Worksheet - Algebra: formulae, sequences and missing numbers

Year: Year 6 · 20

Show your working.

Question 1

Question 1 – Substituting numbers for letters *(Section A · Skills practice)*

Ravi is checking the values of some expressions. Find the value of each expression for the number given.

a. $3n + 2$ when $n = 5$
b. $4n - 3$ when $n = 6$
c. $20 - 2n$ when $n = 7$
d. $5(n + 1)$ when $n = 3$
e. $\frac{n}{2} + 9$ when $n = 10$

Question 2

Question 2 – Using formulae *(Section A · Skills practice)*

Use each formula to find the answer. Write down the formula, then replace each letter with its number, and give the unit of the answer.

a. The perimeter of a square is $P = 4s$. Find P when $s = 7$ cm.
b. The area of a rectangle is $A = lw$. Find A when $l = 9$ cm and $w = 6$ cm.
c. The perimeter of a rectangle is $P = 2l + 2w$. Find P when $l = 8$ cm and $w = 5$ cm.
d. The volume of a cuboid is $V = lwh$. Find V when $l = 4$ cm, $w = 3$ cm and $h = 5$ cm.
e. A bike hire costs $C = 5 + 3h$ pounds for h hours. How much do 4 hours cost?

Question 3

Question 3 – Continuing sequences *(Section A · Skills practice)*

Each of these sequences follows a rule. Find the rule and write down the next two terms.

a. 4, 9, 14, 19, ...
b. 50, 43, 36, 29, ...
c. 1.5, 2, 2.5, 3, ...
d. −7, −4, −1, 2, ...
e. Which of the sequences in (a) to (d) is a decreasing sequence?

Question 4

Question 4 – Finding the nth term *(Section A · Skills practice)*

Find the nth term of each linear sequence. Check your rule using two of the terms.

a. 4, 8, 12, 16, ...
b. 2, 5, 8, 11, ...
c. 7, 12, 17, 22, ...
d. Use the nth term $3n + 2$ to find the 20th term.
e. Use the nth term $5n - 4$ to find the 12th term.

Question 5

Question 5 – Missing number problems *(Section A · Skills practice)*

Write an equation for each statement and solve it. Check your answer by putting it back into the equation.

a. I think of a number, add 8 and get 21.
b. $3a = 24$
c. $2a + 5 = 17$
d. $4b - 3 = 21$
e. $\frac{x}{5} = 9$

Question 6

Question 6 – Pairs of numbers *(Section A · Skills practice)*

Sometimes there are two unknown numbers, so there is more than one answer. Find whole-number pairs that work.

a. Find four different pairs of whole numbers a and b so that $a + b = 10$.
b. Find all the pairs of whole numbers x and y so that $2x + y = 12$.
c. How many pairs are there in part (b)? Explain how you know that you have found them all.

Question 7

Question 7 – The taxi fare *(Section B · Real-life practice)*

A taxi company charges a fixed fee of £3 plus £2 for every mile travelled. The formula for the cost is $C = 2m + 3$, where m is the number of miles.

a. Work out the cost of a 7-mile journey.
b. Work out the cost of a 10-mile journey.
c. Anna has £25. What is the longest journey she can afford? Use an equation to find m.
d. A second company uses the formula $C = 1.5m + 5$. Work out the cost of a 10-mile

journey with the second company. Which company is cheaper for 10 miles?

Question 8

Question 8 – Hiring bikes *(Section B · Real-life practice)*

At a bike hire shop, the cost in pounds of hiring a bike for h hours is $C = 5 + 3h$.

Hours, h	1	2	3	4
Cost, C (£)	8	11	14	?

a. Complete the table for 4 hours.
b. Is the cost sequence linear? Explain.
c. A day ticket costs £29. After how many hours of hire is the day ticket cheaper than the hourly rate?
d. Hana hires a bike for 6 hours. Use the formula to find the cost, and find how much she saves by buying the day ticket.

Question 9

Question 9 – Matchstick squares *(Section B · Real-life practice)*

Jade makes a row of squares from matchsticks. One square uses 4 sticks, two squares use 7 sticks, and three squares use 10 sticks.

Number of squares, n	1	2	3	4	5
Number of sticks	4	7	10	?	?

a. Complete the table.
b. Write the nth term for the number of sticks needed for n squares.
c. How many sticks are needed for 20 squares?
d. Jade has 100 sticks. What is the greatest number of squares she can make?

Question 10

Question 10 – Saving for a bike *(Section B · Real-life practice)*

Ella has £12 in her savings jar. She adds £5 each week from her pocket money. The amount she has after w weeks is $S = 12 + 5w$.

a. How much money will Ella have after 8 weeks?
b. Write the amounts after 1, 2, 3 and 4 weeks as a sequence.
c. A new bike costs £100. Solve an equation to work out how many weeks Ella needs to save. Explain what the answer means.
d. Ella gets an extra £20 for her birthday after 6 weeks. How many weeks does she need then?

