

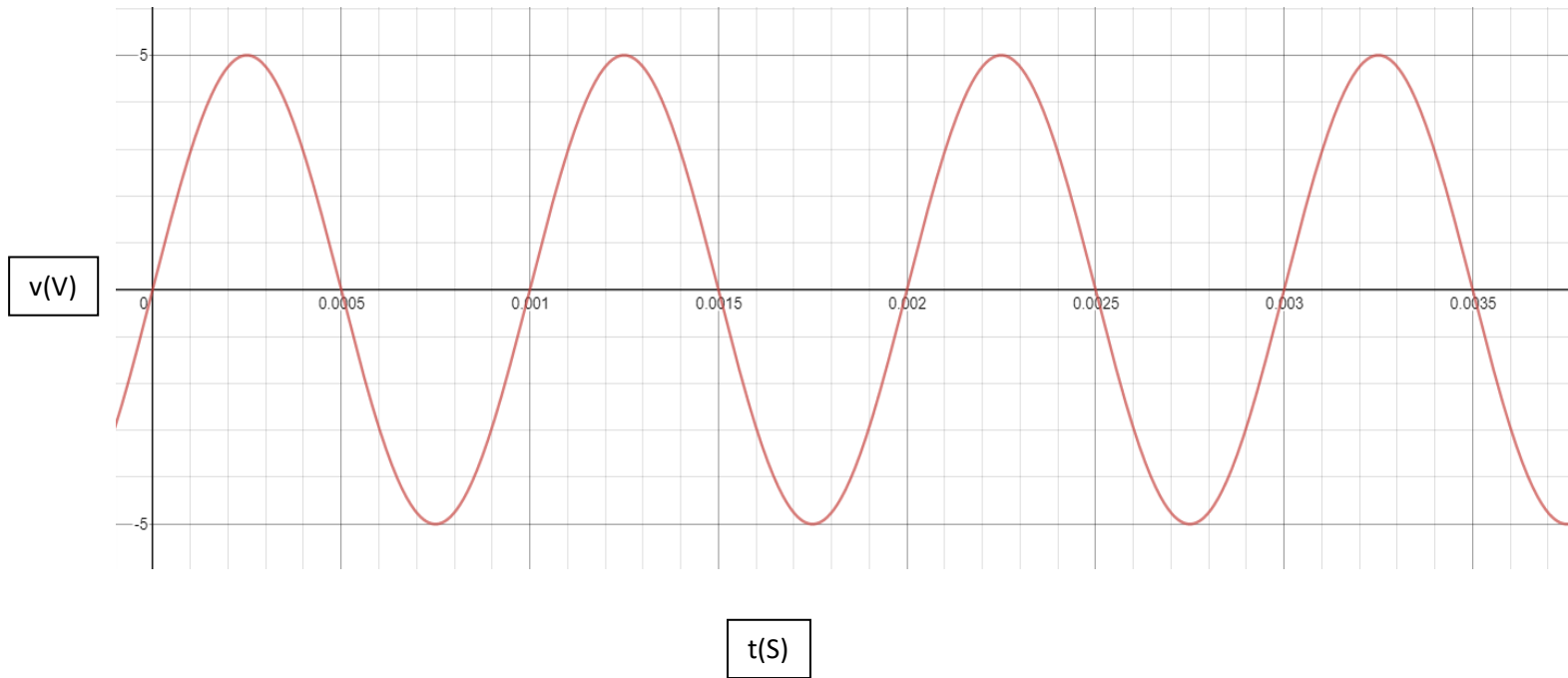
Telecommunications

Lab #1

Manijeh Khataie

1a)

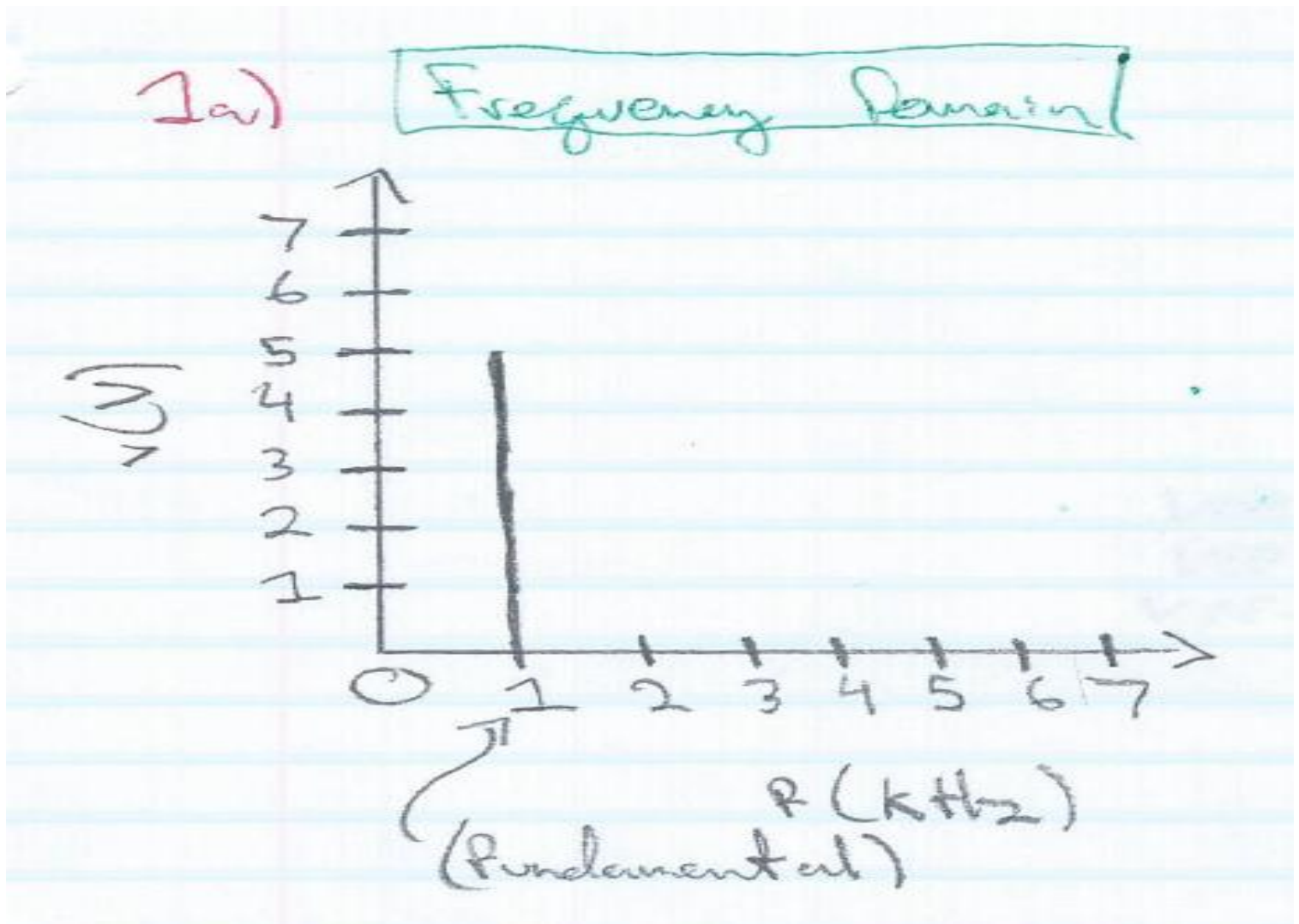
Signal in Time Domain

Calculations & Equation:

