Expressing Missing Number Problems Algebraically

An expression is a mathematical sentence which has an algebraic term, for example:

$$a + 2$$

In this expression, you have two terms. One is a – this is the algebraic term because it includes a letter. The other is 2 – this is the constant term. It is called a constant term because the value of 2 is constant; it does not change.

There is nothing magical about using letters in maths. You just have to remember that the letter represents a number.

Example 1:

A shop has 2 boxes of T-shirts. The number of T-shirts in each box is the same. The shop also has an extra 3 T-shirts that are not in a box. Write an expression for the number of T-shirts the shop has.

In this example, we don't know the number of t-shirts in a box; therefore, we are going to use a letter to represent this unknown number.

First, we need to pick a letter to represent how many T-shirts are in a box. In this case, let's choose b.

We have two boxes so the number of T-shirts inside those boxes will be:

$$2 \times b$$

We can also represent this as:

$$2b$$

We also have an extra 3 T-shirts. This means we take the number of T-shirts in 2 boxes and add 3:

$$2b + 3$$

This is our answer. We can't combine $2b$ and 3 because we don't know what number b represents, so we leave it as it is.

Example 2:

Joe thinks of a number. He takes away 4. He then multiplies his result by 3. Write an expression to represent Joe's number.

Again, the question is asking us to write an expression – a mathematical sentence – to represent the question.

First, we need a letter. Joe chose the number so let's use j. He starts by subtracting 4, so we take 4 away from j:

$$j - 4$$

Remember, we can't do this sum because we don't know what number j represents.

Example 2:

Joe thinks of a number. He takes away 4. He then multiplies his result by 3. Write an expression to represent Joe's number.

The second thing Joe does is to multiply by 3. Now, we have to be careful. Joe isn't just multiplying j by 3. He has to multiply the whole expression by 3. There are two ways of doing this. Use the process that makes more sense to you:

Multiply each term by 3:

$4 \times 3 = 12$

$j \times 3 = 3j$

Therefore, j – 4, multiplied by 3, gives us:

$3j - 12$

We could also use brackets to represent the multiplication:

$3 \times (j - 4)$

or:

$3(j - 4)$

Your Turn

Your Turn

1. **In each question, write an expression for the resulting number. (Hint: to help choose a letter, just use the letter of the question.)**

   a. **You pick a random number, then multiply it by 2.**
   b. **You pick a random number, then add 5.**
   c. **You pick a random number, then subtract 10.**
   d. **You pick a random number, multiply it by 4, then add 2.**
   e. **You pick a random number, then divide it by 4.**
   f. **You pick a random number, multiply it by 3, then subtract 4.**
   g. **You pick a random number, add 2, then multiply it by 3.**
   h. **You pick a random number, multiply it by 2, subtract 4, then multiply it by 10.**

2. **A gardener plants b bulbs in one day. The next day, they plant another 8 bulbs. Write an expression, in terms of b, for the number of bulbs they have planted in total.**

3. **Assan has t pencils. Gerry has twice as many pencils as Assan. Write an expression, in terms of t, for the number of pencils Gerry has.**

Your Turn

4. Ben is x years old. Amy is 5 years younger than Ben. Write an expression, in terms of x, for Amy's age.

5. There are z marbles in a bag. You add 2 marbles to the bag.
   a. Write an expression for the number of marbles in the bag.
   b. Write an expression for the number of marbles in 5 of these bags.

6. Jamie has some sweets. Oliver has twice as many sweets. Write an expression for the number of sweets they have in total.

7. Olivia thinks of a number. She adds 6, then doubles the result, subtracts 12, and then halves the result. If Olivia's starting number was x, what is her final number?

8. An adult ticket to a theme park costs £a. A child ticket is £10 cheaper. Write an expression, in terms of a, for the total cost of two adults and two children.

9. Eddy is e years old. Fran is twice Eddy's age, and George is 5 years older than Fran. Write an expression, in terms of e, for the total of their ages.

Your Turn

10. In a football tournament, a team gets 2 points for a win and 1 point for a draw. Chesterton Champions play c games. They draw 5, lose 6 and win the rest. Write an expression for the number of points they get.

