

1.1

$$3.1.1) A = \{1, 2, 3, 4\}, B = \{2, 3, 5, 7\}, C = \{2, 4, 6\}$$

$$\Delta m(A, B) = \frac{2}{6} = \boxed{\frac{1}{3}}$$

$$\Delta m(A, C) = \boxed{\frac{2}{5}}$$

$$\Delta m(B, C) = \boxed{\frac{1}{6}}$$

3.2.1)  $\{\text{"The"}, \text{"he"}, \text{"e"}, \text{"m"}, \text{"mo"}, \text{"mos"}, \text{"ost"}, \text{"st"}, \text{"t"}, \text{"e"}, \text{"et"}, \text{"eff"}\}$

or

$\{\text{"The most effective"}, \text{"most effective way"}, \text{"effective way to"}, \text{"way to represent"}, \text{"to represent documents"}, \text{"represent documents as"}, \text{"documents as sets"}, \text{"as sets for"}, \text{"sets for purpose"}, \text{"for purpose of"}\}$

element	S1	S2	S3	S4	$2x+1 \% 6$	$3x+2 \% 6$	$5x+2 \% 6$
0	0	1	0	1	1	2	2
1	0	1	0	0	3	5	1
2	1	0	0	1	5	2	0
3	0	0	1	0	1	5	5
4	0	0	1	1	3	2	4
5	1	0	0	0	5	5	3

\* Signature on next page \*

	1	2	3	4
$h_1(0)$	1	1	1	1
$h_2(0)$	1	2	1	2
$h_3(0)$	1	2	1	2
$h_1(1)$	1	1	1	1
$h_2(1)$	1	2	1	2
$h_3(1)$	1	1	1	2
$h_1(2)$	5	1	1	1
$h_2(2)$	2	2	1	2
$h_3(2)$	0	1	1	0
$h_1(3)$	5	1	1	1
$h_2(3)$	2	2	5	2
$h_3(3)$	0	1	5	0
$h_1(4)$	5	1	1	1
$h_2(4)$	2	2	2	2
$h_3(4)$	0	1	4	0
$h_1(5)$	5	1	1	1
$h_2(5)$	2	2	2	2
$h_3(5)$	0	1	4	0