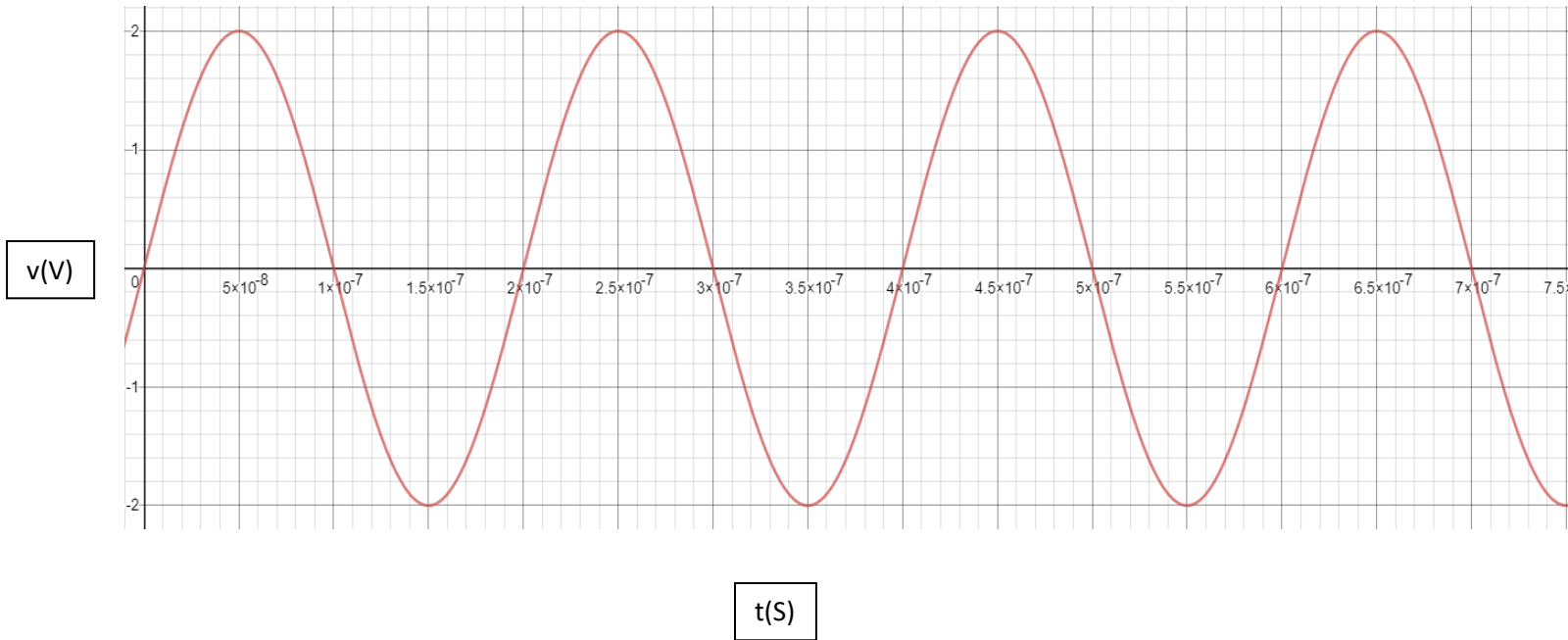
$$f(t) = 5\sin(2\pi(1 * 10^3)t)$$

$$F = \frac{1}{T} \dots 1kHz = \frac{1}{T} \dots T = 1mS$$

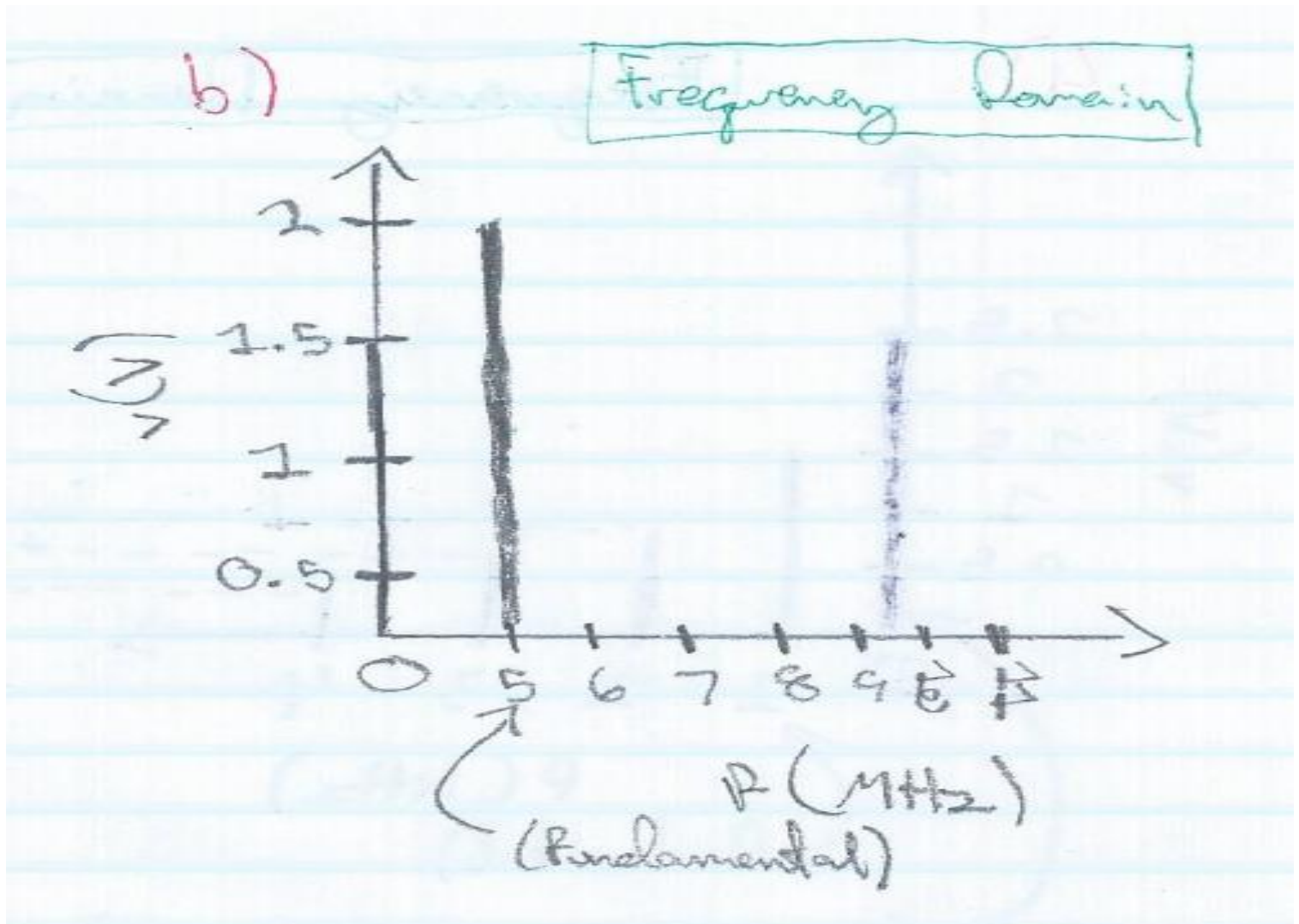
Signal in Frequency Domain



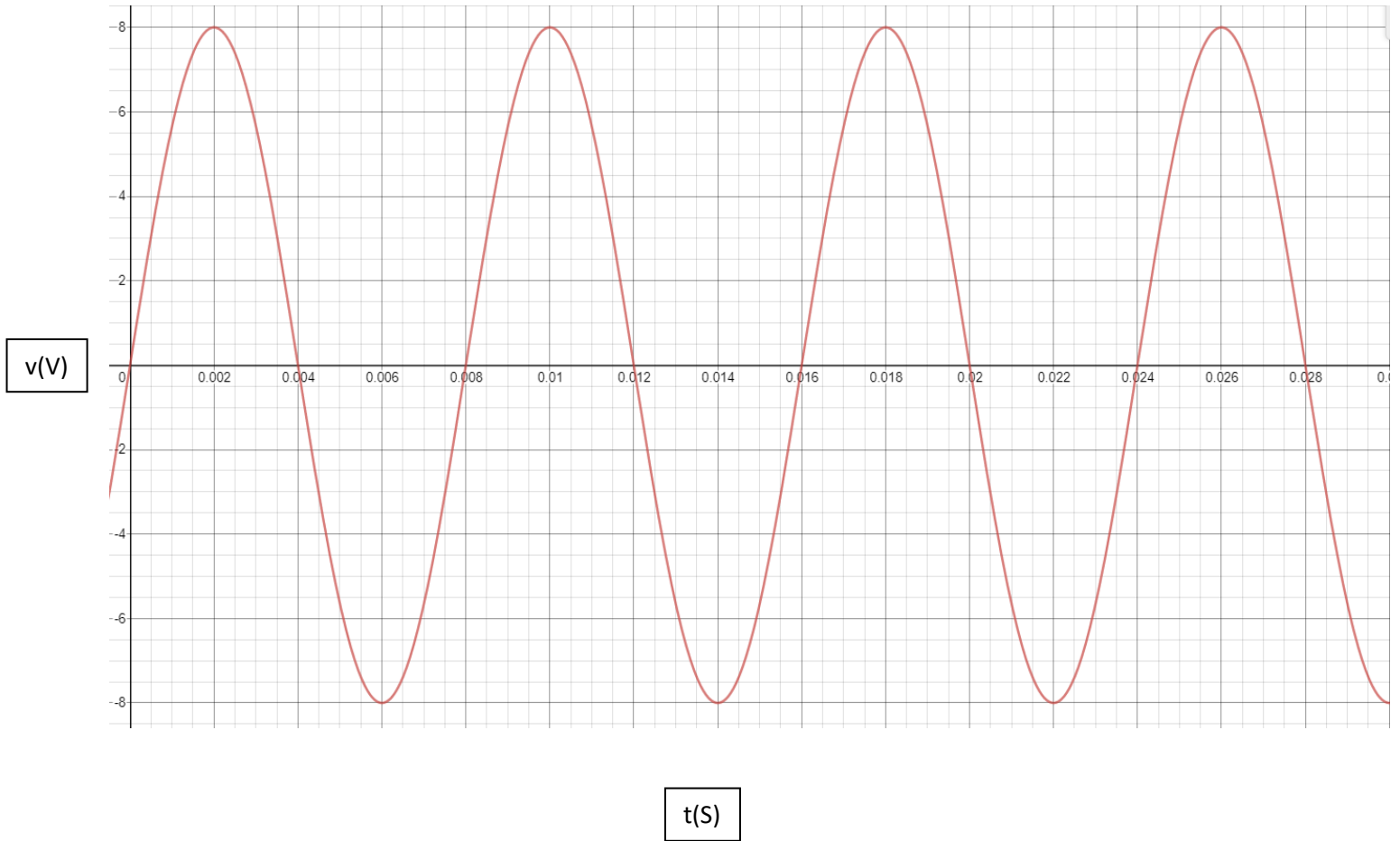
1b)

Signal in Time Domain

Signal in Frequency Domain



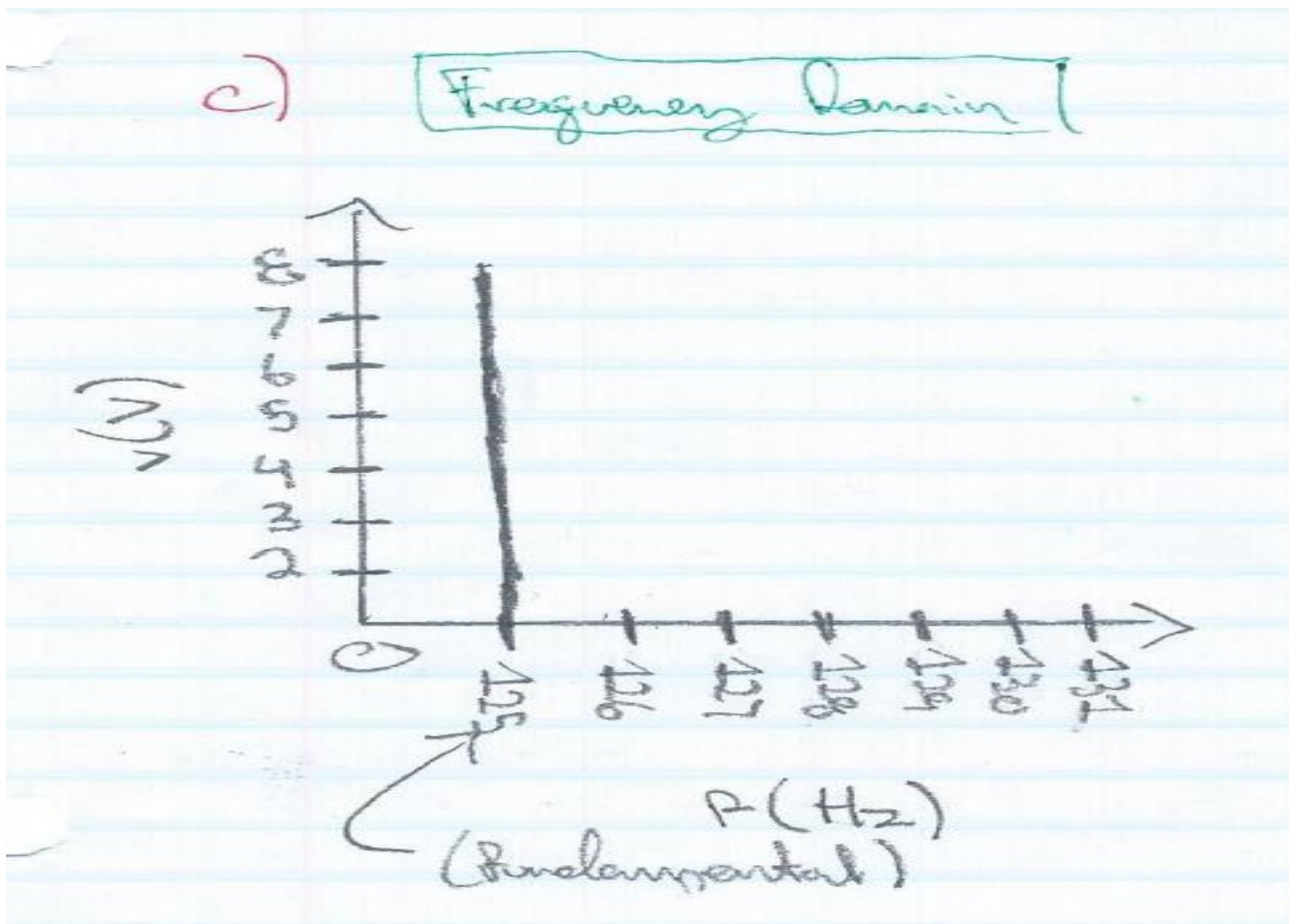
1c)

Signal in Time DomainCalculations & Equation:

