HOMEWORK #2

Due: November 1 (Wednesday) by 5pm

Instructions:

- The assignment consists of *five* questions worth, respectively, 2, 1, 2, 3 and 2 points.
- Submit your assignment *in hardcopy* to the 2E03 locker in the basement of Hamilton Hall (outside the room HH 105).
- The pages of your assignment should be stapled together with solutions to problems appearing in the correct order.
- Your name, student I.D. number and the course number must be clearly written on the first page of the assignment.
- Late submissions and submissions which do not comply with these guidelines will not be accepted.

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1. A loan with principle P_0 and interest rate r is repaid with monthly payments of size x.

   (a) Find the time T needed to pay off the loan as a function of P_0, r and x. Assume the interest is compounded monthly.

   (b) Repeat part (a), but assume that interest is compounded continuously and that payments are made continuously at rate x.

   [problem 3.1 from the textbook (page 60)] *(2 points)*

2. Suppose that an interest rate is constant at 4% this year, 6% next year, and 5% for the following year. Assuming continuous compounding, what is the present value of $\$10,000$? (You expect to have $\$10,000$ at the end of the three years)
   [problem 3.4 from the textbook (page 61)] *(1 point)*

3. Consider a hazard rate function

$$h(x) = \begin{cases} \lambda > 0 & \text{for } 0 \le t \le 50, \\ \lambda + \alpha(t-50) & \text{for } t > 50. \end{cases}$$

   (constant hazard to age 50, linearly increasing hazard rate after 50). Find the survivor function $S(t)$ from $\frac{S'}{S} = -h$ (distinguish $t \le 50$ and $t > 50$).
   Hint: First solve $\frac{S'}{S} = -h$ on $t \in [0,50]$, where $S(0) = 1$. Compute $S(50)$ and use this as the initial value for $\frac{S'}{S} = -h$ on $t \in (50,\infty)$.
   [problem 3.9 from the textbook (page 62)] *(2 points)*

4. Repeat Sir Taylor's problem of the radius of the shock wave in an explosion as a function of time, released energy, ambient air density, and pressure, choosing time, energy and pressure as the primary variables. What functional relationship do you find?
   [problem 4.6 from the textbook (page 82)] *(3 points)*

5. The force K is experienced by an object with a cross–sectional area A in a fluid with density ρ and velocity u. This force is assumed to be a function of ρ, A and u:

$$K = f(\rho, A, u).$$

Show that there is a constant c such that

$$K = c\rho u^2 A.$$

Hint: Choose kg, m and s as the fundamental dimensional units. Note that f depends on three primary quantities and on *no* secondary quantities.
[problem 4.7 from the textbook (page 82)] *(2 points)*