

1. (5 points) Determine $\lim_{n \rightarrow \infty} \tan\left(\frac{2n\pi}{1+8n}\right)$ or show that it diverges.

2. (5 points) A marathon runner travels the first mile in 8 minutes and then decreases the time for each mile after that by $1/30^{\text{th}}$ of the last mile. What will the runner's total time be after 26 miles? Give a calculator-ready answer. Hint: use a geometric series.

3. (5 points) Which of the following series can use the divergence test to show it diverges? **Do not determine the behavior of the series if the divergence test does not apply, merely explain why the test does or does not apply.**

(a) $\sum_{n=1}^{\infty} \frac{e^{1/n}}{n^2}$

(b) $\sum_{k=0}^{\infty} \frac{k(k+1)}{(k+3)^2}$

4. (5 points) Use the comparison test or limit comparison test to determine if $S = \sum_{n=1}^{\infty} \frac{3^n}{4^n - 1}$ converges or diverges. Defend your answer.

5. (5 points) Does $S = \sum_{n=2}^{\infty} (-1)^n \frac{2n^2}{\sqrt{n^5 - 1}}$ converge absolutely, converge conditionally, or diverge? Defend your answer.