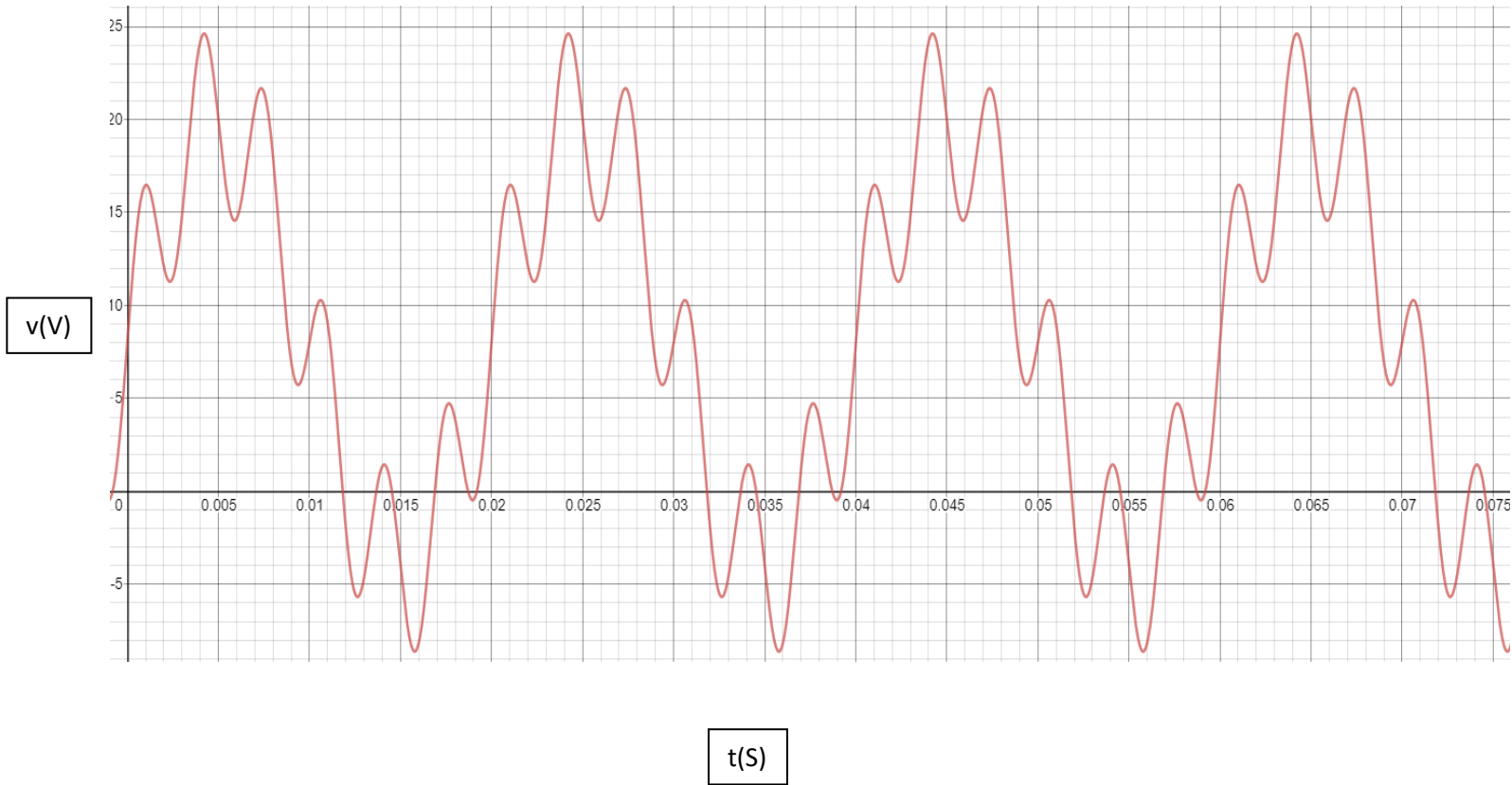
$$f(t) = 8\sin(\pi(250)t)$$

$$F = \frac{1}{T} \dots 125\text{Hz} = \frac{1}{T} \dots T = 8\text{ms}$$

Signal in Frequency Domain



1d)

Signal in Time DomainCalculations & Equation:

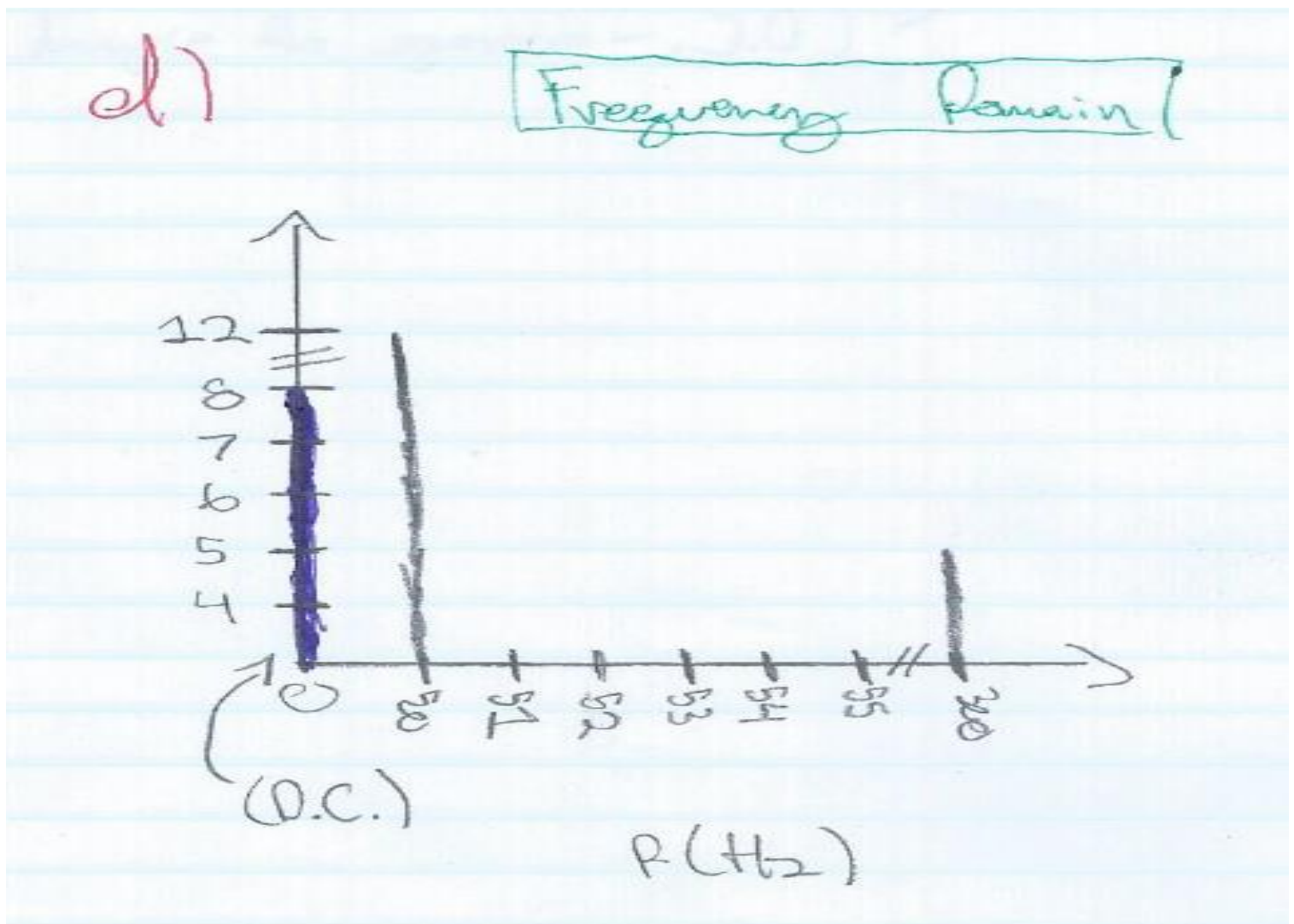
$$f(t) = 8 + 12 \sin(\pi(100)t) + 5 \sin(\pi(600)t)$$

$$F_1 = \frac{100}{2} = 50\text{Hz}$$

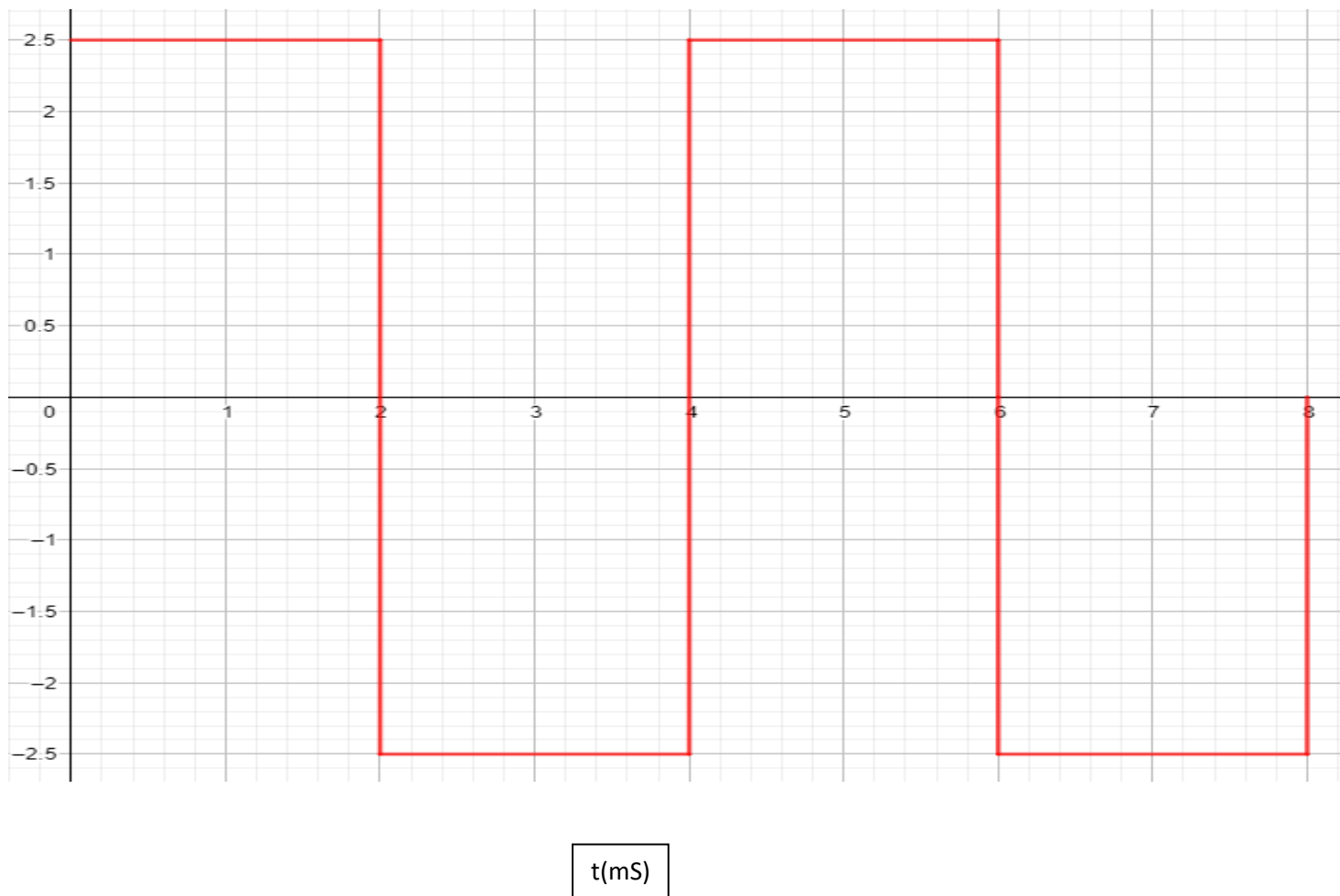
$$F_2 = \frac{600}{2} = 300\text{Hz}$$

$$D.C. = 8\text{V}$$

Signal in Frequency Domain

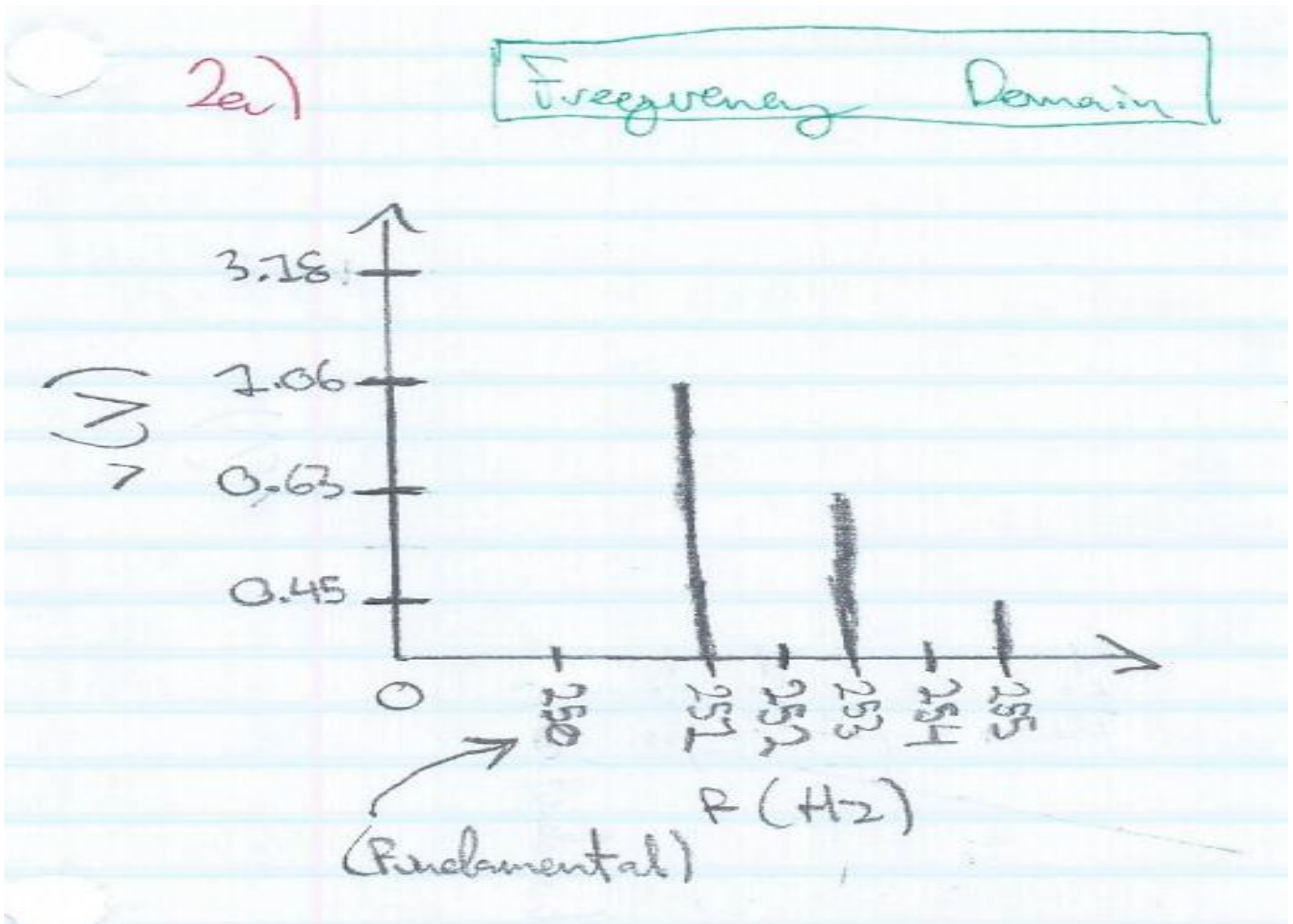


2a)