$\Rightarrow$

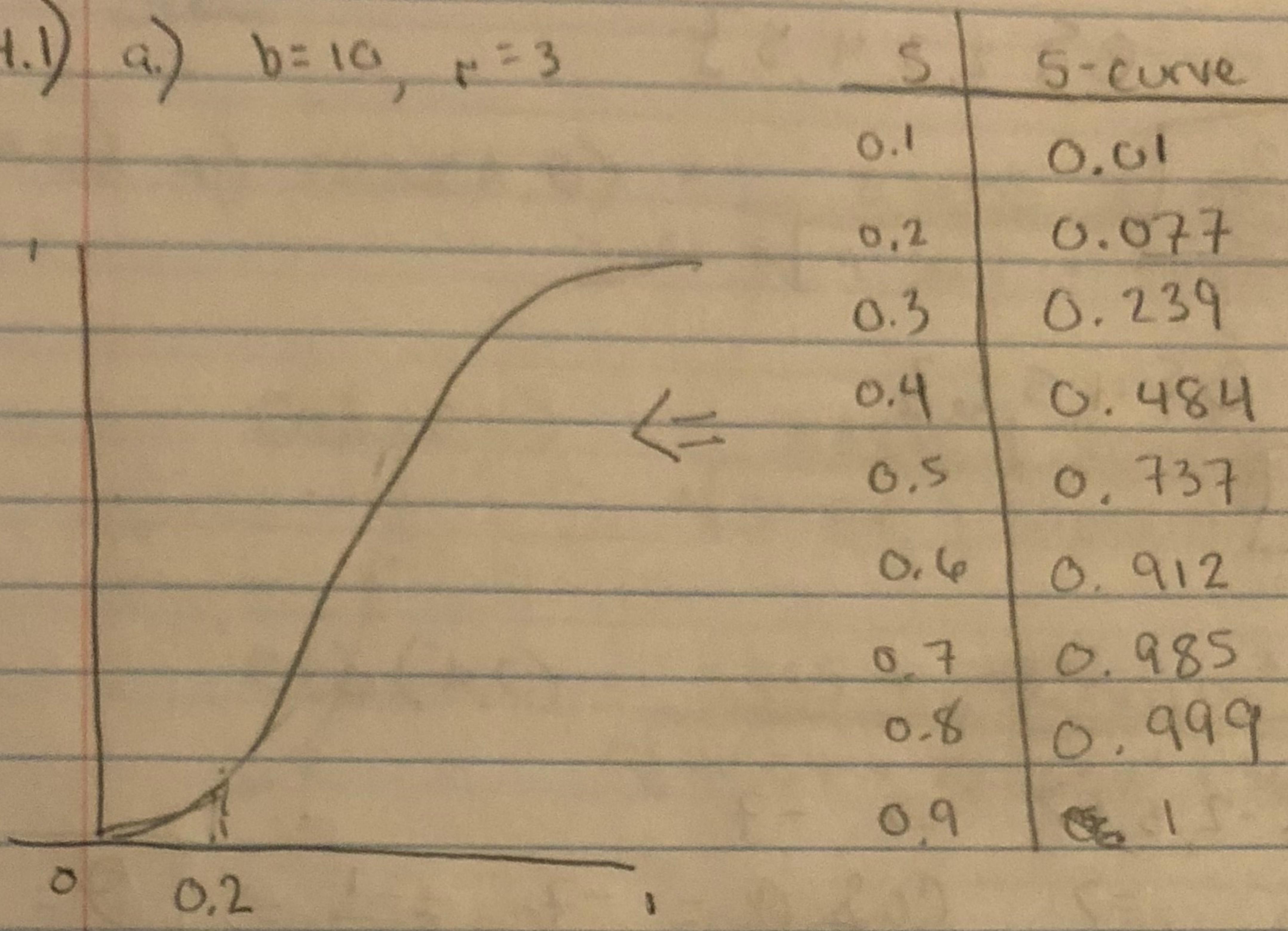
S1	S2	S3	S4
5	1	1	1
2	2	2	2
0	1	4	0

Final  $\nearrow$

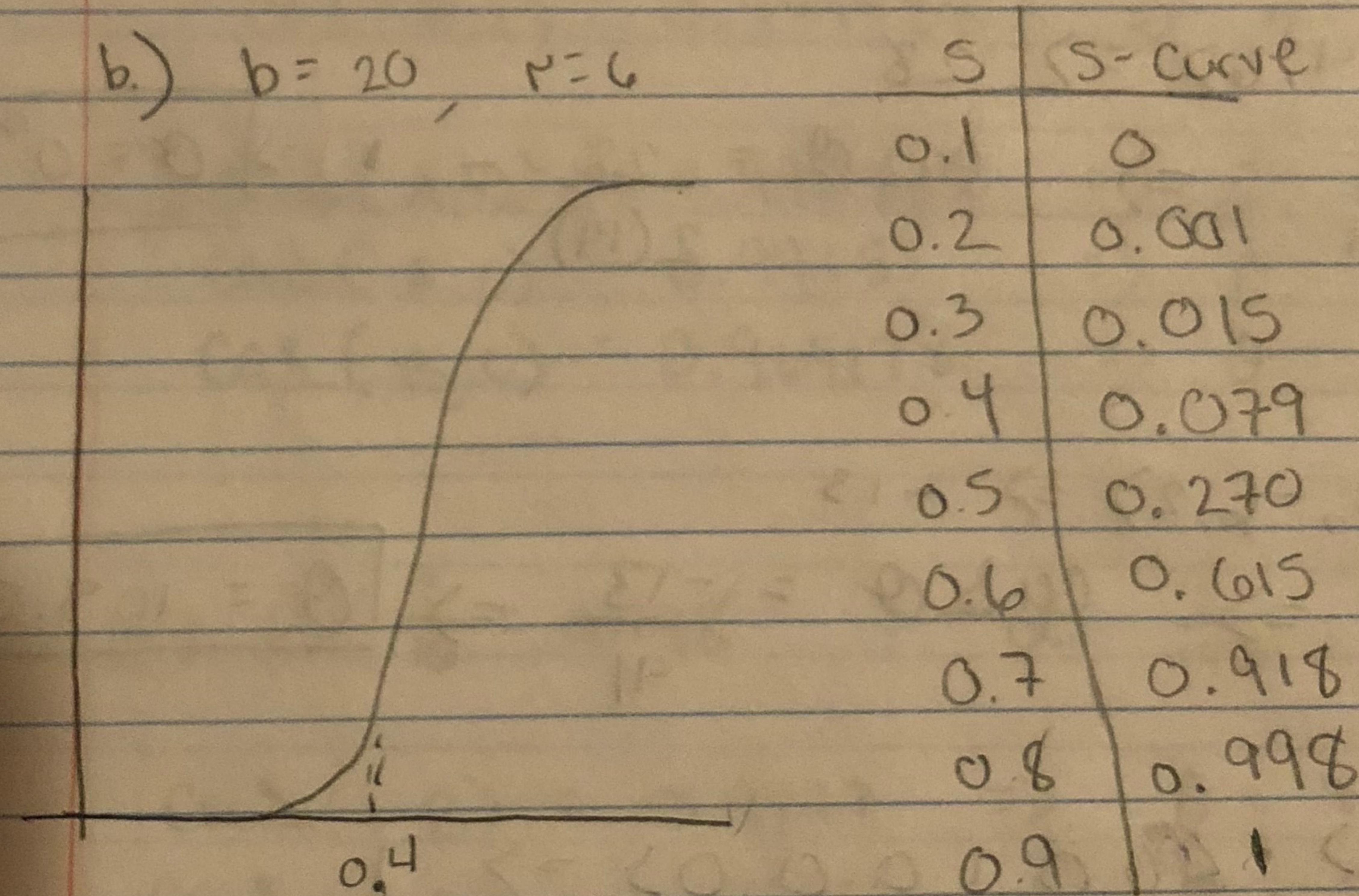
b.) Number 3

c.)	1-2	1-3	1-4	2-3	2-4	3-4
Col	0	0	0,25	0	0,25	0,25
Sig	0,33	0,33	0,67	0,67	0,67	0,67

3.4.1) a.)  $b = 10, r = 3$



b.)  $b = 20, r = 6$



3.5.4) a)  $A \{1, 2, 3, 4\}$      $B \{2, 3, 4, 5\}$

$$1 - \frac{3}{5} = \boxed{\frac{2}{5}}$$

b)  $A \{1, 2, 3\}$      $B \{4, 5, 6\}$

$$1 - \frac{0}{6} = \boxed{1}$$

3.5.5) a.)  $\langle 3, -1, 2 \rangle \cdot \langle -2, 3, 1 \rangle \Rightarrow -7$   
 $\text{norm} = \sqrt{14} \Rightarrow \cos \theta = \frac{-7}{\sqrt{14} \sqrt{14}} = -\frac{1}{2} \Rightarrow \theta = 120^\circ$

b.)  $\langle 1, 2, 3 \rangle \cdot \langle 2, 4, 6 \rangle \Rightarrow 28$   