11. A shop sells short-sleeve shirts for £m each. They sell long-sleeve shirts for £2 more. In one day, they sell 8 short sleeve shirts and 6 long-sleeve shirts. The next day they sell twice as many long-sleeve shirts as the day before, but no short sleeve shirts. Over the two days, how much money did they take?

12. Niamh takes a number, adds 3, then multiplies by 2.
    Kyra takes the same number, multiplies by 2 then adds 3.
    What is the difference between Niamh's final number and Kyra's final number?

Your Turn

Challenge:

a. **I pick a number, a. I multiply by 3, subtract 5, multiply by 2, add 6 then multiply by 3. Think of exactly four more steps that will get you back to your starting number:**

b. **I pick a number, b. Write down six further operations that give a result of $4b$ – 5.**

b → b – 2 → ____ → ____ → ____ → ____ → ____ → ____ → $4b$ – 5

c. **I pick a number, c. I add 3, multiply by 4, subtract 4, multiply by 3, divide by 4 then add 3. If my final number is 24, what number did I start with?**

Answers

Answers

1. **In each question, write an expression for the resulting number. (Hint: to help choose a letter, just use the letter of the question.)**

   a. **You pick a random number, then multiply it by 2.**
   $2 \times a$ or $2a$

   b. **You pick a random number, then add 5.**
   $b + 5$ or $5 + b$

   c. **You pick a random number, then subtract 10.**
   $c - 10$

   d. **You pick a random number, multiply it by 4, then add 2.**
   $4d + 2$

   e. **You pick a random number, then divide it by 4.**
   $e \div 4$ or $\frac{e}{4}$

   f. **You pick a random number, multiply it by 3, then subtract 4.**
   $3f - 4$

   g. **You pick a random number, add 2, then multiply it by 3.**
   $3g + 6$ or $3(g + 2)$

   h. **You pick a random number, multiply it by 2, subtract 4, then multiply it by 10.**
   $20h - 40$ or $10(2h - 4)$

Answers

2. A gardener plants b bulbs in one day. The next day, they plant another 8 bulbs. Write an expression, in terms of b, for the number of bulbs they have planted in total.

   $b + 8$ or $8 + b$

3. Assan has t pencils. Gerry has twice as many pencils as Assan. Write an expression, in terms of t, for the number of pencils Gerry has.

   $2t$ or $2 \times t$

4. Ben is x years old. Amy is 5 years younger than Ben. Write an expression, in terms of x, for Amy's age.

   $x - 5$

5. There are z marbles in a bag. You add 2 marbles to the bag.

   a. Write an expression for the number of marbles in the bag.

      $z + 2$

   b. Write an expression for the number of marbles in 5 of these bags.

      $5z + 10$ or $5(z + 2)$

Answers

6. **Jamie has some sweets. Oliver has twice as many sweets. Write an expression for the number of sweets they have in total.**
   Jamie's sweets: j
   Oliver's sweets: $2j$
   Total sweets: $j + 2j$ or $3j$

7. **Olivia thinks of a number. She adds 6, then doubles the result, subtracts 12, and then halves the result. If Olivia's starting number was x, what is her final number?**
   $x \rightarrow x + 6 \rightarrow 2x + 12 \rightarrow 2x \rightarrow x$

8. **An adult ticket to a theme park costs £a. A child ticket is £10 cheaper. Write an expression, in terms of a, for the total cost of two adults and two children.**
   adult ticket: a
   child ticket: $a - 10$
   2 adults: $2a$
   2 children: $2a - 20$
   Total price: $4a - 20$ or equivalent unsimplified expression

Answers

9. Eddy is e years old. Fran is twice Eddy's age, and George is 5 years older than Fran. Write an expression, in terms of e, for the total of their ages.
   Eddy: e
   Fran: $2e$
   George: $2e + 5$
   Total: $5e + 5$ or equivalent unsimplified expression

10. In a football tournament, a team gets 2 points for a win and 1 point for a draw. Chesterton Champions play c games. They draw 5, lose 6 and win the rest. Write an expression for the number of points they get.
    Games won: $c - 11$ (total games subtract 5, subtract another 6)
    Points for winning: $2c - 22$ (total games won multiplied by 2)
    Points for drawing: 5
    Total points: $2c - 17$ (points for winning plus points for drawing)

