

1) Let  $x(t)$  be a signal with  $x(t) = 0$  for  $t < 3$ . For each signal given below, determine the values of  $t$  for which it is guaranteed to be zero.

- (a)  $x(1-t)$       (b)  $x(1-t) + x(2-t)$       (c)  $x(1-t)x(2-t)$   
 (d)  $x(3t)$       (e)  $x(t/3)$

1.5  $x(t) = 0, t < 3$

(a)  $x(1-t) \rightarrow -t < 3$   
 $t > -3$   
 $x(1-t) \rightarrow t > -2$

(b)  $x(1-t) + x(2-t)$   
 $\downarrow \quad \downarrow$   
 $t > -2 \quad t > -1$   
 $\cap$   
 $\downarrow$   
 $t > -1$

(c)  $x(1-t)x(2-t)$   
 $\downarrow \quad \downarrow$   
 $t > -2 \quad t > -1$   
 $\cup$   
 $t > -2$

(d)  $x(3t) \quad t < 3$   
 $3t < 3 \Rightarrow t < 1$

(e)  $x(t/3) \quad t < 3$   
 $t/3 < 3$   
 $t < 9$

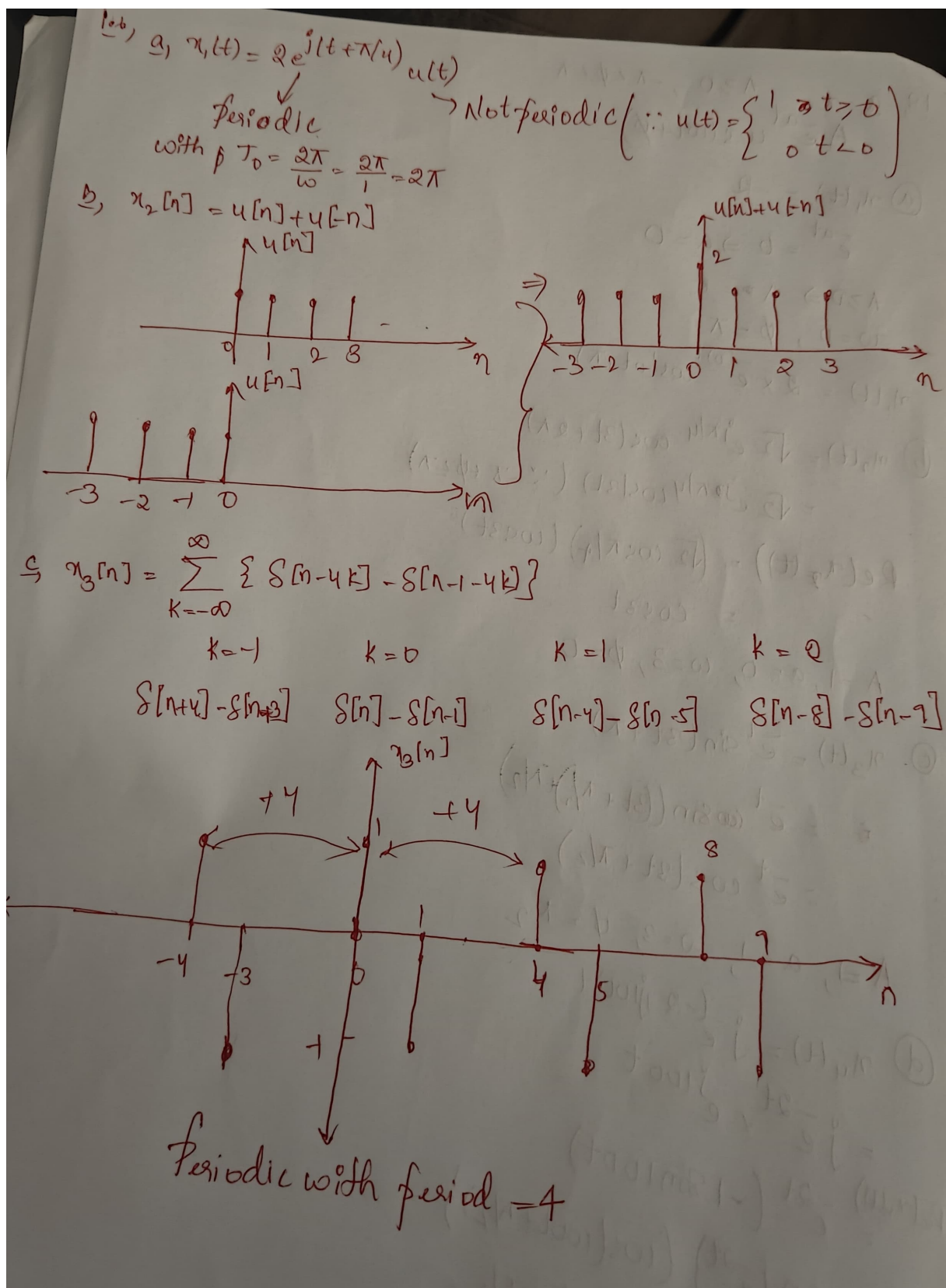
2)

