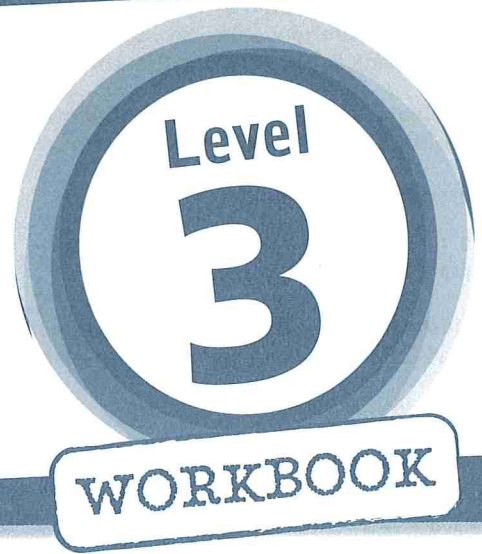


Edexcel Award in **Algebra**



ANSWERS

Diane Oliver

Answers

1 Algebraic manipulation

1.1 Expanding two brackets

1 a $6x^2 - 15x$

\times	x	$+2$
x	x^2	$+2x$
$+3$	$+3x$	$+6$

$$x^2 + 2x + 3x + 6 = x^2 + 5x + 6$$

c $2x^2 - 10x + 3x - 15 = 2x^2 - 7x - 15$

d $6x^2 - 8xy - 15xy + 20y^2 = 6x^2 - 23xy + 20y^2$

2 a $2x^2 + 8x$

b $18x^2 - 30x$

c $10x^2 - 10xy$

d $x^2 + 9x + 20$

e $x^2 + 10x + 21$

f $x^2 + 5x - 14$

g $x^2 - 25$

h $2x^2 + x - 3$

i $6x^2 - x - 2$

j $10x^2 - 31x + 15$

k $12x^2 + 13x - 14$

l $18x^2 + 39xy + 20y^2$

m $35x^2 + 14xy - 15x - 6y$

n $6x^2 - 16x - 9xy + 24y$

1.2 Factorising expressions

1 a $3x^2y(5y^2 + 3x^2)$

b $(2x - 5y)(2x + 5y)$

c $b = 3, ac = -10$

$$x^2 + 3x - 10 = x^2 + 5x - 2x - 10$$

$$= x(x + 5) - 2(x + 5)$$

$$= (x + 5)(x - 2)$$

d $b = -11, ac = -60$

Two numbers are -15 and 4

$$6x^2 - 11x - 10 = 6x^2 - 15x + 4x - 10$$

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

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

2 a $2x^3y^3(3x - 5y)$

b $7a^3b^2(3b^3 + 5a^2)$

c $5x^2y^2(5 - 2x + 3y)$

3 a $(x + 3)(x + 4)$

b $(x + 7)(x - 2)$

c $(x - 5)(x - 6)$

d $(x - 8)(x + 3)$

e $(x - 9)(x + 2)$

f $(x + 5)(x - 4)$

g $(x - 8)(x + 5)$

h $(x + 7)(x - 4)$

4 a $(6x - 7y)(6x + 7y)$

b $(2x - 9y)(2x + 9y)$

c $2(3a - 10bc)(3a + 10bc)$

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

b $(3x + 1)(2x + 5)$

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

d $(2x + 1)(x + 3)$

e $(3x - 1)(3x - 4)$

f $(5x + 3)(2x + 3)$

1.3 Using index laws

1 a 1

b $\sqrt{9} = 3$

c $(\sqrt[3]{27})^2 = 3^2 = 9$

d $\frac{1}{4^2} = \frac{1}{16}$

e $3x^3$

f $\frac{x^8}{x^4} = x^4$

g $\frac{x^5}{x^3} = x^2$

h $\frac{12x^2}{8x^6} = \frac{3}{2x^4}$

2 a 1

b 1

c 1

3 a 7

b 4

c 5

d 2

4 a 125

b 32

c 343

d 8

5 a $\frac{1}{25}$

b $\frac{1}{64}$

c $\frac{1}{32}$

d $\frac{1}{36}$

6 a $\frac{3x^3}{2}$

b $5x^2$

c $3x$

d $\frac{y}{2x^2}$

e $y^{\frac{1}{2}}$

f c^{-3}

g $2x^6$

h x

7 a $\frac{1}{2}$

b $\frac{1}{9}$

c $\frac{8}{3}$

d $\frac{1}{4}$

e $\frac{4}{3}$

f $\frac{16}{9}$

1.4 Algebraic fractions

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

b $\frac{(x+3)(x-7)}{(2x+3)(x+3)} = \frac{x-7}{2x+3}$

c $\frac{2x}{6} + \frac{6x+3}{6} = \frac{8x+3}{6}$

d $\frac{2x+2}{(x-3)(x+1)} - \frac{5x-15}{(x-3)(x+1)} = \frac{-3x+17}{(x-3)(x+1)}$

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

b $\frac{x}{x-1}$

c $\frac{x+2}{x}$

d $\frac{x}{x+5}$

e $\frac{x+3}{x}$

f $\frac{x}{x-5}$

3 a $\frac{13x}{15}$

b $\frac{11x+5}{10}$

c $\frac{x}{28}$

d $\frac{x}{12}$

e $\frac{11x+4}{12}$

f $\frac{7x+13}{20}$

4 a $\frac{5x+11}{(x+3)(x+1)}$

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

c $\frac{x-8}{x(x+4)}$

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

e $\frac{5(x+2)}{(2x-3)(x+1)}$

f $\frac{5x-4}{(x+1)(x-2)}$

5 a $\frac{3x+4}{x+7}$

b $\frac{2x+3}{3x-2}$

c $\frac{2-5x}{2x-3}$

d $\frac{3x+1}{x+4}$

1.5 Completing the square

1 a $(x+3)^2 - 2 - 9 = (x+3)^2 - 11$

b $2(x^2 - \frac{5}{2}x + \frac{1}{2}) = 2[(x - \frac{5}{4})^2 + \frac{1}{2} - \frac{25}{16}] = 2[(x - \frac{5}{4})^2 - \frac{17}{16}] = 2(x - \frac{5}{4})^2 - \frac{17}{8}$

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

b $(x-5)^2 - 28$

c $(x-4)^2 - 16$

d $(x+3)^2 - 9$

e $(x-1)^2 + 6$

f $(x + \frac{3}{2})^2 - \frac{17}{4}$

3 a $2(x-2)^2 - 24$

b $4(x-1)^2 - 20$

c $3(x+2)^2 - 21$

d $2(x + \frac{3}{2})^2 - \frac{25}{2}$

4 a $2(x + \frac{3}{4})^2 + \frac{39}{8}$

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

c $5(x + \frac{3}{10})^2 - \frac{9}{20}$

d $3(x + \frac{5}{6})^2 + \frac{11}{12}$

Don't forget!

* four

* $ax^2 + bx + c$

* $b; ac$

* the difference of two squares; $(x-y)(x+y)$

* $a^m + n$

* $a^m - n$

* a^m

* 1

* $\sqrt[n]{a}$

* $\sqrt[n]{(a^m)}$ or $(\sqrt[n]{a})^m$

* $\frac{1}{a^m}$

* numerator; denominator

* 1

* common denominator; equivalent

* $p(x+q)^2 + r$

Exam-style questions

1 a $3x^2 - 7x - 6$

b $6x^2y^2(2x + 5y^3)$

c x^2

2 a x^{-2}

b $(x-5)(x+7)$

c $(2x-5y)(2x+5y)$

3 $(x+1\frac{1}{2})^2 - 7\frac{1}{4}$

4 $\frac{x+2}{2x+3}$

2 Formulae

2.1 Substitution

1 a $2 \times 8 + (-6) = 16 - 6 = 10$

b $8 + (-6) \times \frac{1}{3} = 8 - 2 = 6$

c $\frac{3 \times 8}{-6} = -4$

d $8^{\frac{1}{3}} - (-6) = 2 + 6 = 8$

2 C = $\frac{5}{9}$ of $(50 - 32)$

C = $\frac{5}{9}$ of 18

C = $5 \times 18 \div 9$

C = 10

- 3 a 7 b 3 c $20\frac{1}{2}$ d 25
 e -324 f -18
 4 a -1.6 b 2.7 c 2.8 d -2.4
 5 a $-2\frac{2}{3}$ b $-\frac{1}{6}$ c $-1\frac{1}{6}$ d -7
 6 610

2.2 Changing the subject of a formula

- 1 $v - u = at$
 $t = \frac{v - u}{a}$
 3 $2(t + r) = 5 \times 3t$
 $2t + 2r = 15t$
 $2r = 13t$
 $t = \frac{2r}{13}$
 5 $d = \frac{C}{\pi}$
 8 $t = \frac{q - r}{p}$
 11 $y = 2 + 3x$
 14 $g = \frac{2h + 9}{7 - h}$
 2 $r = t(2 - \pi)$
 $t = \frac{r}{2 - \pi}$
 4 $r(t - 1) = 3t + 5$
 $rt - r = 3t + 5$
 $rt - 3t = 5 + r$
 $t(r - 3) = 5 + r$
 $t = \frac{5 + r}{r - 3}$
 6 $w = \frac{P - 2I}{2}$
 9 $t = \frac{2u}{2a - 1}$
 12 $a = \frac{3x + 1}{x + 2}$
 15 $e = \frac{1}{x + 7}$
 7 $T = \frac{S}{D}$
 10 $x = \frac{V}{a + 4}$
 13 $d = \frac{b - c}{a}$

Don't forget!