Answers

11. A shop sells short-sleeve shirts for £m each. They sell long-sleeve shirts for £2 more. In one day, they sell 8 short sleeve shirts and 6 long-sleeve shirts. The next day they sell twice as many long-sleeve shirts as the day before, but no short sleeve shirts. Over the two days, how much money did they take?
    Day 1 short-sleeves: $8m$
    Day 1 long-sleeves: $6m + 12$ (6 lots of $m + 2$)
    Day 2 short-sleeves: 0
    Day 2 long-sleeves: $12m + 24$ (2 lots of $6m + 12$)
    Total: $8m + 6m + 12 + 12m + 24$ or $26m + 36$

12. Niamh takes a number, adds 3, then multiplies by 2.
    Kyra takes the same number, multiplies by 2 then adds 3.
    What is the difference between Niamh's final number and Kyra's final number?
    Niamh's number: $2n + 6$
    Kyra's final number: $2n + 3$
    $(2n + 6) – (2n + 3)$:
    $2n – 2n = 0$
    $6 – 3 = 3$
    $(2n + 6) – (2n + 3) = 3$

Answers

Challenge:

a. **I pick a number, a. I multiply by 3, subtract 5, multiply by 2, add 6 then multiply by 3. Think of exactly four more steps that will get you back to your starting number:**

$a \rightarrow 3a \rightarrow 3a - 5 \rightarrow 6a - 10 \rightarrow 6a - 4 \rightarrow 18a - 12 \rightarrow$ any four steps that result in an answer of a.

b. **I pick a number, b. Write down six further operations that give a result of $4b - 5$.**

$b \rightarrow b - 2 \rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow 4b - 5$

Any six operations resulting in the correct answer.

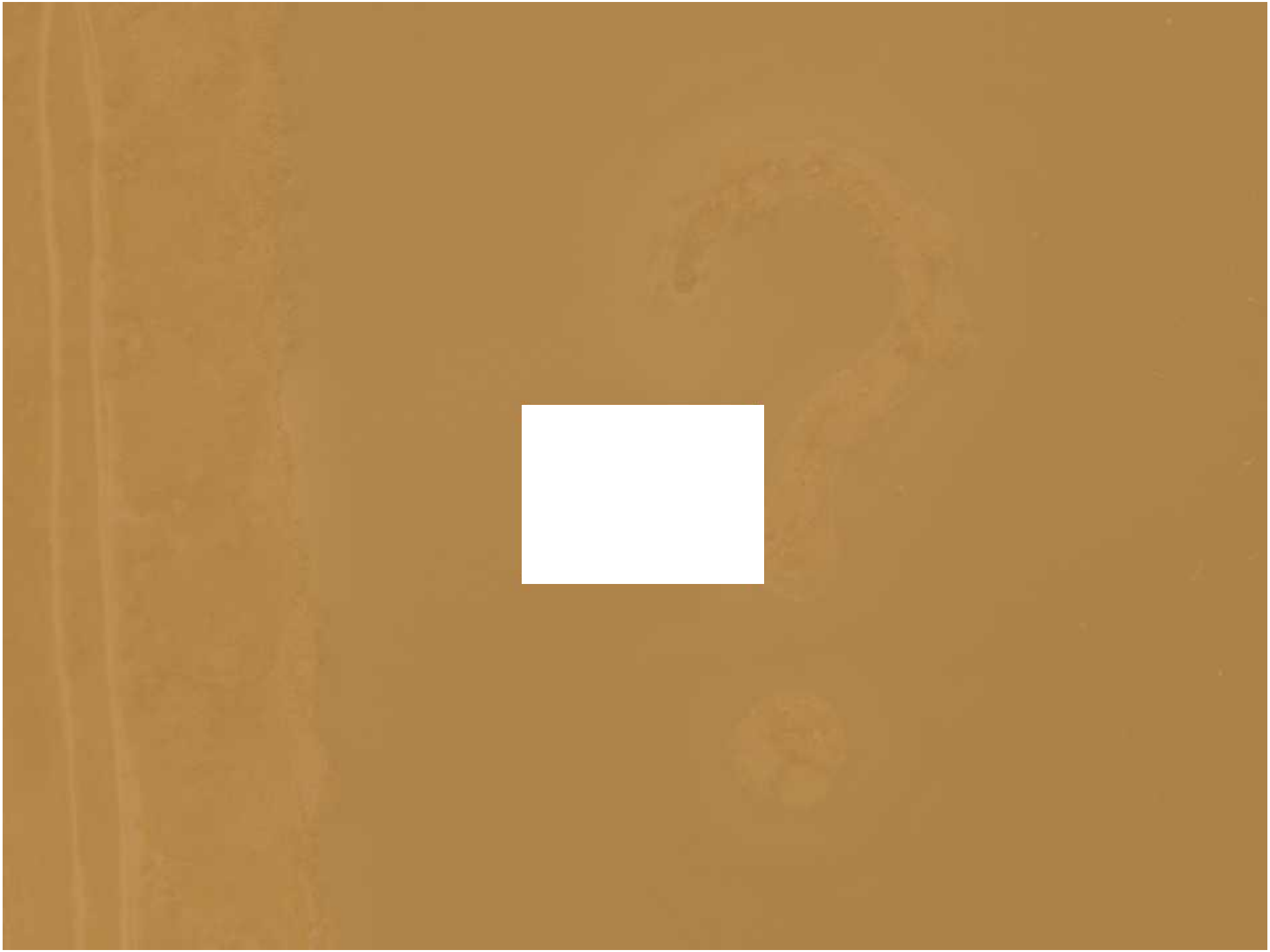
c. **I pick a number, c. I add 3, multiply by 4, subtract 4, multiply by 3, divide by 4 then add 3. If my final number is 24, what number did I start with?**