Signal in Time DomainCalculations:

$$F = \frac{1}{T} \dots 250Hz = \frac{1}{T} \dots T = 4mS$$

Signal in Frequency Domain

Calculations & Equation:

$$v(t) = \frac{4(2.5)}{\pi} \left[\sin(2\pi 250t) + \frac{1}{3} \sin(6\pi 250t) + \frac{1}{5} \sin(10\pi 250t) + \frac{1}{7} \sin(14\pi 250t) \dots \right]$$

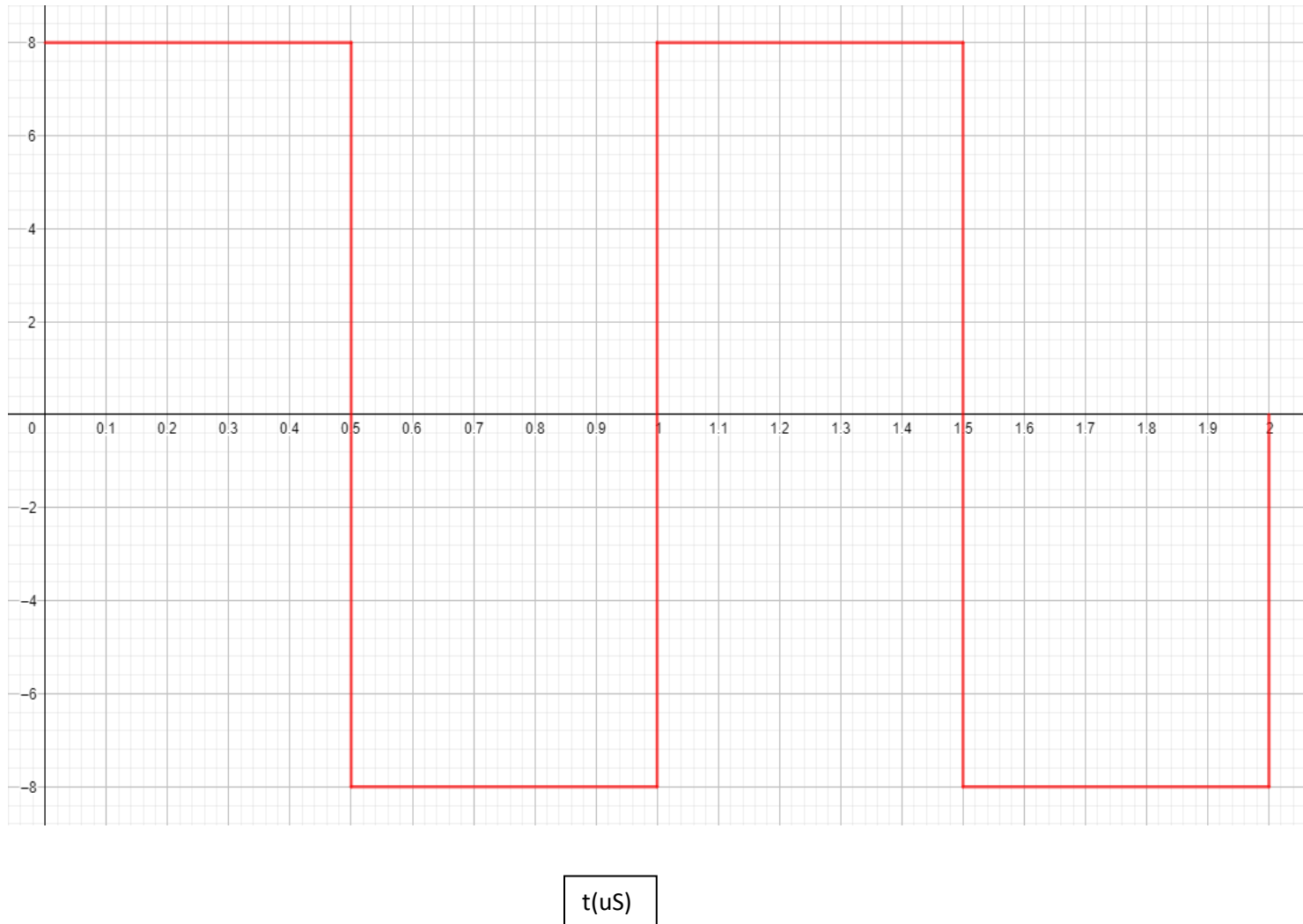
$$V_{250} = \frac{4(2.5)}{\pi} = 3.18V \text{ (0V on graph because frequency not odd)}$$

$$V_{251} = \frac{4(2.5)}{3\pi} = 1.06V$$

$$V_{253} = \frac{4(2.5)}{5\pi} = 0.63V$$

$$V_{255} = \frac{4(2.5)}{7\pi} = 0.45V$$

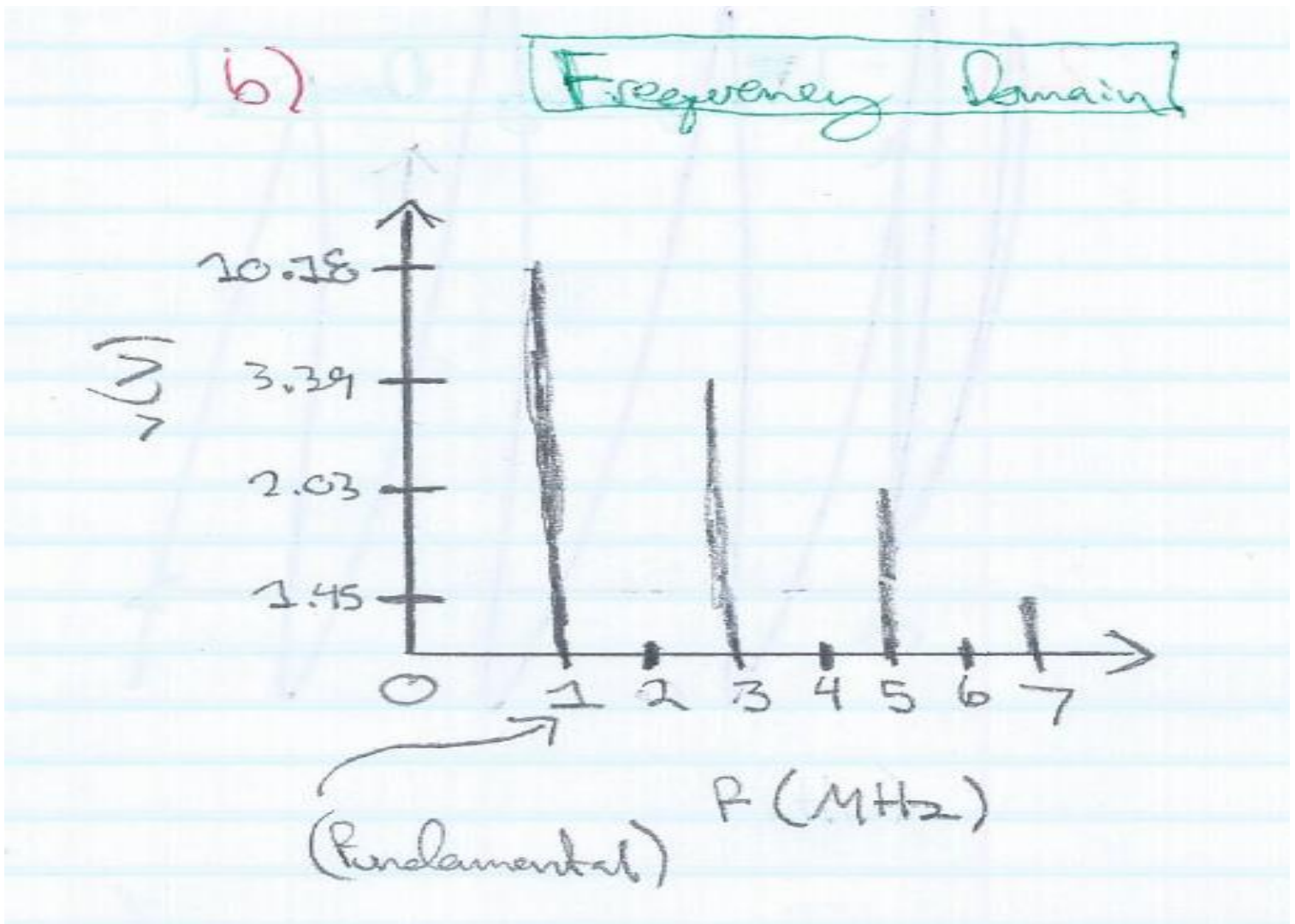
2b)

Signal in Time DomainCalculations:

$$V_{AVG} = \frac{2}{\pi} * V_P \dots 5V = \frac{2}{\pi} * V_P \dots 8V = V_P \dots 16V = V_{PP}$$

$$F = \frac{1}{T} \dots 1MHz = \frac{1}{T} \dots 1\mu s = T$$

Signal in Frequency Domain

Calculations & Equation:

$$v(t) = \frac{4(8)}{\pi} \left[\sin(2\pi(1 * 10^6)t) + \frac{1}{3} \sin(6\pi(1 * 10^6)t) + \frac{1}{5} \sin(10\pi(1 * 10^6)t) + \frac{1}{7} \sin(14\pi(1 * 10^6)t) \dots \right]$$

