

1. Water is poured into a Dixie cup (which is in the shape of a frustrum). The height of the water is a function of the volume of water in the cup. The graph of this function is:

- (a) increasing and concave up
 - (b) decreasing and concave up
 - (c) increasing and concave down
 - (d) decreasing and concave down
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2. Let

$$f(x) = -3x^4 - 4x^3 + -36x^2 + 8$$

- (a) Find $f'(x)$.
 - (b) Find and classify all critical points.
 - (c) Find the intervals where f is concave up.
 - (d) Find the intervals where f is concave down.
 - (e) Sketch the graph of f .
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3. Emperor Palpatine is sitting in a cylindrical tank of radius 2 m . Darth Vader pours water into the tank at a rate of 4 m^3/s .

- (a) At what rate is the water level rising?
 - (b) Express the height of the water level as a function of time.
 - (c) Assume Palpatine is 2 meters tall. How long until the water level is above his head?
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4. Let $f(x) = \frac{x}{\ln(x)}$. Find and classify all critical points of f .