 $\text{norm}_x = \sqrt{14} \Rightarrow \cos \theta = \frac{28}{2(\sqrt{14})} = 1 \Rightarrow \theta = 0^\circ$

c.)  $\langle 5, 0, -4 \rangle \cdot \langle -1, -6, 2 \rangle \Rightarrow -13$   
 $\text{norm}_x = \sqrt{41} \Rightarrow \cos \theta = \frac{-13}{\sqrt{41}} \Rightarrow \theta = 108.5^\circ$

d.)  $\langle 0, 1, 1, 0, 1, 1 \rangle \cdot \langle 0, 0, 1, 0, 0, 0 \rangle \Rightarrow 1$   
 $\text{norm}_x = \sqrt{2} \Rightarrow \cos \theta = \frac{1}{\sqrt{2}} \Rightarrow \theta = 60^\circ$

1.2

a.1) a.)  $\cos(A, B) = \frac{8.2008 + 160000\alpha^2 + 24\beta^2}{\sqrt{9.364 + 250000\alpha^2 + 36\beta^2} \sqrt{7.182 + 102400\alpha^2 + 16\beta^2}}$

$\cos(B, C) = \frac{7.826 + 264800\alpha^2 + 24\beta^2}{\sqrt{7.182 + 102400\alpha^2 + 16\beta^2} \sqrt{8.526 + 409600\alpha^2 + 36\beta^2}}$

