St. Patrick's High School, Keady

Mathematics Department

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GCSE Mathematics Practice Booklet

# M8

# Topic 2 –Algebra 1

Trial and Improvement

Direct Proportion

Simultaneous Equations

Changing the Subject

Inequalities

Indices

Sequences



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Questions taken from CCEA Past Papers

Keady Maths

**Q1** Complete the boxes

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

[2]

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**Q2** Make $v$ the subject of $2s = (u + v)t$

Answer $v =$ _____ [2]

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**Q3** Make $m$ the subject of the formula $H = mr + s$

Answer $m =$ _____ [2]

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**Q4** Rewrite $4 + x = 9 - y$ to make $y$ the subject.

Give your answer in its simplest form.

Answer $y =$ _____ [2]

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**Q5** Rearrange $v = u + at$ to make $a$ the subject.

Answer $a =$ _____ [2]

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**Q6** Solve $4n + 3 > 28$

Answer _____ [2]

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**Q7**

**(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]

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**Q8**

Solve

$$8x < 6x + 7$$

Answer _____ [2]

**Q9** A rectangle has a length of $3x$ cm and a width of $(x + 5)$ cm.

The length is greater than the width.

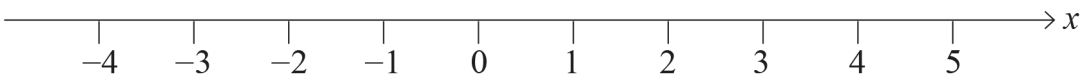
**(a)** Write this information as an inequality in $x$.

Answer _____ [1]

**(b) (i)** Solve the inequality.

Answer _____ [1]

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



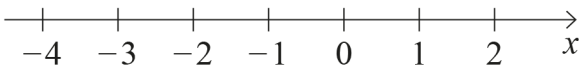

[1]

**Q10**

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

Answer _____ [2]

**(b)** Show your solution on the number line.




[1]

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**Q11**

Solve

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

Answer _____ [3]

---

**Q12** List the values of the integer $n$ which satisfy the inequality

$-7 < 3n \leqslant 6$

Answer _____ [3]

---

**Q13** Solve the inequality $5x + 4 \leqslant 7x - 5$

Answer _____ [2]

---

**Q14** Solve $-9 \leqslant 3y < 6$ where $y$ is an integer.

Answer _____ [2]

---

**Q15** Solve

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

Answer _____ [2]

---

**Q16** 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]

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**Q17** Write down the next two terms in the sequence

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

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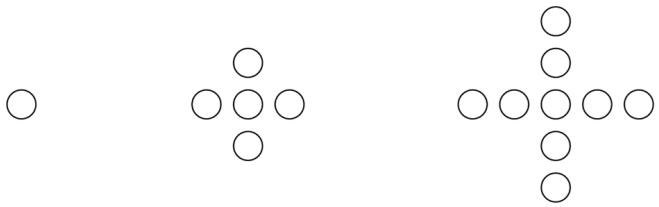
**Q18** Here is a sequence of patterns made with circles.



pattern 1 pattern 2 pattern 3

How many circles are needed for pattern 5?

Answer _____ because the rule is _____ [2]

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**Q19** **(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]

---

**Q20** 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]

---

**Q21** Work out the $n^{th}$ term of the sequence 6, 3, 0, −3, ...

Answer _____ [2]

---

**Q22** 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]

---

**Q23** 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]

---

**Q24** A sequence has $n^{th}$ term $n^2 + 4$

**(a)** Write down the first 3 terms of the sequence.

Answer _____ , _____ , _____ [2]

**(b)** Here are three sequences

$n^3 + 2$ $3n + 1$ $4n - 1$

The number 13 is a term in one of these. Which one?
**Explain your answer clearly.**

Answer _____

because _____

_____ [2]

---

**Q25** The first three terms of a sequence are $\frac{1}{2}, \frac{2}{3}, \frac{3}{4} \ldots$

Write down the $n^{th}$ term.

Answer _____ [1]

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**Q26**

A sequence is formed using the rule:

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

Use this rule to complete the sequence below.

$x$, 4, _____, _____, _____ [1]

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**Q27**

Find the $n$th term of the sequence

7, 4, 1, –2, .....

Answer $n$th term = _____ [2]

---

**Q28** **(a)** The first four terms of a sequence are

$$1, \quad 4, \quad 7, \quad 10$$

What is the $n^{th}$ term for this sequence?

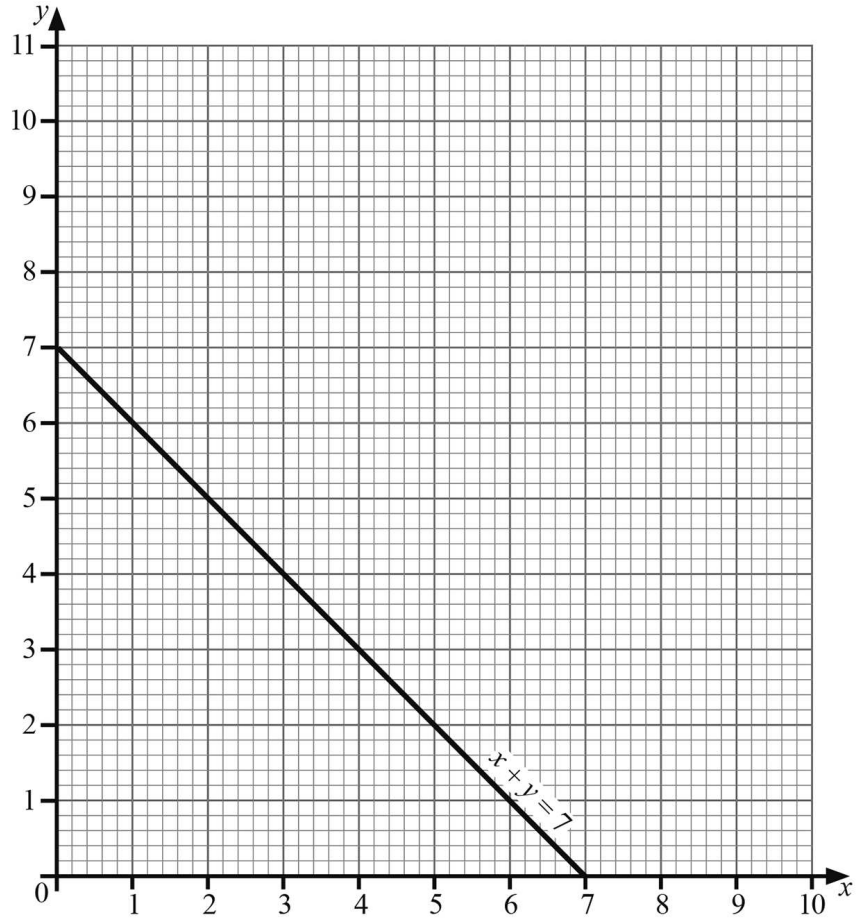
Answer _____ [2]

