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3. A roller mechanism follows a path described by $y = \sqrt{4x+1}$, where displacements are in m and velocities in m/s. If $v_x = 3x$, find the **magnitude** of the resultant velocity for $x = 2$ m. You may leave your answer in radical form or give a decimal approximation, your choice.
4. A metal sphere is placed in seawater to study the corrosive effect of seawater. If the surface area **decreases** at $240 \text{ cm}^2/\text{year}$ due to corrosion, how fast is the radius changing when it is 30 cm? (You may leave your answer in terms of π if you wish.)

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5. A child is flying a kite on a windy day. Assume that the kite maintains a constant height of 40 meters above the ground while moving away from the child at a rate of 1 m/s relative to the ground. At what rate is the string being let out when 50 meters of string are already out?
6. A cylindrical cup (no top) is designed to hold 500 cm^3 (500 mL) of liquid. There is no waste in the material used for the sides. However, there is waste in that the bottom of the cup is made from a square $2r$ on a side. What are the most economical dimensions for a cup made under these conditions?

7. Consider the function $y = \frac{x^2 - 1}{x^2 - 4}$.

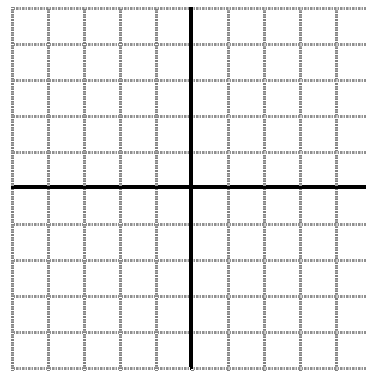
a) Find the x - and y - intercepts, if any.

b) Find the equations of the asymptotes, if any.

c) Find any critical values, if any. If there are critical points, use one of the derivative tests to verify whether these points are relative maxima or minima and show your work.

d) Find the inflection points of this function, if any.

e) Sketch the resulting graph.



8. Find the differential dy for $y = \sqrt{\frac{x}{1+2x}}$.