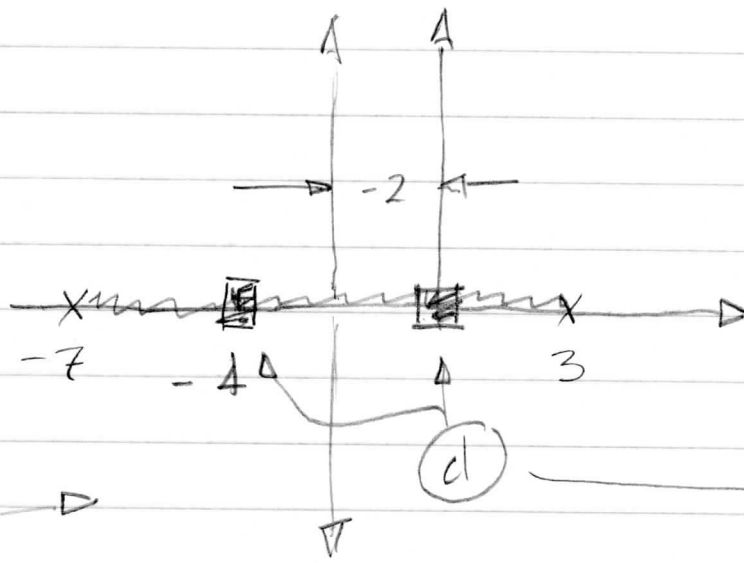


QUIZ 3 - SOLUTION

1.a.



b.
$$G_{cl} = \frac{N_G}{D_G + N_G} = \frac{K}{(s+7)(s+3) + K}$$

$$G_{cl} = \frac{K}{s^2 + 4s - 21 + K}$$

c.
$$s^2 + 4s - 21 + K = 0$$

e.
$$(s+4)s = 0 = s^2 + 4s$$

Rationale:
Other pole @ -4
because both poles have same 3.

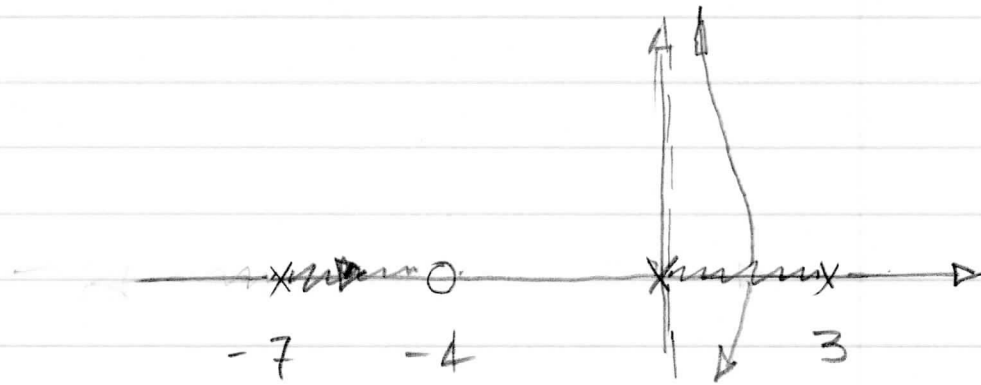
f. If compare 2 versions of char. eq., can see

$$s^2 + 4s = s^2 + 4s - 21 + K = 0$$

So $K = 21$ to make s^0 coef = 0

$$g. \quad G_{PI} = K_p + \frac{K_I}{s} = \frac{K_p s + K_I}{s} = \frac{K_p (s + \frac{K_I}{K_p})}{s}$$

$K_I = 4K_p$ means zero @ -4



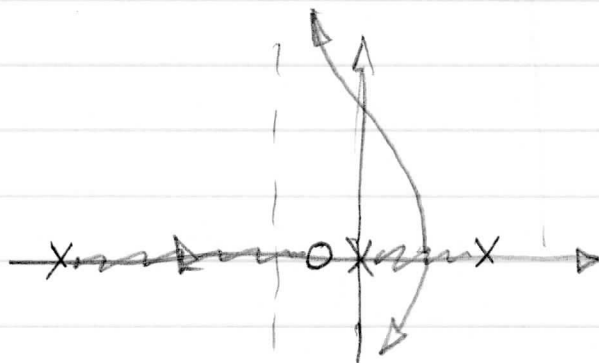
$$\sigma_a = \frac{\sum p - \sum z}{\#p - \#z} = \frac{-7 + 3 - (-4)}{3 - 1}$$

$$\sigma_a = -0$$

System always unstable

$$h. \quad K_I = K_p \Rightarrow \text{zero @ } -1$$

$$\sigma_a = \frac{-7 + 3 - (-1)}{2} = \frac{-3}{2}$$



At higher values of K_p , system becomes stable. h better than g.