

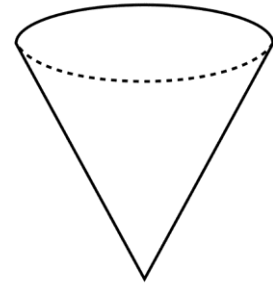
Provide a clear and organized presentation. Show all of your work, completely simplify all answers, and give exact values only.

1. (25 pts) My cat *Pythagoras* is 20 feet due west of a mouse at the moment the mouse acknowledges his existence. The mouse immediately scurries in the direction of $N45^\circ E$ at a constant speed of 5 ft/s, but *Pythagoras* remains at his position, merely observing this mouse. How fast is the distance changing between *Pythagoras* and this mouse after 3 seconds?

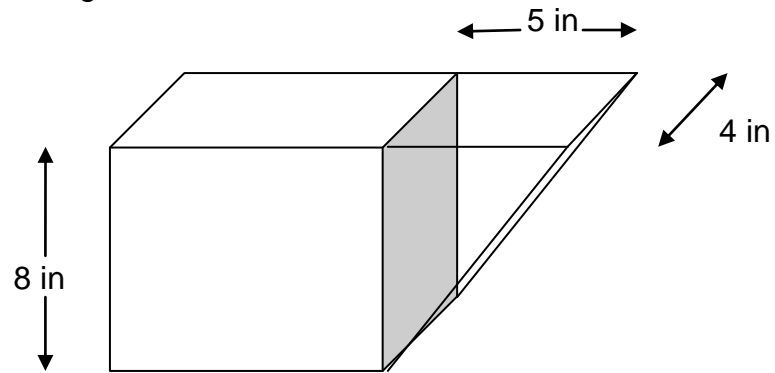
2. (20 pts) Determine the absolute extrema for f over the interval $[-1, 8]$ if

$$f(x) = x^{\frac{2}{3}} - x^2$$

3. (10 pts) Water is sitting in a container (but does not completely fill this container) that has the shape of an inverted right circular cone whose diameter has the same length as its height. Use differentials to approximate the percent change in volume if the height of the body of water within this container increases by 2%.



4. (20 pts) The *Hyperbolic Coffee Maker* has a prism shaped container with dimensions depicted in the following picture off to its side that contains the water. If water exits this tank at $0.3 \text{ in}^3/\text{s}$, how fast is the height of this body of water changing when the height is 3 in.?



5. (10 pts) Create a linear approximation centered about $x = \frac{\pi}{2}$ for f if

$f(x) = \cos x$ and use it to approximate $\cos \frac{5\pi}{12}$

6. (15 pts) Recall that $\tanh x = \frac{\sinh x}{\cosh x}$, i.e., $\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$, to derive:

i) the output of $\tanh^{-1} x$

ii) the derivative of $\tanh^{-1} x$