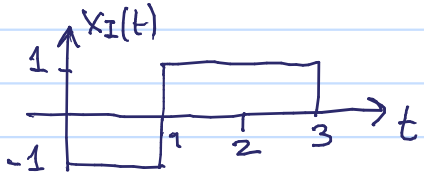
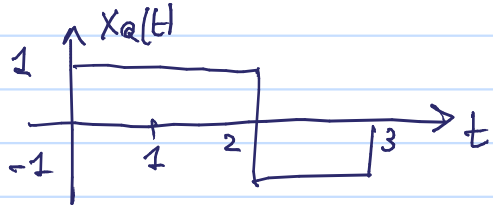
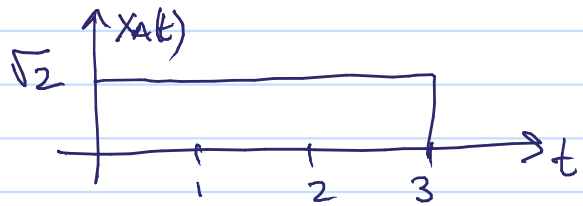
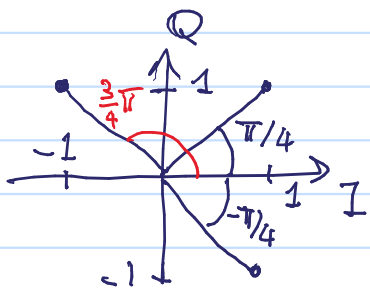
1. a.

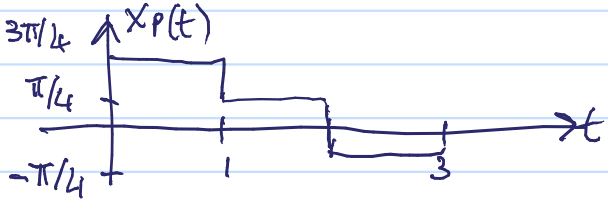




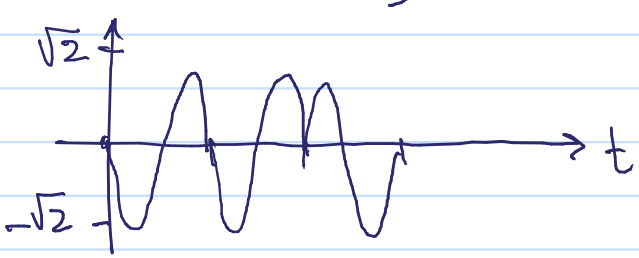
b. $x_A(t) = \sqrt{x_I(t)^2 + x_Q(t)^2} = \sqrt{2}$



