St. Patrick's High School, Keady

Mathematics Department

GCSE Mathematics Practice Booklet

M6

Topic 2 –Algebra l

Trial and Improvement

Changing the Subject

Inequalities

Indices

Sequences

Questions taken from CCEA Past Papers

Keady Maths

Q1 Complete the boxes

$$\frac{2xy}{3y} \times \frac{\square}{\square} = \frac{4xy^2}{9xy}$$

[2]

Q2 Simplify the following.

(a) $4y^3 \times 3y^4$

Answer _____ [1]

(b) $(m^4)^5$

Answer _____ [1]

Q3 Simplify $\frac{m^5 \times m^3}{m^2}$

Answer _____ [1]

Q4 **(a)** Simplify

(i) $12x^5 \div 3x^3$

Answer _____ [2]

(ii) $(x^3)^4$

Answer _____ [1]

Q5 Simplify each of the following.

(a) $4p^3 \times 3p^4$

Answer _____ [1]

(b) $(q^2)^3 \div q^8$

Answer _____ [1]

Q6

(a) Simplify

(i) $w^3 \times w^2$

Answer _____ [1]

(ii) $\frac{y^6}{y^2}$

Answer _____ [1]

(b) Work out the n^{th} term of the sequence

7, 14, 21, 28, 35 …

Answer _____ [1]

Q7 Rewrite $p + 8 = 6 - q$ to make q the subject.

Answer q = _____ [2]

Q8 Rewrite $3y + 1 = 5y - x$ to make x the subject.

Answer $x =$ _____ [2]

Q9 $s = ut + \frac{1}{2}at^2$

Find the value of s when $u = 80$, $a = -5$ and $t = 4$

Answer $s =$ _____ [3]

Q10 Rearrange $y = 8x + 10$ to make x the subject.

Answer _____ [2]

Q11 Make v the subject of $2s = (u + v)t$

Answer v = _____ [2]

Q12

Make m the subject of the formula $H = mr + s$

Answer m = _____ [2]

Q13

Rewrite $4 + x = 9 - y$ to make y the subject.

Give your answer in its simplest form.

Answer y = _____ [2]

Q14 Make y the subject of

$$3y - 12 = 4x$$

Answer $y =$ _____ [2]

Q15 Rearrange $v = u + at$ to make a the subject.

Answer $a =$ _____ [2]

Q16 Solve $4n + 3 > 28$

Answer _____ [2]

Q17

(a) Solve the inequality $6y + 5 \geq 2$

Answer _____ [2]

(b) Write down the smallest **integer** value of y which satisfies the inequality

$6y + 5 \geq 2$

Answer $y =$ _____ [1]

Q18

Solve

$$8x < 6x + 7$$

Answer _____ [2]

Q19 A rectangle has a length of $3x$ cm and a width of $(x + 5)$ cm.

The length is greater than the width.

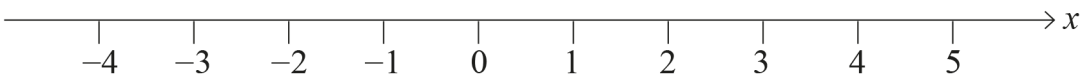
(a) Write this information as an inequality in x.

Answer _____ [1]

(b) (i) Solve the inequality.

Answer _____ [1]

(ii) Show your answer on the number line below.



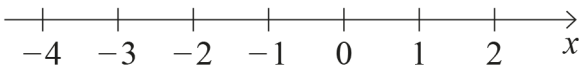
[1]

Q20

(a) Solve $2x - 1 \leq -5$

Answer _____ [2]

(b) Show your solution on the number line.



[1]

Q21

Solve

$4 < 3n \leqslant 18$ for integer n

Answer _____ [3]

Q22 List the values of the integer n which satisfy the inequality

$-7 < 3n \leqslant 6$

Answer _____ [3]

Q23 Solve the inequality $5x + 4 \leqslant 7x - 5$

Answer _____ [2]

Q24 Solve $-9 \leqslant 3y < 6$ where y is an integer.

Answer _____ [2]

Q25 Solve

$$12 - n > 4n - 3$$

Answer _____ [2]

Q26 Look at the sequence below

3 5 9 15 23 .....

(a) What is the next number?

