(1) Member ABC in Fig.1a is made of concrete and is loaded by its own weight.
(30%) Two cross-section types for AB and BC are shown Fig. 1b.
a)   Draw the shear, Moment and Torsional Diagram of ABC due to its own weight.(Assume the density of the material is 2.4 T/m³)
b)   Discuss what equations can be used to calculate the maximum shear and bending stress.

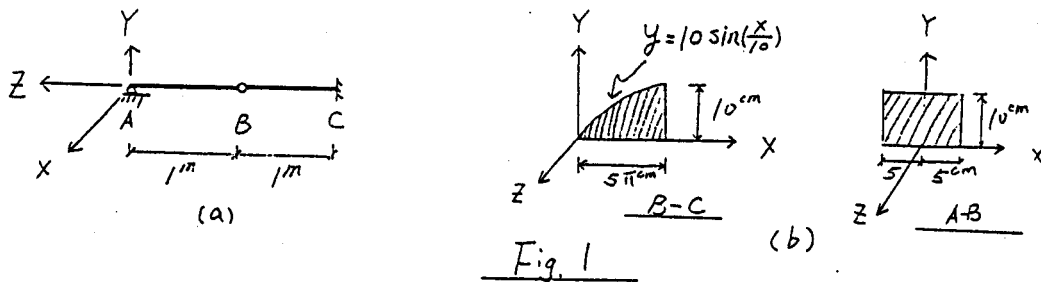

Fig. 1

(2) A concrete member without steel reinforcement is loaded as shown in Fig. 2.
(30%) Two loadings P are acting parallel to X and Y axes. Neglecting the self-weight of the concrete, calculate:
a)   Resultant force and moment at the fixed end.
b)   If P is increased from zero, discuss what will be the likely damage pattern of this member. Show them in figures.
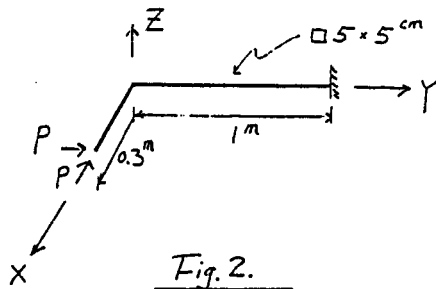

Fig. 2.

(3) In Fig.3, P is a load that produce bending of a circular shaft. Given P = 5kN.
(20%) This shaft is also subjected to a torque T. Determine the magnitude of T so that τ_{max} at A does not exceed 75 MPa. (Note: The moment of inertia for a circle is $\frac{\pi r^4}{4}$)
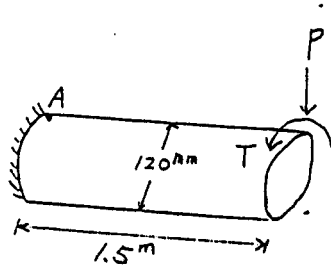

Fig. 3

(4) (A)Explain the following two terms:
(20%)   (a) "Rank" of a matrix.
             (b)A "singular" matrix.
(B)   Calculate the general solution of the following equation.

$$10Y'' + 6Y' + Y = 0$$