- * replacing each letter with its value
- * everything else

Exam-style questions

1 $x = \frac{4y - 3}{2 + y}$

3 Surds

3.1 Surds

- 1 $\sqrt{25 \times 2} = \sqrt{25} \times \sqrt{2} = 5 \times \sqrt{2} = 5\sqrt{2}$
 2 $\sqrt{49 \times 3} - 2\sqrt{4 \times 3} = \sqrt{49} \times \sqrt{3} - 2\sqrt{4} \times \sqrt{3}$
 $= 7 \times \sqrt{3} - 2 \times 2 \times \sqrt{3} = 3\sqrt{3}$
 3 $\sqrt{49} - \sqrt{7\sqrt{2}} + \sqrt{2\sqrt{7}} - \sqrt{4} = 7 - 2 = 5$
 4 a $3\sqrt{5}$ b $5\sqrt{5}$ c $4\sqrt{3}$ d $5\sqrt{7}$
 e $10\sqrt{3}$ f $2\sqrt{7}$ g $6\sqrt{2}$ h $9\sqrt{2}$
 5 a -1 b $9 - \sqrt{3}$ c $10\sqrt{5} - 7$ d $26 - 4\sqrt{2}$
 6 a $15\sqrt{2}$ b $\sqrt{5}$ c $3\sqrt{2}$ d $\sqrt{3}$
 e $6\sqrt{7}$ f $5\sqrt{3}$

3.2 Rationalising the denominator

- 1 a $\frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$
 b $\frac{\sqrt{2}}{\sqrt{12}} \times \frac{\sqrt{12}}{\sqrt{12}} = \frac{\sqrt{2} \times 2\sqrt{3}}{12} = \frac{\sqrt{6}}{6}$
 c $\frac{3}{2 + \sqrt{5}} \times \frac{2 - \sqrt{5}}{2 - \sqrt{5}} = \frac{3(2 - \sqrt{5})}{4 + 2\sqrt{5} - 2\sqrt{5} - 5} = \frac{3(2 - \sqrt{5})}{-1}$
 $= -3(2 - \sqrt{5}) = -6 + 3\sqrt{5}$
 2 a $\frac{\sqrt{5}}{5}$ b $\frac{\sqrt{11}}{11}$ c $\frac{2\sqrt{7}}{7}$ d $\frac{\sqrt{2}}{2}$
 e $\sqrt{2}$ f $\sqrt{5}$ g $\frac{\sqrt{3}}{3}$ h $\frac{1}{3}$
 3 a $\frac{3 + \sqrt{5}}{4}$ b $\frac{2(4 - \sqrt{3})}{13}$ c $\frac{6(5 + \sqrt{2})}{23}$

Don't forget!

- * the square root of a number that is not a square number
- * $\sqrt{2}, \sqrt{3}, \sqrt{5}$, etc.
- * $\sqrt{a} \times \sqrt{b}$
- * $\frac{\sqrt{a}}{\sqrt{b}}$
- * denominator
- * \sqrt{b}
- * $b - \sqrt{c}$

Exam-style questions

- 1 $2\sqrt{5}$ 2 $9 - 4\sqrt{2}$ 3 $10 + 5\sqrt{3}$ 4 $\frac{3\sqrt{5}}{5}$ 5 $7\sqrt{2}$

4 Quadratic equations

4.1 Solving by factorisation

- 1 a $5x^2 - 15x = 0$
 $5x(x - 3) = 0$
 So $5x = 0$ or $x - 3 = 0$
 $x = 0$ or $x = 3$
 b $(x + 4)(x + 3) = 0$
 So $x + 4 = 0$ or $x + 3 = 0$
 $x = -4$ or $x = -3$
 c $(3x + 4)(3x - 4) = 0$
 So $3x + 4 = 0$ or $3x - 4 = 0$
 $x = -1\frac{1}{3}$ or $x = 1\frac{1}{3}$
 d $(2x + 3)(x - 4) = 0$
 So $2x + 3 = 0$ or $x - 4 = 0$
 $x = -1\frac{1}{2}$ or $x = 4$
 2 a $x = 0$ or $x = -\frac{2}{3}$ b $x = 0$ or $x = \frac{3}{4}$
 c $x = -5$ or $x = -2$ d $x = 2$ or $x = 3$
 e $x = -1$ or $x = 4$ f $x = -5$ or $x = 2$
 g $x = 4$ or $x = 6$ h $x = -6$ or $x = 6$
 i $x = -7$ or $x = 4$ j $x = 3$
 k $x = -\frac{1}{2}$ or $x = 4$ l $x = -\frac{2}{3}$ or $x = 5$
 3 a $x = -2$ or $x = 5$ b $x = -1$ or $x = 3$
 c $x = -8$ or $x = 3$ d $x = -6$ or $x = 7$
 e $x = -5$ or $x = 5$ f $x = -4$ or $x = 7$
 g $x = -3$ or $x = 2\frac{1}{2}$ h $x = -\frac{1}{3}$ or $x = 2$

4.2 Solving by completing the square

- 1 $(x + 3)^2 + 4 - 9 = 0$
 $(x + 3)^2 - 5 = 0$
 $(x + 3)^2 = 5$
 $x + 3 = \pm\sqrt{5}$
 $x = -3 \pm\sqrt{5}$
 $x = -3 + \sqrt{5}$ or $x = -3 - \sqrt{5}$
 2 $2[x^2 - \frac{7}{2}x + 2] = 0$
 $2[(x - \frac{7}{4})^2 + 2 - \frac{49}{16}] = 0$
 $(x - \frac{7}{4})^2 - \frac{17}{16} = 0$
 $(x - \frac{7}{4})^2 = \frac{17}{16}$
 $x - \frac{7}{4} = \pm\sqrt{\frac{17}{16}}$
 $x - \frac{7}{4} = \pm\frac{1}{4}\sqrt{17}$
 $x = \frac{7 + \sqrt{17}}{4}$ or $x = \frac{7 - \sqrt{17}}{4}$
 3 a $x = 2 + \sqrt{7}$ or $x = 2 - \sqrt{7}$
 b $x = 5 + \sqrt{21}$ or $x = 5 - \sqrt{21}$
 c $x = -4 + \sqrt{21}$ or $x = -4 - \sqrt{21}$
 d $x = 1 + \sqrt{7}$ or $x = 1 - \sqrt{7}$
 e $x = -2 + \sqrt{6.5}$ or $x = -2 - \sqrt{6.5}$
 f $x = \frac{-3 + \sqrt{89}}{10}$ or $x = \frac{-3 - \sqrt{89}}{10}$
 4 a $x = 1 + \sqrt{14}$ or $x = 1 - \sqrt{14}$
 b $x = \frac{-3 + \sqrt{23}}{2}$ or $x = \frac{-3 - \sqrt{23}}{2}$
 c $x = \frac{5 + \sqrt{13}}{2}$ or $x = \frac{5 - \sqrt{13}}{2}$

4.3 Solving by using the formula

- 1 $x = \frac{-(6) \pm \sqrt{(6)^2 - 4 \times 1 \times 4}}{2 \times 1}$
 $x = \frac{-6 \pm \sqrt{36 - 16}}{2}$
 $x = \frac{-6 \pm \sqrt{20}}{2}$
 $x = \frac{-6 \pm \sqrt{4 \times 5}}{2}$
 $x = \frac{-6 + 2\sqrt{5}}{2}$ or $x = \frac{-6 - 2\sqrt{5}}{2}$
 $x = -3 + \sqrt{5}$ or $x = -3 - \sqrt{5}$

