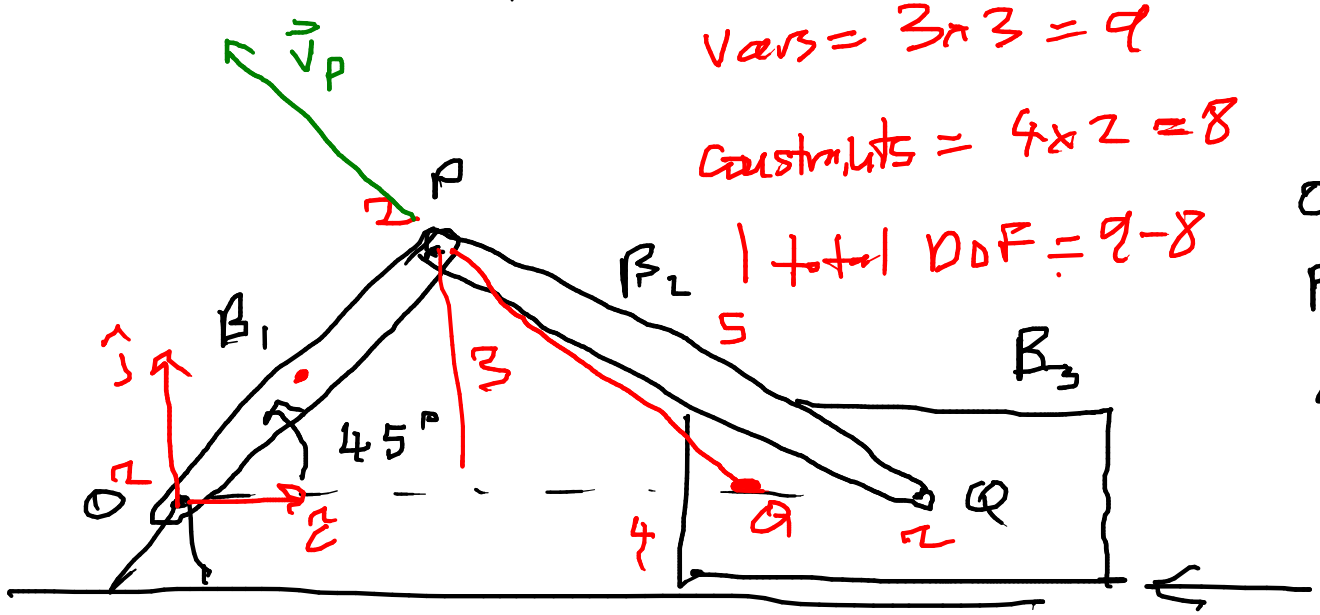
- No electronics in exam (no calculators)
- Short practice exam — discussion
  - online
- Study PL
- HWs 1–4 only (before RBs), also no spherical
  also no torsion
- Wed lecture is review

Coupled RBs



Vars = 3×3 = 9

Constraints = 4×2 = 8

Total DoF = 9 − 8

$OP = 3\sqrt{2}$ m

$PQ = 5$ m

$\vec{\omega}_1 = 4\hat{k}$ rad/s

What is the rotation rate of B_2?

What is velocity of B_3?

$\vec{v}_Q = \vec{v}_P + \vec{\omega} \times \vec{r}_{PQ}$

$\vec{v}_O = 0$

$\vec{v}_P = \vec{v}_O + \vec{\omega}_1 \times \vec{r}_{OP}$

$= -12\hat{i} + 12\hat{j}$

$\vec{v}_Q = \vec{v}_P + \vec{\omega}_2 \times \vec{r}_{PQ}$

$\vec{r}_{OP} = 3\hat{i} + 3\hat{j}$

$\vec{r}_{PQ} = 4\hat{i} - 3\hat{j}$

$\vec{\omega}_2 = \omega_{2k}\hat{k}$

$$= -12\hat{i} + 12\hat{j} + 3\omega_{2k}\hat{i} + \tfrac{4}{3}\omega_{2k}\hat{j}$$

$$= \left(-12 + 3\omega_{2k}\right)\hat{i} + \left(12 + \tfrac{4}{3}\omega_{2k}\right)\hat{j}$$

