Aids Allowed: Calculator, to be supplied by student.

Instructions: Fill in the information on this page, and make sure this test contains 4 pages. Present your solutions in the space provided. Use the back of the preceding page if you need more space. The value for each question is indicated in square brackets beside each question number.

TOTAL MARKS: 40

NAME: ____________________________________________

STUDENT NUMBER: __________________________________

SIGNATURE: ________________________________________

TUTORIAL: (eg Tut0107) _______________________________

TUTOR: ____________________________________________

MARKER'S REPORT:

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1. [15 marks] Consider the curve with parametric equations

\[ x = 3t^2; y = t^3 - 3t, \text{ for } t > 0 \]

(a) [7 marks] Find both \( \frac{dy}{dx} \) and \( \frac{d^2y}{dx^2} \)

(b) [8 marks] Find the length of the curve for \( 1 \leq t \leq 3 \)
2. [12 marks] Plot the two curves with polar equations

\[ r = 2 - 2 \cos \theta \text{ and } r = 1 \]

and find the area inside \( r = 2 - 2 \cos \theta \) but outside \( r = 1 \).
3. [13 marks] Let \( \mathbf{u} = ti - tj + 6k \), and let \( \mathbf{v} = 4\cos ti + 4\sin tj + 3tk \). Find the following:

(a) [4 marks] \[ \mathbf{v} \cdot \frac{d\mathbf{v}}{dt} \]

(b) [4 marks] \[ \frac{d\mathbf{u}}{dt} \times \mathbf{v} \]

(c) [5 marks] \[ \int \left( \mathbf{u} \times \frac{d\mathbf{v}}{dt} \right) dt \] (There is an easy way to do this.)