Introduction To Engineering – Assignment 03

#	Student ID	Student Name	Grade (10)
-			

Delivery Date	

١. يتم تسليم التمرين محلولا في خلال أسبوع من تاريخ التمرين، و يتم حذف درجتين من التمرين عن كل أسبوع تأخير
٢. يتم التسليم لمعيد المقرر مباشرة
٣. تتم أجابه التمرين في نفس ورق الأسئلة

Q1

For the function $y = \frac{2\sin x + \cos^2 x}{\sin^2 x}$, calculate the value of y for the following values of x using element-by-element operations: 20°, 30°, 40°, 50°, 60°, 70°.

Sol 1

Script file:

```
clear, clc
x=20:10:70;
y=(2*sind(x)+cosd(x).^2)./sind(x).^2
```

```
y =

   13.3962    7.0000    4.5317    3.3149    2.6427    2.2608

>>
```

Q2	The length $\|\mathbf{u}\|$ (magnitude) of a vector $\mathbf{u} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ is given by $\|\mathbf{u}\| = \sqrt{x^2 + y^2 + z^2}$. Given the vector $\mathbf{u} = 23.5\mathbf{i} - 17\mathbf{j} + 6\mathbf{k}$, determine its length in the following two ways: (*a*) Define the vector in MATLAB, and then write a mathematical expression that uses the components of the vector. (*b*) Define the vector in MATLAB, then determine the length by writing one command that uses element-by-element operation and MATLAB built-in functions `sum` and `sqrt`.

Sol 2	Script file:
	`clear, clc`
	`u=[23.5 -17 6];`
	`disp('Part (a)')`
	`length_u=sqrt(u(1)^2+u(2)^2+u(3)^2)`
	`disp('Part (b)')`
	`length_u=sqrt(sum(u.*u))`

Q3

Two vectors are given:

$\mathbf{u} = 5\mathbf{i} - 6\mathbf{j} + 9\mathbf{k}$ and $\mathbf{v} = 11\mathbf{i} + 7\mathbf{j} - 4\mathbf{k}$

Use MATLAB to calculate the dot product $\mathbf{u} \cdot \mathbf{v}$ of the vectors in three ways:

(*a*) Write an expression using element-by-element calculation and the MATLAB built-in function sum.

(*b*) Define **u** as a row vector and **v** as a column vector, and then use matrix multiplication.

(*c*) Use the MATLAB built-in function dot.

Sol 3

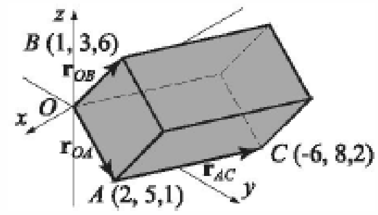
Script file:

```
clear, clc
u=[5,-6,9]; v=[11,7,-4];
disp('Part (a)')
dotuv=sum(u.*v)
disp('Part (b)')
dotuv=u*v'
disp('Part (c)')
dotuv=dot(u,v)
```

```
Part (a)

dotuv =

   -23

Part (b)

dotuv =

   -23

Part (c)

dotuv =

   -23
```

Q4

. The volume of the parallelepiped shown can be calculated by $\mathbf{r}_{OB} \cdot (\mathbf{r}_{OA} \times \mathbf{r}_{AC})$. Use the following steps in a script file to calculate the area. Define the vectors $\mathbf{r}_{OA}$, $\mathbf{r}_{AC}$, and $\mathbf{r}_{OB}$ from knowing position of points A, B, and C. Determine the volume by using MATLAB's built-in functions `dot` and `cross`.



Sol 4

Script file:

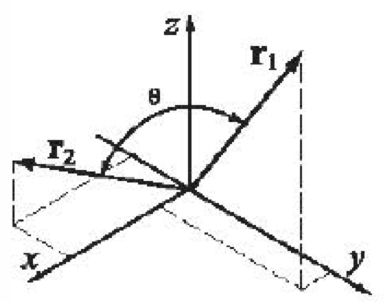
```
clear, clc
rOA=[2,5,1]; rOB=[1,3,6]; rOC=[-6,8,2];
rAC=rOC-rOA;
%note, if order of rOC and rAC reversed will get negative volume
Volume=dot(rOB,cross(rOC,rAC))
```

```
Volume =

   248
```

Q5

The dot product can be used for determining the angle between two vectors:

$$\theta = \cos^{-1}\left(\frac{\mathbf{r}_1 \cdot \mathbf{r}_2}{|\mathbf{r}_1||\mathbf{r}_2|}\right)$$



Use MATLAB's built-in functions `acosd`, `sqrt`, and `dot` to find the angle (in degrees) between $\mathbf{r}_1 = 6\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$ and $\mathbf{r}_2 = 2\mathbf{i} + 9\mathbf{j} + 10\mathbf{k}$.

Recall that $|\mathbf{r}| = \sqrt{\mathbf{r} \cdot \mathbf{r}}$.

Sol 5

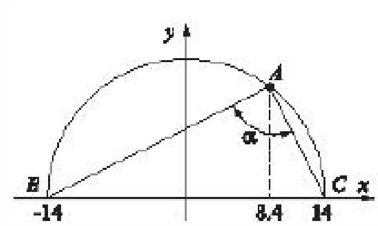
Script file:

```
clear, clc
r1=[6,-3,2]; r2=[2,9,10];
theta=acosd(dot(r1,r2)/(sqrt(dot(r1,r1))*sqrt(dot(r2,r2))))
```

```
theta =

   86.9897
```

Q6

Use MATLAB to show that the angle inscribed in a semi-circle is a right angle. Use the following steps in a script file to calculate the angle. Define a variable with the value of the x coordinate of point A. Determine the y coordinate of point A using the equation $x^2 + y^2 = R^2$. Define vectors that correspond to the position of points A, B, and C and use them for determining position vectors $\mathbf{r}_{AB}$ and $\mathbf{r}_{AC}$. Calculate the angle α in two ways. First by using the equation $\alpha = \cos^{-1}\left(\frac{\mathbf{r}_{AB} \cdot \mathbf{r}_{AC}}{|\mathbf{r}_{AB}||\mathbf{r}_{AC}|}\right)$, and then by using the equation $\alpha = \sin^{-1}\left(\frac{|\mathbf{r}_{AB} \times \mathbf{r}_{AC}|}{|\mathbf{r}_{AB}||\mathbf{r}_{AC}|}\right)$. Both should give $90°$.



Sol 6

Script file:

```
clear, clc
R=14; xA=8.4; yA=sqrt(R^2-xA^2);
B=[-R,0]; A=[xA,yA]; C=[R,0];
rAB=B-A; rAC=C-A;
disp('Part (a)')
alpha=acosd(dot(rAB,rAC)/(sqrt(dot(rAB,rAB))*sqrt(dot(rAC,rAC))))
disp('Part (b)')
%cross function requires 3rd dimension or could just use
%sqrt(abs(rAB(1)*rAC(2)-rAB(2)*rAC(1))) to explicitly calc cross product
alpha=asind(sqrt(sum(cross([rAB 0],[rAC 0]).^2))/ ...
    (sqrt(dot(rAB,rAB))*sqrt(dot(rAC,rAC))))
```

```
Part (a)

alpha =

    90

Part (b)

alpha =

   90.0000
```