# 30-4-10 Algebra

**Days:** 1 and 2 **Topic:** Manipulate simple algebraic expressions.

You need to be able to:

- Use index notation and simple instances of index laws.
- Collect like terms
- Multiply a single term over a bracket
- Take out common factors

* For grade C GCSE, you also need to be able to multiply two brackets and factorise more complicated expressions but examples of these are not included in this unit of work.

You will need to think about:

**Understanding index notation and index laws**

$y^3$ means y x y x y

$a^3 \times a^2 = a \times a \times a \times a \times a = a^5$ Add the powers 3 + 2 = 5

$a^4 \div a^2 = \frac{a^4}{a^2} = \frac{\cancel{a} \times \cancel{a} \times a \times a}{\cancel{a} \times \cancel{a}} = a^2$ Subtract the powers 4-2 = 2

$y^3 \div y^4 = \frac{y^3}{y^4} = \frac{\cancel{y} \times \cancel{y} \times \cancel{y}}{\cancel{y} \times \cancel{y} \times \cancel{y} \times y} = \frac{1}{y^1} = y^{-1}$ Subtract the powers 3- 4 = -1

$(y^3)^2 = (y \times y \times y)^2 = y \times y \times y \times y \times y \times y = y^6$

$y^0 = 1$ Anything to the power 0 = 1

**Recognising and collecting like terms:**

3x + 5 + 2y + 1 + 2x = 5x +2y +6

x + 7 - 2x - 4 = 3 – x

**Multiplying out (or expanding) brackets**:

$3(2y + 5) = 6y + 15$

$y(2y + 3) = 2y^2 + 3y$

**Taking out common factors:**

$10y - 25 = 5\,(2y - 5)$

5 divides exactly into 10 and 25, so you can take 5 outside the bracket

$x^2 + 4x = x\,(x + 4)$

x divides exactly into $x^2$ and 4x, so you can take x outside the bracket

## Quick Questions

1. Simplify

   (a) $y \times y \times y \times y \times y$ (b) $a^0$ (c) $(n^4)^2$

2. Simplify $x^4 \times x^3$

3. Simplify

   (a) $y^5 \div y^2$ (b) $y^2 \div y^5$

4. Simplify

   (a) $3x + 2x + 7 - 4x - 3$

   (b) $2y - 6 + 5y - 1 + y$

   (c) $2x + 4y - 2y + x - 3$

5. Multiply out the brackets

   (a) $3\,(2x + 5)$ (b) $x\,(x - 5)$

6. Factorise

   (a) $20y + 5$ (b) $18x - 12$ (c) $x^2 - 4x$

## Past Paper Questions

**1.** Simplify

(a) $p \times p \times p \times p$

.....

.....

**(1)**

(b) $2a \times 3b \times 4c$

.....

.....

**(1)**

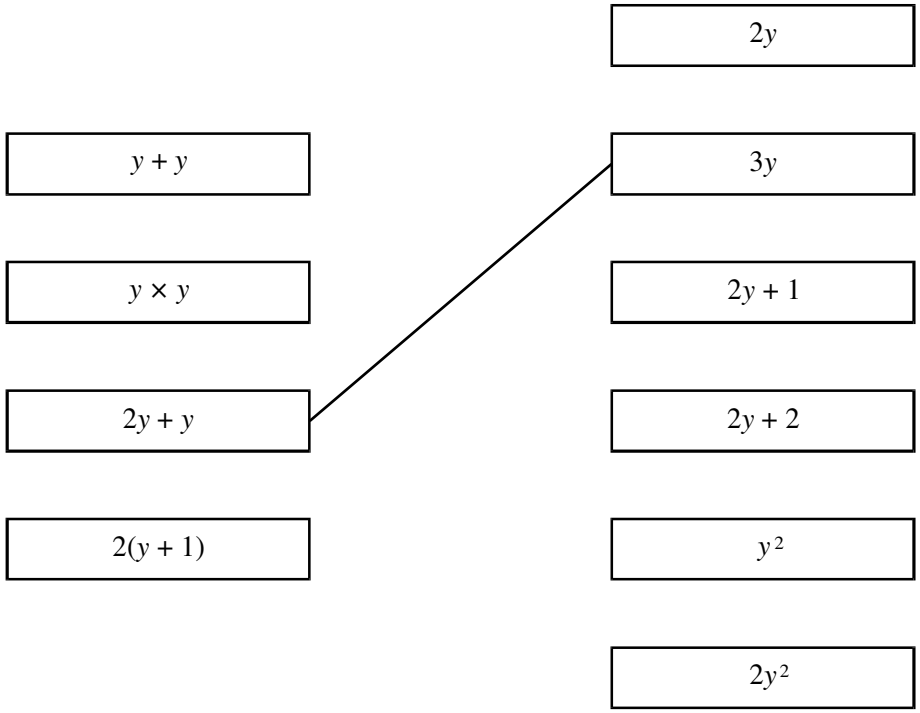
(c) $x^3 \div x^3$

.....

.....

**(1)**

**2.** (a) Draw lines on the diagram below to show which algebraic expressions are equivalent.
One line has been drawn for you.




**(3)**

**3.** (a) Simplify $2x + 3y + 5x - 2y - 4x$

.....

.....

.....

Answer .....

**(2)**

(b) Multiply out

(i) $4(m - 1)$

.....

.....

Answer .....

**(1)**

(ii) $p(p + 3)$

.....

.....

Answer .....

**(1)**

**4.** (a) Factorise $10a + 5$

.....

Answer .....

**(1)**

(b) Factorise $c^2 - 4c$

.....

Answer .....

**(2)**

**5.** (a) Expand $3(y - 4)$

.....

Answer .....

**(1)**

(b) Simplify the expression

$$2c + 6d + 4c - 8c$$

.....

.....

Answer .....

**(2)**

(c) Factorise $x^2 + 5x$

.....

.....

Answer .....

**(2)**

**6.** (a) Simplify

(i) $2a^3 \times 3a^2$,

.....

.....

Answer .....

**(1)**

(ii) $4a^6 \div 2a^3$.

.....

.....

Answer .....

**(1)**

(b) Factorise $2x^2 + 4x$.

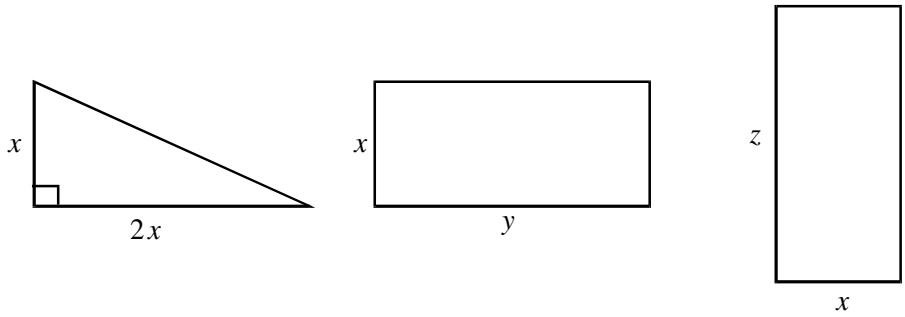
.....