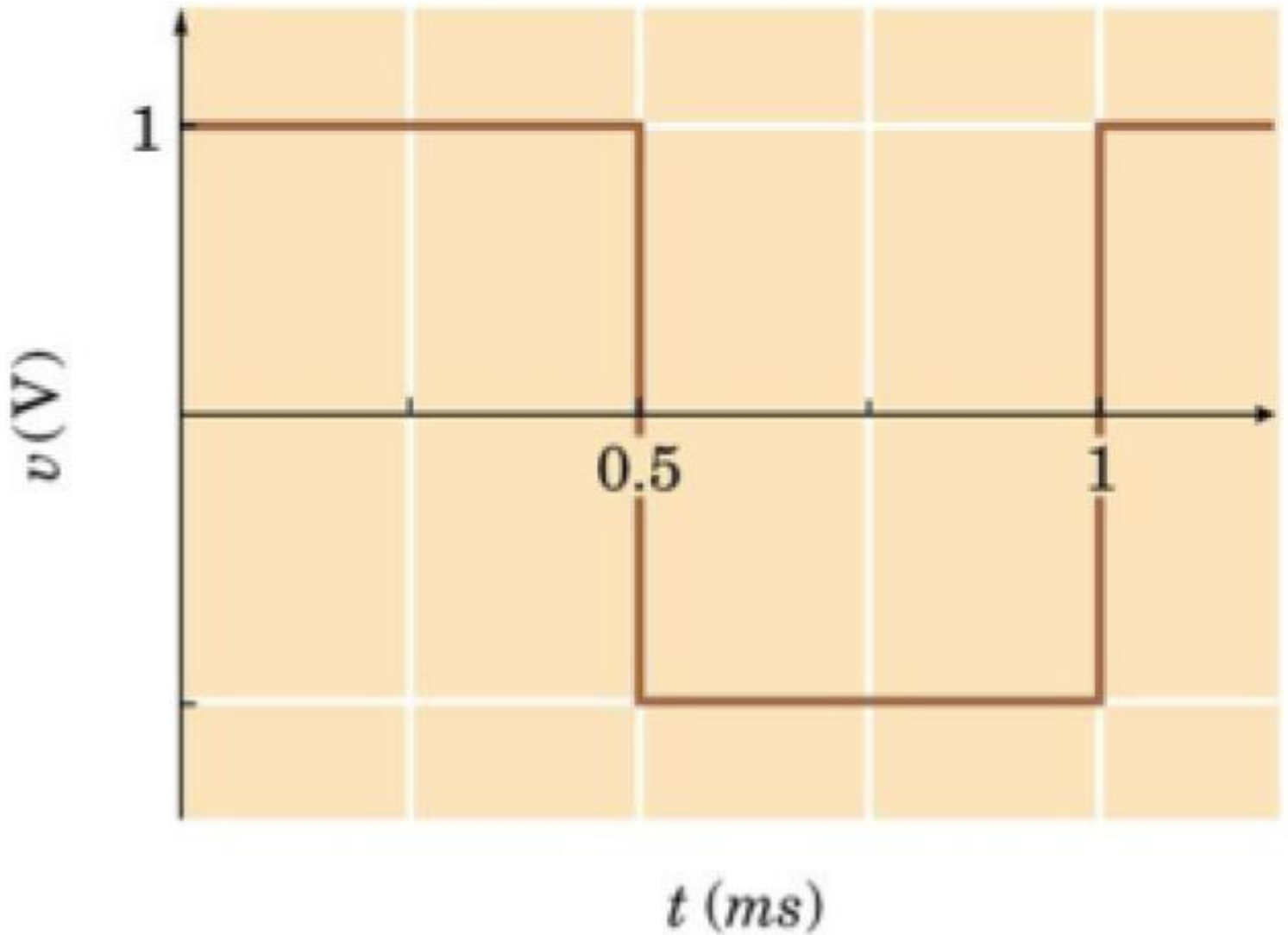
$$V_1 = \frac{4(8)}{\pi} = 10.18V$$

$$V_3 = \frac{4(8)}{3\pi} = 3.39V$$

$$V_5 = \frac{4(8)}{5\pi} = 2.03V$$

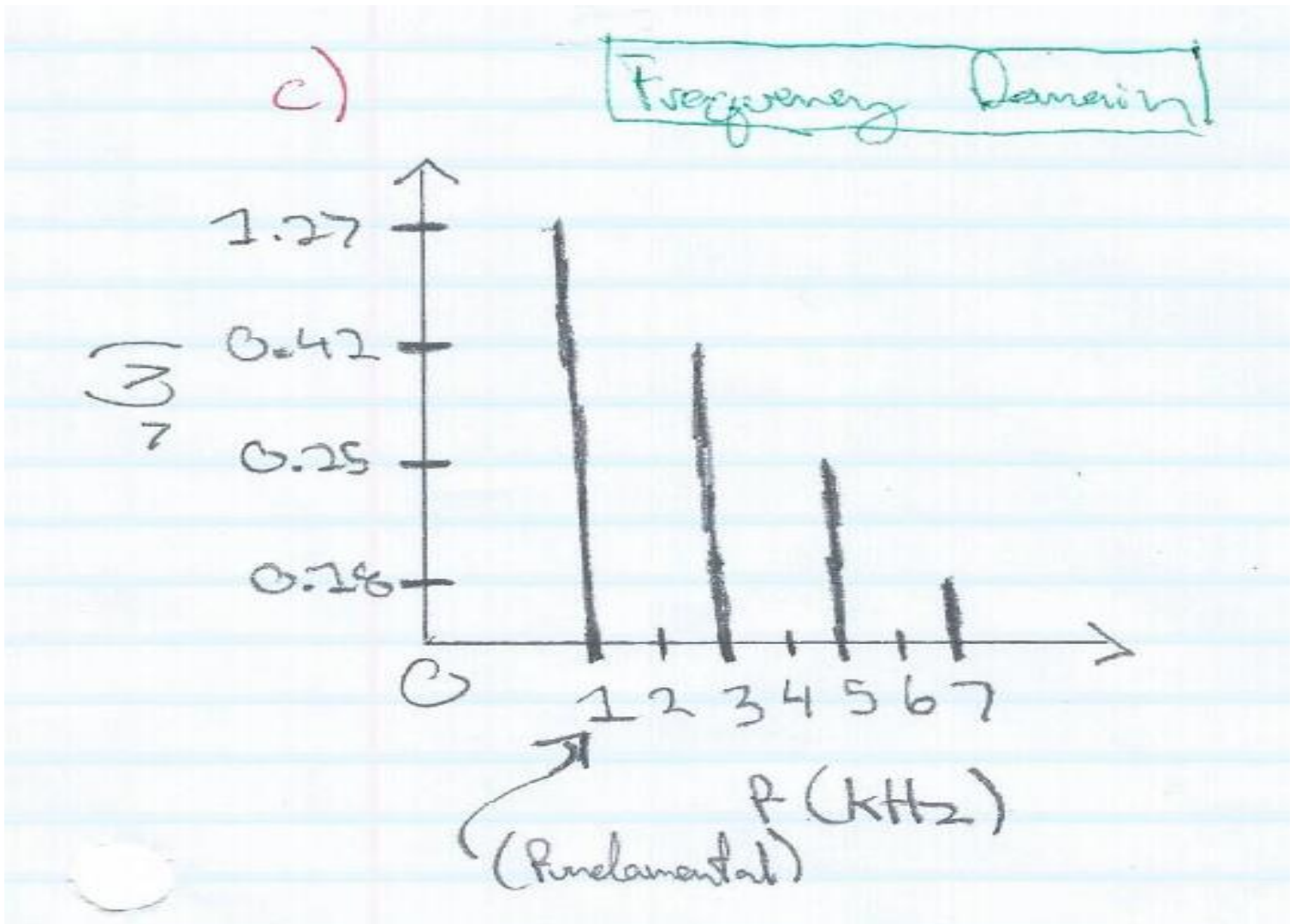
$$V_7 = \frac{4(8)}{7\pi} = 1.45V$$

2c)

Signal in Time DomainCalculations:

$$F = \frac{1}{T} \dots F = \frac{1}{1ms} \dots F = 1kHz$$

Signal in Frequency Domain

Calculations & Equation:

$$v(t) = \frac{4(1)}{\pi} \left[\sin(2\pi(1 * 10^3)t) + \frac{1}{3} \sin(6\pi(1 * 10^3)t) + \frac{1}{5} \sin(10\pi(1 * 10^3)t) + \frac{1}{7} \sin(14\pi(1 * 10^3)t) \dots \right]$$

