On the front of your bluebook print (1) your name, (2) your student ID number and (3) a grading table. Show all your work in your bluebook and box in your final answers where appropriate. A correct answer with no supporting work may receive no credit, while an incorrect answer with some correct work may receive partial credit. Textbooks, class notes, calculators and crib sheets are not permitted. Please start each of the five problems on a new page.

1. (18 points) Calculate the following derivatives. You do not need to simplify the result for part (a).

$$\text{(a) } y = \left(1 + \tan^4\left(\frac{t}{12}\right)\right)^3 \qquad \text{(b) } y = \left(\frac{1+2z}{2z}\right)(2-z) \qquad \text{(c) } y = \frac{1}{\sin(\theta)\cos(\theta)}$$

2. (20 points) Coffee is draining from a conical filter into a coffeepot at the rate of 10 in^3/min. The cone has a height of 6 in and a base diameter of 6 in. The cylindrical coffeepot has a diameter of 6 in and a height of 8 in.
   (a) How fast is the level in the pot rising when the coffee in the cone is 5 in deep?
   (b) How fast is the level in the cone falling then?

3. (18 points) Find the following limits, if they exist. If they do not, state this and explain why.

$$\text{(a) } \lim_{\theta\to 0}\frac{\sin^2(2\theta)}{\theta^2} \qquad \text{(b) } \lim_{x\to-\infty}\frac{\cos(x)-x+x^2}{\sin(x)+2x-5x^2} \qquad \text{(c) } \lim_{x\to\infty}\frac{x-5\sqrt{x}}{\sqrt[3]{x}+2\sqrt{x}}$$

4. (14 points) Find an equation for the line tangent to the curve $y^2 + xy + x^2 = 3$ at $x = 1$ and $y = 1$.

5. (30 points) A particle's position is given by the function $s(t) = \frac{t^3}{3} - \frac{5}{4}t^2 + t$.
   (a) When is the particle moving left? moving right? When is the particle stopped?
   (b) At what times is the acceleration equal to zero?
   (c) When is the acceleration positive? negative?
   (d) Sketch the particle's position as a function of time.