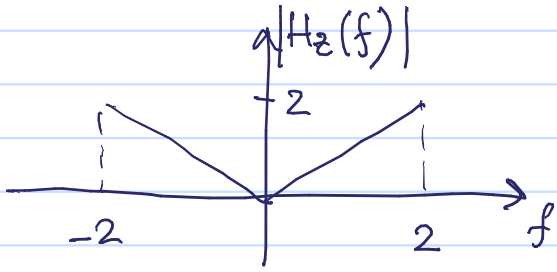


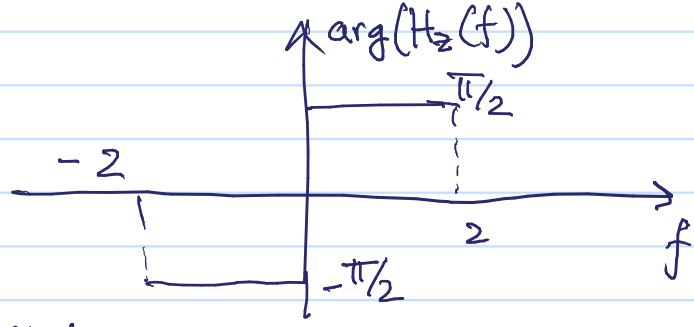


c. $x_C(t) = -\sqrt{2}\, x_Q(t) \sin(2\pi t)$

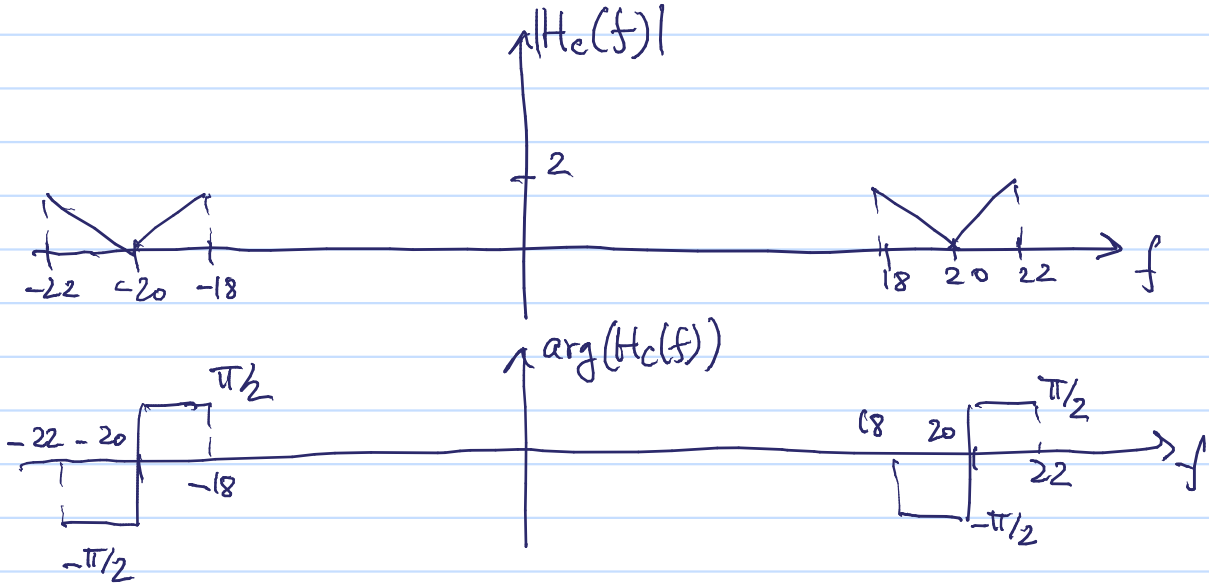


2. a



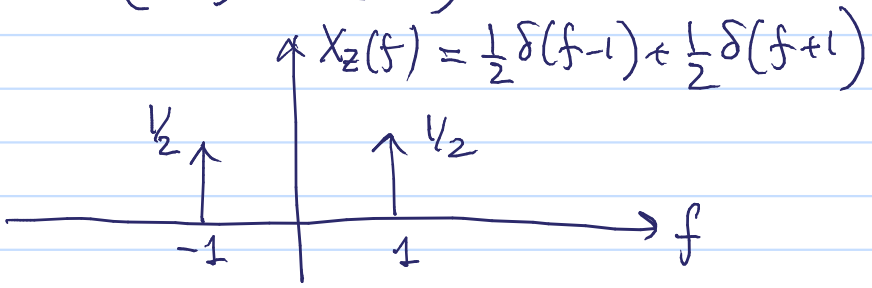


b.



Note: Hermitian symmetry

c. $x_c(t) = \sqrt{2}\cos(2\pi t)\cos(40\pi t)$



$\Downarrow H_2(1) = j$

$$Y_2(f) = \frac{1}{2}j\,\delta(f-1) - \frac{1}{2}j\,\delta(f+1)$$

$$\Rightarrow y_2(t) = -\sin(2\pi t)$$

$$\Rightarrow y_c(t) = -\sqrt{2}\sin(2\pi t)\cos(40\pi t)$$

d. $f_s \geq 2 \times 21 = 42$ Hz

↑ largest frequency in the support of $Y_c(f)$

3. a. $\mathcal{F}\{m(t)\} = (\text{sinc}(t))^2$ (see notes regarding the auto-correlation function of the rectangular pulse)

$W \simeq 5$ Hz

b. $B_T \simeq 2W(1+D)$

$D = \frac{k_f}{2\pi W} \max|m(t)| = \frac{1}{10\pi}$

$\Rightarrow B_T \simeq 10\left(1 + \frac{1}{10\pi}\right) \simeq 10.32$ Hz