- 2 $5n - 2 = 73$
 $5n = 75$
 $n = 15$
- 3 $a = 3, d = 5$
 n th term $= 3 + (n - 1) \times 5$
 $= 3 + 5n - 5$
 $= 5n - 2$
- 4 $8 + 13 + 18$ 5 $3n + 2; 62$ 6 $17 - 2n; -3$ 7 $82; 402$
- 8 $8; -97$ 9 25 10 53 11 5
- 12 first term $= 1$, common difference $= 3$

7.2 The sum of an arithmetic series

- 1 $a = 1, d = 4, n = 30$ 2 $S_n = 432, a = 7, L = 41$
 $S_n = \frac{30}{2} [2 \times 1 + (30 - 1) \times 4]$ $432 = \frac{n}{2}(7 + 41)$
 $S_n = 15 \times (2 + 29 \times 4)$ $432 = 24n$
 $S_n = 1770$ $n = 18$
- 3 $S_n = 352, a = 7, d = 2$ 4 $S_n = 1, n = 2$
 $352 = \frac{n}{2} [2 \times 7 + (n - 1) \times 2]$ $1 = \frac{2}{2} [2a + (2 - 1)d]$
 $704 = n(14 + 2n - 2)$ $2a + d = 1$
 $704 = 2n^2 + 12n$ $93 = a + (20 - 1)d$
 $2n^2 + 12n - 704 = 0$ $a + 19d = 93$
 $n^2 + 6n - 352 = 0$ $a + 19(1 - 2a) = 93$
 $(n + 22)(n - 16) = 0$ $a + 19 - 38a = 93$
 $n = 16$ $19 - 37a = 93$
 $-37a = 74$
 $a = -2, d = 5$
- first term $= -2$; common difference $= 5$
- 5 610 6 1395 7 -5350 8 290
- 9 341 10 1370 11 488 12 10
- 13 first term $= 2$; common difference $= 3$

Don't forget!

- * sequence
- * n th term
- * the same amount
- * $a + (n - 1)d$
- * $\frac{n}{2}[2a + (n - 1)d]$
- * $\frac{n}{2}(a + L)$

Exam-style questions

- 1 a first term $= 60$; common difference $= -7$
 b -1245

8 Coordinate geometry

8.1 The equation of a line

- 1 $y = -\frac{1}{2}x + 3$
 $2y = -x + 6$
 $x + 2y - 6 = 0$
- 3 $m = 3$
 $y = 3x + c$
 $13 = 3 \times 5 + c$
 $13 = 15 + c$
 $c = -2$
 $y = 3x - 2$
- 5 a $m = 3, c = 5$
 c $m = 2, c = -\frac{3}{2}$
 e $m = \frac{2}{3}, c = -\frac{7}{3}$ or $-2\frac{1}{3}$
- 6 $y = 5x$
 $y = -3x + 2$
 $y = 4x - 7$
- 7 a $x + 2y + 14 = 0$
 c $2x - 3y + 12 = 0$
- 8 $y = 4x - 3$
- 9 $y = -\frac{2}{3}x + 7$
- 10 a $y = 2x - 3$
 c $y = 5x - 2$
- 2 $3y = 2x - 4$
 $y = \frac{2}{3}x - \frac{4}{3}$
 gradient $= m = \frac{2}{3}$
 y -intercept $= c = -\frac{4}{3}$ or $-1\frac{1}{3}$
- 4 $m = \frac{7 - 4}{8 - 2} = \frac{3}{6} = \frac{1}{2}$
 $y = \frac{1}{2}x + c$
 4 (or 7) $= \frac{1}{2} \times 2$ (or 8) $+ c$
 4 (or 7) $= 1$ (or 4) $+ c$
 $c = 3$
 $y = \frac{1}{2}x + 3$
- b $m = -\frac{1}{2}, c = -7$
 d $m = -1, c = 5$
 f $m = -5, c = 4$
- b $2x - y = 0$
 d $6x + 5y + 10 = 0$
- b $y = -\frac{1}{2}x + 6$
 d $y = -3x + 19$

8.2 Parallel and perpendicular lines

- 1 $m = 2$
 $y = 2x + c$
 $9 = 2 \times 4 + c$
 $c = 1$
 $y = 2x + 1$
- 2 $m = 2$
 $-\frac{1}{m} = -\frac{1}{2}$
 $y = -\frac{1}{2}x + c$
 $5 = -\frac{1}{2} \times -2 + c = 1 + c$
 $c = 4$
 $y = -\frac{1}{2}x + 4$
- 3 $m = \frac{1}{2}$
 $-\frac{1}{m} = -2$
 $y = -2x + c$
 $3 = -2 \times -5 + c$
 $c = -7$
 $y = -2x - 7$
- 4 $m = \frac{-1 - 5}{9 - 0} = -\frac{6}{9} = -\frac{2}{3}$
 $-\frac{1}{m} = \frac{3}{2}$
 $y = \frac{3}{2}x + c$
 $\left(\frac{0 + 9}{2}, \frac{5 + -1}{2}\right) = \left(\frac{9}{2}, 2\right)$
 $y = \frac{3}{2}x + c$
 $2 = \frac{3}{2} \times \frac{9}{2} + c = \frac{27}{4} + c$
 $c = -\frac{19}{4}$
 $y = \frac{3}{2}x - \frac{19}{4}$
- 5 a $y = 3x - 7$ b $y = -2x + 5$
 c $y = -\frac{1}{2}x$ d $y = \frac{3}{2}x + 8$
- 6 a $y = -\frac{1}{2}x + 2$ b $y = 3x + 7$
 c $y = -4x + 35$ d $y = \frac{5}{2}x - 8$
- 7 a $y = -\frac{1}{2}x$ b $y = 2x$
- 8 a parallel b neither c perpendicular
 d perpendicular e neither f parallel

Don't forget!

- * $y = mx + c$
- * $ax + by + c = 0$
- * $m = \frac{y_2 - y_1}{x_2 - x_1}$
- * gradient
- * $-\frac{1}{m}$

Exam-style questions

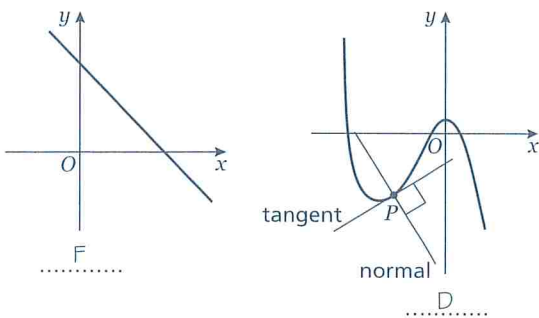
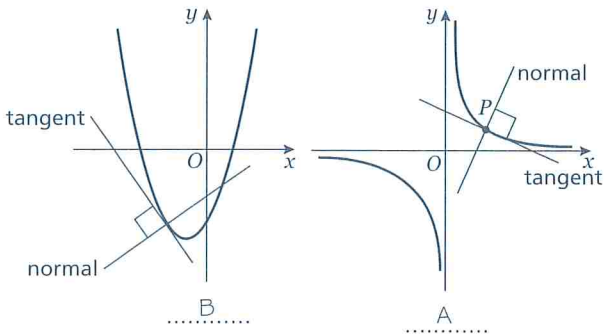
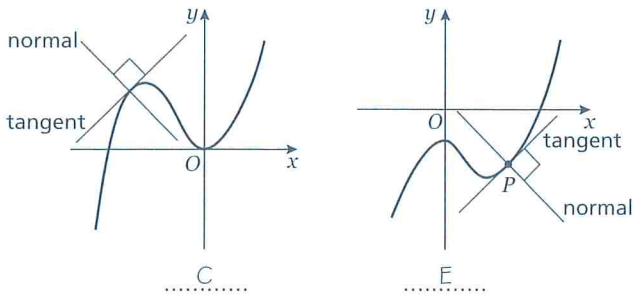
- 1 a $x + 2y - 4 = 0$ b $x + 2y + 2 = 0$ c $y = 2x$

