Question 1 (Unit 1) – 30 marks

Sketch the graph of the function

$$f : x \longmapsto \frac{x^2 - 2x + 1}{2x^2 + x - 1}$$

using the Revised Graph-Sketching Strategy on page 21 of *Unit 1*.

(Credit will be given for carrying out and showing your work on each of the steps in the strategy.) [30]

Question 2 (Unit 1) – 20 marks

(a) Sketch the graph of the function

$$f : x \longmapsto \begin{cases} 4 - x^2, & x < 1, \\ |2 \sin \pi x|, & x \geq 1. \end{cases}$$ [10]

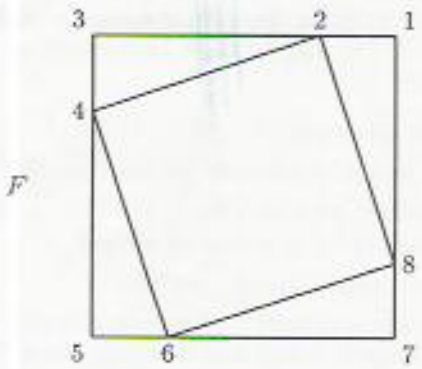
(You should explain clearly how you obtained your sketch.)

(b) Determine whether each of the functions f and g defined below is one–one and onto, justifying your answers.

$$f : \mathbb{R} \longrightarrow \mathbb{R} \qquad g : \mathbb{R} \longrightarrow \mathbb{R}$$
$$x \longmapsto 3 + \cos 2x \qquad x \longmapsto 2x - 3$$ [10]

Question 3 (Unit 2) – 20 marks

This question concerns the following figure F in the plane



(F consists of two squares, one inside the other with the vertices of the smaller square on the edges of the larger square. The area of the smaller square is greater than half that of the larger one.) The vertices of the two squares occupy locations 1, 2, 3, 4, 5, 6, 7, 8, as shown.

(a) Write down the total number of symmetries in $S(F)$, the symmetry group of F. [1]

(b) Describe briefly the effect of each symmetry on F. (Indicate clearly the axis of any reflection and the angle of any rotation about the centre of the figure.) [7]

(c) For each symmetry in part (b), write down the symmetry in two line form using the labelling of the vertex locations in the figure. [4]

(d) Write down the full Cayley table of $S(F)$, using letters to label the elements of the group. [6]

(e) Draw up a table listing each element of $S(F)$ with its inverse. [2]