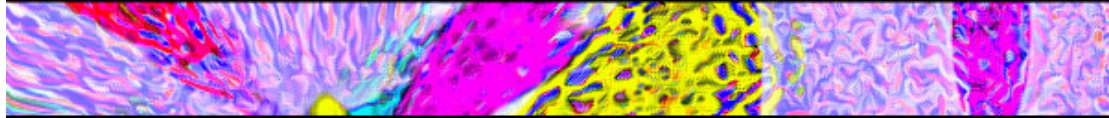
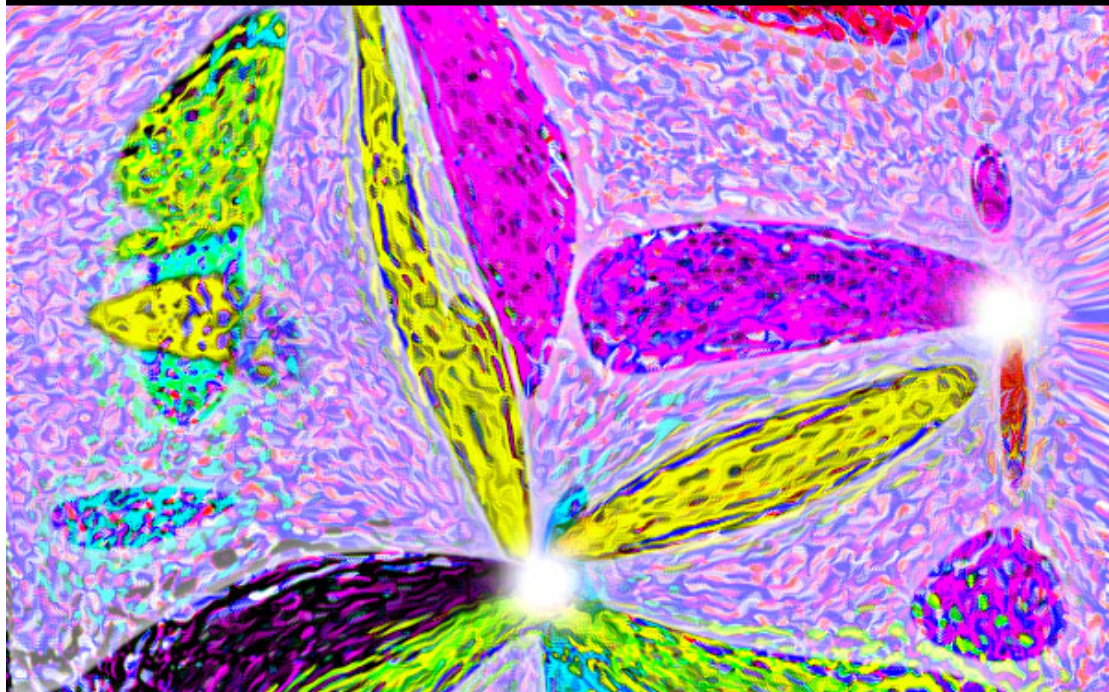


**GCSE MATHS TUTOR**



**Worksheets**



**volume I**

**ALGEBRA**

[www.gcsemathstutor.com](http://www.gcsemathstutor.com)

This book is under copyright to GCSE Maths Tutor. However, it may be distributed freely provided it is not sold for profit.

## Contents

|  |       |
|--|-------|
| expanding brackets I                               | 3,4   |
| factorisation I                                    | 5,6   |
| indices I  | 7,8   |
| algebraic fractions I                              | 9,10  |
| simple equations - changing the subject I          | 11,12 |
| simple equations - substitution/evaluation I       | 13,14 |
| simple equations - trial & improvement I           | 15,16 |
| simultaneous equations I                           | 17,18 |
| quadratic equations – completing the square I      | 19,20 |
| quadratic equations – solution by factorisation I  | 21,22 |
| quadratic equations – solution using the formula I | 23,24 |
| proportion 1                                       | 25,26 |
| inequalities I                                     | 27,28 |
| straight line equations I                          | 29,30 |
| transformation of functions I                      | 31,32 |

## 1. multiply out and simplify

(a)  $a(2 + a)$

(b)  $3(2a + b)$

(c)  $3a(a - 2)$

(d)  $3x(4 - x)$

(e)  $4a(2 + 3a)$

(f)  $x^3(x^2 - 2)$

(g)  $4d(ab + d)$

(h)  $2xy(x^2 + y^2)$

(i)  $3a^2b^2(b + a)$

## 2. expand

(a)  $(x + 1)(x + 2)$

(b)  $(a + 3)(a + 4)$

(c)  $(y + 3)(y + 2)$

(d)  $(x - 1)(x + 2)$

(e)  $(a - 2)(a + 1)$

(f)  $(y + 2)(y - 4)$

(g)  $(x - 3)(x - 5)$

(h)  $(a - 3)(a - 1)$

(i)  $(y - 4)(y - 5)$

## 3. expand

(a)  $(x + 1)^2$

(b)  $(y - 1)^2$

(c)  $(a + 4)^2$

(d)  $(2x - 3)^2$

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

(f)  $(4a - 1)^2$

## 4. expand

(a)  $(2x + 3)(3x - 1)$

(b)  $(x - 1)(2x - 2)$

(c)  $(3x + 1)(4x - 3)$

(d)  $(4x - 2)(x + 5)$

(e)  $(5x + 6)(7x - 1)$

(f)  $(7x + 5)(6x + 1)$

## 5. expand

(a)  $(x + 2)(x - 2)$

(b)  $(x + 5)(x - 5)$

(c)  $(x + a)(x - a)$

(d)  $(4x - 3y)(4x + 3y)$

(e)  $(2x + 3)(2x - 3)$

(f)  $(3x - 1)(3x + 1)$

1.

(a)  $2a + a^2$

(b)  $6a + 3b$

(c)  $3a^2 - 6a$

(d)  $12x - 3x^2$

(e)  $8a + 12a^2$

(f)  $x^5 - 2x^3$

(g)  $4abd + 4d^2$

(h)  $2x^3y + 2xy^3$

(i)  $3a^2b^3 + 3a^3b^2$

2.

