Comments for Q.1.

PC1 : Mistake Caried over from previous part

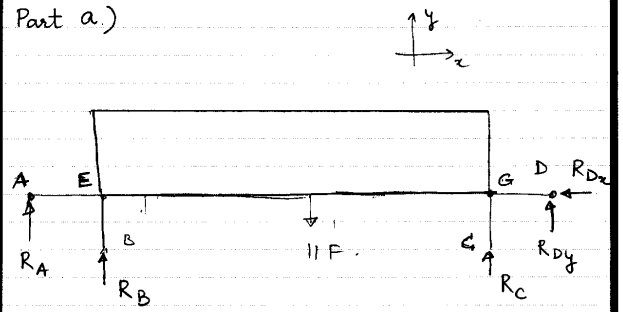
PC2 : Algebra / Calculation mistake.

PC3 : Should use method of Section

PC4 : Using wrong distance.

○ : zero force / force member.

Part a.)



All the members are truss members with loads at the ends so they are two force members and hence the direction of force can only be along the member. Same is true force members AE, EB, GC & GD. so at B & C reaction will only have non zero vertical component.

FBD of A

only vertical component of reaction (R_A) because "Roller Support" and only T_{AE} because it's two force member.

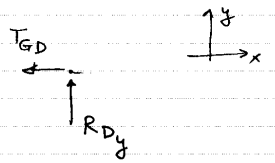
$\Sigma F_x = 0 \Rightarrow T_{AE} = 0$

$\Sigma F_y = 0 \Rightarrow R_A = 0$

From FBD of Entire Structure

$\Sigma F_x = 0 \Rightarrow R_{Dx} = 0$

and if we consider FBD of joint D

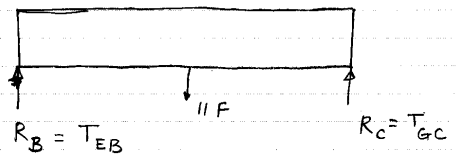


$\Sigma F_x = 0 \Rightarrow T_{GD} = 0$

$\Sigma F_y = 0 \Rightarrow R_{Dy} = 0$

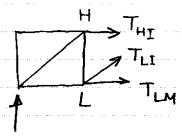
Thus AE and GD are zero force members are reaction forces at supports A and D are zero.

so. our problem reduces to



Part b)

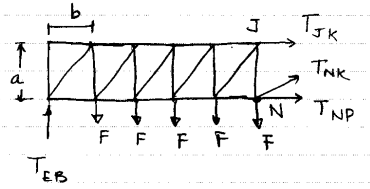
It can be easily solved by method of section (Consider section passing through HI, IL & LM)



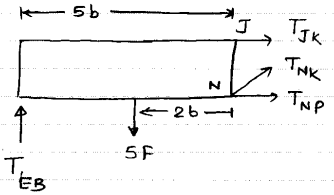
$\Sigma M_L = 0$ will give desired answere.

Part C)

This part "should" be solved by method of section. To find the effective external load and it's location we should consider forces that are acting on that particular section. (not all the forces)



The FBD with effective force will be



and $\Sigma M_N = 0$ will give desired answere.

Comments on Prob. 2 in Prelim I

-zhongping bao

1. 35 pts in total
   part (a): 10 pts (FBD counts 5 pts)
   part (b): 10 pts
   part (c): 15 pts

2. Common mistake

— FBD, the object should be FREE; use arrows instead of lines to indicate forces; draw all forces applied to the object instead of only those you will be using.

— geometry, a lot of mistake in writing the position vector; position vector $\vec{r}_{PI} \neq \vec{r}_{IP}$; unit direction vector $\vec{\lambda}$ should have magnitude 1, for example, $\vec{\lambda}_{PI} = \vec{r}_{PI}/|\vec{r}_{PI}|$.

— there is nothing wrong if you try to solve problems w/ high school geometry. However, it may be easier and makes

more sense to use vectors. For example, to find the moment about axis AD due to gravity force $\vec{w}$, it will be hard to get the perpendicular distance between the line of $\vec{w}$ and axis AD. However, it will be much easier to do $\vec{M}_{A/\vec{w}} \cdot \vec{\lambda}_{AD}$ $= (\vec{r}_{AG} \times \vec{w}) \cdot \vec{\lambda}_{AD}$.