9 Graphs of functions

9.1 Recognising graphs

- 1 a, b
-
- C
- A
- B

2 a, b

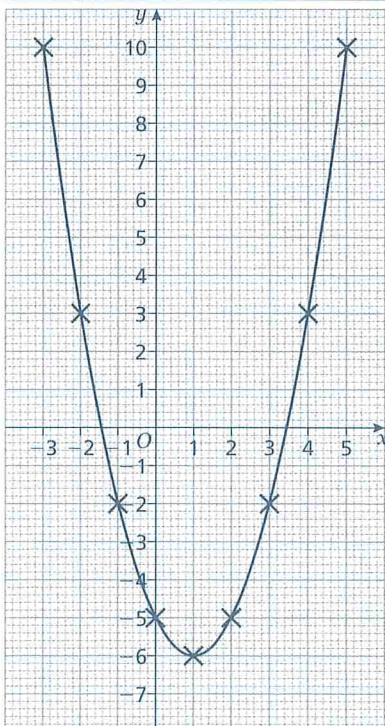


3 B, C, A

9.2 Drawing and using graphs

1 a

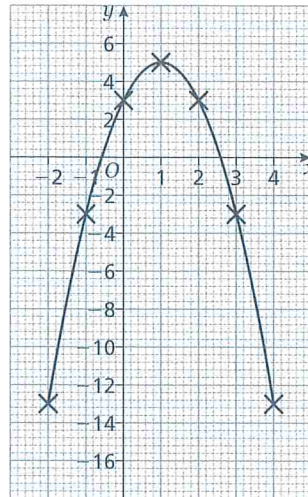
x	-3	-2	-1	0	1	2	3	4	5
y	10	3	-2	-5	-6	-5	-2	3	10



b $x \approx -1.4$ or -1.5 or $x \approx 3.4$ or 3.5

2 a

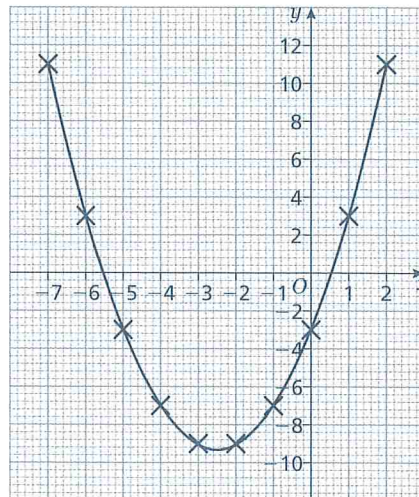
x	-2	-1	0	1	2	3	4
y	-13	-3	3	5	3	-3	-13



b $x \approx -0.6$ or $x \approx 2.6$

3 a

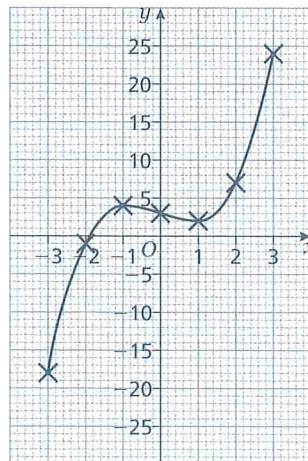
x	-7	-6	-5	-4	-3	-2	-1	0	1	2
y	11	3	-3	-7	-9	-9	-7	-3	3	11



