1.a

x = x'(cos(-B)) - y(sin(-B))

y = x'(sin(-B)) + y(cos(-B))

1.b.

x = x'(cos(-B)) - y(sin(-B)) - a

y = x'(sin(-B)) + y(cos(-B)) - a

1.c.

x = x'(cos(-B)) - y(sin(-B)) - a

y = x'(sin(-B)) + y(cos(-B)) - b

The size of the traslation shouldn't affect the matrix beyond the scaler of the offset.

2.a.

Rotation matrix from a to b is

```
R = sym('r', [3 3])
```

```
R =
```

$$\begin{pmatrix} r_{1,1} & r_{1,2} & r_{1,3} \\ r_{2,1} & r_{2,2} & r_{2,3} \\ r_{3,1} & r_{3,2} & r_{3,3} \end{pmatrix}$$

Rotation matrix from b to a is

```
inv(R)
```

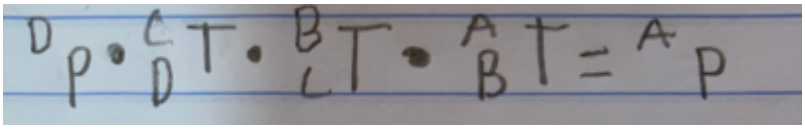
```
ans =
```

$$\begin{pmatrix} \frac{r_{2,2}\,r_{3,3} - r_{2,3}\,r_{3,2}}{\sigma_1} & -\frac{r_{1,2}\,r_{3,3} - r_{1,3}\,r_{3,2}}{\sigma_1} & \frac{r_{1,2}\,r_{2,3} - r_{1,3}\,r_{2,2}}{\sigma_1} \\ -\frac{r_{2,1}\,r_{3,3} - r_{2,3}\,r_{3,1}}{\sigma_1} & \frac{r_{1,1}\,r_{3,3} - r_{1,3}\,r_{3,1}}{\sigma_1} & -\frac{r_{1,1}\,r_{2,3} - r_{1,3}\,r_{2,1}}{\sigma_1} \\ \frac{r_{2,1}\,r_{3,2} - r_{2,2}\,r_{3,1}}{\sigma_1} & -\frac{r_{1,1}\,r_{3,2} - r_{1,2}\,r_{3,1}}{\sigma_1} & \frac{r_{1,1}\,r_{2,2} - r_{1,2}\,r_{2,1}}{\sigma_1} \end{pmatrix}$$

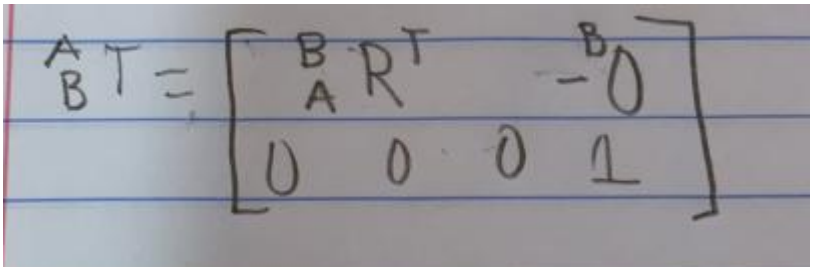
where

$$\sigma_1 = r_{1,1}\,r_{2,2}\,r_{3,3} - r_{1,1}\,r_{2,3}\,r_{3,2} - r_{1,2}\,r_{2,1}\,r_{3,3} + r_{1,2}\,r_{2,3}\,r_{3,1} + r_{1,3}\,r_{2,1}\,r_{3,2} - r_{1,3}\,r_{2,2}\,r_{3,1}$$

2.b.

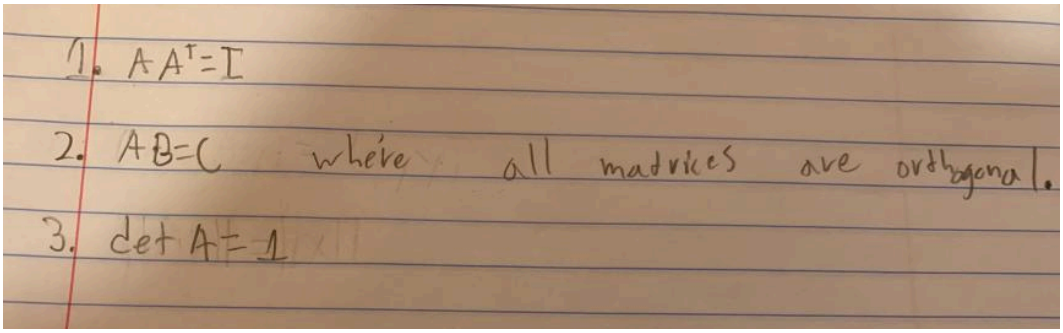


2.c.



