Fractions, indices and surds

8.1 Indices *page 102*

☐☐☐ evaluating an expression with indices

☐☐☐ using $a^0 = 1$, $a^{-p} \equiv \dfrac{1}{a^p}$ and $a^{\frac{m}{n}} \equiv \left(\sqrt[n]{a}\right)^m \equiv \sqrt[n]{a^m}$

☐☐☐ using $\left(\dfrac{a}{b}\right)^p = \dfrac{a^p}{b^p}$

☐☐☐ using $a^p \times a^q \equiv a^{p+q}$, $\dfrac{a^p}{a^q} \equiv a^{p-q}$ and $(a^p)^q \equiv a^{pq}$

☐☐☐ simplifying an expression with indices

☐☐☐ rewriting an expression in index form

8.2 Equations with powers *page 107*

☐☐☐ solving an equation of the form $(px+q)^n = r$ by finding the nth root of each side

☐☐☐ solving a pair of simultaneous equations involving powers above 2

☐☐☐ solving an equation with unknown powers

8.3 Algebraic fractions *page 108*

☐☐☐ simplifying an algebraic fraction by cancelling

☐☐☐ recognising that $(a-b)$ and $(b-a)$ are related: $(b-a) = -(a-b)$

☐☐☐ simplifying an algebraic fraction by factorising and cancelling

☐☐☐ multiplying and dividing algebraic fractions

☐☐☐ simplifying an algebraic fraction by multiplying the numerator and denominator by the same expression

☐☐☐ adding and subtracting expressions with algebraic fractions

8.4 Equations with algebraic fractions *page 115*

☐☐☐ solving an equation with algebraic fractions that leads to a linear equation

☐☐☐ solving an equation with algebraic fractions that leads to a quadratic equation

☐☐☐ solving a pair of simultaneous equations with algebraic fractions

8.5 Surds *page 117*

☐☐☐ simplifying an expression involving surds

☐☐☐ using $\sqrt{ab} \equiv \sqrt{a} \times \sqrt{b}$ and $\sqrt{\dfrac{a}{b}} \equiv \dfrac{\sqrt{a}}{\sqrt{b}}$ (provided $a, b > 0$)

☐☐☐ simplifying a fraction with surds into a form with a rational denominator, by multiplying the numerator and denominator by the same value *or* by using $\dfrac{a}{\sqrt{a}} = \sqrt{a}$

More algebra

9.1 Constructing equations *page 122*

☐☐☐ constructing an expression from given information

☐☐☐ using one expression in the construction of a second

☐☐☐ forming and solving an equation

☐☐☐ solving a word problem

9.2 Changing the subject *page 127*

☐☐☐ changing the subject of a formula

9.3 Completing the square *page 129*

☐☐☐ completing the square

☐☐☐ solving a quadratic equation by completing the square

9.4 Functions *page 131*

☐☐☐ using functional notation

☐☐☐ finding the values of unknown coefficients in a function

Progress to Advanced Mathematics

Checklist of learning outcomes

Basic algebra

1.1 Simplifying expressions *page 1*

☐☐☐ simplifying an expression involving multiplication

☐☐☐ simplifying an expression by collecting like terms together

1.2 Expanding brackets *page 4*

☐☐☐ expanding single brackets and simplifying

☐☐☐ expanding double brackets and simplifying

1.3 Factorising by finding a common factor *page 7*

☐☐☐ factorising an expression by finding a common factor

☐☐☐ recognising that $(a-b)$ and $(b-a)$ are related: $(b-a) = -(a-b)$

1.4 Factorising quadratic expressions *page 9*

☐☐☐ factorising a difference of two squares using $a^2 - b^2 \equiv (a-b)(a+b)$

☐☐☐ factorising a ‘trinomial’ quadratic expression into two brackets

☐☐☐ factorising a quadratic expression by first finding a common factor

1.5 Substituting into expressions *page 12*

☐☐☐ substituting values into an expression

Linear equations

2.1 Simple linear equations *page 16*

☐☐☐ solving a simple linear equation

2.2 Linear equations with fractions *page 18*

☐☐☐ solving a linear equation with fractions, by multiplying every term by the same value

2.3 Linear inequalities *page 19*

☐☐☐ solving a linear inequality

2.4 Simultaneous linear equations *page 20*

☐☐☐ solving a pair of simultaneous linear equations

Coordinates

3.1 Coordinates *page 23*

☐☐☐ working with coordinates and using the associated vocabulary

☐☐☐ relating points and an equation, using the equation of a curve (or straight line) is the connection between the y- and x-coordinates of any point on the curve