b $x \approx -5.5$ or -5.6 or $x \approx 0.5$ or 0.6

4 a

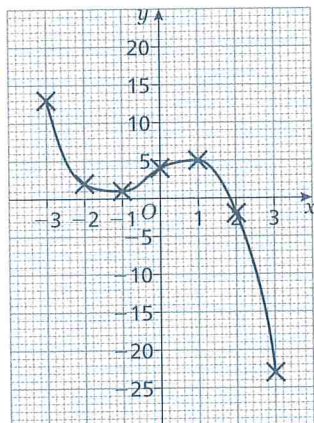
x	-3	-2	-1	0	1	2	3
y	-18	-1	4	3	2	7	24



b $x \approx -1.4$, $x = 0$ or $x \approx 1.4$

5 a

x	-3	-2	-1	0	1	2	3
y	13	2	1	4	5	-2	-23

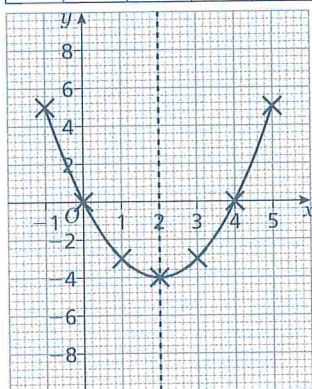


b $x \approx 1.8$

c $x = -2, x = -1$ or $x = 2$

6 a, b

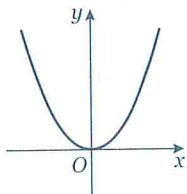
x	-1	0	1	2	3	4	5
y	5	0	-3	-4	-3	0	5



b $x = 2$

9.3 Sketching graphs

1



2 When $x = 0, y = 0^2 - 0 - 6 = -6$

$(0, -6)$

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

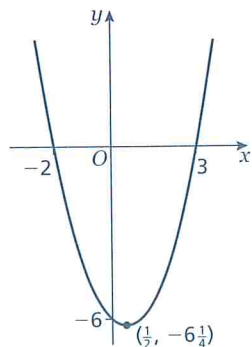
$x = 3$ or $x = -2$

$(-2, 0)$ and $(3, 0)$

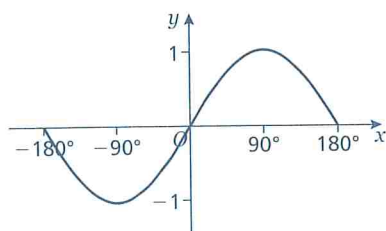
$(x - \frac{1}{2})^2 - 6\frac{1}{4}$

$x = \frac{1}{2}$ and $y = -6\frac{1}{4}$

$(\frac{1}{2}, -6\frac{1}{4})$



3

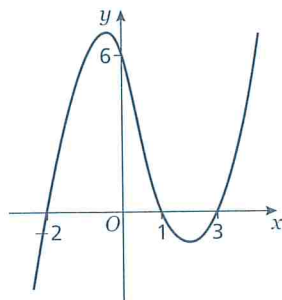


4 $x = 3, 1$ or -2

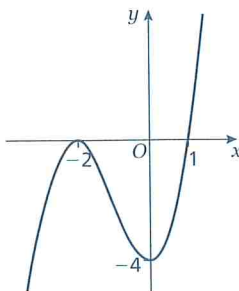
$(-2, 0), (1, 0)$ and $(3, 0)$

$y = -3 \times -1 \times 2 = 6$

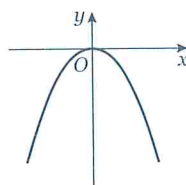
$(0, 6)$



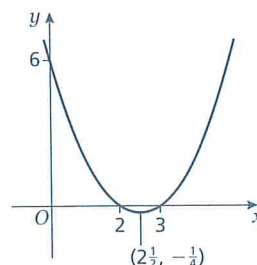
5



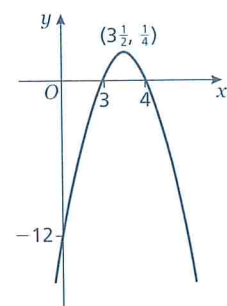
6



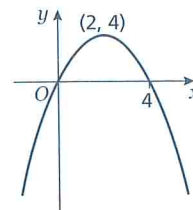
7



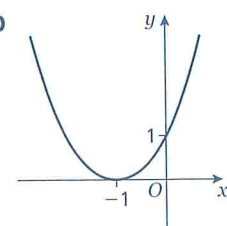
8



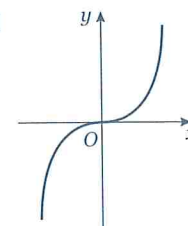
9



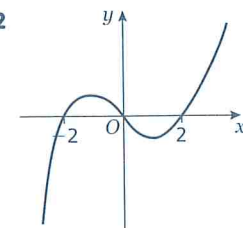
10



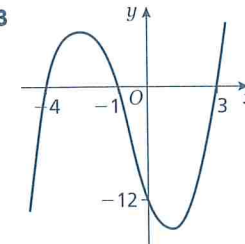
11



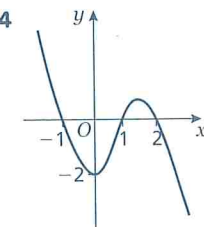
12



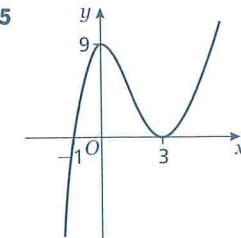
13



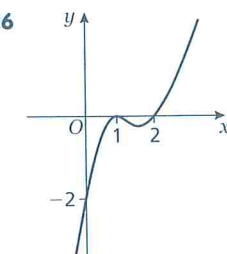
14



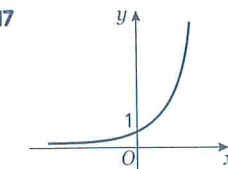
15

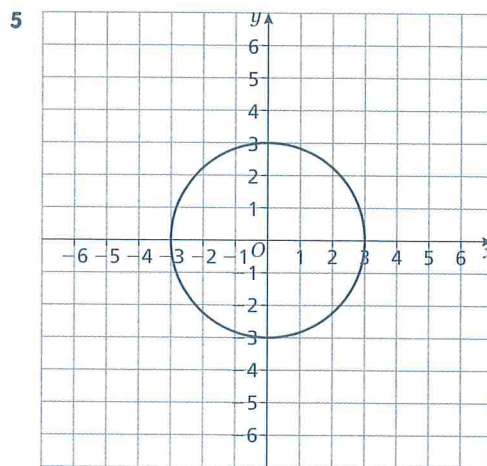
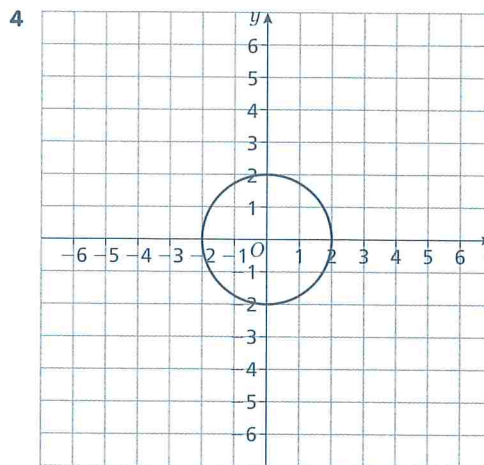
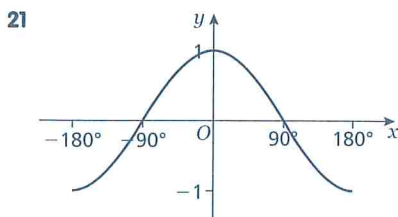
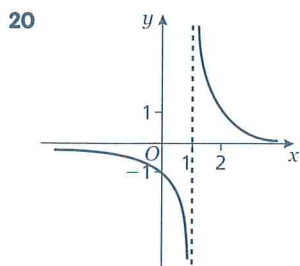
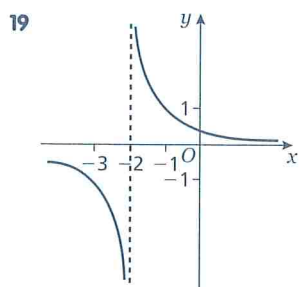
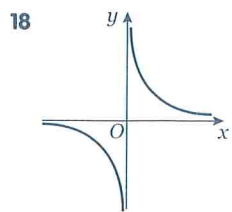


16

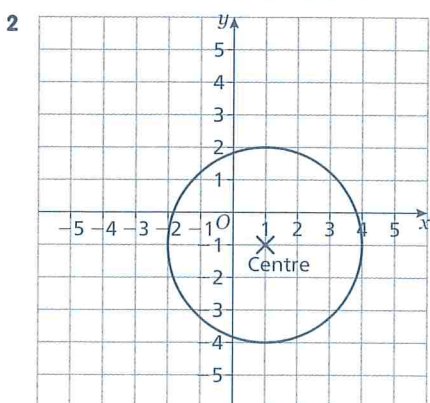
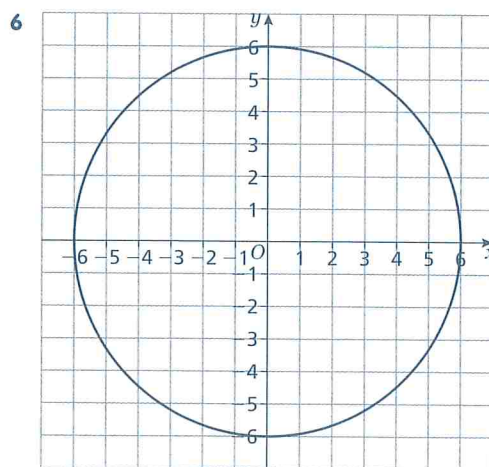
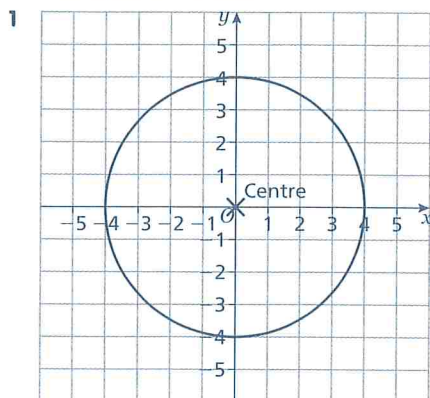


17

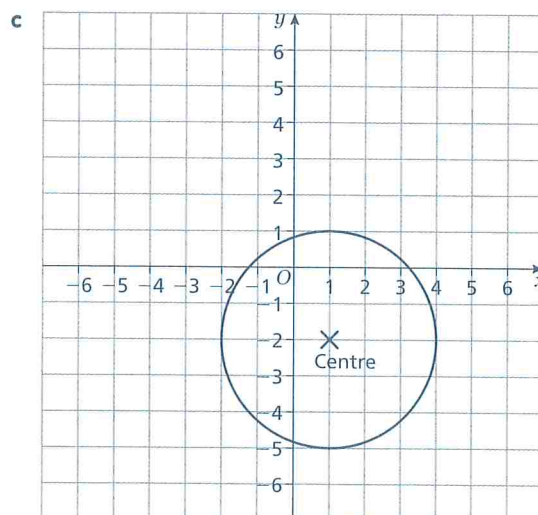
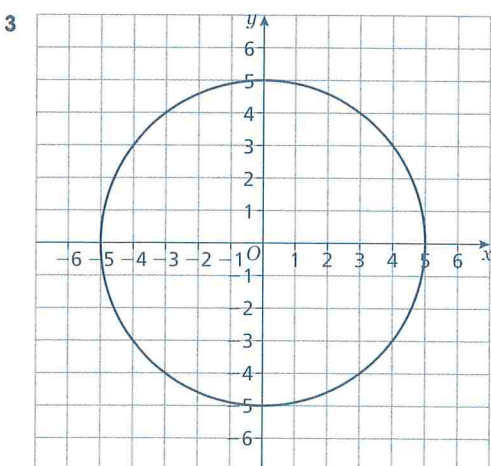




9.4 Graphs of circles

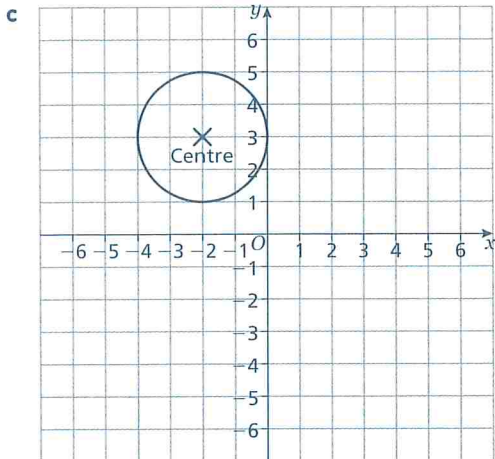


7 a (1, -2) b 3



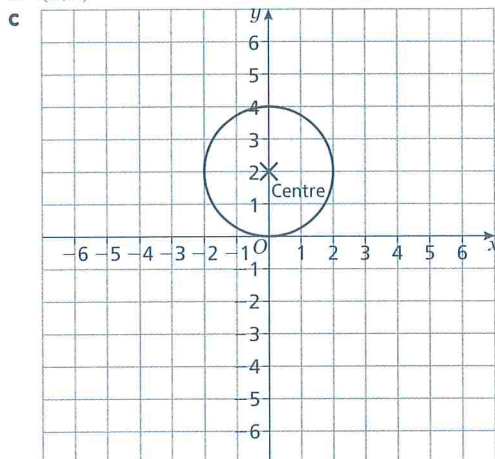
8 a (-2, 3)

b 2



9 a (0, 2)

