I pledge my honor that I have abided by the Stevens honor system

1. $y(n) = 3x(n) + 7$

Non linear due to constant which is independent of the signal

a) $y_1(n) = 3x_1(n) + 7$

$y_2(n) = 3x_2(n) + 7$

$y(n) = 3(x_1(n) + x_2(n)) + 7 = 3x_1(n) + 3x_2(n) + 7$

$y_1(n) + y_2(n) = 3x_1(n) + 3x_2(n) + 14$

$3x_1(n) + 3x_2(n) + 14 \neq 3x_1(n) + 3x_2(n) + 7$

$\boxed{\text{non linear}}$

b) $x_1(n) = x(n-n_0)$

$y_1(n) = 3x_1(n) + 7 = 3x(n-n_0) + 7$

$y_1(n-n_0) = 3x(n-n_0) + 7$

$y_1(n-n_0) = x(n-n_0)$ so $\boxed{\text{time invariant}}$

2. $y_1(n) = x(n) \cdot h(n)$

$y_2(n) = h(n) \cdot x(n)$

$y_1(n) = \sum_{-\infty}^{\infty} x(k) h(n-k)$

$y_2(n) = \sum_{-\infty}^{\infty} h(k) \cancel{h}(n-k)$ → $k = n - k'$ since infinite

so $y_1(n) = \sum_{-\infty}^{\infty} x(n-k') h(\cancel{n-n}+k') = y_2(n)$

so it is in fact commutative

3. $x(n) = \{-1, -1, 0, 0, \underset{\uparrow}{0}, 1, 0, 2, 3, 3, 1\}$

$h(n) = \{1, 2, \underset{\uparrow}{1}, 2, 1, 0, -1\}$

$n = (-4-2)$ to $(5+4) = -6$ to 9

$h(-n) = \{-1, 0, 1, 2, \underset{\uparrow}{1}, 2, 1\}$

$h(-6-n) = \{-1, 0, 1, 2, 1, 2, 1\}$

$y(-6) = -1$

$h(-5-n) =$ shifted right 1

$y(-5) = \sum_{m=-4} x(m) h(-5+m) = -2 - 1 = -3$

$y(0) = 3$ for $n = 0$

$y(1) = 1 + 0 + 4 + 3 = 8$

$y(9) = x - 1 = -1$

So $y(n) = \{-1, -3, -3, -3, -3, -1, \underset{\uparrow}{3}, 8, 11, 14, 13, 10, 3, -2, -3, -1\}$