3.a.

A 3 × 3 matrix (A) must satisfy these three conditions.



3.b.

4.a.

```
X = [5; 4.8; 4.6; 4.4; 4.2; 4; 3.8; 3.6; 3.4; 3.2; 3; 2.8; 2.6; 2.4; 2.2; 2; 1.8; 1.6;
```

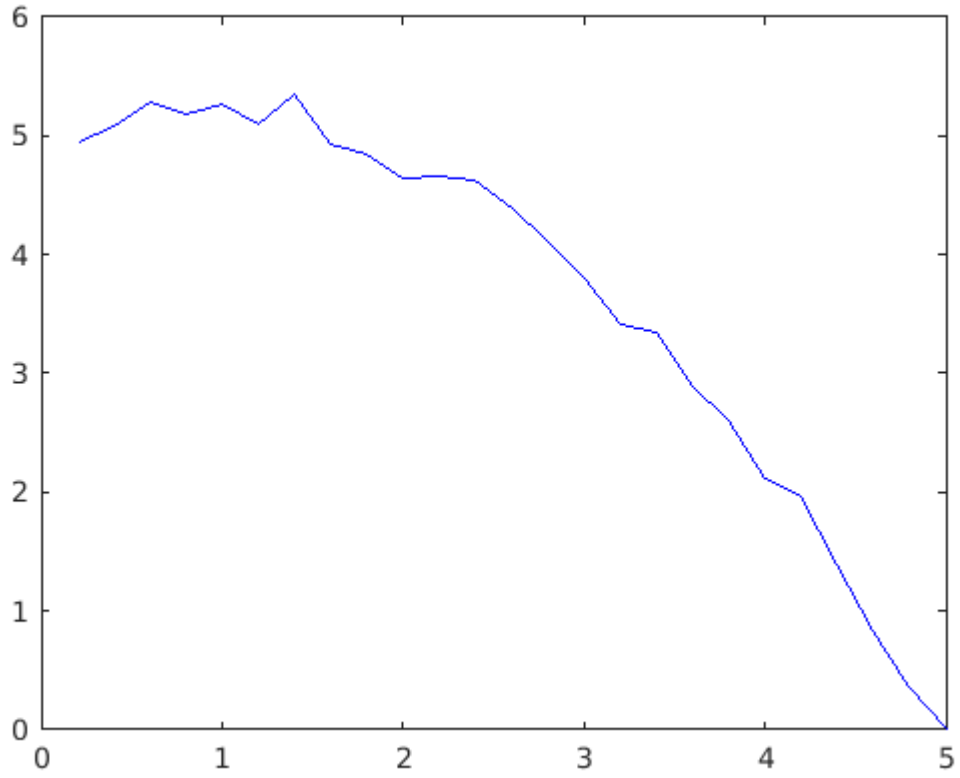
```
X = 25×1
    5.0000
    4.8000
    4.6000
    4.4000
    4.2000
    4.0000
    3.8000
    3.6000
    3.4000
    3.2000
     ⋮
```

```
Y = [
0.0077;
0.3666;
0.8406;
1.3913;
1.9613;
2.1230;
```

```
2.6051;
2.8894;
3.3437;
3.4191;
3.8033;
4.1033;
4.3821;
4.6264;
4.6566;
4.6508;
4.8538;
4.9258;
5.3470;
5.1064;
5.2748;
5.1888;
5.2809;
5.0755;
4.9478;
]
```

```
Y = 25×1
    0.0077
    0.3666
    0.8406
    1.3913
    1.9613
    2.1230
    2.6051
    2.8894
    3.3437
    3.4191
     ⋮
```

```
plot(X, Y, 'b')
```




```
A = [5 1; 4.8 1; 4.6 1; 4.4 1; 4.2 1; 4 1; 3.8 1; 3.6 1; 3.4 1; 3.2 1; 3 1; 2.8 1; 2.6
```

```
A = 25×2
    5.0000    1.0000
    4.8000    1.0000
    4.6000    1.0000
    4.4000    1.0000
    4.2000    1.0000
    4.0000    1.0000
    3.8000    1.0000
    3.6000    1.0000
    3.4000    1.0000
    3.2000    1.0000
     ⋮
```

```
W = A\Y
```

```
W = 2×1
   -1.0602
    6.4033
```

4.b.

Static stability means stability without any help while dynamic stability requres some kind of outside force, like adjustments to center of gravity.

4.c.

Legged robots are able to travers more complicated terrain, but require more work for stability and can't move as fast while wheeled robots are staticly stable and can move very quickly, but have a hard time with rough terrains.