1. Let $\vec{v}$ and $\vec{w}$ be any two nonzero vectors in 3-space, which are not parallel to one another. Write expressions for the vectors representing the following:

   a) a vector parallel to $\vec{v}$ with a magnitude of $\sqrt{2}$ units.

   b) a vector perpendicular to $\vec{v}$ and $\vec{w}$

   c) what is the value of $\vec{v} \cdot \left(\vec{v} \times \vec{w} \right)$? Explain.

2. Given the points $P(0,2,2)$, $Q(2,0,2)$ and $R(2,2,0)$

   a) find an equation of the plane containing P, Q and R.
   b) find the measure of the angle between the vectors $\overrightarrow{RP}$ and $\overrightarrow{RQ}$.
   c) Use a computer algebra system to produce a picture of the plane, the points P, Q and R, and the vectors $\overrightarrow{RP}$ and $\overrightarrow{RQ}$.

3. a) Find vector $\vec{v}$ from point $(e,-e,-e)$ to the point $(3e,e,e)$.
   b) Find parametric equations for the line l, through (π,π,π) in the direction of vector $\vec{v}$.
   c) Does the line l pass through the origin (contain the point (0,0,0))? Explain your reasoning.
   d) Use a computer algebra system to produce a picture of the line, the vector $\vec{v}$ and the points: $(e,-e,-e)$, $(3e,e,e)$, (π,π,π), $(0,0,0)$.

4. a) Find the length of the arc of the circular helix with vector Equation $r(t) = \langle t, \cos(t), \sin(t) \rangle$ from the point $(0,1,0)$ to the point $(\pi,-1,0)$.
   b) Find an equation for the **NORMAL PLANE** to the curve $r(t) = \langle t, \cos(t), \sin(t) \rangle$ when $t = \pi$. What point in R^3 corresponds to $r(\pi)$?
   c) Use a computer algebra system to produce a picture of the helix, plane and point you identified in part b).

5. a) Your catapult launches a projectile **TWO METERS** above ground level with an initial speed of 50 meters per second. Find an angle measure so that you can hit a target **FIFTEEN METERS** above the ground one hundred meters away.
   b) What was the maximum height of your projectile on its way to the target?
   c) How long did it take for your projectile to hit the target?
   d) Use a computer algebra system to produce a picture representing the trajectory of your projectile, the target and the highest point of the projectiles trajectory.