Barbara started from rest. Barbara rode a distance of $128 \text{ m} \pm 32 \text{ m}$ in a time of $8 \text{ min} \pm 2 \text{ min}$ from her starting point.

What is the uncertainty $\Delta a$ in her acceleration

$$a = \frac{2d}{t^2} = \frac{2(128 \text{ m})}{(8 \text{ min})^2} = 4 \text{ m/min}$$

A) $\Delta a = 2 \text{ m/min}$

B) $\Delta a = 3 \text{ m/min}$

C) $\Delta a = 4 \text{ m/min}$

D) $\Delta a = 5 \text{ m/min}$

E) $\Delta a = 6 \text{ m/min}$
A first-order approximation is

\[
\Delta a = \left| \frac{\partial a}{\partial t} \right| \Delta t + \left| \frac{\partial a}{\partial d} \right| \Delta d \\
= 4 \frac{d}{t^3} \Delta t + 2 \frac{1}{t^2} \Delta d \\
= 4 \frac{(128 \text{ m})}{(8 \text{ min})^3} (2 \text{ min}) + 2 \frac{1}{(8 \text{ min})^2} (32 \text{ m}) \\
= (2 \text{ m/min}^2) + (1 \text{ m/min}^2) \\
= 3 \text{ m/min}^2,
\]

since

\[
\frac{\partial a}{\partial d} = \frac{\partial}{\partial d} \left( 2 \frac{d}{t^2} \right) = +2 \frac{1}{t^2}, \quad \text{and}
\]

\[
\frac{\partial a}{\partial t} = \frac{\partial}{\partial t} \left( 2 \frac{d}{t^2} \right) = -4 \frac{d}{t^3}.
\]

Answer bf B.

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