2009100111031

Answers

1) Find ω_i in Rad/sec

Very simple. Since the truck started from rest the Tires also must be at rest, so the initial angular velocity must be Zero

$\therefore \omega_i = 0$ Rad/sec

2) Find ω_f in Rad/sec

Since $V_f = 60 \frac{\text{miles}}{\text{hr}} = 88$ ft/sec the Tire Tread must also be moving at 88 ft/sec. The Tire must rotate to move ahead since The Tires are not slipping

$V_f = r\omega_f$ so $\omega_f = \frac{V_f}{r}$

but $r = \frac{\text{Diameter}}{2} = \frac{30\text{in}}{2} \cdot \frac{1\text{ft}}{12\text{in}} = 1.25$ ft

$\omega_f = \frac{V_f}{r} = \frac{88 \text{ ft/sec}}{1.25 \text{ ft}} = \frac{352}{5 \text{ sec}} = 70.4/\text{sec}$

$\therefore \omega_f = 70.40$ Radians/Second

3) Circumference of Tire in inches

The Tire is 30.00 inches tall so its diameter is 30.00 inches

Use $C = 2\pi r = \pi d$ to get the Circumference

$$C = \pi d = \pi(30in) = 30\pi \text{ inches}$$

$\therefore$ Circumference $= 30\pi in = 94.25$ inches

4) Number of rotations the Tire makes during acceleration.

The number of rotations will be the total distance covered divided by the Circumference of the Tire since one rotation of the Tire will move the Truck ahead a distance equal to the Circumference

We know the Circumference in inches from #3.

4 (continued) Next find distance covered during acceleration.

$\Delta x = v_i t + \frac{1}{2} a t^2$ but $v_i = 0$ so

$\Delta x = \frac{1}{2} a t^2$ but $a = \frac{v_f - v_i}{t}$ so

$\Delta x = \frac{1}{2}\left(\frac{v_f - v_i}{t}\right) t^2$ but $v_i = 0$ so

$\Delta x = \frac{1}{2} v_f t$ or $\frac{v_f t}{2}$

$\Delta x = \frac{(88 \text{ ft/sec})(6 \text{ sec})}{2} = (88 \text{ ft})(3)$

$\therefore \Delta x = 264 \text{ feet}$

$\text{Rotations} = \frac{\text{Total Distance}}{\text{Distance / Revolution}} = \frac{264 \text{ ft}}{\text{Circumference}}$

$\#\text{Rotations} = \frac{264 \text{ ft}}{(30 \text{ inches})(\pi)}$ Convert inches into feet

$= \frac{264 \text{ ft}}{(30\pi)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)} = \frac{264}{2.5\pi} = \frac{528}{5\pi}$ Revs.

$\therefore \#\text{ of Revolutions} = \frac{528}{5\pi} = 33.61$ Revs.

5) Find linear velocity of the Tire Tread.

Since the Tire is not slipping the Tire Tread must be moving at the same speed as the Truck is moving.

∴ Tread speed = 88.00 ft/sec.

Note that this is the speed the Tread is moving at with respect to the center of the Tire, which is moving at the same speed as the Truck.

The Tire Tread is not moving with respect to the point where it is in contact with the road or it would be slipping.

The top of the Tire is going toward the front of the Truck while the bottom of the Tire is heading to the back of the Truck

6) Find angular acc. in Rad/sec²

Use $\omega_f = \omega_i + \alpha t$ but $\omega_i = 0$

$\omega_f = \alpha t$ so $\alpha = \frac{\omega_f}{t} = \frac{70.4 \text{ r/sec}}{6 \text{ sec}}$

$\therefore \alpha = \frac{704}{60s^2} = \frac{352}{30s^2} = \frac{176}{15s^2} = 11.73/s^2$

Note t was given and ω_f was from #2

7) The linear displacement was found in #4 so

$\Delta X = 264$ feet from #2

8) Find Angular Displacement in radians

we know it in Revolutions from #4 so simply convert

$\therefore \phi = \frac{528 \text{ rev}}{5 \text{ ft}} \cdot \frac{2\pi}{1 \text{ rev}} = \frac{1056}{5} = 211.2 \text{ Rad.}$

9) Find linear acc. use $V_f = V_i + at$

$a = \frac{V_f - V_i}{t} = \frac{88 \text{ ft/s} - 0 \text{ ft/s}}{6 \text{ sec}} = \frac{88}{6} \text{ ft/s}^2$

$\therefore a = \frac{44}{3} \frac{\text{ft}}{s^2}$ or $14\frac{2}{3} \frac{\text{ft}}{\text{sec}^2}$