Answer _____ [1]

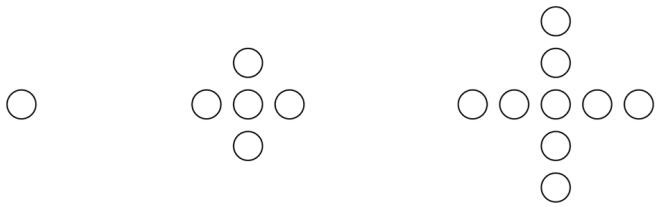
(b) Explain the rule for finding the next number each time.

Answer _____ [1]

Q27 Write down the next two terms in the sequence

23, 21, 17, 11, _____ , _____ [2]

Q28 Here is a sequence of patterns made with circles.



pattern 1 pattern 2 pattern 3

How many circles are needed for pattern 5?

Answer _____ because the rule is _____ [2]

Q29 **(a)** What is the n^{th} term for the sequence?

12, 24, 36, 48, ……

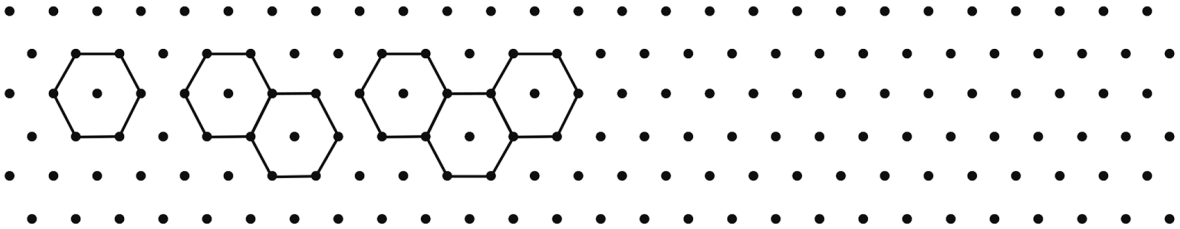
Answer _____ [1]

(b) What is the n^{th} term for the sequence?

13, 9, 5, 1, –3, ……

Answer _____ [2]

Q30 Regular hexagons of side length 1 cm are placed to form a pattern.



pattern 1 pattern 2 pattern 3 pattern 4

(a) Draw pattern 4 [1]

(b) Complete the following table.

pattern number	1	2	3	4
perimeter of shape (cm)	6	10		

[2]

(c) Describe how the perimeter of the shape changes as each new hexagon is added.

_____

_____ [1]

(d) What is the perimeter of pattern 9?

Answer _____ cm [2]

Q31 Write down the next two terms in the following sequence

18, 17, 14, 9, _____ , _____ [2]

Q32 Write down the two missing numbers in this sequence.

1, 3, 6, 10, 15, _____ , 28, _____ [2]

Q33 The first four terms of a sequence are

3, 8, 13, 18, ...

(a) Write down the n^{th} term of the sequence.

Answer _____ [2]

(b) Which term of the sequence will equal 73?

Answer _____ [1]

Q34 **(a)** Write down the next two numbers in the sequence

25 24 20 13 _____ _____ [2]

(b) Explain the rule for this sequence.

Answer _____ [2]

Q35 A sequence is formed using the rule:

"Find the next term by adding the previous two terms"

Use this rule to complete the sequences below.

(a) 1, 7, _____, _____, _____ [1]

(b) 3, −5, _____, _____, _____ [1]

(c) x, 4, _____, _____, _____ [1]

Q36

(a) Jenny writes the first six square numbers as

2, 4, 9, 16, 25, 36

Explain why she is wrong.

Answer _____ [1]

(b) Part of the sequence of triangular numbers is shown.

… 21, 28, 36, 45, 55, 66 …

(i) Which triangular number comes directly before 21?

Answer _____ [1]

(ii) Write down the smallest triangular number which is greater than 100

Answer _____ [1]

Q37

Work out the n^{th} term of the sequence 6, 3, 0, −3, ...

Answer _____ [2]

Q38

(a) Fill in the next two terms of this sequence.

14, 13, 11, 8, ☐, ☐ [2]

(b) Write down the name of the numbers in the sequence below.

1, 8, 27, 64, ...

Answer _____ [1]

Q39

Find the *n*th term of the sequence

7, 4, 1, –2, ...

Answer *n*th term = _____ [2]

Q40 Cathy is working on a sequence:

4, 9, 14, 19, ____

She continues this sequence for a few more terms and spots a pattern.

She uses the pattern to predict correctly what the **last digit** is in the 30th term.

What is the last digit?

