ENED 1091: Homework #5
Due: Week 4 at beginning of Recitation

Problem 1: Resultant Force
Consider the following three forces:

$$F_1 = 15\angle 30^o\ N;\ \ F_2 = \ 20\angle 150^o\ N;\ \ F_3 = 75\ \angle -140^o\ N$$

(a) Resolve each force into an x-component and y-component. Fill in the table below. **Show your work!**

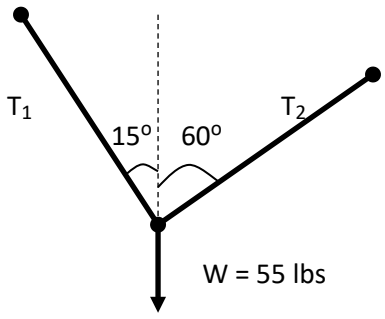
Force	x-component	y-component
F1	12.99	7.5
F2	-17.32	10
F3	-57.45	-48.21

(b) Calculate the resultant force in rectangular form and polar form. **Show your work and include units in your answers!**

Resultant Force (Rectangular Form): F_x = ____-61.78N_____ F_y = ____-30.71N_____

Resultant Force (Polar Form): ____68.99N_____198.53^o_____

Problem 2: Statics
Write the force balance equations for the diagram shown below that represents an object hanging from two wires. Then write the equations in matrix form (Ax = b) and use MATLAB to solve for the tension (T_1 and T_2) in the two wires. **Show your work and include units in your answers!**



Force Balance Equations:
T1*cos(15/180*pi)+T2*cos(60/180*pi)= 55

T1*sin(15/180*pi)=T2*sin(60/180*pi)

Matrix Equation:

A:	x:	b:
0.9659 0.5000	T1	55
0.2588 - 0.8660	T2	0

MATLAB Commands:

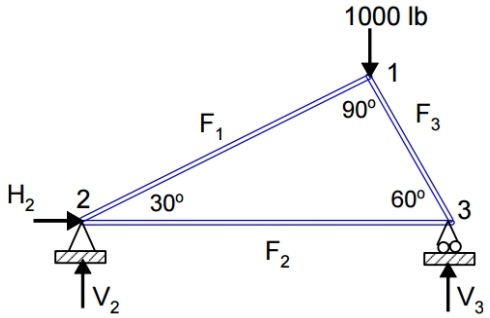
```
A=[0.9659 0.5;0.2588 -0.8660];
if det(A)~=0
    solution=inv(A)*[4.4482;0];
end
disp(solution)
```

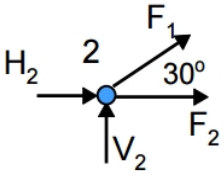
SOLUTION:

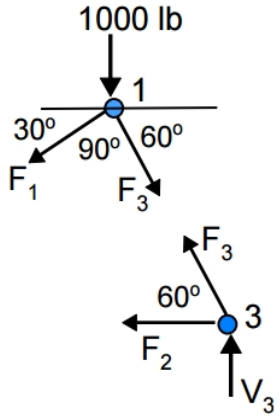
T1 = 49.3131 lbs **T2 = 14.7370 lbs**

Problem 3: Systems of Linear Equations

Shown below is a diagram of a simple truss along with a free body diagram assuming the beams are all in compression.







Equilibrium Equations for Joint 1:

$$\sum F_x = 0: \qquad -F_1\cos(30^o) + F_3\cos(60^o) = 0$$

$$\sum F_y = 0: \qquad -F_1\sin(30^o) - F_3\sin(60^o) - 1000 = 0$$

(a) Equilibrium Equations for Joint 2? Enter Equations below:
$H_2+F_2+F_1\cos(30°)=0$
$V_2+F_1\sin(30°)=0$

(b) Equilibrium Equations for Joint 3? Enter Equations below:
$F_2+F_3\cos(60°)=0$
$V_3+ F_3\sin(60°)=0$

(c) Enter the matrix equation below by completing the table below:

-cos(30)	0	cos(60)	0	0	0		F1		0
-sin(30)	0	-sin(60)	0	0	0		F2		1000
cos(30)	1	0	0	0	1	*	F3	=	0
sin(30)	0	0	1	0	0		V2		0
0	1	cos(60)	0	0	0		V3		0
0	0	sin(60)	0	1	0		H2		0

(d) Use MATLAB to solve for F1, F2, F2, V2, V3, and H.

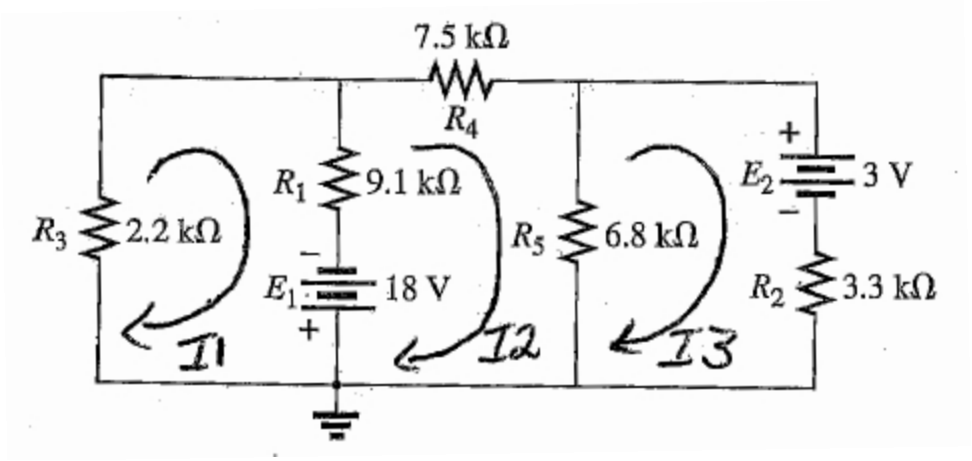
MATLAB COMMANDS:

```
A=[ -cosd(30),0,cosd(60),0,0,0;
    -sind(30),0,-sind(60),0,0,0;
    sind(30),1,0,0,0,1;
    cosd(30),0,0,1,0,0;
    0,1,cosd(60),0,0,0;
    0,0,sind(60),0,1,0];
B=[0;1000;0;0;0;0];
X=inv(A)*B
```

