15.15 Strobe flashes ever 8.00e-5 s. This is the period (T) of a "cycle".

$$f = \frac{1}{T} = \frac{1}{8e\text{-}5\,s} = 12500 \text{ cycles/sec}$$

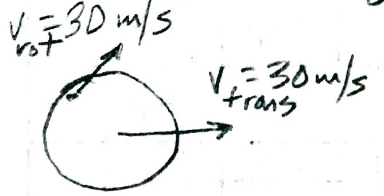
$$= 1.25e4 \text{ Hertz}$$

$$= \boxed{1.25e4 \text{ Hz}}$$

15.26

Tire tread pattern

distance between "crevices" = 2.00 cm



Find frequency of vibration produced by crevices if car is travelling at 30.0 m/s.

For rolling object, if $V_{trans} = 30.0$ m/s,

$V_{rotational} = 3.0$ m/s as well

If Δx between crevizes is 2e-2 m,

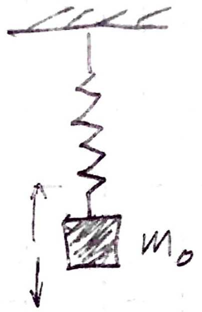
$$t = \frac{\Delta x}{v} = \frac{2e-2\,\cancel{m}}{30\,\cancel{m}/s} = \underline{6.67e-4\ s}$$

time for a crevize to move from one position to the next.

$$\text{frequency} = \frac{1}{T} = \frac{1}{6.67e-4\ s} = \boxed{1500\ Hz}$$

This is a tone that is within the range of human hearing.
(20 – 20,000 Hz)

15.29



freq of oscillation $= f_0$

If m_0 replaced with mass $9m_0$, how does frequency change?

The relationship $T = 2\pi\sqrt{\frac{m}{k}}$ can be derived, but is also on our equation sheet.

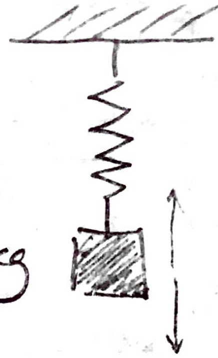
$$T = \frac{1}{f}, \text{ so } f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

We can see from $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ that the frequency varies with the inverse square root of the mass. For the same spring, k is constant, so...

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{k}{m_0}}$$

$$f' = \frac{1}{2\pi}\sqrt{\frac{k}{9m_0}} = \frac{1}{3}\left(\frac{1}{2\pi}\sqrt{\frac{k}{m_0}}\right) = \boxed{\frac{1}{3}f_0}$$

15.30



$m = 0.500\,kg$ Oscillating

$T = 1.50\,s$

Currently $T = 2\pi\sqrt{\frac{m}{k}}$

Given current m & T,

$$T^2 = 4\pi^2 \frac{m}{k}$$

$$k = 4\pi^2 \frac{m}{T^2}$$

$$= 4\pi^2 \frac{0.5}{1.5^2}$$

$$k = 8.773\,N/m$$

To produce $T = 2.00\,s$:

$$m = \frac{kT^2}{4\pi^2} = \frac{(8.773)(2)^2}{4\pi^2} = \underline{0.8889\,kg}$$

We already have 0.5 kg, so we'd need to add $0.88889 - 0.500 = \boxed{0.389\,kg}$

Can also solve with ratios:

If T needs to go from 1.5 to 2.0, it is increasing by a factor of $\frac{2}{1.5} = 1.33$.

We thus need $\sqrt{m}$ to increase by a factor of 1.33, or m by 1.33^2 or 1.778. $m_0 = 0.5$, so

$(m_0)(1.778) = \underline{0.8889\,kg}$, the new m needed.

$$m_{added} = m_{needed} - m_0 = 0.8889 - 0.5 = \boxed{0.389\,kg}$$