2. Bin-bet Nanipulations and Namalization

(a) 
$$|x\rangle = c \cdot (|+2i|)$$

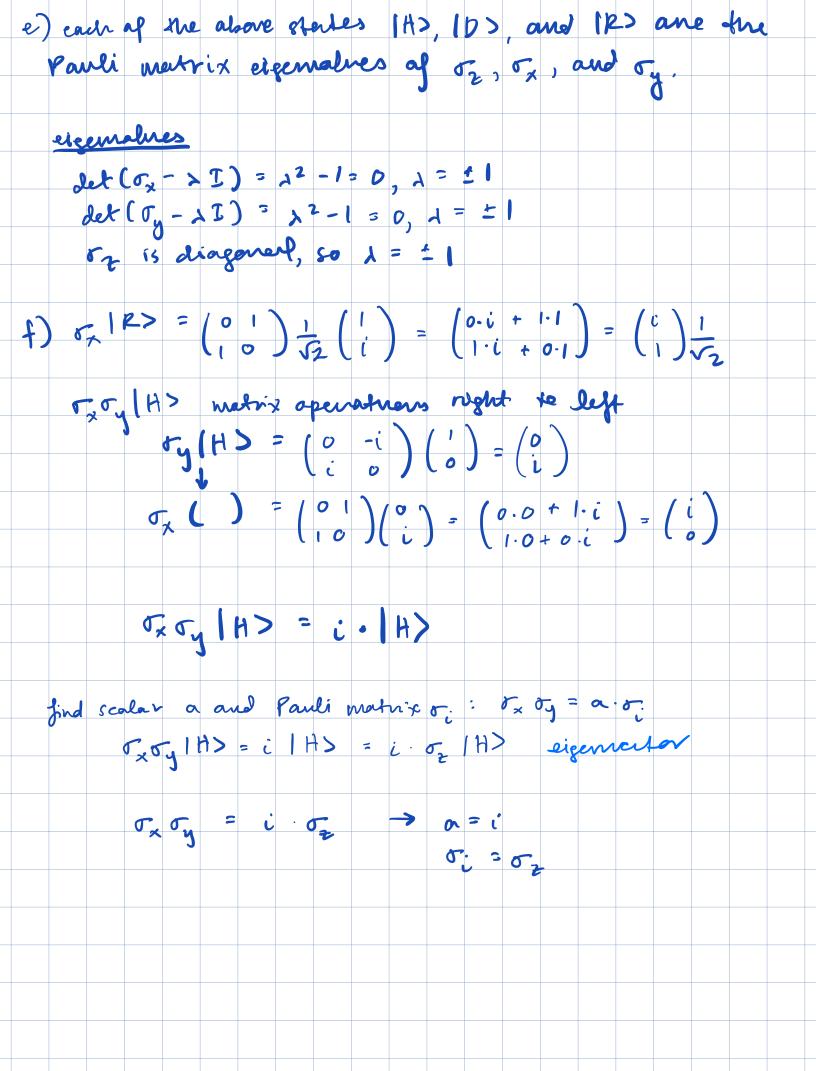
(b)  $|x\rangle = c \cdot (|+2i|)$ 

(c)  $|x\rangle = c \cdot (|-2i|)$ 

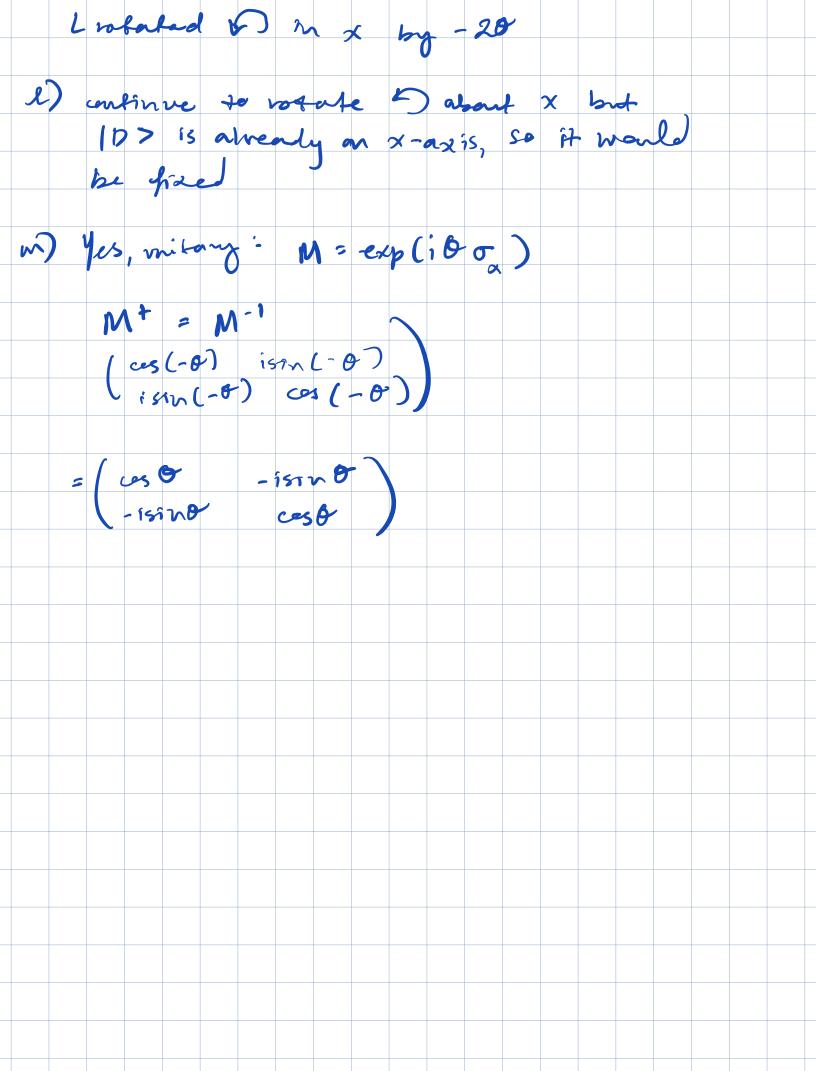
(d)  $|x\rangle = c^2 = |x\rangle \Rightarrow c = \frac{1}{\sqrt{6}} = \frac{c^2}{c^2} ((|-2i|)(|+2i|) + |x|)$ 

