HIGHER

5.1 Differentiation: Gradients and Turning Points: 1-hour Pack

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A curve has equation $y = x^3 - 27x - 4$.
Find the coordinates of the turning points of the curve and determine the nature of each turning point.

(Total for Question 1 is 6 marks)

---

2 $y = 2x^5 + 7x$
Find dy/dx.

(Total for Question 2 is 2 marks)

---

3 A curve has equation $y = -2x^3 + 6x^2 + 5x + 1$.
Find the gradient of the curve at the point where $x = 4$.

(Total for Question 3 is 2 marks)

© Revision Library | revisionlibrary.co.uk

4 A curve has equation $y = -x^3 + 6x^2 + 1$.
Find the values of x for which y is decreasing (the gradient is negative).

(Total for Question 4 is 4 marks)

---

5 The curve C has equation $y = -6x^3 - 5x^2 - 4x - 8$.
Find an equation of the normal to C at the point where $x = -1$. Give your answer in the form $y = mx + c$.

(Total for Question 5 is 5 marks)

---

6 $y = -x^3 + 2x^{-3} + 9x$
Find dy/dx.

(Total for Question 6 is 3 marks)

---

7 A curve has equation $y = -x^3 + 5x^2 + 3x - 3$.
Find the gradient of the curve at the point where $x = 2$.

(Total for Question 7 is 2 marks)

© Revision Library | revisionlibrary.co.uk

8 A curve has equation $y = x^3 + 6x^2 - 2x - 9$.
Find the coordinates of the points on the curve where the gradient is -11.

(Total for Question 8 is 5 marks)

---

9 A ball is thrown upwards. Its height h metres above the ground after t seconds is $h = -5t^2 + 20t$.
Find the maximum height reached by the ball.

(Total for Question 9 is 4 marks)

---

10 A curve has equation $y = x^3 + 3x^2 - 2x - 4$.
Find the coordinates of the points on the curve where the gradient is 22.

(Total for Question 10 is 5 marks)

---

11 A curve has equation $y = x^3 + 3x^2 - 24x + 4$.
Find the values of x for which y is increasing (the gradient is positive).

(Total for Question 11 is 4 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 5.1 Differentiation: Gradients and Turning Points: 1-hour Pack

Question 1

$dy/dx = 3x^2 - 27$	**M1**
sets $dy/dx = 0$ and solves the quadratic	**M1**
$x = -3$ and $x = 3$	**A1**
substitutes both x values into the equation of the curve	**M1**
turning points at (-3, 50) and (3, -58)	**A1**
d2y/dx2 = 6x shows (-3, 50) is a maximum and (3, -58) is a minimum	**B1**

Answer: (-3, 50) is a maximum and (3, -58) is a minimum

Question 2

differentiates at least two terms correctly, using $n\ x^{n-1}$	**M1**
$dy/dx = 10x^4 + 7$ cao (a constant term differentiates to 0)	**A1**

Answer: $dy/dx = 10x^4 + 7$

Question 3

$dy/dx = -6x^2 + 12x + 5$ found	**M1**
gradient = -43 cao, from substituting x = 4	**A1**

Answer: Gradient = -43

Question 4

$dy/dx = -3x^2 + 12x$	**M1**
solves $dy/dx = 0$ to get $x = 0$ and $x = 4$	**M1**
identifies the sign of dy/dx between and outside these roots (a negative x^2 coefficient)	**M1**
$x < 0$ or $x > 4$ cao	**A1**

Answer: $x < 0$ or $x > 4$

Question 5

$dy/dx = -18x^2 - 10x - 4$	**M1**
gradient of the curve = -12 at x = -1	**M1**
gradient of the normal = -1/(-12) = 1/12	**M1**
y = -3 at x = -1, so the point is (-1, -3)	**M1**
$y = (1/12)x - 35/12$ cao	**A1**

Answer: $y = (1/12)x - 35/12$

Question 6

differentiates a positive-power term correctly	**M1**
differentiates the negative-power term correctly, e.g. reducing the power by 1 and multiplying by it	**M1**
$dy/dx = -3x^2 - 6x^{-4} + 9$ cao	**A1**

Answer: $dy/dx = -3x^2 - 6x^{-4} + 9$

Question 7

$dy/dx = -3x^2 + 10x + 3$ found	**M1**
gradient = 11 cao, from substituting x = 2	**A1**

Answer: Gradient = 11

Question 8

$dy/dx = 3x^2 + 12x - 2$	**M1**
sets $dy/dx = -11$ and rearranges to $3x^2 + 12x + 9 = 0$	**M1**
solves the quadratic to get $x = -3$ and $x = -1$	**M1**
substitutes both x values into the equation of the curve	**M1**
(-3, 24) and (-1, -2) cao	**A1**

Answer: (-3, 24) and (-1, -2)

Question 9

$dh/dt = -10t + 20$	**M1**
sets $dh/dt = 0$ to find the time of maximum height	**M1**
t = 2 seconds	**A1**
maximum height = 20 m cao	**A1**

Answer: Maximum height = 20 m

Question 10

$dy/dx = 3x^2 + 6x - 2$	**M1**
sets $dy/dx = 22$ and rearranges to $3x^2 + 6x - 24 = 0$	**M1**
solves the quadratic to get $x = -4$ and $x = 2$	**M1**
substitutes both x values into the equation of the curve	**M1**
(-4, -12) and (2, 12) cao	**A1**

Answer: (-4, -12) and (2, 12)

Question 11

$dy/dx = 3x^2 + 6x - 24$	**M1**
solves $dy/dx = 0$ to get $x = -4$ and $x = 2$	**M1**
identifies the sign of dy/dx between and outside these roots (a positive x^2 coefficient)	**M1**
$x < -4$ or $x > 2$ cao	**A1**

Answer: $x < -4$ or $x > 2$

© Revision Library | revisionlibrary.co.uk