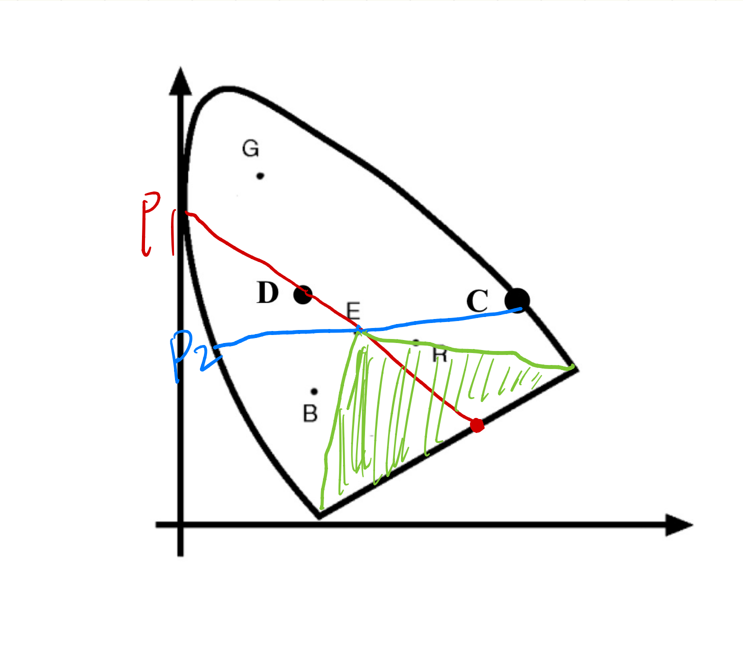
Q1



i. P1

ii. No, in green area, there is not corresponding dominant wavelength. The color in this area is combination of other colors.

iii. P2

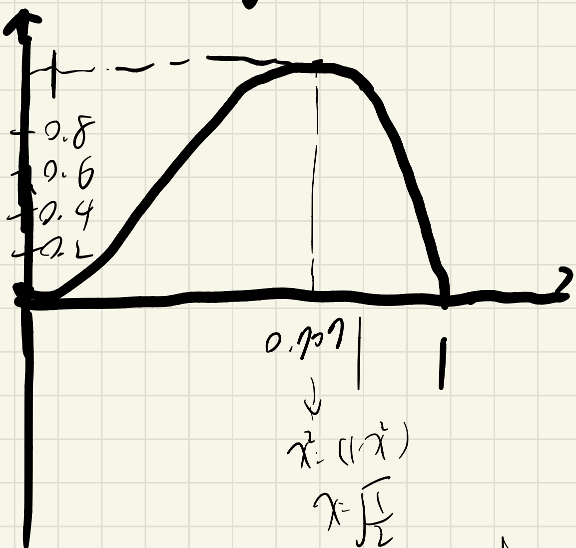
iv. white, black, grayscale

Q2:

1. $k=2$
$P(X) = x^2 \quad P(Y) = 1 - x^2$

$H(X) = -\sum p_i \log p_i = -x^2 \log_2 x^2 - (1-x^2)\log_2(1-x^2)$

$= -2x^2 \log_2 x - (1-x^2)\log_2(1-x^2)$



$x^2 = (1-x^2)$

$x = \sqrt{\frac{1}{2}}$

2. Entropy will be minimum at $x = 1, 0$
∵ Entropy minimum would happen when a symbol that are much more likely to appear than other symbols

3. happen at $P(X) = 1$ or $P(Y) = 1$

$x^k = 1$ or $1 - x^k = 1$

$\underline{x = 1}$ $\quad$ $\underline{x = 0}$

4. $P(X) = P(Y)$ maximum entropy would happen at

$x^2 = 1 - x^2$ if all symbols are equally probable

$x = \frac{1}{\sqrt{2}}$

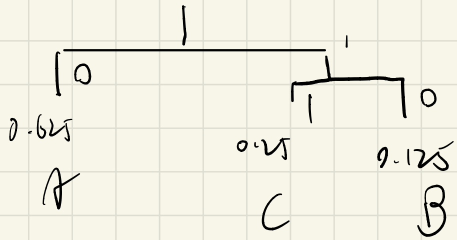
5. $P(X) = P(Y)$

$1 - x^k = x^k$

$x^k = \frac{1}{2}$

$x = \frac{1}{\sqrt[k]{2}}$

Q3



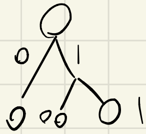
		code.	length
A	0.625	0	1
B	0.125	10	2
C	0.25	11	2

1. average length $= 0.625 \times 1 + 0.125 \times 2 + 0.25 \times 2 = \underline{1.375}$ 位

2. $2^2 = 4$

A	0	0	1	1
B	10	11	00	01
C	11	10	01	00

3. 2^{N-1}



A binary tree has $N-1$ edges for N nodes

each edge can represent as 0 or 1 in coding

$\therefore$ 2^{N-1} → edges

0 or 1

4.

$E(X) = -(0.625\log_2 0.625 + 0.125\log 0.125 + 0.25\log 0.25)$

$= 1.298$

$\because E(X) \neq$ averge length

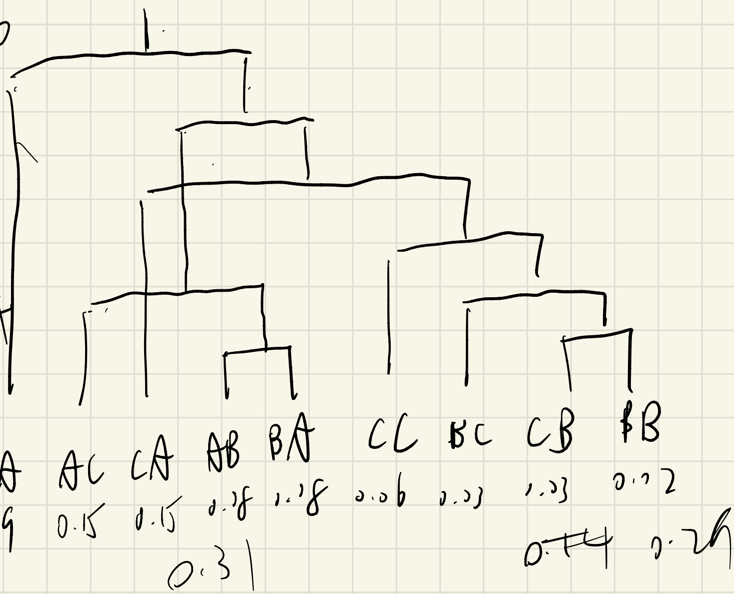
Better solution:

try to encode as two characters

		bits
P(AA)	= 0.39	1
P(AB)	= 0.08	4
P(AC)	= 0.15	3
P(BA)	= 0.08	4
P(BB)	= 0.02	6
P(BC)	= 0.03	5
P(CA)	= 0.15	3
P(CB)	= 0.03	6
P(CC)	= 0.06	4

average length = 1.3203

< 1.375



1.3203