MATLAB Assignment 5 (B)

1. Write a function called **light_time** that takes as input a row vector of distances in miles and returns two row vectors of the same length. Each element of the first output argument is the time in minutes that light would take to travel the distance specified by the corresponding element of the input vector. To check your math, it takes a little more than 8 minutes for sunlight to reach Earth which is 92.9 million miles away. The second output contains the input distances converted to kilometers. Assume that the speed of light is 300,000 km/s and that one mile equals 1.609 km.

2. **Cross Product :** Write a function to calculate the cross product of two vectors V_1 and V_2
   $V_1 \times V_2 = \left(V_{y1}V_{z2} - V_{y2}V_{z1}\right)i + (V_{z1}V_{x2} - V_{z2}V_{x1})j + \left(V_{x1}V_{y2} - V_{x2}V_{y1}\right)k$
   Where $V_1 = V_{x1}i + V_{y1}j + V_{z1}k$ and $V_2 = V_{x2}i + V_{y2}j + V_{z2}k$. Note that this function will return a real array as it results. Use the function to calculate the cross product of two vectors $V_1 = [\,-2,4,0.5]$ and $V_2 = [0.5,3,2]$.

3. **Dice Simulation**: It is often useful to be able to simulate the throw of a fair die. Write a MATLAB function dice that simulates the throw of a fair die by returning some random integer between 1 and 6 every time that it is called. (*Hint:* Call random0 to generate a random number. Divide the possible values out of random0 into six equal intervals and return the number of the interval that a given random value falls into.)

4. **The Birthday Problem** The Birthday Problem is stated as follows: if there is a group of n people in a room, what is the probability that two or more of them have the same birthday? It is possible to determine the answer to this question by simulation. Write a function that calculates the probability that two or more of n people will have the same birthday, where n is a calling argument. (Hint: To do this, the function should create an array of size n and generate n birthdays in the range 1 to 365 randomly. It should then check to see if any of the n birthdays are identical. The function should perform this experiment at least 5000 times and calculate the fraction of those times in which two or more people had the same birthday.) Write a test program that calculates and prints out the probability that two or more of n people will have the same birthday for n = 2,3,...,40.

5. Write a function called **hulk** that takes a row vector **v** as an input and returns a matrix **H** whose first column consist of the elements of **v**, whose second column consists of the squares of the elements of **v**, and whose third column consists of the cubes of the elements **v**. For example, if you call the function likes this, **A = hulk(1:3)** , then **A** will be **[1 1 1; 2 4 8; 3 9 27].**

6. **Road Traffic Density Function** random0 produces a number with a uniform probability distribution in the range [0.0, 1.0). This function is suitable for simulating random events if each outcome has an equal probability of occurring. However, in many events the probability of occurrence is not equal for every event, and a uniform probability distribution is not suitable for simulating such events.
   For example, when traffic engineers studied the number of cars passing a given location in a time interval of length t, they discovered that the probability of k cars passing during the interval is given by the equation
   $P(k,t) = e^{\lambda t}\frac{(\lambda t)^k}{k!}$ for t>=0, λ>0, and k=0,1,2………………..
   This probability distribution is known as the *Poisson distribution*; it occurs in many applications in science and engineering. For example, the number of calls k to a telephone switchboard in time interval t, the number of bacteria k in a specified volume t of liquid, and the number of failures k of a complicated system in time interval t all have Poisson distributions.
   Write a function to evaluate the Poisson distribution for any , t, and λ. Test your function by calculating the probability of 0, 1, 2, . . ., 5 cars passing a particular point on a highway in 1 minute, given that λ is 1.6 per minute for that highway. Plot the Poisson distribution for t = 1 and λ = 1.6.