2.114

$$\text{Gain} = 1 + \frac{R_2}{R_1} = 96 \text{ V/V}$$

$$f_{3dB} = 8 \text{ kHz}$$

$$f_t = 96 \times 8 = 768 \text{ kHz}$$

for $f_{3dB} = 24 \text{ kHz}$

$$\text{Gain} = \frac{768}{24} = 32 \text{ V/V}$$

2.117

a) Assume two identical stages, each with a gain function: $G = \dfrac{G_O}{1 + j\dfrac{w}{w_1}} = \dfrac{G_O}{1 + jf/f_1}$

$$G = \frac{G_O}{\sqrt{1 + \left(\frac{f}{f_1}\right)^2}}$$

overall gain of the cascade is $\dfrac{G_O^2}{\sqrt{1 + \left(\frac{f}{f_1}\right)^2}}$

The gain will drop by 3db when:

$$1 + \left(\frac{f_{3db}}{f_1}\right)^2 = \sqrt{2}, \text{ Note } 3\text{db} = 20\log\sqrt{2}$$

$$f_{3db} = F_1\sqrt{\sqrt{2} - 1}$$

b) 40 db = 20 log $G_O \Rightarrow G_O = 100 = 1 + \dfrac{R_2}{R_1}$

$$f_{3db} = \frac{f_t}{1 + \frac{R_2}{R_1}} = \frac{1 \text{ MHz}}{100} = 10 \text{ kHz}$$

c) Each stage should have 20db gain or

$1 + \dfrac{R_2}{R_1} = 10$ and therefore a 3db frequency of:

$$f_1 = \frac{10^6}{10} = 10^5 \text{ Hz}.$$

The overall $f_{3db} = 10^5\sqrt{\sqrt{2} - 1} = 64.35 \text{ kHz}$
which is 6 time greater than the bandwidth achieved using single op amp.
(case b above)