Quiz

1) Identify and *briefly* explain the physical meaning of the following expressions for inertia.

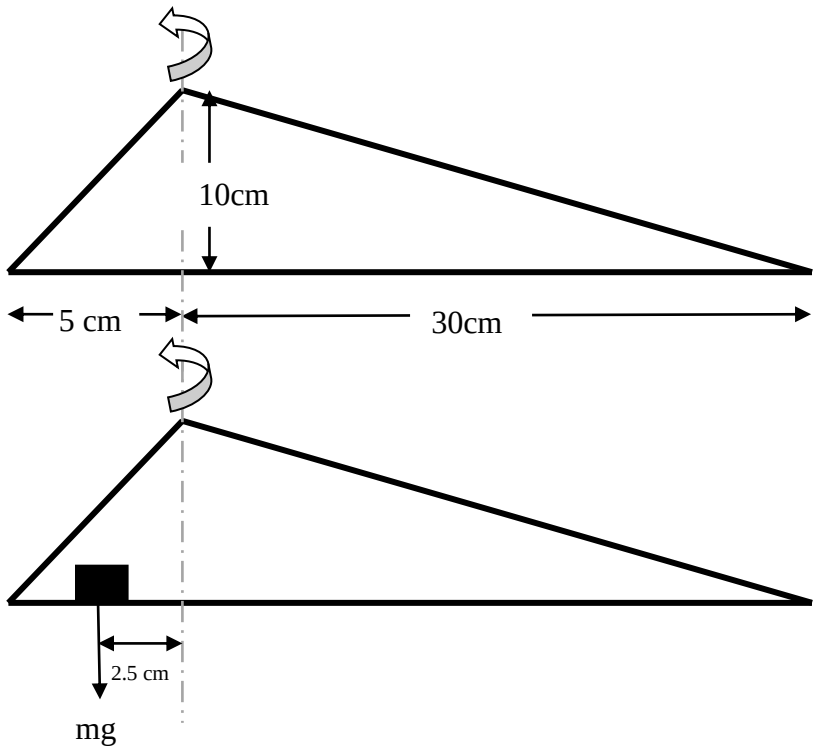
$$I = \frac{\pi D^4}{64}$$

Area moment of inertia – a body's resistance to bending (1/2 mark).

$$I = \frac{1}{12} mL^2$$

Mass moment of inertia – a body's resistance to rotation (1/2 mark).

2) Calculate the mass moment of inertia for the structures below. Use your results to explain how a counter balance affects a rotating truss structure. Assume all rods have the same x-sectional area (A).



Quiz

L1	0.316	m	angle 1	1.249046
L2	0.35	m	angle 2	0
L3	0.111803399	m	angle 3	0.463648

m1	0.316
m2	0.35
m3	0.111803399

I1	0.009466349
I2	0.009041667
I3	0.007011005

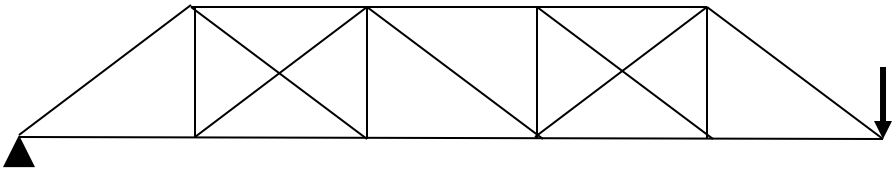
Itot	0.02551902

Imass	0.000625	m

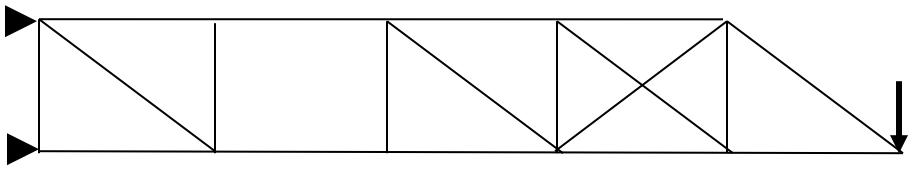
Mass increases total inertia in system, reducing max acceleration for a given torque. A counter balance is used to reduce bending moment on the vertical column of the motor but is detrimental to the inertial characteristics of a system.

