MATH 241 Calculus III
Chapter 13 Review
Vector Functions

13.1 Vector Functions and Space Curves

Find a function r(t) that describes the line or line segment.

1) The line through P(4, 9, 3) and Q(1, 6, 7)

Find the domain of the function.

2) $r(t) = \sqrt{t-1}\,i + \ln(t-2)j + \frac{1}{t-5}k$

Evaluate the limit.

3) $\lim\limits_{t \to \ln 6} = (6e^{-t}\,i + 3e^{-t}\,j)$

13.2 Derivatives and Integrals of Vector Functions

Differentiate the function.

4) $r(t) = (8t^2 - 12)i + \left(\frac{1}{18}t^3\right)j$

Find the unit tangent vector of the given curve.

5) $r(t) = \left(3\cos\frac{5}{3}t\right)i + \left(3\sin\frac{5}{3}t\right)j - 12tk$

For the smooth curve r(t), find the parametric equations for the line that is tangent to r at the given parameter value $t = t_0$.

6) $r(t) = (4t^2 - 3t)i + (t + 7)j + k$; $t_0 = 2$

Compute r''(t).

7) $r(t) = (7\ln(5t))i + (3t^3)j$

Solve the initial value problem.

8) Differential Equation: $\frac{dr}{dt} = i + (4t^3 - 10t)j + \frac{1}{t+2}k$

Initial Condition: $r(0) = 2j + (\ln 2)k$

Evaluate the integral.

9) $\int_0^{\pi/4} [(2\sec^2 t)i - (7 + \sin t)j - (3\sec t\tan t)k]dt$

Answer Key
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1) $r(t) = \langle 4 - 3t, 9 - 3t, 3 + 4t \rangle$
2) $(2,5) \cup (5, \infty)$
3) $i + \frac{1}{2} j$
4) $r'(t) = (16t) i + \left(\frac{1}{6} t^2 \right) j$
5) $T = \left(-\frac{5}{13} \sin \frac{5}{3} t \right) i + \left(\frac{5}{13} \cos \frac{5}{3} t \right) j - \frac{12}{13} k$
6) $x = 10 + 13t, y = 9 + t, z = 1$
7) $r''(t) = -\frac{7}{t^2} i + 18tj$
8) $r(t) = ti + \left(\frac{t^2}{4}(4t^2 - 20) + 2 \right) j + \ln(t + 2) k$
9) $2i + \left(\frac{2\sqrt{2} - 7\pi - 4}{4} \right) j + 3(1 - \sqrt{2}) k$