Further Mathematics A-level

This double-sided A4 sheet contains questions which we expect you to do before coming to your first Further Mathematics lesson.

You **MUST** show all your working, and you are **not allowed to use a calculator**!

You will be awarded marks for **presentation**, so make sure you write out your solutions on **A4 lined** or **squared paper**, **underline** your answers, and write your **name** and **student** number on your work. This work will be collected in at the beginning of your first Further Mathematics lesson.

Section 1: Surds (simplifying and rationalising)

Show all your working

1. Write $\sqrt{45}$ in the form $a\sqrt{5}$, where a is an integer.

    (1)

2. Express $(2 - \sqrt{3})^2$ in the form $b + c\sqrt{3}$, where b and c are integers to be found.

    (3)

3. Express $\dfrac{2(3 + \sqrt{5})}{(3 - \sqrt{5})}$ in the form $b + c\sqrt{5}$, where b and c are integers.

    (5)

Section 2: Indices (fractional, negative and laws of indices)

4. Write down the value of $16^{\frac{1}{4}}$.

    (1)

5. Evaluate $81^{\frac{3}{2}}$

    (2)

6. Simplify $(16x^{12})^{\frac{3}{4}}$

    (2)

7. Simplify fully $x^2 \left(4x^{-\frac{1}{2}} \right)^2$

    (2)

8. Write $\dfrac{2\sqrt{x} + 3}{x}$ in the form $2x^{p} + 3x^{q}$, where p and q are constants.

(2)

Section 3: Completing the square

9.
$$x^2 + 2x + 3 \equiv (x + a)^2 + b.$$

   (*a*) Find the values of the constants *a* and *b*. **(2)**
   (*b*) Sketch the graph of $y = x^2 + 2x + 3$, indicating clearly the coordinates of any intersections with the coordinate axes.

(3)

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10. Given that f(x) = $2x^2 + 8x + 3$,

   Express f(x) in the form $p(x + q)^2 + r$ where *p*, *q* and *r* are integers to be found.

(3)

Section 4: Factorising & Graph sketching

11. Factorise fully $25x - 9x^3$ **(3)**

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12. Sketch the graph of $y = x(6 - x)$, showing clearly the coordinates of the points where the curve meets the coordinate axes. **(3)**

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13. The curve *C* has equation
$$y = (x + 3)(x - 1)^2$$
(*a*) Sketch *C*, showing clearly the coordinates of the points where the curve meets the coordinate axes.

(4)

   (*b*) Show that the equation of *C* can be written in the form
$$y = x^3 + x^2 - 5x + k$$

   where *k* is a positive integer, and state the value of *k*. **(2)**

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14. (*a*) Factorise completely $x^3 - 6x^2 + 9x$ **(3)**
   (*b*) Hence sketch the curve with equation
$$y = x^3 - 6x^2 + 9x$$

   showing the coordinates of the points at which the curve meets the *x*-axis.

(4)