.....

Answer .....

**(2)**

**7.**




(i) Write down and simplify an expression, in terms of $x$, for the area of the triangle.

.....

.....

.....

**(2)**

(ii) Write down an expression, in terms of $x$, $y$ and $z$, for the **total** area of the triangle and the two rectangles.

.....

.....

.....

**(1)**

(b) Factorise your answer to part (a)(ii).

.....

.....

.....

**(2)**

**30-4-10 Algebra Answers**

**Day:** 1 & 2 **Topic:** Manipulate simple algebraic expressions

**Quick Questions:**

1) (a) $y^4$ (b) 1 (anything to the power 0 = 1) (c) $n^8$
2) $x^7$
3) (a) $y^3$ (b) $y^{-3}$
4) (a) x + 4 (b) 8y – 7 (c) 3x +2y – 3
5) (a) 6x + 15 (b) $x^2$ - 5x
6) (a) 5(4y + 1) (b) 6(3x – 2) (c) x(x – 4)

**Past Paper Questions:**

1) (a) $p^4$ (b) 24abc (c) $x^0 = 1$

2) Join
y + y to 2y y x y to $y^2$ 2(y+1) to 2y + 2

3) (a) 3x + y (b) (i) 4m - 4 (ii) $p^2 + 3p$

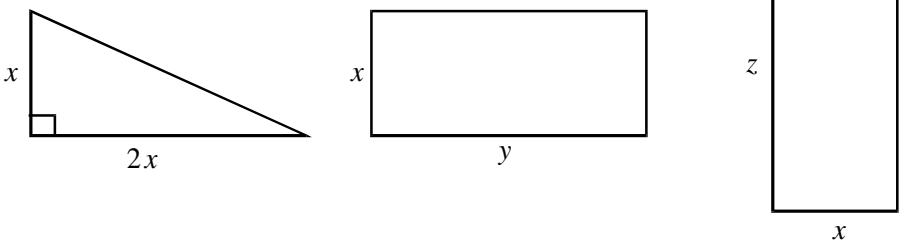
4) (a) 5(2a + 1) (b) c(c – 4)

5) (a) 3y – 12 (b) 6d – 2c (c) x(x + 5)

6) (a) (i) $6a^5$ (ii) $2a^3$ (b) 2x(x + 2)

7)
(a) (i) Area of triangle = ½ x base x height = ½ **x** 2*x* **x** *x* = ½ **x** $2x^2$ = $x^2$

(a) (ii)




Area = $x^2$ Area = *xy* Area = *xz*

Total Area = $x^2$ + xy + xz

(b) Area = x ( x + y + z)

# 30-4-10 Algebra

**Days:** 3 and 4 **Topic:** Substituting numbers in to expressions and formulae

You need to be able to:

- Use formulae from mathematics and other subjects
- Substitute numbers into expressions and formulae

*The numbers you substitute may include fractions, decimals and negative numbers*

You will need to think about:

**The order of operations**
Remember:
**B**rackets first, then **I**ndices, then **M**ultiply or **D**ivide, then **A**dd or **S**ubtract (**BIDMAS**)

**Calculating with negative numbers**
-3 + 7 = 4
3 x (-6) = -18
-2 x -5 = 10
$(-4)^2 = 16$
-10 ÷ -2 = 5
-16 ÷ 4 = -4

Use a number line

**Understanding algebraic expressions**
5ab means 5 x a x b
$2y^2$ means 2 x y x y
$\frac{c}{4}$ means c ÷ 4

**Quick Questions**

**1.** a) $-11 + 5 =$ b) $(-8)^2 =$ c) $6 \times (-5) =$

d) $-12 \div -3 =$ e) $-7 - (-5) =$

**2.** Find the value of these expressions when $p = 3$, $q = 5$ and $r = -4$

a) $6q$ b) $qr$ c) $5p - q$

d) $4(q + r)$ e) $3r^2$ f) $2p + q^2$

**3.** Find the value of these expressions when $a = \frac{1}{2}$ and $b = \frac{3}{4}$

a) $4a + b$ b) $\frac{8a}{4}$ c) $12a^2$ d) $5(2b + 7)$

**4.** $c = 2d + e^2$

Work out the value of c when

a) $d = 6.5$ and $e = 5$

b) $d = 3.2$ and $e = 2.5$

## Past Paper Questions

**1.** A formula is given as $V = 4h + p^2$

Find the value of $V$ when $h = 0.5$ and $p = 8$

……

……

……

**(2)**

**2.** Using the formula

$$v = 3u + 5t$$

calculate the value of $v$ when $u = 5.1$ and $t = 27.3$

.....

.....

.....

**(2)**

**3.** The area, $A$, of a cyclic quadrilateral is given by the formula

$A = \sqrt{(S-a)(S-b)(S-c)(S-d)}$,

where $a$, $b$, $c$ and $d$ are the lengths of the sides of the cyclic quadrilateral and $S = \frac{a+b+c+d}{2}$.

When $a = 44$ cm, $b = 15$ cm, $c = 27$ cm and $d = 30$ cm, calculate

(a) the value of $S$,

.....

.....

.....

**(2)**

(b) the value of $A$.

.....

.....

..... (3)

**4.** An approximate rule for converting degrees Fahrenheit into degrees Centigrade is

$$C = \frac{F - 30}{2}$$

Use this rule to convert 22°F into °C.

.....

.....

.....

Answer ..... degrees Centigrade

**(2)**

**5.** (a) Find the value of $a^3$ when $a = 4$

.....

**(1)**

(b) Find the value of $5x + 3y$ when $x = -2$ and $y = 4$

.....

.....

**(2)**

**6.** You are given that $m = \frac{3}{4}$, $p = \frac{1}{2}$ and $t = 2$

Find the value of

(a) $mp + t$

.....

.....

Answer .....

**(2)**

(b) $\frac{m + p}{t}$

.....

.....

Answer .....

**(2)**

**7.** Here are four expressions.

| | | | |
|---|---|---|---|
| $n^2$ | $\frac{n}{3}$ | $n + 3$ | $\frac{3}{n}$ |

(a) If $n = 3$, which expression has the greatest value? Show your working.

.....

.....

.....

.....

Answer .....

**(2)**

(b) If $n = 0.3$, which expression has the greatest value?
Show your working.

.....

.....

.....

.....

Answer .....

**(2)**

**8.** (a) Find the value of $5p + 2q$ when $p = 4$ and $q = -7$

.....

.....

Answer .....

**(2)**

(b) Find the value of $u^2 - v^2$ when $u = 5$ and $v = 3$

.....

.....