$$V_1 = \frac{4(1)}{\pi} = 1.27V$$

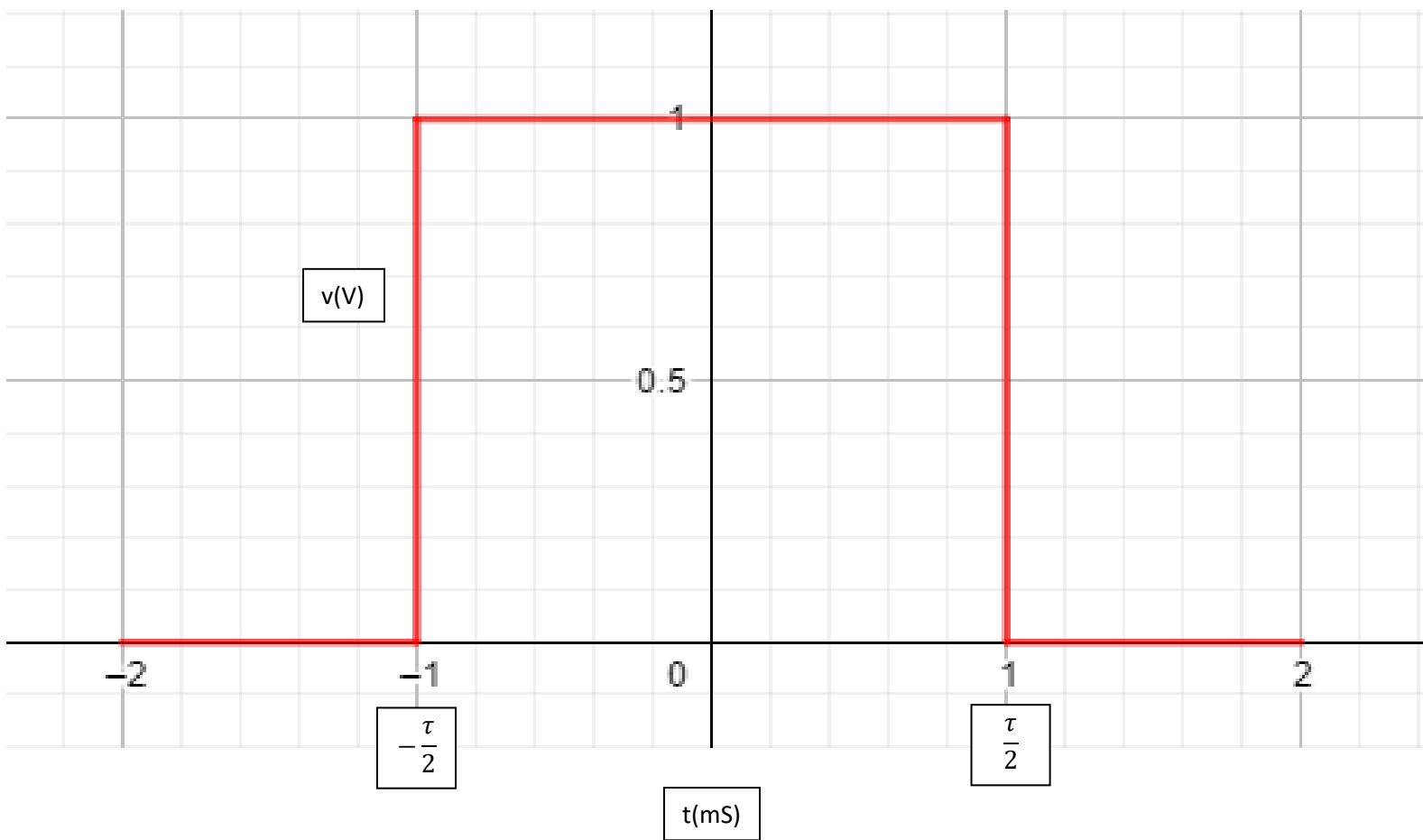
$$V_3 = \frac{4(1)}{3\pi} = 0.42V$$

$$V_5 = \frac{4(1)}{5\pi} = 0.25V$$

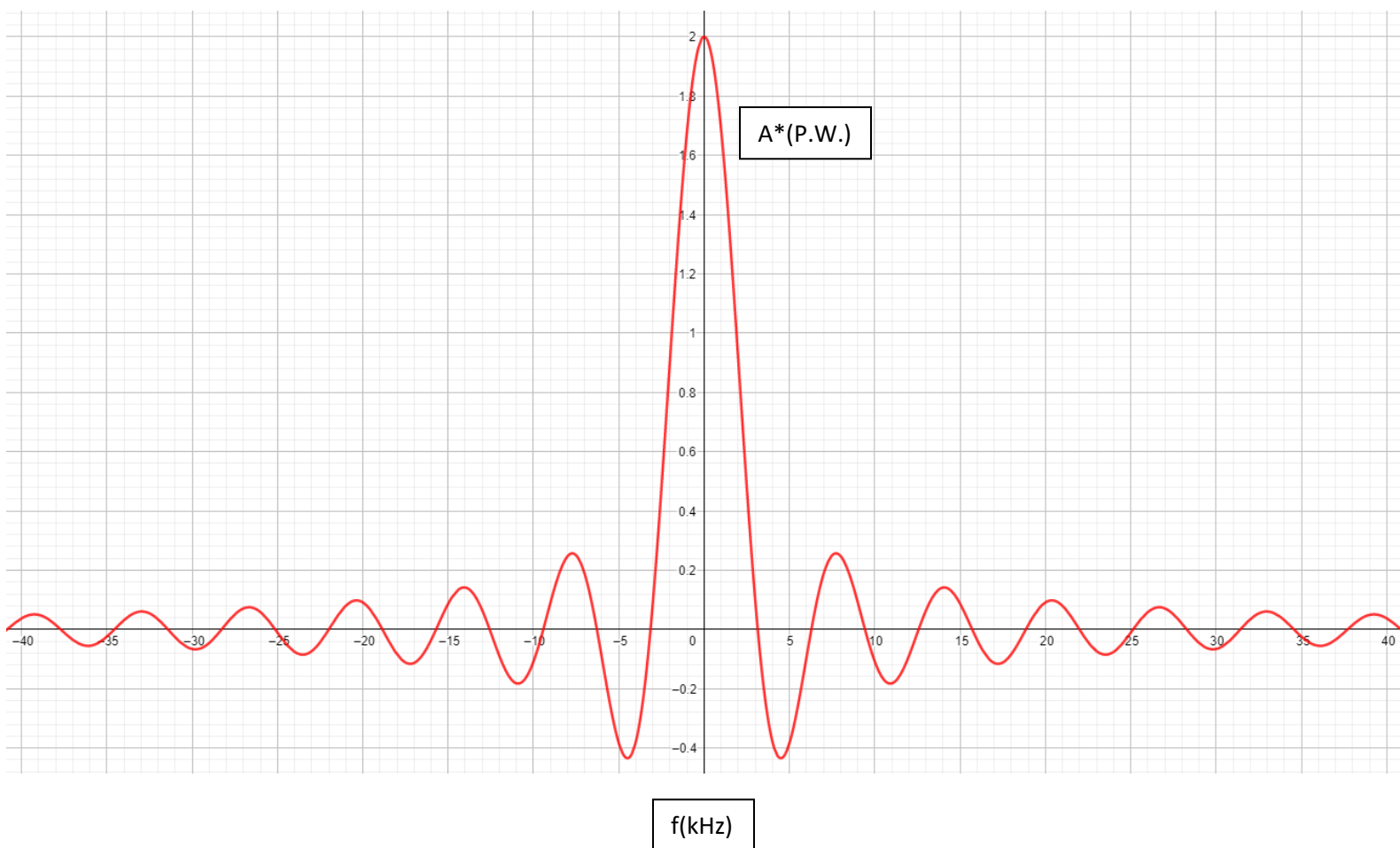
$$V_7 = \frac{4(1)}{7\pi} = 0.18V$$

3a)

Signal in Time Domain



Signal in Frequency Domain



Equation:

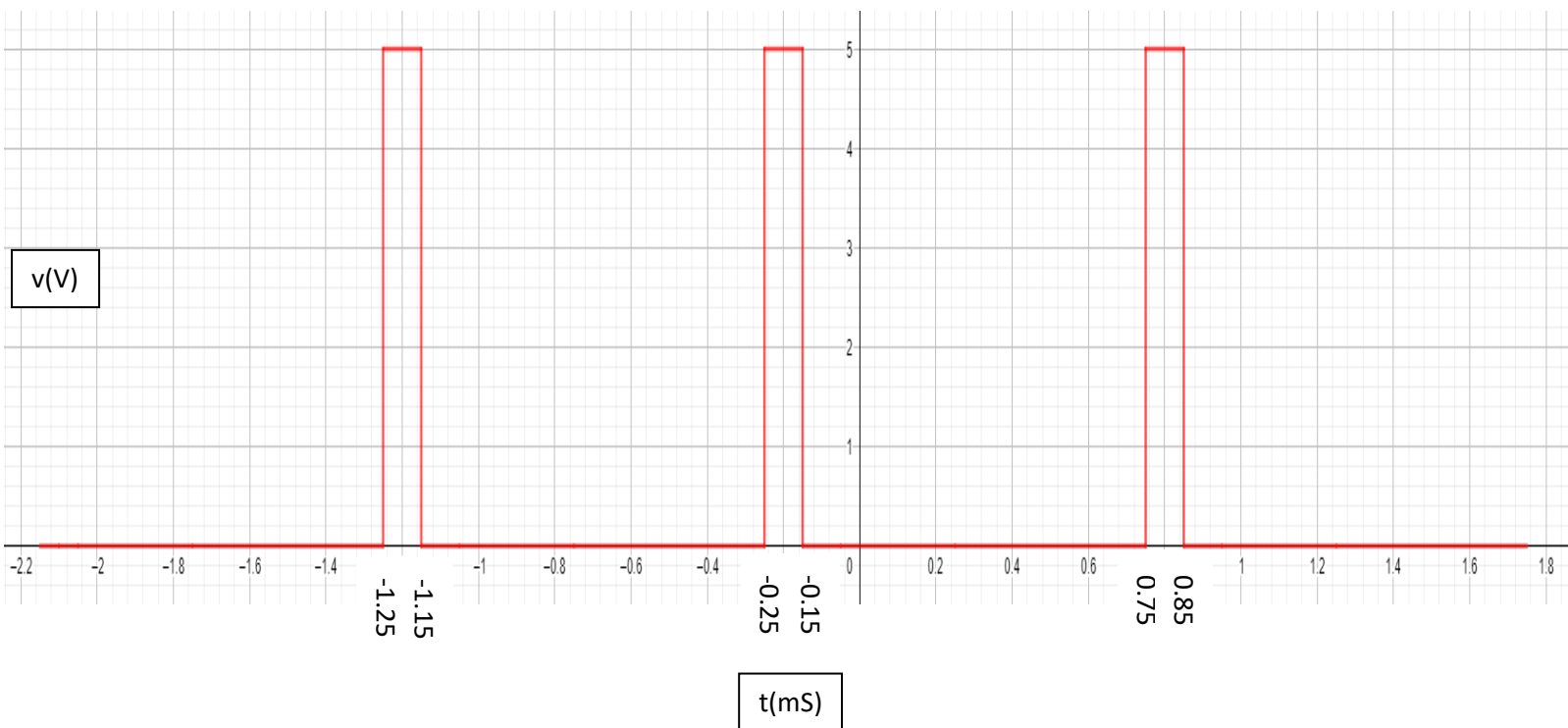
$$y = A * \tau * \frac{\sin(x)}{x}$$

where $A * \tau = 1 * 2 \dots$

\dots and $x = \pi * 2 * 1$

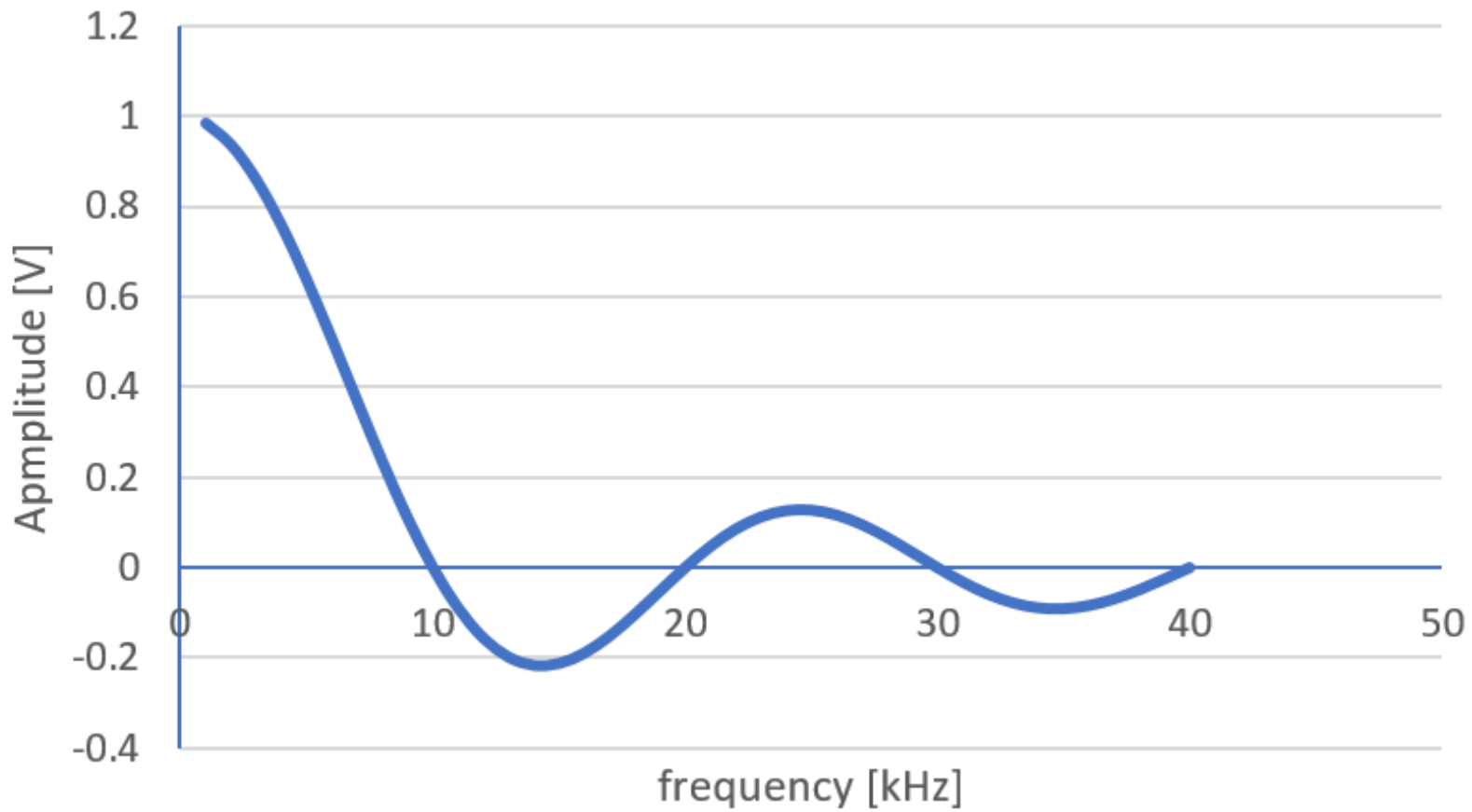
3bi)

Signal in Time Domain

Calculations:

$$T = \frac{1}{F} \dots T = \frac{1}{1kHz} \dots T = 1mS$$

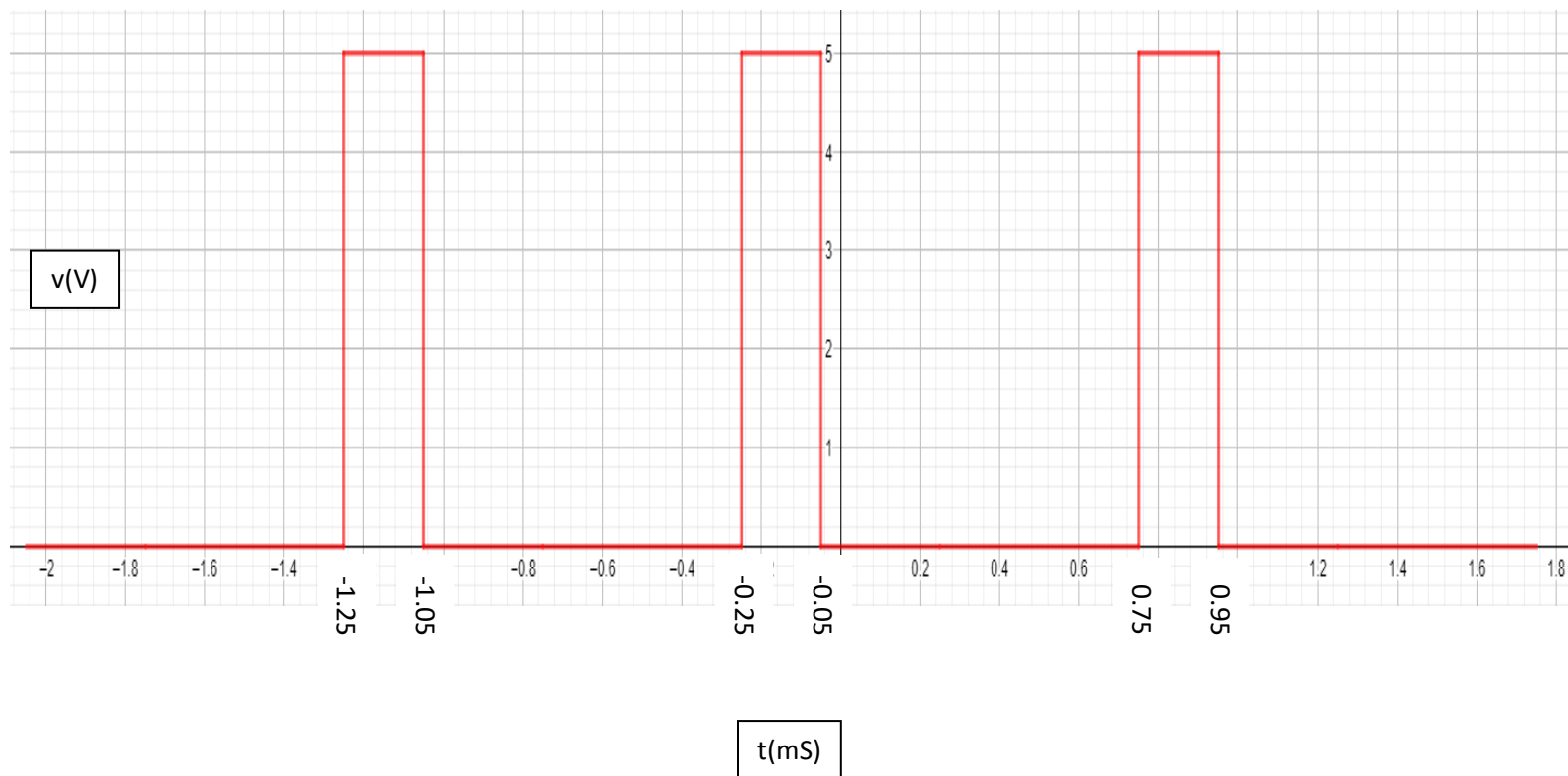
$$D.C. = \frac{P.W.}{T} \dots 0.1 = \frac{P.W.}{1mS} \dots P.W. = 100uS$$

