

## problem 01

```
clearvars all;  
clc;
```

### part a

```
% given  
angs_deg = [30, 40, 10];  
syms psi theta phi;  
  
% solution  
angs = deg2rad(angs_deg);  
Rx = [  
    1, 0, 0;  
    0, cos(phi), sin(phi);  
    0, -sin(phi), cos(phi);  
];  
Ry = [  
    cos(theta), 0, -sin(theta);  
    0, 1, 0;  
    sin(theta), 0, cos(theta);  
];  
Rz = [  
    cos(psi), sin(psi), 0;  
    -sin(psi), cos(psi), 0;  
    0, 0, 1;  
];  
  
R_sym = Rx*Ry*Rz;  
R = double(subs(R_sym, [psi theta phi], angs));  
  
% display  
R_sym, R
```

R\_sym =

$$\begin{pmatrix} \cos(\psi) \cos(\theta) & \cos(\theta) \sin(\psi) & -\sin(\theta) \\ \cos(\psi) \sin(\phi) \sin(\theta) - \cos(\phi) \sin(\psi) & \cos(\phi) \cos(\psi) + \sin(\phi) \sin(\psi) \sin(\theta) & \cos(\theta) \sin(\phi) \\ \sin(\phi) \sin(\psi) + \cos(\phi) \cos(\psi) \sin(\theta) & \cos(\phi) \sin(\psi) \sin(\theta) - \cos(\psi) \sin(\phi) & \cos(\phi) \cos(\theta) \end{pmatrix}$$

R = 3×3

```
0.6634    0.3830   -0.6428  
-0.3957    0.9087    0.1330  
0.6350    0.1661    0.7544
```

### part b

```
% solution  
phi = acos(1/2*(R(1,1)+R(2,2)+R(3,3)-1));  
e = 1/(2*(sin(phi)))*[
```

```

    R(2,3)-R(3,2);
    R(3,1)-R(1,3);
    R(1,2)-R(2,1);
];

% display
phi, e

```

```

phi =
0.8456
e = 3×1
    -0.0221
     0.8537
     0.5203

```

## part c

```

% solution
q = [
    e(1)*sin(phi/2);
    e(2)*sin(phi/2);
    e(3)*sin(phi/2);
    cos(phi/2)
];

% display
q

```

```

q = 4×1
    -0.0091
     0.3503
     0.2135
     0.9119

```

## part d

```

% given
omega = [0.1, 0.2, 0];

% solution
beta0 = q(4);
beta1 = q(1);
beta2 = q(2);
beta3 = q(3);

beta_dot = 1/2*[
    beta0, -beta1, -beta2, -beta3;
    beta1, beta0, -beta3, beta2;
    beta2, beta3, beta0, -beta1;
    beta3, -beta1, beta1, beta0;
]*[
    0;

```

```
    omega(1);  
    omega(2);  
    omega(3);  
];
```

```
% display  
beta_dot
```

```
beta_dot = 4×1  
-0.0346  
 0.0242  
 0.1019  
-0.0005
```