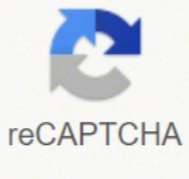




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**Limit**  
**Definition:** We say  $\lim_{x \rightarrow c} f(x) = L$  if for every  $\epsilon > 0$  there is a  $\delta > 0$  such that whenever  $0 < |x - c| < \delta$  then  $|f(x) - L| < \epsilon$ .

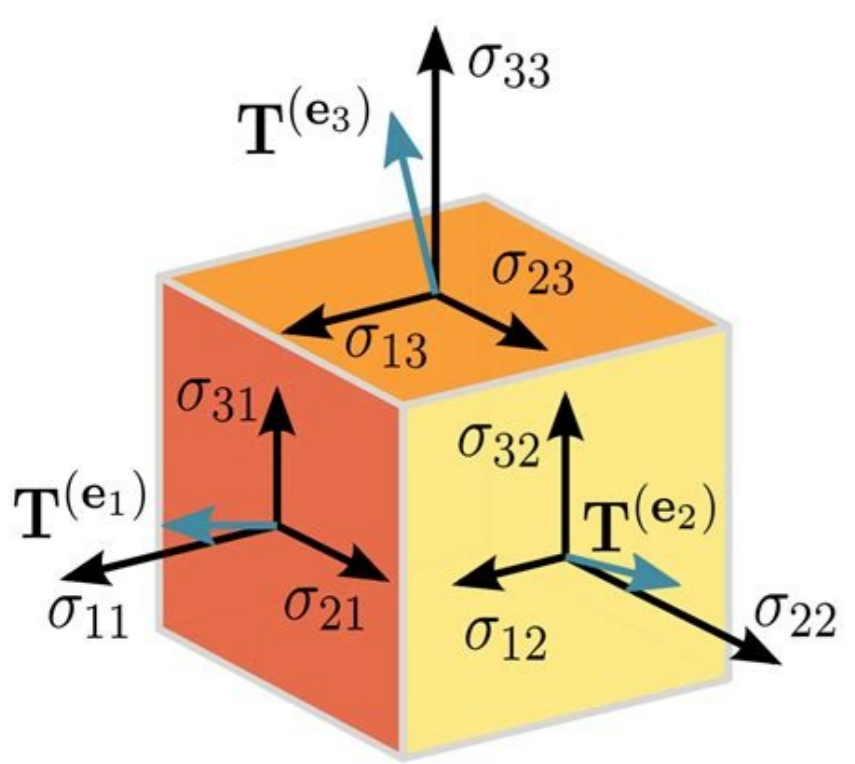
**Working Definition:** We say  $\lim_{x \rightarrow c} f(x) = L$  if we can make  $f(x)$  as close to  $L$  as we want by taking  $x$  sufficiently close to  $c$  on either side of  $c$  without taking  $x = c$ .

**Right-hand Limit:**  $\lim_{x \rightarrow c^+} f(x) = L$ . This has the same definition as the limit except it requires  $x > c$ .

**Left-hand Limit:**  $\lim_{x \rightarrow c^-} f(x) = L$ . This has the same definition as the limit except it requires  $x < c$ .

**Relationship between the limit and one-sided limits:**  
 $\lim_{x \rightarrow c} f(x) = L \iff \lim_{x \rightarrow c^+} f(x) = L \text{ and } \lim_{x \rightarrow c^-} f(x) = L$

**Properties:**  
 Assume  $\lim_{x \rightarrow c} f(x) = A$  and  $\lim_{x \rightarrow c} g(x) = B$  both exist and  $c$  is any number then:  
 1.  $\lim_{x \rightarrow c} (f(x) + g(x)) = A + B$   
 2.  $\lim_{x \rightarrow c} (f(x) - g(x)) = A - B$   
 3.  $\lim_{x \rightarrow c} (kf(x)) = k \lim_{x \rightarrow c} f(x)$   
 4.  $\lim_{x \rightarrow c} (f(x)g(x)) = A \cdot B$   
 5.  $\lim_{x \rightarrow c} \frac{f(x)}{g(x)} = \frac{A}{B}$  provided  $B \neq 0$   
 6.  $\lim_{x \rightarrow c} (f(x)g(x)) = A \cdot \lim_{x \rightarrow c} g(x)$  provided  $\lim_{x \rightarrow c} g(x) \neq 0$   
 7.  $\lim_{x \rightarrow c} (f(x)g(x)) = A \cdot \lim_{x \rightarrow c} g(x)$  provided  $\lim_{x \rightarrow c} g(x) = 0$  and  $\lim_{x \rightarrow c} f(x) = 0$   
 8.  $\lim_{x \rightarrow c} (f(x)g(x)) = A \cdot \lim_{x \rightarrow c} g(x)$  provided  $\lim_{x \rightarrow c} g(x) = 0$  and  $\lim_{x \rightarrow c} f(x) = \infty$   
 9.  $\lim_{x \rightarrow c} (f(x)g(x)) = A \cdot \lim_{x \rightarrow c} g(x)$  provided  $\lim_{x \rightarrow c} g(x) = 0$  and  $\lim_{x \rightarrow c} f(x) = \infty$



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Name \_\_\_\_\_ Version A

AP Calculus Second Semester Final BC Calculus

**Multiple Choice**  
 Identify the choice that best completes the statement or answers the question.  
 (Directions: answer: use AB for answer F.)