**(b)** Hence find the $n^{th}$ term for the sequence below.

$$\frac{1}{1}, \quad \frac{4}{4}, \quad \frac{9}{7}, \quad \frac{16}{10}$$

Answer _____ [2]

**Q29** The line $x + y = 7$ is shown below.




**(a)** On the diagram illustrate the region represented by the inequalities

$x + y \leqslant 7, \qquad y \geqslant 1, \qquad y \leqslant 5x + 1$

Mark the region with the letter R. [2]

**(b)** In the region R, what is the greatest value of $2x + y$?

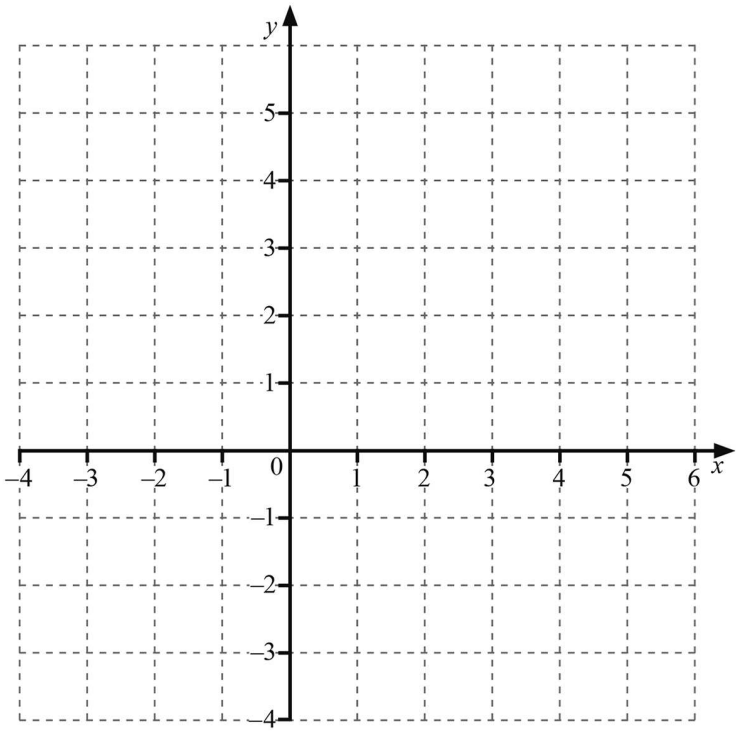
Answer _____ [2]

**Q30** **(a)** On the grid below use suitable shading and the letter R to show the region represented by the inequalities

$y \geqslant 4 - 2x$

$y \geqslant 2x$

$y \leqslant 4$

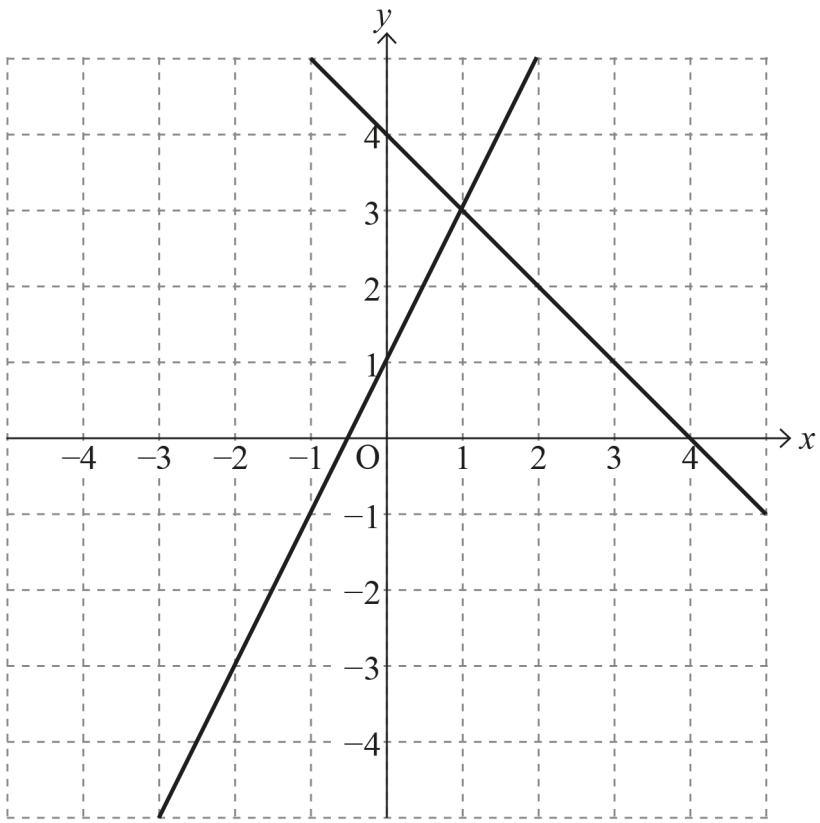



[3]

**(b)** In the region R, what is the maximum value of $x + y$?

Answer _____ [1]

**Q31** **(a)**

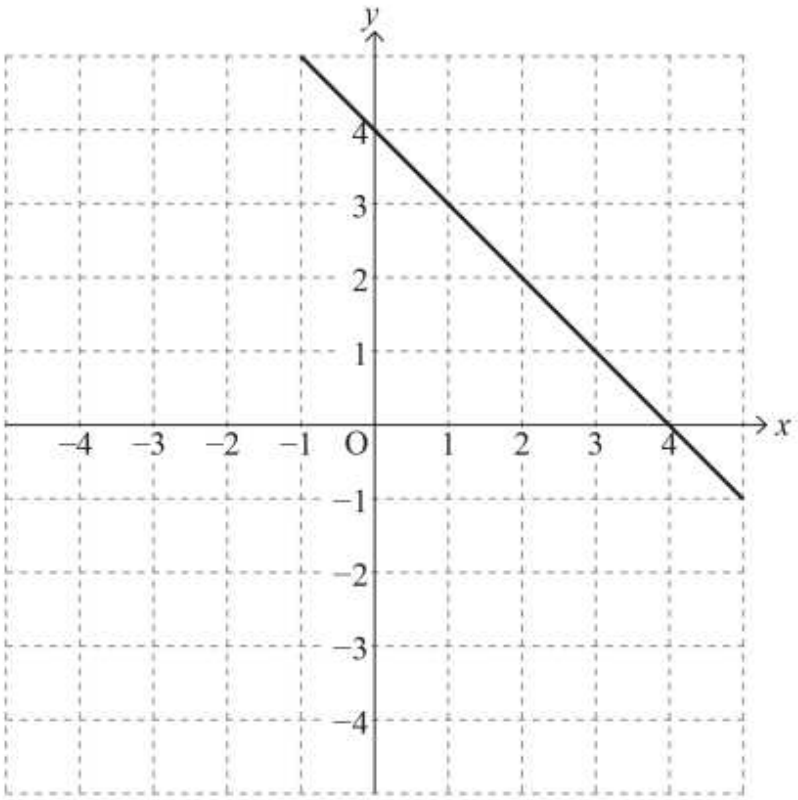



The lines $y = 2x + 1$ and $x + y = 4$ have been drawn on the grid.