(a)  $x^2 + 3x + 2$

(b)  $a^2 + 7a + 12$

(c)  $y^2 + 5y + 6$

(d)  $x^2 + x - 2$

(e)  $a^2 - a - 2$

(f)  $y^2 - 2y - 8$

(g)  $x^2 - 8x + 15$

(h)  $a^2 - 4a + 3$

(i)  $y^2 - 9y + 20$

3.

(a)  $x^2 + 2x + 1$

(b)  $y^2 - 2y + 1$

(c)  $a^2 + 8a + 16$

(d)  $4x^2 - 12x + 9$

(e)  $9y^2 + 12y + 4$

(f)  $16a^2 - 8a + 1$

4.

(a)  $6x^2 + 7x - 3$

(b)  $2x^2 - 4x + 2$

(c)  $12x^2 - 5x - 3$

(d)  $4x^2 + 18x - 10$

(e)  $35x^2 + 37x - 6$

(f)  $42x^2 + 37x + 5$

5.

(a)  $x^2 - 4$

(b)  $x^2 - 25$

(c)  $x^2 - a^2$

(d)  $16x^2 - 9y^2$

(e)  $4x^2 - 9$

(f)  $9x^2 - 1$

1. Factorise the following expressions into two pairs of brackets.

(a)  $84 - a(a - 5)$

(b)  $3 - 2p(4p + 5)$

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

(d)  $a^2 + 2(a - 4)$

(e)  $x^2 - 16$

(f)  $x^2 - 36$

(g)  $9m^2 - 64$

(h)  $4a^2 - 49$

(i)  $25p^2 - 81$

(j)  $2x^2 - 32$

(k)  $3m^2 - 27$

(l)  $3p^2 - 5 - 22$

2. Factorise the following expressions into two pairs of brackets.

(a)  $2a^2 - 7a - 9$

(b)  $x^2 - 15x - 54$

(c)  $p^2 + 2p - 35$

(d)  $x^2 + 20x + 51$

(e)  $a^2 + 7a - 44$

(f)  $2m^2 + 13m + 6$

(g)  $p^2 - 26p + 133$

(h)  $m^2 - m - 90$

(i)  $2x^2 - 5x + 3$

(j)  $x^2 + 15x - 54$

(k)  $p^2 + 24p + 143$

(l)  $a^2 - 12a + 32$

3. Factorise the following expressions into two pairs of brackets.

(a)  $a^2 + 8 - 6a$

(b)  $x^2 + 10x + 21$

(c)  $30 - m^2 + 7m$

(d)  $x^2 + 20 - 9x$

(e)  $a^2 - 6a - 27$

(f)  $m + 56 - m^2$

(g)  $15 - 4p^2 - 4p$

(h)  $x + 56 - x^2$

(i)  $13m - 3 - 12m^2$

(j)  $4x^2 + 7x - 2$

(k)  $2 - x^2 + x$

(l)  $3 - p^2 - 2p$

1.

(a)  $(a + 7)(a - 12)$

(b)  $(4p - 1)(2p + 3)$

(c)  $(3x - 1)(x - 3)$

(d)  $(a - 2)(a + 4)$

(e)  $(x - 4)(x + 4)$

(f)  $(x - 6)(x + 6)$

(g)  $(3m + 8)(3m - 8)$

(h)  $(2a + 7)(2a - 7)$

(i)  $(5p + 9)(5p - 9)$

(j)  $(x + 4)(x - 4)$

(k)  $(m + 3)(m - 3)$

(l)  $(p + 3)(p - 3)$

2.

(a)  $(2a - 9)(a + 1)$

(b)  $(x + 3)(x - 18)$

(c)  $(p + 7)(p - 5)$

(d)  $(x + 3)(x + 17)$

(e)  $(a + 11)(a - 4)$

(f)  $(2m + 1)(m + 6)$

(g)  $(p - 19)(p - 7)$

(h)  $(m + 9)(m - 10)$

(i)  $(2x - 3)(x - 1)$

(j)  $(x + 18)(x - 3)$

(k)  $(p + 11)(p + 13)$

(l)  $(a - 8)(a - 4)$

3.

(a)  $(a - 2)(a - 4)$

(b)  $(x + 3)(x + 7)$

(c)  $(m + 3)(m - 10)$

(d)  $(x - 4)(x - 5)$

(e)  $(a + 3)(a - 9)$

(f)  $(m + 7)(m - 8)$

(g)  $(2p - 3)(2p + 5)$

(h)  $(x + 7)(x - 8)$

(i)  $(4m - 3)(3m - 1)$

(j)  $(4x - 1)(x + 2)$

(k)  $(x + 1)(x - 2)$

(l)  $(p - 1)(p + 3)$

## 1. multiply out

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

(b)  $b^3 \times b^4$

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

(d)  $ab^3 \times a^3b$

(e)  $b^3(ab^4)$

(f)  $a^2(a^2b^3)$

(g)  $a^2b^3(a^2b^4 - ab)$

(h)  $ab(a^2b + ab^2)$

(i)  $a^2bc^3(a^3b - c)$

## 2. simplify

(a)  $\frac{a^3b^4}{ab}$

(b)  $\frac{x^2y^3}{xy}$

(c)  $\frac{a^4b^2c^3}{a^2bc^2}$

(d)  $\frac{a^2b - ab^2}{ab}$

(e)  $\frac{x^3y^2 + x^2y^4}{xy}$

(f)  $\frac{a^2b^3c - abc^3}{abc}$

(g)  $\frac{a^2b^3(a^3b^2)}{a^4b}$

(h)  $\frac{x^3y^2(xy^2)}{x^4y}$

(i)  $\frac{a^3b(x^3y^2)}{a^2x^2y}$

## 3. simplify

(a)  $(a^2)^3$

(b)  $(x^3)^4$

(c)  $(y^5)^2$

(d)  $(ab)^2$

(e)  $(xy)^3$

(f)  $(a^2b)^3$

(g)  $(a^3b^2)^5$

(h)  $(x^2y^4)^2$

(i)  $(x^5y^3z^2)^4$



1.

