# MA 213 Worksheet #8

Sections 13.3 and 13.4
9/18/18

**1** Find the length of the following curves.

*13.3.1* $\mathbf{r}(t) = \langle t, 3\cos(t), 3\sin(t)\rangle \quad -5 \le t \le 5$

*13.3.3* $\mathbf{r}(t) = \sqrt{2}t\mathbf{i} + e^t\mathbf{j} + e^{-t}\mathbf{k} \quad 0 \le t \le 1$

*13.3.5* $\mathbf{r}(t) = \mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k} \quad 0 \le t \le 1$

**2** *13.3.13* Let $\mathbf{r}(t) = (5-t)\mathbf{i} + (4t-4)\mathbf{j} + 3t\mathbf{k}$.

**a** Find the arc length function for $\mathbf{r}(t)$ measured from the point $P = (4, 1, 3)$ in the direction of increasing $t$ and then reparameterize the curve with respect to arc length starting from $P$.

**b** Find the point 4 units along $\mathbf{r}(t)$ (in the direction of increasing $t$) from $P$.

**3** Find the unit tangent vector, the unit normal vector and the curvature for the following curves.

*13.3.17* $\mathbf{r}(t) = \langle t, 3\cos(t), 3\sin(t)\rangle$

*13.3.19* $\mathbf{r}(t) = \langle \sqrt{2}t, e^t, e^{-t}\rangle$

**4** Find the curvature of the following curves.

*13.3.27* $y = x^4$ (in $\mathbf{R}^2$)

*13.3.21* $\mathbf{r}(t) = t^3\mathbf{j} + t^2\mathbf{k}$

*13.3.23* $\mathbf{r}(t) = \sqrt{6}t^2\mathbf{i} + 2t\mathbf{j} + 2t^3\mathbf{k}$

**5** *12.3.47* Find the vectors $\mathbf{T}$, $\mathbf{N}$ and $\mathbf{B}$ for $\mathbf{r}(t) = \langle t^2, \frac{2}{3}t^3, t\rangle$ at the point $(1, \frac{2}{3}, 1)$.

**6** *12.3.49* Find equations of the normal plane and osculating plane of the following curve at $(0, 1, 2\pi)$.

$x = \sin(2t) \quad y = -\cos(2t) \quad z = 4t$

**7** Find the velocity, acceleration and speed of a particle with the given position function. Sketch the path of the particle. Draw the velocity and acceleration vectors for the specified value of $t$.

*13.4.3* $\mathbf{r}(t) = \langle -\frac{1}{2}t^2, t\rangle \quad t = 2$

*13.4.7* $\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + 2\mathbf{k} \quad t = 1$

**8** *13.4.25* A ball is thrown at an angle of $\pi/4$ to the ground. if the ball lands 90 m away, what was the initial speed of the ball?

**9** Find the tangential and normal components of the acceleration vector.

*13.4.37* $\mathbf{r}(t) = (t^2+1)\mathbf{i} + t^3\mathbf{j} + 2\mathbf{k}, \quad t \ge 0$

*13.4.39* $\mathbf{r}(t) = \cos(t)\mathbf{i} + \sin(t)\mathbf{j} + t\mathbf{k}$