.4^{-2}

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

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

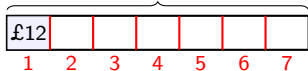
$$\times x \quad \times x$$

$$12 = 3x$$

$$\div 3 \quad \div 3$$

$$4 = x$$

The bill for Q8
£80 plus 5%



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

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

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.

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

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

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

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 $\frac{50}{x+2} = 0.8^{-2}$.
 $\left(\frac{4}{5}\right)^{-2} = \frac{25}{16}$, $800 = 25(x+2)$, $x = 30$

Worked Solution: Starter 4, Question 1

Question: $\frac{7}{20} = ?\%$

Worked Solution: Starter 4, Question 1

Question: $\frac{7}{20} = ?\%$

Solution:

$$\frac{7}{20} = \frac{7 \times 5}{20 \times 5} = \frac{35}{100} = 35\%.$$

Worked Solution: Starter 4, Question 2

Question: $0.4^{-2} = ?$

Worked Solution: Starter 4, Question 2

Question: $0.4^{-2} = ?$

Solution:

$$0.4 = \frac{4}{10} = \frac{2}{5}, \quad \text{so} \quad 0.4^{-2} = \left(\frac{2}{5}\right)^{-2} = \left(\frac{5}{2}\right)^2 = \frac{25}{4}.$$

Worked Solution: Starter 4, Question 3

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

Worked Solution: Starter 4, Question 3

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

Solution: Pack A: £1.60 for 4 rolls, so per roll:

$$1.60 \div 4 = 0.40 \text{ (40p).}$$

Pack B: £2.10 for 6 rolls, so per roll:

$$2.10 \div 6 = 0.35 \text{ (35p).}$$

Pack B is cheaper per roll, so B is the better buy.

Worked Solution: Starter 4, Question 4

Question: Solve an equation to find n for pack C.

Worked Solution: Starter 4, Question 4

Question: Solve an equation to find n for pack C.

Solution: Pack C has n rolls at £3.60, and costs 30p per roll, i.e. £0.30.
So

$$0.30n = 3.60.$$

Divide by 0.30:

$$n = \frac{3.60}{0.30} = \frac{360}{30} = 12.$$

So $n = 12$.

Worked Solution: Starter 4, Question 5

Question: Solve $\frac{12}{x} = 3$.

Worked Solution: Starter 4, Question 5

Question: Solve $\frac{12}{x} = 3$.

Solution: Multiply both sides by x :

$$12 = 3x.$$

Divide by 3:

$$x = 4.$$

Worked Solution: Starter 4, Question 6

Question: Solve $\frac{35}{x-2} = 5$.

Worked Solution: Starter 4, Question 6

Question: Solve $\frac{35}{x-2} = 5$.

Solution: Multiply both sides by $x - 2$:

$$35 = 5(x - 2).$$

Divide by 5:

$$7 = x - 2.$$

Add 2:

$$x = 9.$$

Worked Solution: Starter 4, Question 7

Question: Solve $3 + \frac{18}{x} = 9$.

Worked Solution: Starter 4, Question 7

Question: Solve $3 + \frac{18}{x} = 9$.

Solution: Subtract 3:

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

Multiply by x :

$$18 = 6x.$$

Divide by 6:

$$x = 3.$$

Worked Solution: Starter 4, Question 8

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

Worked Solution: Starter 4, Question 8

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

Solution: Total bill with service:

$$80 \times 1.05 = 84.$$

Split equally:

$$\frac{84}{p} = 12.$$

Multiply by p :

$$84 = 12p.$$

Divide by 12:

$$p = 7.$$

So there are 7 people.

Worked Solution: Starter 4, Question 9

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

Worked Solution: Starter 4, Question 9

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

Solution:

$$5x^{-1} = \frac{5}{x} = 20.$$

Multiply by x :

$$5 = 20x.$$

Divide by 20:

$$x = \frac{5}{20} = \frac{1}{4}.$$

Worked Solution: Starter 4, Question 10

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

Worked Solution: Starter 4, Question 10

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

Solution: First,

$$0.8^{-2} = \left(\frac{4}{5}\right)^{-2} = \left(\frac{5}{4}\right)^2 = \frac{25}{16}.$$

So

$$\frac{50}{x+2} = \frac{25}{16}.$$

Cross-multiply:

$$50 \times 16 = 25(x+2).$$

$$800 = 25(x+2).$$

Divide by 25:

$$32 = x + 2.$$

Subtract 2:

$$x = 30.$$

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

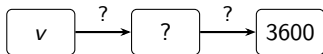
2. $\left(\frac{3}{4}\right)^{-2}$

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

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

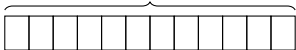
6. $\frac{x+3}{2} = \frac{x+7}{3}$

A car's value in £, over 2 years



Sam's money

£x



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

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

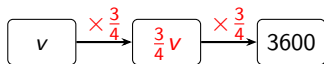
$$\times 3 \quad \times 3$$

$$x + 2 = 15$$

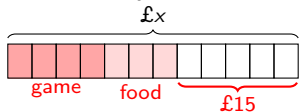
$$-2 \quad -2$$

$$x = 13$$

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 . $\frac{3}{x} = \frac{4}{x+4}$,
 $3(x+4) = 4x, \quad x = 12$