$c \rightarrow c + 3 \rightarrow 4c + 12 \rightarrow 4c + 8 \rightarrow 12c + 24 \rightarrow 3c + 6 \rightarrow 3c + 9$

$3c + 9$ is the same as 24.

Therefore, $3c$ is the same as: $24 - 9 = 15$

If $3c$ is 15, c must be: $15 \div 3 = 5$



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Example 2:

Joe thinks of a number. He takes away 4. He then multiplies his result by 3. Write an expression to represent Joe's number.

Again, the question is asking us to write an expression – a mathematical sentence – to represent the question.

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Remember, we can't do this sum because we don't know what number j represents.

The second thing Joe does is to multiply by 3. Now, we have to be careful. Joe isn't just multiplying j by 3. He has to multiply the whole expression by 3. There are two ways of doing this. Use the process that makes more sense to you:

Multiply each term by 3:

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$j \times 3 = 3j$

Therefore, $j - 4$, multiplied by 3, gives us:

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We could also use brackets to represent the multiplication:

$3 \times (j - 4)$

or:

$3(j - 4)$

Expressing Missing Number Problems Algebraically
Worksheet

1. In each question, write an expression for the resulting number.

   (Hint: to help choose a letter, just use the letter of the question.)

   a. You pick a random number, then multiply it by 2.

   b. You pick a random number, then add 5.

   c. You pick a random number, then subtract 10.

   d. You pick a random number, multiply it by 4, then add 2.

   e. You pick a random number, then divide it by 4.

   f. You pick a random number, multiply it by 3, then subtract 4.

   g. You pick a random number, add 2, then multiply it by 3.

   h. You pick a random number, multiply it by 2, subtract 4, then multiply it by 10.

2. A gardener plants b bulbs in one day. The next day, they plant another 8 bulbs. Write an expression, in terms of b, for the number of bulbs they have planted in total.

3. Assan has t pencils. Gerry has twice as many pencils as Assan. Write an expression, in terms of t, for the number of pencils Gerry has.

4. Ben is x years old. Amy is 5 years younger than Ben. Write an expression, in terms of x, for Amy's age.

5. There are z marbles in a bag. You add 2 marbles to the bag.

   a. Write an expression for the number of marbles in the bag.

   b. Write an expression for the number of marbles in 5 of these bags.