$\cos(A, C) = \frac{8.935 + 320600\alpha^2 + 36\beta^2}{\sqrt{9.364 + 250000\alpha^2 + 36\beta^2} \sqrt{8.526 + 409600\alpha^2 + 36\beta^2}}$

b.)  $\cos(A, B) = 0.999997 \Rightarrow \theta = 0.1403^\circ$

$\cos(A, C) = 0.999995 \Rightarrow \theta = 0.1811^\circ$

$\cos(B, C) = 0.999988 \Rightarrow \theta = 0.2806^\circ$

c.)  $\cos(A, B) = 0.990882 \Rightarrow \theta = 8.22^\circ$

$\cos(A, C) = 0.99155 \Rightarrow \theta = 7.43^\circ$

$\cos(B, C) = 0.969178 \Rightarrow \theta = 14.25^\circ$

d.)  $B = \frac{3}{16} = 0.188 \quad \alpha = \frac{3}{146} = 0.002$

$\cos(A, B) = 0.9897 \Rightarrow \theta = 8.22^\circ$

$\cos(A, C) = 0.9916 \Rightarrow \theta = 7.43^\circ$

$\cos(B, C) = 0.9692 \Rightarrow \theta = 14.25^\circ$

$$9.2.3) \text{ a.) mean} = (4+2+5)/3 = \frac{11}{3}$$

$$A \Rightarrow 4 - \frac{11}{3} = \frac{1}{3}$$

$$B \Rightarrow 2 - \frac{11}{3} = -\frac{5}{3}$$

$$C \Rightarrow 5 = \frac{11}{3} = \frac{4}{3}$$

$$\text{b.) Speed: } 3.06(\frac{1}{3}) - 2.68(\frac{5}{3}) + 2.92(\frac{4}{3}) = 0.447$$

$$\text{Disk: } 500(\frac{1}{3}) - 320(\frac{5}{3}) + 640(\frac{4}{3}) = 486.7$$

$$\text{Memory: } 6(\frac{1}{3}) - 4(\frac{5}{3}) + 6(\frac{4}{3}) = 3.33 = 3.33$$

$$9.3.1) \text{ a.) } \gamma(A,B) = \frac{4}{8} = \frac{1}{2} = \gamma(B,C) = \gamma(A,C)$$

$$\text{b.) } \text{cas}(A,B) = \frac{34}{40\sqrt{2}} = 0.601$$

$$\text{cas}(A,C) = \frac{11}{8\sqrt{5}} = 0.615$$

$$\text{cas}(B,C) = \frac{11}{8\sqrt{10}} = 0.435$$

$$\text{c.) } \gamma(A,B) = 1 - \frac{2}{5} = \frac{3}{5}$$

$$\gamma(B,C) = 1 - \frac{1}{6} = 0.833$$

$$\gamma(A,C) = 1 - \frac{1}{3} = \frac{2}{3}$$

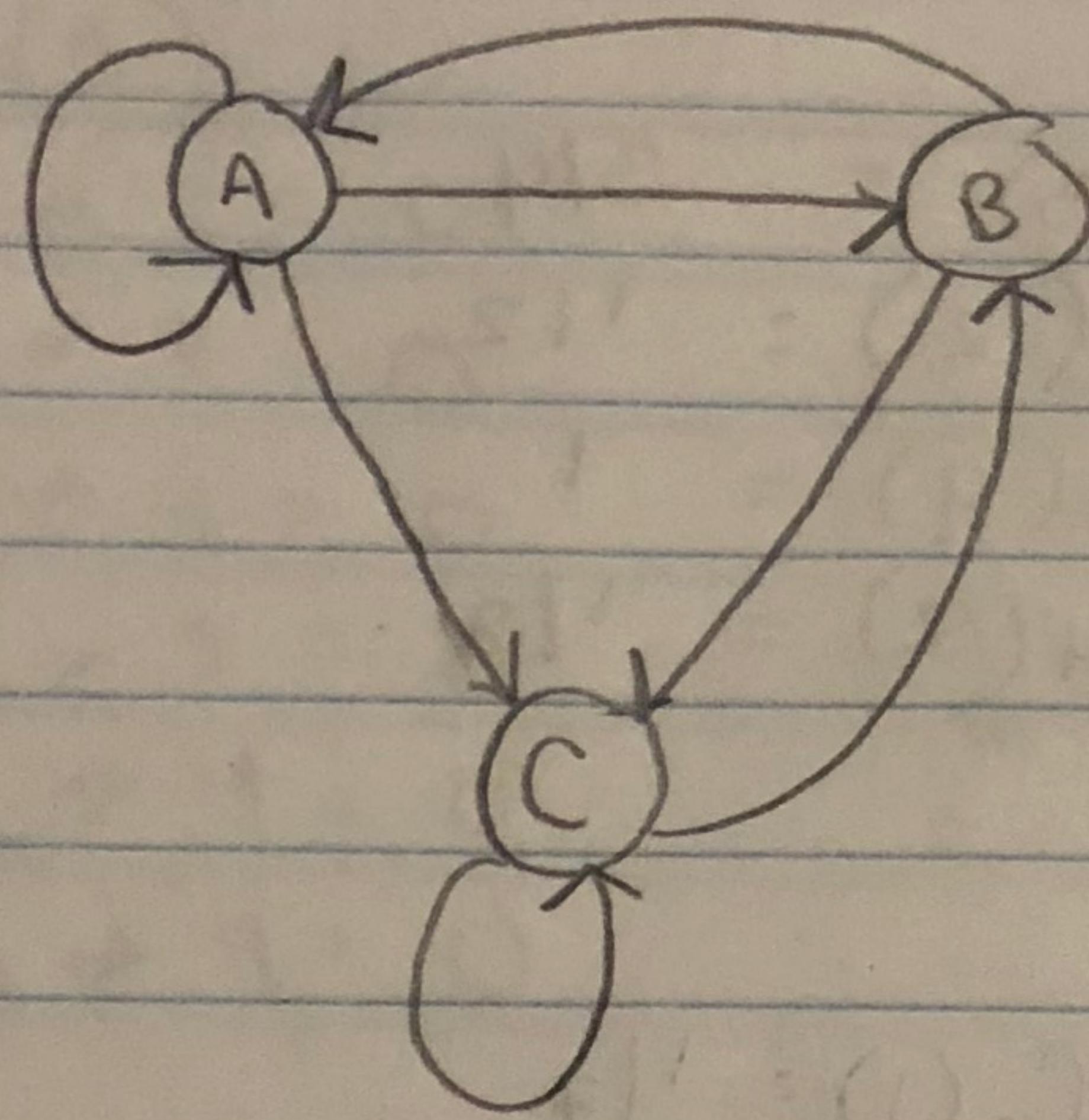
$$\text{d.) } \text{cas}(A,B) = \frac{2}{\sqrt{12}} = 0.577$$