(a)  $a^5$

(b)  $b^7$

(c)  $a^5b^5$

(d)  $a^4b^4$

(e)  $ab^7$

(f)  $a^4b^3$

(g)  $a^4b^7 - a^3b^4$

(h)  $a^3b^2 + a^2b^3$

(i)  $a^5b^2c^3 - a^2bc^4$

2.

(a)  $a^2b^3$

(b)  $xy^2$

(c)  $a^2bc$

(d)  $a - b$

(e)  $x^2y + xy^3$

(f)  $ab^2 - c^2$

(g)  $ab^4$

(h)  $y^3$

(i)  $abxy$

3.

(a)  $a^6$

(b)  $x^{12}$

(c)  $y^{10}$

(d)  $a^2b^2$

(e)  $x^3y^3$

(f)  $a^6b^3$

(g)  $a^{15}b^{10}$

(h)  $x^4y^8$

(i)  $x^{20}y^{12}z^8$



1. Express each fraction in its simplest form:

(a)  $\frac{3(x+1)}{x+1}$

(b)  $\frac{x-y}{y-x}$

(c)  $\frac{a-3}{3-a}$

(d)  $\frac{y-2}{2-y}$

(e)  $\frac{4x+8}{4}$

(f)  $\frac{9x-27}{3}$

(g)  $\frac{5x}{10+15x}$

(h)  $\frac{5-2x}{4x-10}$

(i)  $\frac{3+5a}{15a+9}$

2. Express each fraction in its simplest form:

(a)  $\frac{3x}{3x-9}$

(b)  $\frac{15x+20x^2}{5x}$

(c)  $\frac{x+1}{x^2+2x+1}$

(d)  $\frac{x+3}{x^2+5x+6}$

(e)  $\frac{x^2-y^2}{(x-y)^2}$

(f)  $\frac{(x+y)^2}{x^2-y^2}$

(g)  $\frac{a^2-4a}{a^2-16}$

(h)  $\frac{x^2+xy}{x^2-y^2}$

(i)  $\frac{2x+1}{6x^2+x-1}$

3. Express each fraction in its simplest form:

(a)  $\frac{3}{x-1} + \frac{x}{x-1}$

(b)  $\frac{3}{x-1} + \frac{x}{2x-3}$

(c)  $\frac{a}{a+3} + \frac{2}{a-2}$

(d)  $\frac{x}{x+1} - \frac{3}{2x-1}$

(e)  $\frac{6}{1-2a} - \frac{a}{3+a}$

(f)  $\frac{3}{2x+3y} - \frac{5}{x-y}$

4. Express each fraction in its simplest form:

(a)  $\frac{x^2}{x^2-2x} \times \frac{3+x}{x}$

(b)  $\frac{2x+2}{3x} \times \frac{12}{12x-8}$

(c)  $\frac{3x^2}{4} \times \frac{x}{x^2-x-6}$

(d)  $\frac{x^2-y^2}{x} \div \frac{x+y}{x}$

(e)  $\frac{a}{a^2-b^2} \div \frac{2a}{a-b}$

(f)  $\frac{x^2-16}{x^2} \div \frac{x-4}{3x}$

1.

(a) 3

(b)  $-1$

(c)  $-1$

(d)  $-1$

(e)  $x + 2$

(f)  $3x - 9$

(g)  $\frac{x}{2 + 3x}$

(h)  $-\frac{1}{2}$

(i)  $\frac{1}{3}$

2.

(a)  $\frac{x}{x - 3}$

(b)  $3 + 4x$

(c)  $\frac{1}{x + 1}$

(d)  $\frac{1}{x + 2}$

(e)  $\frac{x + y}{x - y}$

(f)  $\frac{x + y}{x - y}$

(g)  $\frac{a}{a + 4}$

(h)  $\frac{x}{x - y}$

(i)  $\frac{1}{3x - 1}$

3.

(a)  $\frac{3 + x}{x - 1}$

(b)  $\frac{x^2 + 5x - 9}{(x - 1)(2x - 3)}$

(c)  $\frac{a^2 + 6}{(a + 3)(a - 2)}$

(d)  $\frac{2x^2 - 4x - 3}{(x + 1)(2x - 1)}$

(e)  $\frac{2a^2 + 5a + 18}{(1 - 2a)(3 + a)}$

(f)  $\frac{-7x - 18y}{(2x + 3y)(x - y)}$

4.

(a)  $\frac{3 + x}{x - 2}$

(b)  $\frac{2x + 2}{3x^2 - 2x}$

(c)  $\frac{3x^3}{4(x - 3)(x + 2)}$

(d)  $x - y$

(e)  $\frac{1}{2(a + b)}$

(f)  $\frac{3(x + 4)}{x}$

1. make  $x$  the subject in each case:

(a)  $4y + 7 = 11 + x$       (b)  $x - 7y = 13$       (c)  $12 + 3x = 14y + 4x$

(d)  $11 + 5x = 13y + 4x$       (e)  $5x - 2y = 9 + 4x$       (f)  $x - 6y = 15$

2. make  $y$  the subject in each case:

(a)  $2x - y = 5$       (b)  $p - 2y = 5 - q - 3y$       (c)  $\frac{p}{4} = \frac{y}{2}$

(d)  $p - y = 5 - q$       (e)  $4y = 9 - x + 3y$       (f)  $4y + 7 = 3y + 11 + 2x$

3. make  $a$  the subject in each case:

(a)  $4b + 2c = a - b$       (b)  $7a + 2p = 8a - 3$       (c)  $5p = q - a$

(d)  $2p = 3 - a - q$       (e)  $3 - a - q = b$       (f)  $5q = 2b + a$

4. make  $p$  the subject in each case:

(a)  $2b + p - y = 5 - q$       (b)  $p - q = 4 - a + 2p$       (c)  $2p = 3p - 4 - a$

(d)  $p - 5 = 2p - q$       (e)  $3 - 5q = a - p$       (f)  $3 - 2p = q - p$

5. make  $x$  the subject in each case:

(a)  $q - 7a - 2x = 5 - x$       (b)  $3xa = 5yb$       (c)  $7ya = 2xb$

(d)  $3ya^2 = 5xc$       (e)  $5a^2 = \frac{3xb}{c}$       (f)  $b^2z = \frac{2a}{3xc}$

