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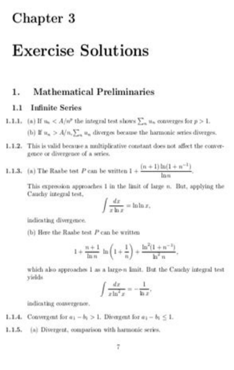
Solution Exercises Arfken



Chapter 3

Exercise Solutions

1. Mathematical Preliminaries

1.1 Infinite Series

1.1.1. (a) If $u_n < A/n^p$ the integral test shows $\sum_n u_n$ converges for $p > 1$.
(b) If $u_n > A/n$, $\sum_n u_n$ diverges because the harmonic series diverges.

1.1.2. This is valid because a multiplicative constant does not affect the convergence or divergence of a series.

1.1.3. (a) The Raabe test P can be written $1 + \frac{(n+1)\ln(1+n^{-1})}{\ln n}$.

This expression approaches 1 in the limit of large n. But, applying the Cauchy integral test,

$$\int \frac{dx}{x \ln x} = \ln \ln x,$$

indicating divergence.

(b) Here the Raabe test P can be written

$$1 + \frac{n+1}{\ln n} \ln\left(1 + \frac{1}{n}\right) + \frac{\ln^2(1+n^{-1})}{\ln^2 n},$$

which also approaches 1 as a large-n limit. But the Cauchy integral test yields

$$\int \frac{dx}{x \ln^2 x} = -\frac{1}{\ln x},$$

indicating convergence.

1.1.4. Convergent for $a_1 - b_1 > 1$. Divergent for $a_1 - b_1 \leq 1$.

1.1.5. (a) Divergent, comparison with harmonic series.

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