ECE 166/265A Solution

a.

$kT \cdot BW = -174dBm + 60 = -114dBm$

3 pts for noise power in kT, 2 pts for final answer

b.

$$SFDR = \frac{2}{3}\left(IIP3 - MDS_{in}\right)$$

$$IIP3 = 10dBm \quad MDS_{in} = -174 + 3 = -171dBm$$

$$SFDR = \frac{2}{3}\left(10dBm - (-164dBm)\right) = 120.66dB$$

2 pts for the SFDR, 2 pts for final answer

c.

$$F_{total} = F_1 + \frac{F_2 - 1}{G_1} = 2 + \left(\frac{1}{\frac{1}{2}}\right) = 4 \rightarrow 6dB$$

4 pts for noise factor cascade, 2 pts for final answer

d.

$$IIP3_{total}^{-1} = IIP3_A^{-1} + G_A IIP3_B^{-1}$$

$$IIP3_{total}^{-1} = \infty + \frac{1}{2}\left(\frac{1}{10mW}\right) \rightarrow IIP3_{total} = 20mW$$

or 13 dBm

4 pts for the IIP3 cascade of power, 1pts for each term of IIP3 term , 2 pts for final answer.

e.

$$SFDR = \frac{2}{3}\left(IIP3 - MDS_{in}\right)$$

$$IIP3 = 13dBm \quad MDS_{in} = -174 + 6 = -168dBm$$

$$SFDR = \frac{2}{3}\left(177\right) = 120.66dB$$

The SFDR doesn't change.

2 pts for the SFDR expression, 2 pts for conclusion that SFDR doesn't change.

f.

IM3 tones at 800 MHz and at 1.4 GHz.
IM2 tones would occur at 100 MHz and 2.1 GHz but should not appear since IIP2 is infinity

2 pts for each IM3 tone

g.

The filter knocks the power of the IM3 at 800 MHz down by 10 dB (20 dB in voltage).

5 pts for recognizing that power at 1.1 GHz has a linear impact on IM3 product at 900 MHz.

h.

The IIP3 has been improved by 20 dB since the IM3 tone is reduced by 20 dB. The filter

is assumed to have a negligible impact on the noise. Therefore, the SFDR has improved by 12 dB to 132 dB

5 pts for describing that the SFDR should improve with the higher IIP3 but the MDS is unchanged.