By drawing another line on the grid above, indicate clearly by the letter R

the region satisfying $y \geq 2x + 1$ and $x + y \leq 4$ and $x \geq -1$ [2]

**(b)**




By drawing more lines on the grid above, indicate clearly by the letter B the region satisfying $y \leq 2x$ and $x + y \leq 4$ and $y \geq 1$ [2]

**Q32**

Rewrite $3a - b = c(2 - a)$ to make $a$ the subject.

Answer $a =$ _____ [3]

**Q33** Rearrange $p = 2q - 5r^2t$ to make $r$ the subject of the formula.

Answer $r$ = _____ [3]

**Q34** Rearrange $8(xy - 5) = 3y - 7x$ to make $x$ the subject.

Answer $x =$ _____ [4]

**Q35** Make $n$ the subject of the formula $H = \frac{5 - 2n}{6 + n}$

Answer _____ [4]

---

**Q36** Make $b$ the subject of $3(b + 4) = a(5 - 2b)$

Answer $b$ = _____ [4]

---

**Q37** Make $x$ the subject of the formula $y = \frac{b}{\sqrt{x}}$

Answer $x =$ _____ [2]

---

**Q38** Simplify

**(a)** $m^3 \times m^4$

Answer _____ [1]

**(b)** $\frac{n^6}{n^3}$

Answer _____ [1]

**(c)** $\frac{r \times r^3}{r^6}$

Answer _____ [1]

---

**Q39** Simplify each of the following.

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

Answer _____ [1]

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

Answer _____ [1]

**Q40**

**(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]

**(c)** Work out the value of

**(i)** $5^{-2}$

Answer _____ [1]

**(ii)** $1^5 + 6^0$

Answer _____ [1]

**Q41**

The height of a balloon, $h$, varies directly as the square root of its surface area, $A$.

When the balloon's surface area is 81 its height is 12

What is its height when its surface area is 144?

Answer _____ [3]

**Q42**

$T$ varies as the square of $d$

When $d = 0.3$, $T = 10.8$

**(a)** Express $T$ in terms of $d$

Answer _____ [3]

**(b)** Find a value of $d$ for which $T = 30$

Answer _____ [2]

**Q43** Solve the simultaneous equations

$$3x - y = 7 \text{ and } 5x - 2y = 10$$

**A solution by trial and improvement will not be accepted.**

Answer $x =$ _____ $y =$ _____ [3]

**Q44** Solve $y = 1 - x$ and $x^2 + y^2 + x = 16$

Answer _____ [5]

**Q45** Solve $x - 15 = 5y$
$3x = -8y - 1$

**Show all your working.**
**A solution by trial and improvement will not be accepted.**

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

**Q46** Solve the simultaneous equations

$x + 2y = -3$ and $x^2 - 2xy = 20$

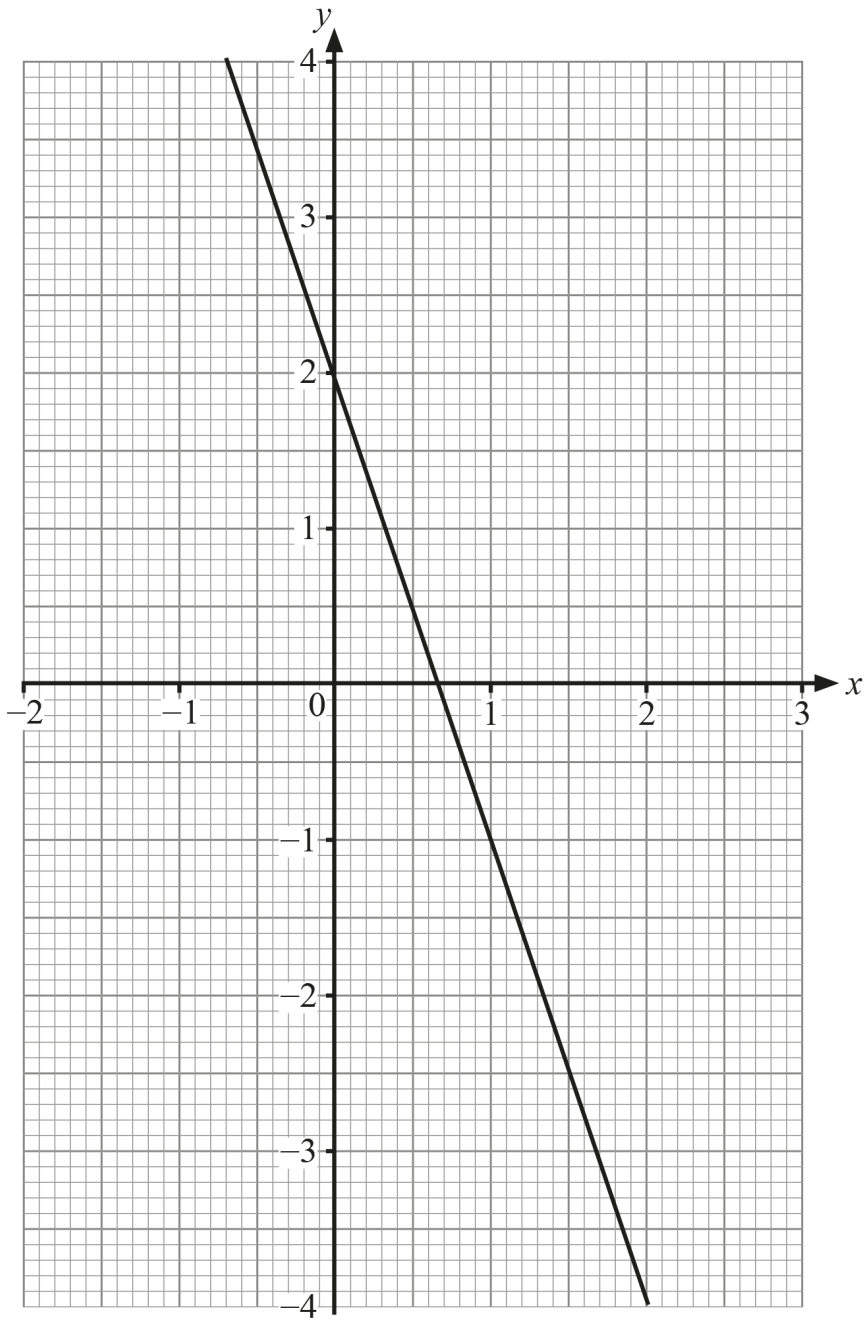
Answer _____ [7]

**Q47** Solve the simultaneous equations

$$2x^2 + 3y^2 = 2 \text{ and } x - y + 1 = 0$$

Answer _____ [7]