6. Jamie has some sweets. Oliver has twice as many sweets. Write an expression for the number of sweets they have in total.

7. Olivia thinks of a number. She adds 6, then doubles the result, subtracts 12, and then halves the result. If Olivia's starting number was x, what is her final number?

8. An adult ticket to a theme park costs £a. A child ticket is £10 cheaper. Write an expression, in terms of a, for the total cost of two adults and two children.

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12. Niamh takes a number, adds 3, then multiplies by 2.

    Kyra takes the same number, multiplies by 2 then adds 3.

    What is the difference between Niamh's final number and Kyra's final number?

Challenge:

a. I pick a number, a. I multiply by 3, subtract 5, multiply by 2, add 6 then multiply by 3. Think of exactly four more steps that will get you back to your starting number:

b. I pick a number, b. Write down six further operations that give a result of $4b - 5$.

$b \rightarrow b - 2 \rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow$ ____ $\rightarrow 4b - 5$

c. I pick a number, c. I add 3, multiply by 4, subtract 4, multiply by 3, divide by 4 then add 3. If my final number is 24, what number did I start with?

Expressing Missing Number Problems Algebraically **Worksheet**

1. In each question, write an expression for the resulting number.

   (Hint: to help choose a letter, just use the letter of the question.)

   a. You pick a random number, then multiply it by 2.

   _____

   b. You pick a random number, then add 5.

   _____

   c. You pick a random number, then subtract 10.

   _____

   d. You pick a random number, multiply it by 4, then add 2.

   _____

   e. You pick a random number, then divide it by 4.

   _____

   f. You pick a random number, multiply it by 3, then subtract 4.

   _____

   g. You pick a random number, add 2, then multiply it by 3.

   _____

   h. You pick a random number, multiply it by 2, subtract 4, then multiply it by 10.

   _____

2. A gardener plants b bulbs in one day. The next day, they plant another 8 bulbs. Write an expression, in terms of b, for the number of bulbs they have planted in total.

   _____

   _____

3. Assan has t pencils. Gerry has twice as many pencils as Assan. Write an expression, in terms of t, for the number of pencils Gerry has.

   _____

   _____

4. Ben is x years old. Amy is 5 years younger than Ben. Write an expression, in terms of x, for Amy's age.

   _____

   _____

5. There are z marbles in a bag. You add 2 marbles to the bag.

   a. Write an expression for the number of marbles in the bag.

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    What is the difference between Niamh's final number and Kyra's final number?

Challenge:

a. I pick a number, a. I multiply by 3, subtract 5, multiply by 2, add 6 then multiply by 3. Think of exactly four more steps that will get you back to your starting number:

b. I pick a number, b. Fill in the six missing operations to get a result of $4b - 5$.

$b \rightarrow b - 2 \rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow 4b - 5$

c. I pick a number, c. I add 3, multiply by 4, subtract 4, multiply by 3, divide by 4 then add 3. If my final number is 24, what number did I start with?

Expressing Missing Number Problems Algebraically
Answers

1. In each question, write an expression for the resulting number.

   (Hint: to help choose a letter, just use the letter of the question.)

   a. You pick a random number, then multiply it by 2.

      $2 \times a$ or $2a$

   b. You pick a random number, then add 5.

      $b + 5$ or $5 + b$

   c. You pick a random number, then subtract 10.

      $c - 10$

   d. You pick a random number, multiply it by 4, then add 2.

      $4d + 2$

   e. You pick a random number, then divide it by 4.

      $e \div 4$ or $\frac{e}{4}$

   f. You pick a random number, multiply it by 3, then subtract 4.

      $3f - 4$

   g. You pick a random number, add 2, then multiply it by 3.

      $3g + 6$ or $3(g + 2)$

   h. You pick a random number, multiply it by 2, subtract 4, then multiply it by 10.

      $20h - 40$ or $10(2h - 4)$

2. A gardener plants b bulbs in one day. The next day, they plant another 8 bulbs. Write an expression, in terms of b, for the number of bulbs they have planted in total.