1. make  $x$  the subject in each case:

(a)  $x = 4y - 4$

(b)  $x = 13 + 7y$

(c)  $x = 12 - 14y$

(d)  $x = 13y - 11$

(e)  $x = 2y + 9$

(f)  $x = 15 + 6y$

2. make  $y$  the subject in each case:

(a)  $y = 2x - 5$

(b)  $y = 5 - q - p$

(c)  $y = \frac{p}{2}$

(d)  $y = p - 5 + q$

(e)  $y = 9 - x$

(f)  $y = 2x + 4$

3. make  $a$  the subject in each case:

(a)  $a = 5b + 2c$

(b)  $a = 2p + 3$

(c)  $a = q - 5p$

(d)  $a = 3 - 2p - q$

(e)  $a = 3 - q - b$

(f)  $a = 5q - 2b$

4. make  $p$  the subject in each case:

(a)  $p = 5 - q + y - 2b$

(b)  $p = a - q - 4$

(c)  $p = 4 + a$

(d)  $p = q - 5$

(e)  $p = a + 5q - 3$

(f)  $p = 3 - q$

5. make  $x$  the subject in each case:

(a)  $x = q - 7a - 5$

(b)  $x = \frac{5yb}{3a}$

(c)  $x = \frac{7ya}{2b}$

(d)  $x = \frac{3ya^2}{5c}$

(e)  $x = \frac{5a^2c}{3b}$

(f)  $x = \frac{2a}{3b^2cz}$

1. evaluate when  $x = 1$ ,  $y = 2$  and  $z = 3$

(i)  $3xy$

(ii)  $2z$

(iii)  $\frac{9}{yz}$

(iv)  $\frac{yz}{14}$

(v)  $2y + 4z$

(vi)  $x + 3y - 2z$

(vii)  $yz + xz$

(viii)  $y^2 + z^2$

(ix)  $2x^2 + y$

(x)  $2y^2 - z^3$

(xi)  $y^2z$

(xii)  $3y^2z^2$

2. evaluate when  $p = 4$ ,  $q = 5$  and  $r = 6$

(i)  $p^2 + q^3 - r^2 + 3pqr$

(ii)  $(p - q + r)(2q - 4r)$

(iii)  $(p - r)^2 + (q - p)^2$

(iv)  $\frac{p}{r} - \frac{q}{p} + \frac{r}{q}$

(v)  $\frac{p-1}{3} - \frac{q-r}{2}$

(vi)  $\frac{r+p}{4} - \frac{p-q}{3}$

(vii)  $3p^2 + 2q - 2pq^2r$

(viii)  $p^2 + 2q^3 - 2r^2$

(ix)  $\frac{p+q}{r} - \frac{pq+r}{p}$

(x)  $\frac{p+2q}{r-q} - \frac{p+r}{p+q}$

(xi)  $\frac{3r^2+2p}{pq-r} - \frac{2q}{r}$

(xii)  $\frac{p^2 - q^2}{r} - \frac{p - r^2}{r + 2p}$

1.

(i) 6

(ii) 6

(iii)  $\frac{3}{2}$

(iv)  $\frac{3}{7}$

(v) 16

(vi) 1

(vii) 9

(viii) 13

(ix) 4

(x) -19

(xi) 12

(xii) 108

2.

(i) 465

(ii) -70

(iii) 5

(iv)  $\frac{37}{60}$

(v)  $1\frac{1}{2}$

(vi)  $2\frac{5}{6}$

(vii) -1142

(viii) 194

(ix) -5

(x)  $12\frac{8}{9}$

(xi)  $6\frac{13}{21}$

(xii)  $3\frac{11}{14}$

Calculators are **NOT** to be used.

1. Using a trial & improvement method, solve: (answers are whole numbers)

(a)  $x^2 + x = 42$

(b)  $x^2 - x = 20$

(c)  $x^2 - 2x = 8$

(d)  $x^3 + x = 10$

(e)  $x^3 - x = 24$

(f)  $x^3 + 2x = 33$

(g)  $x^5 + x = 34$

(h)  $x^4 - x = 78$

(i)  $x^4 - 3x = 244$

(j)  $2x^3 - 3x = 10$

(k)  $3x^4 - 5x = 1850$

(l)  $5x^3 - x^2 = 126$

2. Using a trial & improvement method, solve: (answers to 2 decimal places)

\*note square roots have both positive and negative results

(a)  $a^3 + 1 = 4$

(b)  $m^3 - 1 = 10$

(c)  $p^3 - 2 = 4$

(d)  $2x^3 - 1 = 10$

(e)  $2x^3 + 2 = 19$

(f)  $2x^3 - 2 = 22$

(g)  $x + \sqrt{x} = 7$

(h)  $x - \sqrt{x} = 4$

(i)  $x + \sqrt{x} = 5$

3. Find the square root of each number. (answers to 2 decimal place)

(a) 10

(b) 15

(c) 18

(d) 23

(e) 26

(f) 47

(g) 63

(h) 145

(i) 1213

4. Find the cube root of each number. (answers to 2 decimal place)

(a) 17

(b) 22

(c) 13

(d) 29

(e) 59

(f) 131

(g) 173

(h) 295

(i) 1001



1.

(a) 6

(b) 5

(c) 4

(d) 2

(e) 3

(f) 3

(g) 2

(h) 3

(i) 4

(j) 2

(k) 5

(l) 3

2.

(a) 1.44

(b) 2.22

(c) 1.82

(d) 1.77

(e) 2.04

(f) 2.29

(g) 4.81, 10.19

(h) 6.57, 2.44

(i) 3.21, 7.79

3.

(a) 3.16

(b) 3.87

(c) 4.24

(d) 4.80

(e) 5.10

(f) 6.86

(g) 7.94

(h) 12.04

(i) 34.83

4.