Answer ..... **(2)**

**30-4-10 Algebra Answers**

**Day:** 3 & 4 **Topic:** Substituting numbers in to expressions and formulae

**Quick Questions**

**1.** a) -6
b) 64
c) -30
d) 4
e) -7 - (-5) = -7 + 5 = -2

**2.** a) 6 x 5 = 30

b) 5 x (-4) = -20

c) 5 x 3 – 5 = 15 – 5
= 10

d) 4 ( 5 + -4) = 4 x 1
= 4

e) 3 x $(-4)^2$ = 3 x 16
= 48

f) 2 x 3 + $5^2$ = 6 + 25
= 31

**3.** a) 4 x ½ + ¾ = 2 + ¾
= 2¾

b) 8 x ½ ÷ 4 = 4 ÷ 4
= 1

c) 12 x $(½)^2$ = 12 x ¼
= 3

d) 5 ( 2 x ¾ + 7) = 5 (1½ + 7)
= 5 x 8½
= 42½

**4.** a) c = 2 x 6.5 + $5^2$
c = 13 + 25
c = 38

b) c = 2 x 3.2 + $2.5^2$
c = 6.4 + 6.25
c = 12.65

## Past Paper Questions

**1.** $4 \times 0.5 + 8 \times 8$
$= 66$

**2.** $3 \times 5.1 + 5 \times 27.3$

$= 151.8$

**3.** (a) $S = \frac{44 + 15 + 27 + 30}{2}$ or $\frac{116}{2}$

$= 58$

(b) $\sqrt{(58 - 44)(58 - 15)(58 - 27)(58 - 30)}$

$14 \times 43 \times 31 \times 28 = 522536$

$\sqrt{522536} = 722.9$

**4.** $C = \frac{22 - 30}{2}$

$= -4$

**5.** (a) 64

(b) $-10 + 12 = 2$

**6.** (a) $¾ \times ½ + 2$

$= 2\frac{3}{8}$

*Accept 0.75 × 0.5 + 2*
*2.375 or 19/8*

(b) $(¾ + ½) \div 2 = 5/8$

*or (0.75 + 0.5) ÷ 2 = 0.625*

**7.** (a) $n^2$

$n^2 = 9$, $\frac{n}{3} = 1$, $n + 3 = 6$, $\frac{3}{n} = 1$

(b) $\frac{3}{n}$

$n^2 = 0.09$, $\frac{n}{3} = 0.1$,

$n + 3 = 3.3$, $\frac{3}{n} = 10$

**8.** (a) $(5 \times 4) + (2 \times -7) = 20 + -14$

$= 6$

(b) $25 - 9$

$= 16$

# 30-4-10 Algebra

**Days:** 5 and 6 **Topic:** Solving a range of equations.

You need to be able to:

- Solve simple equations
- Manipulate simple equations and expressions
- Form and solve linear equations

Work on simultaneous equations, quadratic equations and inequalities is not included in this unit of work, but may be needed depending on the examination you are entered for.

You will need to think about:

**Strategies you have used to solve equations**

- **inverse operations** — *I undo the operations*

$2x + 7 = 13$. $x \rightarrow \times 2 \rightarrow +7 = 13$

inverse $13 \rightarrow -7\ (=6) \rightarrow \div 2 = 3$

$x = 3$ Now check your answer $2 \times 3 + 7 = 13$ ✓

- **balancing** — *Have I done the same to both sides?*

$5p - 4 = 26$

$+4 \quad +4$

$5p = 30$

$\div 5 \quad \div 5$

$p = 6$

$5t - 4 = 2t + 8$ — *Subtract 2t*

$3t - 4 = 8$ — *Add 4*

$3t = 12$ — *Divide by 3*

$t = 4$ And check answer

**Expanding any brackets**

$3(2a - 5) = 12$

$6a - 15 = 12$

$6a = 27$

$a = 4\frac{1}{2}$

or

$3(2a - 5) = 12$

$2a - 5 = 4$

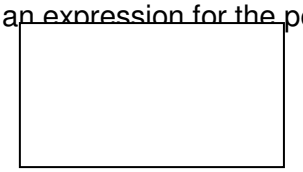
$2a = 9$

$a = 4\frac{1}{2}$

**Constructing and solving equations from word problems**

A rectangle has a length of p centimetres and its width is 7 centimetres less than its length.

Write an expression for the perimeter of the rectangle.



p – 7

*Draw a diagram to help*

p

perimeter is p + p + p – 7 + p – 7

*Simplify expression*

perimeter is 4p – 14 centimetres

## Quick Questions

Solve these equations:

1. 3x = 6
2. 5x = - 30
3. 8x = 37
4. 2x – 3 = 7
5. x / 3 = 4
6. 12 / x = 3
7. 2x / 3 = 6
8. 4(x + 3) = 32
9. 3(x + 2) = 14
10. 12 – 3x = 2x – 8
11. 14 + 7x = 6 + 5x
12. 4(x – 5) = 2(x + 8)

## Past Paper Questions

**1.** Solve the equations

(a) $3x + 2 = 16$,

.....

.....

**(2)**

(b) $5(2x - 1) = 35$,

.....

.....

**(2)**

(c) $4x + 3 = 18 - 2x$.

.....

.....

**(2)**

**2.** (a) Solve $2(3x + 1) + 4(x - 1) = 3$.

.....

.....

**(3)**

(b) A teacher wrote two numbers on the board.
She asked James to multiply them together.
She asked Elizabeth to add them together.
Elizabeth and James found that their answers were the same.
One of the numbers written on the board was 4.
Use $x$ to represent the other number on the board.

(i) Write down an equation in $x$ which shows that Elizabeth's and James' results were equal.

.....

.....

(ii) Solve your equation to find the other number written on the board.

.....

.....

**(3)**

**3.** John had maths tests on Monday, Tuesday and Wednesday.

On Monday he scored $x$ marks.
On Tuesday he scored twice as many marks as he did on Monday.
On Wednesday he scored 17 more marks than he did on Monday.

(a) Write down, in terms of $x$, the number of marks he scored

(i) on Tuesday,

.....

**(1)**

(ii) on Wednesday,

.....

**(1)**

(b) Altogether in these three tests John scored 93 marks.

(i) Use this information to write down an equation in $x$.

.....

.....

**(2)**

(ii) Solve your equation to find the number of marks John scored on Monday.

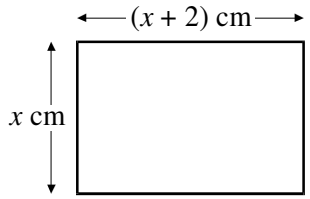
.....

.....

.....

**(3)**

**4.** The diagram shows the dimensions of a rectangle.



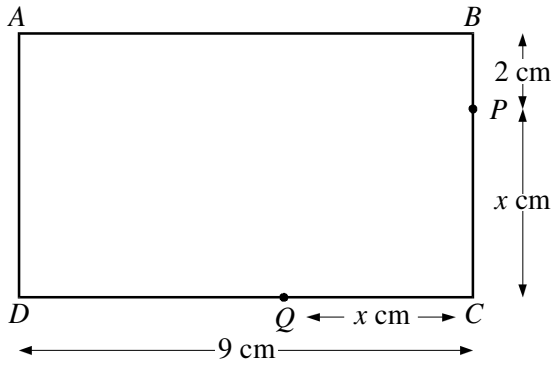

The perimeter of the rectangle is 18 cm.

