2.3 Algebra: Sequences and Graphs: 2-hour Pack

Calculator allowed · about 120 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A straight line has equation y = -9x + 9.
Write down (a) the gradient (b) the y-intercept.

(2)

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2 A pattern uses 9 tiles in pattern number 1, 15 in pattern number 2 and 21 in pattern number 3, and continues in the same way.
Which pattern number uses 147 tiles?

(3)

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3 A straight line has equation y = 6 - x.
Write down (a) the gradient (b) the y-intercept.

(2)

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4 Complete a table of values for y = 4x - 2 for x = -3, x = -1 and x = 4.

(2)

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5 A straight line has gradient -4 and passes through the point (1, -9). Find the equation of the line.

(3)

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6 A straight line has equation $2y = -2x - 10$.
Write down (a) the gradient (b) the y-intercept.

(2)

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7 Complete a table of values for $y = -2x + 3$ for $x = -3$, $x = -2$ and $x = 2$.

(2)

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8 A pattern uses 8 matchsticks in pattern number 1, 13 in pattern number 2 and 18 in pattern number 3, and continues in the same way.
How many matchsticks are needed for pattern number 16?

(3)

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9 Here are the first five terms of an arithmetic sequence.
-2, -8, -14, -20, -26
Find an expression for the nth term.

(2)

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10 Here are the first four terms of a sequence.
18, 4, 22, 26
Write down the next two terms and describe the rule.

(2)

11 A straight line has gradient 4 and passes through the point (3, 12). Find the equation of the line.

(3)

12 A straight line has equation y = -7 + 6x.
Write down (a) the gradient (b) the y-intercept.

(2)

13 A straight line has gradient -8 and passes through the point (4, -34). Find the equation of the line.

(3)

14 The nth term of a sequence is 8n + 2.
Write down the first three terms of the sequence.

(2)

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15 The nth term of a sequence is 9n - 5.
Write down the first three terms of the sequence.

(2)

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16 A pattern uses 4 dots in pattern number 1, 6 in pattern number 2 and 8 in pattern number 3, and continues in the same way.
Which pattern number uses 34 dots?

(3)

---

17 Complete a table of values for y = -x + 3 for x = 0, x = 3 and x = 4.

(2)

---

18 Here are the first four terms of a sequence.
6, 14, 22, 30
Write down the next two terms and describe the rule.

(2)

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19 Here are the first four terms of a sequence.
225, 256, 289, 324
Write down the next two terms and describe the rule.

.....

.....

(2)

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20 Aisha makes patterns from matchsticks. Pattern 1 uses 4 matchsticks, Pattern 2 uses 7 matchsticks, Pattern 3 uses 10 matchsticks and Pattern 4 uses 13 matchsticks.

(a) Write down the number of matchsticks needed for Pattern 5. **(1)**

.....

(b) Find an expression, in terms of n, for the number of matchsticks in Pattern n. **(2)**

.....

(c) Work out the number of matchsticks needed for Pattern 20. **(1)**

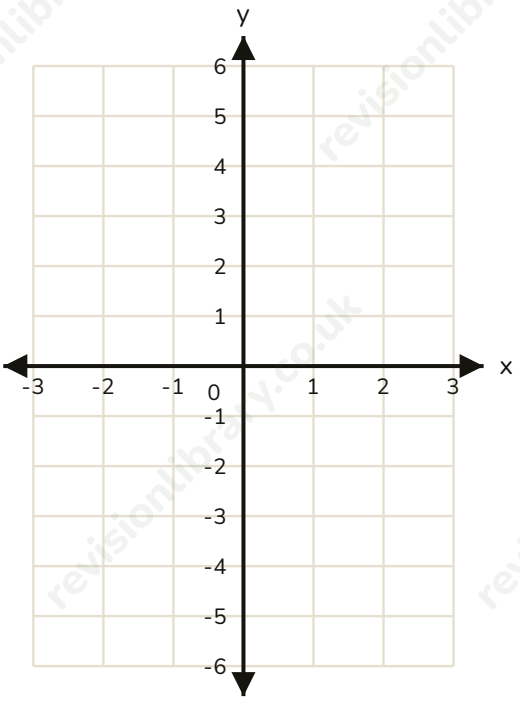
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(d) Aisha has 88 matchsticks. Work out the largest pattern number she can build completely, showing that no matchsticks are wasted. **(2)**

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21 $y = 2x - 1$



(a) Complete a table of values for $y = 2x - 1$ when $x = -2, -1, 0, 1, 2$. **(2)**

(b) State the gradient of the line $y = 2x - 1$. **(1)**

(c) State the y-intercept of the line $y = 2x - 1$. **(1)**

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22 For each equation, write down the gradient and the y-intercept.

