Instructions:

Write the answers and show all your work in the blue books. There are 5 problems. Make sure you do all 5. No books, notes, or collaboration with others.

Problem 1. (7 points) Use the definition of the definite integral as a limit of Riemann sums to find
\[ \int_{-1}^{0} x^2 \, dx. \]
You may use the summation formula
\[ \sum_{j=1}^{n} j^2 = \frac{n(n+1)(2n+1)}{6}. \]

Problem 2. (20 points) Calculate the integrals shown:
(a.) \[ \int_{1}^{3} -2x + \frac{1}{x^3} \, dx. \]
(b.) \[ \int \frac{\sin(x)}{(1 + \cos(x))^2} \, dx. \]
(c.) \[ \int_{0}^{2} x^2 \sqrt{x^3 + 1} \, dx. \]
(d.) \[ \int \sin(\cos(2x)) \sin(2x) \, dx. \]
(e.) \[ \int (u^4 + u^2)(2u^2 + 1) \, du. \]

Problem 3. (3 points) Rewrite the differentiation formula
\[ \frac{d}{dx} (\sec(x)) = \sec(x) \tan(x) \]
as an equivalent integration formula.
Problem 4. (5 points) Find the derivative indicated without doing any integration:

\[
\frac{d}{dx} \int_{1-x}^{1+x} \frac{1}{t^2 + 2} \, dt.
\]
(Hint: break into two integrals where each has one constant limit of integration.)

Problem 5. (5 points) The acceleration due to gravity on the Moon is only one fifth of its value (32 feet per second per second) on Earth. If a ball is thrown straight up at 25 feet per second from the surface of the Moon, how long before it comes back down?