**Q48**



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

$y = 2x - 2$

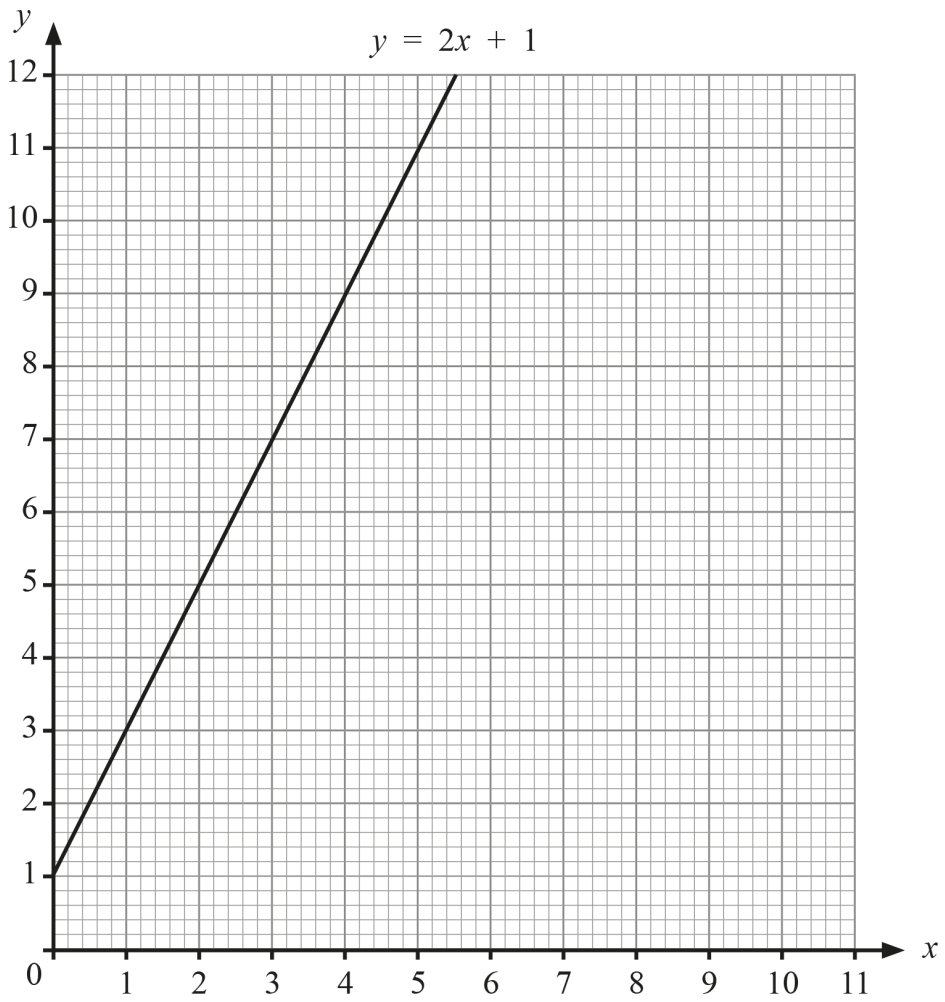
$y = -3x + 2$

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

**Q49** Use graphs to solve the simultaneous equations

$$y = 2x + 1 \quad \text{and} \quad y = 10 - x$$

The graph of $y = 2x + 1$ has already been drawn for you.




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

**Q50** Andy and Zoe have the same rates of pay.

Andy worked 12 hours normal time and 8 hours overtime and earned £238

Zoe worked 10 hours normal time and 15 hours overtime and earned £315

Calculate the rates of pay for normal time and overtime.

**A solution by trial and improvement will not be accepted.**

Answer normal £ _____ per hour; overtime £ _____ per hour

[5]

**Q51** **(a)** Given $\sqrt{x+2} = 3a$ find $x$ in terms of $a$

Answer $x =$ _____ [2]

**(b)** Simplify $(\frac{1}{2}xy^3)^2$

Answer _____ [2]

**Q52** **(a)** Y is directly proportional to the cube of X.

Y = 960 when X = 4

Express Y in terms of X.

Answer _____ [2]

**(b)** Calculate the value of X when Y = 405

Answer _____ [2]

**Q53**

The height of a balloon, $h$, varies directly as the square root of its surface area, $A$.

When the balloon's surface area is 81 its height is 12

What is its height when its surface area is 144?

Answer _____ [3]

**Q54**

A scale model of a car is made.

The length of the model is $\frac{1}{10}$ of the length of the car.

The volume of the petrol tank of the car is $50\,000\,\text{cm}^3$

What is the volume of the petrol tank of the model?

Answer _____ $\text{cm}^3$ [2]

**Q55** **(a)** Given $(2^n)^{\frac{2}{3}} = 16$, find the value of $n$.

Answer $n =$ _____ [2]

**(b)** The value of P = 81 and the value of Q = 32

Find the value of $m$ given that $(P^{\frac{1}{2}} + Q^{\frac{4}{5}})^{-m} = \frac{1}{5}$

Answer $m =$ _____ [3]

**Q56**

Simplify $\sqrt[3]{(x^6y^9)^2}\,(xy)^{-2}$

Answer _____ [3]

---

**Q57**

Simplify the expressions

**(a)** $(4x^5\,y^3)\,(3x^2y^2)$

Answer _____ [2]

**(b)** $(2pq^2)^3$

Answer _____ [2]

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**Q58**

Simplify $\left(x^{-\frac{1}{2}}\right)\left(x^{5}\right)^{\frac{1}{2}}$

Answer _____ [2]

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

---

2. $2s - ut = vt$ MA1

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

**or**

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

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

---

3. $H - s = mr$ MA1

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

---

4.

$4 + y = 9 - x$ A1

$y = 9 - x - 4$

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

---

5.

$at = v - u$ MA1

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

---

6.

$4n > 25$ MA1

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

---

7.

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

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

**(b)** 0 A1

---

8.

$2x < 7$ MA1

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

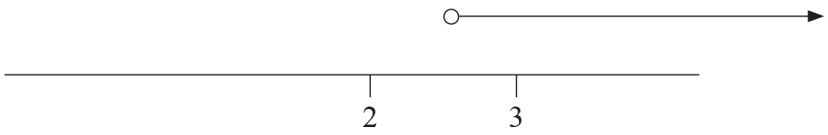
---

9.

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

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

$x > 2.5$ A1

**(ii)** 

A1

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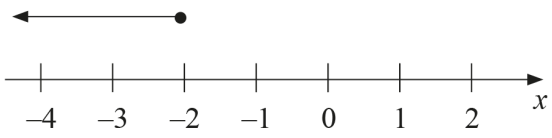
10.

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

$2x \leq -4$

$x \leq -2$ A1

**(b)** 

A1

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

2, 3, 4, 5, 6 A2

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

–2, –1, 0, 1, 2 MA2

---

13. $5 + 4 \leqslant 7x - 5x$ (*or* $9 \leqslant 2x$) M1

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

---

14. $-3 \leqslant y < 2$ MA1

–3, –2, –1, 0, 1 A1

---

15.

| | |
|---|---|
| $15 > 5n$ | MA1 |
| $n < 3$ | A1 |

---

16.

| | |
|---|---|
| **(a)** 33 | A1 |
| **(b)** add an extra 2 each time | MA1 |

---

17.

| | |
|---|---|
| 3, –7 | A1 A1 |

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18.

| | |
|---|---|
| 17 | MA1 |
| You add 4 each time | MA1 |

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19. **(a)** $12n$ A1

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

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20. **(a)** $5n - 2$ A1 A1

**(b)** 15th A1

---

21. $9 - 3n$ **or** $-3n + 9$ A2
(A1 for answer of $-3n$ + any constant)

---

22. $5n - 3$ A2

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

---

23.