$$\text{cas}(A,C) = \frac{2}{4} = 0.5$$

$$\text{cas}(B,C) = \frac{1}{\sqrt{12}} = 0.289$$

1.3

5.1.1)



$$M = \begin{bmatrix} 1/3 & 1/2 & 0 \\ 1/3 & 0 & 1/2 \\ 1/3 & 1/2 & 1/2 \end{bmatrix} \begin{bmatrix} 1/3 \\ 1/3 \\ 1/3 \end{bmatrix} = \begin{bmatrix} 5/18 \\ 5/18 \\ 8/18 \end{bmatrix}$$

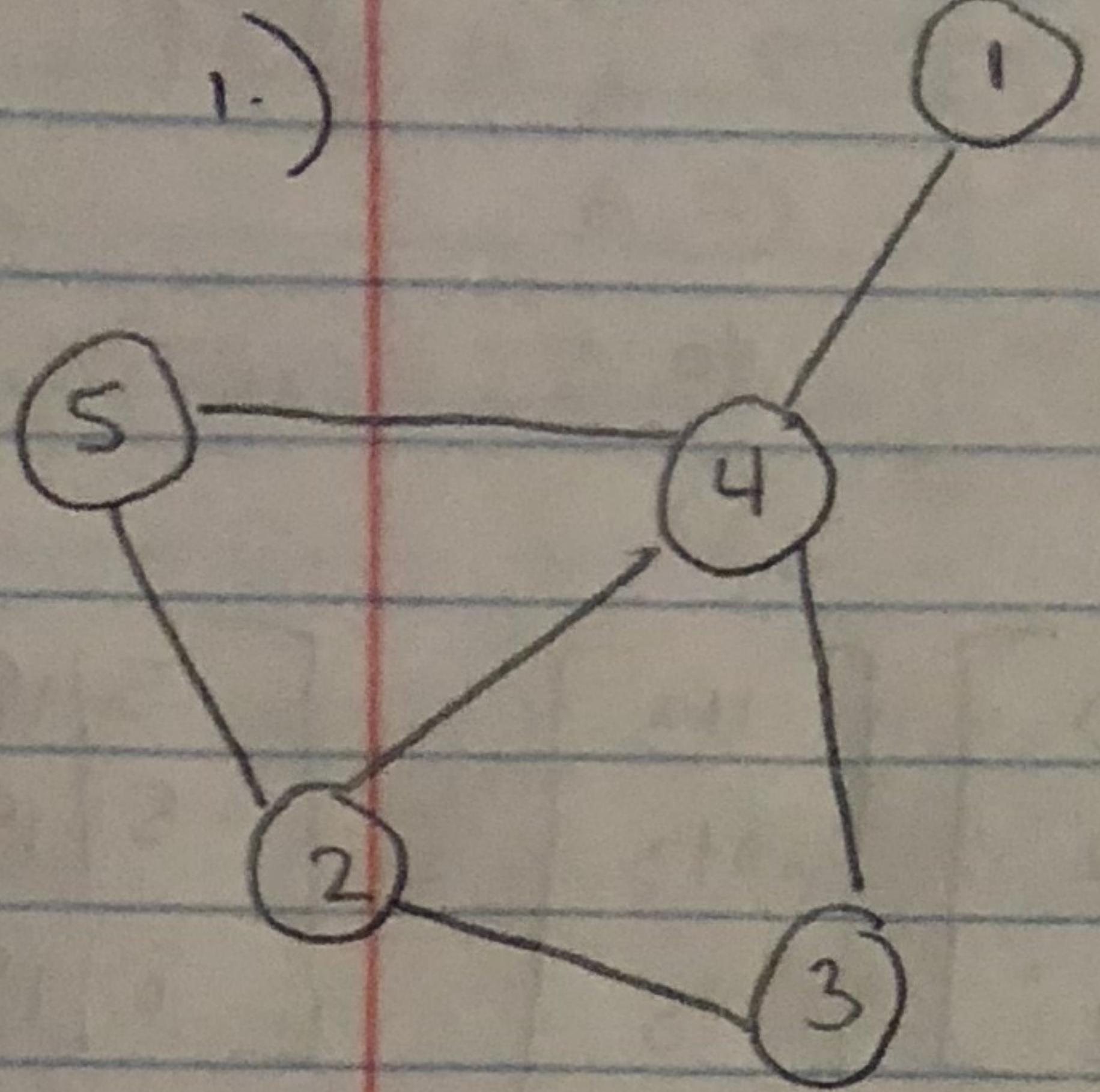
$$\begin{bmatrix} 1/3 \\ 1/3 \\ 1/3 \end{bmatrix}, \begin{bmatrix} 0.288 \\ 0.288 \\ 0.422 \end{bmatrix}, \begin{bmatrix} 0.259 \\ 0.312 \\ 0.426 \end{bmatrix}, \begin{bmatrix} 0.260 \\ 0.307 \\ 0.432 \end{bmatrix}, \dots, \begin{bmatrix} 0.259 \\ 0.308 \\ 0.432 \end{bmatrix}$$

5.1.2)  $V = (-\beta)e/n + \beta M V$

$$V' = \begin{bmatrix} 4/15 & 2/5 & 0 \\ 4/15 & 0 & 2/5 \\ 4/15 & 2/5 & 2/5 \end{bmatrix} V + \begin{bmatrix} 1/15 \\ 1/15 \\ 1/15 \end{bmatrix}$$

