a) $f_R = 20\,GHz$ $\quad a, b, c$? $\quad a = c = 2b$

$$\omega_{mnp} = \pi v_p \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2 + \left(\frac{p}{c}\right)^2} = 2\pi f_{R\,mnp}$$

$$\omega_{101} = \pi v_p \sqrt{\frac{1}{a^2} + \frac{1}{a^2}} \Rightarrow f_{R101} = \frac{1}{\sqrt{2}} v_p \frac{1}{a} \rightarrow a = \frac{1}{\sqrt{2}} v_p \frac{1}{f_{R101}} = \underline{1{,}06\,cm}$$

$\underline{c = 1{,}06\,cm}$

$\underline{b = 0{,}53\,cm}$

b) $$Q_0 = \frac{\pi \eta}{2 R_m} \frac{b\sqrt{(a^2+c^2)^3}}{ac(a^2+c^2)+2b(a^3+c^3)}$$

$$\frac{\pi\eta}{2R_m} \frac{\frac{a}{2}\sqrt{(2a^2)^3}}{a^2(2a^2)+2\frac{a}{2}(2a^3)} = \frac{\pi\eta}{2R_m} \frac{\frac{a}{2}\sqrt{2}\,a^3}{2a^4+2a^4} = \frac{\pi\eta}{2R_m} \frac{\sqrt{2}\,a^4}{4a^4} = \underline{\frac{\pi\eta\sqrt{2}}{8R_m}}$$

$= \underline{6974}$

c) $f_R = 15\,GHz$ $\quad f_{R101} = \frac{1}{\sqrt{2}} v_p \frac{1}{a}$ (siehe a))

$$v_p = \frac{1}{\sqrt{\mu\varepsilon}}$$

$$f_{R101} = \frac{1}{\sqrt{2}} \frac{1}{\sqrt{\mu\varepsilon}} \frac{1}{a} \rightarrow \varepsilon_r = \left(\frac{1}{f_{R101}\, a\sqrt{2}}\right)^2 \frac{1}{\mu_0 \varepsilon_0} = \underline{1{,}77}$$

$v_p = 224{,}862 \cdot 10^6\ m/s$

$$Q_0 = \frac{\pi\eta\sqrt{2}}{8R_m} = \frac{\pi\sqrt{\frac{\mu}{\varepsilon}}\sqrt{2}}{8R_m} = \underline{5231}$$