3.2 The midpoint of a line segment *page 26*

☐☐☐ using the fact that the midpoint of a line segment is

(mean x-coordinate, mean y-coordinate)

or $\left(\tfrac{1}{2}(x_1+x_2), \tfrac{1}{2}(y_1+y_2)\right)$

3.3 The length of a line segment *page 27*

☐☐☐ finding the length of a line segment *either* by drawing an appropriate right-angled triangle *or* by using the fact that the length is

$$\sqrt{(\text{change in } x)^2 + (\text{change in } y)^2}$$

or $$\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$$

3.4 Straight lines parallel to the axes *page 28*

☐☐☐ using the fact that the equation of a straight line parallel to the y-axis has the form $x = k$

☐☐☐ using the fact that the equation of a straight line parallel to the x-axis has the form $y = \ell$

3.5 Areas *page 30*

☐☐☐ finding the area of a shape defined by the coordinates of the vertices

3.6 Circles *page 32*

☐☐☐ using circle diagrams plotted in the coordinate plane

☐☐☐ using diameter and tangent properties of a circle

☐☐☐ calculating the distance between circles

Triangles

4.1 Sine, cosine and tangent *page 37*

☐☐☐ using sine, cosine or tangent in a right-angled triangle

☐☐☐ dividing an isosceles triangle into two right-angled triangles

4.2 The sine rule *page 43*

☐☐☐ using the sine rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$or \quad \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

4.3 The cosine rule *page 45*

☐☐☐ using the cosine rule

$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$or \quad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

4.4 The area of a triangle *page 48*

☐☐☐ using the fact that the area of a triangle is $\frac{1}{2}ab\sin C$

Straight lines

5.1 The gradient of a straight line *page 54*

☐☐☐ finding the gradient of a straight line using

$$\text{gradient} = \frac{\text{change in } y}{\text{change in } x}$$

☐☐☐ finding the gradient of a straight line through two points (x_1, y_1) and (x_2, y_2) using

$$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

5.2 The equation of a straight line *page 57*

☐☐☐ relating the equation of a straight line and the coordinates of points on the line

☐☐☐ finding the equation of a straight line through a given point with a given gradient, using $y = mx + c$ *or* $y - y_1 = m(x - x_1)$

☐☐☐ finding the equation of a straight line through two given points, *either* by first finding the gradient *or* by using

$$\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$$

☐☐☐ finding the points of intersection of a line with the x- and y-axes (the x- and y-intercepts)

☐☐☐ finding the gradient m of a line by converting the equation to the form $y = mx + c$

☐☐☐ converting the equation of a line into a different form

5.3 Parallel lines *page 62*

☐☐☐ using the fact that parallel lines have equal gradients *or* that lines with equations of the form $ax + by + c_1 = 0$ and $ax + by + c_2 = 0$ are parallel

5.4 Perpendicular lines *page 65*

☐☐☐ using the fact that the gradients m_1 and m_2 of two perpendicular straight lines satisfy $m_1 \times m_2 = -1$

5.5 The intersection of two lines *page 68*

☐☐☐ finding the point of intersection of two straight lines

Quadratic equations

6.1 Quadratic equations by factorising *page 73*

☐☐☐ solving a quadratic equation by factorising

☐☐☐ solving a quadratic equation not in standard form by rearranging the terms

☐☐☐ solving a harder quadratic equation by factorising

☐☐☐ solving a harder quadratic equation not in standard form by rearranging the terms

6.2 Using the quadratic formula *page 76*

☐☐☐ solving a quadratic equation of the form $ax^2 + bx + c = 0$ using the formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

☐☐☐ solving a quadratic equation not in standard form by rearranging the terms and using the formula

6.3 Special quadratic equations *page 77*

☐☐☐ solving an equation of the form $k(x - p)^2 = q$ by finding the square root of each side

☐☐☐ solving an equation by making a substitution to convert it into a quadratic equation

6.4 Simultaneous equations where one is non-linear *page 78*

☐☐☐ solving a pair of simultaneous equations one of which is non-linear

Curves

7.1 Simple quadratic curves *page 80*

☐☐☐ sketching the graph of a quadratic curve

☐☐☐ using the fact that the y-intercept occurs where $x = 0$

☐☐☐ using the fact that the turning point of $y = (x - p)^2 + q$ is at (p, q)

☐☐☐ finding an equation of the form $y = kx^2$ or $y = kx^2 + q$ for a parabolic graph

7.2 Quadratic curves in factorised form *page 85*

☐☐☐ using the fact that the roots occur where $y = 0$

☐☐☐ sketching the graph of a general quadratic curve

☐☐☐ finding an equation of the form $y = k(x - a)(x - b)$ for a parabolic graph

7.3 Cubic curves *page 89*

☐☐☐ finding the roots and the y-intercept of a cubic curve

☐☐☐ sketching the graph of a cubic curve

7.4 The intersection of a line and a quadratic curve *page 90*

☐☐☐ finding the points of intersection of a straight line and a quadratic curve

7.5 The intersection of two quadratic curves *page 93*

☐☐☐ finding the points of intersection of two quadratic curves

7.6 The intersection of a line and a curve *page 95*

☐☐☐ finding the points of intersection of a line and a curve