Signal in Frequency DomainEquation:

$$f(t) = \frac{5(0.0001)}{0.001} + \frac{2(5)(0.0001)}{0.001} \left[\frac{\sin \frac{\pi 0.0001}{0.001}}{\frac{\pi 0.0001}{0.001}} \cos \frac{2\pi 0.0001}{0.001} + \frac{\sin \frac{2\pi 0.0001}{0.001}}{\frac{2\pi 0.0001}{0.001}} \cos \frac{4\pi 0.0001}{0.001} + \frac{\sin \frac{3\pi 0.0001}{0.001}}{\frac{3\pi 0.0001}{0.001}} \cos \frac{6\pi 0.0001}{0.001} + \dots \right]$$

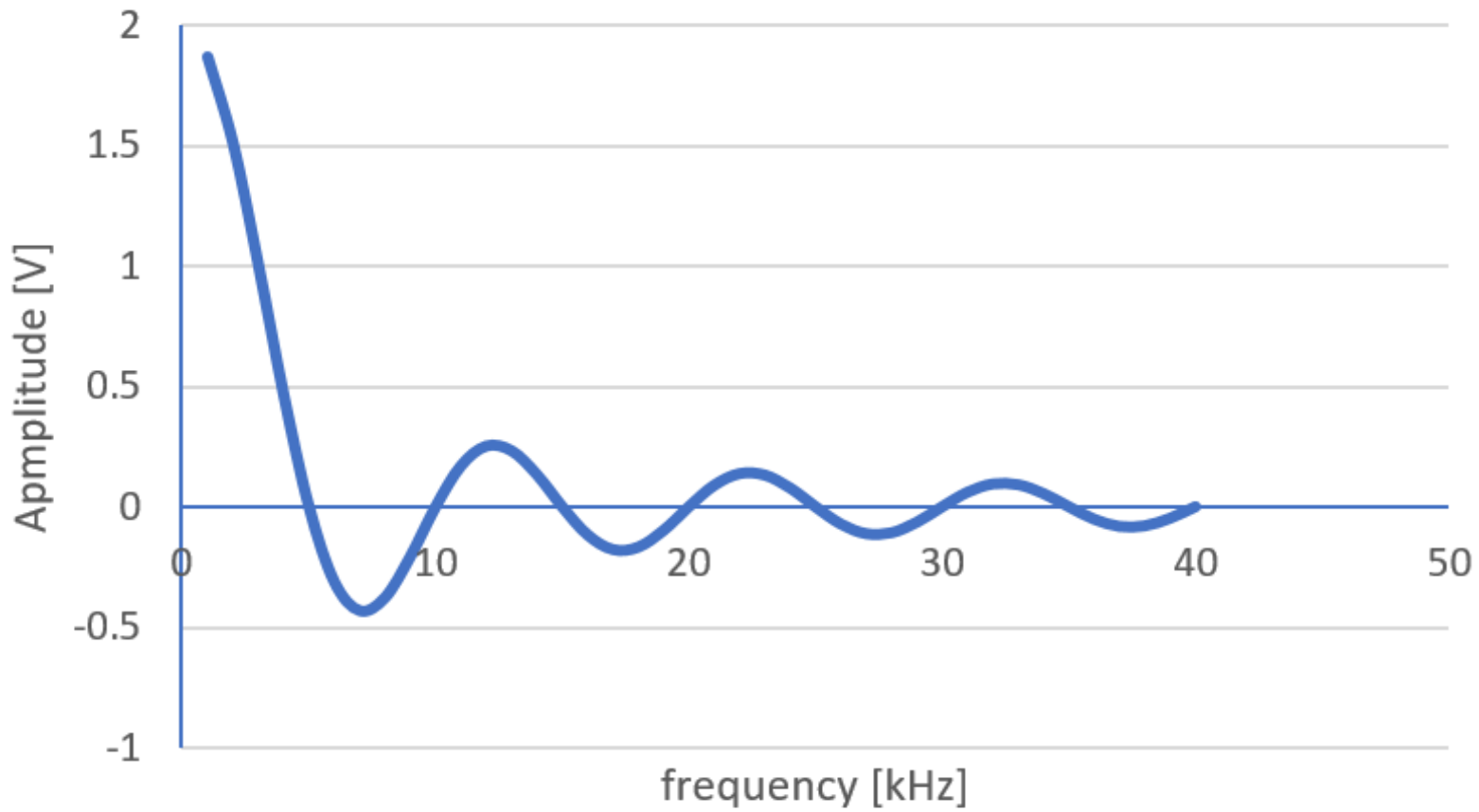
3bii)

Signal in Time Domain

Calculations:

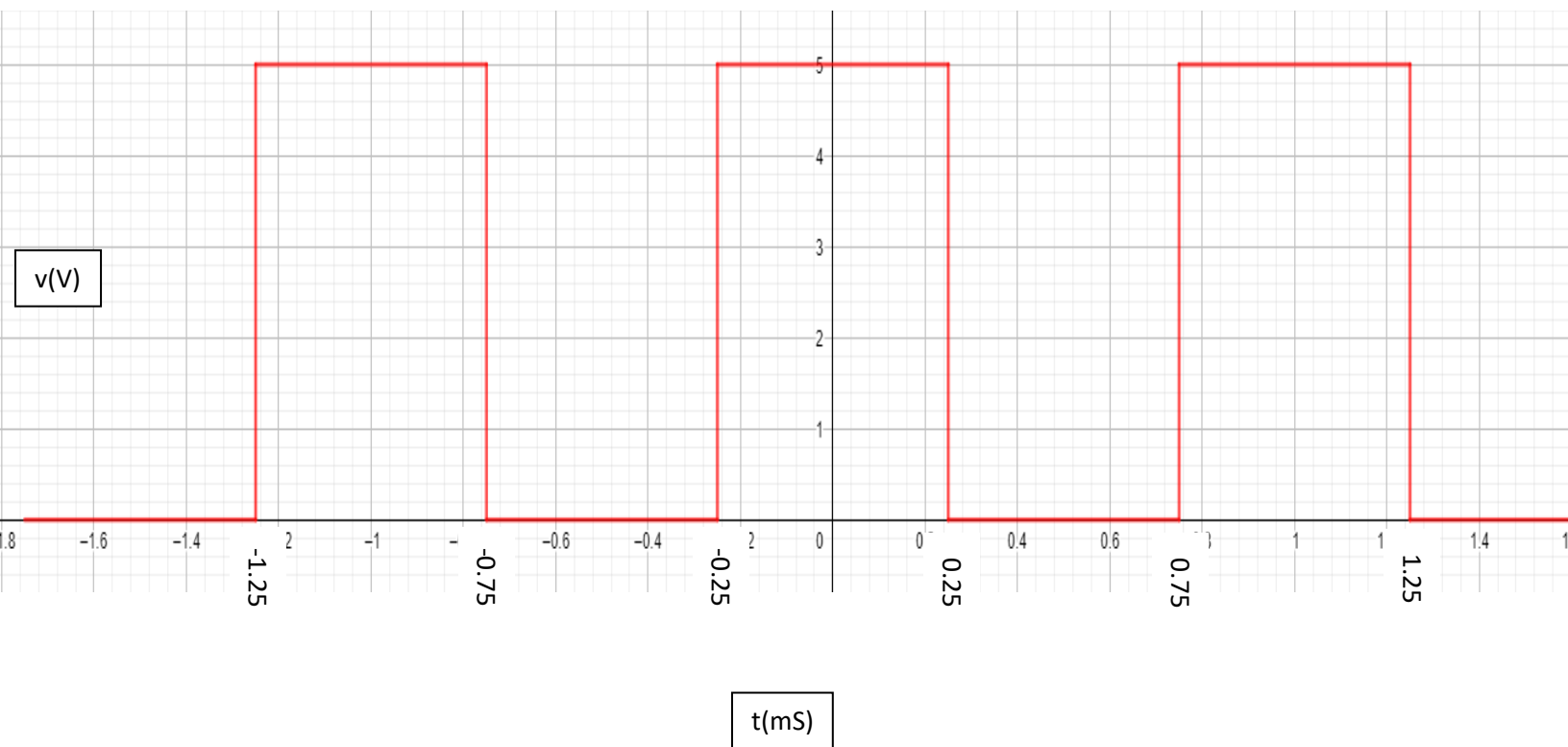
$$T = \frac{1}{F} \dots T = \frac{1}{1kHz} \dots T = 1mS$$

$$D.C. = \frac{P.W.}{T} \dots 0.2 = \frac{P.W.}{1mS} \dots P.W. = 200uS$$

Signal in Frequency DomainEquation:

$$f(t) = \frac{5(0.0002)}{0.001} + \frac{2(5)(0.0002)}{0.001} \left[\frac{\sin \frac{\pi 0.0002}{0.001}}{\frac{\pi 0.0002}{0.001}} \cos \frac{2\pi 0.0002}{0.001} + \frac{\sin \frac{2\pi 0.0002}{0.001}}{\frac{2\pi 0.0002}{0.001}} \cos \frac{4\pi 0.0002}{0.001} + \frac{\sin \frac{3\pi 0.0002}{0.001}}{\frac{3\pi 0.0002}{0.001}} \cos \frac{6\pi 0.0002}{0.001} + \dots \right]$$

