**ADDITIONAL MATERIALS**

In addition to this examination paper, you will need:

• a 12 page answer book;
• a Formula Booklet.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen.

Answer **all** questions.

Sufficient working must be shown to demonstrate the **mathematical** method employed.

Calculators are **not** allowed for this paper.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

**1.** The points *A, B, C, D* have coordinates $(-5, 14)$, $(1, 2)$, $(5, 4)$, $(3, 8)$ respectively.

    *(a)*    (i)    Show that *AB* and *CD* are parallel.

           (ii)    Find the equation of *AB*.

           (iii)    The line *L* passes through the point *D* and is perpendicular to *AB*. Show that *L* has equation

$$x - 2y + 13 = 0.$$
                [8]

    *(b)*    The lines *L* and *AB* intersect at the point *E*.

           (i)    Find the coordinates of *E*.

           (ii)    Calculate the length of *EF*, where *F* denotes the mid-point of *AB*.     [6]


**2.** Simplify

    *(a)*   $\dfrac{9 + 4\sqrt{2}}{5 + 3\sqrt{2}}$,                      [4]

    *(b)*   $\left(\sqrt{8} \times \sqrt{10}\right) + \dfrac{\sqrt{90}}{\sqrt{2}} - \dfrac{30}{\sqrt{5}}$.         [4]


**3.** The curve *C* has equation $y = 2x^2 - 8x + 13$. The point *P*, whose *x*-coordinate is 3, lies on the curve *C*. Find the equation of the **normal** to *C* at *P*.     [6]


**4.**   *(a)*   Use the binomial theorem to expand $\left(x + \dfrac{3}{x}\right)^4$, simplifying each term of the expansion.
                [4]

    *(b)*   The coefficient of $x^2$ in the expansion of $(1 + 2x)^n$ is 760. Given that *n* is a positive integer, find the value of *n*.     [3]


**5.**   *(a)*   Express $3x^2 - 6x + 5$ in the form $a(x + b)^2 + c$, where *a*, *b* and *c* are constants whose values are to be found.     [3]

    *(b)*   **Use your answer to part *(a)*** to find the greatest value of

$$\frac{1}{3x^2 - 6x + 11}.$$
                [2]

**6.** Given that the quadratic equation

$$(k + 6)x^2 + 4x + (k + 3) = 0$$

has no real roots, show that

$$k^2 + 9k + 14 > 0.$$

Find the range of values of $k$ satisfying this inequality. [7]

**7.** *(a)* Given that $y = 8x^2 - 5x - 6$, find $\dfrac{dy}{dx}$ from first principles. [5]

*(b)* Given that $y = \dfrac{a}{x} + 10\sqrt{x}$ and that $\dfrac{dy}{dx} = 3$ when $x = 4$,

find the value of the constant $a$. [4]

**8.** *(a)* When $ax^3 - 21x - 10$ is divided by $x - 3$, the remainder is 35.
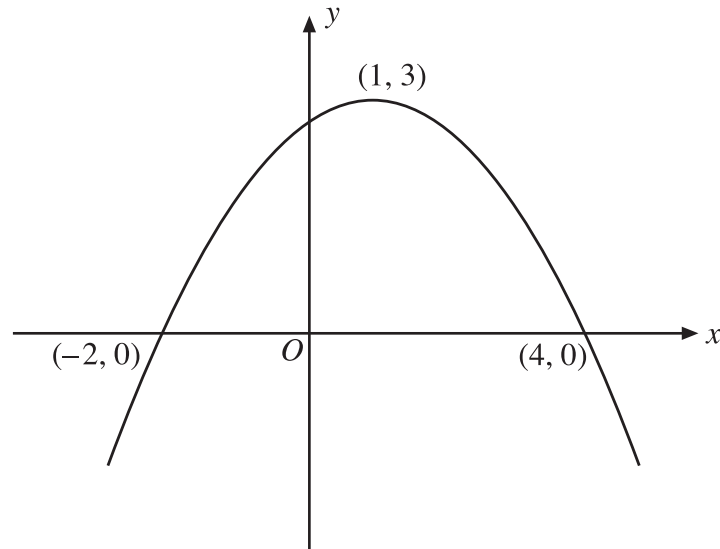Write down an equation satisfied by $a$ and hence show that $a = 4$. [2]

*(b)* Factorise $4x^3 - 21x - 10$. [5]

# TURN OVER

**9.** The diagram shows a sketch of the graph of $y = f(x)$. The graph has a maximum point at $(1, 3)$ and intersects the $x$-axis at the points $(-2, 0)$ and $(4, 0)$.



*(a)* Sketch the graph of $y = f(2x)$, indicating the coordinates of the stationary point and the coordinates of the points of intersection of the graph with the $x$-axis. [3]

*(b)* (i) Sketch the graph of $y = f(x) - 5$, indicating the coordinates of the stationary point.

(ii) Given that $f$ is a quadratic function, use the graph you have drawn in part (i) to write down the number of real roots of the equation

$$f(x) - 5 = 0.$$ [3]

**10.** The curve $C$ has equation

$$y = x^3 - 6x^2 + 12x - 9.$$

*(a)* Show that $C$ has only one stationary point. Find the coordinates of this point. [4]

*(b)* Verify that this stationary point is a point of inflection. [2]