(a) $y = 5x + 3$ **(1)**

(b) $y = -2x + 7$ **(1)**

(c) $y = x - 4$ **(1)**

(d) $y = 6 - 3x$ **(2)**

23 A sequence has nth term 6n - 5. Work out the 10th term, showing your substitution.

(2)

24 A straight line has gradient -2 and passes through (0, 5). Write down the equation of the line.

(2)

25 Work out the gradient of the line joining the points (1, 2) and (4, 11).

(2)

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26 A sequence has nth term $2n^2 + 1$. Work out the 4th term, showing your method.

(3)

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27 Kofi makes patterns from tiles. Pattern 1 uses 3 tiles, Pattern 2 uses 7 tiles, Pattern 3 uses 11 tiles and Pattern 4 uses 15 tiles. Find an expression, in terms of n, for the number of tiles in Pattern n, then use it to find the number of tiles in Pattern 10.

(3)

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28 Find an expression, in terms of n, for the nth term of the sequence 2, 5, 8, 11, ...

(2)

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29 Find an expression, in terms of n, for the nth term of the sequence 7, 4, 1, -2, ...

(2)

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30 A sequence begins: 2, 5, 10, 17, 26, ...

(a) Find the first differences between consecutive terms. **(1)**

(b) Find the second differences. **(1)**

(c) Using the pattern in the second differences, work out the next two terms of the sequence. **(2)**

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31 A straight line passes through the points (0, -1) and (3, 8). Find the equation of the line in the form $y = mx + c$.

(3)

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32 A conversion graph changes between miles and kilometres. The graph is a straight line through the origin, showing that 5 miles is equivalent to 8 kilometres.

(a) Find the gradient of the graph, in kilometres per mile.

(b) Use your gradient to convert 15 miles into kilometres.

(4)

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33 Priya cycles from home to the park, a distance of 9 km, at a constant speed, taking 30 minutes. She stays at the park for 20 minutes, then cycles home again, taking 45 minutes.

(a) Work out her speed, in km/h, cycling to the park.

(b) Work out her speed, in km/h, cycling home.

(4)

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34 Stretch. A quadratic sequence has nth term of the form $an^2 + b$. The sequence is 4, 7, 12, 19, 28, ... Find the values of a and b, then use the formula to find the 6th term.

(4)

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Mark scheme · 2.3 Algebra: Sequences and Graphs: 2-hour Pack

Question 1

(a) -9	B1
(b) 9	B1

Answer: **(a) -9, (b) 9**

Question 2

nth term 6n + 3	M1
6n + 3 = 147	M1
pattern number 24 cao	A1

Answer: **pattern number 24**

Question 3

(a) -1	B1
(b) 6	B1

Answer: **(a) -1, (b) 6**

Question 4

at least one value of y correct	M1
all three values correct	A1

Answer: **x = -3: y = -14, x = -1: y = -6, x = 4: y = 14**

Question 5

y = -4x + c with (1, -9) substituted	M1
c = -5 found	M1
y = -4x - 5 cao	A1

Answer: **y = -4x - 5**

Question 6

(a) -1	B1
(b) -5	B1

Answer: **(a) -1, (b) -5**

Question 7

at least one value of y correct	M1
all three values correct	A1

Answer: **x = -3: y = 9, x = -2: y = 7, x = 2: y = -1**

Question 8

identifies the common difference 5	M1
nth term 5n + 3 or continues the pattern correctly	M1
83 cao	A1