Find the value of $x$.

……..

…….. **(3)**

**5.** *ABCD* is a rectangle.




Not drawn to scale

(a) Write down the expression, in terms of *x*, for

(i) the length of *BC*,

.....

**(1)**

(ii) the length of *DQ*.

.....

**(1)**

(b) (i) Given that *BC* = *DQ*, use your answers to (a) to write down an equation in terms of *x*.

.....

**(1)**

(ii) Solve your equation to find the value of *x*.

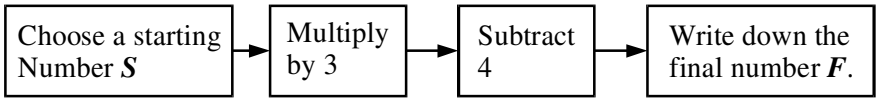
.....

.....

.....

**(2)**

**6.** Here is a rule for working out a sequence of numbers




Write down an **equation** connecting the final number, ***F*** and the starting number ***S***.

……

…… **(2)**

**30-4-10 Algebra Answers**

**Day:** 5 and 6 **Topic:** Recognise, continue and describe sequences

**Quick Questions**

1. x = 2

2. x = -6

3. x = 4 5/8 (4.625)

4. 2x = 10

   x = 5

5. x = 12

6. 12 / x = 3

   12 = 3x

   4 = x or x = 4

7. 2x = 18

   x = 9

8. x + 3 = 8

   x = 5

9. 3(x + 2) = 14

   3x + 6 = 14

   3x = 8

   x = 2 2/3 (2.666..)

10. 12 – 3x = 2x – 8

    20 = 5x

    4 = x or x = 4

11. 14 + 7x = 6 + 5x

    2x = -8

    x = -4

12. 4(x – 5) = 2(x + 8)

    4x - 20 = 2x + 16

    2x = 36

    x = 18

**Past Paper Questions**

**1.** (a) 3x = 14

x = $4^{2}/_{3}$

or 4.66666 .. or 4.67 to 2dp

(b) 2x – 1 = 7

x = 4

(c) 6x = 15

x = 2.5

**2.** (a) $6x + 2 + 4x - 4 = 3$

$10x - 2 = 3$

$10x = 5$

$x = 5/10$ or $1/2$

(b) (i) $4 + x$ and $4x$

$4 + x = 4x$

(ii) $x = 4/3$ (1.33333)

**3.** (a) (i) $2x$

(ii) $x + 17$

(b) (i) $x + 2x + x + 17 = 93$

(ii) $4x + 17 = 93$

$4x = 76$

$x = 76/4$

$x = 19$

**4.** $x + (x + 2) + x + (x + 2) = 18$ or $x + (x + 2) = 9$

$4x = 18 - 4$ or $2x = 9 - 2$

$4x = 14$ $2x = 7$

$x = 3.5$

**5.** (a) (i) $x + 2$

or $2 + x$

(ii) $9 - x$

(b) (i) $x + 2 = 9 - x$

(ii) $2x = 7$

$x = 3.5$ or $7/2$

**6.** $F = 3S - 4$

# 30-4-10 Algebra

**Days:** 7 and 8 **Topic:** Recognise, continue and describe sequences

You need to be able to:

- spot the pattern in a sequence of numbers and use it to continue the sequence
- describe the rule for finding the next term or the nth term
- describe how to find the nth term using symbols

You will need to think about:

**The term's position as well as the term's value**

e.g. 3, 7, 11, 15, 19, …. The *fourth* term has a value of 15

It may help to record it as follows:

| 1 | 2 | 3 | 4 | 5 | nth |
|---|---|---|---|---|---|
| **3** | **7** | **11** | **15** | **19** | **4n-1** |

*Adding 4 each time means 4n must be part of rule*

or

| term | value |
|---|---|
| 1 | **3** |
| 2 | **7** |
| 3 | **11** |
| 4 | **15** |
| 5 | **19** |
| n | **4n-1** |

*For first term n is 1, so 4n is 4 (not 3); So include -1 to the rule Test with, say, n is 5*

**Remember:**

nth term means the general term, so to find a fourth term substitute n = 4 into the sequence's rule

**Quick Questions**

**1.** Here is a sequence of numbers.

3 5 9 17

The rule for continuing this sequence is

| Multiply by 2 and subtract 1 |
|---|

The same rule is used for a sequence that starts with the number –5.

What are the next **three** numbers in this sequence?

**2.** What is the next number in each of these sequences?

(a) 3, 6, 9, 12 .....

(b) 1, 4, 7, 10 .....

(c) 1, 4, 9, 16 .....

(d) 4, 16, 36, 64 .....

(e) 3, 6, 11, 18, 27 .....

**3.** What is the nth term of each of above sequences?

**4.** The nth term of a sequence is given as $5n - 2$

What is the value of the 3rd term? .....

What is the value of the 6th term?.....

## Past Paper Questions

**1.** (i) A sequence begins

–2, –1, 0, 1, 2, .....

Write an expression in terms of $n$ for the $n$th term of the sequence.

.....

.....

.....

Answer .....

**(2)**

(ii) The $n$th term of a different sequence is $3n + 1$.

What is the difference between the 1st term and the 2nd term of the sequence?

.....

.....

.....

Answer .....

**(1)**

**2.** (a) Fill in the **two** missing numbers in this sequence.

31, 29, 25, 19, ....., 1, ……

Answer .....

**(2)**

(b) A sequence begins

–2, 1, 6, 13, 22, .....

Write, in terms of $n$, the $n$th term of the sequence.

.....

.....

Answer ..... (2)

**3.** The rule for a sequence is

| Next number = Multiply the previous number by 3 then subtract 3 |
|---|

A sequence starts with –6.

What are the next two numbers in this sequence?

.....

Answer ..... and .....

**(2)**

**4.** A pattern using pentagons is made of sticks.

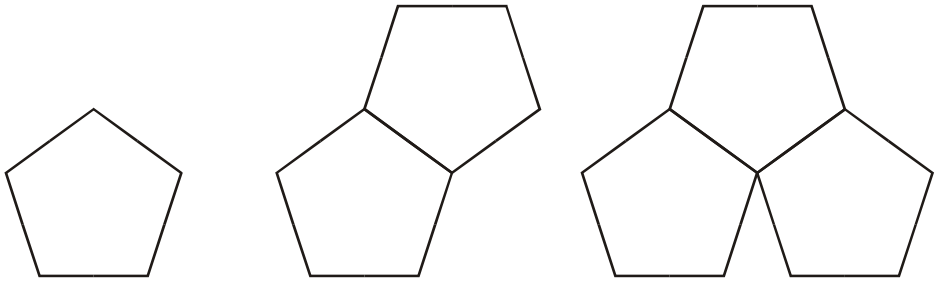


Diagram 1 — 5 sticks

Diagram 2 — 9 sticks

Diagram 3 — 13 sticks

(a) How many sticks are needed for Diagram 5?

.....

