Question 1

a)

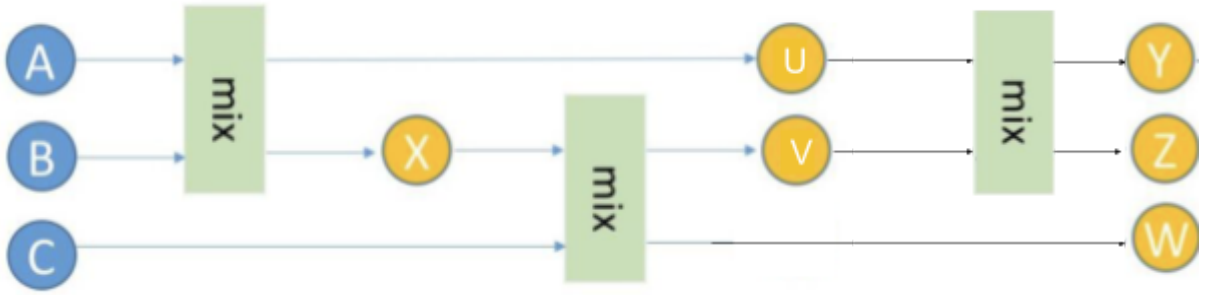
	A	B	C
Y	0.5	0.5	0
Z	0.25	0.25	0.5
W	0.25	0.25	0.5

b) If W is revealed to be controlled by Bob, then it reveals that Z is Carol and Y is Alice.

c) Following the diagram below, the first mix will be of equal distribution, allowing U and X to both be 0.5A and 0.5 B.

Taking X, we mix it with C, to give V and W. V would be a distribution of ⅔ C and ⅓ X, while W will be ⅓ C and ⅔ X. Expanding X in W, we ⅓C and ⅔ (½ A and ½ B), leading to ⅓ C, ⅓ A, and ⅓ B, thus giving us equal distribution for all 3 parties in W.

Lastly, we mix U and V together with equal distribution. This would give Y and Z, where they would both have ½ U and ½ V. Expanding it, we would get ½ (½ A and ½ B) and ½ (⅔ C and ⅓ X), which gives us ¼ A and ¼ B from U mixed with ⅓ C, $\frac{1}{12}$ A and $\frac{1}{12}$ B from V. Adding them all together, we get ⅓ C, ⅓ A, and ⅓ B, thus giving us equal distribution for all 3 parties in both Y and Z as well.



Question 2

a) $B(t, W, \frac{t}{W})$ where B is the Bernoulli distribution.

b) $B(0, W, \frac{t}{W})$ where B is the Bernoulli distribution.

c) $1 - \sum_{k=0}^{1} B(k, W, \frac{t}{W})$ where B is the Bernoulli distribution.

d) If no block is proposed then it may take longer to validate and finalise a transaction, thus reducing throughput. If multiple blocks are proposed then there will be an issue of how to choose a leader/winner amongst those blocks. However, with multiple blocks, designers can use a tie breaker, such as choosing the coin with the largest hashed VRF output. Hence, multiple winners may be slightly more favourable.

Question 3

a) Assuming 70 transactions in a block with 1024 bit public keys and 256 bits signatures, we would be saving on 69 x 1024 x 256 = 18087936 bits worth of bandwidth.

b) Assuming 70 transactions in a block with 256 bits signatures (since Ethereum doesn't have public keys), we would be saving on 69 x 256 = 17664 bits worth of bandwidth.

c) This could allow for faster verification of blocks in BitcoinNG, thus allowing for higher throughput.