Write your name here

Surname	Other Names

AS/A Level Mathematics

Differentiation

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled..
- Answer the questions in the spaces provided
  – there may be more space than you need.
- You should show sufficient working to make your methods clear.
  Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- The marks for **each** question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

1 $y = 2x^3 + 5x^2 - 7x + 10$

(a) Find $\dfrac{dy}{dx}$ **(2)**

(b) Find the gradient of the curve when $x = 2$ **(1)**

(Total for question 1 is 3 marks)

2 $y = 3x + \dfrac{1}{x}$

(a) Find $\dfrac{dy}{dx}$ **(2)**

(b) Find the x coordinates of points where the gradient is zero. **(2)**

(Total for question 2 is 4 marks)

3 $f(x) = 3x^{\frac{3}{2}} + \dfrac{3}{x^2} - 6x$

Find $f'(x)$

(Total for question 3 is 4 marks)

4 $y = 4\sqrt{x} + \dfrac{1}{2x} + 10$

(a) Find $\dfrac{dy}{dx}$ **(3)**

(b) Find $\dfrac{d^2y}{dx^2}$ **(2)**

(Total for question 4 is 5 marks)

5 $y = \dfrac{2x^2 - 5x + 3}{x}$

(a) Find $\dfrac{dy}{dx}$ **(3)**

(b) Find the gradient when $x = 3$ **(1)**

(Total for question 5 is 4 marks)

6 $y = x^3 - 4x^2 - 3x + 9$

(a) Find $\dfrac{dy}{dx}$ **(2)**

(b) Find the range values of x for which y is increasing **(3)**

(Total for question 6 is 5 marks)

7   A curve has the equation $y = 2x^3 + 9x^2 - 24x + 13$
Find the coordinates of the curve's local maximum.

(Total for question 7 is 6 marks)

8 $y = 2x^3 + 5x^2 - 7x + 10$

Find the equation of the tangent at the point where $x = 1$
Give your answer in the form $y = mx + c$

_____**(Total for question 8 is 6 marks)**

9 $f(x) = 2x^3 + x^2 - 18x + 2$

The points A and B lie on the curve $y = f(x)$. The gradient at both A and B is 2.
Find the coordinates of A and B.

_____**(Total for question 9 is 6 marks)**

10 $y = \dfrac{(4x - 1)(x + 2)}{2x}$

Find the equation of the normal at the point when $x = -2$
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

_____**(Total for question 10 is 6 marks)**

11   A simple model for the cost of a car journey £C when a car is driven at a steady speed of v mph is

$$C = \frac{4500}{v} + v + 10$$

(a) Use this model to find the value of v which minimises the cost of the journey.   **(5)**

(b) Use $\dfrac{d^2C}{dv^2}$ to verify that C is a minimum for this value of v **(2)**

(c) Calculate the minimum cost of the journey   **(2)**

_____**(Total for question 11 is 9 marks)**

12   A cylinder has a radius r and a height h.
The surface area of the cylinder is 500cm^2

(a) Show that the volume (V cm^3) of the cylinder is given by $V = 250r - \pi r^3$ **(4)**

Given that r varies

(b) Calculate the maximum value of V, to the nearest cm^3 **(6)**

(c) Justify that the value of V you found is a maximum.   **(2)**

_____**(Total for question 12 is 12 marks)**

13   A curve has the equation $y = 4x^3 + 15x^2 - 18x + 5$

Find the coordinates of the stationary points and determine the nature of each stationary point.

_____**(Total for question 13 is 6 marks)**