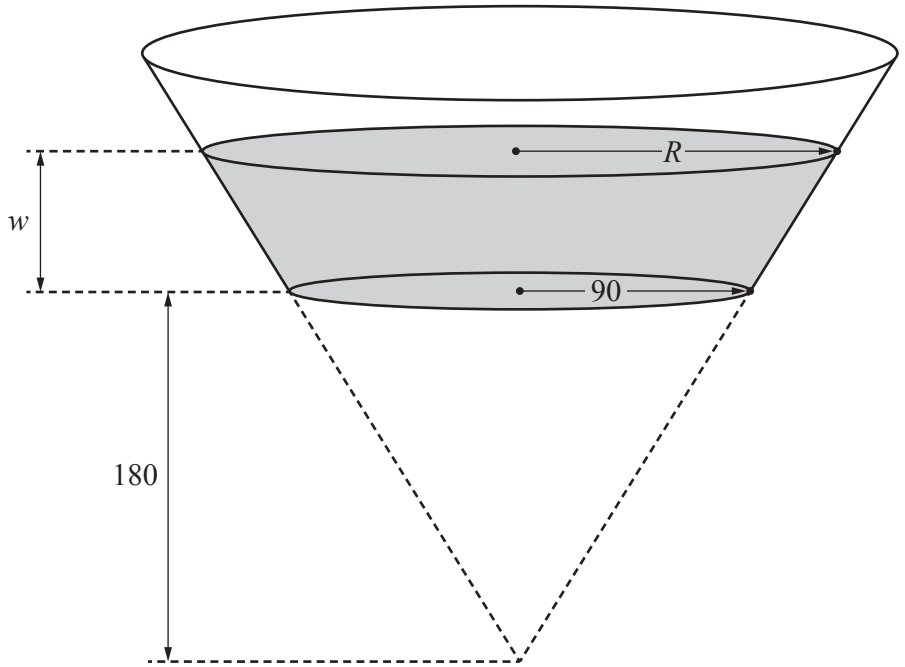
11 In this question all lengths are in centimetres.

The volume, V, of a cone of height h and base radius r is given by $V = \frac{1}{3}\pi r^2 h$.



The diagram shows a large hollow cone from which a smaller cone of height 180 and base radius 90 has been removed. The remainder has been fitted with a circular base of radius 90 to form a container for water. The depth of water in the container is w and the surface of the water is a circle of radius R.

(a) Find an expression for R in terms of w and show that the volume V of the water in the container is given by $V = \frac{\pi}{12}(w+180)^3 - 486000\pi$. [3]

(b) Water is poured into the container at a rate of 10 000 $cm^3 s^{-1}$. Find the rate at which the depth of the water is increasing when $w = 10$. [4]

12 **(a)** **(i)** Given that $f(x) = \frac{1}{\cos x}$, show that $f'(x) = \tan x \sec x$. [3]

(ii) Hence find $\int \left(3 \tan x \sec x - \sqrt[4]{e^{3x}}\right) dx$. [3]