b 2

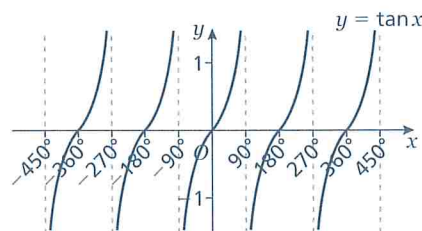
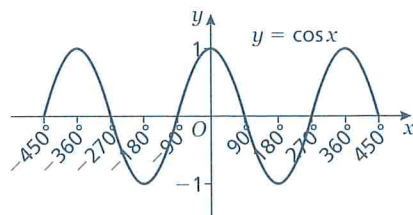
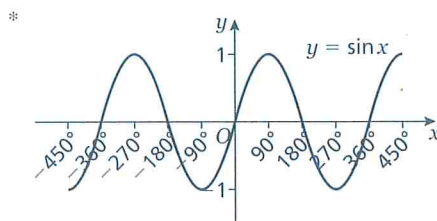
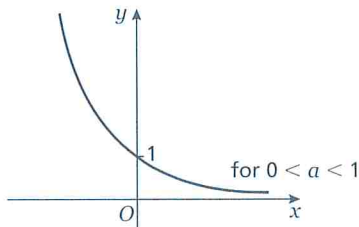
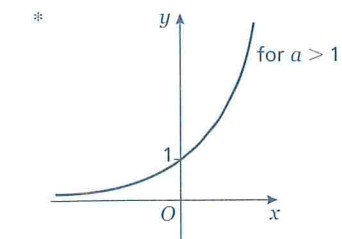
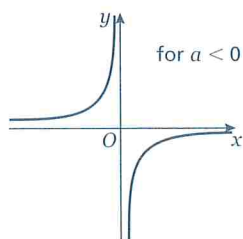
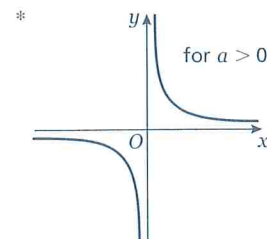
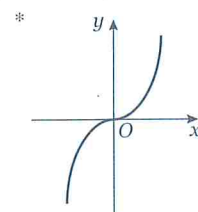
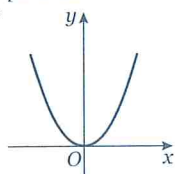


10 $(x - 2)^2 + (y - 3)^2 = 36$

11 centre = (-2, 5), radius = 4

Don't forget!

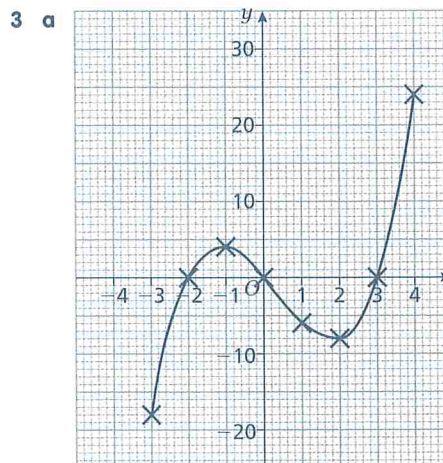
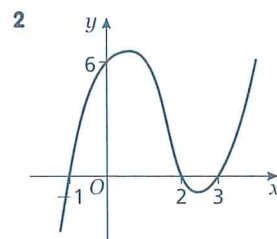
- * a straight line
- * parabola
- *



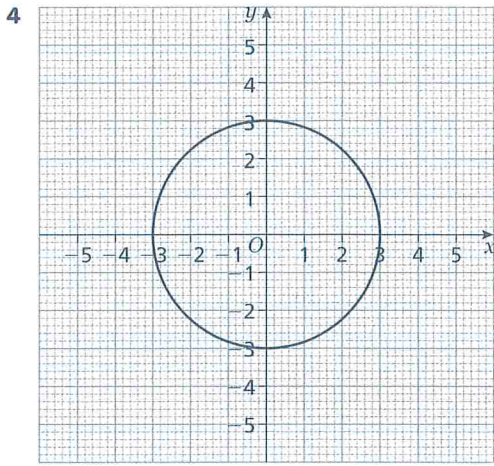
- * touches the curve but does not cross it
- * perpendicular
- * $x = 0$
- * $y = 0$
- * the curve gets closer to but never touches or crosses
- * complete the square
- * turning points
- * $(x - a)^2 + (y - b)^2 = r^2$; centre; radius; $x^2 + y^2 = r^2$

Exam-style questions

Equation	Graph
$y = 3^x$	D
$y = (x + 2)(x - 2)$	C
$y = (2 - x)(2 + x)$	A
$y = \frac{2}{x}$	E
$y = (x + 2)^2(1 - x)$	B



b -2.4, 0.8, 2.6



10 Inequalities

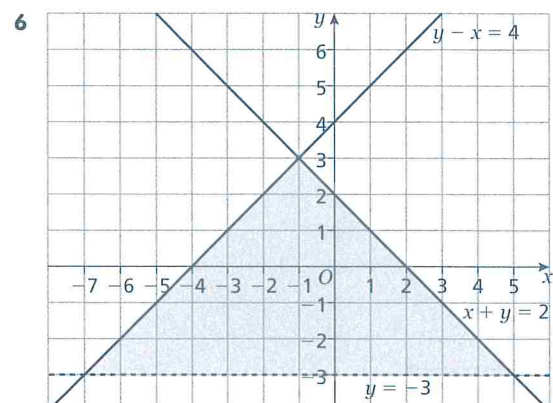
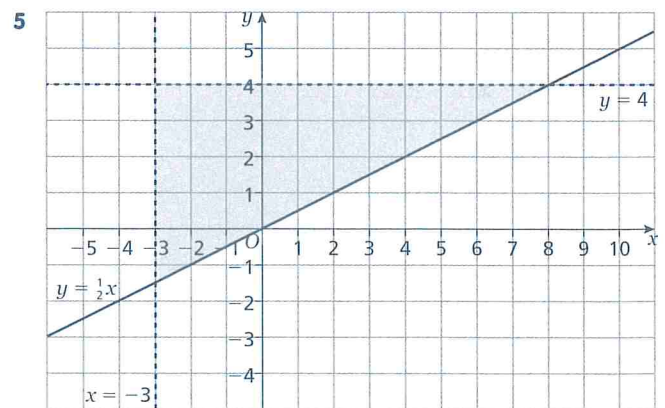
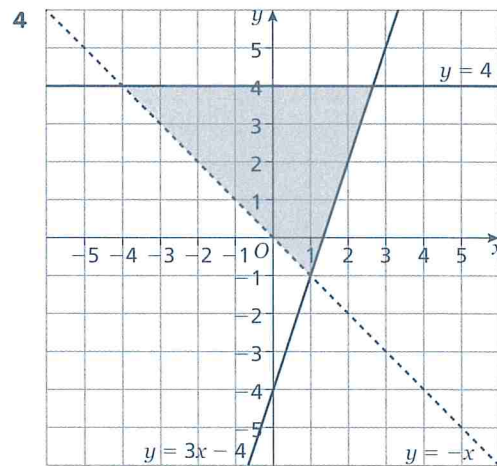
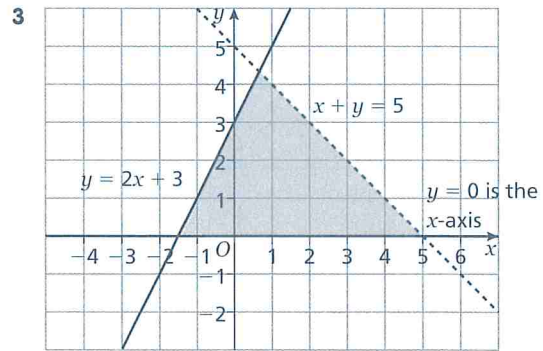
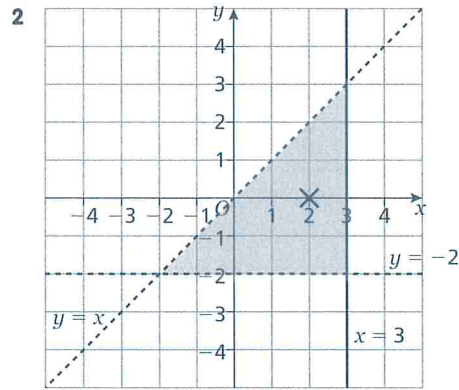
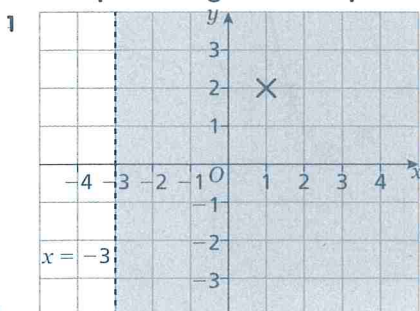
10.1 Solving linear inequalities

- 1 **a** $-2 \leq x < 4$ **b** $\frac{4}{5} < x \leq 2$
c $2x < 12$ **d** $-5x \geq -10$
 $x < 6$ $x \leq 2$
e $4x - 8 > 27 - 3x$
 $7x > 35$
 $x > 5$
- 2 **a** $x \leq -4$ **b** $-1 \leq x < 5$ **c** $x \leq 1$
d $x < -3$ **e** $x > 2$ **f** $x \leq -6$
- 3 **a** $x < -6$ **b** $x < \frac{3}{2}$
- 4 $x > 5$ (which also satisfies $x > 3$)