Answer _____ [1]

Q41 The first four terms of a sequence are

2 7 12 17

Write down an expression for the n^{th} term of the sequence.

Answer _____ [2]

Q42

Each new number in a sequence is found using the rule

multiply the previous number by 3 and then subtract 5

Find the next two numbers in this sequence.

2 , _____ , _____

[2]

Q43

The first three terms of a sequence are 1, 5 and 13

The rule is “add the next multiple of 4”

Find the next two terms in this sequence.

1 5 13 _____ _____ [2]

---

1. $\frac{2y}{3x}$ A1 A1

---

2. **(a)** $12y^7$ A1

(b) m^{20} A1

---

3. m^6 A1

---

4. **(a)** **(i)** $4x^2$ A1 A1

(ii) x^{12} A1

5.

(a) $12p^7$ A1

(b) $\frac{1}{q^2}$ or q^{-2} A1

6.

(a) **(i)** w^5 A1

(ii) y^4 A1

(b) 7n A1

7.

$p + q = -2$ MA1

$q = -2 - p$ MA1

8.

$x = 5y - 3y - 1$ MA1

$x = 2y - 1$ A1

9.

$s = 80 \times 4 + \frac{1}{2} \times (-5) \times 16$ MA1

$s = 320 - 40$ A1

$s = 280$ A1

10.

$y - 10 = 8x$ **or** $8x = y - 10$ A1

$\frac{y-10}{8} = x$ **or** $x = \frac{y-10}{8}$ A1

11.

$2s - ut = vt$ MA1

$v = \frac{2s - ut}{t}$ MA1

or

$\frac{2s}{t} = u + v$ MA1

$v = \frac{2s}{t} - u$ MA1

12.

$H - s = mr$ MA1

$m = \frac{H - s}{r}$ A1

13.

$4 + y = 9 - x$ A1

$y = 9 - x - 4$

$y = 5 - x$ or $y = -x + 5$ A1

14.

$3y = 4x + 12$ MA1

$y = \frac{4x + 12}{3}$ or $y = \frac{4}{3}x + 4$ A1

15.

$at = v - u$ MA1

$a = \frac{v - u}{t}$ MA1

16.

$4n > 25$ MA1

$n > \frac{25}{4}\left(6\frac{1}{4}\right)$ MA1

17.

(a) $6y \geq -3$ M1

$y \geq -\frac{1}{2}$ A1

(b) 0 A1

18.

$2x < 7$ MA1

$x < \frac{7}{2}$ or 3.5 A1

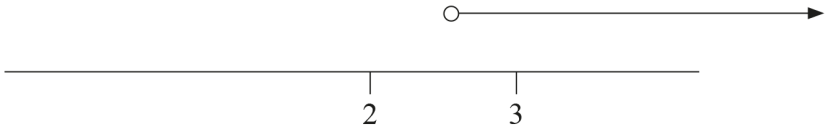
19.

(a) $3x > x + 5$ MA1

(b) **(i)** $2x > 5$

$x > 2.5$ A1

(ii) A1



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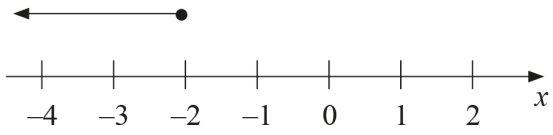
20. **(a)** $2x \leq -5 + 1$ MA1

$2x \leq -4$

$x \leq -2$ A1

(b)



A1

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21. $\frac{4}{3} < n \leq 6$ M1

2, 3, 4, 5, 6 A2

---

22. $-\frac{7}{3} < n \leqslant 2$ MA1

–2, –1, 0, 1, 2 MA2

---

23. $5 + 4 \leqslant 7x - 5x$ (*or* $9 \leqslant 2x$) M1

$x \geqslant 4.5$ *or* $x \geqslant 4\frac{1}{2}$ *or* $x \geqslant \frac{9}{2}$ A1

24.

$-3 \leqslant y < 2$ MA1

$-3, -2, -1, 0, 1$ A1

25.

$15 > 5n$ MA1

$n < 3$ A1

26.

(a) 33 A1

(b) add an extra 2 each time MA1

27.

$3, -7$ A1 A1

28.

17 MA1

You add 4 each time MA1

29.

(a) $12n$ A1

(b) $-4n + 17$ or $17 - 4n$ A1 A1

30.