Determine whether or not each of the following signals is periodic:

(a)  $x_1(t) = 2e^{j(t+\pi/4)}u(t)$

(b)  $x_2[n] = u[n] + u[-n]$

(c)  $x_3[n] = \sum_{k=-\infty}^{\infty} \{\delta[n-4k] - \delta[n-1-4k]\}$



3)

Express the real part of each of the following signals in the form  $Ae^{-at} \cos(\omega t + \phi)$ , where  $A$ ,  $a$ ,  $\omega$ , and  $\phi$  are real numbers with  $A \geq 0$  and  $-\pi < \phi \leq \pi$ :

(a)  $x_1(t) = -2$

(b)  $x_2(t) = \sqrt{2}e^{j\pi/4} \cos(3t + 2\pi)$

(c)  $x_3(t) = e^{-t} \sin(3t + \pi)$

(d)  $x_4(t) = je^{(-2+j100)t}$

1.8)  $A \geq 0, -\pi < \phi \leq \pi$   
 $Ae^{-at} \cos(\omega t + \phi)$

(a)  $x_1(t) = -2$   
 $e^{-at} = 0 \Rightarrow a = 0$   
 $A \geq 0 \Rightarrow A = 2$   
 $\omega = 0, \phi = \pi$   
 $x_1(t) = 2 \times e^{-0t} \cos(0t + \pi)$

(b)  $x_2(t) = \sqrt{2} e^{j\pi/4} \cos(3t + 2\pi)$   
 $= \sqrt{2} e^{j2\pi/4} \cos(3t) \quad (\because -\pi < \phi \leq \pi)$   
 $\text{Re}\{x_2(t)\} = (\sqrt{2} \cos \pi/4) (\cos 3t)$   
 $= \cos 3t$   
 $A = 1, a = 0, \omega = 3, \phi = 0$

(c)  $x_3(t) = e^{-t} \sin(3t + \pi)$   
 $= e^{-t} \cos((3t + \pi/2) + \pi/2)$   
 $= e^{-t} \cos(3t + \pi/2)$   
 $A = 1, a = 1, \omega = 3, \phi = \pi/2$

(d)  $x_4(t) = j e^{(-2+j100)t}$   
 $= j e^{-2t} \times e^{j100t}$   
 $\text{Re}\{x_4(t)\} = e^{-2t} (-1 \sin 100t)$   
 $= (1) (e^{-2t}) (\cos(100t + \pi/2))$   
 $A = 1, a = 2, \omega = 100, \phi = \pi/2$

SOME EXTRA QUESTIONS FOR PRACTICE:

<http://materias.df.uba.ar/l5a2021c1/files/2021/05/Alan-V.-Oppenheim-Alan-S.-Willsky-with-S.-Hamid-Signals-and-Systems-Prentice-Hall-1996.pdf>

Solve 1.5 ,1.6 .