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

---

24.

**(a)** 5, 8, 13 [A1 for any 2 correct] A2

**(b)** 3n + 1 A1
because $3 \times 4 + 1 = 13$ A1

**Alternative solution**

3n + 1 A1
because there is no $n$ value such that $n^3 + 2 = 13$ or such that $4n - 1 = 13$ A1

---

25.

$\frac{n}{n+1}$ A1

---

26.

$x + 4, \quad x + 8, \quad 2x + 12$ A1

---

27.

$-3n + 10$ A2

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

---

28.

**(a)** $3n - 2$ A1 A1
Allow A1 for $3n + c (c \neq -2)$

**(b)** $\frac{n^2}{3n - 2}$ M1 A1

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29.

**(a)** $y = 5x + 1$ and $y = 1$ drawn plus an attempt at shading a region MA1
Region R correct A1

**(b)** 13 A2
(Allow A1 for (6, 1) identified)

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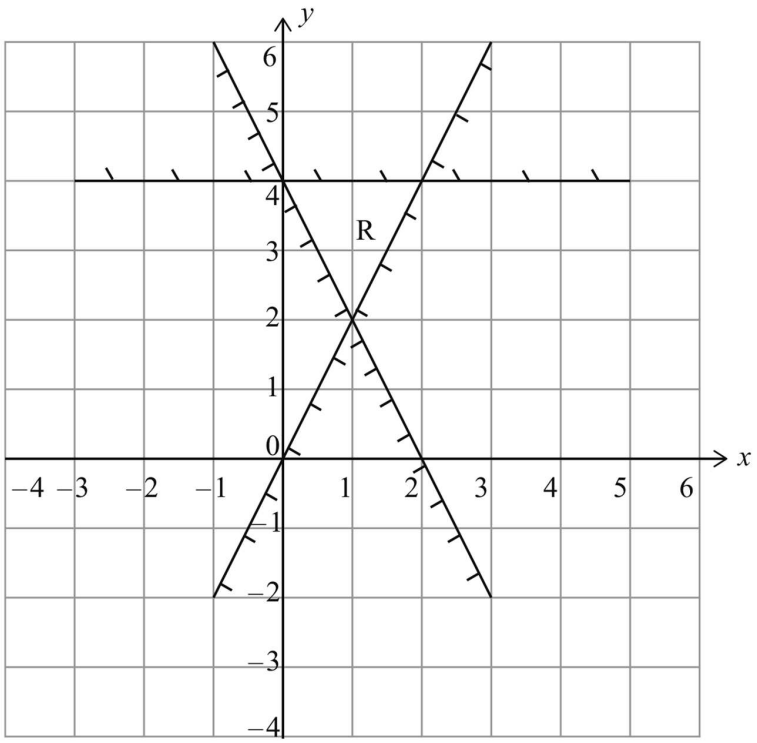
30. **(a)**




Each line and appropriate shading MA1 MA1 MA1

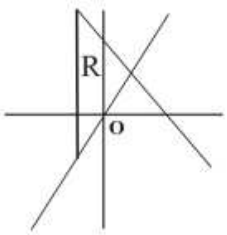
**(b)** 6 A1

31.

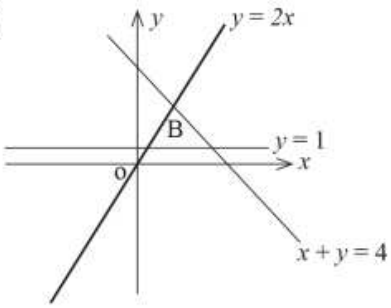
**(a)** line $x = -1$ drawn, correct triangle indicated MA1 A1

**(b)** lines $y = 2x$ and $y = 1$, correct triangle indicated MA1 A1

**(a)**




**(b)**

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32.

$3a - b = 2c - ac$

$3a + ac = 2c + b$ MA1

$a(3 + c) = 2c + b$ MA1

$a = \dfrac{2c + b}{3 + c}$ A1

---

33.

$5r^2t = 2q - p$ C1

$r^2 = \dfrac{2q - p}{5t}$ C1

$r = \sqrt{\dfrac{2q - p}{5t}}$ C1

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34.

| | |
|---|---|
| $8xy - 40 = 3y - 7x$ | MA1 |
| $8xy + 7x = 3y + 40$ | MA1 |
| $x(8y + 7) = 3y + 40$ | MA1 |
| $x = \frac{3y + 40}{8y + 7}$ | A1 |

35.

| | |
|---|---|
| $6H + Hn = 5 - 2n$ | MA1 |
| $Hn + 2n = 5 - 6H$ | MA1 |
| $n(H + 2) = 5 - 6H$ | MA1 |
| $n = \frac{5 - 6H}{H + 2}$ | A1 |

36.

| | |
|---|---|
| $3b + 12 = 5a - 2ab$ | MA1 |
| $2ab + 3b = 5a - 12$ | MA1 |
| $b(2a + 3) = 5a - 12$ | MA1 |
| $b = \frac{5a - 12}{2a + 3}$ | A1 |

37.

$\sqrt{x} = \frac{b}{y}$ M1

$x = \frac{b^2}{y^2}$ **or** $x = \left(\frac{b}{y}\right)^2$ A1

**Alternative**

$y^2 = \frac{b^2}{x}$

$xy^2 = b^2$ M1

$x = \frac{b^2}{y^2}$ A1

---

38.

**(a)** $m^7$ A1

**(b)** $n^3$ A1

**(c)** $r^{-2}$ **or** $\frac{1}{r^2}$ A1

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39.

**(a)** $12p^7$ A1

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

---

40.

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

**(ii)** $y^4$ A1

**(b)** 7n A1

**(c)** **(i)** $\frac{1}{25}$ or 0.04 A1

**(ii)** 1 + 1 = 2 A1

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41.

$h = k\sqrt{A}$ M1

$12 = k\sqrt{81}$

$k = \frac{4}{3}$ A1

$h = \frac{4}{3}\sqrt{144} = 16$ A1

---

42.

**(a)** $T = kd^2$ MA1

$10.8 = 0.09k$, $k = 120$ MA1

$T = 120d^2$ A1

**(b)** $30 = 120d^2$ MA1

$d = 0.5$ (accept $-0.5$) A1

---

43.

$6x - 2y = 14$
$5x - 2y = 10$

$x = 4$
$y = 5$

OR

$15x - 5y = 35$
$15x - 6y = 30$

$y = 5$
$x = 4$

MA1
MA1
MA1

---

44.