.....

Answer .....

**(2)**

(b) Write down an expression for the number of sticks in Diagram *n*.

.....

.....

Answer .....

**(2)**

(c) Which Diagram uses 201 sticks?

.....

Answer ..... **(3)**

**5.** (a) $p$ is an odd number.

Is $2p + 1$ an odd number, an even number or could it be either?
Tick the correct box.

| odd | even | either |
|---|---|---|
| ☐ | ☐ | ☐ |

**(1)**

(b) The $n$th term of a sequence is $4n - 1$

(i) Write down the first **three** terms of the sequence.

.....

.....

Answer .....

**(2)**

(ii) Is 122 a term in this sequence?
You **must** explain your answer.

.....

.....

**(1)**

(c) Tom builds fencing from pieces of wood as shown below.

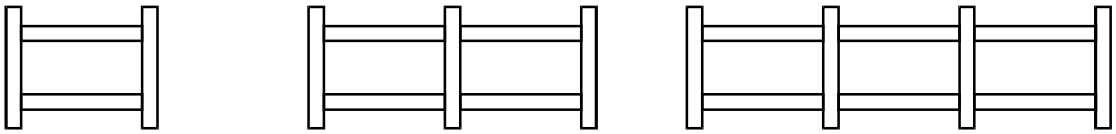


Diagram 1
4 pieces of wood

Diagram 2
7 pieces of wood

Diagram 3
10 pieces of wood

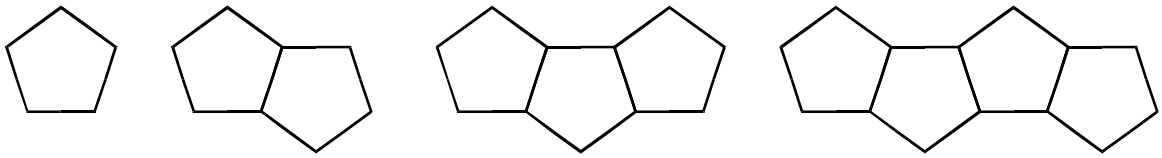
How many of pieces of wood will be in Diagram $n$?

. .....

.....

Answer .....(2)

**6.** Regular pentagons are used to form patterns, as shown.



Pattern 1
5 sides

Pattern 2
8 sides

Pattern 3
11 sides

Pattern 4
14 sides

Write, in terms of *n*, the number of sides in Pattern *n*.

.....

.....

.....

Answer .....

**(2)**

**7.** (a) Write down the first **three** terms of the sequence whose nth term is given by 5n - 1.

.....

.....

Answer.....

**(2)**

(b) The letters p and q represent integers.
*p* is an odd number and q is an even number.

(i) Which of these statements describes the number $2p + q$?

| always even | always odd | could be odd or even |
|---|---|---|

Explain your answer.

.....

.....

**(2)**

(ii) Anna says that $p + \frac{1}{2}q$ is always even.
Give an example to show that Anna is wrong.

.....**(1)**

**8.** (a) The first four terms of a sequence are

5, 8, 11, 14, . . .

Write down

(i) the eighth term in this sequence,

.....

**(1)**

(ii) The *n*th term of this sequence.

.....

.....

**(2)**

(b) The *n* th term of another sequence is given by $7n + 11$.

What is the least value of *n* which will give a term greater than 1000?

.....

.....

.....

.....

**(3)**

**9.** Write down the *n*th terms of the following sequences:

(i) 2, 4, 6, 8, 10, …

.....

(ii) 3, 5, 7, 9, 11 ...

.....

(iii) 1, 8, 27, 64, …

.....

(iv) $\frac{1}{2}, \frac{8}{3}, \frac{27}{4}, \frac{64}{5}, \ldots$

..... **(5)**

**30-4-10 Algebra Answers**

**Day:** 7 & 8 **Topic:** Recognise, continue and describe sequences

**Quick Questions**

**1.** -11, -23, -47

**2.** a) 15 b) 13 c) 25 d) 100 e) 38

**3.** a) 3n b) 3n - 2 c) $n^2$ d) $(2n)^2$ or $4n^2$

e) $n^2 + 2$

**4.** 13, 28

**Past Paper Questions**

**1.** (i)

| 1 | 2 | 3 | 4 | 5 | nth |
|---|---|---|---|---|---|
| **-2** | **-1** | **0** | **1** | **2** | **n-3** |

(ii) nth term = 3n + 1

1st term = 4, 2nd term = 7

7-4 = 3

**2.** (a) 11 -11

(b)

| 1 | 2 | 3 | 4 | 5 | nth |
|---|---|---|---|---|---|
| **-2** | **1** | **6** | **13** | **22** | **$n^2$-3** |

**3.** -21 -66

**4.** (a) 21

(b) $4n + 1$

( c) $4n + 1 = 201$

$n = 50$

**5.** (a) odd

(b) (i) 3, 7, 11

(ii) no, every term must be an odd number, and 122 is even

(c) $3n + 1$

**6.** $3n + 2$

**7.** (a) 4, 9, 14

(b) (i) always even

(ii) any example e.g. p = 5 and q = 8, producing an odd number

**8.** (a) (i) 26, (ii) $3n+2$

(b) $7n + 11 > 1000$

$7n > 989$

$n > 141.29$

So the least value of n is 142

**9**. (i) $2n$ (ii) $2n + 1$ (iii) $n^3$ (iv) $n^3 / n+1$

Enabling world-class education

# 30-4-10 Algebra

**Days:** 9 and 10 **Topic:** Straight Line Graphs

You need to be able to:

- Generate points and plot graphs of linear functions
- Given values of m and c find the gradient of lines for equations of the form y=mx+c
- Interpret graphs arising from real situations

You will need to think about:

**Straight line graphs you should know**
y = x a diagonal line passing through (1,1) (2,2) (3,3) etc
horizontal lines eg y = 1, y = -2, y = 6
vertical lines eg x = 3, x = 5, x = -4

**Constructing a table of values**
Use the equation of the graph to work out values for y for suitable values of x.
You need at least 3 points to be able to plot a straight line.
Be careful with signs and calculating with negative numbers.

**Plotting coordinates accurately**
Look carefully at the scales used on axes that are drawn. What does each small square represent?
Use a pencil and ruler. Label the line with its equation.

