Name: ESG 162
Professor: Engineering Math

Quiz 1

60 pts

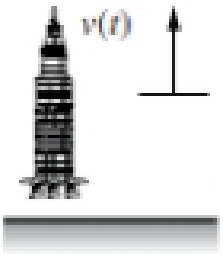
Directions:

This is an “open book” quiz where you may have one page of notes open and available to you. You may not consult with any outside entity or intelligence beyond God and your professor. You may use the internet to look things up. You will have a maximum of 80 minutes to complete the quiz. Please turn in a pdf file. Please show all work.

1. Identify the independent variable, the dependent variable, the slope, and the y-intercept for the following engineering equations. (12 pts)

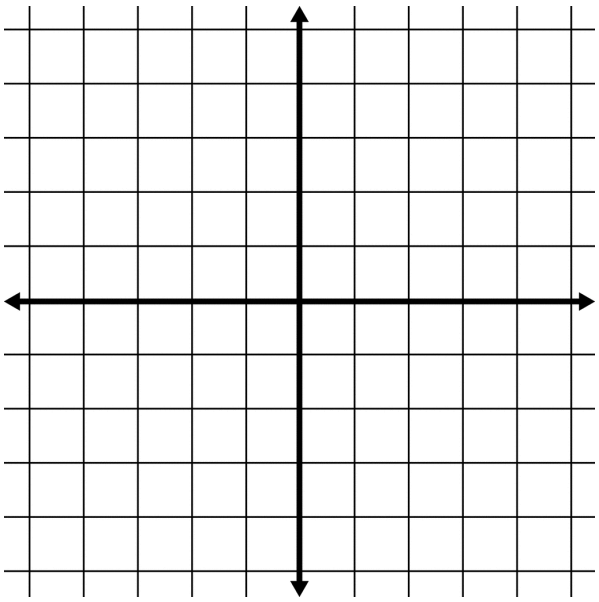
Equation	Ind. Var.	Dep. Var.	Slope	Y-intercept
$v(t) = v_0 + at$				
$v_o = \left(1 + \frac{25}{77}\right) - \frac{45}{R} v_i$				
$F(x) = kx$				

2. An evil scientist has launched a rocket fired in the vertical plane to try to destroy the moon. The velocity v(t) is measured. The velocity satisfies the equation $v(t) = v_o + at$, where v_0 is the initial velocity of the rocket in m/s.



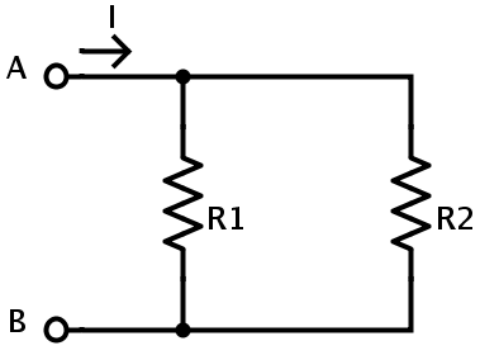
$v(t)\ (\frac{m}{s})$	$t(s)$
50	0.5
125	2.0

a. Determine the equation of the rocket's velocity over time. (4 pts)
b. Plot the line on the given axes (4 pts)
c. If the missile cannot be stopped after it reaches escape velocity (~20,000 m/s), how long does Captain Engineering have to deactivate the warhead before the moon is destroyed and we lose tide pools forever? (What time does v= 20,000?) (4 pt)



3. Two resistors in parallel have a total resistance of $R_{tot} = \frac{R_1 R_2}{R_1 + R_2}$. The designer would like at least 2 times as much current to go through R_2 which means that R_1 must be a little more than 2 times larger than R_2, or $R_1 = 2R_2 + 40$. The total resistance required is 1000 Ω.

    a. Re-write the equation as a standard form quadratic equation and, (6pts)
    b. Find the solution for R_1 and R_2? (6pts)



4. You are tasked to calculate the height of the Golden Dome at the University of Notre Dame using simple tools. You measure your horizontal distance from base of the building to you as 100 feet and then measure the angle from your location to the peak as 63°.
    a. Sketch the triangle you would use to solve this problem (6pts)
    b. Determine the approximate height of the building using trigonometry (6pts)

5. A one link robot is designed with link lengths of $L_1 = 50$ cm.
    a. Find the end location (x, y) if $\theta_1 = 30°$ (4pts)
    b. Sketch the solution on the axes provided. (2 pts)

   A two-link robot is designed with link lengths L1 = 40 cm, L2 = 60 cm.
    c. Find the end location (x, y) if $\theta_1 = 110°$, and $\theta_2 = -80°$. (4pts)
    d. Sketch the solution on the axes provided. (2 pts)