

3. A tortoise can run with a speed of .16 m/s, and a hare can run exactly 15 times as fast. In a race, they both start at the same time, but the hare stops to rest for 2.00 min. If the tortoise wins by 20 cm
- a. How long does the race take? Give your answer in seconds, you should get an answer between 100 – 150 seconds.

$$V_T = .16 \text{ m/s} \quad V_H = 2.4 \text{ m/s}$$

$$V = \frac{\Delta X}{\Delta t} \therefore \Delta X_T = V_T \Delta t_T \quad \Delta X_H = V_H \Delta t_H$$

ΔX_T : displacement of tortoise
 Δt_T : amount of time the tortoise ran for
 ΔX_H : displacement of hare, distance hare ran
 Δt_H : amount of time the hare ran for
 V_H : velocity of hare

★ At end of race, tortoise wins by 20 cm, so

$$\Delta X_T = \Delta X_H + .2 \text{ m} \quad \boxed{\Delta X_T = \Delta X_H + .2 \text{ m}}$$

At end of race, tortoise has run for 2 min longer than the hare, so

$$\Delta t_T = \Delta t_H + 120 \text{ sec} \quad \boxed{\Delta t_H = \Delta t_T - 120 \text{ s}}$$

Find Δt_T (Algebraic method)

$$\boxed{V = \frac{\Delta X}{\Delta t}}$$

$$\Delta X_T = \Delta X_H + .2 \text{ m}$$

$$V_T \Delta t_T = V_H \Delta t_H + .2 \text{ m}$$

$$V_T \Delta t_T = V_H (\Delta t_T - 120 \text{ s}) + .2 \text{ m}$$

↙ distribute

$$V_T \Delta t_T = V_H \Delta t_T - (V_H)(120 \text{ s}) + .2 \text{ m}$$

↖

(Factor) $V_T \Delta t_T - V_H \Delta t_T = -(V_H)(120 \text{ s}) + .2 \text{ m}$

$$\Delta t_T (V_T - V_H) = -(V_H)(120 \text{ s}) + .2 \text{ m}$$

$$\Delta t_T = \frac{-(V_H)(120 \text{ s}) + .2 \text{ m}}{V_T - V_H} = \boxed{128 \text{ seconds}}$$

$$\Delta X_{\text{race}} = \Delta X_T = V_T \Delta t_T = (.16)(128) = \boxed{20.48 \text{ m}}$$