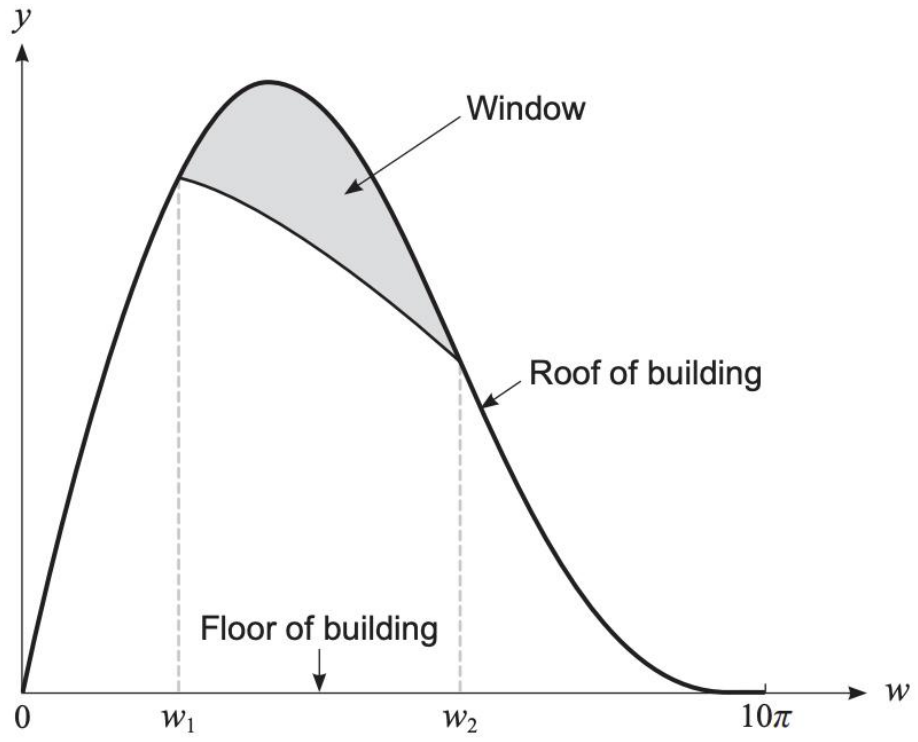
Question 9 **(10 marks)**

A new entertainment venue is being proposed. The preliminary design has a constant cross-section, as shown in the figure below.



The roof height $h(w)$ of the building at any point w along its width is given by

$$h(w) = 6 \sin\left(\frac{w}{10}\right) + 3 \sin\left(\frac{w}{5}\right)$$

where h and $0 \leq w \leq 10\pi$ are measured in metres.

(a) Determine the cross-sectional area of the building. (2 marks)

The designer would like to place a window, as shown in the figure above, that is bounded above by the roof of the building and below by the formula

$$g(w) = 7 \cos\left(\frac{w}{20}\right).$$

(b) With reference to the figure

(i) determine the values of w_1 and w_2. (2 marks)

(ii) determine the area of the window. (2 marks)

(c) Use calculus techniques to determine the maximum height of the building. (4 marks)