— most of you got part (a). And if you follow the hint, part (b) is not hard at all. Just want to emphasize, any force that intersects axis AK or is parallel to AK does not have any moment about AK.

part (c) is a little hard. But still, you can take moment about axis AD or axis AJ to get one eqn w/ one unknown in it. Or, you could take moment about pt. A. Then

you will get 3 eqns ($\Sigma M_x = 0$, $\Sigma M_y = 0$, $\Sigma M_z = 0$) with 2 unknowns ($T_{DI} = 0$). $\Sigma M_z = 0$ is satisfied because $T_{DZ} = 0$. Thus we have 2 eqns w/ 2 unknowns.

— doing cross product seems a little difficult to some of us. Arithmetic needs more practice (without calculator).

(1) Part a

- At least 2 FBDs (BD & AC OR BD & whole frame OR AC & whole frame) : 4' each.
- Set up correct equations and find out force at C: 8'.
- Set up correct equations and find out force at N: 9'.

* If part of the FBDs, or the equations, or the answers were correct, I gave partial credit.
* The equations set up should be useful, i.e. it should be hopeful to get the answer from the equations obtained even though you didn't have time to finish it

(2) Part b

① "Greater" : 1/5

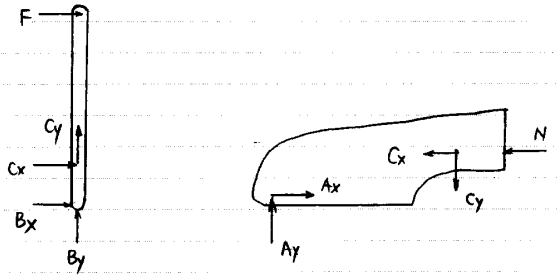
③ "1 mechanical advantage" + ① : 2/5

④ "2 mechanical advantages" + ① : 3/5

⑤ "3 mechanical advantages" + ① : 7/5

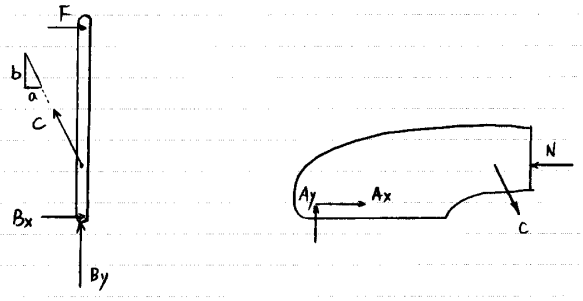
* Only a few students found out the 3 mechanical advantages, so we gave 2' as bonus.

1. Many, Many students treated C_x & C_y as independent components and drew FBD like these:



So totally there were 7 unknowns (A_x, A_y, B_x, B_y, C_x, C_y, N), but there were only 2 two-dimensional objects (BD & AC), and thus there were at most $2 \times 3 = 6$ independent equations available. It was not possible to solve for 7 unknowns with 6 equations, and actually this became an undetermined problem which couldn't be solved with what we had learned so far.

The correct FBDs are



Since C is a sliding pin, it can slide freely in the slot, and thus the force at C is perpendicular to the slot.

* FBD is the most important thing for this problem. Most of the students who got correct FBDs finally got the right answer.

2. Abundant Equations

For example, some gave 5 equations for BD:

$$\Sigma F_x = 0$$
$$\Sigma F_y = 0$$
$$\Sigma M_{/B} = 0$$
$$\Sigma M_{/C} = 0$$
$$\Sigma M_{/D} = 0,$$

but only 3 of them are independent, and the other 2 are combinations of these 3.

* For a 2D object: 3 independent equations
  For a 3D object: 6 independent equations.

3. Sign Mistakes

* The sign of a force or a moment should be consistant with the FBDs.

4. Some used "$\Sigma M_{/AB} = 0 = Na - Fb$". The first "=" is correct but the second one is not.
Notice that N & F are parallel to AB, and thus they don't have moment about AB. So the equation "$\Sigma M_{/AB} = 0$" becomes a "$0 = 0$" equation.

5. When you are writing down a equation, it will be better if you tell which FBD this equation is for.