$x^2 + (1 - x)^2 + x = 16$ MA1

$2x^2 - x - 15 = 0$ MA1

$(2x + 5)(x - 3)$ MA1

$x = -\frac{5}{2}$ $x = 3$ MA1

$y = \frac{7}{2}$ $y = -2$ MA1

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45.

| | |
|---|---|
| $x - 5y = 15$<br>$3x + 8y = -1$ | MA1 |
| $3x - 15y = 45$<br>$3x + 8y = -1$ | MA1 |
| $-23y = 46$<br>$y = -2$ | A1 |
| $x = 5$ | A1 |

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46.

| | |
|---|---|
| $x = -3 - 2y$ | MA1 |
| $(-3 - 2y)^2 - 2(-3 - 2y)y = 20$ | MA1 |
| $9 + 12y + 4y^2 + 6y + 4y^2 = 20$ | MA1 |
| $8y^2 + 18y - 11 = 0$ | MA1 |
| $(4y + 11)(2y - 1)$ | MA1 |
| $y = \frac{1}{2}$ or $-\frac{11}{4}$ | MA1 |
| $x = -4$ or $\frac{5}{2}$ | MA1 |

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47.

| | | | |
|---|---|---|---|
| $2x^2 + 3(x + 1)^2 = 2$ | **or** | $2(y - 1)^2 + 3y^2 = 2$ | MA2 |
| $2x^2 + 3(x^2 + 2x + 1) = 2$ | | $2(y^2 - 2y + 1) + 3y^2 = 2$ | MA1 |
| $5x^2 + 6x + 1 = 0$ | | $5y^2 - 4y = 0$ | MA1 |
| $(5x + 1)(x + 1) = 0$ | | $y(5y - 4) = 0$ | MA1 |
| $x = -\frac{1}{5}$ and $x = -1$ | | $y = 0$ and $y = \frac{4}{5}$ | MA1 |
| $y = \frac{4}{5}$ and $y = 0$ | | $x = -1$ and $y = -\frac{1}{5}$ | MA1 |

---

48.

| | |
|---|---|
| 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 |

---

49.

| | |
|---|---|
| Line $x + y = 10$ passes through points (0, 10) and (10, 0) | M1 A1 |
| $x = 3$ and $y = 7$ | A1 A1 |

---

50.

| | |
|---|---|
| $12x + 8y = 238$ | MA1 |
| $10x + 15y = 315$ | MA1 |
| $120x + 80y = 2380$ | |
| $120x + 180y = 3780$ | MA1 |
| $100y = 1400$; $y = 14$ | A1 |
| $x = 10.50$ | A1 |

---

51. **(a)** $x + 2 = 9a^2$ M1
$x = 9a^2 - 2$ A1

**(b)** $\frac{1}{4}x^2y^6$ A2 (A1 for two parts correct)

---

52. **(a)** $960 = k \times 64$ MA1
$k = 15$ hence $Y = 15X^3$ MA1

**(b)** $\frac{405}{15} = X^3$ MA1
$X = 3$ A1

---

53. $h = k\sqrt{A}$ M1

$12 = k\sqrt{81}$

$k = \frac{4}{3}$ A1

$h = \frac{4}{3}\sqrt{144} = 16$ A1

---

54.

$\frac{1}{1000} \times 50\,000$ M1

50 A1

---

55.

**(a)** $2^{\frac{2}{3}n} = 2^4$ MA1

$\frac{2}{3}n = 4 \quad n = 6$ A1

**(b)** $(9 + 16)^{-m} = \frac{1}{5}$ A1

$5^{-2m} = 5^{-1}$ MA1

$m = \frac{1}{2}$ A1

---

56.

$x^4y^6$ seen MA1

$x^2y^4$ A1 A1

---

57.

**(a)** $12x^7y^5$ allow 1 for only 1 error A2

**(b)** $8p^3q^6$ allow 1 for only 1 error A2

---

58.

$x^2$ A2

Allow one mark for $\frac{5}{2}$ seen

**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** **(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]

---

**Q10** Solve

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

Answer _____ [3]

---

**Q11** Solve the inequality $5x + 4 \leqslant 7x - 5$

Answer _____ [2]

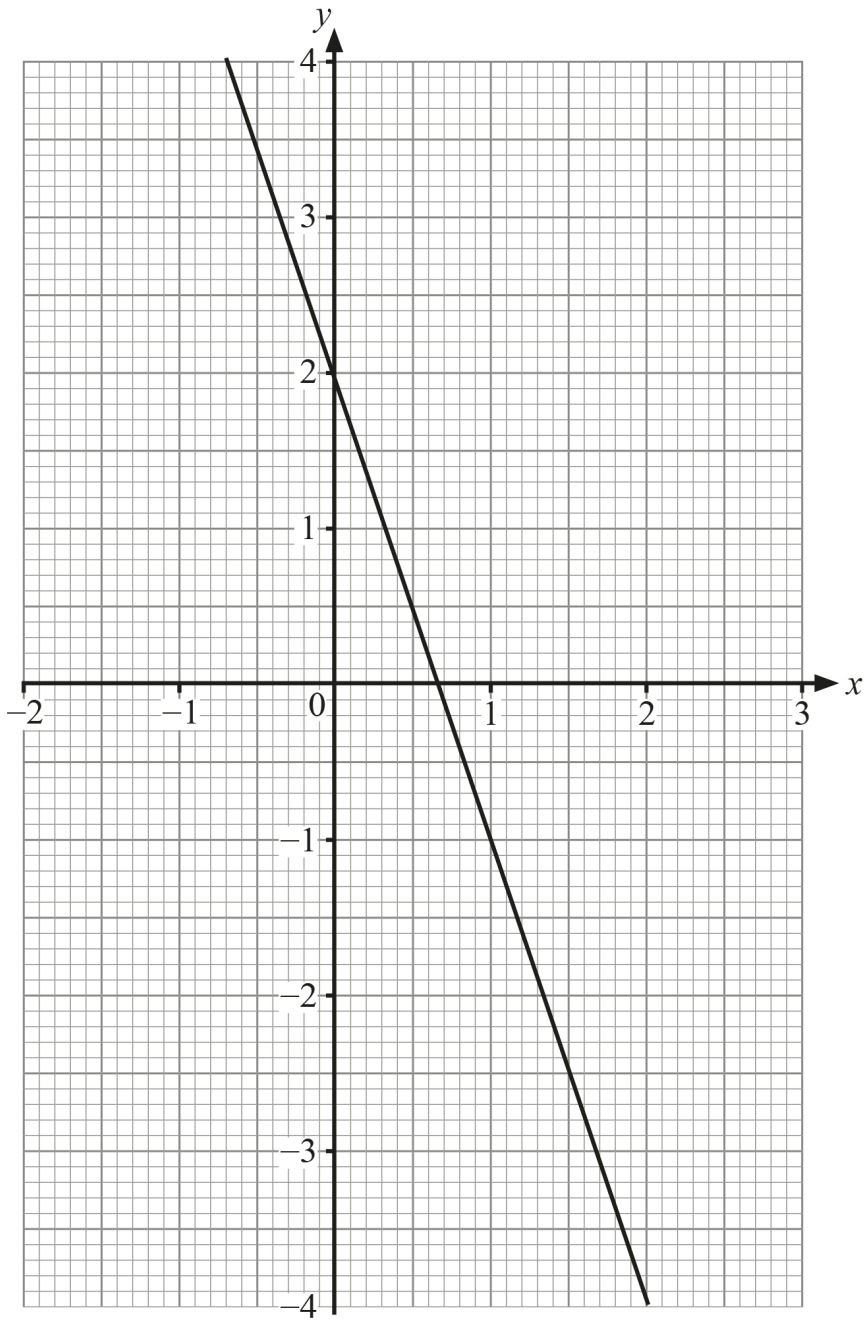
---

**Q12** Solve $-9 \leqslant 3y < 6$ where $y$ is an integer.

Answer _____ [2]

---

**Q13**



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

$y = 2x - 2$

$y = -3x + 2$

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

---

**Q14** **(a)** Y is directly proportional to the cube of X.

Y = 960 when X = 4

Express Y in terms of X.

