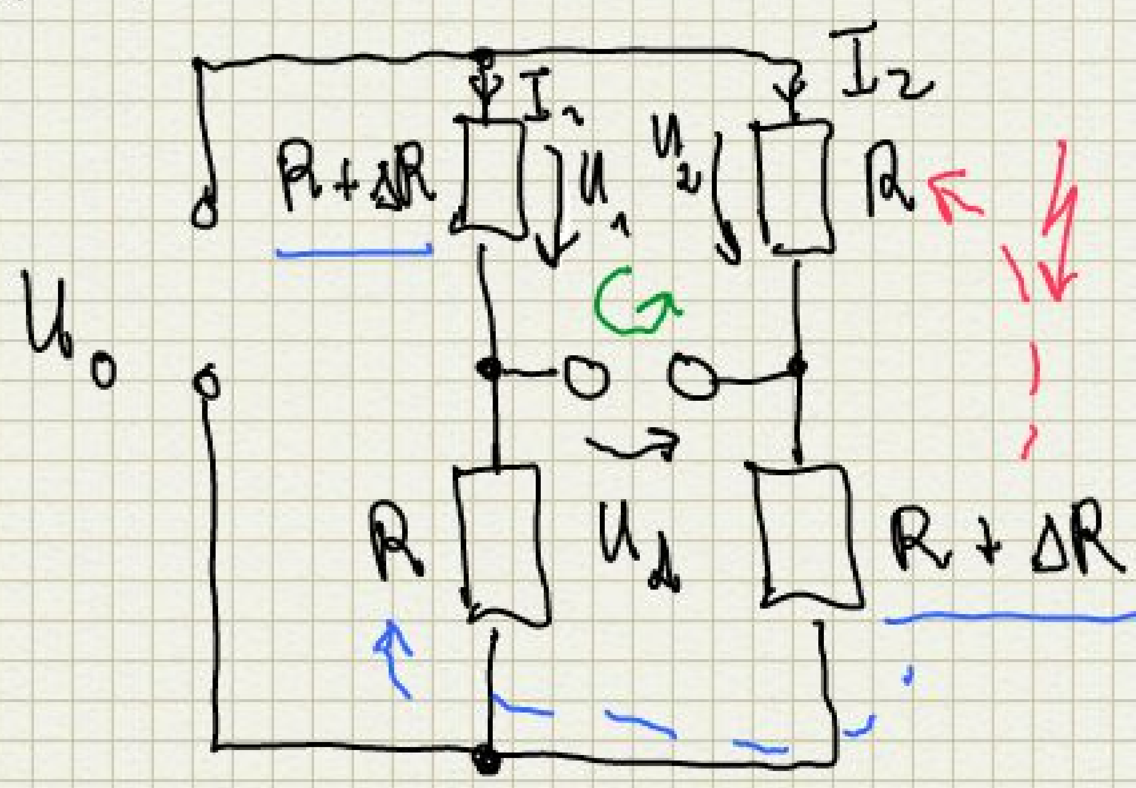
Ex 3.3

a)



$$I_1 = \frac{U_0}{2R+\Delta R}$$

$$I_2 = \frac{U_0}{2R+\Delta R}$$

$$U_1 = \frac{(R+\Delta R)}{2R+\Delta R} U_0$$

$$U_2 = \frac{R}{2R+\Delta R} U_0$$

b)

$\sum U_i = 0$: $U_d - U_2 + U_1 = 0$

$$\Rightarrow U_d = U_2 - U_1$$

$$= \frac{R}{2R+\Delta R} U_0 - \frac{R+\Delta R}{2R+\Delta R} U_0$$

$$= \frac{-\Delta R}{2R+\Delta R} U_0 \quad (1)$$

c) $\Delta R = \frac{R_0 k M_A}{\pi r^3 G}$ (2)