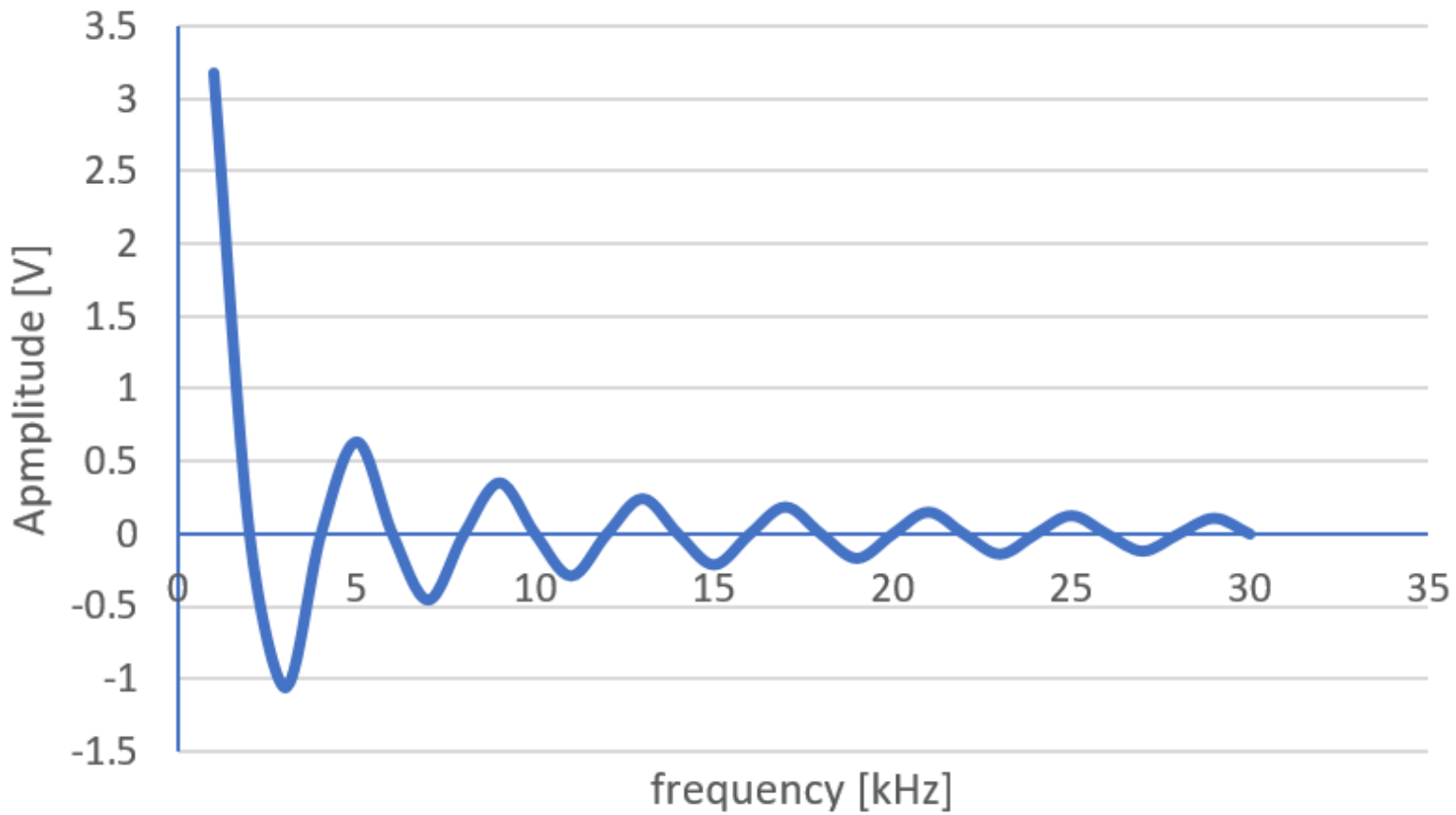
3biii)

Signal in Time DomainCalculations:

$$T = \frac{1}{F} \dots T = \frac{1}{1kHz} \dots T = 1mS$$

$$D.C. = \frac{P.W.}{T} \dots 0.5 = \frac{P.W.}{1mS} \dots P.W. = 500\mu S$$

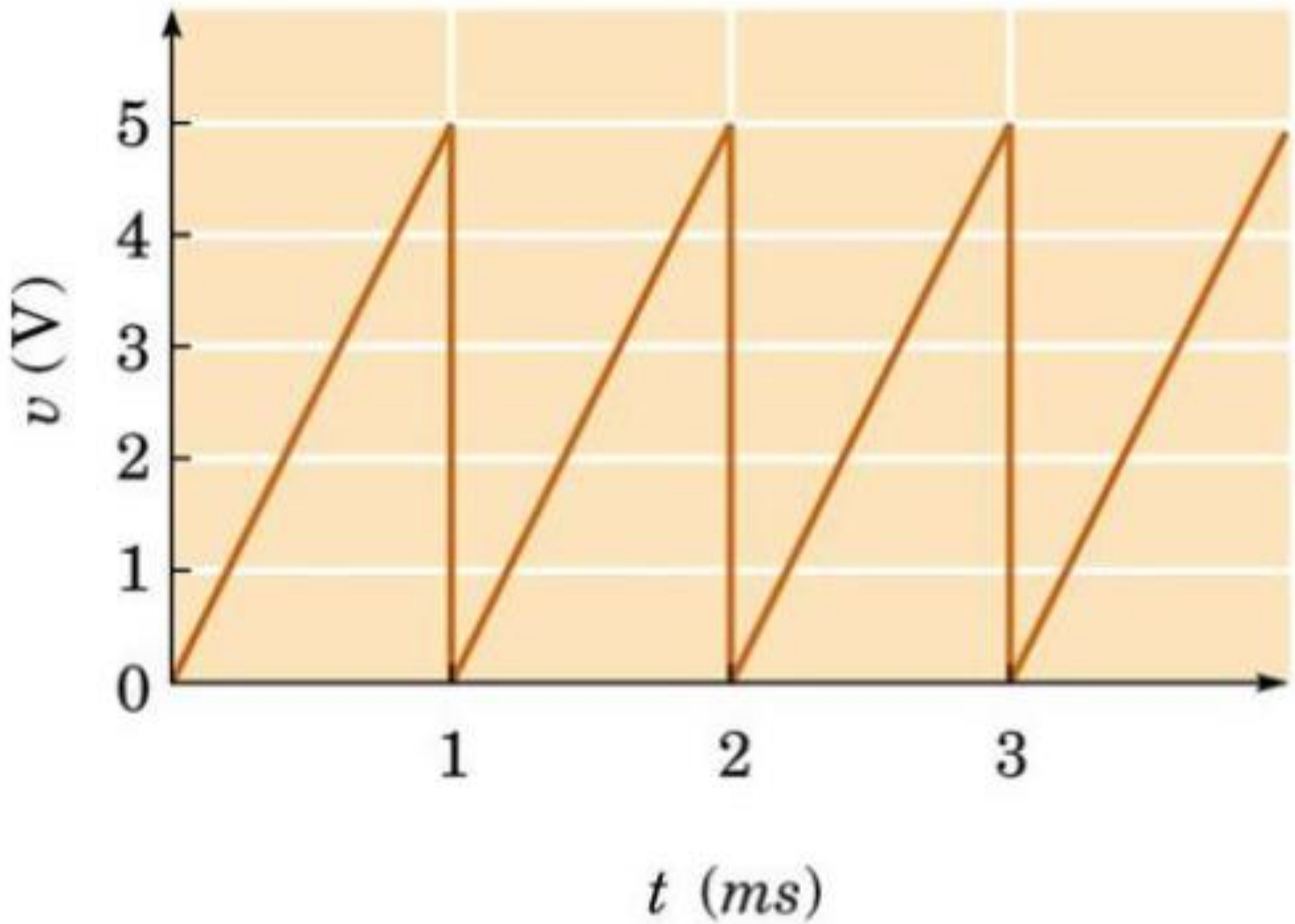
Signal in Frequency Domain



Equation:

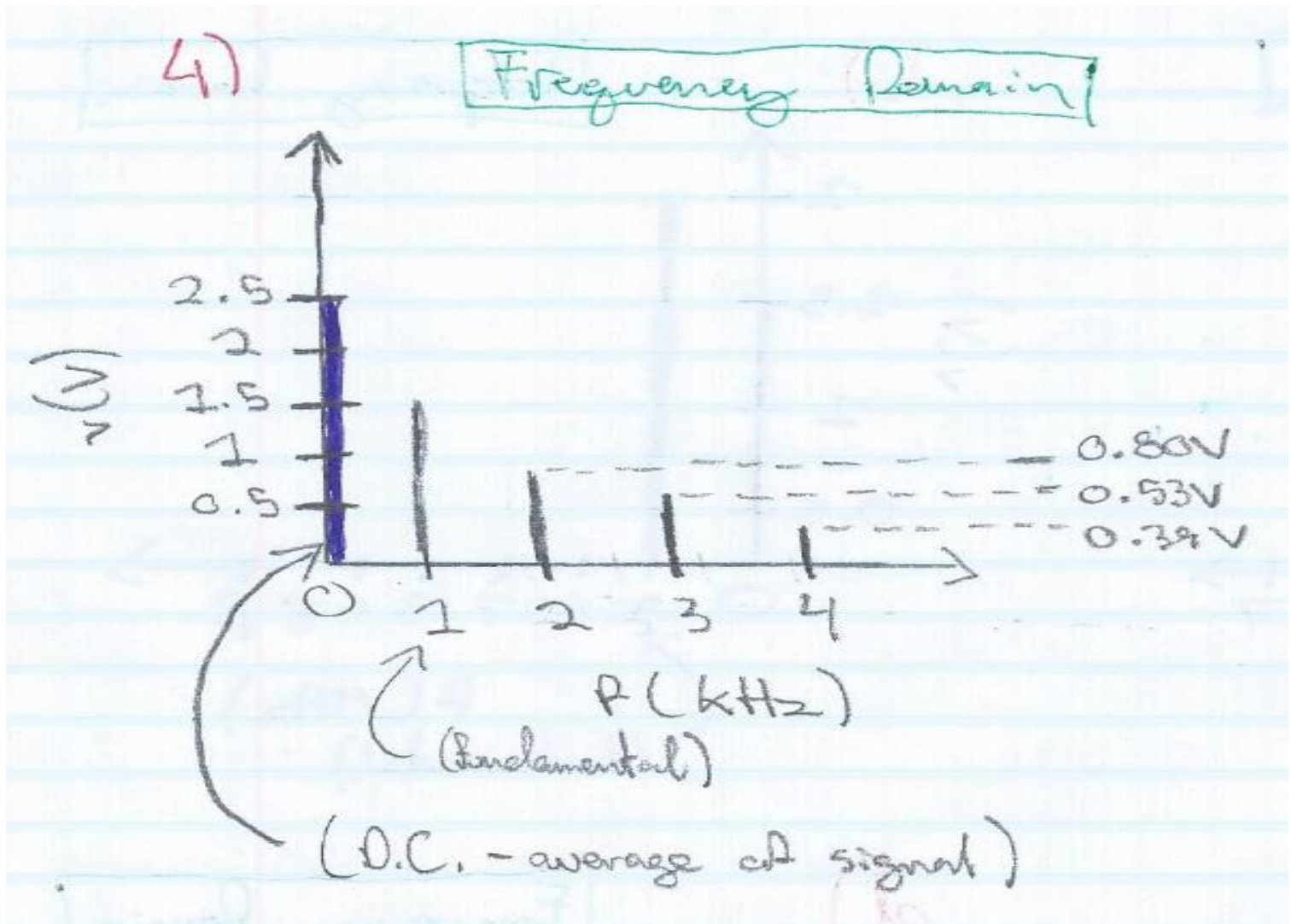
$$f(t) = \frac{5(0.0005)}{0.001} + \frac{2(5)(0.0005)}{0.001} \left[\frac{\sin \frac{\pi 0.0005}{0.001}}{\frac{\pi 0.0005}{0.001}} \cos \frac{2\pi 0.0005}{0.001} + \frac{\sin \frac{2\pi 0.0005}{0.001}}{\frac{2\pi 0.0005}{0.001}} \cos \frac{4\pi 0.0005}{0.001} + \frac{\sin \frac{3\pi 0.0005}{0.001}}{\frac{3\pi 0.0005}{0.001}} \cos \frac{6\pi 0.0005}{0.001} + \dots \right]$$

4)

Signal in Time DomainCalculations:

$$F = \frac{1}{T} \dots F = \frac{1}{1\text{ms}} \dots F = 1\text{kHz}$$

Signal in Frequency Domain

Calculations & Equation:

$$v(t) = \frac{5}{2} - \left(\frac{5}{\pi}\right) \left[\sin(2\pi(1 * 10^3)t) + \frac{1}{2} \sin(4\pi(1 * 10^3)t) + \frac{1}{3} \sin(6\pi(1 * 10^3)t) + \frac{1}{4} \sin(8\pi(1 * 10^3)t) \dots \right]$$

$$V_1 = \frac{5}{\pi} = 1.5V$$

$$V_2 = \frac{5}{2\pi} = 0.80V$$

$$V_3 = \frac{5}{3\pi} = 0.53V$$

$$V_4 = \frac{5}{4\pi} = 0.39V$$