Problem 1
The velocity is proportional to $T^{1/2}$, and the frequency is proportional to velocity. Thus if the tension is increased by factor of 3, frequency is increased by $3^{1/2}$.

Problem 2. This question is not very clear. If the bell and the traveler are both on the train then no Doppler effect will be noticed. That is not the answer that the problem call right (or even offers as a choice) however. If the passenger is on the station and the bell is moving toward him at 20 m/sec

$$f = f_0 \left[ \frac{v}{v-v_S} \right]$$

$$f = 500 \left( \frac{335}{315} \right) = 532$$

If the bell is on the platform and the observer is moving toward it at 20 m/sec

$$f = f_0 \left[ \frac{v-v_0}{v} \right] = 500 \left( \frac{355}{335} \right) = 330$$ (this is the answer called correct by ilrn)

Problem 3.
$$v = f \lambda$$
$v$ also is $(T/\mu)^{1/2}$ where $\mu = m/L$
Since $\frac{1}{2} \lambda = L$ for this case (fundamental), $(T/\mu)^{1/2} = 2Lf$, or $\mu = T/(2Lf)^2$

$$\mu = \frac{304}{(2*2.275)^2} = .0251 \text{kg/m}$$
$$m = \mu L = .052 \text{kg or 50 grams.}$$

Problem 4
$$f_0 = 390 \text{Hz,}$$
$$f_1 = f_0 \left[ \frac{v}{v-36} \right] \text{ (approaching source)}$$
$$f_2 = f_0 \left[ \frac{v}{v+36} \right] \text{ (receding source)}$$

$$f_1 = 390 \left( \frac{335}{299} \right) = 437$$
$$f_2 = 390 \left( \frac{335}{371} \right) = 352$$
$$437-352 = 85 \text{Hz} \text{ (rounding error for me, the required answer is 82.8)}$$

Problem 5
Fundamental mode is $\frac{1}{2} \lambda = L$ or $\lambda = 2L = 1.3 \text{ meter}$
$$f = 205 \text{Hz,} \ v = f \lambda = 205(1.3) = 266.5 \text{m/s}$$

$$v = (T/\mu)^{1/2}, \ \mu = 0.0012/0.65 = 0.00185$$
$$T = (266.5)^2(0.00185) = 131 \text{nt}$$
The length of the air column when the first resonance is heard is $L_1 = \frac{\lambda_a}{4}$, where $\lambda_a$ is the wavelength of the sound in air. Thus, $\lambda_a = 4L_1 = 4(0.340 \text{ m}) = 1.36 \text{ m}$.

The frequency of the sound wave, and hence the vibrating wire producing the sound, is $f = \frac{v_{\text{sound}}}{\lambda_a} = \frac{340 \text{ m/s}}{1.36 \text{ m}} = 250 \text{ Hz}$.

When the wire vibrates in its third harmonic, its length is $L_w = \frac{3}{2} \lambda_w$ where $\lambda_w$ is the wavelength of the waves traveling in the wire.

Therefore, $\lambda_w = \frac{2L_w}{3} = \frac{2(1.20 \text{ m})}{3} = 0.800 \text{ m}$, and the speed of transverse waves in the wire is $v_w = \lambda_w f = (0.800 \text{ m})(250 \text{ Hz}) = 200 \text{ m/s}$.