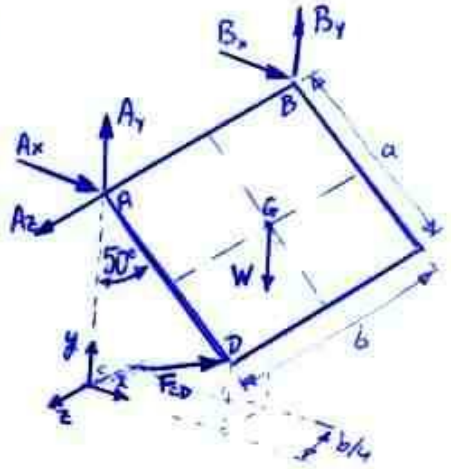
Q 3/91 Data mass = 50kg; b=1.2m; a=0.8m



NOTE 3 components for $\vec{A}$ (force @ Pt. A)
2 components for $\vec{B}$ (force @ pt. B)
Because we are told hinge A supports thrust while hinge B does NOT

$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$; $\vec{B} = B_x\hat{i} + B_y\hat{j}$

weight force is $-W\hat{j}$ ... minus because arrow drawn along neg direction of y-axis

$\vec{F}_{CD}$ if force from prop CD $\Rightarrow$ parallel to $\vec{CD}$

find unit vector in this direction ... $\frac{\vec{CD}}{\|\vec{CD}\|}$

$$\frac{\vec{CD}}{\|\vec{CD}\|} = \frac{a\sin(50^\circ)\hat{i} + a(1-\cos(50^\circ))\hat{j} + b/4\,\hat{k}}{\sqrt{a^2\sin^2(50^\circ) + a^2(1-\cos(50^\circ))^2 + b^2/16}}$$

Then $\vec{F}_{CD}$ is $\|\vec{F}_{CD}\|\left(\frac{\vec{CD}}{\|\vec{CD}\|}\right) = \|\vec{F}_{CD}\|\left(\frac{a\sin(50^\circ)\hat{i} + a(1-\cos(50^\circ))\hat{j} + b/4\,\hat{k}}{\sqrt{a^2\sin^2(50^\circ) + a^2(1-\cos(50^\circ))^2 + b^2/16}}\right)$ (1)

$\|\vec{F}_{CD}\|$ is unknown, rest is ok.

Now - look at equilibrium equations; look at moments first: $\sum\vec{M} = 0$

USE A as reference point since a lot of components pass through it
B would be OK too; G or D would be trickier,

for each force, write down force vector & vector from pt. A to a point on line of action of the force; then $\vec{M} = \vec{r}\times\vec{F}$ gives moment.

Weight force: $\vec{F} = \vec{W} = -W\hat{j}$ $\vec{r}_{AG} = \frac{1}{2}a\sin(50^\circ)\hat{i} - \frac{1}{2}a\cos(50^\circ)\hat{j} - \frac{1}{2}b\hat{k}$ (I)

Rxn @ hinge B: $\vec{F} = \vec{B} = B_x\hat{i} + B_y\hat{j}$ $\vec{r}_{AB} = -1.2\hat{k} = -b\hat{k}$ (II)

Rxn @ hinge A: $\vec{F} = \vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$ $\vec{r}_{AA} = \vec{0}$ (III)

Prop force @ D: $\vec{F} = \vec{F}_{CD} = \|\vec{F}_{CD}\|\left[\frac{a\sin(50^\circ)\hat{i} + a(1-\cos(50^\circ))\hat{j} + b/4\,\hat{k}}{\|\vec{CD}\|}\right]$ (IV)

Note ... $\|\vec{CD}\|$ is bottom line of (1) above ... $\|\vec{CD}\| = 0.740$
however, it is sometimes convenient to leave calculation with numbers until the end.

$\vec{r}_{AD} = a\sin(50^\circ)\hat{i} - a\cos(50^\circ)\hat{j}$

for each of (I), (II) (III) (IV) calculate $\vec{M} = \vec{r}\times\vec{F}$

NOTE 6 unknowns ... A_x, A_y, A_z, $\|\vec{F}_{CD}\|$, B_x, B_y

6 Equations $\sum F_x = 0$, $\sum F_y = 0$, $\sum F_z = 0$, $\sum M_x = 0$, $\sum M_y = 0$, $\sum M_z = 0$ } so it is OK! DETERMINATE