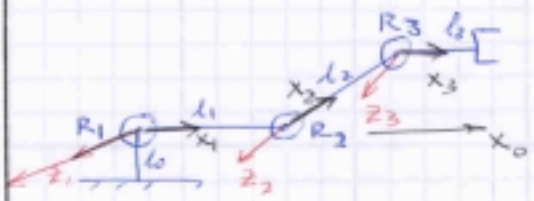
Problem 1

3 link planar

$X_{i-1} = \frac{Z_{i-1} \times Z_i}{\|Z_{i-1} \times Z_i\|}$

MDH Table

	a	α	θ	d
R_1	0	0	θ_1	0
R_2	l_1	0	θ_2	0
R_3	l_2	0	θ_3	0

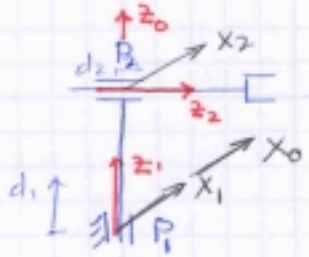


Problem 2

2 link cartesian

MDH Table

	a	α	θ	d
P1	0	0	0	d_1
P2	0	$\pi/2$	0	d_2



Problem 3

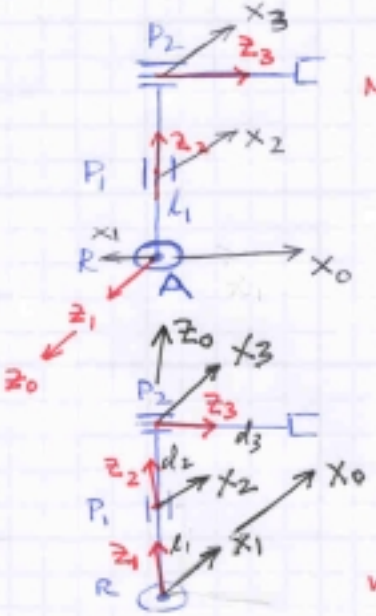
Cylindrical 3D

MDH Table

	a	α	θ	d
R	0	0	$\theta_1+\pi$	0
P1	0	90	270	d_2+l_1
P2	0	90	0	d_3

2D note Z_1

However, note that the distance between R and P_1 is not accounte for. Could do this w/ intermediate frame, or assign both jnt 1 & jnt 2 origins at pt A and use constant offset.



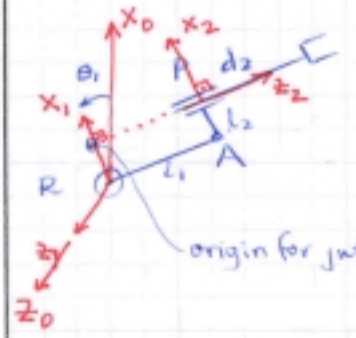
3D note Z_1

	a	α	θ	d
R	0	0	θ_1	0
P_1	0	0	0	d_2+l_1
P_2	0	90	0	d_3

$X_{i-1} = \frac{Z_{i-1} \times Z_i}{\| \; \downarrow \; \|}$

Problem 4

2 link planar.



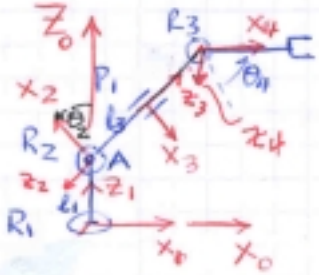
MDH Table

	a	α	θ	d
R	0	0	θ_1	0
P	l_2	90	0	d_2+l_1

if not setting origin for jnt 2 at shown position, then need to use intermediate/auxiliary frame at point A to account for l_1, l_2
Assigning/using auxiliary frames is encouraged if it makes understanding better even though it increases complexity!

Problem 5

3D manipulator



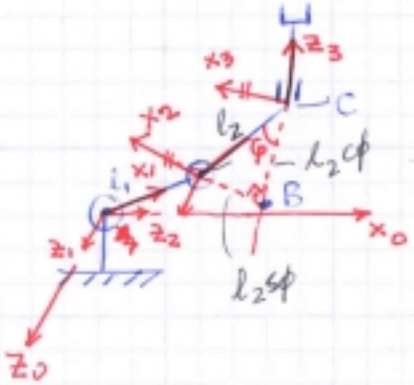
MDH Table:

	a	α	θ	d
R1	0	0	θ_1	0
R2	0	90	θ_2+90	0
P1	0	90	180	d_3+l_3
R3	0	90	θ_4	0

Note origin of jnt 3 is at pt A, same as origin for jnt 2 but drawn where it is shown for clarity.
if jnt 3 origin is set at ~~jnt~~ as shown then use auxiliary frame to account for offset distance l_3.
Same auxiliary frame idea holds for accounting for l_1.

Problem 6

Planar 3R bent link



MDH table

	a	α	θ	d
R1	0	0	θ_1	0
R2	l_1	0	$\theta_2+\phi+90$	0
P	$-l_2s\phi$	90	0	$d_3+l_2c\phi$

Could attach auxiliary frame at point C, ~~and~~ (dummy frame) and then re-orient to get frame 3.

Note the angle for joint 2.

$\underbrace{\theta_2}_{\text{joint angle}} + \underbrace{(\phi+90)}_{\text{fixed offset}}$