(2) in (1): $U_d = \frac{-R_0 k M_A}{\pi r^3 G \left(2R + \frac{R_0 k M_A}{\pi r^3 G}\right)} U_0$

$$\Leftrightarrow U_d = \frac{-R_0 k M_A U_0}{2\pi r^3 G R + R_0 k M_A}$$

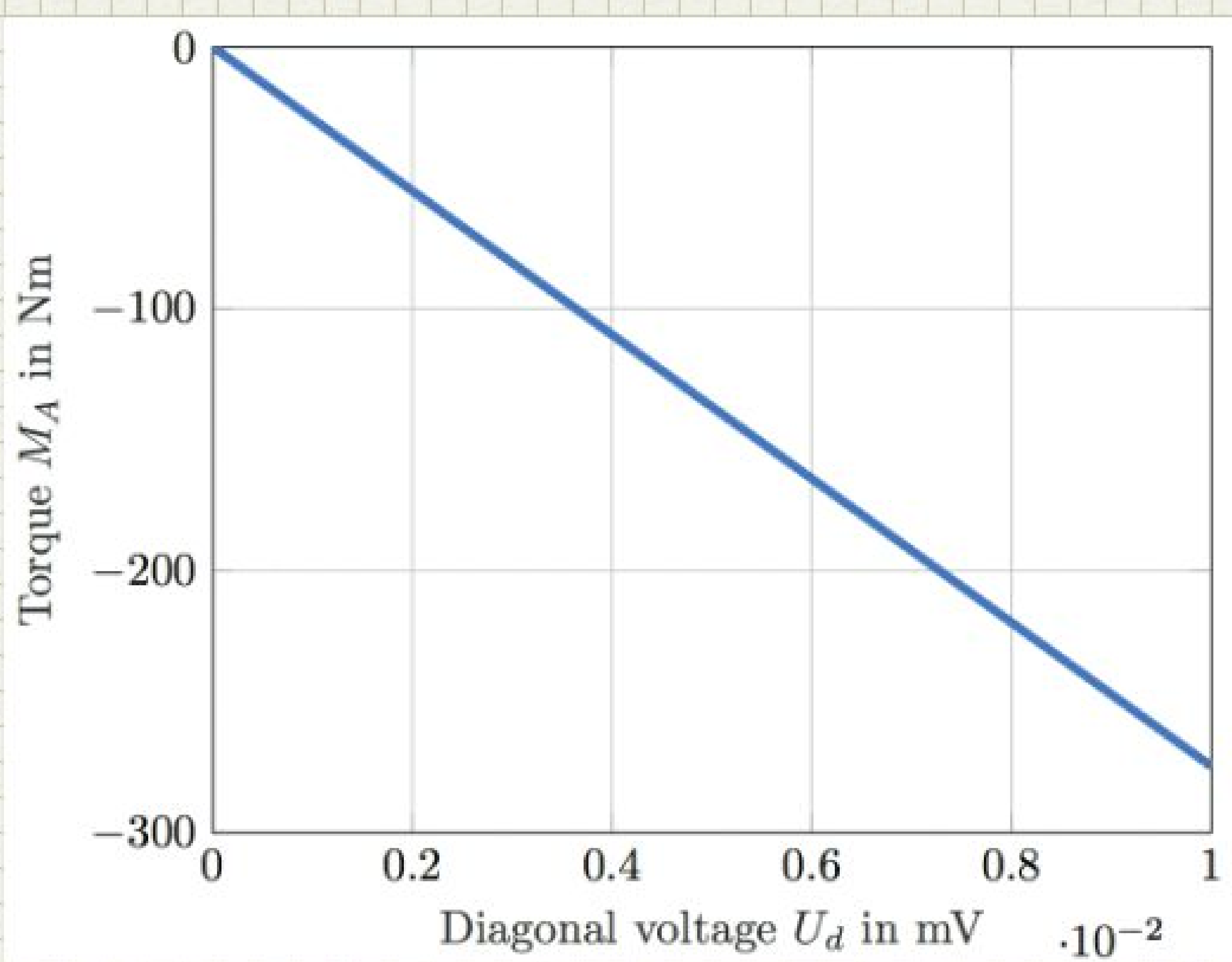
$$\Leftrightarrow U_d \left(2R \pi r^3 G + R_0 k M_A \right) = - R_0 k M_A U_0$$

$$\Leftrightarrow M_A \left(U_d R_0 k + R_0 k U_0 \right) = - U_d 2 R \pi r^3 G$$

$$\Leftrightarrow M_A = \frac{-2R \pi r^3 G \; M_A U_0}{R_0 k \left(U_d + U_0 \right)}$$