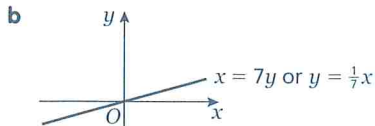
10.2 Solving quadratic inequalities

- 1 $(x + 3)(x + 2) = 0$
 $x = -3, x = -2$
 $x < -3$ or $x > -2$
- 2 $x(x - 5) = 0$
 $x = 0, x = 5$
-
- $0 \leq x \leq 5$
- 3 $x^2 + 3x - 10 = 0$
 $(x + 5)(x - 2) = 0$
 $x = -5, x = 2$
-
- $-5 \leq x \leq 2$
- 4 $x \leq -2$ or $x \geq 6$
- 5 $-7 \leq x \leq 4$
- 6 $\frac{1}{2} < x < 3$
- 7 $x < -\frac{3}{2}$ or $x > \frac{1}{2}$
- 8 $-3 \leq x \leq 4$
- 9 $2 < x < 2\frac{1}{2}$
- 10 $x \leq -\frac{3}{2}$ or $x \geq \frac{5}{3}$

10.3 Representing linear inequalities on a graph

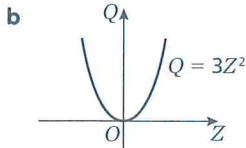


3 a $x = 7y$



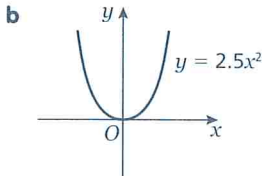
- c 91
d 9

4 a $Q = 3Z^2$



- c 75
d 10

5 a $y = 2.5x^2$



- c 6

6 a $B = 2\sqrt{C}$

- b 16 c 100

7 a $C = \frac{2}{3}D$

- b 300

8 a $x = 3y$

- b 11.1

9 a $m = 2n^3$

- b 5

12.2 Inverse proportion

1 a $100 = \frac{k}{10}$

b $P = \frac{1000}{Q}$

$k = 100 \times 10$

$20 = \frac{1000}{Q}$

$k = 1000$

$Q = 1000 \div 20$

$P = \frac{1000}{Q}$

$Q = 50$

2 a $y \propto \frac{1}{\sqrt{x}}$

b $y = \frac{5}{\sqrt{x}}$

$y = \frac{k}{\sqrt{x}}$

$5 = \frac{5}{\sqrt{x}}$

$1 = \frac{k}{\sqrt{25}}$

$\sqrt{x} = 5 \div 5 = 1$

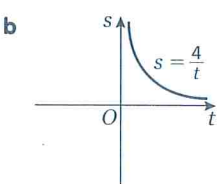
$k = 1 \times 5$

$x = 1$

$k = 5$

$y = \frac{5}{\sqrt{x}}$

3 a $s = \frac{4}{t}$

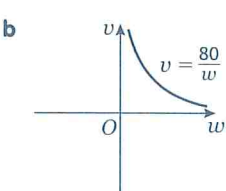


- c 4

4 a $a = \frac{100}{b}$

- b 2 c 10

5 a $v = \frac{80}{w}$



- c 40

6 a $L = \frac{36}{W}$

- b 6

7 a $s = \frac{72}{t}$

- b 24 c 4

8 a $y = \frac{16}{x^2}$

- b 1

9 a $a = \frac{0.2}{b}$

- b 0.1 c 0.1

Don't forget!

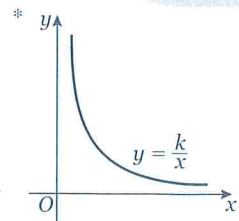
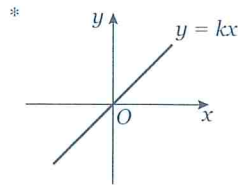
* direct

* inverse

* \propto

$\propto x; = kx$

$\propto \frac{1}{x}; = \frac{k}{x}$

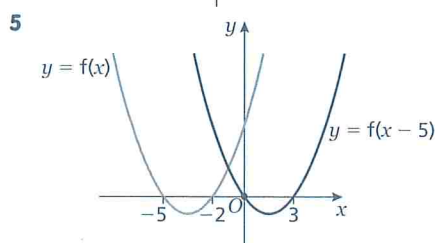
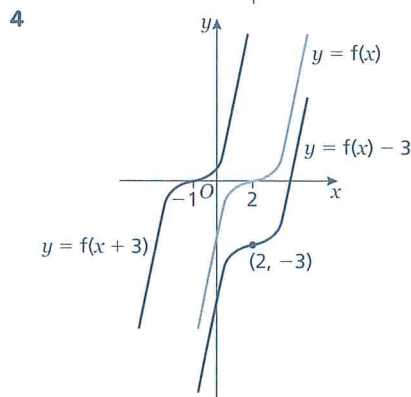
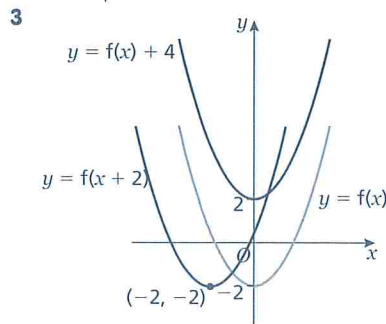
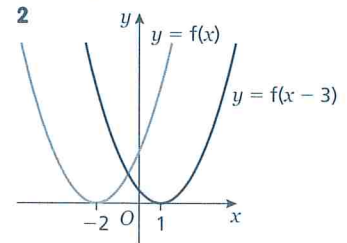
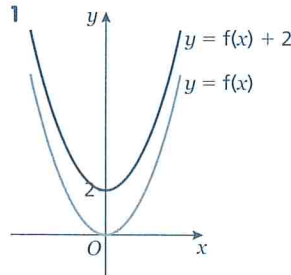


Exam-style questions

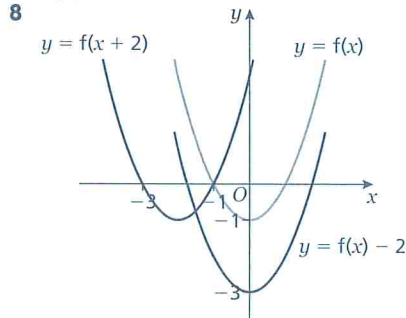
- 1 a $A = 3B^2$ b $\frac{3}{4}$ c 0.6

13 Transformations of functions

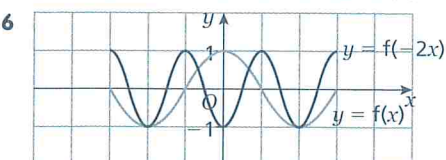
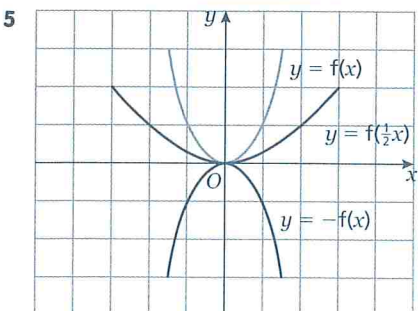
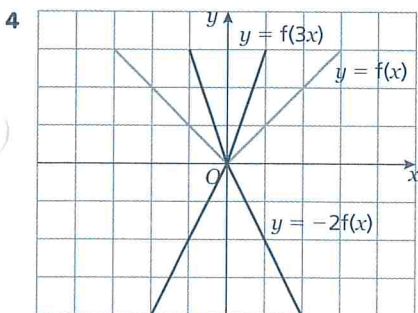
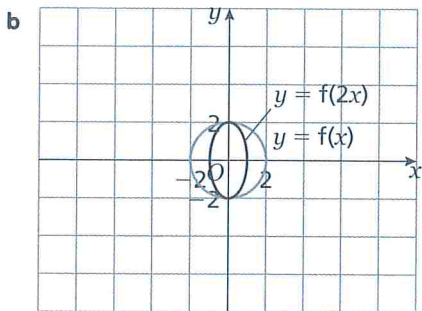
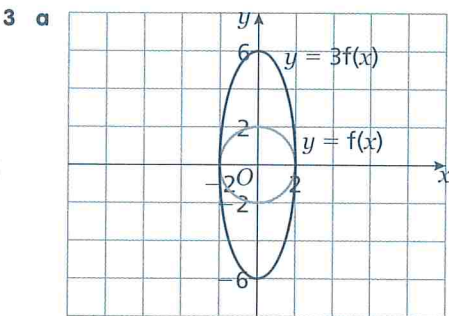
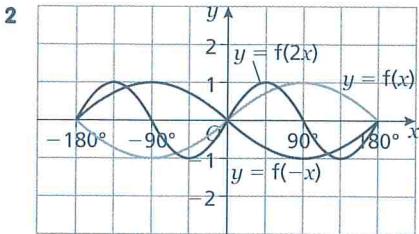
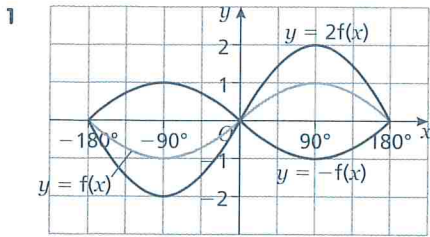
13.1 Applying the transformations $y = f(x) \pm a$ and $y = f(x \pm a)$ to the graph of $y = f(x)$



