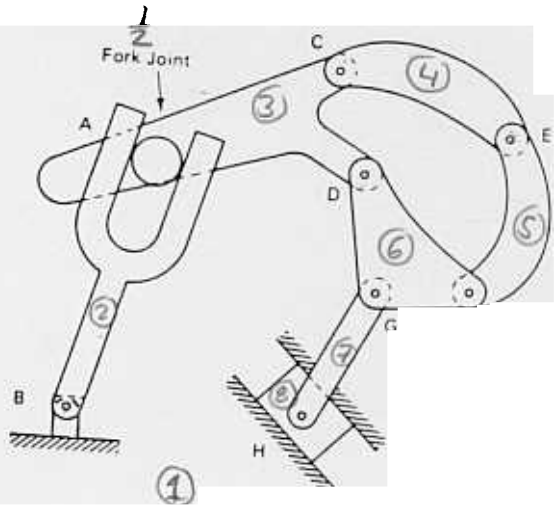
Problem 1: Determine the number of degrees-of-freedom are associated with the linkage in the figure.



Grübler's Equation is

$F = 3(L-1) - 2J$

$L = 8$

$J = 8\frac{1}{2}$

$F = 3(8-1) - 2(8\frac{1}{2})$

$21 - 17 = \boxed{4 = F}$

Problem 2: Determine all possible link combinations for a linkage with 8 links and 1 degree-of-freedom.

$$L = B + T + Q + P + \cdots$$

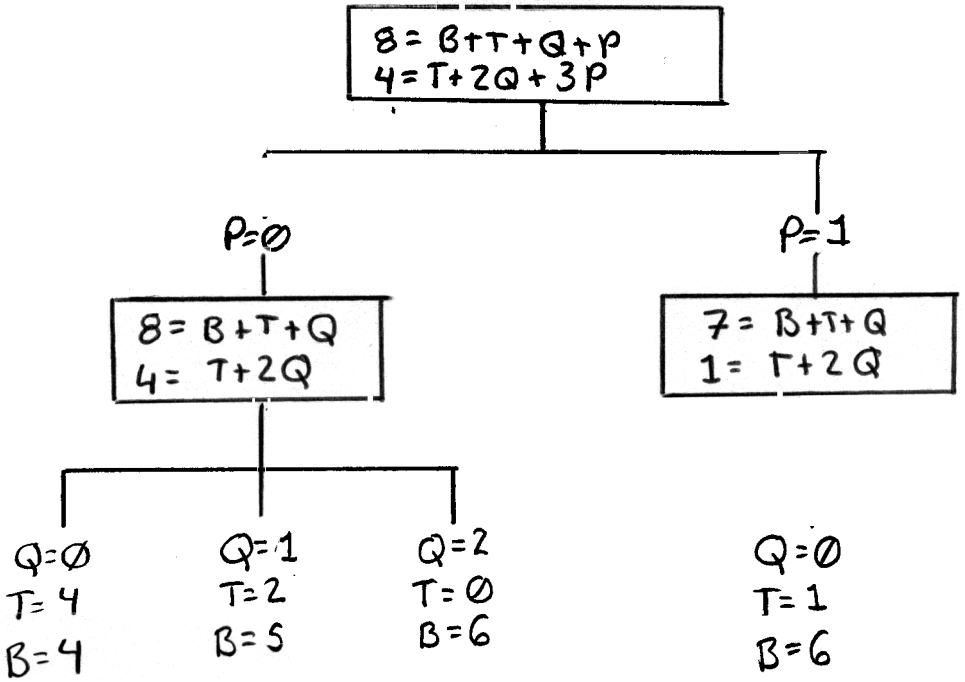
$$T + 2Q + 3P = L - (F+3)$$

For this problem $F = +1$ and $L = 8$

$$8 = B + T + Q + P + \cdots \Rightarrow \underline{8 = B + T + Q + P + H} \quad (1)$$

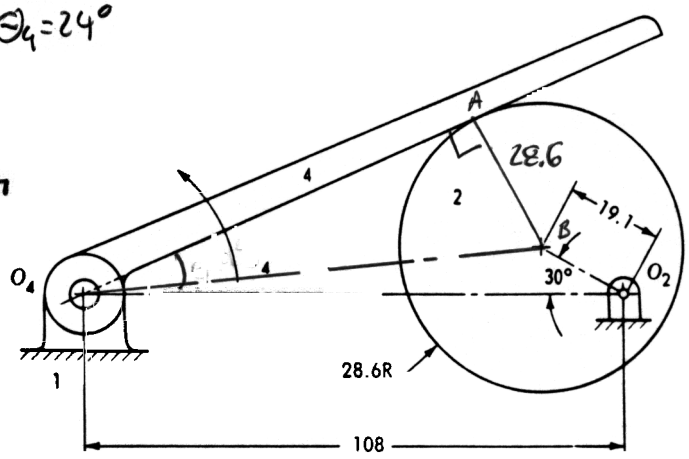
$$T + 2Q + 3P + \cdots = 8 - (1+3) = 4 \Rightarrow \underline{4 = T + 2Q + 3P + 4H} \quad (2)$$

We can not have hexagonal links because (1) and (2) limit this solution to include only 4 additional binary links. This is not even enough to connect all the joints independently



Problem 3: Write the loop closure equation for the mechanism in the figure and determine the angle the follower link (4) makes with the horizontal axis using first the graphical approach and then one of the analytical approaches.

$\Theta_4 = 24°$



$$O_4B = \sqrt{(108)^2 + (19.1)^2 - 2(108)(19.1)\cos 30^\circ}$$

$$91.96$$

$$\frac{91.96}{\sin 30} = \frac{19.1}{\sin \Theta_{BO_4O_2}}$$

$$\sin \Theta_{BO_4O_2} = \frac{19.1}{91.96} \sin 30$$

$$\Theta_{BO_4O_2} = 5.961°$$

$$\Theta_{AO_4B} = \sin \frac{28.6}{91.96} = 18.12$$

$$\Theta_4 = \Theta_{BO_4O_2} + \Theta_{AO_4B} = 5.96° + 18.12° = \boxed{24.08°}$$