1. (40 pts.) Find matrices that represent the following linear maps \( f: \mathbb{R}^3 \rightarrow \mathbb{R}^3 \) with respect to the standard basis for \( \mathbb{R}^3 \):
   
   (a) projection to the \( x-z \) plane,
   
   (b) reflection with respect to the \( x-z \) plane,
   
   (c) rotation by \( \pi \) around the \( y \) axis clockwise if you look from the positive \( y \) direction,
   
   (d) projection to the line \( \ell(t) = t(1, 1, 1) \).

2. (40 pts.) Find the determinants and inverses of the following matrices:

   (a) \[
   \begin{pmatrix}
   0 & 1 & 1 \\
   1 & 0 & 1 \\
   1 & 1 & 0 \\
   \end{pmatrix}
   \]
   
   (b) \[
   \begin{pmatrix}
   3 & 2 & 1 \\
   0 & 3 & 2 \\
   0 & 0 & 3 \\
   \end{pmatrix}
   \]

3. (30 pts.) Find parametric formulas for the following curves in \( \mathbb{R}^2 \):

   (a) The line through \((-1, 2)\) and \((5, -3)\).

   (b) The circle of radius 5 centered at \((-1, -1)\).

   (c) The parabola \( x = y^2 \).

4. (40 pts.) Suppose that the position of a particle in \( \mathbb{R}^2 \) as a function of time \( t \geq 0 \) is given by \( r(t) = (t \cos(2\pi t), t \sin(2\pi t)) \).

   (a) Sketch the trajectory of the particle.

   (b) Find the velocity as a function of \( t \).

   (c) Find the speed as a function of \( t \) (simplify!).

   (d) Find a parametric formula for the line tangent to the trajectory at the point \( r(1) \).

---

A useful formula:

Projection of \( u \) to the line through the origin spanned by \( v \neq 0 \) is \( \frac{u \cdot v}{||v||^2} v \).