(a) 2.57

(b) 2.80

(c) 2.35

(d) 3.07

(e) 3.89

(f) 5.08

(g) 5.57

(h) 6.66

(i) 10.00

1. solve for  $x$  and  $y$

(a)  $2x - y = 1$   
 $2x + 2y = 10$

(b)  $2x + 3y = 8$   
 $5x - 2y = 1$

(c)  $3x + 5y = 7$   
 $4x + 3y = 2$

(d)  $5x - y = 15$   
 $x + y = -3$

(e)  $3x - y = 6$   
 $2x + 5y = -13$

(f)  $3x + 5y = 1$   
 $x - y = -5$

(g)  $2x - 5y = 3$   
 $3x + 2y = 14$

(h)  $2x + 3y = 6$   
 $3x + 2y = -1$

(i)  $3x - y = 18$   
 $x + 2y = -1$

2. solve for  $x$  and  $y$

(a)  $2x + 13 = 5y$   
 $3x + 4y - 15 = 0$

(b)  $3x + 2y - 14 = 0$   
 $2x + 16 = 5y$

(c)  $5y - 13 = 3x$   
 $2x + 3y - 4 = 0$

(d)  $x + 5y - 2 = 0$   
 $3y - 9 = 2x$

(e)  $4x + 3y + 10 = 0$   
 $5y - 18 = 2x$

(f)  $2x + 5y + 5 = 0$   
 $2y + 31 = 5x$

3. John buys 20 postage stamps for £5.36 . If he only buys stamps of value 22p and 30p, how many of each kind did he buy?
4. If Mary and Tom put their money together they have £36 . If Mary's money were halved and Tom's money doubled they would have £42. How much money does each have?
5. A packet of razors and a bar of soap cost £5.50 . If the soap costs £2.50 less than the razors, find the cost of each.
6. James bought 2 bottles of lemonade and 1 bag of crisps for £1.40 .  
Jill bought 1 bottle of lemonade and 3 bags of crisps for £1.70 .  
How much is a bottle of lemonade? How much is a bag of crisps?

1.

(a)  $x = 2$     $y = 3$

(b)  $x = 1$     $y = 2$

(c)  $x = -1$     $y = 2$

(d)  $x = 2$     $y = -5$

(e)  $x = 1$     $y = -3$

(f)  $x = -3$     $y = 2$

(g)  $x = 4$     $y = 1$

(h)  $x = -3$     $y = 4$

(i)  $x = 5$     $y = -3$

2.

(a)  $x = 1$     $y = 3$

(b)  $x = 2$     $y = 4$

(c)  $x = -1$     $y = 2$

(d)  $x = -3$     $y = 1$

(e)  $x = -4$     $y = 2$

(f)  $x = 5$     $y = -3$

3. 8 @ 22p,      12 @ 30p

4. Mary £20,      Tom £16

5. razors £4.00,      soap £1.50

6. bag of crisps 40p,      bottle of lemonade 50p

1. solve the following equations

(a)  $(a - 3)^2 = 16$

(b)  $(3x - 2)^2 - 4 = 0$

(c)  $(2y + 1)^2 - 16 = 0$

(d)  $(5x + 2)^2 = 25$

(e)  $(x - 5)^2 - 36 = 0$

(f)  $(a + 2)^2 = 9$

2. solve the following equations

(a)  $(3x + 4)^2 - 81 = 0$

(b)  $(2x - 5)^2 = 4$

(c)  $(2x - 1)^2 = 25$

(d)  $(2y + 3)^2 - 49 = 0$

(e)  $(2x + 5)^2 = 9$

(f)  $64 = (3y - 3)^2$

3. solve and answer to 1 d.p.

(a)  $x^2 - 5x + 1 = 0$

(b)  $x^2 + 9x + 1 = 0$

(c)  $x^2 - 4x + 2 = 0$

(d)  $x^2 - 4x - 4 = 0$

(e)  $x^2 + 2x - 2 = 0$

(f)  $x^2 - 3x - 4 = 0$

1.

(a)  $a = 7, a = -1$

(b)  $x = 1\frac{1}{3}, x = 0$

(c)  $y = 1\frac{1}{2}, y = -2\frac{1}{2}$

(d)  $x = \frac{3}{5}, x = -1\frac{2}{5}$

(e)  $x = 11, x = -1$

(f)  $a = 1, a = -5$

2.

(a)  $x = 1\frac{2}{3}, x = -4\frac{1}{3}$

(b)  $x = 1\frac{1}{2}, x = 3\frac{1}{2}$

(c)  $x = 3, x = -2$

(d)  $y = 2, y = -5$

(e)  $x = -1, x = -4$

(f)  $y = 3\frac{2}{3}, y = -1\frac{2}{3}$

3.

(a)  $x = 4.8, x = 0.2$

(b)  $x = -8.9, x = -0.1$

(c)  $x = 3.4, x = 0.6$

(d)  $x = -0.8, x = 4.8$

(e)  $x = 0.7, x = -2.7$

(f)  $x = 4, x = -1$

1. Solve for  $x$ .

(a)  $2a^2 - 7a - 9 = 0$

(b)  $x^2 - 15x - 54 = 0$

(c)  $p^2 + 2p - 35 = 0$

(d)  $x^2 + 20x + 51 = 0$

(e)  $a^2 + 7a - 44 = 0$

(f)  $2m^2 + 13m + 6 = 0$

(g)  $p^2 - 26p + 133 = 0$

(h)  $m^2 - m - 90 = 0$

(i)  $2x^2 - 5x + 3 = 0$

(j)  $x^2 + 15x - 54 = 0$

(k)  $p^2 + 24p + 143 = 0$

(l)  $a^2 - 12a + 32 = 0$

2. Solve for  $x$ .

(a)  $a^2 + 8 = 6a$

(b)  $x^2 + 10x + 21 = 0$

(c)  $30 = m^2 - 7m$

(d)  $x^2 + 20 = 9x$

(e)  $a^2 = 6a + 27$

(f)  $m + 56 = m^2$

(g)  $15 = 4p^2 + 4p$

(h)  $x + 56 = x^2$

(i)  $13m - 3 = 12m^2$

(j)  $4x^2 + 7x = 2$

(k)  $2 = x^2 - x$

(l)  $3 = p^2 + 2p$

3. Solve for  $x$ .

(a)  $84 = a(a - 5)$

(b)  $3 = 2p(4p + 5)$

(c)  $3x(x - 2) = 4x - 3$

(d)  $a^2 + 2(a - 4) = 0$

(e)  $x^2 - 16 = 0$

(f)  $x^2 = 36$

(g)  $9m^2 = 64$

(h)  $4a^2 = 49$

(i)  $25p^2 = 81$

(j)  $2x^2 = 32$

(k)  $3m^2 = 27$

(l)  $3p^2 - 5 = 22$

1.