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3. Assan has t pencils. Gerry has twice as many pencils as Assan. Write an expression, in terms of t, for the number of pencils Gerry has.

   $2t$ or $2 \times t$

4. Ben is x years old. Amy is 5 years younger than Ben. Write an expression, in terms of x, for Amy's age.

   $x - 5$

5. There are z marbles in a bag. You add 2 marbles to the bag.
   a. Write an expression for the number of marbles in the bag.

      $z + 2$

   b. Write an expression for the number of marbles in 5 of these bags.

      $5z + 10$ or $5(z + 2)$

6. Jamie has some sweets. Oliver has twice as many sweets. Write an expression for the number of sweets they have in total.

   Jamie's sweets: j

   Oliver's sweets: $2j$

   Total sweets: $j + 2j$ or $3j$

7. Olivia thinks of a number. She adds 6, then doubles the result, subtracts 12, and then halves the result. If Olivia's starting number was x, what is her final number?

   $x \rightarrow x + 6 \rightarrow 2x + 12 \rightarrow 2x \rightarrow x$

8. An adult ticket to a theme park costs £a. A child ticket is £10 cheaper. Write an expression, in terms of a, for the total cost of two adults and two children.

   adult ticket: a

   child ticket: $a - 10$

   2 adults: $2a$

   2 children: $2a - 20$

   Total price: $4a - 20$ or equivalent unsimplified expression

9. Eddy is e years old. Fran is twice Eddy's age, and George is 5 years older than Fran. Write an expression, in terms of e, for the total of their ages.

   Eddy: e

   Fran: $2e$

   George: $2e + 5$

   Total: $5e + 5$ or equivalent unsimplified expression

10. In a football tournament, a team gets 2 points for a win and 1 point for a draw. Chesterton Champions play c games. They draw 5, lose 6 and win the rest. Write an expression for the number of points they get.

    Games won: $c - 11$ (total games subtract 5, subtract another 6)

    Points for winning: $2c - 22$ (total games won multiplied by 2)

    Points for drawing: 5

    Total points: $2c - 17$ (points for winning plus points for drawing)

11. A shop sells short-sleeve shirts for £m each. They sell long-sleeve shirts for £2 more. In one day, they sell 8 short sleeve shirts and 6 long-sleeve shirts. The next day they sell twice as many long-sleeve shirts as the day before, but no short sleeve shirts. Over the two days, how much money did they take?

    Day 1 short-sleeves: 8m

    Day 1 long-sleeves: 6m + 12 (6 lots of m + 2)

    Day 2 short-sleeves: 0

    Day 2 long-sleeves: 12m + 24 (2 lots of 6m + 12)

    Total: 8m + 6m + 12 + 12m + 24 or 26m + 36

12. Niamh takes a number, adds 3, then multiplies by 2.

    Kyra takes the same number, multiplies by 2 then adds 3.

    What is the difference between Niamh's final number and Kyra's final number?

    Niamh's number: 2n + 6

    Kyra's final number: 2n + 3

    (2n + 6) – (2n + 3):

    2n – 2n = 0

    6 – 3 = 3

    (2n + 6) – (2n + 3) = 3

Challenge:

a. I pick a number, a. I multiply by 3, subtract 5, multiply by 2, add 6 then multiply by 3. Think of exactly four more steps that will get you back to your starting number:

    a → 3a → 3a – 5 → 6a – 10 → 6a – 4 → 18a – 12 → any four steps that result in an answer of a.

b. I pick a number, b. Write down six further operations that give a result of 4b – 5.

    b → b – 2 → _____ → _____ → _____ → _____ → _____ → _____ → 4b – 5

    Any six operations resulting in the correct answer.

c. I pick a number, c. I add 3, multiply by 4, subtract 4, multiply by 3, divide by 4 then add 3. If my final number is 24, what number did I start with?

    c → c + 3 → 4c + 12 → 4c + 8 → 12c + 24 → 3c + 6 → 3c + 9

    3c + 9 is the same as 24.

    Therefore, 3c is the same as: 24 – 9 = 15

    If 3c is 15, c must be: 15 ÷ 3 = 5