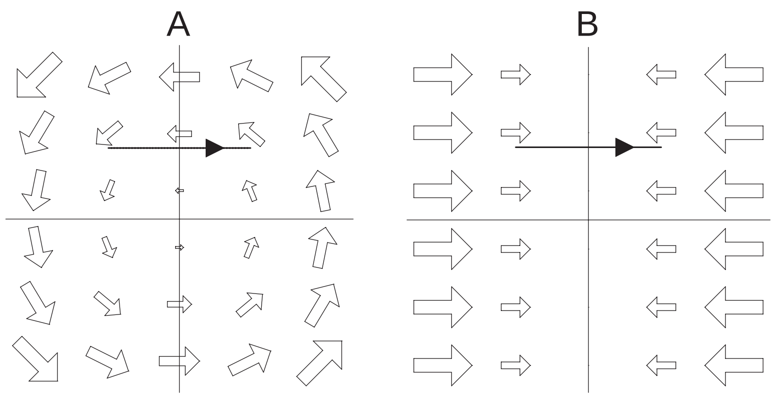
Directions: Show **ALL** work for credit; Give **EXACT** answers when possible; Start each problem on a **SEPARATE** page; Use only **ONE** side of each page; Be neat; Leave margins on the left and top for the **STAPLE**; Calculators can be used for graphing and calculating only; Nothing written on this page will be graded;

1. $S = \{(u,v) : 0 \le u, 0 \le v, 1 \le u^2 + v^2 \le 4\}$, $x = u + v$ $y = v - u$.
   (a) sketch S in the uv-plane.
   (b) compute the Jacobian of the transformation.
   (c) compute the inverse transformation.
   (d) sketch R, the image of S in the xy-plane.
2. Find formulas for the two vector fields below. (There are many possible answers.) Decide if the line integrals over the given curves will be positive negative or zero in each plot.



3. Write down but do **NOT** evaluate a triple integral which will give mass for the volume E which is bounded below by the paraboloid $z = 2x^2 + 2y^2$ and bounded above the paraboloid $z = 3 - x^2 - y^2$ and which has the density function $\delta(x,y,z) = xyz$.
4. Sketch the region (include drawings of the shadow in the xy-plane and a 2D z vs r plot ($r > 0$)) for integral below. Rewrite the triple integeral in rectangle and spherical coordinates. Do **NOT** evaluate any of the integrals.
$$\int_{\theta=-\pi/2}^{\pi/2} \int_{r=0}^{1} \int_{z=r\sqrt{3}}^{\sqrt{3}} r^2 \cos\theta \, dz \, dr \, d\theta$$
5. Find the surface area of the surface $z = xy$ over the region R, where R is that portion of the first quadrant of the xy-plane which lies inside the circle $x^2 + y^2 \le 1$