(a)  $4\frac{1}{2}, -1$

(b)  $-3, 18$

(c)  $-7, 5$

(d)  $-3, -17$

(e)  $-11, 4$

(f)  $-\frac{1}{2}, -6$

(g)  $19, 7$

(h)  $-9, 10$

(i)  $1\frac{1}{2}, 1$

(j)  $-18, 3$

(k)  $-11, -13$

(l)  $8, 4$

2.

(a)  $2, 4$

(b)  $-3, -7$

(c)  $-3, 10$

(d)  $4, 5$

(e)  $-3, 9$

(f)  $-7, 8$

(g)  $1\frac{1}{2}, -2\frac{1}{2}$

(h)  $-7, 8$

(i)  $\frac{3}{4}, \frac{1}{3}$

(j)  $\frac{1}{4}, -2$

(k)  $-1, 2$

(l)  $1, -3$

3.

(a)  $-7, 12$

(b)  $\frac{1}{4}, -1\frac{1}{2}$

(c)  $\frac{1}{3}, 3$

(d)  $2, -4$

(e)  $4, -4$

(f)  $6, -6$

(g)  $-2\frac{2}{3}, 2\frac{2}{3}$

(h)  $-3\frac{1}{2}, 3\frac{1}{2}$

(i)  $-1\frac{4}{5}, 1\frac{4}{5}$

(j)  $-4, 4$

(k)  $-3, 3$

(l)  $-3, 3$



1. Solve the quadratic equations by using the formula, giving answers to 2 decimal places.

(a)  $x^2 + 3x + 1 = 0$

(b)  $x^2 + 4x + 1 = 0$

(c)  $x^2 + 5x + 1 = 0$

(d)  $x^2 - 3x + 1 = 0$

(e)  $x^2 - 4x + 1 = 0$

(f)  $x^2 - 5x + 1 = 0$

(g)  $x^2 - 6x + 1 = 0$

(h)  $x^2 + x - 1 = 0$

(i)  $x^2 + x - 3 = 0$

(j)  $x^2 + x - 4 = 0$

(k)  $x^2 + x - 5 = 0$

(l)  $x^2 + 2x - 2 = 0$

2. Solve the quadratic equations by using the formula, giving answers to 2 decimal places.

(a)  $4 = x^2 + 2x$

(b)  $5 = x^2 + 2x$

(c)  $2 = x^2 + 3x$

(d)  $3 = x^2 + 3x$

(e)  $5 = x^2 + 3x$

(f)  $2 = x^2 + 4x$

(g)  $3 = x^2 + 4x$

(h)  $4 = x^2 + 4x$

(i)  $6 = x^2 + 4x$

(j)  $1 = x^2 + 5x$

(k)  $2 = x^2 + 5x$

(l)  $3 = x^2 + 5x$

3. Solve the quadratic equations by using the formula, giving answers to 2 decimal places.

(a)  $2x^2 + 6x + 3 = 0$

(b)  $2x^2 + 7x + 3 = 0$

(c)  $2x^2 + 5x + 3 = 0$

(d)  $4 - 6x = 2x^2$

(e)  $2x^2 = 4 - 5x$

(f)  $2x^2 + 4x = 4$

4. A rectangular box has dimensions  $(x + 6)$  cm by  $(x + 5)$  cm by 10 cm.

If the box has a volume of 1 litre, what is the value of  $x$ ?  
(answer to 2 decimal places)

5. A rectangular box has dimensions in cm of height  $x$ , width  $(x - 2)$  and length  $3x$ .

If the surface area of the box is 300 square cm, what is the value of  $x$ ?  
(answer to 2 decimal places)

1.

(a)  $-0.38, -2.62$

(b)  $-0.27, -3.73$

(c)  $-0.21, -4.79$

(d)  $2.62, 0.38$

(e)  $3.73, 0.27$

(f)  $4.79, 0.21$

(g)  $5.83, 0.17$

(h)  $0.62, -1.62$

(i)  $1.3, -2.3$

(j)  $1.56, -2.56$

(k)  $1.79, -2.79$

(l)  $0.73, -2.73$

2.

(a)  $1.24, -3.24$

(b)  $1.45, -3.45$

(c)  $0.56, -3.56$

(d)  $0.79, -3.79$

(e)  $1.19, -4.19$

(f)  $0.45, -4.45$

(g)  $0.65, -4.65$

(h)  $0.83, -4.83$

(i)  $1.16, -5.16$

(j)  $0.19, -5.19$

(k)  $0.37, -5.37$

(l)  $0.54, -5.54$

3.

(a)  $-0.63, -2.37$

(b)  $-0.50, -3.00$

(c)  $-1.00, -1.50$

(d)  $0.56, -3.56$

(e)  $0.64, -3.14$

(f)  $0.73, -2.73$

4.  $4.51 \text{ cm}$

5.  $5.24 \text{ cm}$

1. Copy and complete the table using the proportionality given:

(a)  $y \propto x$

|     |   |   |   |
|-----|---|---|---|
| $x$ | 1 | 3 | 5 |
| $y$ | 5 |   |   |

(b)  $a \propto b$

|     |   |    |    |
|-----|---|----|----|
| $a$ | 2 | 7  | 11 |
| $b$ |   | 21 |    |

(c)  $y \propto \frac{1}{x}$

|     |     |   |   |
|-----|-----|---|---|
| $x$ | 0.5 | 1 | 2 |
| $y$ | 10  |   |   |

(d)  $u \propto \frac{1}{v}$

|     |    |   |   |
|-----|----|---|---|
| $u$ | 2  | 3 | 4 |
| $v$ | 12 |   |   |

(e)  $y \propto x^2$

|     |    |    |   |
|-----|----|----|---|
| $x$ | 2  |    | 6 |
| $y$ | 24 | 54 |   |

(f)  $y \propto \frac{1}{x^2}$

|     |     |   |   |
|-----|-----|---|---|
| $x$ | 0.5 | 1 | 2 |
| $y$ | 8   |   |   |

2. The crop  $c$  of potatoes is directly proportional to the amount of fertiliser  $f$  used.

It is found that 50kg of potatoes are produced from 4kg of fertiliser.

