

Lesson 10

GCSE Mathematics Differentiation I

10.1 TEST

Marks Available : 72

Question 1

Write down the exact value of each of the following:

(i) 5^3 (ii) $(-7)^2$ (iii) $\left(\frac{1}{2}\right)^4$

(iv) $64^{\frac{1}{2}}$ (v) $64^{\frac{1}{3}}$ (vi) $(-1)^{19}$

(vii) $\left(\frac{2\sqrt{\pi}}{7^2 - 5}\right)^0$ (viii) 0^8 (ix) $\left(\frac{9}{11}\right)^2$

[9 marks]

Question 2

Consider the curve, $y = x^3 - 5x$

Write down the points on the curve that have the x part as given;

(i) $(2, \text{_____})$ (ii) $(10, \text{_____})$ (iii) $(-10, \text{_____})$

[3 marks]

Question 3

Consider the quartic curve, $y = 3x^4 - 7x^2$

(i) Write down the gradient equation of the polynomial curve.

[2 marks]

(ii) Write down the bend detector equation of the polynomial curve.

[1 mark]

(iii) Use the appropriate equation to find the point on the curve when $x = 1$

[1 mark]

(iv) Use the appropriate equation to find the gradient of the curve when $x = 1$

[1 mark]

(v) Determine, when $x = 1$, if the curve is bending anticlockwise or clockwise.

[2 marks]

Question 4

Write down the exact value of the following:

(i) 4^{-2}

(ii) $27^{\frac{2}{3}}$

[2 marks]

Question 5

A curve has equation, $y = x^3 - 12x$

(i) Find $\frac{dy}{dx}$

[2 marks]

(ii) Find the gradient of the curve at the point where $x = -3$

[1 mark]

(iii) The curve has two turning points.
Find the coordinates of the two turning points.

[4 marks]

Question 6

Differentiate the following,

(i) $y = 6x^{-4}$

[2 marks]

(ii) $y = (3x + 5)^2$

[3 marks]

Some Theory of Mechanics

Starting with a displacement, s

Differentiate the displacement to get the velocity...

$$velocity = \frac{ds}{dt}$$

Differentiate the velocity to get the acceleration...

$$acceleration = \frac{d^2s}{dt^2}$$

Question 7

GCSE Examination question from May 2016, 3H, Q14

A particle is moving along a straight line.

The fixed point O lies on this line.

The displacement of the particle from O at time t seconds is s metres, where

$$s = 2t^3 - 12t^2 + 7t$$

(a) Find an expression for the velocity, $v \text{ ms}^{-1}$, of the particle at time t seconds.

[2 marks]

(b) Find the time at which the acceleration of the particle is instantaneously zero.

[2 marks]

Question 8

A curve has equation, $y = x^3 - 27x + 55$

- (a) Find the gradient of the curve at (3, 1)

[4 marks]

- (b) What does your answer to part (a) tell you about the point (3, 1) ?

[1 mark]

Question 9

- (i) Find the gradient equation of the curve,

$$y = \frac{25}{x^5}$$

[3 marks]

- (ii) Find the gradient of the curve when $x = -2$

[2 marks]

Question 10

GCSE Examination question from November 2006, 3H, Q14

- (a) For the equation $y = 5000x - 625x^2$, find $\frac{dy}{dx}$

[2 marks]

- (b) Find the coordinates of the turning point on the graph of,
 $y = 5000x - 625x^2$

[3 marks]

- (c) (i) State whether this turning point is a maximum or a minimum.
- (ii) Give a reason for your answer.

[2 marks]

- (d) A publisher has to set the price for a new book.
The profit, £ y , depends on the price of the book, £ x , where
 $y = 5000x - 625x^2$

- (i) What price would you advise the publisher to set for the book ?
- (ii) Give a reason for your answer.