$$\begin{bmatrix} 1/3 \\ 1/3 \\ 1/3 \end{bmatrix}, \begin{bmatrix} 13/45 \\ 13/45 \\ 16/45 \end{bmatrix}, \begin{bmatrix} 7/27 \\ 193/1675 \\ 271/1675 \end{bmatrix}, \dots, \begin{bmatrix} 5/20 \\ 6/20 \\ 9/20 \end{bmatrix}$$

5.1.6) Recursively dropping the dead ends will end up with only the head node, pointing to itself. Page rank = 1



1.4

$$a.) C_D^*(1) = \frac{1}{4}$$

$$C_D^*(2) = \frac{1}{4}(3) = \frac{3}{4}$$

$$C_D^*(3) = \frac{1}{4}(2) = \frac{1}{2}$$

$$C_D^*(4) = \frac{1}{4}(4) = 1$$

$$C_D^*(5) = \frac{1}{4}(2) = \frac{1}{2}$$

$$b.) \sum_{j \in N} (1, j) = 7 \Rightarrow C_C(1) = \frac{1}{7}$$

$$\sum_{j \in N} (2, j) = 5 \quad C_C(2) = \frac{1}{5}$$

$$\sum_{j \in N} (3, j) = 6 \quad C_C(3) = \frac{1}{6}$$

$$\sum_{j \in N} (4, j) = 4 \quad C_C(4) = \frac{1}{4}$$

$$\sum_{j \in N} (5, j) = 6 \quad C_C(5) = \frac{1}{6}$$

$$C_C^*(1) = \frac{4}{7}$$

$$C_C^*(2) = \frac{4}{5}$$

$$C_C^*(3) = \frac{2}{3}$$

$$C_C^*(4) = 1$$

$$C_C^*(5) = \frac{2}{3}$$

c.) Betweenness (1)

