Worksheet #11: Art Class
Date: 09/26/2022
Math 53: Fall 2022
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Problem 1. Because you will need it: in 3D space, draw...

(a) Labeled coordinate axes

(b) A plane

(c) A sphere

(d) A torus (donut shape)

(e) A helix/spring shape

(f) A paraboloid

(g) A cube

(h) A cylinder (with finite height)

(i) A (single) cone (with finite height)

(j) A pyramid/tetrahedron

(k) An octahedron

The exact dimensions and orientation of the shapes don't matter, but you should try for a genuine 3D appearance. I'd suggest dotting lines that are in the background and choosing your perspective wisely. Shading is also an option. Most imporantly, make it clear that the objects you are drawing could be recognized unambiguously by someone else.

Problem 2. (Based on Stewart 13.4.44) The *angular momentum* of a particle with mass m and position vector $r(t)$ is $L(t) = mr(t) \times v(t)$, and its *torque* is $\tau(t) = mr(t) \times a(t)$.

(a) Note that we treat both of these quantities as vectors; which directions do these vectors point? What is the particle "rotating" around with these formulas?

(b) Prove that $L'(t) = \tau(t)$, and thus conservation of angular momentum: $L(t)$ is constant if $\tau(t) = 0$.

(c) Show that a particle moving in a straight line at a constant *velocity* has constant angular momentum in two ways: i) using (b) and ii) doing the computation directly.

(d) Show that a particle moving in a circle with constant *speed* about the origin also has constant angular momentum using any method you like.