• This exam is closed book. You may use one 8\(\frac{1}{2}\) \times 11 sheet of notes.

• Graphing calculators are not allowed.

• In order to receive credit, you must show your work. Explain why your answers are correct.

• If you use a trial and error (or guess and check) method when a calculus method is available, you will not receive full credit.

• Place a box around [YOUR FINAL ANSWER] to each question.

• If you need more room, use the backs of the pages and indicate to the reader that you have done so.

• Raise your hand if you have a question.
Evaluate the following double integrals.

(a) (8 points) \[ \iint_{R} x \sec^2(xy) \, dA, \quad R = [0, \pi/4] \times [0, 1] \]

(b) (8 points) \[ \iint_{D} 2xy \, dA \quad D \text{ is the triangle with vertices } (0, 0), (1, 2) \text{ and } (0, 3). \]
(9 points) Find the absolute maximum of the function \( f(x, y) = x + 2y - xy \) on the closed rectangular region with vertices \((0, 0), (0, 2), (3, 0)\) and \((3, 2)\).
If three resistors with resistances \( R_1, R_2 \) and \( R_3 \) are connected in parallel, then the total resistance \( R \) of the circuit is given by
\[
\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}
\]
Suppose that the resistances are measured in ohms with \( R_1 = 25, R_2 = 40 \) and \( R_3 = 50 \), and that there is a possible error of 0.5 ohms in each measurement. Use differentials to estimate the maximum error in the calculated value of \( R \).

Find all the points on the curve \( r = 1 + \cos \theta \) where the tangent line is horizontal.
(9 points) Let \( r(t) = 3t^2 \mathbf{i} + t^3 \mathbf{j} + 3t^2 \mathbf{k} \). Find all times \( t \) when the normal component of acceleration is equal to 8.