



Question: _____

SUPPLEMENTARY PAGE

Question: _____

Course: _____

Methods _____

Year: 11

Student Name: _____

Teacher Name: _____

Date: 29/07/22

Task Type: Response

Time Allowed: 40 minutes

Number of Questions: 6

Materials Required: One double-sided A4 pages of notes (to be provided by the student)

Standard Items: Pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler and highlighters

Special Items: Drawing instruments, templates, notes on one unfolded sheet of A4 paper (both sides)

Marks Available: 40 marks

Task Weighting: 10 %

Formula Sheet Provided: Yes

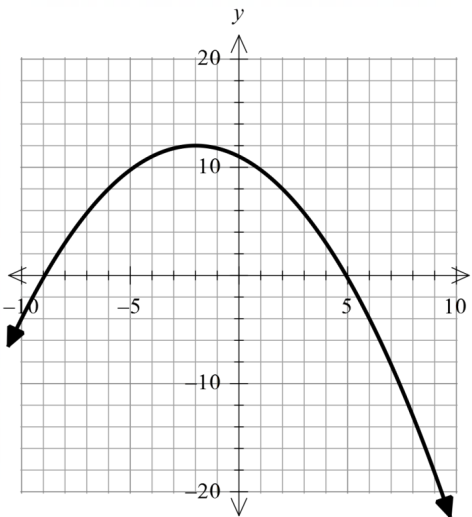
Note: All questions worth more than 2 marks require working to obtain full marks.

TEST 3: DIFFERENTIAL CALCULUS

Question 1 [2 marks – 1, 1]

(2.3.1-3)

Consider the function shown below. For the interval $[2, 6]$:



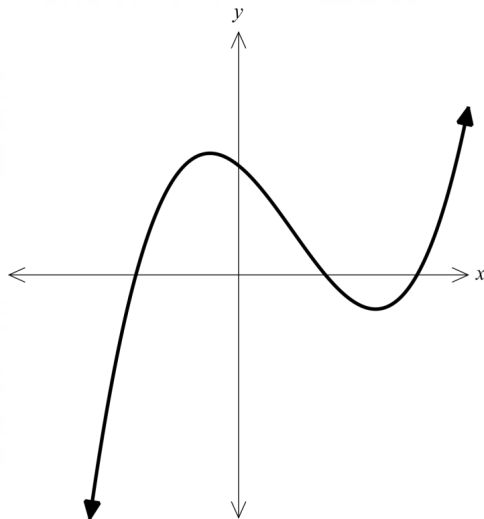
a) State the values of δx and δy .

b) Determine the average rate of change of the function.

Question 2 [3 marks]

(2.3.8-9, 11, 20)

Sketch a possible graph of $\frac{dy}{dx}$ for the cubic shown below, on the same axes.



Question 6 (continued)

b) Given that $V(x) = 2x^3 - 33x^2 + 108x$, find the dimensions of the box that will maximise its volume, state the volume and show that it is a maximum, using calculus.

Question 5 (continued)
c) Hence, calculate the distance travelled over the given interval.

i) $f(x) = 4x^5 - 9x^4$

a) Differentiate the following:

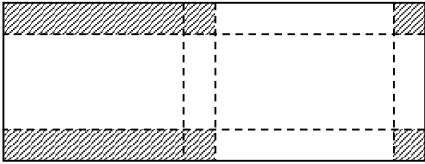
Question 3 [8 marks – 1, 2, 2, 3]

(2.3.7, 12-15, 22)

Question 6 [10 marks – 4, 6]

(2.3.20-21)

A rectangular sheet of metal, 9 cm by 24 cm, will be made into a closed rectangular box. Two squares of side x cm and two rectangles will be removed from the corners to form the net of the box as shown right.



a) Label the diagram with the appropriate dimensions and variables, then clearly show below that the volume of the box, $V \text{ cm}^3$, is given by $V(x) = x(12 - x)(9 - 2x)$.

ii) $f'(x) = \frac{12x^5 - 9x^2}{6x^2}$

i) $\frac{dy}{dx} = 24x^3 + 27x^2$

b) Anti-differentiate the following:

iii) $y = (2x + 3)(6x - 7)$

(continued on next page)

Question 4 [7 marks – 3, 4]

(2.3.4, 6, 9, 17)

Consider points $A(3, 18)$ and $B(3 + h, f(3 + h))$ on the curve $f(x) = 2x^2$.

- a) Determine the expression for the gradient of chord AB , using the difference quotient

$$\text{formula } \frac{\delta y}{\delta x} = \frac{f(x+h) - f(x)}{h}.$$

- b) Hence, by applying first principles to your answer above, determine the gradient and equation of the tangent to point A .

Question 5 [10 marks – 3, 4, 3]

(2.3.16, 18-20)

An object moves such that its position x metres from point O after t seconds is given by $x(t) = t^3 + at^2 + 24t$ for $0 \leq t \leq 5$. After 1 second, it has a velocity of 9 m/s.

- a) Show that $a = -9$.

- b) Determine when the object is stationary and its positions at those times.
You do not need to prove the nature of these stationary points.