

MATHEMATICS ENRICHMENT CLUB.
Problem Sheet 1, May 6, 2019

1. Express $0.\overline{284284284}$ as a fraction in simplest terms.
2. Let x

Senior Questions

1. (a) Prove the identity

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

- (b) Using the this result, show that the infinite series satisfies

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

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