$\vec{\omega}_2 = -6\hat{k}$

$\omega_2 = 6$

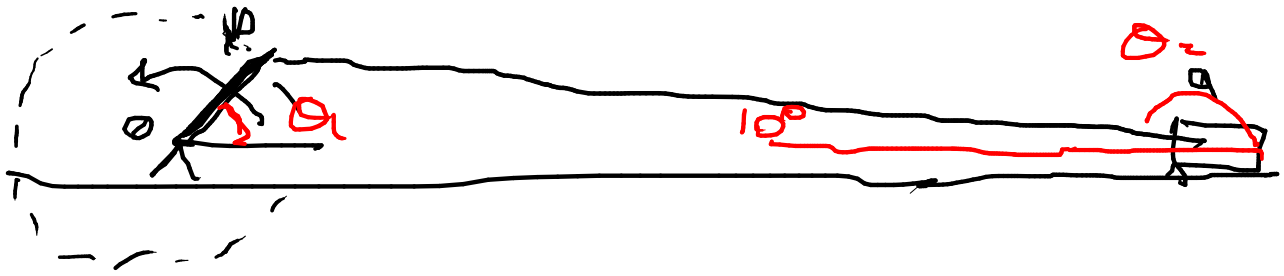
$\omega_{2k} = -6$

$\vec{\omega}_2 = \omega_{2k}\hat{k}$

constraint: $\vec{v}_Q$ is horizontal $\Rightarrow v_{Qj} = 0$

$\Rightarrow 12 + \tfrac{4}{3}\omega_{2k} = 0 \Rightarrow \omega_{2k} = -3$ rad/s

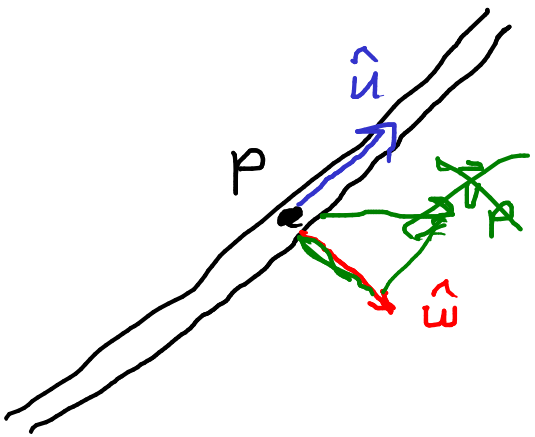
$\Rightarrow \vec{v}_Q = -21\hat{i}$ m/s



2 ways to apply directional constraint.

① $\vec{v}_Q = v_{Qi}\hat{i}$ ← Q must move horizontally

② j component of $\vec{v}_Q$ is zero. ← Q can't move vertically



① $\vec{V}_P = V_{P4}\,\hat{u}$ — 1 var

$\hat{u} = \frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j}$

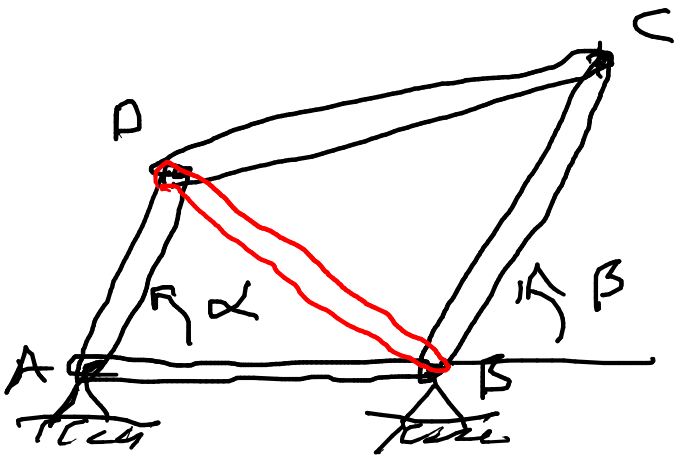
② $\vec{V}_P \cdot \hat{w} = 0$ — 1 eqn

$\hat{w} = \frac{1}{\sqrt{2}}\hat{i} - \frac{1}{\sqrt{2}}\hat{j}$

$\vec{V}_P = V_{Pi}\,\hat{i} + V_{Pj}\,\hat{j}$

2 vars

4-bar linkages



1 DOF