(a) write an equation relating  $c$  to  $f$

(b) what is the expected crop when 10kg of fertiliser are used

(c) how much fertiliser would be needed to produce a crop of 120kg of potatoes

3. An elastic band stretches uniformly when a force is applied to it.

A force of 20 Newtons produces an increase in length of 4 cm.

(a) what force will produce an increase in length of 7.5 cm?

(b) what increase in length will be produced by a 17 Newton force?

4. It is believed that the value of a car is inversely proportional to its age.

(a) if the value of a car is £3000 at one year old, what is its value when it is 3 years old?

(b) how old will the car be when it has reached a value of £500?

1.

(a)  $y \propto x$

|     |   |    |    |
|-----|---|----|----|
| $x$ | 1 | 3  | 5  |
| $y$ | 5 | 15 | 25 |

(b)  $a \propto b$

|     |   |    |    |
|-----|---|----|----|
| $a$ | 2 | 7  | 11 |
| $b$ | 6 | 21 | 33 |

(c)  $y \propto \frac{1}{x}$

|     |     |   |     |
|-----|-----|---|-----|
| $x$ | 0.5 | 1 | 2   |
| $y$ | 10  | 5 | 2.5 |

(d)  $u \propto \frac{1}{v}$

|     |    |   |   |
|-----|----|---|---|
| $u$ | 2  | 3 | 4 |
| $v$ | 12 | 8 | 6 |

(e)  $y \propto x^2$

|     |    |    |     |
|-----|----|----|-----|
| $x$ | 2  | 3  | 6   |
| $y$ | 24 | 54 | 216 |

(f)  $y \propto \frac{1}{x^2}$

|     |     |   |     |
|-----|-----|---|-----|
| $x$ | 0.5 | 1 | 2   |
| $y$ | 8   | 2 | 0.5 |

2.

(a)  $c = 12.5f$

(b) 125kg

(c) 9.6kg

3.

(a) 37.5 Newtons

(b) 3.4 cm

4.

(a) £1000

(b) 6 years old

1. Solve for  $x$  and represent your answer on a number line.

(a)  $5x - 3 > 7$

(b)  $3x - 2 > 5$

(c)  $x + 1 > 4$

(d)  $2x + 5 \leq 2$

(e)  $3x + 7 \geq 1$

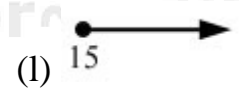
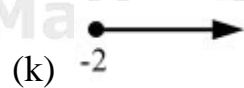
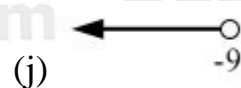
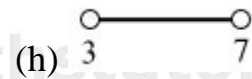
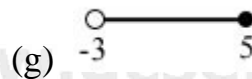
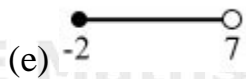
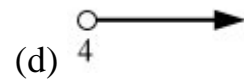
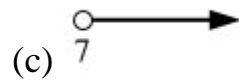
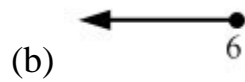
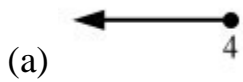
(f)  $x + 9 \leq 2$

(g)  $\frac{x-3}{3} > 9$

(h)  $\frac{2x+5}{2} \leq 6$

(i)  $\frac{3x+1}{5} \geq 10$

2. For each number line describing  $x$  write down the inequality.



3. Solve for  $x$ .

(a)  $6 \leq x + 3 < 9$

(b)  $3 \leq x + 2 < 5$

(c)  $4 \leq x + 1 < 7$

(d)  $-3 < 2x + 1 < 5$

(e)  $-1 < 2x + 6 \leq 8$

(f)  $-6 \leq 3x + 2 \leq 8$

(g)  $-7 < x - 2 \leq -5$

(h)  $-6 > 3x + 2 \geq -10$

(i)  $-8 \leq x + 6 \leq 8$

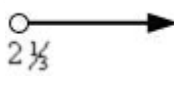
(j)  $5 < \frac{2x+1}{5} \leq 10$

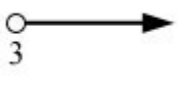
(k)  $6 \leq \frac{x-1}{3} < 24$


(l)  $8 \leq \frac{3x-4}{4} \leq 16$

1.

(a)  $x > 2$  

(b)  $x > 2\frac{1}{3}$  


(c)  $x > 3$  

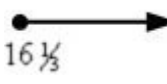
(d)  $x \leq -1\frac{1}{2}$  

(e)  $x \geq -2$  

(f)  $x \leq -7$  

(g)  $x > 30$  

(h)  $x \leq 3\frac{1}{2}$  

(i)  $x \geq 16\frac{1}{3}$  

2.

(a)  $x \leq 4$

(b)  $x \leq 6$

(c)  $x > 7$

(d)  $x > 4$

(e)  $-2 \leq x < 7$

(f)  $-1 \leq x \leq 2$

(g)  $-3 < x \leq 5$

(h)  $3 < x < 7$

(i)  $x < 3$

(j)  $x < -9$

(k)  $x \geq -2$

(l)  $x \geq 15$

3.