FORCES:

F1 = -500.000 F2 = 433.0127 F3 =-866.0254 V2 =250.000 V3 = 750.000
H =0.000

Problem 4: Mesh Analysis
A student in a circuits class writes mesh equations for the circuit shown below and now must solve for the unknown currents (I_1, I_2, and I_3).



$$11.3\,I_1 - 9.1\,I_2 = 18$$

$$-9.1\,I_1 + 23.4\,I_2 - 6.8\,I_3 = -18$$

$$-6.8\,I_2 + 10.1\,I_3 = -3$$

(a) Write the equations in matrix form and use MATLAB to solve for all three currents. The units for the currents will be in milliamps (mA).

Matrix Equation:

A:			**x:**	**b:**
11.3	**-9.1**	**0**	**I1**	**18**
-9.1	**23.4**	**-6.8**	**I2**	**-18**
0	**-6.8**	**10.1**	**I3**	**-3**

MATLAB Commands:

```
A=[11.3 -9.1 0;-9.1 23.4 -6.8;0  -6.8 10.1];
B=[18;-18;-3];
X=inv(A)*B
```

SOLUTION:

I1 =1.2059A I2 = -0.4806A I3 = -0.6206A

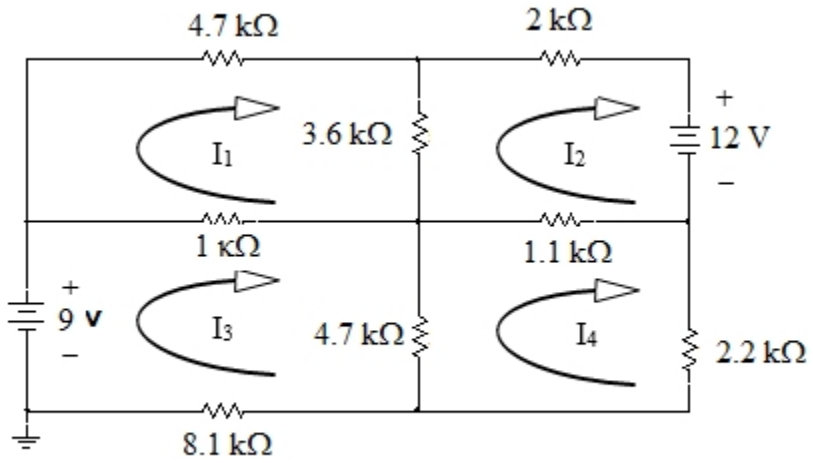
(b) Find the current through the 9.1 kΩ resistor and find the voltage drop across the 9.1 kΩ resistor. **Show your calculations and include units in your answers.**

I=I1+I2=1.6865mA

U=I*9.1 kΩ=15.34715V

Problem 5: Mesh Analysis

A student in a circuits class writes mesh equations for the circuit shown below and now must solve for the unknown currents (I_1, I_2, I_3, and I_4).



$$4.7\,I_1 + 3.6(I_1 - I_2) + 1(I_1 - I_3) = 0$$
$$3.6(I_2 - I_1) + 2I_2 + 1.1(I_2 - I_4) = -12$$
$$1(I_3 - I_1) + 4.7(I_3 - I_4) + 8.1I_3 = 9$$
$$4.7(I_4 - I_3) + 1.1(I_4 - I_2) + 2.2I_4 = 0$$

(a) Write the equations in matrix form and use MATLAB to solve for all four currents. The units for the currents will be in milliamps (mA).

Matrix Equation:

A:				**x:**	**b:**
9.3	**-3.6**	**-1**	**0**	**I1**	**0**
-3.6	**6.7**	**0**	**-1.1**	**I2**	**-12**
-1	**0**	**13.8**	**-4.7**	**I3**	**9**
0	**-1.1**	**-4.7**	**8**	**I4**	**0**

MATLAB Commands:

```
A=[9.3 -3.6 -1 0;-3.6 6.7  0 -1.1;-1 0 13.8 -4.7;0  -1.1  -
4.7  8];
B=[0;-12;9;0];
X=inv(A)*B
```

SOLUTION:

I1 = -0.7872mA **I2 = -2.2045mA** **I3 = 0.6149mA** **I4 = 0.0582mA**

(b) Find the current through the 1.1 kΩ resistor and find the voltage drop across the 1.1 kΩ resistor. **Show your calculations and include units in your answers.**

$\mathbf{I_4 - I_2 = 2.2627}\boldsymbol{mA}$

$\mathbf{U = (I_4 - I_2) \times 1.1\ k\Omega = 2.49V}$