

5. (a) What are the main components of a GPU-based framebuffer graphics system? [4]
- (b) Detail the 3D Viewing Pipeline, carefully explaining where texture-mapping, blending and atmospheric effects, like fog, can be combined with vertex operations. [4]
- (c) Derive Bresenham's decision parameter  $P_{k+1}$  for the  $k + 1$  step of a line, given that  $P_k = 2\Delta y x_k - 2\Delta x y_k + K$ , where  $(x_k, y_k)$  is the currently set pixel, the slope is  $\frac{\Delta y}{\Delta x}$  and  $K$  is a constant term. What are the two values that  $P_{k+1}$  can take? [8]
- (d) Outline how the Mid-point method works in efficiently scan converting implicit curves. Derive the starting decision parameter value,  $P_0$ , for a drawing a circle centred at the origin, with radius  $r$ . [9]