(a) Correct pattern drawn A1

(b) 14 18 A1 A1

(c) The perimeter increases by 4 cm A1

(d) 38 M1 A1

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31. 2 –7 A1, A1

---

32. 21, 36 A1 A1

33.

(a) $5n - 2$ A1 A1

(b) 15th A1

34.

(a) 3 – 10 A1 A1

(b) Each time you subtract 3 more than the time before A2

35.

(a) 8, 15, 23 A1

(b) –2, –7, –9 A1

(c) $x + 4$, $x + 8$, $2x + 12$ A1

36.

(a) 2 is not a square number A1

(b) **(i)** 15 A1

(ii) 105 A1

---

37. $9 - 3n$ **or** $-3n + 9$ A2

(A1 for answer of $-3n$ + any constant)

38.

(a) 4 and –1 A1 A1

(b) Cube A1

---

39. $-3n + 10$ A2

(A1 for $-3n + d$ for any value of d except 10)

---

40. 9 A1

41.

$5n - 3$ A2

(A1 for $5n + d,\ d \neq -3$)

42.

$2 \times 3 - 5 = 1$ MA1

$1 \times 3 - 5 = -2$ MA1

43.

1 5 13 25 41

+4 +8 +12 +16

A1 A1

Q1 A solution to the equation $x^3 - 4x = 26$ lies between 3 and 4
Use trial and improvement to solve this equation.
Give your answer correct to 1 decimal place.
Show each stage of your working.

x	$x^3 - 4x$	

Answer $x =$ _____ [3]

Q2 Use the method of trial and improvement to solve the equation

$x^3 - 6x = 12$

Give your answer correct to 1 decimal place.

Show all your working.

x	$x^3 - 6x$	

Answer $x =$ _____ [4]

Q3 A solution to the equation $x^2 + 3x = 15$ lies between 2 and 3

Use trial and improvement to solve this equation.

Give your answer correct to 1 decimal place.

Show each stage of your working.

x	$x^2 + 3x$	

Answer x = _____ [3]

Q4 A solution to the equation $3x^2 + x = 67$ lies between $x = 4$ and $x = 5$
Use trial and improvement to solve this equation.
Give your answer correct to 1 decimal place.
Show all your working.

x	$3x^2 + x$	

Answer $x =$ _____ [3]

Q5 The equation $x^3 + 4x^2 = 100$ has a solution between 1 and 5
Use a trial and improvement method to find this solution.
Give your answer correct to one decimal place.
You must show all your working.

Answer $x =$ _____ [4]

Q6

(a) Show that $20x - x^3 = 1$ has a solution between 4 and 5

[1]

(b) Use Trial and Improvement to find this solution correct to 1 decimal place.

Show all your working.

Answer _____ [3]

Q7 Rewrite $3y + 1 = 5y - x$ to make x the subject.

Answer $x =$ _____ [2]

Q8 Rearrange $y = 8x + 10$ to make x the subject.

Answer _____ [2]

Q9 Look at the sequence below

3 5 9 15 23 .....

(a) What is the next number?

Answer _____ [1]

(b) Explain the rule for finding the next number each time.

Answer _____ [1]

Q10 **(a)** What is the n^{th} term for the sequence?

12, 24, 36, 48, ……

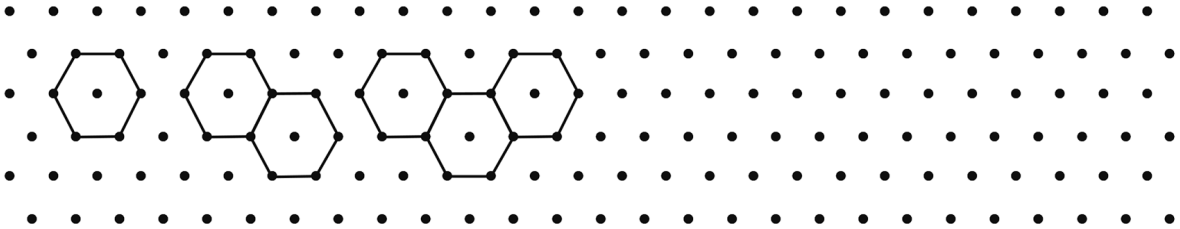
Answer _____ [1]

(b) What is the n^{th} term for the sequence?

