FOLDS

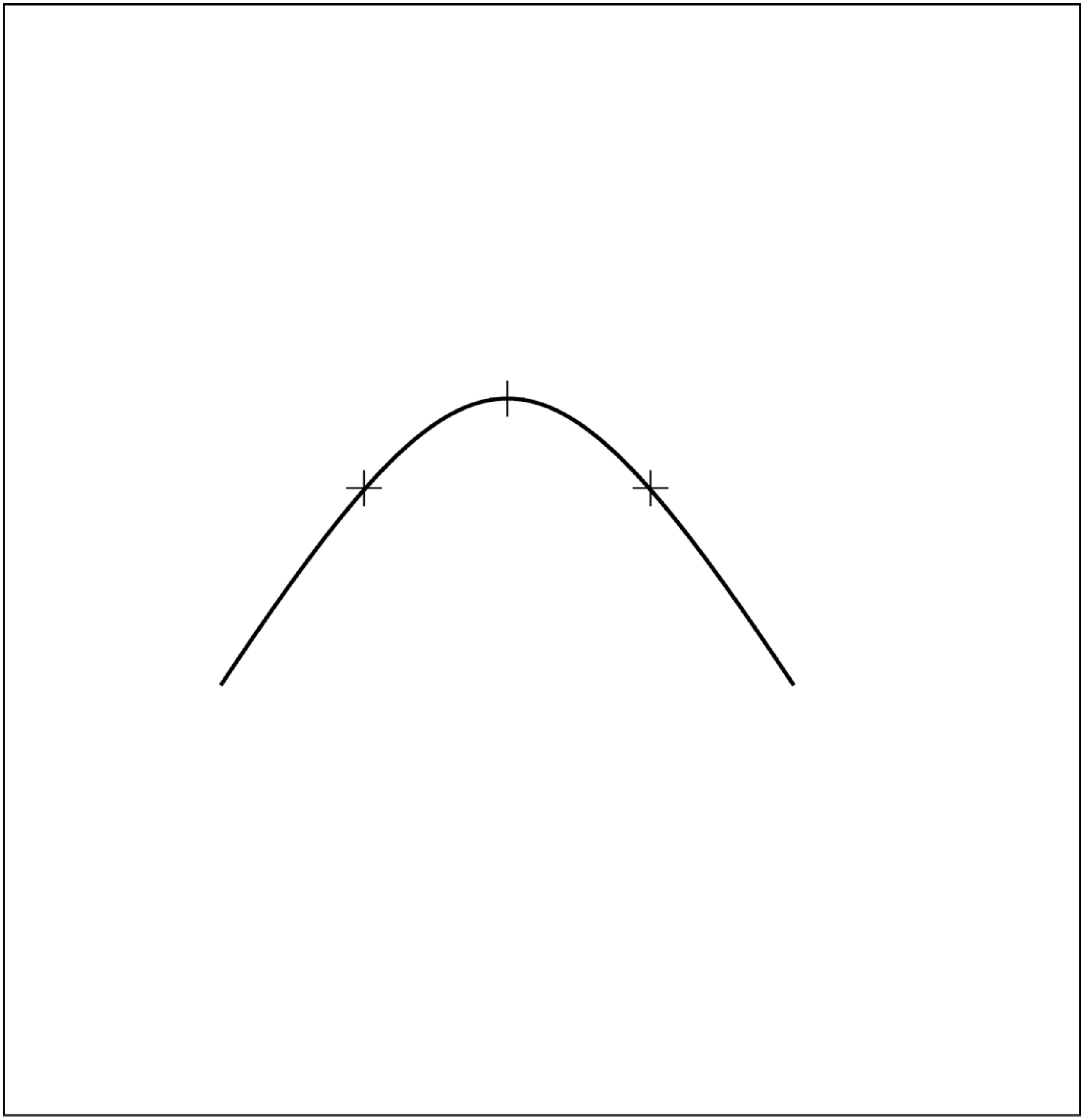
<u>Exercise 1: Graphical solution for curvature</u> (**10 points total**)

Find the curvature graphically at the crest of the curve on the next page using the three marked points and the procedure described in the notes for the lab lecture.

A Give the absolute value of the curvature in cm^{-1} to 2 significant figures.
4 pts for graphical construction, 2 points for curvature value (2 points if within 0.2 cm^{-1}, 1 point if within 0.5 cm^{-1}, 0 pts if answer is off by more than 0.5 cm^{-1}).

