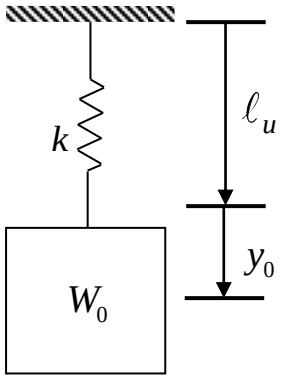
ENGR 1990 Engineering Mathematics
Homework #1 – Applications of Lines

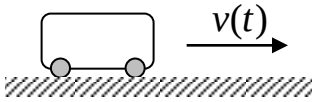
1. A weight $W_0 = 10$ (lb) is hanging from a spring of stiffness k (lb/in). When weights of 50 and 75 pounds were added to W_0, it displaced by the additional amounts shown in the table. Use the two data values to find the average spring stiffness. Express your results in both (lb/in) and (lb/ft). Use the average stiffness to find the displacement y_0 due to weight W_0.



Weight, ΔW (lb)	Displacement, Δy (in)	Stiffness, $k = \Delta W / \Delta y$
50	0.87	
75	1.31	

2. A car is traveling with velocity $v(t)$ when the brakes are applied, causing the car to decelerate at a constant rate until it stops. The following speeds were measured during the deceleration period.

Measurement	Time, t (sec)	Velocity, $v(t)$ (ft/s)
1	2.3	98.5
2	5.1	71.6
3	8.7	36.2



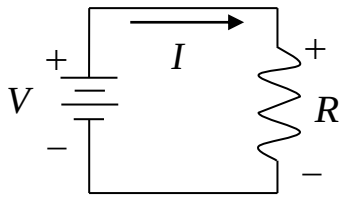
(a) Using two different pairs of measured velocities (for example, measurement pairs (1, 2) and (2, 3)), calculate an average deceleration of the car. Using this average deceleration, (b) find an equation for the velocity $v(t)$ of the car, (c) estimate the car's initial velocity in miles/hour, and (d) estimate time t^* required to stop.

3. A car starts from rest and accelerates at a constant rate of $a_0 = 15.9$ (ft/s^2) for 5 seconds, and then it decelerates at a constant rate $a_1 = -9.25$ (ft/s^2) until it stops. Find (a) equations for the velocity $v(t)$ during the acceleration and deceleration phases, (b) the time t^* when the car stops, (c) the time t^* as a function of the acceleration a_1, and (d) the maximum velocity of the car in miles/hour.

4. The table below shows the currents I (amps) measured in the simple circuit for a series of applied voltages V (volts).

   a) Complete the table below by calculating the resistance associated with each voltage-current pair.
   b) Write an equation that models the relationship between voltage and current for the range of voltages shown.

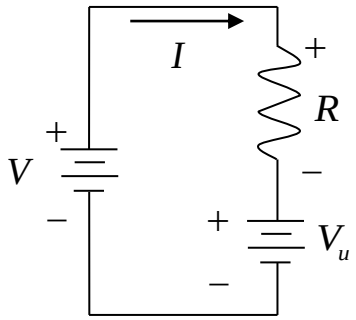
V (volts)	I (amps)	$R = V/I$ (ohms)
1.31	0.1637	
3.25	0.4065	
4.57	0.5720	
6.03	0.7528	
7.51	0.9400	
	Average, R	



5. In the single-loop electrical circuit shown, the current I is related to applied voltage V and the unknown constant voltage V_u as follows:

$$I = \left(\frac{1}{R}\right)V - \left(\frac{V_u}{R}\right)$$

where R is the resistance of the resistor in ohms. The following table shows the currents associated with two applied voltages.



V (volts)	I (amps)
20	1.75
35	3.5

   a) Find the value of resistor R.
   b) Write the relation between the voltage source and the resulting current.
   c) Sketch a plot of current I as a function of the applied voltage V.