[2 marks]

Question 11

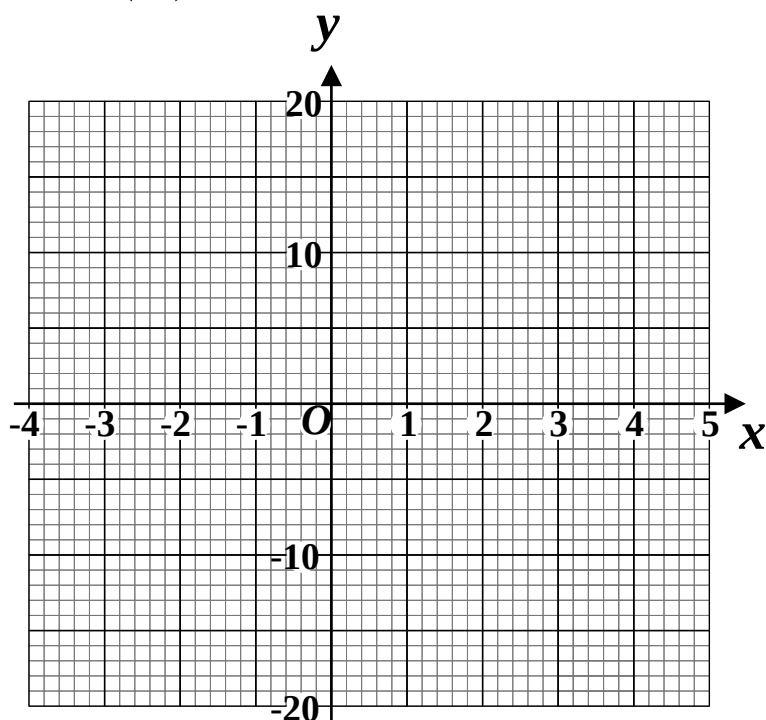
GCSE Examination question from June 2010, 3H, Q12

(a) Complete the table of values for, $y = x^3 - 12x + 2$

x	-3	-2	-1	0	1	2	3	4
y	11						-7	18

[2 marks]

(b) On the grid, draw the graph of $y = x^3 - 12x + 2$ for values of x from (-3) to 4



[2 marks]

(c) For the curve with equation $y = x^3 - 12x + 2$

(i) find $\frac{dy}{dx}$

(ii) find the gradient of the curve at the point where $x = 5$

[4 marks]

Question 12

GCSE Examination question from June 2011, 3H, Q21

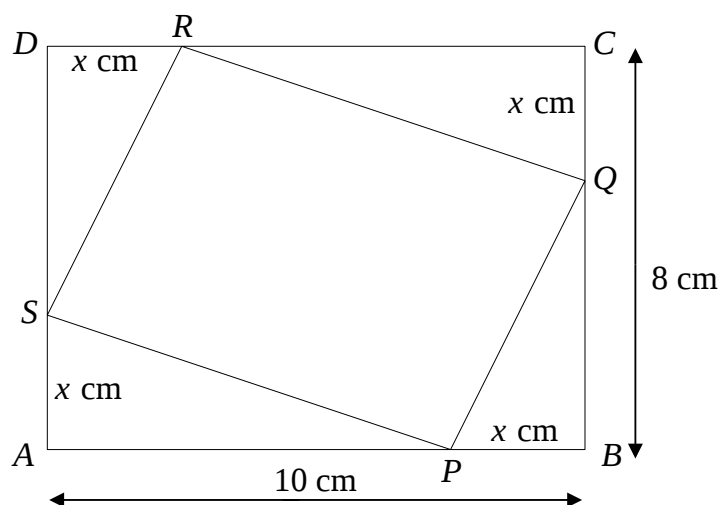


Diagram NOT
accurately drawn

$ABCD$ is a rectangle.

$AB = 10\text{ cm}$.

$BC = 8\text{ cm}$.

P , Q , R and S are points on the sides of the rectangle.

$BP = CQ = DR = AS = x\text{ cm}$.

(a) Show that the area, $A\text{ cm}^2$, of the quadrilateral $PQRS$ is given by the formula

$$A = 2x^2 - 18x + 80$$

[3 marks]

(b) For $A = 2x^2 - 18x + 80$

(i) find $\frac{dA}{dx}$

(ii) find the value of x for which A is a minimum.

(iii) Explain how you know that A is a minimum for this value of x .

[5 marks]

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Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com