

SOLUTIONS ELET2230

TEST 1 2020

1.

$$\begin{aligned} I_A &= 1.25 \\ I_B &= 2.0 \\ I_C &= 2.25 \\ I_D &= 3.05 \end{aligned}$$

(a)

1.25	A
2.0	B
3.05	D
2.25	C
2.0	B
1.25	A
<u>2.0</u>	B
13.8	BITS

(b)

$$\begin{aligned} H(x) &= P_A I_A + P_B I_B + P_C I_C + P_D I_D \\ &= 1.86 \text{ BITS/SYMB} \\ 1.86 * 7 &= 13.02 \text{ BITS} \end{aligned}$$

(c)

7 SYMBOLS EVERY 10ms
IS 700 SYMBOLS/SECOND

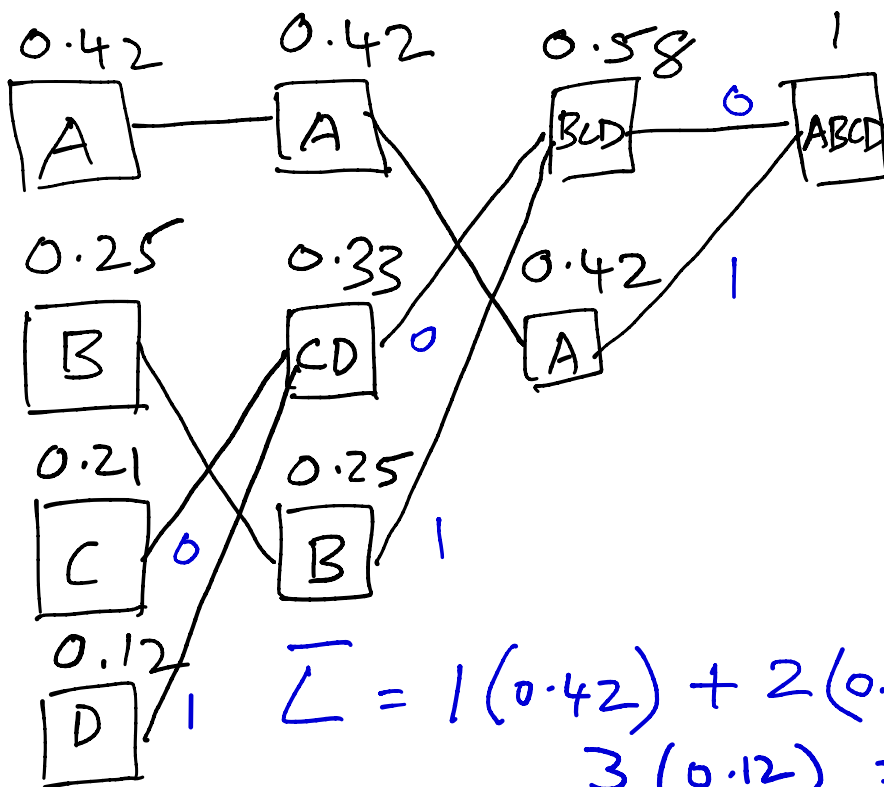
(d)

1

01

000

001



$$\bar{L} = 1(0.42) + 2(0.25) + 3(0.21) + 3(0.12) = 1.91 \text{ BITS}$$

$$\text{EFFICIENCY} = \frac{H(x)}{\bar{L}} \times 100 = 97\%$$

(c) AVERAGE # OF BINARY DIGITS
PER SECOND

$$\gamma_s \bar{L} = 700(1.91) = 1337 \text{ bits/SEC}$$

$$\gamma_s H(x) = 700(1.86) = 1302 \text{ bits/SEC}$$

$$\text{INFORMATION RATE } (R) = 1302 \text{ bits/SEC}$$

$$\text{BINARY DIGIT RATE } (\gamma_b) = 1337 \text{ bits/SEC}$$

$$\gamma_b \geq R \text{ (SHANNON SOURCE CODING THEOREM)}$$

γ_b IS GREATER THAN R

SINCE CODE IS NOT

100% EFFICIENT

1110111001101101

0, 1, 11

11011 1001 1011101

0, 1, 11, 110

11 1001 1011101

0, 1, 11, 110, 111

001 1011101

0, 1, 11, 110, 111, 00

11011101

0, 1, 11, 110, 111, 00, 1101

1101

0, 1, 11, 110, 111, 00, 1101, 1101

	1	2	3	4	5	6	7	8
	0	1	11	110	111	00	1101	1101
		2	3	3	1	4	4	
CODE		0101	0110	0111	0010	1001	1001	

OUTPUT IS LONGER THAN INPUT
FOR SHORT SEQUENCES.

COMPRESSION IS ONLY EFFECTIVE
ON LONG INPUT STRINGS

3.

$$\begin{aligned}
 I(X, Y) &= H(Y) - H(Y|X) \\
 &= [H(p) + 1 - p] - 2q H(\alpha) \\
 &= [H(p) + 1 - p] - H(\alpha)(1 - p) \\
 &= [H(p) + 1 - p] - H(\alpha) + p H(\alpha) \\
 &= H(p) + (1 - p) [1 - H(\alpha)]
 \end{aligned}$$

For $\alpha = 0$ $H(\alpha) = 0$ $H(Y) = H(X)$

$$\therefore I(X, Y) = H(p) + 1 - p = H(Y)$$

$\alpha = 0$ MEANS A NOISELESS
CHANNEL