You must measure the volume \( V \) of a can (right circular cylinder) to within \(.1\) cubic foot. How accurately must you measure the radius \( r \) if your radius estimate is 5 feet and the height \( h \) (a constant here) is known to be 5 feet? Decimals are not allowed in any answers.

Volume formula for a can.

\[
V = \]

(A) \( \pi rh \) \hspace{1cm} (B) \( 2\pi rh \) \hspace{1cm} (C) \( \pi r^2 h \) \hspace{1cm} (D) \( \pi rh^2 \) \hspace{1cm} (E) \#

The needed derivative.

(A) \[
\frac{dV}{dh} = 2\pi rh
\] \hspace{1cm} (B) \[
\frac{dV}{dh} = \pi r^2
\]

(C) \[
\frac{dV}{dr} = 2\pi h
\] \hspace{1cm} (D) \[
\frac{dV}{dr} = 2\pi rh
\] \hspace{1cm} (E) \#
You need to have the volume accurate to .1 cubic foot. Hence for the error \( dV \) in the volume we must have \( dV \leq .1 \).

Replace \( dV \) with its formula to get:

(A) \( 2\pi rh dh \leq .1 \)  
(B) \( \pi r^2 dh \leq .1 \)

(C) \( 2\pi h dr \leq .1 \)  
(D) \( 2\pi rh dr \leq .1 \)  
(E) #

Replace \( h \) by its known value 5 and \( r \) by its estimated value 5. Solve for the maximum allowed error for \( r \). Multiply top and bottom by 10 to eliminate the decimal.

(A) \( dh \leq \frac{1}{500\pi} \) ft.  
(B) \( dh \leq \frac{1}{250\pi} \) ft.

(C) \( dr \leq \frac{1}{10\pi} \) ft.  
(D) \( dr \leq \frac{1}{500\pi} \) ft.  
(E) #
List, in increasing order, the intervals of increase and decrease. List and classify the critical points. Classify as abs/loc/end max/min/crit. Write in the form $f(1) = 2$ abs loc max or $f(2) = f(4) = -1$ endpt. min.

- $f(x) = \sqrt{x^2 - 2x - 3} = \sqrt{(x - 3)(x + 1)}$

Domain. $(-\infty, -1] \cup [3, \infty)$
For large $x$, the graph looks like its lead term.

- Lead term for $f$:
  
  (A) $x$ (B) $|x|$ or $\sqrt{x^2}$ (C) $\sqrt{x^2 - 2x}$  (D) $\sqrt{2x - 3}$  (E) #

Given: $f'(x) = \frac{2x - 2}{2 \sqrt{x^2 - 2x - 3}} = \frac{(x - 1)}{\sqrt{(x - 3)(x + 1)}}$

- Lead term for $f'$:
  
  (A) $x$ (B) $\frac{1}{x}$ (C) $\frac{1}{\sqrt{x^2}} = \frac{1}{|x|}$  (D) $\frac{x}{\sqrt{x^2}} = \frac{x}{|x|}$  (E) #

- Critical points (note, critical points must be in the function’s domain).
  
  (A) $x = -1$  (B) $x = 3$  (C) $x = -1, 3$  (D) $x = -1, 1, 3$  (E) #
Classify the intervals.

- $(-\infty, -1]$ is an interval of
  - (A) increase (B) decrease (E) #

- $[3, \infty)$ is an interval of
  - (A) increase (B) decrease (E) #

Classify the critical points (as specifically as possible).

- $x = -1$ is a
  - (A) loc. min. (B) loc. max (C) loc. abs. max
  - (D) end. max (E) end. abs. min

Classify the critical points (as specifically as possible).

- $x = 3$ is a
  - (A) loc. min. (B) loc. max (C) loc. abs. max
  - (D) end. max (E) end. abs. min