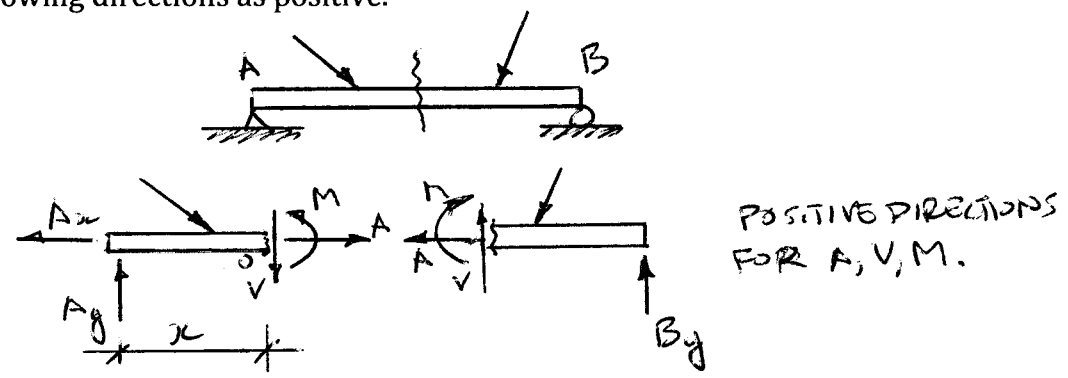
Axial (A), Shear (V), Bending Moment (M) and Deflected Shape (DS) Diagrams for Beams

Long Method – Cutting the Beam and Writing Equations
Approach to Solving Problems

1. Calculate the Support Reactions.
   a. Draw a FBD and assume a direction for unknown forces (reactions).
   b. Apply the equations of statics (assume a direction as positive for the purpose of writing the equation of equilibrium).
   c. Solve for the reactions. Compare your answers to assumed directions in 1a. (not in 1b.)
   d. Redraw your FBD with the correct directions.

2. Write the Equations of Equilibrium for A, V, M.
   a. Determine the number of times you will have to cut the beam (ie. Each time the loading condition changes).
   b. For each 'cut', draw a FBD, including the internal forces A, V, M. Assume the following directions as positive.



   c. Assume that the cut is made at a distance x from the left hand side of the beam.
   d. Assume a positive direction for the purpose of writing the equations of equilibrium, and solve for the unknown internal forces, A, V, M.
   e. A, V, M will be expressed as a function of x, however ensure to include the limits for x (ex. X greater 0 and less than 2.)

3. Draw the A, V, M Diagrams.
   a. Under your redrawn FBD in 1d, draw the A, V, M diagrams by substituting values of x in the equations. Show your calculations for these and label the diagrams carefully. Your diagrams should be shown reasonably to scale. If you are dealing with a parabola, you will need to find the maxima/minima values.

4. Draw the DS Diagram.
   a. Draw the beam as a single line with no loads on it.
   b. Start with supports and look at what constraints the supports provide.
   c. A positive moment corresponds to a concave up curvature and a negative moment corresponds to a concave downwards curvature.