AQA Qualifications

AQA Level 2 Certificate FURTHER MATHEMATICS

Level 2 (8360)

Worksheet 9

Coordinate Geometry - Calculus

Version 2.0

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9 Coordinate Geometry - Calculus

Question 1

For each of these straight lines, work out

(i) The gradient of the line *(1 mark for each part)*

(ii) The gradient of the line that is perpendicular to the given line *(1 mark for each part)*

(iii) The y-intercept of the line *(1 mark for each part)*

(a) $y = 5x - 4$ (b) $3y = 9 - 6x$ (c) $3y - 12 = 2x$

(d) $5x - 2y + 15 = 0$ (e) $\frac{x}{4} - \frac{y}{3} = 2$

Question 2

For each of these straight line segments, AB, work out

(i) The mid-point of AB *(2 marks for each part)*

(ii) The gradient of AB *(1 mark for each part)*

(iii) The length of AB, giving your answer as an integer or a surd *(2 marks for each part)*

(a) $A = (-3, -4)$ $B = (4, 3)$ (b) $A = (-4, 1)$ $B = (1, 5)$ (c) $A = (5, -2)$ $B = (0, 10)$

(d) $A = (-2, -6)$ $B = (-6, 0)$ (e) $A = (1, 9)$ $B = (9, -6)$ (f) $A = (7, 1)$ $B = (-5, -3)$

Question 3

In each of these line segments, B lies between A and C.

Work out the coordinates of C in each case. *(2 marks for each part)*

(a) $A = (-1, 3)$ $B = (1, 1)$ and $AB : BC = 1 : 2$

(b) $A = (-4, -2)$ $B = (2, -5)$ and $AB : BC = 3 : 1$

(c) $A = (11, 0)$ $B = (1, -5)$ and $AB : BC = 5 : 3$

(d) $A = (-6, 2)$ $B = (0, 4)$ and $AB : BC = 2 : 3$

(e) $A = (2, -9)$ $B = (-3, 1)$ and $AB : BC = 5 : 4$

Question 4

Work out the coordinates of the points of intersection of the curve $y = x^2 + 7$ and the straight line $y = 5x + 1$ *(4 marks)*

Question 5

Line L has equation $y + 3x = 7$

Line N is perpendicular to line L and passes through $(3, -1)$.

Work out the equation of line N.

Give your answer in the form $y = ax + b$ *(4 marks)*

Question 6

Work out $\frac{dy}{dx}$ for each of the following

(a) $y = 7x + 3$ *(1 mark)*

(b) $y = 8 - 5x + x^2$ *(2 marks)*

(c) $y = 3x^3 + 4x$ *(2 marks)*

(d) $y = x^3 - 7x^2 + 10x - 1$ *(2 marks)*

(e) $y = 4x(x^2 + 2x - 3)$ *(3 marks)*

(f) $y = (3x - 5)(x + 8)$ *(3 marks)*

(g) $y = x(7 - x)(6 - 2x)$ *(3 marks)*

(h) $y = (x + 3)(x - 1)(x - 6)$ *(4 marks)*

Question 7

A curve has equation $y = x^3 + x^2 + 2x - 4$

Work out the equation of the tangent to this curve where $x = -2$

Give your answer in the form $y = ax + b$ *(5 marks)*

Question 8

A curve has equation $y = x^3 + 2x^2 - 9x + 3$

Work out the equation of the normal to this curve at the point $(1, -3)$

Give your answer in the form $ax + by + c = 0$, where a, b and c are integers. *(5 marks)*

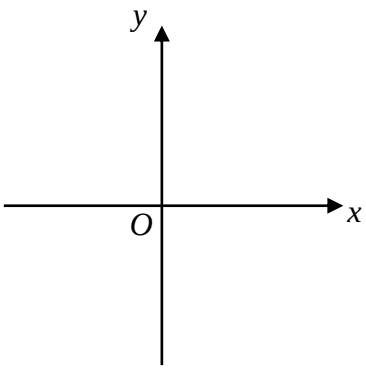
Question 9

A curve has equation $y = x^3 - 6x^2 + 20$

(a) Write down an expression for $\frac{dy}{dx}$ *(1 mark)*

(b) Work out the coordinates of the points at which the gradient is zero and determine whether they are maximum or minimum. *(5 marks)*

(c) Sketch the curve on the axes clearly labelling the maximum and minimum points. *(2 marks)*



Question 10

A curve has equation $y = x^3 - x^2 + k\,x - 2$

(a) Write down an expression for $\frac{dy}{dx}$ *(1 mark)*

(b) The curve has a minimum point at the point where $x = 2$

Work out the value of k. *(2 marks)*

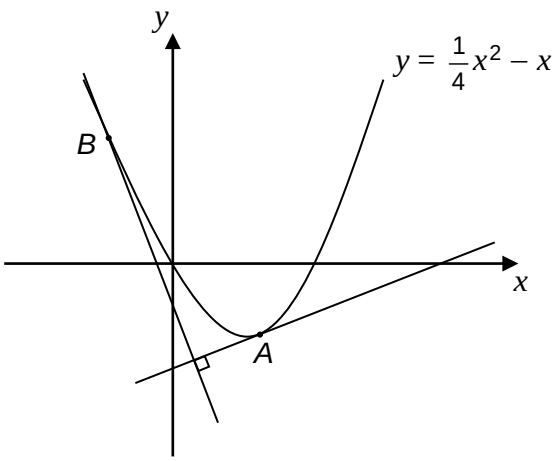
(c) Work out the x coordinate of the maximum point on the curve. *(3 marks)*

Question 11

(a) Show that the line $y = \frac{1}{2}x - \frac{9}{4}$ is the tangent to the curve $y = \frac{1}{4}x^2 - x$

at the point A $(3, -\frac{3}{4})$. *(4 marks)*

(b) The point *B* on the curve is such that the tangent at *B* is perpendicular to the tangent at *A*, as shown in the diagram.



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Work out the coordinates of *B*. *(4 marks)*

Question 12

Work out $\frac{dy}{dx}$ for each of the following

(a) $y = 3x^{-2} + 3$ *(1 mark)*

(b) $y = 5x^{-1} + 2x^2$ *(2 marks)*

(c) $y = 3x^{-3} - 4x^{-5}$ *(2 marks)*

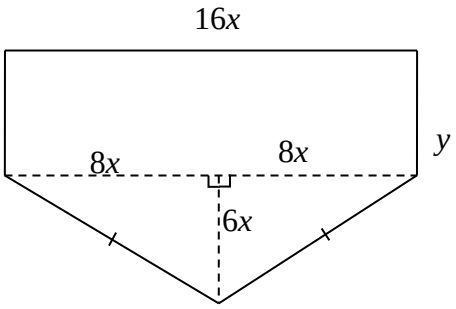
(d) $y = \frac{5 + x}{x^2}$ *(2 marks)*

(e) $y = \frac{1}{x}(x^4 + 2x - 4)$ *(3 marks)*

(f) $y = \frac{3x + 2x^6}{4x^3}$ *(3 marks)*

Question 13

A pentagon is made from a rectangle and an isosceles triangle.



(a) The perimeter of the pentagon is 84 cm

Show that $y = 42 - 18x$

(*2 marks*)

(b) Show that the area, A cm^2, of the pentagon is given by

$A = 672x - 240x^2$

(*2 marks*)

(c) Using calculus, work out the maximum value of A as x varies.

(*3 marks*)

Question 13

The curve $y = \frac{x}{4} + \frac{8}{x^2}$ has a minimum point

Work out this minimum value of y.

(4 marks)