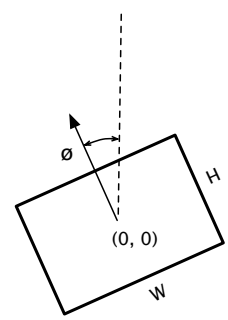
6. (a) What is meant by orthographic and perspective projection? What is the screen y coordinate of (p_x, p_y, p_z) if the centre of projection is at $(0, 0, 0)$ and the view-plane is at a distance d from the viewer? [6]

(b) A viewing system is defined with the eye at $(0, 0, 1)$, an up-vector $(0, -1, 0)^T$ and a view plane given by

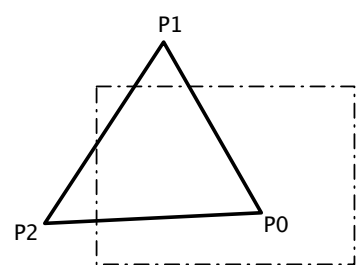
$$\begin{pmatrix} 0 & 0 & -1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = 0.$$

i. What are the view coordinates (v_x, v_y) of world coordinates (w_x, w_y, w_z)? [4]

ii. What are the screen coordinates of the same points on a viewport of size $H \times W$ which is centred on the view axis and has an up-vector which is at ϕ degrees to the vertical axis? [4]



(c) Describe carefully the Sutherland-Hodgman polygon clipping algorithm. Illustrate your answer with the following example. Show when it can fail to work correctly.



[6]

(d) What are winding numbers and how do they work? [5]