Question 1

$x(t) = 10\cos(800\pi t + \pi/4) + 7\cos(1200\pi t - \pi/3) - 3\cos(1600\pi t)$

Fundamental freq of $x(t)$?

$f_1 = 400 \quad f_2 = 600 \quad f_3 = 800$

$f_0 = 200$ Hz because that devides all 3 freq.

Question 2:

$$x(t) = \sin\left(\frac{5\pi}{6}t\right) + \cos\left(\frac{3\pi}{4}t\right) + \sin\left(\frac{\pi}{3}t\right)$$

The frequencies and periods of three terms are, respectively,

$$w_1 = \frac{5\pi}{6},\ f_1 = \frac{5}{12},\ T_1 = \frac{12}{5},\ w_2 = \frac{3\pi}{4},\ f_2 = \frac{3}{8},\ T_2 = \frac{8}{3},\ w_3 = \frac{\pi}{3}$$

$$f_3 = 1/6,\ T_3 = 6$$

The fundamental frequency f_0 is the GCD of f_1, f_2 and f_3:

$$f_0 = \text{GCD}\left(\frac{5}{12}, \frac{3}{8}, \frac{1}{6}\right) = \text{GCD}\left(\frac{10}{24}, \frac{9}{24}, \frac{4}{24}\right) = \frac{1}{24}$$

Question 3:

Sketch the spectrum of this signal:

Euler identity: $e^{\pm j\theta} = \cos\theta \pm j\sin\theta$

$$\cos\theta = \frac{1}{2}(e^{j\theta} + e^{-j\theta}) \qquad \sin\theta = \frac{1}{2j}(e^{j\theta} - e^{-j\theta})$$

$10\cos(800\pi t + \pi/4) = \text{Re}\{10e^{j\pi/4}e^{j800\pi t}\}$

$7\cos(1200\pi t - \pi/3) = \text{Re}\{7e^{-j\pi/3}\cdot e^{j1200\pi t}\}$

$-3\cos(1600\pi t) = \text{Re}\{3e^{j\pi}e^{j1600\pi t}\}$