Worked Solution: Starter 5, Question 1

Question: $\frac{1}{3} + \frac{1}{4}$

Worked Solution: Starter 5, Question 1

Question: $\frac{1}{3} + \frac{1}{4}$

Solution: Common denominator 12:

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

Worked Solution: Starter 5, Question 2

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

Worked Solution: Starter 5, Question 2

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

Solution:

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

Worked Solution: Starter 5, Question 3

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

Worked Solution: Starter 5, Question 3

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

Solution: Multiply both sides by 3:

$$x + 2 = 15.$$

Subtract 2:

$$x = 13.$$

Worked Solution: Starter 5, Question 4

Question: Solve $\frac{2x-1}{5} = 3$.

Worked Solution: Starter 5, Question 4

Question: Solve $\frac{2x-1}{5} = 3$.

Solution: Multiply both sides by 5:

$$2x - 1 = 15.$$

Add 1:

$$2x = 16.$$

Divide by 2:

$$x = 8.$$

Worked Solution: Starter 5, Question 5

Question: Solve $\frac{x}{3} + \frac{x}{4} = 14$.

Worked Solution: Starter 5, Question 5

Question: Solve $\frac{x}{3} + \frac{x}{4} = 14$.

Solution: Common denominator 12:

$$\frac{4x}{12} + \frac{3x}{12} = \frac{7x}{12} = 14.$$

Multiply by 12:

$$7x = 168.$$

Divide by 7:

$$x = 24.$$

Worked Solution: Starter 5, Question 6

Question: Solve $\frac{x+3}{2} = \frac{x+7}{3}$.

Worked Solution: Starter 5, Question 6

Question: Solve $\frac{x+3}{2} = \frac{x+7}{3}$.

Solution: Cross-multiply:

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

Expand:

$$3x + 9 = 2x + 14.$$

Subtract $2x$:

$$x + 9 = 14.$$

Subtract 9:

$$x = 5.$$

Worked Solution: Starter 5, Question 7

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

Worked Solution: Starter 5, Question 7

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

Solution: The multiplier for a 25% loss is $1 - 0.25 = 0.75 = \frac{3}{4}$. After two years:

$$v \times \frac{3}{4} \times \frac{3}{4} = v \times \frac{9}{16} = 3600.$$

So

$$\frac{9}{16}v = 3600.$$

Multiply by 16:

$$9v = 57600.$$

Divide by 9:

$$v = 6400.$$

So the initial value was £6400.

Worked Solution: Starter 5, Question 8

Question: 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 .

Worked Solution: Starter 5, Question 8

Question: 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 .

Solution: Total spent:

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

Remaining:

$$1 - \frac{7}{12} = \frac{5}{12}.$$

So

$$\frac{5}{12}x = 15.$$

Multiply by 12:

$$5x = 180.$$

Divide by 5:

$$x = 36.$$

So Sam had £36.

Worked Solution: Starter 5, Question 9

Question: Solve $\left(\frac{2}{3}\right)^x = \frac{9}{4}$.

Worked Solution: Starter 5, Question 9

Question: Solve $\left(\frac{2}{3}\right)^x = \frac{9}{4}$.

Solution: Note that

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

So

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

Equate exponents:

$$x = -2.$$

Worked Solution: Starter 5, Question 10

Question: (Challenge) £3 buys x rolls and £4 buys $x + 4$ rolls, at the same price per roll. Find x .

Worked Solution: Starter 5, Question 10

Question: (Challenge) £3 buys x rolls and £4 buys $x + 4$ rolls, at the same price per roll. Find x .

Solution: Price per roll for the first purchase:

$$\frac{3}{x}.$$

Price per roll for the second purchase:

$$\frac{4}{x + 4}.$$

Since the price per roll is the same:

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

Cross-multiply:

$$3(x + 4) = 4x.$$

Expand:

$$3x + 12 = 4x.$$

Starter 6: Simultaneous Equations

Two receipts

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

£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 $3^x \div 3^y = \frac{1}{9}$.
 $x + y = 6$, $x - y = -2$; $x = 2$, $y = 4$

Worked Solution: Starter 6, Question 1

Question: 0.125 as a fraction

Worked Solution: Starter 6, Question 1

Question: 0.125 as a fraction

Solution:

$$0.125 = \frac{125}{1000} = \frac{1}{8}.$$

Worked Solution: Starter 6, Question 2

Question: $2^{-1} + 2^{-2}$ as a percentage

Worked Solution: Starter 6, Question 2

Question: $2^{-1} + 2^{-2}$ as a percentage

Solution:

$$2^{-1} = \frac{1}{2}, \quad 2^{-2} = \frac{1}{4}.$$

Sum:

$$\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4} = 75\%.$$

Worked Solution: Starter 6, Question 3

Question: Write each receipt as an equation, with c for a coffee and k for a cake. Subtract to find k and c .