13, 9, 5, 1, –3, ……

Answer _____ [2]

Q11 Regular hexagons of side length 1 cm are placed to form a pattern.



pattern 1 pattern 2 pattern 3 pattern 4

(a) Draw pattern 4 [1]

(b) Complete the following table.

pattern number	1	2	3	4
perimeter of shape (cm)	6	10		

[2]

(c) Describe how the perimeter of the shape changes as each new hexagon is added.

_____

_____ [1]

(d) What is the perimeter of pattern 9?

Answer _____ cm [2]

Q12

Write down the two missing numbers in this sequence.

1, 3, 6, 10, 15, _____ , 28, _____ [2]

Q13

(a) Jenny writes the first six square numbers as

2, 4, 9, 16, 25, 36

Explain why she is wrong.

Answer _____ [1]

(b) Part of the sequence of triangular numbers is shown.

… 21, 28, 36, 45, 55, 66 …

(i) Which triangular number comes directly before 21?

Answer _____ [1]

(ii) Write down the smallest triangular number which is greater than 100

Answer _____ [1]

Q14 Solve

$$4 < 3n \leqslant 18 \text{ for integer } n$$

Answer _____ [3]

Q15 Solve $4n + 3 > 28$

Answer _____ [2]

Q16 Solve the inequality $5x + 4 \leqslant 7x - 5$

Answer _____ [2]

Q17 Solve $-9 \leqslant 3y < 6$ where y is an integer.

Answer _____ [2]

Q18

Jenny's height is given as 156 cm, correct to the nearest cm.

Between what limits does Jenny's height lie?

Complete the following:

_____ $\leqslant$ Jenny's height $<$ _____ [2]

Q19

Simplify

(a) $t^3 \times t^8$

Answer _____ [1]

(b) $(t^2)^3$

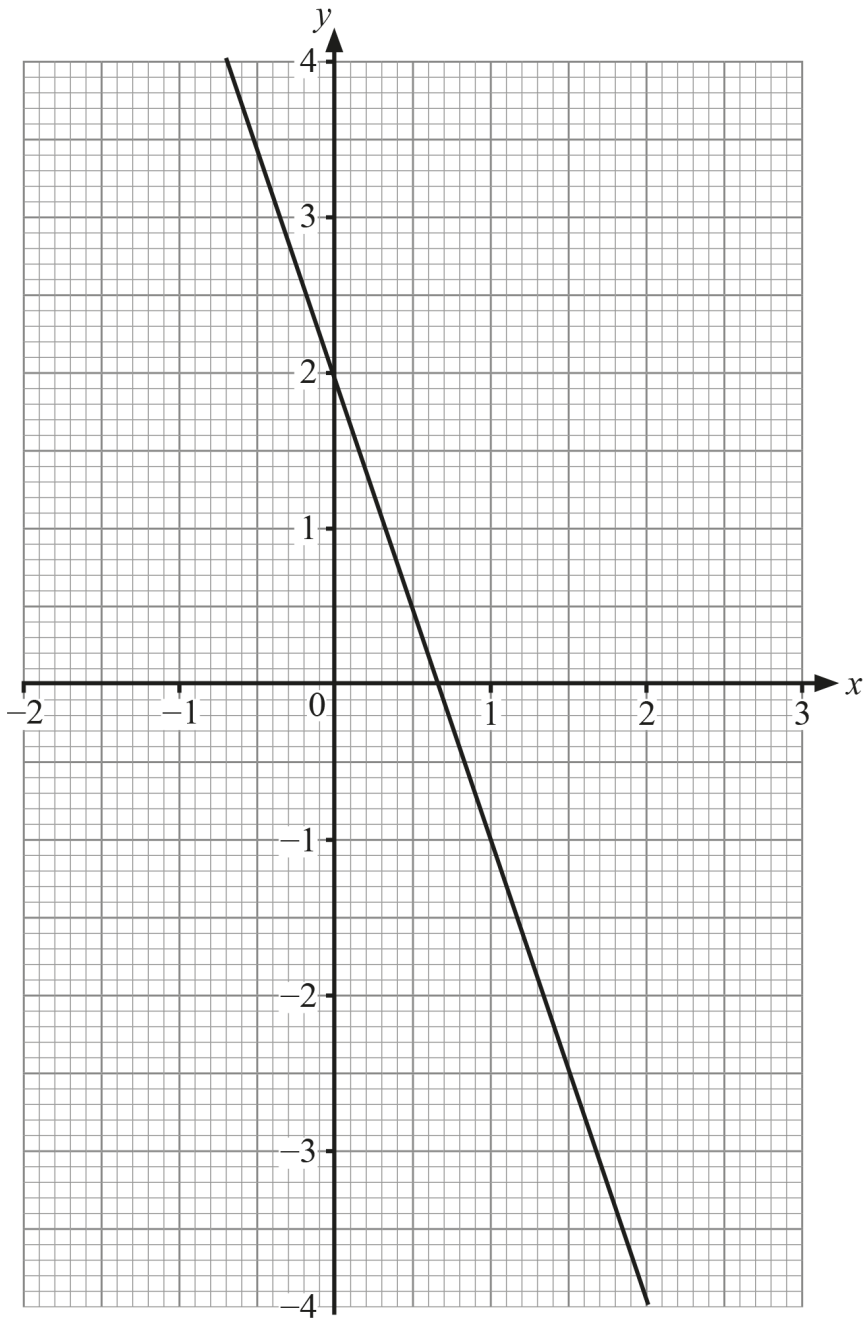
Answer _____ [1]