B Explain whether your solution is greater than or is less than the true curvature value at the crest. (**2 pts**)

C Explain whether you think you would get a more accurate graphical solution if the points were more closely spaced. Give a practical answer, not just a theoretical answer. (**2 pts**)



Exercise 2: Analytical solution for curvature (**40 points total**)

Calculate the curvature of the following curves using the formula most college-level calculus books derive for the curvature of a plane curve: $k = |y''|/[(1+\{y'\}^2)^{3/2}]$:

a $y = x^{1/3}$ (an inverse cubic function);

b $y = \sin(x)$ (sine wave);

c $y = \mathrm{atan}(x)$ (arctangent, a function resembling a monocline);

d $y = x^4 - 2x^2 + 1$ (function that yields the shape of a beam with a constant overpressure on one side, the shape is like that of a laccolith);

A Derive the solutions for the first derivative of y with respect to x (i.e., y') and second derivative with respect to x (i.e., y") for each curve neatly on a separate page. (**2 points for each derivative; 16 points total**)

B Download the Matlab script curvature.m from my web page, and modify it with your solutions for y' and y" for each of the four functions on the lines marked by asterisks (yp = *********; ypp = *********;). I have provided a complete example in the Matlab script for the solution for a parabolic curve. The script runs by typing "curvature". Include hard copies of the plots produced and your Matlab scripts. (**1 pt for each curve; 4 pts total**).

C Locate and clearly label the hinge points <u>on the top and bottom of each of the four curved layers</u> where highest strains of extension and the highest strains of contraction occur. Label the points of highest extension (there can be more than one) with a plus sign (+) and the points of highest contraction (there can be more than one) with a minus sign (-). (**1 point per location and label; 18 points total**)

D For curve (c), describe how the locations in (C) correspond to the <u>approximate</u> locations of buckles and fissures along the Ohale Fault. (**2 pts**)

Exercise 3: Fold classification (**32 points total**)

For the following cases find the orientation of the fold axes using an equal angle projection (stereonet). For each fold plot the orientation of the limbs, the orientation of the axial surface on the equal angle projection. Find the orientation of the fold axis and the angles between the limbs ***<u>as measured across the axial surface</u>***. Using Fleuty's classification scheme to classify the folds according to the orientation of the fold axis and the axial surface. Also classify the folds using the classification scheme based on the interlimb angle.

<u>Plot fold A and fold B on separate pages!</u>

Limb A1 **(2 pts)**	Strike: 20	Dip: 30SE
Limb A2 **(2 pts)**	Strike: 250	Dip: 30NW
Axial surface **(2 pts)**	Strike: 315	Dip: 14
Fold axis **(2 pts)**	Trend:	Plunge:
Fleuty fold classification	**(2 pts)**	xxxxxxxxxxx
Interlimb angle	**(2 pts)**	xxxxxxxxxxx
Interlimb fold classification	**(4 pts)**	xxxxxxxxxxx
Limb B1 **(2 pts)**	Strike: 330	Dip: 10E
Limb B2 **(2 pts)**	Strike: 150	Dip: 70W
Axial surface **(2 pts)**	Strike: 330	Dip: 60E
Fold axis **(2 pts)**	Trend:	Plunge:
Fleuty fold classification	**(2 pts)**	xxxxxxxxxxx
Interlimb angle	**(2 pts)**	xxxxxxxxxxx
Interlimb fold classification	**(4 pts)**	xxxxxxxxxxx

For the interlimb angle, full credit for angles within two degrees of the correct value, half credit for angles within four degrees of the correct value.

Exercise 4: Principal curvatures (32 points total)

This exercise ties into a key theme of the class – finding a perspective that allows you to see the essence of a phenomenon in the simplest and clearest way. Find the orientation and magnitudes of the principal curvatures at one point on a folded sedimentary surface, where the equation of the folded surface is $z = -x^2 - 4xy - 2y^2$. Use the example in the notes for Lab 14. Include your Matlab command printouts and plots, and <u>show your algebraic work</u>.

A Plot z in the region $-2 \le x \le 2$, $-2 \le y \le 2$ in Matlab. (28 pts)

B Evaluate the partial derivatives $\partial z/\partial x$ and $\partial z/\partial y$ algebraically. (2 pts)

C Find the coordinates of a point where both partial derivatives equal zero. (2 pts)

D Prepare a contour plot of the surface z over the region of interest in Matlab. (2 pts)

E Evaluate the second partial derivatives $\partial^2 z/\partial x^2$, $\partial^2 z/\partial y^2$, $\partial^2 z/\partial x \partial y$, and $\partial^2 z/\partial y \partial x$ algebraically. (8 pts)

F Evaluate the second partial derivatives at the point you found in question C. (4 pts)

G Form the Hessian matrix H from the values of the second partial derivatives from step F. (2 pts)

H Find the directions and magnitudes of the principal curvatures using Matlab. (2 pts)

I Plot the directions of the principal curvatures on your contour plot, and indicate the magnitudes of the curvatures associated with each principal direction. (4 pts)

J Classify the hold using the curvature-based scheme in the notes from Lecture 27. (2 pts)