20091002-0923

P1

1) Find Tire height in inches
Simply convert 0.700 m into inches

$$\text{Height} = \frac{.7\,m}{1} \cdot \frac{100\,cm}{1\,m} \cdot \frac{1\,in}{2.54\,cm}$$

$$= \frac{70\,in}{2.54} = \frac{7000\,in}{254} = \frac{3500\,in}{127}$$

∴ Height = $\frac{3500}{127}$ inches or 27.6 to 3SF

2) Find initial linear velocity
Since the Truck started from rest the initial linear velocity must be zero.

∴ $V_i = 0.00\ m/s$ to 3SF

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3) Find final linear velocity

Since we know V_f is 40.0 miles per hour simply convert it into meters per second.

$$V_f = \frac{40\,\text{mi}}{1\,\text{hr}} \cdot \frac{5280\,\text{ft}}{1\,\text{mi}} \cdot \frac{12\,\text{in}}{1\,\text{ft}} \cdot \frac{2.54\,\text{cm}}{1\,\text{in}} \cdot \frac{1\,\text{m}}{100\,\text{cm}} \cdot \frac{1\,\text{hr}}{3600\,\text{sec}}$$

$$= \frac{40}{1} \cdot \frac{5280}{1} \cdot \frac{12}{1} \cdot \frac{2.54}{1} \cdot \frac{1}{100} \cdot \frac{1}{3600} \frac{\text{m}}{\text{s}} \quad (3600 \to 300)$$

$$= \frac{(4)(528)(2.54)}{300_{75}}\,\text{m} = \frac{264}{75} \cdot \frac{127}{\cancel{254}_{25}}\,\frac{\text{m}}{\text{s}} \quad (528 \to 264,\ 254 \to 127,\ 100 \to 50 \to 25)$$

$$= \frac{(264)(127)\,\text{m}}{(75)(25)\,\text{s}} = \frac{33528\,\text{m}}{1875\,\text{s}} = \frac{11176}{625}\,\frac{\text{m}}{\text{s}}$$

$$V_f = \frac{11176}{625}\ \text{m/s} \quad \text{or} \quad 17.8816\ \text{m/s}$$

$\therefore V_f = 17.9$ m/s to 3 SF

Exact answer is $\frac{11176}{625}$ m/s

4) Find linear acceleration in m/s^2

$V_f = V_i + at$ but $V_i = 0$ so

$V_f = at$ solve for a

$$a = \frac{V_f}{t} = \frac{\frac{11176}{625}\frac{m}{s}}{12s} = \frac{2794}{1875}\cdot\frac{1}{3}\frac{m}{s^2}$$

$$a = \frac{2794}{1875}\frac{m}{s^2}$$ Exact Answer

$\therefore a = 1.490133\ m/s^2$ or $1.49\ m/s^2$ to 3SF

5) Find Radius of tire in meters
Since the radius is ½ of the diameter simply divide the diameter by 2.

Diameter = (2)(Radius)

$$Radius = \frac{Diam}{2} = \frac{0.700m}{2} = 0.350m$$

$\therefore$ Radius = 0.350 meters

6) Find linear distance for acceleration

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

$\Delta x = \frac{1}{2} a t^2 = \frac{1}{2} \cdot \frac{2794\,m}{1875\,s^2} \cdot (125s)^2$

$\Delta x = \frac{1}{\cancel{2}} \cdot \frac{2794\,m}{1875\,\cancel{s^2}} \cdot \overset{72}{\cancel{144}}\,\cancel{s^2}$

$\Delta x = \frac{(2794)(72)}{1875} m = \frac{201168}{1875} m$

$\Delta x = \frac{67056}{625} m$ Exact Answer

$\therefore \Delta x = 107.2896\,m$ or $107m$ to 3SF

7) Convert linear distance into feet

$\Delta x = \frac{67056\cancel{m}}{\cancel{625}\,25} \cdot \frac{\overset{4}{\cancel{100}}\cancel{cm}}{1\cancel{m}} \cdot \frac{1\cancel{in}}{2.54\cancel{cm}} \cdot \frac{1\,ft}{\cancel{12in}\,3} = \frac{67056\,ft}{190.5}$

