Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Stationary points

Time allowed: 1 hour 50 minutes

Subject code **0606**

Additional Mathematics

Questions from Paper 1 and Paper 2

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
Questions 1-2, 4, 7-10 (Paper 1): no calculator.
Questions 3, 5-6 (Paper 2): calculator allowed.

Total marks

/ 72

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 72 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 Find the coordinates of the stationary point on the curve $y = x^2 + \frac{16}{x}$. [4]

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2 Find the coordinates of the stationary point of the curve $y = \dfrac{x+2}{\sqrt{2x-1}}$. [6]

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3 Show that the curve $y = x - \ln(x^2 + 2x)$ has exactly one stationary point.

Find the x-coordinate of this point. [6]

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4 A curve has equation $y = 6\cos\frac{x}{2} + 4\sin\frac{x}{2}$, for $0 < x < 2\pi$ radians.

(i) Find the x-coordinate of the stationary point on the curve. [5]

(ii) Determine the nature of this stationary point. [2]

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5 A curve has equation $y = 32x^2 + \frac{1}{8x^2}$ where $x \neq 0$.

(a) Find the coordinates of the stationary points of the curve. [5]

(b) These stationary points have the same nature. Use the second derivative test to determine whether they are maximum points or minimum points. [3]

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6 **(a)** Find the x-coordinates of the stationary points on the curve $y = 3\ln x + x^2 - 7x$, where $x > 0$. [5]

(b) Determine the nature of each of these stationary points. [3]

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7 Show that the curve $y = (3x^2 + 8)^{\frac{5}{3}}$ has only one stationary point. Find the coordinates of this stationary point and determine its nature. [8]

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8 A curve has equation $y = \dfrac{(3x^2 - 5)^{\frac{1}{3}}}{x + 4}$.

(a) Show that $\dfrac{dy}{dx}$ can be written in the form $\dfrac{Ax^2 + Bx + C}{(3x^2 - 5)^{\frac{2}{3}}(x + 4)^2}$, where A, B and C are integers. [5]

(b) Hence find the x-coordinates of the stationary points on the curve. Give your answers in their simplest exact form. [3]

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9 A curve has equation $y = \left(\dfrac{x^2-1}{x^2+1}\right)^4$.

(a) Show that $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ can be written as $\dfrac{Ax\left(x^2-1\right)^3}{\left(x^2+1\right)^5}$, where A is a positive integer to be found. [5]

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(b) **(i)** Show that the curve has stationary points where $x = -1$, $x = 0$ and $x = 1$. [1]

(ii) Use the first derivative test to determine which two stationary points have the same nature and state whether they are maximum or minimum points. [2]

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10 **(i)** Write $\ln\left(\frac{2x+1}{2x-1}\right)$ as the difference of two logarithms. [1]

A curve has equation $y = \ln\left(\frac{2x+1}{2x-1}\right) + 4x$ for $x > \frac{1}{2}$.

(ii) Using your answer to part **(i)** show that $\frac{dy}{dx} = \frac{ax^2+b}{4x^2-1}$, where a and b are integers. [4]

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(iii) Hence find the x-coordinate of the stationary point on the curve. [2]

(iv) Determine the nature of this stationary point. [2]

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