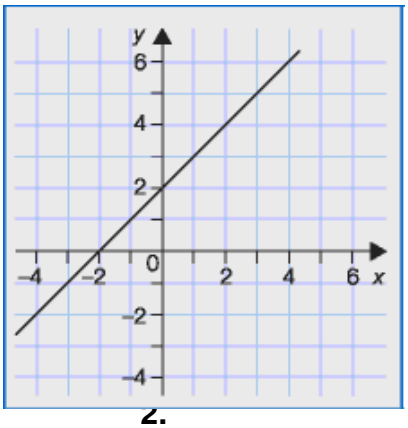
**The general equation of a straight line y=mx+c**
Where m = the gradient of the line
And c = the point where the line crosses the y axis (the intercept)
Parallel lines have the same gradient
Lines that slope up from left to right have positive gradients
Lines that slope down from left to right have negative gradients

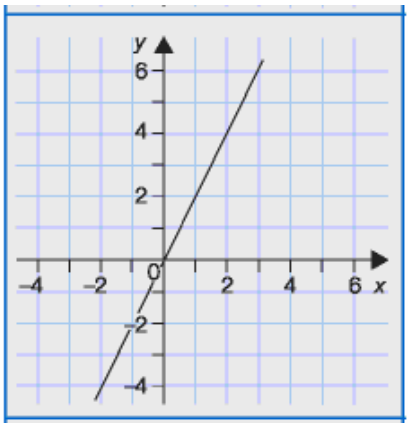
**Interpreting information from a graph**
Reading coordinates of points that lie on the line
Calculating the gradient = $\frac{\text{difference in y}}{\text{difference in x}}$

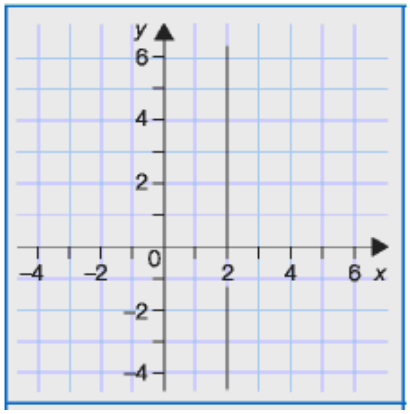
**Quick Questions**

1. Match each graph with its equation. You may find it helpful to read off some coordinates from each graph and record them in a table eg

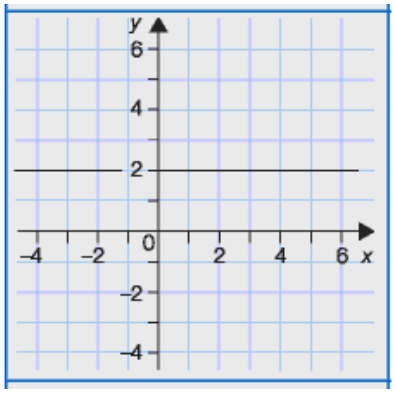
| X | -2 | -1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| y | -1 | -½ | 0 | ½ | 1 | 1½ |

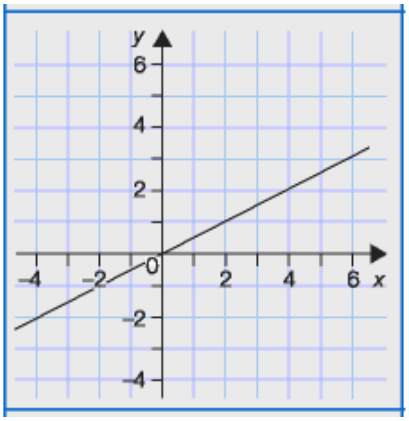


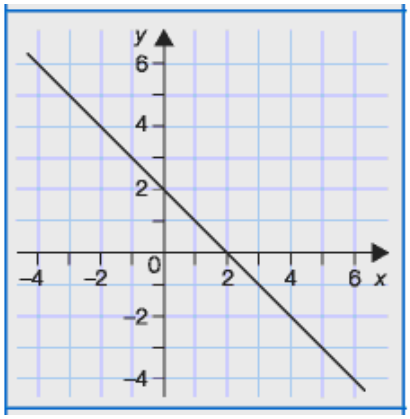




2.




**X = 2** **y = ½x** **y = 2x** **Y = 2**

**y = x + 2** **x + y = 2**

**2.** a) Complete this table of values for the equation y = 2x + 3

| x | -1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| y | | | 5 | | |

b) Draw the graph of y = 2x + 3 for x = -1 to 3

**3.** By completing your own table of values
draw the graph of y = 3x + 2 for x = -3 to 2

**4.** Write down the gradient and intercept for each line given below

a) y = 5x – 3
b) y = -4x + 6
c) y = 8 – 2x

(note question 1 was taken from DfES SNS Subject Leader Materials 2005)

## Past Paper Questions

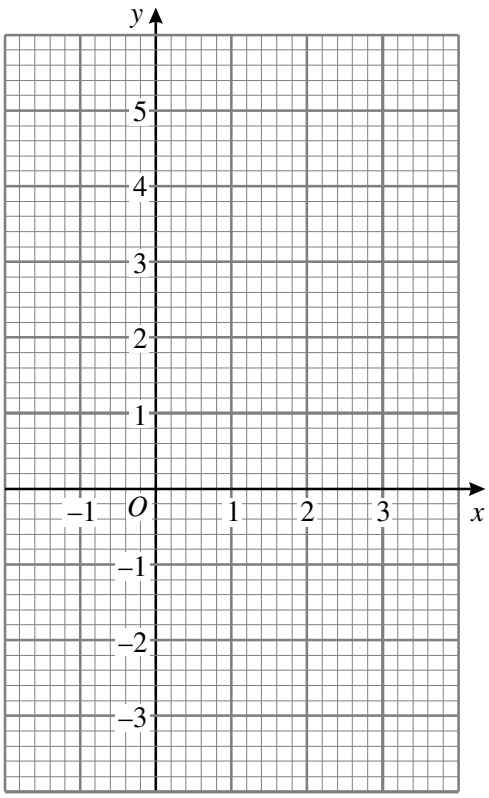
**1.** (a) Complete this table of values for $y = 2x - 1$

| $x$ | – 1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| $y$ | – 3 | | 1 | | 5 |

.....

**(1)**

(b) On the grid draw the graph of $y = 2x - 1$ for values of $x$ from –1 to +3.




**(2)**

(c) Find the coordinates of the point where the line $y = 2x - 1$ crosses the line $y = -2$.

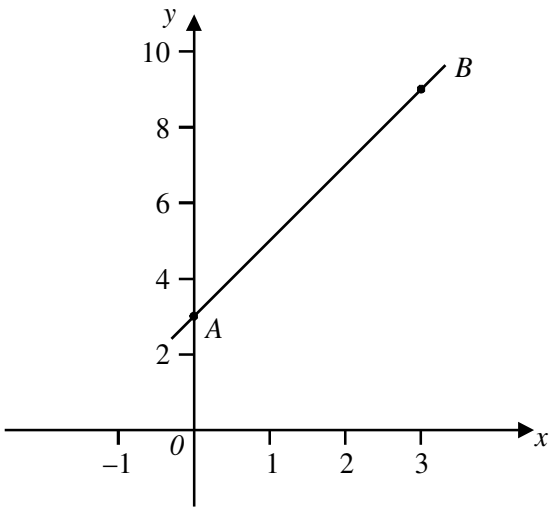
.....

.....

Answer (....., .....)

**(2)**

**2.** A is the point (0,3) and B is the point (3,9)




(a) Calculate the gradient of the line $AB$.

.....

.....

.....

**(2)**

(b) Write down the equation of the line $AB$.

