Problem Set 3

Use Matlab to calculate the answers to the following:

Problem 1

The voltage V_C t seconds after closing the switch in the circuit shown is:

$$V_C = V_o\left(1 - e^{\frac{-t}{RC}}\right)$$

Given $V_C = 36V$, $R = 2500\Omega$, and $C = 1600\mu F$, calculate the current 8 seconds after the switch is closed.

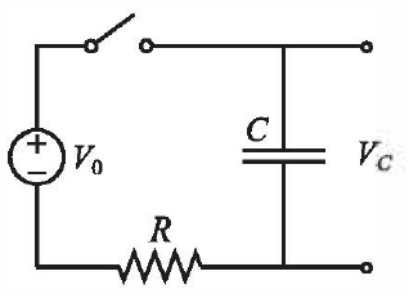

Figure 1: Problem 1 Figure

Problem 2

Radioactive decay of carbon-14 is used for estimating the age or organic material. The decay is modeled with the exponential function $f(t) = f(0)e^{kt}$, where t is the time, $f(0)$ is the amount of material at $t = 0$, $f(t)$ is the amount of material at time t, and k, is the constant. Carbon-14 has a half-life of approximately 5,5730 years. A sample taken from the ancient footprints of Achaualinca in Nicarahua shows that 77.45% of the initial ($t = 0$) carbon-14 is present. Determine the estimated age of the footprint. Solve the problem by writing a program in a script file. The program first determines the constant k, then calculates t for $f(t) = 0.7745f(0)$, and finally rounds the answer to the nearest year.

Problem 3

The greatest common divisor is the largest positive integer that divides the number without a remainder. For example, the GCD of 8 and 12 is 4. Use MATLAB Help Window to find a MATLAB built-in function that determines the greatest common divisor of two numbers. The use the function to show that the greatest common divisor of :

a) 91 and 147 is 7.

b) 555 and 962 is 37.

Problem 4

The value B of a principal P that is deposited in a savings account with a fixed annual interest rate r after n years can be calculated by the formula:

$$B = P\left(1 + \frac{r}{m}\right)^{nm}$$

where m is the number of times that the interest is compounded annually. Consider an \$80,000 for 5 years. Determine how much more money will be earned if the interest is compounded daily instead of yearly.

Problem 5

Use the Help Window to find a display format that displays the output as a ratio of integers. For example, the number 3.125 will be displayed as $\frac{25}{8}$. Change the display to this format and execute the following operations:

a) $\frac{5}{8} + \frac{16}{6}$

b) $1/3 - 11/13 + 2.7^2$

Problem 6

Stirling's approximation for large factorials is given by:

$$n! = \sqrt{2\pi n}\left(\frac{n}{e}\right)^n$$

Use the formula for calculating 20!. Compare the result with the true value obtained with MATLAB's built-in function *factorial* by calculating the error $(Error = (TrueVal - ApproxVal)/TrueVal)$.