

Jane has been riding for  $8 \text{ min} \pm 2 \text{ min}$ . She has been riding at a constant velocity of  $24 \text{ m/min} \pm 5 \text{ m/min}$ .

What is the uncertainty  $\Delta d$  in the distance  $d = v t = (8 \text{ min}) (24 \text{ m/min}) = 192 \text{ m}$ , she traveled.

- A)  $\Delta d = 88 \text{ m}$
  - B)  $\Delta d = 90 \text{ m}$
  - C)  $\Delta d = 92 \text{ m}$
  - D)  $\Delta d = 94 \text{ m}$
  - E)  $\Delta d = 96 \text{ m}$
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A first-order approximation is

$$\begin{aligned}\Delta d &= \left| \frac{\partial d}{\partial t} \right| \Delta t + \left| \frac{\partial d}{\partial v} \right| \Delta v \\ &= v \Delta t + t \Delta v \\ &= (24 \text{ m/min}) (2 \text{ min}) + (8 \text{ min}) (5 \text{ m/min}) \\ &= (48 \text{ m}) + (40 \text{ m}) \\ &= 88 \text{ m},\end{aligned}$$

since

$$\begin{aligned}\frac{\partial d}{\partial t} &= \frac{\partial}{\partial t} v t = +v, \quad \text{and} \\ \frac{\partial d}{\partial v} &= \frac{\partial}{\partial v} v t = +t.\end{aligned}$$

Answer bf A.