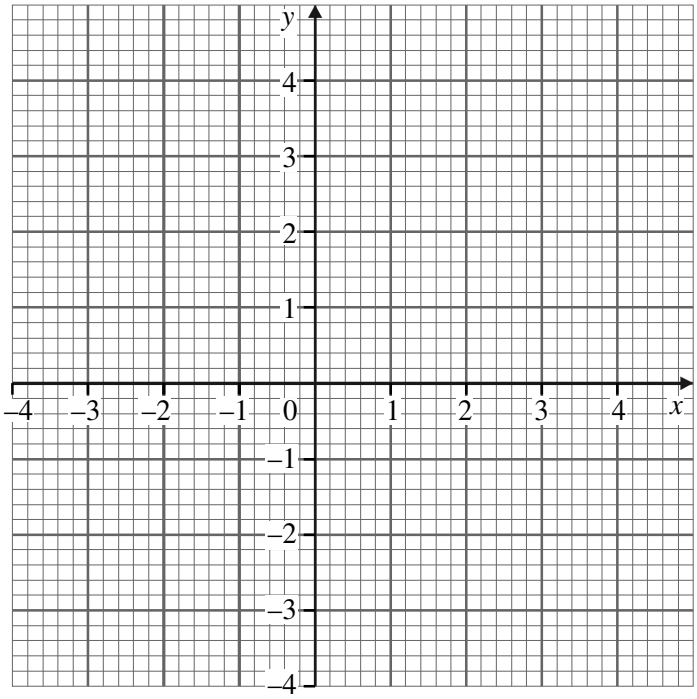
.....

.....

.....

**(2)**

**3.** (a) On the grid, draw the line $y = 2x$.




**(2)**

(b) The line $y = 2x$ crosses the line $x = -1$ at $P$.

Give the coordinates of $P$.

.....

Answer $P$ (....., .....)

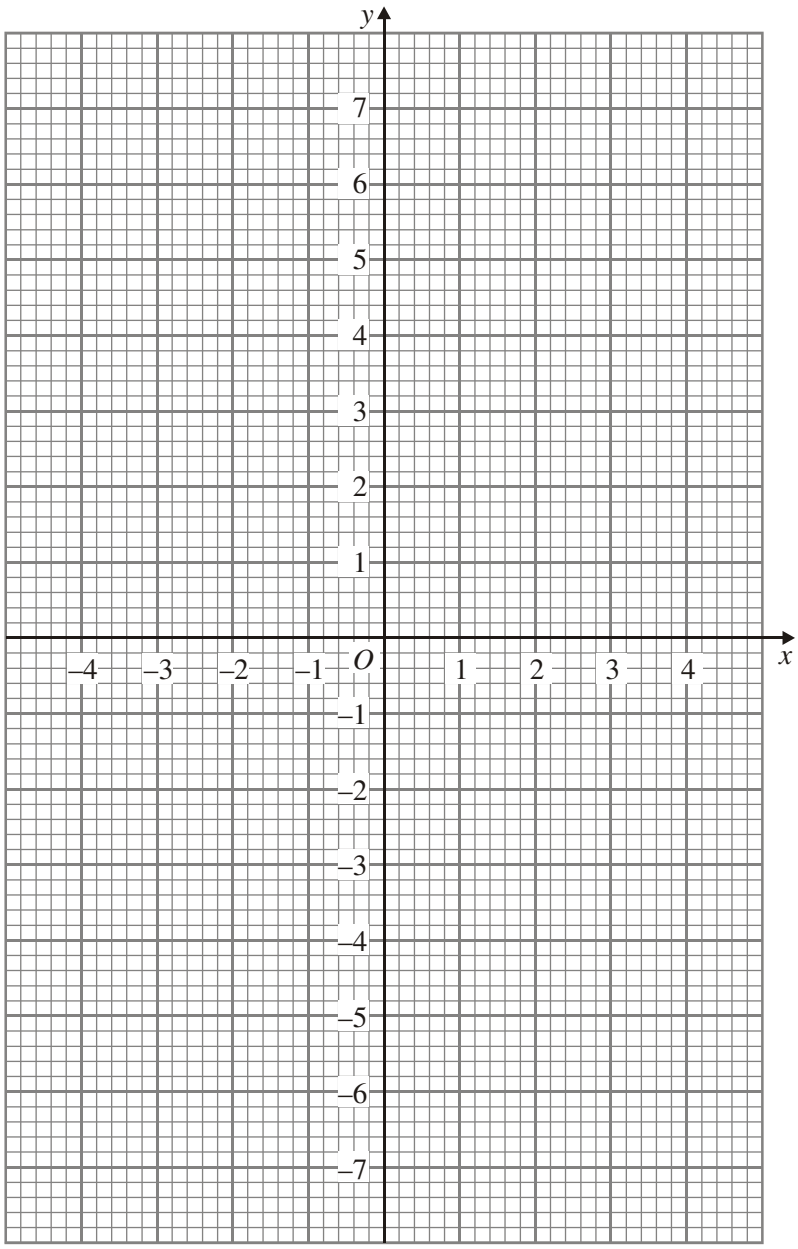
**(1)**

**4.** (a) On the grid below draw and label the lines $y = -4$ and $y = 2x + 1$

.....

.....

.....



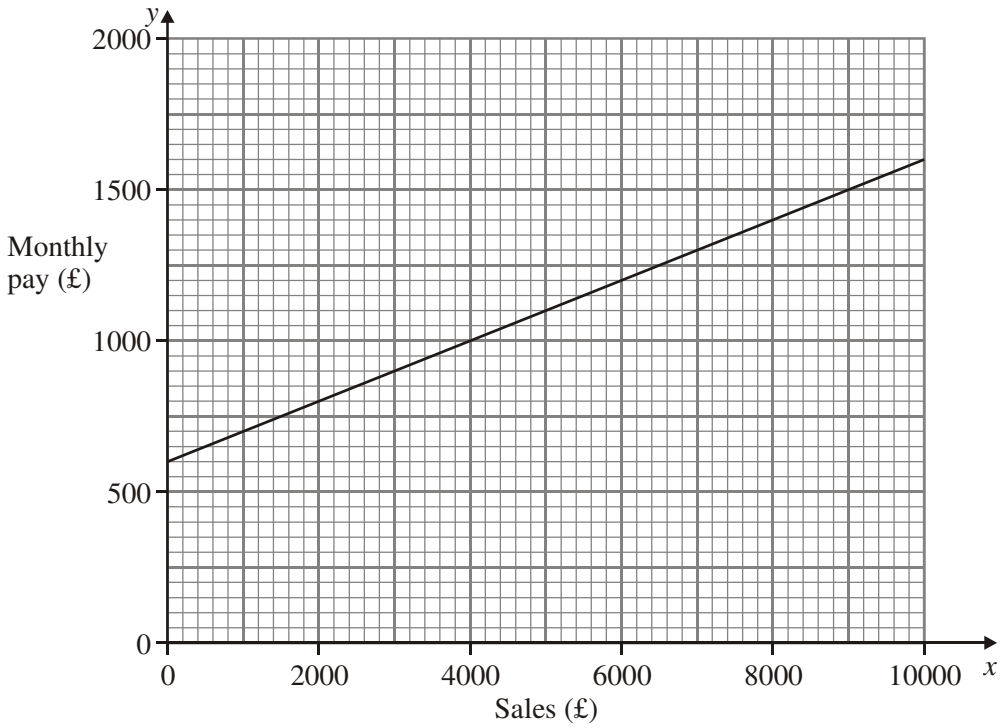

**(4)**

(b) Write down the coordinates of the point where the lines $y = -4$ and $y = 2x + 1$ cross.