Quiz

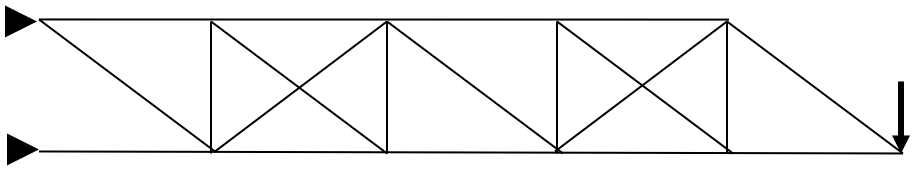
3) Identify each of the following systems as stable or unstable, determinate or indeterminate and the number of redundant members.



Unstable – no external equilibrium

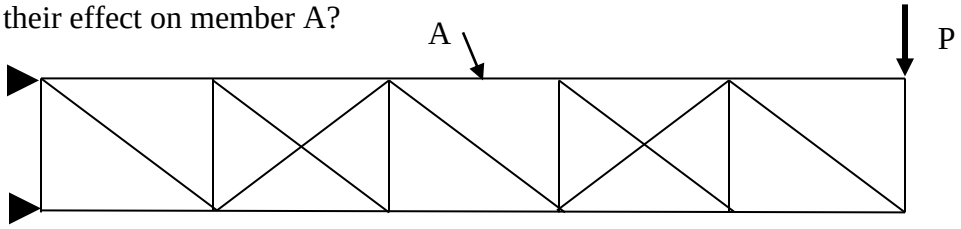


Unstable and redundant – open block is unstable, block with 2 diagonal members has a redundant member.



Stable, 2 redundant members.

4) If we have two redundant members in the following system how do we determine their effect on member A?



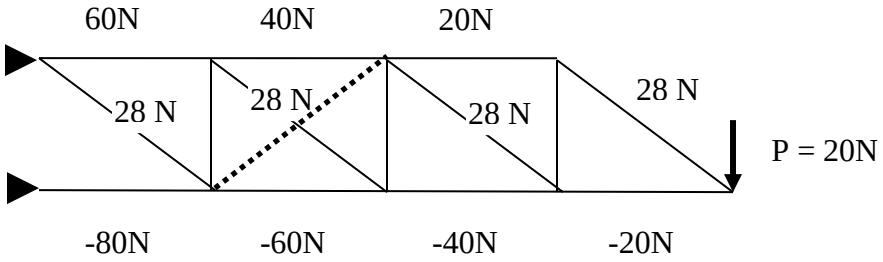
From methods of sections it is easy to see there is no effect of the redundant members on A.

5) List 3 critical assumptions that you make when doing a truss analysis. Comment on why (or why not) these assumptions are valid for analyzing the 3D truss structures you are building.

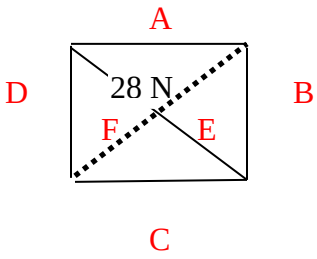
Quiz

Assumptions: 1) pin joints, 2) only tension/compression no bending, 3) only 2D structure, no out of plane loading, 4) all members are in the same plane, but redundant members to do not intersect, 5) deformation is small (elastic).

6) An indeterminate structure below is subject to a load P = 20N. The resulting force in each member when reduced to a determinate structure is shown. Determine the effect of including the redundant member (dashed) in the middle square on the forces in the structure.



To solve for effect of redundant member isolate the section of truss with the redundancy – all other forces are not affected or system would not maintain equilibrium.



Solution see spreadsheet (members correspond to letter labels as shown).