(e)  $|x\rangle = |x\rangle = |x\rangle$ 

C) 
$$\langle R | \overline{z} | R \rangle^{\frac{1}{2}} = \frac{1}{\sqrt{2}} (1, -i)$$
 $\langle R | x \rangle = \frac{1}{\sqrt{2}} (1, -i)$ 
 $\overline{z}$ 
 $\langle R | x \rangle = \frac{1}{\sqrt{2}} (1, -i)$ 
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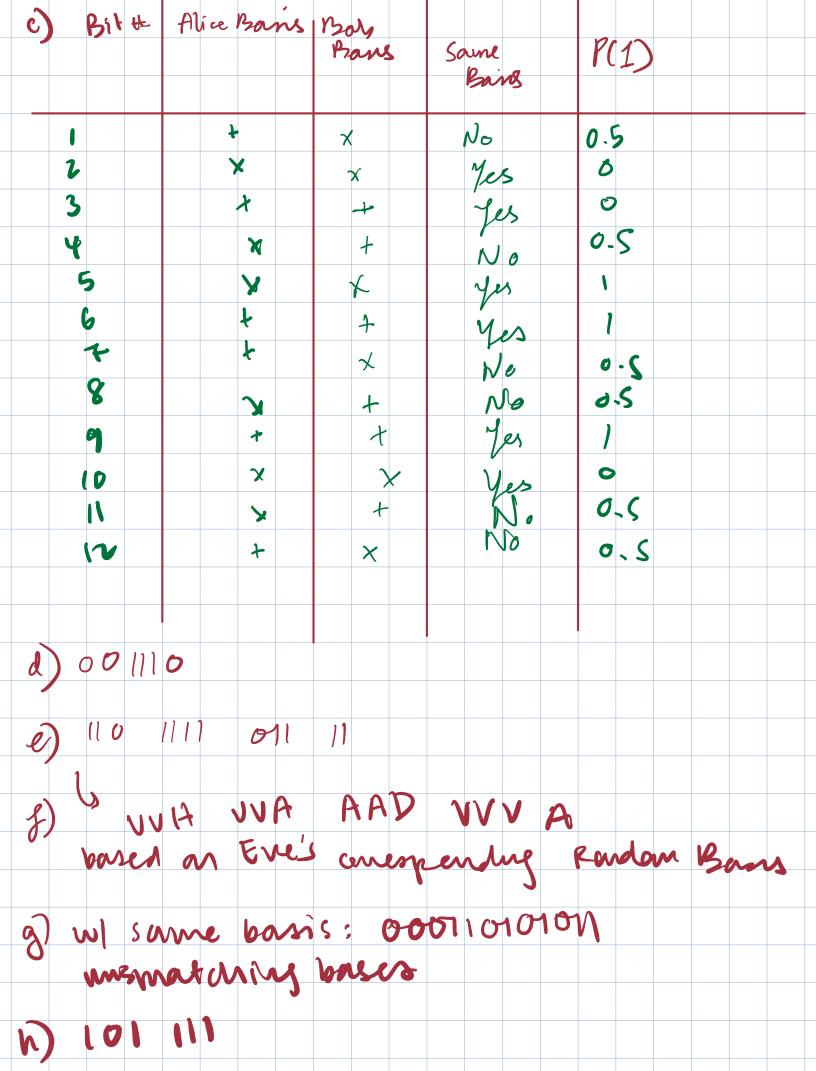


So 
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3a) W= e' Rz(M)Rx(B)Rz(x)  $R_{2}(\theta) = e^{-i\theta x/2}$   $R_{2}(\theta) = e^{-i\theta x/2}$ eit global phase that doesn't affect meas outcomes a matrix is unitary if UtU = I b preserves the norm u = ( ° ° ) 1A12 + 1612 = 1 → 1 coustroud 1612 + 1 d12 = 1 - 2 contract a.b+c.d=0 > 2 constraint 78 vavs 4 complex numbers but 4 constraints >8-4=4 def b, a, B, y -> 4 real parameters
some as # of depress of freedom in general 2x2 U Now: show that this decemposition can match any unitary matrix 1. R2(9) = (e-i012 0i012) phase diff btmn 103 and 11> 1.  $P_{\chi}(\theta) = cos(\frac{\theta}{2}) \cdot \frac{1}{2} - i \sin(\frac{\theta}{2}) \times \frac{1}{2} \cdot \frac{cos(\theta h)}{cos(\theta h)} - i \sin(\frac{\theta}{2})$ 4=eig Ro(4) Rx(B) Rx(X) rotate about & (phase), votote about x (amplitudus), volak agan orand E, great phone

Question 5 - BB84 Protocols a) detorme X\_HWP\_B angle schrys for Bob Alice wants to practice H, V, D, A from Shup (8) (b) = (4) = (6) 10>= -(1) (1) = (V) 1A>= 5 (1) X = 0 ° x = 45° XD 5 22.5° -> 2xA = 45° X A = - 22.5° -> cos(2xn) = 1/52 b) Alive will transmit: VOD HON HOV



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