- 6 $C_1: y = f(x - 90^\circ)$ 7 $C_1: y = f(x - 5)$
 $C_2: y = f(x) - 2$ $C_2: y = f(x) - 3$

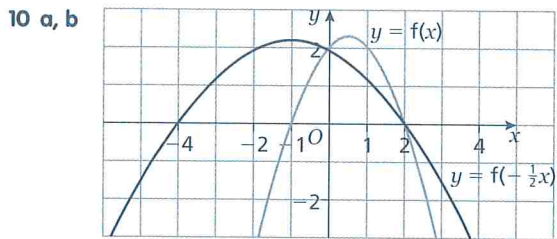
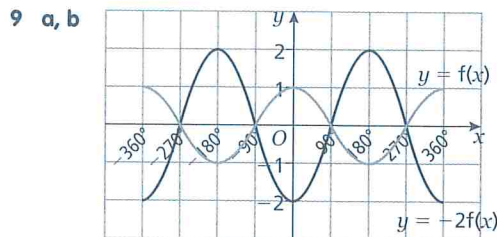


13.2 Applying the transformations $y = f(\pm ax)$ and $y = \pm af(x)$ to the graph of $y = f(x)$



7 $y = f(2x)$

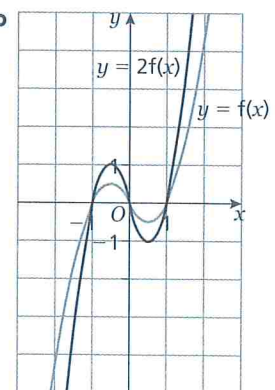
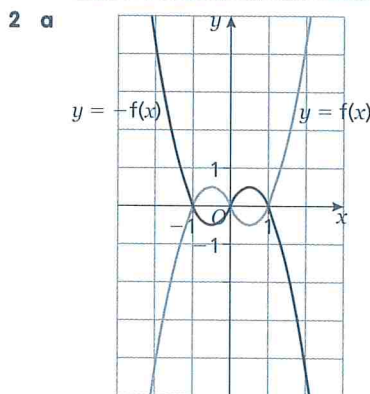
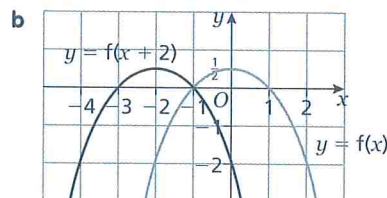
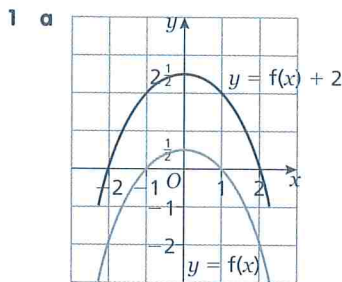
8 $y = -2f(2x)$ or $y = 2f(-2x)$



Don't forget!

- * y
- * x ; left; right
- * $\frac{1}{a}$; x
- * $\frac{1}{a}$; x ; y
- * a ; y
- * a ; y ; x

Exam-style questions



14 Area under a curve

14.1 The trapezium rule

1 $h = 1$

x	0	1	2	3
$y = (3 - x)(x + 2)$	6	6	4	0

$y_0 = 6, y_1 = 6, y_2 = 4, y_3 = 0$

$A = \frac{1}{2} \times 1 \times [6 + 2(6 + 4) + 0]$

$= \frac{1}{2} [26]$

$= 13$ sq units

2 $h = \frac{10 - 4}{3} = 2$

x	4	6	8	10
y coordinate for the curve	7	12	13	4
y coordinate for the straight line	7	6	5	4

$y_0 = 0, y_1 = 6, y_2 = 8, y_3 = 0$

$A = \frac{1}{2} \times 2 [0 + 2(6 + 8) + 0]$

$= 1 \times 28$
 $= 28$ sq units

- 3 34 sq units 4 149 sq units 5 14 sq units
6 $25\frac{1}{4}$ sq units 7 35 sq units 8 42 sq units
9 $26\frac{7}{8}$ sq units 10 56 sq units 11 $6\frac{1}{4}$ sq units

Don't forget!

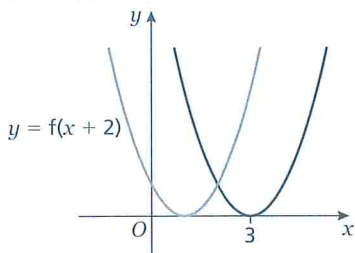
- * the area under a curve
- * Area = $\frac{1}{2}h[y_0 + 2(y_1 + y_2 + \dots + y_{n-1}) + y_n]$; the values of y for each value of x used
- * number of equal strips the area has been divided up into; the vertical boundaries of the area
- * the number of strips, n
- * $= \frac{b - a}{n}$

Exam-style questions

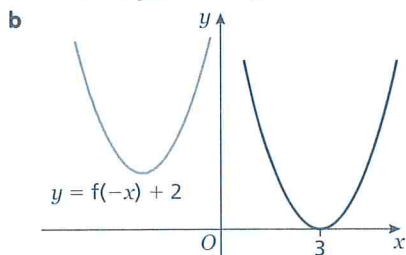
- 1 71.25 sq units
2 35 sq units
3 72 sq units

Practice Paper

- 1 $x = -4, y = -5$ 2 $m = \pm\sqrt{\frac{k}{6}}$
3 $4y^2 - 6xy - 6x^2$
4 a $(2x - 3)(x + 1)$ b 525
5 a



Minimum point at (1, 0)

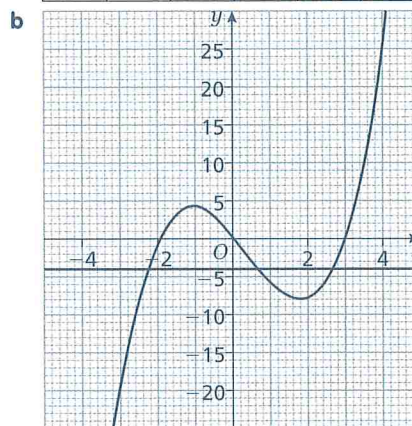


Minimum point at (-3, 2)

- 6 a $3 \pm \sqrt{2}$ b $45 - 29\sqrt{2}$
7 a $\frac{1}{2x}$ b $\frac{c}{9a^4b^2}$ c $\frac{1}{3}$
8 a $b = 1, c = -6$ b $a = 4, q = 16$
9 a $x > \frac{5}{3}$ b $-3, -2, -1, 0, 1, 2, 3$
10 a 399 b 22
11 a $\frac{4-1}{6-2} \times \frac{8-4}{3-6} = -1$ b 12.5

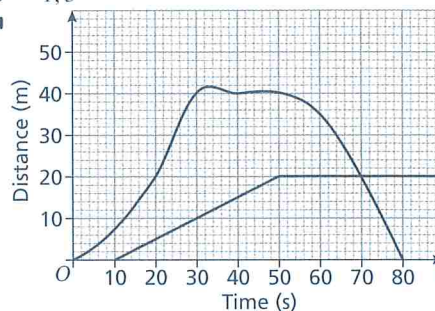
12 a

x	-3	-2	-1	0	1	2	3	4
y	-18	0	4	0	-6	-8	0	24



c x is approximately $-2.3, 0.6$ or 2.7

- 13 a $\frac{4x - 3}{x^2 - 1}$ b $\frac{3}{4}$
14 a $16p^2 - 4 \times 4 \times (4p + 5) = 16p^2 - 64p - 80$
b $-1, 5$
15 a



- b 70 c 1.7 ± 0.2 m/s
16 a (3, -2) b A (3, 2); B (3, -6) c $-2 \pm 2\sqrt{3}$
17 a 540 g
b $C \propto d$
 $C = kd$
 $36 = k \times 12$
 $C = 3d$
 $= 3\sqrt{\frac{3m}{5}}$
 $= 3 \times \sqrt{\frac{9m}{15}}$
 $= 9\sqrt{\frac{m}{15}}$
18 a (4, 12) b 14 sq units