

- (a) Find the length of QC .
- (b) Let a and b be whole numbers, show that the ratio $a:b \notin \sqrt{2}$.
5. (a) Show that if a whole number is divisible by 4, then so is the number formed by its last two digits.
- (b) Show that if a whole number is divisible by 9, then so is the sum of all of its digits.
6. $[n(n+1)(n+2)]^2 = 481273563 \quad 6$, use the results of 5: to find the missing digit .

Senior Questions

1. Prove the identity

$$\frac{d}{dx} \tan^{-1}(x) = \frac{1}{1+x^2}.$$

2. Using the above result, show that the infinite series satisfies

$$x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots = \tan^{-1}(x):$$

3. For an integer n , show that $n(n+1)(n+2)(n+3) + 1$ is a perfect square. Thus evaluate $\frac{1}{(31)(30)(29)(28) + 1}$.