Question 11

Question 11 – Seats in the theatre *(Section B · Real-life practice)*

A theatre has rows of seats. Row 1 has 12 seats. Each row has 2 more seats than the row in front.

a. Write the number of seats in rows 1 to 5.
b. Find the nth term for the number of seats in row n.
c. How many seats are in row 15?
d. Which row has 36 seats?
e. Is there a row with exactly 45 seats? Explain.

Question 12

Question 12 – The phone bill *(Section B · Real-life practice)*

Sam pays £8 each month for his phone, plus 5p for every minute of calls. The monthly cost in pounds is $C = 8 + 0.05m$.

a. Work out the cost for 120 minutes of calls.
b. Work out the cost when Sam makes no calls.
c. Sam has a budget of £20 a month. What is the greatest number of minutes he can use?
d. Sam sees a different plan with £12 each month and 2p for every minute. How many minutes would make both plans cost the same?

Question 13

Question 13 – Growing sunflowers *(Section B · Real-life practice)*

Leo plants a sunflower. When he first measures it, it is 20 cm tall. It then grows 6 cm each week. The height in cm after w weeks is $h = 20 + 6w$.

Weeks, w	0	1	2	3	4
Height, h (cm)	20	26	32	38	?

a. Complete the table.
b. How tall is the sunflower after 10 weeks?
c. Leo says the sunflower will be 2 m tall after 30 weeks. Is he right? Show your working.
d. After how many weeks is the sunflower first taller than 1 m?

Question 14

Question 14 – Planning the party *(Section B · Real-life practice)*

Hana is organising a birthday party in a hall. The hall costs £40 and the food costs £6 for each guest. The total cost in pounds for g guests is $C = 40 + 6g$.

a. Work out the total cost for 15 guests.
b. Hana has a budget of £160. How many guests can she afford? Solve an equation.
c. The hall changes its price to £55. Write a new formula for the cost.
d. Work out the new total cost for 15 guests and the difference from your answer to part (a).

Question 15

Question 15 – Function machines *(Section C · Problem solving)*

Priya uses a two-step number machine. An input number n is multiplied by 3, and then 4 is subtracted to give the output.

Input, n	1	2	5	9	?
Output	−1	2	11	23	?

a. Write an expression for the output using n.
b. Fill in the missing output when the input is 5. Check it matches the table.
c. Find the input that gives an output of 23. Show your working.
d. Another machine adds 7 to the input and then multiplies by 2. Write an expression for the output.
e. Priya says "the two machines give the same output for some input". Find this input by trying numbers or by solving an equation.

Question 16

Question 16 – Fencing the rectangle *(Section C · Problem solving)*

Mr Evans is putting a fence round a rectangular vegetable patch. The perimeter formula is $P = 2l + 2w$. The length of the patch is 12 m. The total length of fencing he buys is 40 m.

a. Use the formula to write an equation, and solve it to find the width w.
b. Work out the area of the patch.
c. The fencing costs £6.50 a metre. How much does it cost?
d. Mr Evans wants the width to be 2 m longer so that the area is bigger. He keeps the length at 12 m. Find the new perimeter and the new area.
e. By how much has the area increased?

Question 17

Question 17 – The tile patterns *(Section C · Problem solving)*

Hamza makes patterns with square tiles. Pattern 1 uses 5 tiles, pattern 2 uses 8 tiles and pattern 3 uses 11 tiles.

Pattern number, n	1	2	3	4
Number of tiles	5	8	11	?

a. How many tiles are there in pattern 4?
b. Find the nth term for the number of tiles.
c. How many tiles are in pattern 12?
d. Which pattern uses 50 tiles?
e. Each tile costs 15p. How much do the tiles for pattern 20 cost?

Question 18

Question 18 – Two unknown numbers *(Section C · Problem solving)*

Use what you know about equations to solve these problems about two unknown numbers.

a. a and b are whole numbers. $a + b = 20$ and $a = 3b$. Find a and b.
b. Mum is 4 times as old as her son. The sum of their ages is 45. How old is each of them?
c. Two numbers have a sum of 15 and a difference of 3. What are the numbers?
d. A pencil costs £p and a rubber costs £r. Three pencils and two rubbers cost £2.40. A pencil costs 40p. How much does a rubber cost?

Question 19

Question 19 – Which phone deal? *(Section C · Problem solving)*

Two companies offer phone deals. Alpha charges £5 per month plus £2 for each gigabyte (GB) of data. Beta charges £11 per month plus £1 for each GB of data.

a. Write a formula for the cost, C_A, of Alpha for d GB.
b. Write a formula for the cost, C_B, of Beta for d GB.
c. Complete the table for $d = 2$, 4, 6, 8 for both companies.
d. For how many GB do the two companies cost the same? Form an equation and solve it.
e. Ravi uses about 9 GB each month. Which company is cheaper for him, and how much does he save over a year?

Question 20

Question 20 – Challenge: the sequence 6n − 4 *(Section D · Challenge)*

The nth term of a sequence is $6n - 4$.

a. Write down the first four terms of the sequence.
b. Which term of the sequence is equal to 62?
c. Is 100 a term of the sequence? Explain how you know.
d. What is the first term of the sequence that is bigger than 200?