$$2 \rightarrow 3 = 0$$

$$2 \rightarrow 4 = 0 \quad C_B = 0$$

$$2 \rightarrow 5 = 0 \quad C_B^* = 0$$

$$3 \rightarrow 4 = 0$$

$$3 \rightarrow 5 = 0$$

$$4 \rightarrow 5 = 0$$

B(2)

$$1 \rightarrow 3 = 0$$

$$1 \rightarrow 4 = 0$$

$$1 \rightarrow 5 = 0$$

$$3 \rightarrow 4 = 0$$

$$3 \rightarrow 5 = \frac{1}{2}$$

$$4 \rightarrow 5 = 0$$

$$C_B(2) = 2 \cdot \frac{1}{2} = 1$$

$$C_B^*(2) = \frac{1}{12}$$

B(3)

$$1 \rightarrow 2 = 0$$

$$1 \rightarrow 4 =$$

$$1 \rightarrow 5 =$$

$$2 \rightarrow 4 =$$

$$2 \rightarrow 5 =$$

$$4 \rightarrow 5 =$$

$$C_B = 0$$

$$C_B^* = 0$$

B(5)

$$1 \rightarrow 2 = 0$$

$$1 \rightarrow 3 = 0$$

$$1 \rightarrow 4 = 0$$

$$2 \rightarrow 3 = 0$$

$$2 \rightarrow 4 = 0$$

$$3 \rightarrow 4 = 0$$

$$C_B = 0$$

$$C_B^* = 0$$

B(4)

