UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
School of Computer Science and Applied Mathematics

APPM3039A
Mechanics III

Quiz 04

Total: 5 Marks

Duration: 15 Minutes

Instructions:

- Write your student number on this answer sheet.
- Show all workings.

Question 1 [5 Marks]

Consider a two-dimensional flow where the path of each fluid element is described the equation

$$(x_1(t), x_2(t)) = \left(\sqrt{t + X_1^2} + t, \frac{1}{t + X_1^2} - \frac{1}{X_1^2} + X_2\right),$$

where (X_1, X_2) are the initial coordinates, $(x_1(t), x_2(t))$ are the coordinates of the element at time t.

1. Derive the velocity of the fluid in terms of x_1, x_2 and t. (2 marks)
2. Calculate the Lagrangian time derivative of the velocity of the fluid (acceleration) in terms of X_1, X_2 and t. (1 mark)
3. Calculate the Eulerian time derivative of the velocity of the fluid in terms of x_1, x_2 and t. (2 marks)