In general my quizzes and exams are closed book, except that you may use appendices C, D, and E from the textbook (math formulas and integral tables). Calculators are also allowed. Be sure to show your work.

Consider a projectile fired vertically downward with initial speed \( v_0 \) in a constant gravitational field from an initial height \( b \) above the ground. Find as a function of \( v_0, k, \) and \( b \) the speed \( v \) of the projectile when it hits the ground for two cases:

a) Zero resistance \((k=0)\).

b) Resistance proportional to the square of the instantaneous speed \((kmv^2)\).

c) Then show explicitly that the result for Case (b) reduces to the result for Case (a) when \( k \) goes to zero.

\[
\int \frac{dx}{a^2 + x^2} = \frac{1}{a} \tan^{-1} \left( \frac{x}{a} \right) \\
\int \frac{xdx}{a^2 + x^2} = \frac{1}{2} \ln \left( a^2 + x^2 \right) \\
\int \frac{dx}{x(a^2 + x^2)} = \frac{1}{2a^2} \ln \left( \frac{x^2}{a^2 + x^2} \right) \\
\int \frac{dx}{ax^2 - b^2} = \frac{1}{2ab} \ln \left( \frac{ax - b}{ax + b} \right) \\
\int \frac{dx}{\sqrt{ax^2 + bx}} = \frac{2}{b} \sqrt{a + bx} \\
\int \frac{dx}{\sqrt{x^2 + a^2}} = \ln \left( x + \sqrt{x^2 + a^2} \right)
\]