



## **STEP II, 2001, Q4**

4 Let

$$f(x) = P \sin x + Q \sin 2x + R \sin 3x .$$

Show that if  $Q^2 < 4R(P - R)$ , then the only values of  $x$  for which  $f(x) = 0$  are given by  $x = m\pi$ , where  $m$  is an integer.

[You may assume that  $\sin 3x = \sin x(4 \cos^2 x - 1)$ .]

Now let

$$g(x) = \sin 2nx + \sin 4nx - \sin 6nx,$$

where  $n$  is a positive integer and  $0 < x < \pi/2$ . Find an expression for the largest root of the equation  $g(x) = 0$ , distinguishing between the cases where  $n$  is even and  $n$  is odd.



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