(a)  $3 \leq x < 6$

(b)  $1 \leq x < 3$

(c)  $3 \leq x < 6$

(d)  $-2 < x < 2$

(e)  $-3\frac{1}{2} < x \leq 1$

(f)  $-2\frac{2}{3} \leq x \leq 2$

(g)  $-5 < x \leq -3$

(h)  $-2\frac{2}{3} > x \geq -4$

(i)  $-14 \leq x \leq 2$

(j)  $12 < x \leq 24\frac{1}{2}$

(k)  $19 \leq x < 73$

(l)  $12 \leq x \leq 22\frac{2}{3}$

1. Write down the straight line equation from the information given.

(m – gradient, i – intercept on y-axis)

(a)  $m = 3, i = 4$

(b)  $m = 2, i = -1$

(c)  $m = 5, i = 3$

(d)  $m = -2, i = 1$

(e)  $m = 4, i = -3$

(f)  $m = 1, i = -1$

(g)  $m = 7, i = -4$

(h)  $m = -2, i = -5$

(i)  $m = 2, i = -11$

(j)  $m = 6, i = 7$

(k)  $m = 9, i = -10$

(l)  $m = -2, i = -9$

2. For each equation write down the gradient and intercept on the y-axis.

(a)  $y = 3x + 4$

(b)  $y = x - 1$

(c)  $y = 2x - 5$

(d)  $y = 5x + 1$

(e)  $y = x - 6$

(f)  $y = 4x + 7$

(g)  $y = 3x - 9$

(h)  $y = 2(x - 4)$

(i)  $y = 5(x - 3)$

(j)  $y = 3(2x - 1)$

(k)  $2y = 2x - 3$

(l)  $3y = 6x + 1$

3. Find the equation of the line that passes through the following points.

(a) (0,0) (2,3)

(b) (0,0) (-3,-4)

(c) (0,0) (-2,1)

(d) (1,0) (-3,1)

(e) (1,0) (2,-1)

(f) (1,0) (-1,2)

(g) (-1,0) (1,4)

(h) (-3,-2) (2,2)

(i) (2,-1) (3,5)

(j) (-1,-1) (-2,-6)

(k) (-6,-2) (-4,-7)

(l) (-1,-7) (-9,-10)

4. For each equation write down the intercept on the x-axis.

(a)  $y = x + 6$

(b)  $y = 2x - 8$

(c)  $y = 3x - 9$

(d)  $y = x + 3$

(e)  $y = 5x - 2$

(f)  $y = 3 - 2x$

(g)  $y = 5 - x$

(h)  $2y = 4 + 3x$

(i)  $3y = 2(3 - 2x)$



1.

(a)  $y = 3x + 4$

(b)  $y = 2x - 1$

(c)  $y = 5x + 3$

(d)  $y = -2x + 1$

(e)  $y = 4x - 3$

(f)  $y = x - 1$

(g)  $y = 7x - 4$

(h)  $y = -2x - 5$

(i)  $y = 2x - 11$

(j)  $y = 6x + 7$

(k)  $y = 9x - 10$

(l)  $y = -2x - 9$

2.

(a) 3, 4

(b) 1, -1

(c) 2, -5

(d) 5, 1

(e) 1, -6

(f) 4, 7

(g) 3, -9

(h) 2, -8

(i) 5, -15

(j) 6, -3

(k) 1,  $-1\frac{1}{2}$

(l) 2,  $\frac{1}{3}$

3.

(a)  $y = \frac{3}{2}x$

(b)  $y = \frac{4}{3}x$

(c)  $y = -\frac{1}{2}x$

(d)  $y = -\frac{1}{4}x + \frac{1}{4}$

(e)  $y = -x + 1$

(f)  $y = -x + 1$

(g)  $y = 2x + 2$

(h)  $y = \frac{4}{5}x + \frac{2}{5}$

(i)  $y = 6x - 13$

(j)  $y = 5x + 4$

(k)  $y = -\frac{5}{2}x - 17$

(l)  $y = \frac{3}{8}x - 6\frac{5}{8}$

4.

(a) -6

(b) 4

(c) 3

(d) -3

(e)  $\frac{2}{5}$

(f)  $1\frac{1}{2}$

(g) 5

(h)  $-1\frac{1}{3}$

(i)  $1\frac{1}{2}$

1. Write down the matrix that will transform the first equation into the second.

(a)  $y = x + 3$ ,  $y = x - 4$

(b)  $y = x + 1$ ,  $y = x + 3$

(c)  $y = x - 1$ ,  $y = x - 5$

(d)  $y = x - 3$ ,  $y = x + 2$

(e)  $y = x + 5$ ,  $y = x - 7$

(f)  $y = x - 4$ ,  $y = x + 6$

2. Write down the equation of the line after the matrix transformation.

(a)  $y = x + 1$   $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$  (b)  $y = x - 2$   $\begin{pmatrix} 0 \\ 3 \end{pmatrix}$  (c)  $y = x + 3$   $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$

(d)  $y = x - 3$   $\begin{pmatrix} 0 \\ -1 \end{pmatrix}$  (e)  $y = x + 2$   $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$  (f)  $y = x - 1$   $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$

3. Write down the matrix that will transform the first equation into the second.

(a)  $y = x^2$ ,  $y = (x + 2)^2$  (b)  $y = 2x^2$ ,  $y = 2(x - 1)^2$

(c)  $y = 3x$ ,  $y = 3(x + 3)$  (d)  $y = 2x^3$ ,  $y = 2(x - 2)^3$

(e)  $y = 3x^2$ ,  $y = 3(x - 3)^2$  (f)  $y = 5x$ ,  $y = 5(x + 2)$

4. Write down the equation of the line after the matrix transformation.

(a)  $y = x^2$   $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$  (b)  $y = 2x^2$   $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$  (c)  $y = 3x$   $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$

(d)  $y = 2x^3$   $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$  (e)  $y = 3x^2$   $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$  (f)  $y = 5x^3$   $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$

1.

(a)  $\begin{pmatrix} 0 \\ -7 \end{pmatrix}$

(b)  $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$

(c)  $\begin{pmatrix} 0 \\ -4 \end{pmatrix}$

(d)  $\begin{pmatrix} 0 \\ 5 \end{pmatrix}$

(e)  $\begin{pmatrix} 0 \\ -12 \end{pmatrix}$

(f)  $\begin{pmatrix} 0 \\ 10 \end{pmatrix}$

2.

(a)  $y = x + 3$

(b)  $y = x + 1$

(c)  $y = x + 1$

(d)  $y = x - 4$

(e)  $y = x - 1$

(f)  $y = x - 3$

3.

(a)  $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$

(b)  $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$

(c)  $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$

(d)  $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$

(e)  $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$

(f)  $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$

4.

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

(b)  $y = 2(x - 2)^2$

(c)  $y = 3(x + 1)$

(d)  $y = 2(x - 3)^3$

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

(f)  $y = 5(x - 4)^3$