Worked Solution: Starter 6, Question 3

Question: Write each receipt as an equation, with c for a coffee and k for a cake. Subtract to find k and c .

Solution: The equations are

$$2c + 3k = 9.30 \quad (1)$$

$$2c + k = 5.50 \quad (2)$$

Subtract (2) from (1):

$$(2c + 3k) - (2c + k) = 9.30 - 5.50 \Rightarrow 2k = 3.80.$$

So

$$k = 1.90.$$

Substitute into (2):

$$2c + 1.90 = 5.50 \Rightarrow 2c = 3.60 \Rightarrow c = 1.80.$$

So a coffee is £1.80 and a cake is £1.90.

Worked Solution: Starter 6, Question 4

Question: Solve $x + y = 10$ and $x - y = 4$.

Worked Solution: Starter 6, Question 4

Question: Solve $x + y = 10$ and $x - y = 4$.

Solution: Add the two equations:

$$(x + y) + (x - y) = 10 + 4 \Rightarrow 2x = 14 \Rightarrow x = 7.$$

Substitute into $x + y = 10$:

$$7 + y = 10 \Rightarrow y = 3.$$

So $x = 7$, $y = 3$.

Worked Solution: Starter 6, Question 5

Question: Solve $2x + 3y = 13$ and $x + y = 5$.

Worked Solution: Starter 6, Question 5

Question: Solve $2x + 3y = 13$ and $x + y = 5$.

Solution: From $x + y = 5$, we have $x = 5 - y$. Substitute into $2x + 3y = 13$:

$$2(5 - y) + 3y = 13.$$

$$10 - 2y + 3y = 13.$$

$$10 + y = 13 \Rightarrow y = 3.$$

Then $x = 5 - 3 = 2$. So $x = 2$, $y = 3$.

Worked Solution: Starter 6, Question 6

Question: Write two equations from the table, and solve them. Find the interest rate.

Worked Solution: Starter 6, Question 6

Question: Write two equations from the table, and solve them. Find the interest rate.

Solution: Let P be the principal and I the annual interest. From the table:

$$P + 2I = 560 \quad (1)$$

$$P + 5I = 650 \quad (2)$$

Subtract (1) from (2):

$$3I = 90 \Rightarrow I = 30.$$

Substitute into (1):

$$P + 60 = 560 \Rightarrow P = 500.$$

Interest rate:

$$\frac{I}{P} = \frac{30}{500} = 0.06 = 6\%.$$

Worked Solution: Starter 6, Question 7

Question: Write the euros, y , that each bureau gives for £ x . When are they equal?

Worked Solution: Starter 6, Question 7

Question: Write the euros, y , that each bureau gives for $\pounds x$. When are they equal?

Solution: Airport: no fee, $\text{€}1.10$ per $\pounds 1$. So

$$y = 1.1x.$$

High Street: $\pounds 5$ fee, then $\text{€}1.20$ per $\pounds 1$ left. So

$$y = 1.2(x - 5) = 1.2x - 6.$$

Set equal:

$$1.1x = 1.2x - 6.$$

$$6 = 0.1x.$$

$$x = \frac{6}{0.1} = 60.$$

So they are equal when exchanging $\pounds 60$.

Worked Solution: Starter 6, Question 8

Question: (Challenge) Solve $2^x \times 2^y = 64$ and $3^x \div 3^y = \frac{1}{9}$.

Worked Solution: Starter 6, Question 8

Question: (Challenge) Solve $2^x \times 2^y = 64$ and $3^x \div 3^y = \frac{1}{9}$.

Solution: First equation:

$$2^x \times 2^y = 2^{x+y} = 64 = 2^6 \Rightarrow x + y = 6.$$

Second equation:

$$3^x \div 3^y = 3^{x-y} = \frac{1}{9} = 3^{-2} \Rightarrow x - y = -2.$$

Add the two equations:

$$(x + y) + (x - y) = 6 + (-2) \Rightarrow 2x = 4 \Rightarrow x = 2.$$

Then from $x + y = 6$:

$$2 + y = 6 \Rightarrow y = 4.$$

So $x = 2$, $y = 4$.