Answer _____ [2]

**(b)** Calculate the value of X when Y = 405

Answer _____ [2]

---

**Q15** The time (T) of swing of a pendulum varies as the square root of the length (L) of the pendulum.

When T = 1.8 seconds the length of the pendulum is 0.81 m.

**(a)** Find the formula for T in terms of L.

Answer T = _____ [3]

**(b)** Use your formula to find T when L = 1.21 m.

Answer _____ seconds [1]

**(c)** Find the value of L for which the time of swing is 0.5 seconds.

Answer _____ m [1]

**Q16** $s$ is directly proportional to the square of $v$.

When $v = 20$, $s = 250$

Express $s$ in terms of $v$.

Answer _____ [3]

**Q17** $T$ varies as the square of $d$

When $d = 0.3$, $T = 10.8$

**(a)** Express $T$ in terms of $d$

Answer _____ [3]

**(b)** Find a value of $d$ for which $T = 30$

Answer _____ [2]

**Q18** Simplify

**(a)** $m^3 \times m^4$

Answer _____ [1]

**(b)** $\frac{n^6}{n^3}$

Answer _____ [1]

**(c)** $\frac{r \times r^3}{r^6}$

Answer _____ [1]

---

**Q19** Simplify $4x^3y^5 \times 3x^2y$

Answer _____ [2]

---

**Q20**

Simplify

$t^3 \times t^8$

Answer _____ [1]

$(t^2)^3$

Answer _____ [1]

$\frac{t^{-3}}{t^2}$

Answer _____ [1]

**Q21** Solve the simultaneous equations $5x + 2y = 19$
$4x - 3y = 29$

A solution by trial and improvement will not be accepted.

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

**Q22** Solve $x - 15 = 5y$
$3x = -8y - 1$

**Show all your working.**
**A solution by trial and improvement will not be accepted.**

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

**Q23** The total weight of 5 brown and 2 white eggs was 21.6 g.

The total weight of 3 brown and 5 white eggs was 23.6 g.

Write down two simultaneous equations and solve them to find the weight of a brown egg and the weight of a white egg.

You may assume that all brown eggs have the same weight and all white eggs have the same weight.

Show all your working.

Answer Brown egg weighs_____ g

White egg weighs _____ g [5]

**Q24** A bag contains 60 coins.

Each coin in the bag is either a 20p coin or a 50p coin.

The total value of the coins in the bag is £22.80

Work out how many of each coin is in the bag.

A solution by trial and improvement will not be accepted.

Answer _____ 20p coins

_____ 50p coins [5]

**Q25** John earns £$x$ per hour on Fridays and £$y$ per hour on Saturdays.

In March he worked 20 hours on Fridays, 12 hours on Saturdays and earned £322

In April he worked 16 hours on Fridays, 10 hours on Saturdays and earned £262

Use simultaneous equations to find the values of $x$ and $y$.

Answer $x =$_____

$y =$_____ [5]

**Q26** 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]

**Q27** P is inversely proportional to the square of Q.
P = 6 when Q = 3

**(a)** Express P in terms of Q.

Answer _____ [2]

**(b)** Hence

**(i)** find the value of P when Q = 4

Answer _____ [1]

**(ii)** find the value of Q when P = 24

Answer _____ [2]

**Q28** The force, $F$ newtons, between two particles is inversely proportional to the square of the distance, $d$ mm, between them.
When the particles are 4 mm apart the force between them is 12.5 newtons.
How far apart are the particles when the force between them is 3.125 newtons?

Answer _____ mm [5]

**Q29** A scientist collected the following data from an experiment.

| | | |
|---|---|---|
| $d$ | 4 | 6 |
| W | 9 | 4 |

The scientist was unsure as to the correct formula linking the variables $d$ and W.

He tried these three possible formulae:

A $W = kd^2$

B $W = \frac{k}{d^2}$

C $W = \frac{k}{d}$

**(a)** Explain clearly why formula A could not be correct.

_____

_____ [1]

**(b)** Show clearly which is the correct formula and find the value of k for that formula.

Formula _____ and k = _____ [3]

**(c)** Hence find the value of

**(i)** W when $d = 12$

Answer _____ [1]

**(ii)** $d$ when W = 0.04

Answer _____ [1]

**Q30** Solve $y = x + 3$ and $x^2 + y^2 = 14$

Give your answers to 2 decimal places.

Answer _____ [7]

**Q31** Solve the simultaneous equations $y = 3x - 1$
$3x^2 + 2y^2 = 35$

Answer _____ [7]

**Q32** Solve the simultaneous equations

$$y^2 = 6x - 23$$
$$y = x - 3$$

**Show all your work.**
**A solution by trial and improvement will not be accepted.**

Answer _____ [5]

**Q33** A customer bought a number of toys all at the same price. In total she spent £60

If the price of each toy had been £1 more she could have bought 16 less toys for £60

Find the price paid for each toy.

**A method of trial and improvement will not be accepted.**

Answer £ _____ [7]

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 |

---

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

---

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)** $12n$ A1

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

---

10.

| | |
|---|---|
| $\frac{4}{3} < n \leq 6$ | M1 |
| 2, 3, 4, 5, 6 | A2 |

11.

| | |
|---|---|
| $5 + 4 \leqslant 7x - 5x$ (*or* $9 \leqslant 2x$) | M1 |
| $x \geqslant 4.5$ *or* $x \geqslant 4\frac{1}{2}$ *or* $x \geqslant \frac{9}{2}$ | A1 |

12.

| | |
|---|---|
| $-3 \leqslant y < 2$ | MA1 |
| –3, –2, –1, 0, 1 | A1 |

13.

| | |
|---|---|
| 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 |

14.

**(a)** $960 = k \times 64$ MA1

$k = 15$ hence $Y = 15X^3$ MA1

**(b)** $\frac{405}{15} = X^3$ MA1

$X = 3$ A1

---

15.

