1 (50 pts.) Evaluate the following integrals (consider them as improper integrals where appropriate, and state clearly when you are doing so):

(a) \[ \int x\sqrt{1 - \cos 2x} \, dx. \]

(b) \[ \int \frac{x^2}{(x - 1)(x^2 + 2x + 1)} \, dx. \]

(c) \[ \int_{0}^{2} \frac{x + 1}{\sqrt{4 - x^2}} \, dx. \]

(d) \[ \int \frac{7 \, dx}{(9x^2 + 1)^2}. \]

(e) \[ \int_{-\infty}^{2} \frac{5 \, dx}{x^2 + 4}. \]

2 (20 pts.) Consider the integral \[ \int_{0}^{2} \sin x^2 \, dx. \]

(a) Use the trapezoidal rule with \( n = 4 \) to estimate this integral. (You do not have to express your answer as a single fraction or decimal)

(b) Using the error bound formula, what is an upper bound for the error of the estimate from (a)?

3 (10 pts.) Sketch the graph of the polar coordinate curve \[ r = \cos 2\theta. \]

4 (20 pts.) Find the area of the region inside the outer loop and outside the inner loop of the polar coordinate curve \[ r = 2\cos \theta + 1. \]