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EE 5340

Part 1:

Creating a qubit in the state $|0\rangle$:

- **state vector:**

```
     [,1]
[1,] 1+0i
[2,] 0+0i
```

- **dirac representations:**

```
[1] "1|0>"
```

- **probability of measuring**

```
[1,]    1
[2,]    0
```

$\rightarrow$ $|0\rangle$ has probability of 100%

$\rightarrow$ $|1\rangle$ has probability of 0%

Part 2:

Performing an X gate to the qubit $|0\rangle$:

- **state vector:**

```
     [,1]
[1,] 0+0i
[2,] 1+0i
```

- **dirac representations:**

```
[1] "1|1>"
```

- **probability of measuring**

```
[1,]    0
[2,]    1
```

$\rightarrow$ $|0\rangle$ has probability of 0%

$\rightarrow$ $|1\rangle$ has probability of 100%

The output resulted in performing an X gate to a single qubit is the state vector of the qubit are swiped. It is seen in part one and two as the probity of getting zero or one has been swiped.

Part 3:

Creating a qubit in the state $\sqrt{\frac{2}{3}}|\mathbf{0}\rangle + \sqrt{\frac{1}{3}}|\mathbf{1}\rangle$:

- state vector:

```
             [,1]
[1,] 0.8164966+0i
[2,] 0.5773503+0i
```

- dirac representations:

```
[1] "0.816|0> + 0.577|1>"
```

- probability of measuring

`[1,] 0.6666667` → $|0\rangle$ has probability of 66.6%

`[2,] 0.3333333` → $|1\rangle$ has probability of 33.3%

Performing an X gate to the qubit $\sqrt{\frac{2}{3}}|\mathbf{0}\rangle + \sqrt{\frac{1}{3}}|\mathbf{1}\rangle$

- state vector:

```
             [,1]
[1,] 0.5773503+0i
[2,] 0.8164966+0i
```

- dirac representations:

```
[1] "0.577|0> + 0.816|1>"
```

- probability of measuring

`[1,] 0.3333333` → $|0\rangle$ has probability of 33.3%

`[2,] 0.6666667` → $|1\rangle$ has probability of 66.6%