Q20

Simplify $(x^5)^3$

Answer _____ [1]

Q21



By drawing a suitable line on the grid opposite solve the simultaneous equations

$y = 2x - 2$

$y = -3x + 2$

Answer $x =$ _____ $y =$ _____ [4]

1.

$x = 3.5 \rightarrow 28.875$ and	
$x = 3.4 \rightarrow 25.704$	MA1
$x = 3.45 \rightarrow 27.263625$	MA1
$x = 3.4$	MA1

2.

$3^3 - 6 \times 3 = 9$	
$4^3 - 6 \times 4 = 40$	MA1
$3.1^3 - 6 \times 3.1 = 11.191$	
$3.2^3 - 6 \times 3.2 = 13.568$	MA1
$3.15^3 - 6 \times 3.15 = 12.355875$	MA1
Ans = 3.1	A1

3.

$x = 2.6$	14.56	
$x = 2.7$	15.39	MA1
$x = 2.65$	14.9725	MA1
$x = 2.7$		A1

4.

$x = 4.5$	65.25	
$x = 4.6$	68.08	MA1
$x = 4.55$	66.6575	MA1
$x = 4.6$		A1

5.

x	$x^3 + 4x^2$	Comment
3.5	91.875	too low
3.6	98.496	too low
3.7	105.413	too high
3.65	101.917125	too high

between 3 and 4	MA1
between 3.6 and 3.7	MA1
Using 3.65	MA1
3.6	A1

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6. **(a)** $20 \times 4 - 64 = 16$ and $20 \times 5 - 125 = -25$ MA1

(b)

x	$20x - x^3$		
4.5	–1.125	(too small)	
4.4	2.816	(too big)	MA1
4.45	0.878875	(too small)	MA1

Answer 4.4 A1

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7. $x = 5y - 3y - 1$ MA1

$x = 2y - 1$ A1

---

8. $y - 10 = 8x$ **or** $8x = y - 10$ A1

$\frac{y-10}{8} = x$ **or** $x = \frac{y-10}{8}$ A1

---

9. **(a)** 33 A1

(b) add an extra 2 each time MA1

10.

(a) $12n$ A1

(b) $-4n + 17$ or $17 - 4n$ A1 A1

11.

(a) Correct pattern drawn A1

(b) 14 18 A1 A1

(c) The perimeter increases by 4 cm A1

(d) 38 M1 A1

12.

21, 36 A1 A1

13.

(a) 2 is not a square number A1

(b) **(i)** 15 A1

(ii) 105 A1

14.

$\frac{4}{3} < n \leq 6$ M1

2, 3, 4, 5, 6 A2

15.

$4n > 25$ MA1

$n > \frac{25}{4}\left(6\frac{1}{4}\right)$ MA1

16.

$5 + 4 \leqslant 7x - 5x$ (*or* $9 \leqslant 2x$) M1

$x \geqslant 4.5$ *or* $x \geqslant 4\frac{1}{2}$ *or* $x \geqslant \frac{9}{2}$ A1

17.

$-3 \leqslant y < 2$ MA1

$-3, -2, -1, 0, 1$ A1

18.

$155.5 \leqslant$ Jenny's height < 156.5 A1 A1

19.

(a) t^{11} A1

(b) t^{6} A1

20.

x^{15} A1

21.

Correct line drawn M1 A1

$x = 0.8$ $y = -0.4$ A1 A1

Correct line drawn M1 A1

$x = 0.8$ $y = -0.4$ A1 A1