Assumption for the calculations: $R_0 = R = 120\,\Omega$

U_d [mV]	0	2	4	6	8	10
M_A [Nm]	0	-55	-110	-165	-220	-275



Ex. 4 3

$$y(t) = \sin(2\pi \cdot 10\,Hz \cdot t)$$

$$f_s = 9\,Hz$$

Shannon's sampling theorem is violated:

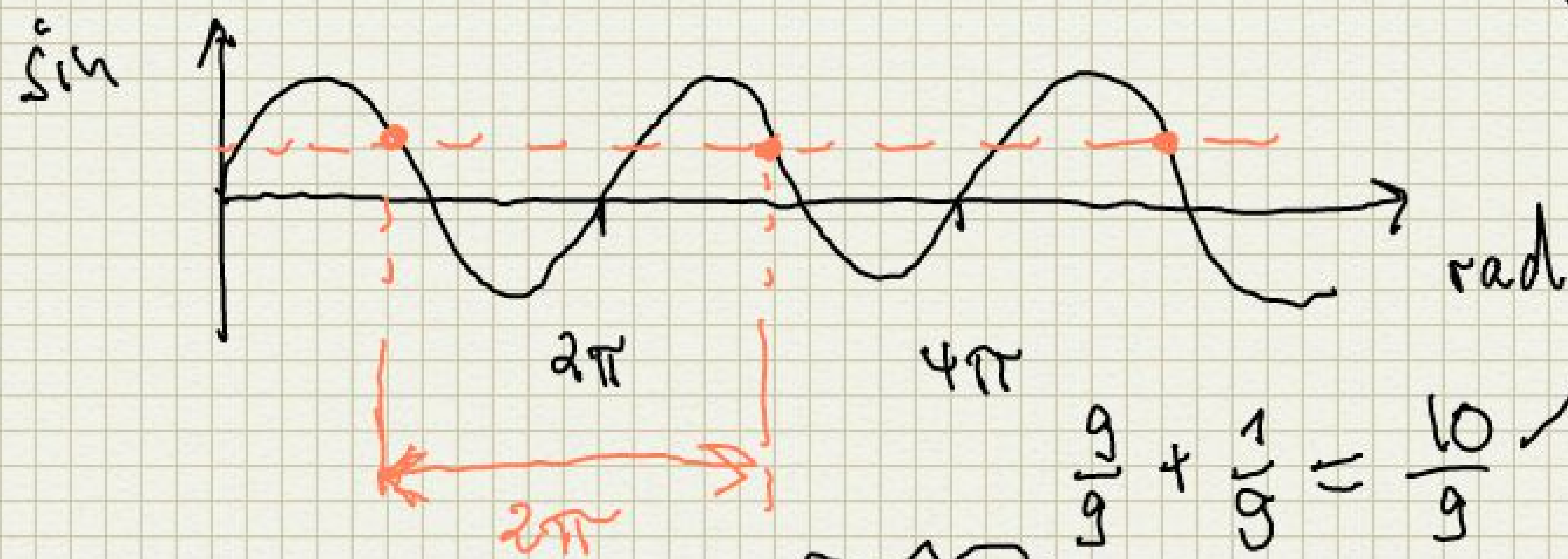
$$f_s > 2 f_{max}$$

$$9\,Hz \not> 2 \cdot 10\,Hz$$

$t = T_s k$ here $k = 0, 1, 2, \ldots$

$= \frac{1}{f_s} k$ (1) $\quad y(k) = \sin(2\pi\, 10\,Hz\, \frac{1}{f_s} k)$

$$\Leftrightarrow y(k) = \sin(2\pi \frac{10\,Hz}{9\,Hz} k)$$



$$\frac{9}{9} + \frac{1}{9} = \frac{10}{9}$$

$$\Leftrightarrow y(k) = \sin(2\pi (1 + \frac{1}{9}) k)$$

$$\Leftrightarrow y(k) = \sin(2\pi k + \frac{2\pi}{9} k) \longrightarrow$$

$$y(k) = \sin(2\pi k + 2\pi \frac{1}{9} k)$$

($2\pi k$:) multiple of 2π ⇒ it can be omitted here

$$y(k) = \sin(2\pi \frac{1}{9} k)$$

$$t = \frac{1}{f_s} k$$

$$= \sin(2\pi \boxed{1} \frac{1}{9} k)$$

($\boxed{1}$) → 1 Hz

2nd → Delayed!