

## Math 203 — Calculus of vector-valued functions

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**Problem 1.** Plot the curve given by  $\mathbf{r}(t) = \langle t, t^3 \rangle$  for  $-2 \leq t \leq 2$  and plot the tangent vectors  $\mathbf{r}'(t)$  at times  $t = -2, -1, 0, 1, 2$ .

**Problem 2.** Plot the curve given by  $\mathbf{r}(t) = \langle t^2, t \rangle$  for  $-2 \leq t \leq 2$  and plot the tangent vectors  $\mathbf{r}'(t)$  at times  $t = -2, -1, 0, 1, 2$ .

**Problem 3.** Find a vector equation for the tangent line to curve  $\mathbf{r}(t)$  at the given  $t$  value.

a.  $\mathbf{r}(t) = \langle 3t^3 - 2t^2 + t + 1, t^4 + t^3 - 3t \rangle, t = 1$

b.  $\mathbf{r}(t) = \langle 3 \cos t, 3 \sin t, \frac{t}{2\pi} \rangle, t = \pi$

**Problem 4.** Compute  $\mathbf{r}'(t)$  for the following functions.

a.  $\mathbf{r}(t) = \langle \cos t, e^t, \ln t \rangle$

b.  $\mathbf{r}(t) = \langle \sin(2t), e^{t^2}, \cos(t^3) \rangle$  (remember the chain rule)

c.  $\mathbf{r}(t) = \langle t \cos t, t^2 \sin t, t^3 \ln t \rangle$  (remember the product rule)

**Problem 5.** Find the arc length of the following curves

a.  $\mathbf{r}(t) = \langle t^3, 3t^2, 6t \rangle, 0 \leq t \leq 4$

b.  $\mathbf{r}(t) = \langle \frac{1}{2}t^2, 2t, \frac{4}{3}t^{3/2} \rangle, 2 \leq t \leq 4$

c.  $\mathbf{r}(t) = \langle \cos(2t), \sin(2t), 4t^{3/2} \rangle, 1 \leq t \leq 2$