20. (a) The tension in each string is given by $\tau = Mg/2$. Thus, the wave speed in string 1 is

$$v_1 = \sqrt{\frac{\tau}{\mu_1}} = \sqrt{\frac{Mg}{2\mu_1}} = \sqrt{\frac{(500\,\mathrm{g})\,(9.8\,\mathrm{m/s^2})}{2(3.00\,\mathrm{g/m})}} = 28.6\ \mathrm{m/s}\ .$$

(b) And the wave speed in string 2 is

$$v_2 = \sqrt{\frac{Mg}{2\mu_2}} = \sqrt{\frac{(500\,\mathrm{g})\,(9.8\,\mathrm{m/s^2})}{2(5.00\,\mathrm{g/m})}} = 22.1\ \mathrm{m/s}\ .$$

(c) Let $v_1 = \sqrt{M_1 g/(2\mu_1)} = v_2 = \sqrt{M_2 g/(2\mu_2)}$ and $M_1 + M_2 = M$. We solve for M_1 and obtain

$$M_1 = \frac{M}{1+\mu_2/\mu_1} = \frac{500\,\mathrm{g}}{1+5.00/3.00} = 187.5\,\mathrm{g} \approx 188\ \mathrm{g}\ .$$

(d) And we solve for the second mass: $M_2 = M - M_1 = 500\,\mathrm{g} - 187.5\,\mathrm{g} \approx 313\,\mathrm{g}$.