$\therefore \Delta x = \frac{134112\,ft}{381} = \frac{44704\,ft}{127} = 352\,ft$

8) Find initial angular velocity

Since the tires started at rest $\omega_i = 0$

$\therefore \omega_i = 0$ radians/sec or $0.00 \frac{rad}{sec}$ to 3SF

9) Find final angular velocity

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

$$\omega_f = \frac{\frac{11176m}{625s}}{0.350m} = \frac{11176m}{(625s)(.35m)}$$

$$\omega_f = \frac{(11176)(100)}{\frac{625}{125}s\,(\frac{35}{7})} = \frac{11176\,(4)}{125\,(7)\,sec}$$

$$\omega_f = \frac{44704}{875\,sec} \qquad \text{Exact Answer}$$

$$\therefore \omega_f = \frac{44704}{875\,sec} = 51.090285\,71$$

$\therefore \omega_f = 51.1$ Rad/sec to 3SF

10) Find Angular acceleration ($^{rad}/_{s^2}$)

$$\omega_f = \cancel{\omega_i}^{0} + \alpha t \quad \text{so} \quad \alpha = \frac{\omega_f}{t}$$

$$\alpha = \frac{\frac{44704}{875\,sec}}{12\,sec} = \frac{44704}{(875)(12)\,sec^2} = \frac{11176}{(875)(3)\,sec^2}$$

$$\alpha = \frac{11176}{2625\,sec^2} = 4.25752381\ ^{Rad}/_{s^2}$$

$$\therefore \alpha = 4.26\ ^{Radians}/_{second^2}$$

11) Find Angular displacement in radians

$$\phi = \cancel{\omega_i t}^{0} + \frac{1}{2}\alpha t^2$$

$$\phi = \frac{1}{2}\,\frac{11176}{2625\,sec^2}\,\frac{(12sec)^2}{1} = \frac{(5588)(144)}{2625}$$

$$\phi = \frac{804672}{2625}\ Radians \qquad \text{Exact Answer}$$

$$\therefore \phi = 306.541714\,3\ Radians$$

$$\therefore \phi = 307\ Radians\ to\ 3SF$$

12) Find angular displacement in revolutions
Since we know ϕ in radians from #11 simply convert.

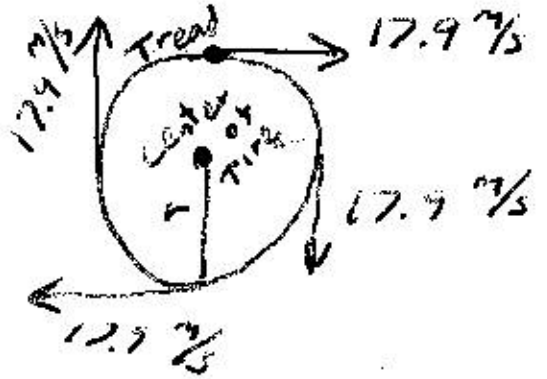
$$\phi = \frac{804622 \text{ Radians}}{2625} \cdot \frac{1 \text{ Revolution}}{2\pi \text{ Radians}}$$

$$\phi = \frac{402336 \text{ Rev}}{2625\pi}$$ Exact Answer

$\therefore \phi = 48.78762909$ Revolutions

$\therefore \phi = 48.8$ Revolutions to 3SF

13) Linear velocity of Tread with respect to center of Tire
An insect riding on the Tread of the Tire would be moving at a velocity of (11176/625) m/s or 17.9 m/s around the Tire. at the end of the acceleration.



14) Linear velocity of tread w.r.t. road of the tread touching the road.

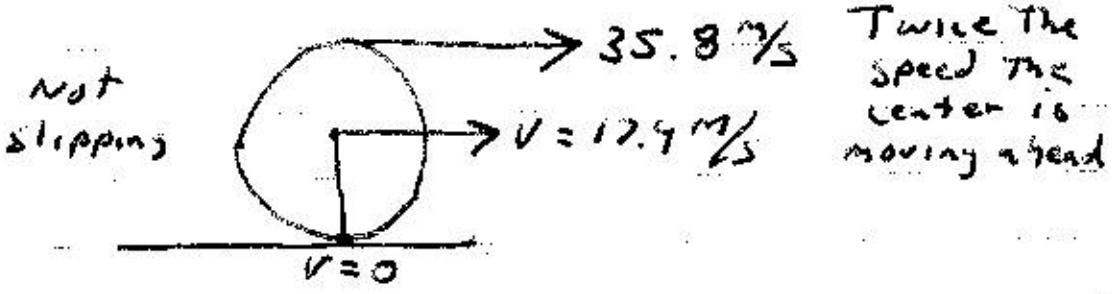
From the standpoint of the road the tread that is touching the road is not moving since the tire is not slipping on the road

$\therefore V_s = 0$ m/s w.r.t. road surface.

15) Linear vel of top of tire w.r.t center of tire.

See #13 $V = 17.9$ m/s

16) Linear vel of top w.r.t. road



17) Billy Bob's Truck is a Red Chevy pickup Truck. From website of previous problems.