**NO CALCULATOR SECTION**

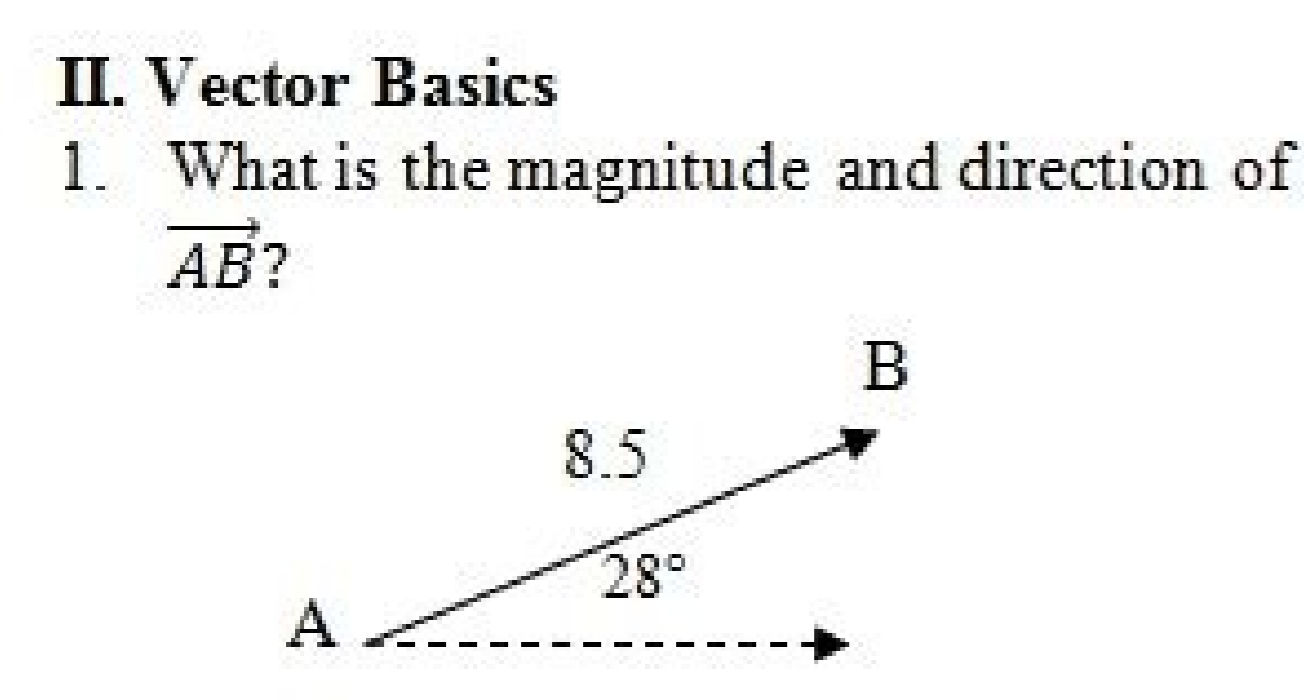
1) Write the first three terms of the Maclaurin series for  $\frac{3x^3}{1+3x^2}$   
 A)  $3x^3 - 9x^5 + 27x^7$  C)  $-3x^3 + 9x^5 - 27x^7$  E)  $3x^3 + 9x^5 + 27x^7$   
 B)  $-3x^3 - 9x^5 - 27x^7$  D)  $3x^3 + 9x^5 + 27x^7$

2) Find the exact value of  $\sum_{n=1}^{\infty} \frac{4}{(n+4)(n+5)}$   
 A) 3 B)  $\frac{4}{3}$  C)  $\frac{1}{3}$  D)  $\frac{11}{3}$

3) Which of the following can be used to find an approximation for  $e^2$ , using the 2nd order Maclaurin series for  $e^x$ ?  
 A)  $1 + 2 + \frac{2^2}{2!} + \frac{2^3}{3!}$  C)  $1 - 2 + \frac{2^2}{2!} - \frac{2^3}{3!}$  E)  $4 + \frac{4}{2!} + \frac{4}{3!}$   
 B)  $1 + 2 + \frac{2^2}{2!} + \frac{2^3}{3!}$  D)  $1 - 2 + \frac{2^2}{2!} - \frac{2^3}{3!}$  F)  $3 + \frac{3}{2!} + \frac{3}{3!}$

4) Which of the following series converges?  
 I.  $\sum_{n=2}^{\infty} \frac{e^n}{n^2}$  II.  $\sum_{n=1}^{\infty} \frac{\ln n}{n^2}$  III.  $\sum_{n=1}^{\infty} \left(\frac{e}{10}\right)^n$   
 A) I only C) I & II E) none of the three  
 B) II only D) I only F) all three

5) Which of the following series converges conditionally?  
 I.  $\sum_{n=1}^{\infty} (-1)^n \frac{n+1}{n^2}$  II.  $\sum_{n=1}^{\infty} (-1)^n \frac{n^2}{n^2}$  III.  $\sum_{n=1}^{\infty} \frac{(-1)^n n^2}{n^2 + 1}$   
 A) none of the three C) I & II E) I & III  
 B) I & II D) I & III F) all three



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