

Assignment 1 Cover Sheet

Student name: _____

Student number: _____

Tutor name: _____

Tutorial time and day: _____

Marking scheme:

- There will be 7 method marks and 2 answer marks for Question 1.
- There will be 1 mark overall for correct notation and mathematical expression.
- The total number of marks available is 10.

Assignment Instructions

This assignment is worth 2% of your final MAST10005 mark.

Submit your assignment to your tutor's MAST10005 assignment box, near the drink machine in the Peter Hall Building. You should present your work written neatly with your name and student number on each page and attach this cover sheet at the front. Please do not write your answers on the question sheet.

Full working should be shown in your solutions. Marks will be deducted for incorrect mathematical notation.

Full solutions will be uploaded to the LMS site after the assignment is due.

Assignment 1**Due: 4:00PM, Friday 3 August.**

Late assignments will not be accepted.

In this assignment we will investigate the sets:

$$A = \{n \in \mathbb{N} \mid \sin(n) > 0\}$$

$$B = \{n \in \mathbb{N} \mid \sin^2(n) \leq \sin(n)\}$$

$$C = \{x \in \mathbb{R} \mid x^2 \leq x\}$$

$$D = \{n \in \mathbb{N} \mid \sin(n) = 0\}$$

$$E = \{x \in \mathbb{R} \mid \sin(x) \leq 0\}$$

and the relationships between them. Remember that in MAST10005 we express angles in radians.

1. (a) Find a subset of A with exactly 12 elements. No proof is required for this part and you may use a calculator.
- (b) Express the set C as an interval and prove that your answer is correct.
- (c) Use proof by contradiction to prove that $D = \emptyset$. You may assume that $\pi \notin \mathbb{Q}$. You should show clearly where you use the *definition* of \mathbb{Q} .
- (d) Prove carefully that $A \subseteq B$. You will need to use the result of part (b).
- (e) Prove carefully that $B \subseteq A$. You will need to use the results of parts (b) and (c).
- (f) What can you conclude by combining the results of parts (d) and (e)?
- (g) The set E is a union of infinitely many intervals. Write down a typical interval in E , expressing your answer in terms of an arbitrary $k \in \mathbb{Z}$.
- (h) Decide whether $25 \in A$ and prove your claim carefully using the fact that

$$\pi \in \left(\frac{25}{8}, \frac{22}{7}\right) \quad (\dagger).$$

You must give a proof using (\dagger) . A calculator value is not sufficient.

[Hints: Start by writing (\dagger) as a pair of inequalities. You may find the answer to part (g) useful.]