1. Define the values of the singularity function $<x-a>^n$.

2. A timber beam is shown. (a) Determine the reactions $A$ and $C$ at supports $A$ and $C$. (b) Using singularity functions, find the location $x_D$ and magnitude $M_D$ of the maximum bending moment in the beam occurring at $D$. (c) Knowing that the available stock consists of beams with an allowable stress of 12 MPa and a rectangular cross section of 30-mm width and depth $h$ varying from 80 mm to 160 mm in 10-mm increments, determine the value of $h$ for most economical cross section.

1. $<x-a>^n = (x-a)^n$ if $x-a \geq 0 \quad \& \quad n > 0$
   $<x-a>^n = 1$ if $x-a \geq 0 \quad \& \quad n = 0$  \[3\]
   $<x-a>^n = 0$ if $x-a < 0 \quad \text{or} \quad n < 0$

2. (a) FBD & Equilibrium: $A = 695 \text{ N} \uparrow$ & $C = 865 \text{ N} \uparrow$.  \[2\]
   (b) $q = -200 <x>^2 + 695 <x>^1 - 320 <x>^1 + 320 <x-1.5>^1$
   $V = -200 <x>^1 + 695 <x>^0 - 160 <x>^2 + 160 <x-1.5>^2$ \[2\]
   $M = -200 <x>^0 + 695 <x>^1 - \frac{160}{3} <x>^3 + \frac{160}{3} <x-1.5>^3$
   Noting that $M$ is maximum when $V = 0$, we get
   $x_D = 2.1979 \text{ m} \quad x_D = 2.20 \text{ m}$ \[1\]
   $M_{max} = M_D = 779.4 \text{ N} \cdot \text{m} \quad M_D = 779 \text{ N} \cdot \text{m}$ \[1\]
   (c) $h_{min} = 0.11397 \text{ m}$. Choose beam with $h = 120 \text{ mm}$. \[1\]