MATHS – YEAR 9 – UNIT 14 – FORMULAE AND MANIPULATION

1. Tier 3 Vocabulary

Variable	A symbol or letter used for a value that can change e.g. x
Coefficient	A number used to multiply a variable. Example: 4y means 4 multiplied by y and y is a variable, so 4 is a coefficient.
Simplify	Collecting like terms to put an expression in its simplest form
Formulae	A factor or a rule that uses mathematical symbols e.g. Area of a rectangle = b x h
Solve	Find a value (or values) to make the equation true
Square root	A square root of a number is a value that, when multiplied by itself, gives the number
Cube root	The cube root of a number is a value that, when used in a multiplication three times, gives that number
Rational number	A number that results from the division of two integers (where the denominator is not equal to 0)
Surd	An irrational number. A number that cannot be simplified to remove a square root.
Right angle	An angle measuring 90 degrees
Hypotenuse	The longest side in a right angled triangle. It is the side opposite the right angle

2. EXPRESSIONS, EQUATIONS AND TERMS

Expression

A mathematical statement written using symbols, numbers and/or letters (no equals sign)

E.g. $3x + 2$

Equation

A statement showing that two expressions are equal (involves an equals sign). You can solve an equation.

E.g. $2y – 17 = 15$

Term

Either a single number or variable, or numbers and variables multiplied together.

E.g. $4x^2$

4. SIMPLIFYING BY COLLECTING LIKE TERMS

7x and 2x are like terms because they are both "x"

$3x^2$ and $-2x^2$ are like terms because they are both "x^2"

4 and -10 are like terms as they are both constants

7x and $7x^2$ are not like terms as the powers are different - they are unlike terms

Like terms can be added together

E.g. $5x + 9 + 4x – 2 = 9x + 7$

$4y + 7y^3 - y - 7 = 3y + 7y^3 - 7$

3. EXPANDING AND FACTORISING

Expanding

To expand a bracket, multiply out each term in the bracket by the expression outside the bracket

E.g. $5(x - 2)=5x – 10$

Factorising

Factorising is the reverse of expanding. To factorise a bracket we write an expression as a product of terms by taking out the highest common factor

E.g. $10y – 70 = 10(y - 7)$

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5. SUBSTITUTION

Substitution is where we replace the letter that we see for the number that we have been told it is worth

E.g. if w = 7 and y =-3

w + 5 = (7) + 5 = 12

3y – 2 = 3(-3)-2 = -9 – 2 = -11

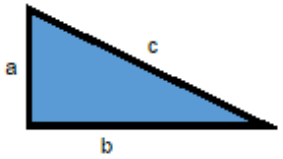
8w + 2y = 8(-3) + 2(7) = -24 + 14 = -10

$y^2 = (-3)^2 = (-3) \times (-3) = 9$

6. PYTHAGORAS' THEOREM

For any right angled triangle with sides of length a, b and c, where c is the longest side (hypotenuse), the lengths of the sides are linked by the formula:

$$a^2 + b^2 = c^2$$



7. PYTHAGORAS' THEOREM: FINDING THE HYPOTENUSE

If a = 5 and b = 12, find c

Step 1: write the formula

$$a^2 + b^2 = c^2$$

Step 2: substitute in a and b

$$5^2 + 12^2 = c^2$$

Step 3: calculate

$$25 + 144 = c^2$$

$$169 = c^2$$

Step 4: take the square root of both sides

$$13 = c$$

8. SOLVING EQUATIONS INVOLVING POWERS AND ROOTS

E.g. Solve root $\sqrt{x+2} = 3$

Step 1: the inverse of square root is to square. Square both sides

x+2 = 9

Step 2: Subtract 2 from both sides

x = 7

At times, you may have more than one solution:

E.g. Solve $x^2 = 9$

Step 1: the inverse to square is square root. Square root both sides.

x = -3 or 3

Notice that although the square root of 9 is 3, -3 is also a solution. This is because $(-3)^2=9$

9. FINDING THE DISTANCE BETWEEN TWO POINTS

The distance between two points (x_1, y_1) and (x_2, y_2) can be found by the formula

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

10. PYTHAGORAS' THEOREM: FINDING THE SHORT SIDES

If b = 9 and c = 15, find a

Step 1: write the formula

$$a^2 + b^2 = c^2$$

Step 2: substitute in b and c

$$a^2 + 9^2 = 15^2$$

Step 3: calculate

$$a^2 + 81 = 225$$

Step 4: rearrange to make a^2 the subject (subtract 81 from both sides)

$$a^2 = 144$$

Step 5: take the square root of both sides

$$a = 12$$