$$1 \rightarrow 2 = 1$$

$$1 \rightarrow 3 = 1$$

$$1 \rightarrow 5 = 1$$

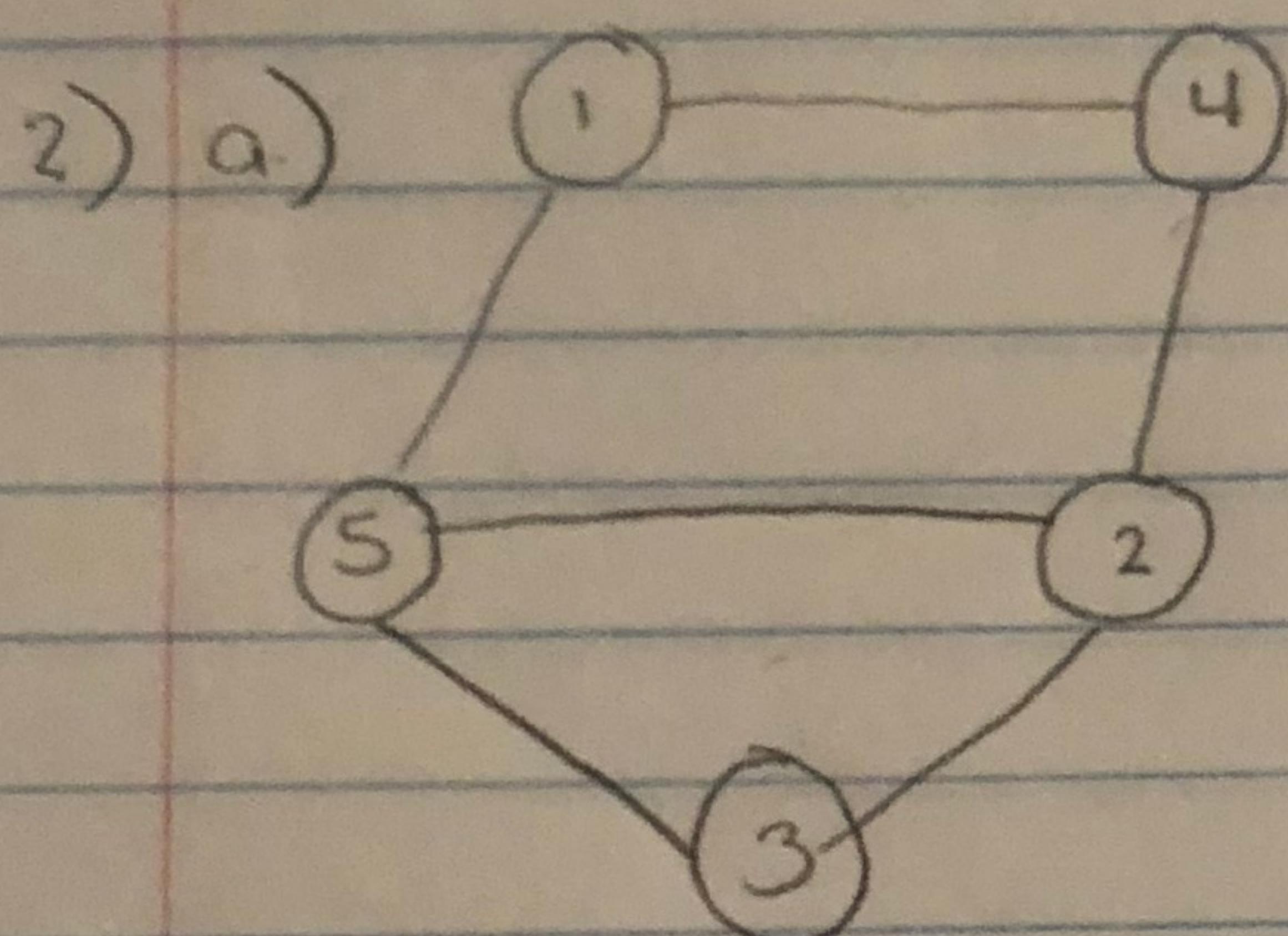
$$2 \rightarrow 3 = 0$$

$$2 \rightarrow 5 = 0$$

$$3 \rightarrow 5 = 1/2$$

$$C_B = 2(3)(5) = 7$$

$$C_B^* = \frac{7}{12}$$



$$C_D^*(1) = 1/4(2) = 1/2$$

$$C_D^*(2) = 1/4(3) = 3/4$$

$$C_D^*(3) = 1/4(2) = 1/2$$

$$C_D^*(4) = 1/4(2) = 1/2$$

$$C_D^*(5) = 1/4(3) = 3/4$$

$$b) \sum(1, g) = 7$$

$$\sum(2, g) = 5$$

$$\sum(3, g) = 6$$

$$\sum(4, g) = 6$$

$$\sum(5, g) = 5$$

$$C_C^* = 4(1/7) = 4/7$$

$$C_C^* = 4(1/5) = 4/5$$

$$C_C^* = 4(1/6) = 2/3$$

$$C_C^* = 4(1/6) = 2/3$$

$$C_C^* = 4(1/5) = 4/5$$

c) B(1)

$$2 \rightarrow 3 = 0$$

$$2 \rightarrow 4 = 0$$

$$2 \rightarrow 5 = 0$$

$$3 \rightarrow 4 = 0$$

$$3 \rightarrow 5 = 0$$

$$4 \rightarrow 5 = 1/2$$

$$C_B = \frac{1}{2} \cdot 2 = 1$$

$$C_B^* = \frac{2}{25}$$

B(2)

$$1 \rightarrow 3 = 0$$

$$1 \rightarrow 4 = 0$$

$$1 \rightarrow 5 = 0$$

$$3 \rightarrow 4 = 1/11$$

$$3 \rightarrow 5 = 0$$

$$4 \rightarrow 5 = 1/2$$

$$C_B = \frac{3}{2} \cdot 2 = 3$$

$$C_B^* = \frac{3}{12}$$

B(3)

$$1 \rightarrow 2 = 0$$

$$1 \rightarrow 4 = 0$$

$$1 \rightarrow 5 = 0$$

$$2 \rightarrow 4 = 0$$

$$2 \rightarrow 5 = 0$$

$$4 \rightarrow 5 = 0$$

$$C_B = 0$$

$$C_B^* = 0$$

B(4)

$$1 \rightarrow 2 = 1/2$$

$$1 \rightarrow 3 = 0$$

$$1 \rightarrow 5 = 0$$

$$2 \rightarrow 3 = 0$$

$$2 \rightarrow 5 = 0$$

$$3 \rightarrow 5 = 0$$

$$C_B = \frac{1}{2} \cdot \frac{1}{2} = 1$$

$$C_B^* = \frac{2}{25}$$

B(5)

$$1 \rightarrow 2 = 1/2$$

$$1 \rightarrow 3 = 1/1$$

$$1 \rightarrow 4 = 0$$

$$2 \rightarrow 3 = 0$$

$$2 \rightarrow 4 = 0$$

$$3 \rightarrow 4 = 0$$

$$C_B = \frac{3}{2} \cdot \frac{1}{2} = 3$$

$$C_B^* = \frac{3}{12}$$