Answer: **83**

Question 9

common difference -6 identified (or -6n in the expression)	M1
-6n + 4 cao	A1

Answer: **nth term = -6n + 4**

Question 10

next two terms 48, 74	B1
rule: add the previous two terms	B1

Answer: **48, 74 (add the previous two terms)**

Question 11

y = 4x + c with (3, 12) substituted	M1
c = 0 found	M1
y = 4x cao	A1

Answer: **y = 4x**

Question 12

(a) 6	B1
(b) -7	B1

Answer: **(a) 6, (b) -7**

Question 13

y = -8x + c with (4, -34) substituted	M1
c = -2 found	M1
y = -8x - 2 cao	A1

Answer: **y = -8x - 2**

Question 14

substitutes n = 1, 2 or 3 correctly for at least one term	M1
10, 18, 26 cao	A1

Answer: **10, 18, 26**

Question 15

substitutes n = 1, 2 or 3 correctly for at least one term	M1
4, 13, 22 cao	A1

Answer: **4, 13, 22**

Question 16

nth term 2n + 2	M1
2n + 2 = 34	M1
pattern number 16 cao	A1

Answer: **pattern number 16**

Question 17

at least one value of y correct	M1
all three values correct	A1

Answer: **x = 0: y = 3, x = 3: y = 0, x = 4: y = -1**

Question 18

next two terms 38, 46	B1
rule: add 8	B1

Answer: **38, 46 (add 8)**

Question 19

next two terms 361, 400	B1
rule: square numbers	B1

Answer: **361, 400 (square numbers)**

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Question 20

(a) 16 cao **B1**

(a) Answer: **16**

(b) common difference of 3 identified and used **M1**

(b) 3n + 1 oe **A1**

(b) Answer: **3n + 1**

(c) 61 ft from their expression in part (b) **B1**

(c) Answer: **61**

(d) correct inequality or equation, e.g. $3n + 1 \leq 88$ **M1**

(d) n = 29, with correct reasoning that this uses exactly 88 matchsticks (no leftover) **A1**

(d) Answer: **Pattern 29 (uses exactly 88 matchsticks)**

Question 21

(a) all five y-values correct: -5, -3, -1, 1, 3 (B1 for at least three correct) **B2**

(a) Answer: **-5, -3, -1, 1, 3**

(b) gradient = 2 **B1**

(b) Answer: **2**

(c) y-intercept = (0, -1) oe -1 **B1**

(c) Answer: **(0, -1)**

Question 22

(a) gradient 5 and y-intercept 3 (or (0,3)) both correct **B1**

(a) Answer: **gradient = 5, y-intercept = (0, 3)**

(b) gradient -2 and y-intercept 7 (or (0,7)) both correct **B1**

(b) Answer: **gradient = -2, y-intercept = (0, 7)**

(c) gradient 1 and y-intercept -4 (or (0,-4)) both correct **B1**

(c) Answer: **gradient = 1, y-intercept = (0, -4)**

(d) equation rearranged to y = -3x + 6 **M1**

(d) gradient -3 and y-intercept 6 (or (0,6)) both correct **A1**

(d) Answer: **gradient = -3, y-intercept = (0, 6)**

Question 23

substitutes n = 10 correctly, e.g. 6(10) - 5 **M1**

55 cao **A1**

Answer: **55**

Question 24

uses y = mx + c with m = -2 and c = 5 **M1**

y = -2x + 5 cao **A1**

Answer: **y = -2x + 5**

Question 25

correct gradient method, e.g. (11 - 2) / (4 - 1) **M1**

3 cao **A1**

Answer: **3**

Question 26

substitutes n = 4 into n^2 correctly, e.g. $4^2 = 16$ **M1**

correct further working, e.g. 2(16) = 32 **M1**

33 cao **A1**

Answer: **33**

Question 27

identifies the common difference is 4 **M1**

4n - 1 cao **A1**

Pattern 10 uses 39 tiles cao **A1**

Answer: **4n - 1; Pattern 10 uses 39 tiles**

Question 28

identifies the common difference is 3 **M1**

3n - 1 cao **A1**

Answer: **3n - 1**

Question 29

identifies the common difference is -3 **M1**

10 - 3n cao **A1**

Answer: **10 - 3n**

Question 30

(a) 3, 5, 7, 9 all correct **B1**

(a) Answer: **3, 5, 7, 9**

(b) 2, 2, 2 all correct **B1**

(b) Answer: **2, 2, 2**

(c) correct method using the constant second difference **M1**

(c) 37 and 50 both correct **A1**

(c) Answer: **37, 50**

Question 31

correct gradient found, e.g. (8 - (-1)) / (3 - 0) = 3 **M1**

correctly identifies c = -1 from the point (0, -1) **M1**

y = 3x - 1 cao **A1**

Answer: **y = 3x - 1**

Question 32

correct gradient method, e.g. 8 / 5 **M1**

1.6 km per mile cao **A1**

uses the gradient to scale 15 miles, e.g. 15 x 1.6 **M1**

24 km cao **A1**

Answer: **1.6 km per mile; 15 miles = 24 km**

Question 33

converts 30 minutes to 0.5 hours and divides, e.g. 9 / 0.5 **M1**

18 km/h cao **A1**

converts 45 minutes to 0.75 hours and divides, e.g. 9 / 0.75 **M1**

12 km/h cao **A1**

Answer: **To the park: 18 km/h; home: 12 km/h**

Question 34

finds the second differences are constant and equal to 2 **M1**

correctly uses 2a = 2 to find a = 1 **M1**

substitutes the 1st term to find b, e.g. 1 + b = 4, so b = 3 **M1**

39 cao **A1**

Answer: **a = 1, b = 3; the 6th term is 39**

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