Some buffer calculations:

Buffer of pyridinium Chloride & pyridine, K_b of pyridine $= 1.7 \times 10^{-9}$

pyridinium Chloride $\Rightarrow [C_5H_5NH]Cl$ Pyridine $\Rightarrow C_5H_5N$

a) Which is the acid? (ie HA)
b) What is the ka of the acid component?
c) What pH range is this conj acid / conj base system be good for?
d) What is the pH when $[HA] = 0.15\ M$ & $[A^-] = 0.075\ M$?
e) What buffer component ratio would be needed to make a pH = 5.50 buffer with this system?
f) How many grams pyridine needed to be added to 250 mL of 0.100 M Soln of pyridinium Chloride to make a pH = 5.50 buffer?

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a) HA = pyridinium Chloride = $[C_5H_5NH]Cl$

* for those not in my sections on my mailing list, I typically abbreviate acid as HA & conj base as A^- for ease of writing everything

b) $K_a \cdot K_b = K_w$

$$K_a = \frac{1.00 \times 10^{-14}}{1.7 \times 10^{-9}} = 5.9 \times 10^{-6}$$

c) buffers are good within $\pm$ 1 pH unit of the pka

$pka = -\log ka = -\log(5.93 \times 10^{-6}) = 5.23$

buffer range $\Rightarrow$ 4.23 to 6.23

d) need H-H eqn here:

$$pH = pka + \log \frac{[base]}{[acid]} = 5.23 + \log(0.075 / 0.15)$$
$$= 4.92$$

pH = 4.92

e) $pH = pka + \log \frac{A^-}{HA} \Rightarrow 10^{pH - pka} = A^-/HA$ (logs... raise both sides)

$$\frac{A^-}{HA} = 10^{(5.50 - 5.23)} = 1.86 = 1.9$$

↳ 2 sig figs due to log calc