Answer ( ....., .....)

**(1)**

**5.** The graph shows how Ellie's monthly pay depends on her sales.




(a) Find the equation of the line in the form $y = mx + c$

.....

.....

.....

Answer $y$ = .....

**(3)**

(b) Calculate Ellie's pay when her sales are £16 000.

.....

.....

.....

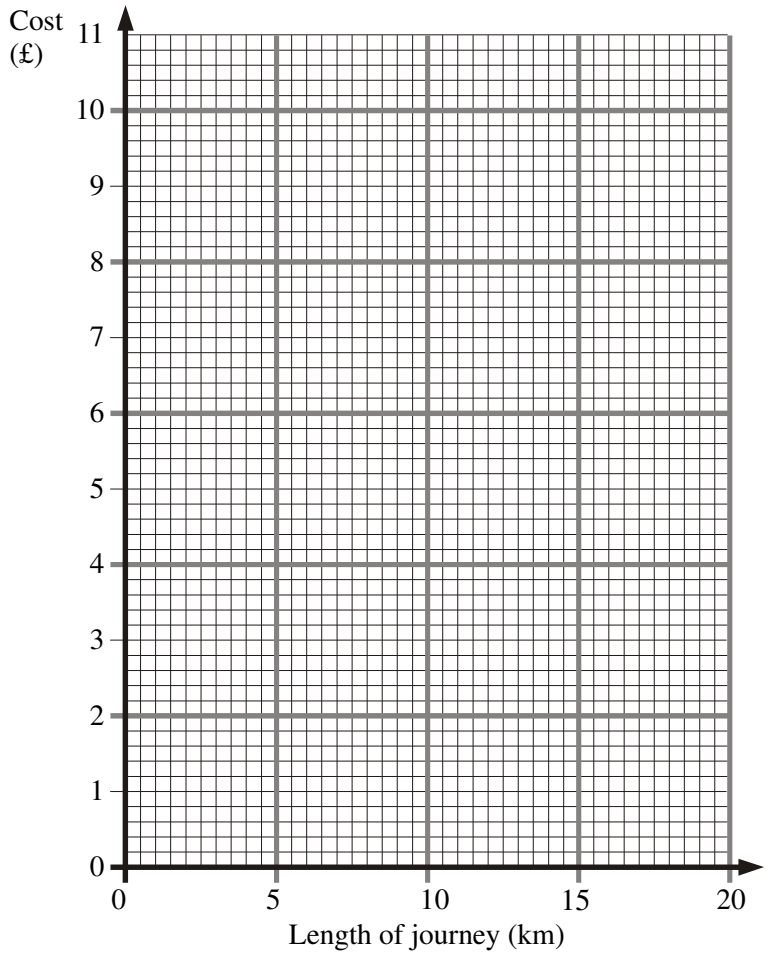
Answer £ .....

**(2)**

**6.** These are the prices charged for different journeys by taxi.

| Length of journey (km) | 1 | 2 | 3 | 5 | 8 | 13 | 14 | 18 |
|---|---|---|---|---|---|---|---|---|
| Cost (£) | 1.80 | 2.30 | 2.50 | 2.80 | 5.40 | 7.50 | 8.40 | 10.30 |

(a) (i) On the grid below, draw a scatter diagram to show this information.




**(2)**

(ii) What does this diagram tell you about the relationship between the length of a journey and its cost?

**(1)**

(iii) Draw a line of best fit.

**(1)**

(b) (i) Estimate the cost of a taxi journey of 16 km.

**(1)**

(ii) I was charged £6.20 for a taxi journey.
Estimate the length of the journey.

**(1)**

**30-4-10 Algebra Answers**

**Day:** 9 & 10 **Topic:** Straight Line Graphs

**Quick Questions**

**1.**

| X | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| y | 0 | 1 | 2 | 3 | 4 |

y = x + 2

| X | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| y | -4 | -2 | 0 | 2 | 4 |

y = 2x

| X | 2 | 2 | 2 | 2 | 2 |
|---|---|---|---|---|---|
| y | -2 | -1 | 0 | 1 | 2 |

x=2

| X | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| y | 2 | 2 | 2 | 2 | 2 |

y = 2

| X | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| y | -1 | -½ | 0 | ½ | 1 |

y = ½ x

| X | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| y | 4 | 3 | 2 | 1 | 0 |

x+y = 2

**2.** a) y = 2x + 3

| x | -1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| y | 1 | 3 | 5 | 7 | 9 |

b) Points plotted correctly, joined with a straight line and labelled.

**3.** y = 3x + 2

| X | -3 | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|---|
| y | -7 | -4 | -1 | 2 | 5 | 8 |

Points plotted correctly, joined with a straight line and labelled.

**4.** a) Gradient = 5 Intercept = (0, -3)
b) Gradient = -4 Intercept = (0, 6)
c) Gradient = -2 Intercept = (0, 8)

**Past Paper Questions**

**1.** a) Missing values: -1 and 3
b) points plotted correctly and joined with a straight line
c) Draw in line y = -2. Read off coordinate where 2 lines cross (-½, -2)

**2.** a) Gradient = $\frac{(9-3)}{(3-0)} = \frac{6}{3} = 2$
b) y = 2x + 3

**3.** a) Points plotted correctly and joined with a straight line. Points could be (-1, -2) (0, 0) (1,2) (2,4) (3,6)

b) Draw in line x=-1. Read off coordinates where two lines cross.
P= (-1, -2)

**4.** a) Draw line y = -4.
Draw line y = 2x + 1. Points could be (0,1) (1, 3) (2,5) (3, 7)
b) Read off coordinate where two lines cross (-2.5, -4)

**5.** a) Choose 2 points on the graph and calculate the distance up and the distance across between them
eg (9000, 1500) and (4000, 1000)

$$\text{Gradient} = \frac{(1500 - 1000)}{(9000 - 4000)}$$

$$= \frac{500}{5000}$$

$$= \frac{1}{10}$$

Intercept = (0, 600)

Equation is $y = \frac{1}{10}x + 600$

b) If x = 16000

$y = \frac{1}{10} \times 16000 + 600$

y = 1600 + 600
y = 2200
Ellie's pay is £2200

**6.** a) i) Points plotted
ii) the longer the journey the more it costs
iii) Draw line of best fit

b) i) Draw a vertical line on the graph at 16km.
Read point from the graph £9.20 (± 9p)
ii) Draw a horizontal line on the graph at £6.20.
Read point from the graph 10 km (± 0.25km)