**(a)** $T = k\sqrt{L}$ MA1

$1.8 = k\sqrt{0.81}$

$k = 2$ MA1

$T = 2\sqrt{L}$ MA1

**(b)** $T = 2\sqrt{1.21} = 2.2$ MA1

**(c)** $0.5 = 2\sqrt{L}$

$L = 0.0625\left(\frac{1}{16}\right)$ MA1

---

16.

$s = Kv^2$

$250 = K \times 400, K = \frac{5}{8}$ M1 A1

$s = \frac{5}{8}v^2$ A1

---

17.

**(a)** $T = kd^2$ MA1

$10.8 = 0.09k$, $k = 120$ MA1

$T = 120d^2$ A1

**(b)** $30 = 120d^2$ MA1

$d = 0.5$ (accept $-0.5$) A1

---

18.

**(a)** $m^7$ A1

**(b)** $n^3$ A1

**(c)** $r^{-2}$ **or** $\frac{1}{r^2}$ A1

---

19.

$12x^5y^6$ A2
(A1 for 2 terms correct)

---

20.

**(a)** $t^{11}$ A1

**(b)** $t^{6}$ A1

**(c)** $t^{-5}$ or $\frac{1}{t^5}$ A1

---

21.

| | | | |
|---|---|---|---|
| $15x + 6y = 57$ | **or** | $20x + 8y = 76$ | M1 |
| $8x - 6y = 58$ | | $20x - 15y = 145$ | M1 |
| $23x = 115 \Rightarrow x = 5$ | | $23y = -69 \Rightarrow y = -3$ | A1 |
| $25 + 2y = 19$ | | $5x - 6 = 19$ | |
| $y = -3$ | | $x = 5$ | A1 |

---

22.

$x - 5y = 15$
$3x + 8y = -1$ MA1

$3x - 15y = 45$
$3x + 8y = -1$ MA1

$-23y = 46$
$y = -2$ A1

$x = 5$ A1

---

23.

| | | | |
|---|---|---|---|
| $5b + 2w = 21.6$ | | | |
| $3b + 5w = 23.6$ | | | MA1 |
| $25b + 10w = 108$ | or | $15b + 25w = 118$ | MA1 |
| $6b + 10w = 47.2$ | | $15b + 6w = 64.8$ | MA1 |
| $19b = 60.8$ | | $19w = 53.2$ | |
| $b = 3.2$ | | $w = 2.8$ | A1 |
| $16 + 2w = 21.6$ | | $5b + 5.6 = 21.6$ | |
| $w = 2.8$ | | $b = 3.2$ | A1 |

---

24.

$x$ 20p coins and $y$ 50p coins

$x + y = 60$ MA1

$20x + 50y = 2280$ MA1

$2x + 5y = 228$

$2x + 2y = 120$ or $5x + 5y = 300$ M1

$3y = 108$ or $3x = 72$

$y = 36$ or $x = 24$ A1

$x = 24$ or $y = 36$ A1

(24 are 20p and 36 are 50p)

---

25. $20x + 12y = 322$ (Follow through all parts for numerical errors)

$16x + 10y = 262$ (both equations correct) MA1

$100x + 60y = 1610$ (1st equation × 5) MA1

$96x + 60y = 1572$ (2nd equation × 6) MA1

$4x = 38,\ x = 9.50$ (solving for $x$) MA1

$190 + 12y = 322 \quad y = 11$ (substituting for $y$) MA1

**alternative** (after 2 correct equations)

$80x + 48y = 1288$ (1st equation × 4) MA1

$80x + 50y = 1310$ (2nd equation × 5) MA1

$2y = 22, y = 11$ (solving for $y$) MA1

$20x + 132 = 322 \quad x = 9.50$ (substituting for $x$) MA1
Correct answers with no simultaneous equations – no marks awarded

---

26. **(a)** $5n - 2$ A1 A1

**(b)** 15th A1

---

27.

**(a)** $P = \frac{k}{Q^2}$

$6 = \frac{k}{3^2}$ MA1

$k = 54$

$P = \frac{54}{Q^2}$ MA1

**(b)** **(i)** 3.375 MA1

**(ii)** $24Q^2 = 54$ MA1

$Q = 1.5$ A1

---

28.

$F = \frac{k}{d^2}$ M1

$12.5 = \frac{k}{16}$ MA1

$k = 200$ A1

$F = \frac{200}{d^2} \Rightarrow 3.125 = \frac{200}{d^2}$ M1

$d^2 = 64 \Rightarrow d = 8$ A1

---

29.

**(a)** As d increases W decreases so $W = kd^2$ is not possible A1

**(b)** Show $W = \frac{k}{d}$ wrong MA1

Show $W = \frac{k}{d^2}$ correct MA1

$k = 144$ MA1

**(c)** **(i)** $w = 1$ A1

**(ii)** $d = 60$ A1

---

30.

| | |
|---|---|
| $x^2 + (x + 3)^2 = 14$ | MA1 |
| $2x^2 + 6x - 5 = 0$ | MA1 |
| $x = \frac{-6 \pm \sqrt{36 + 40}}{4}$ | M1 |
| $x = 0.68$ or $x = -3.68$ | A1 A1 |
| $y = 3.68$ or $y = -0.68$ | A1 A1 |

31.

| | |
|---|---|
| $3x^2 + 2(3x - 1)^2 = 35$ | MA1 |
| $3x^2 + 2(9x^2 - 6x + 1) = 35$ | MA1 |
| $21x^2 - 12x - 33 = 0$ or $7x^2 - 4x - 11 = 0$ | A1 |
| $3(7x - 11)(x + 1) = 0$ or $(7x - 11)(x + 1) = 0$ | MA2 |
| $x = \frac{11}{7}$ or $-1$ | MA1 |
| $y = \frac{26}{7}$ or $-4$ | MA1 |

32.

| | |
|---|---|
| $(x - 3)^2 = 6x - 23$ | MA1 |
| $x^2 - 6x + 9 = 6x - 23$ | |
| $x^2 - 12x + 32 = 0$ | MA1 |
| $(x - 4)(x - 8) = 0$ | MA1 |
| $x = 4, x = 8$ | A1 |
| $y = 1, y = 5$ | A1 |

33.

Let $x$ = price of a toy, Let $y$ = number of toys bought

$xy = 60$ $\qquad (x + 1)(y - 16) = 60$ C1

$xy + y - 16x - 16 = xy$

$y = 16x + 16$ C1

$x(16x + 16) = 60$ C1

$16x^2 + 16x - 60 = 0$

$4x^2 + 4x - 15 = 0$ C1

$(2x + 5)(2x - 3) = 0$ C1

$x = -\frac{5}{2}$ or $\frac{3}{2}$ C1

Therefore answer = £1.50 C1

**Alternative**

$\frac{60}{t} = \frac{60}{t+1} + 16$ $\qquad t$ = cost of toy C2

$60(t + 1) = 60t + 16t(t + 1)$ C1

$60t + 60 = 60t + 16t^2 + 16t$

$4t^2 + 4t - 15 = 0$ C1

$(2t + 5)(2t - 3) = 0$ C1

$t = \frac{-5}{2}$ $\qquad t = \frac{3}{2}$ C1

Answer £1.50 C1