5.1 Differentiation of Polynomials: 1-hour Pack

AQA 8365 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Differentiate $y = 6x$ with respect to x.

(Total for Question 1 is 1 mark)

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2 Differentiate $y = 11$ with respect to x.

(Total for Question 2 is 1 mark)

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3 Differentiate $y = 3x^5$ with respect to x.

(Total for Question 3 is 1 mark)

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4 Differentiate each of the following expressions with respect to x.

(a) $y = x^3$ **(1)**

(b) $y = x^5$ **(1)**

(c) $y = 4x^2$ **(1)**

(d) $y = 7x$ **(1)**

(e) $y = 9$ **(1)**

(f) $y = 2x^4$ **(1)**

(Total for Question 4 is 6 marks)

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5 Find dy/dx for the curve $y = 2x^3 - 5x^2 + 4x - 1$.

(Total for Question 5 is 2 marks)

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6 Find dy/dx for the curve $y = x^4 + 3x^3 - 2x$.

(Total for Question 6 is 2 marks)

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7 The curve $y = x^2 - 4x + 9$ has a tangent that is parallel to the line $y = 6x - 1$. Find the coordinates of the point on the curve where this occurs.

(Total for Question 7 is 5 marks)

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8 A curve has equation $y = x^3 - 6x^2 + 2$. Find the range of values of x for which the curve is a decreasing function.

(Total for Question 8 is 5 marks)

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9 The volume of water, V cm^3, in a container t seconds after a tap is turned on is modelled by $V = 30t^2 - t^3$, for $0 \leq t \leq 30$.

(a) Find dV/dt. **(2)**

.....

(b) Find the rate of change of the volume of water when t = 10 seconds. **(2)**

.....

(c) Find the value of t at which the volume of water is a maximum, for $0 < t \leq 30$, and find this maximum volume. **(5)**

.....

(Total for Question 9 is 9 marks)

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10 $y = (2x^4 + 6x^3 + 7x^2) / x^2$. Find dy/dx.

(Total for Question 10 is 4 marks)

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11 A curve has equation $y = kx^2 + 8x - 4$. The gradient of the curve at the point where x = 1 is 12. Find the value of k.

(Total for Question 11 is 4 marks)

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12 $y = x^4 + 5x^3 - 7x^2 + 5x + 1$. Find dy/dx and d^2y/dx^2.

(Total for Question 12 is 4 marks)

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

(Total for Question 13 is 3 marks)

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14 Differentiate $y = -3x^3 - 7x^2 + 6x + 2$ with respect to x.

(Total for Question 14 is 3 marks)

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15 The curve C has equation $y = x^3 - 2x^2 - x + 4$. Show that the gradient of C at the point where $x = 3$ is 14.

(Total for Question 15 is 3 marks)

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Mark scheme · 5.1 Differentiation of Polynomials: 1-hour Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

dy/dx = 6 cao **B1**

Answer: dy/dx = 6

Question 2

dy/dx = 0 cao **B1**

Answer: dy/dx = 0

Question 3

dy/dx = $15x^4$ cao **B1**

Answer: dy/dx = $15x^4$

Question 4

(a) dy/dx = $3x^2$ cao **B1**

(a) Answer: dy/dx = $3x^2$

(b) dy/dx = $5x^4$ cao **B1**

(b) Answer: dy/dx = $5x^4$

(c) dy/dx = 8x cao **B1**

(c) Answer: dy/dx = 8x

(d) dy/dx = 7 cao **B1**

(d) Answer: dy/dx = 7

(e) dy/dx = 0 cao **B1**

(e) Answer: dy/dx = 0

(f) dy/dx = $8x^3$ cao **B1**

(f) Answer: dy/dx = $8x^3$

Question 5

differentiates at least two terms correctly (e.g. $6x^2$ and -10x seen) **M1**

dy/dx = $6x^2$ - 10x + 4 cao **A1**

Answer: dy/dx = $6x^2$ - 10x + 4

Question 6

differentiates at least two terms correctly (e.g. $4x^3$ and $9x^2$ seen) **M1**

dy/dx = $4x^3$ + $9x^2$ - 2 cao **A1**

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

Question 7

differentiates the curve to obtain dy/dx = 2x - 4 **M1**

identifies that the gradient of the line y = 6x - 1 is 6 **B1**

sets 2x - 4 = 6 and solves for x, dependent on both previous marks (dM1) **M1**

x = 5 **A1**

y = 14, so the point is (5, 14) **A1**

Answer: (5, 14)

Question 8

differentiates to obtain dy/dx = $3x^2$ - 12x **M1**

sets dy/dx = 0 and factorises to find the critical values, dependent on previous M1 (dM1) **M1**

x = 0 and x = 4 **A1**

tests the sign of dy/dx between and outside the critical values (or sketches the upward parabola dy/dx = 3x(x-4)) **M1**

0 < x < 4 oe **A1**

Answer: 0 < x < 4

Question 9

(a) differentiates at least one term correctly **M1**

(a) dV/dt = 60t - $3t^2$ cao **A1**

(a) Answer: dV/dt = 60t - $3t^2$

(b) substitutes t = 10 into dV/dt, ft from part (a) **M1**

(b) rate of change = 300 cm^3/s cao **A1**

(b) Answer: 300 cm^3 per second

(c) sets dV/dt = 0 and solves, e.g. 3t(20-t)=0, ft from part (a) **M1**

(c) t = 20, rejecting t = 0 as it lies outside the range $0 < t \leq 30$ **A1**

(c) uses the second derivative d2V/dt2 = 60 - 6t (or a sign test) evaluated at t = 20 **M1**

(c) d2V/dt2 = -60 < 0, so t = 20 gives a maximum, dependent on previous M1 (dM1) **A1**

(c) maximum volume = 4000 cm^3 (substituting t = 20 into V) **A1**

(c) Answer: t = 20 seconds, maximum volume = 4000 cm^3

Question 10

divides each term by x^2 **M1**

y = $2x^2$ + 6x + 7 **A1**

differentiates **M1**

dy/dx = 4x + 6 cao **A1**

Answer: dy/dx = 4x + 6

Question 11

differentiates **M1**

dy/dx = 2kx + 8 **A1**

substitutes x = 1 and sets equal to 12 **M1**

k = 2 cao **A1**

Answer: k = 2

Question 12

differentiates once **M1**

dy/dx = $4x^3$ + $15x^2$ - 14x + 5 **A1**

differentiates again **M1**

d^2y/dx^2 = $12x^2$ + 30x - 14 **A1**

Answer: dy/dx = $4x^3$ + $15x^2$ - 14x + 5, d^2y/dx^2 = $12x^2$ + 30x - 14

Question 13

differentiates **M1**

dy/dx = $3x^2$ - 6x - 5 **A1**

40 cao **A1**

Answer: 40

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Question 14

multiplies by the power and reduces the power by 1 for at least one term	**M1**
at least two terms correct	**A1**
$dy/dx = -9x^2 - 14x + 6$ cao	**A1**

Answer: $dy/dx = -9x^2 - 14x + 6$

Question 15

differentiates correctly to obtain $dy/dx = 3x^2 - 4x - 1$	**M1**
substitutes $x = 3$ into dy/dx	**M1**
gradient = 14 fully shown cso (answer printed, all working correct)	**A1**

Answer: 14 (shown)

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