

1. (Physics review): A projectile is launched from ground level at an angle $\theta=\pi/3$ with an initial speed of 100m/s, and hits a target at an altitude (vertical elevation) of 50m. What is the horizontal distance to this target? Show that there are two solutions (i.e. two possible values of horizontal distance), and make a rough sketch of both trajectories. You can use an approximate value for the acceleration of free fall of 10m/s^2 .
2. Consider an object moving with acceleration $\mathbf{a}(t) = \left\langle t, \cos(t), \frac{1}{t+1} \right\rangle$. Find its velocity and position if its initial velocity is $\mathbf{v}(0) = \langle 1, 2, 0 \rangle$ and its initial position is $\mathbf{r}(0) = \langle 0, 1, 2 \rangle$
3. Sketch the following space-curve, along with its tangent line at $t=1$:

$$\mathbf{r}(t) = \left\langle \frac{\cos(\pi t)}{1+t}, \frac{\sin(\pi t)}{1+t} \right\rangle, t \in [1, 4]$$

4. Find the total length of the curve on the given interval:

$$\mathbf{r}(t) = \langle t \cos(\pi t), t \sin(\pi t), 2t^{3/2} \rangle, t \in [0, 2]$$