# Math 114 HW 2

due Tuesday, 5/31

1. (Spring 2013) Find the equation of the plane that passes through $(1, 3, 2)$ and contains the line

   | | | | | |
   |---|---|---|---|---|
   | x | = | 1 | + | t |
   | y | = | -1 | - | 2t |
   | z | = | 3 | + | 2t |

   What is the y-coordinate of the point where this plane intersects the y-axis?

2. (Spring 2013) Let $\vec{\mathbf{r}}(t) = \sqrt{2}\cos t\hat{\mathbf{i}} + \sqrt{2}\sin t\hat{\mathbf{j}} + t\hat{\mathbf{k}}$. Using the parametric equations for the line tangent to the curve at $t = \frac{\pi}{4}$, find the coordinates of the point where the tangent line intersects the xy-plane.

3. (Fall 2011) Find $\vec{\mathbf{r}}(t)$ if

   $$\begin{aligned} \frac{d^2\vec{\mathbf{r}}}{dt^2} &= \langle t^2, 1, -t\rangle \\ \frac{d\vec{\mathbf{r}}}{dt}(1) &= \left\langle \frac{2}{3}, 0, -\frac{1}{2}\right\rangle \\ \vec{\mathbf{r}}(0) &= \langle 1, -1, 0\rangle \end{aligned}$$

   What is the value of $\vec{\mathbf{r}}(1)$?

4. (Spring 2012) A particle in space accelerates according to $\vec{a}(t) = 2\hat{\mathbf{i}} + (t^2 - 1)\hat{\mathbf{j}} + \hat{\mathbf{k}}$ with initial velocity $\vec{v_0} = 3\hat{\mathbf{i}} + 4\hat{\mathbf{j}}$ and initial position $\vec{r_0} = \hat{\mathbf{i}} + 5\hat{\mathbf{k}}$. What is the position of the particle at time $t = 2$?

5. (Fall 2013) A projectile is launched from the ground at an angle of $\frac{\pi}{4}$, and with an initial speed of $48\sqrt{2}$ feet/sec. How many seconds does it take a projectile to reach a height of 32 feet for the first time? Take gravitational acceleration $g$ to be 32 feet/sec$^2$.

6. (Spring 2013) Assume the acceleration of gravity is 10 m/sec$^2$ downwards. A canon ball is fired at ground level. If the cannon ball rises to a height of 80 meters and travels a distance of 240 meters before it hits the ground, what is the magnitude of the initial velocity in meters per second?

7. (Fall 2010) Let $\vec{\mathbf{r}}(t) = \langle 2t, t^2, \ln t\rangle$. Find the arclength for $1 \le t \le e$.

8. (Fall 2013) A curve $C$ in 3-space is defined by

   $$\vec{\mathbf{r}}(t) = (4\cos t)\hat{\mathbf{i}} + (4\sin t)\hat{\mathbf{j}} + 3t\hat{\mathbf{k}}$$

   Find the point $p_0$ on the curve $C$ which has distance $\frac{5\pi}{4}$ from the point $(4, 0, 0)$, as measured along the curve.

9. (Fall 2009) A kid is riding a roller coaster in an amusement park. Part of the track follows the curve

$$\vec{\mathbf{r}}(t) = \left\langle t, t^2, \frac{2}{3}t^3 \right\rangle, \qquad 0 \leq t \leq 2$$

How long is this part of the coaster track?

10. (Spring 2005) Find the unit tangent vector to the curve

$$\vec{\mathbf{r}}(t) = e^{2t}\cos t\hat{\mathbf{i}} + e^{2t}\sin t\hat{\mathbf{j}} + e^{2t}\hat{\mathbf{k}}$$

at the point where $t = \frac{\pi}{2}$.