This exam covers:

- Techniques of Integration: substitution, ibp, partial fractions, trig substitution (7.1, 7.2, 7.4)
- Limits and Improper Integrals: the limit of the values of a function, infinite limits, limits at infinity, indeterminate forms, L'Hopital's rule, convergent and divergent integrals (1.8, 4.7, 7.6)
- Parametric Equations: parametic equations of motion, velocities in x and y directions, speed, parametric curves: slope, concavity, area (4.8 and supplementary notes)

Textbook exercises for review:

- Ch 1 Review: 44, 45, 46
- Ch 4 Review: 7*, 8*, 9*, 37, 38, 82, 83, 84, 85
  *Find the limits only.
- Ch 7 Review: 3-69, 72, 77-78, 88, 112, 115, 119, 120, 122, 125, 126a, 128-134, 140-151, 154, 181, 189

Additional exercises for review:

1. Consider the parametric equations $x = \sqrt{t}$, $y = 1/t$.
   (a) Find an equation for the tangent line to the curve at the point $(1, 1)$.
   (b) Determine whether the curve is concave up or concave down at the point $(1, 1)$.
   (c) Find the area under the curve from $x = 1$ to $x = 4$.
2. Consider the parametric equations $x = 2t^3 + 1$, $y = t^2$.
   (a) Find the area encosed by the curve and the x-axis from $x = 1$ to $x = 3$ by setting up and evaluating an integral in terms of t.
   (b) Check your answer by eliminating the parameter to obtain a Cartesian equation for the curve and integrating with respect to x.
3. Consider the parametric equations $x = 2t$, $y = 3 - 3t^2$
   (a) Find the area between the curve and the x-axis by setting up and evaluating an integral in terms of t.
   (b) Check your answer by eliminating the parameter to obtain a Cartesian equation for the curve and integrating with respect to x.
4. The motion of a reflector on a bicycle wheel of radius 1 is given by $x = t - \sin t$, $y = 1 - \cos t$. The path traced out by the reflector is a curve called a **cycloid**.
   (a) Find the velocity of the reflector in the x-direction, the velocity of the reflector in the y-direction, and the speed of the reflector at arbitrary time t.
   (b) Are there any moments when the reflector is momentarily paused? When its motion is purely up and down? Purely left and right?
   (c) Find the horizontal and vertical tangents of the cycloid.
   (d) Where is the cycloid concave up? Concave down?
   (e) Sketch the cycloid by plotting x and y coordinates for $t = 0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi, \ldots$.
   (f) Find the area under one arch of the cycloid.