HIGHER

5.1 Differentiation: Gradients and Turning Points: 30-minute Pack

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 The curve C has equation $y = 6x^3 - 5x^2 - 5x + 4$.
Find an equation of the normal to C at the point where $x = 2$. Give your answer in the form $y = mx + c$.

(Total for Question 1 is 5 marks)

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2 A curve has equation $y = -x^3 + 48x - 10$.
Find the coordinates of the turning points of the curve and determine the nature of each turning point.

(Total for Question 2 is 6 marks)

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3 A curve has equation $y = x^3 - 2x - 3$.
Find the coordinates of the points on the curve where the gradient is 25.

(Total for Question 3 is 5 marks)

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4 A curve has equation $y = x^3 + 3x^2 + 3$.
Find the values of x for which y is increasing (the gradient is positive).

(Total for Question 4 is 4 marks)

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5 A ball is thrown upwards. Its height h metres above the ground after t seconds is $h = -5t^2 + 50t$.
Find the maximum height reached by the ball.

(Total for Question 5 is 4 marks)

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Mark scheme · 5.1 Differentiation: Gradients and Turning Points: 30-minute Pack

Question 1

$dy/dx = 18x^2 - 10x - 5$	**M1**
gradient of the curve = 47 at x = 2	**M1**
gradient of the normal = -1/(47) = -1/47	**M1**
y = 22 at x = 2, so the point is (2, 22)	**M1**
y = -(1/47)x + 1036/47 cao	**A1**

Answer: y = -(1/47)x + 1036/47

Question 2

$dy/dx = -3x^2 + 48$	**M1**
sets dy/dx = 0 and solves the quadratic	**M1**
x = -4 and x = 4	**A1**
substitutes both x values into the equation of the curve	**M1**
turning points at (-4, -138) and (4, 118)	**A1**
d2y/dx2 = -6x shows (-4, -138) is a minimum and (4, 118) is a maximum	**B1**

Answer: (-4, -138) is a minimum and (4, 118) is a maximum

Question 3

$dy/dx = 3x^2 - 2$	**M1**
sets dy/dx = 25 and rearranges to $3x^2 - 27 = 0$	**M1**
solves the quadratic to get x = -3 and x = 3	**M1**
substitutes both x values into the equation of the curve	**M1**
(-3, -24) and (3, 18) cao	**A1**

Answer: (-3, -24) and (3, 18)

Question 4

$dy/dx = 3x^2 + 6x$	**M1**
solves dy/dx = 0 to get x = -2 and x = 0	**M1**
identifies the sign of dy/dx between and outside these roots (a positive x^2 coefficient)	**M1**
x < -2 or x > 0 cao	**A1**

Answer: x < -2 or x > 0

Question 5

dh/dt = -10t + 50	**M1**
sets dh/dt = 0 to find the time of maximum height	**M1**
t = 5 seconds	**A1**
maximum height = 125 m cao	**A1**

Answer: Maximum height = 125 m

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