SCHOOL OF MATHEMATICS AND PHYSICS, UQ

MATH1072
Assignment 1
Semester Two 2024

Submit your answers by 1pm on Monday, 12th August, using the Blackboard assignment submission system. Assignments must consist of a single PDF.

You may find some of these problems challenging. Attendance at weekly tutorials is assumed.

Family name:

Given names:

Student number:

Marker's use only

Each question marked out of 3.

- Mark of 0: You have not submitted a relevant answer, or you have no strategy present in your submission.
- Mark of 1: Your submission has some relevance, but does not demonstrate deep understanding or sound mathematical technique.
- Mark of 2: You have the right approach, but need to fine-tune some aspects of your calculations.
- Mark of 3: You have demonstrated a good understanding of the topic and techniques involved, with well-executed calculations.

Q1:	Q2:	Q3a:
		Q3b:
		Q3c:

Total (out of 15):

1. Consider a sphere of radius r moving at speed v through a fluid of density ρ and viscosity μ. *Use dimensional analysis* to find a relationship for the drag force F, as a function of these other variables, i.e. determine a relationship of the form

$$F = f(r, v, \rho, \mu).$$

2. When disturbed, a buoy floating in the ocean will oscillate up and down at a frequency f. Assume this frequency depends on the buoy's mass m, its diameter at the waterline d, and the specific weight γ (force exerted by gravity per unit volume) of the water. If d and γ are assumed constant and m is halved, use dimensional analysis to determine how f will change.

3. Consider the function

$$f(x, y) = \frac{x^3 y - x y^3}{x^2 + y^2}.$$

The domain D of f is given by $\mathbb{R}^2 \setminus \{(0, 0)\}$.

(a) Use MATLAB to plot the surface $z = f(x, y)$ in a neighbourhood of $(x, y) = (0, 0)$ in D. Make sure you include your MATLAB code in your final submission.

(b) Show that $|\cos^3(\theta)\sin(\theta) - \cos(\theta)\sin^3(\theta)| \leq \frac{1}{4}$.

(c) Determine $\lim\limits_{(x,y)\to(0,0)} f(x, y)$ if it exists, and confirm this with an $\varepsilon - \delta$ proof, or show that the limit does not exist.