Problem number 3

```
T03 = [1,0,0,10;
    0, cos(pi/6),-sin(pi/6),20;
    0,sin(pi/6),cos(pi/6),5;
    0,0,0,1];
R03 = T03(1:3,1:3);
P10 = T03(1:3,4);
P10v = [0 -P10(3) P10(2);P10(3) 0 -P10(1);-P10(2) P10(1) 0];

Ad3g0 = [R03, P10v*R03;zeros(3),R03];
twi = [1;0;0;1;0;0];
twi0 = Ad3g0 * twi;
twi0
```

twi0 =

```
     1
     5
   -20
     1
     0
     0
```

Problem number 2

```
syms t b d l
q = [t,0,b];
a = [0,0,l*sin(b)];
alpha = [((pi/2)+t), 0, 0];
d = [0, d, 0];
A1 = DHmatrix(alpha(1),q(1),a(1),d(1));
A2 = DHmatrix(alpha(2),q(2),a(2),d(2));
A3 = DHmatrix(alpha(3),q(3),a(3),d(3));

T03 = A1*A2*A3;
T02 = A1*A2;

Z00 = [0;0;1];
Z01 = A1(1:3,3);
Z02 = T02(1:3,3);
Z03 = T03(1:3,3);

O00 = [0;0;0];
O01 = A1(1:3,4);
O02 = T02(1:3,4);
O03 = T03(1:3,4);

J1 = [cross(Z00,(O03-O00));Z00];
J2 = [cross(Z01,(O03-O01));Z01];
```

```matlab
J3 = [cross(Z02,(O03-O02));Z02];

J = [J1,J2,J3];

%C = det(J); % Requirement C = 0 for singularity
```

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