Be sure to include your name and a grading table on the front of your blue book. You must work all of the problems on this exam. Show ALL of your work and **BOX IN YOUR FINAL ANSWERS**. A correct answer with no relevant work may receive no credit, a wrong answer with no work will receive no credit, and an incorrect answer accompanied by some correct work may receive partial credit. Text books, class notes, crib sheets, cell phones, calculators, or electronic devices of any kind are NOT permitted. Please start each problem **on a new page**. Good luck!

1. (30 points) Integrate

   (a) $\displaystyle\int \sec^2(t) - \frac{1}{\sqrt[5]{t^3}} + \pi\, dt$ (b) $\displaystyle\int 10t\sqrt{2t+5}\, dt$ (c) $\displaystyle\int_{-3}^{3} r\sqrt{r^2+1}\, dr$

   (e) $\displaystyle\frac{d}{dx}\int_5^{x^2} \frac{\ln(z)}{\sqrt{z^4+9}}\, dz$ (f) $\displaystyle\int_{-2}^{-1} \frac{3x^4-4x^2}{x^2}\, dx$

2. (15 points) You are at the bottom of a hole and throw a shovel full of dirt up with an initial velocity of $32\frac{ft}{sec}$. The dirt must rise 17 feet above the release point to clear the edge of the hole. Does the pile of dirt have enough of an initial velocity to escape from the hole? If so, by how much? If not, how short was it? Recall that $g = 32\frac{ft}{sec^2}$.

3. (15 points) The outside temperature in degrees Fahrenheit at CU on February 1, 2007 can be approximated by the function $T(t) = -10\sin\left(\frac{\pi t}{12}\right) + 15$ Where T is the temperature and t is the time from midnight ($t = 0$ corresponds to midnight, $t = 13$ would correspond to 1pm, etc). What was the average outside temperature at CU on February 1 (from $t = 0$ to $t = 24$)? Round your answer to the nearest degree if applicable.

4. (20 points) Linearization and Newton's Method!

   (a) Approximate $\sqrt{12}$ by rewriting it as $f(x) = \sqrt{x}$ and finding **TWO equations** for the local linear approximation of $f(x) = \sqrt{x}$ by selecting two different points **near** $x = 12$. Let $L_1(x)$ represent the linearization about the smaller x value and $L_2(x)$ represent the linearization about the larger x value.

   (b) Find $L_1(12)$ and $L_2(12)$.

   (c) Now use Newton's Method with an initial guess of $x_0 = 4$ to approximate $\sqrt{12}$ by letting $g(x) = x^2 - 12$ and solving for the positive root of $g(x) = 0$. Compute both x_1 and x_2. NOTE: There is some algebra involved, but I have faith that you can do it. $\ddot\smile$

5. (20 points) A computer gives a digital readout of fuel consumption for a small aircraft in $\frac{gallons}{min}$. During a 30 minute trip, the following data was collected every 5 minutes:

Time (min)	0	5	10	15	20	25	30
$\frac{gal}{min}$	2	3	1	3	2	3	1

   (a) Make a sketch of the data and **clearly label** the x and y axis. Note: Even though the *data* is not continuous, both time and fuel consumption are. Therefore we can "connect the dots" using straight lines to form a continuous graph for the purposes of this problem. Just remember that anything that is not a data point is an estimate.

   (b) Adding to your sketch from part a, show what a **left** endpoint approximation method with six rectangles would look like.

   (c) Using a left endpoint approximation method with six rectangles, estimate the total consumption of gas during the trip.

   (d) Have you found an over or under-estimate of the total gas consumption? Justify your answer.

97% of all statistics are made up.