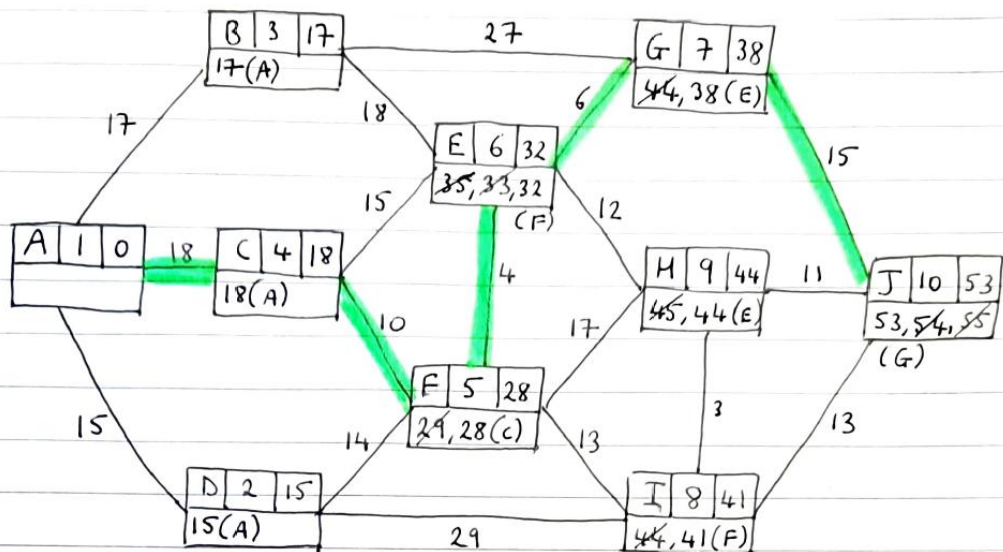


Worked Solutions

Q1.

i)

a)

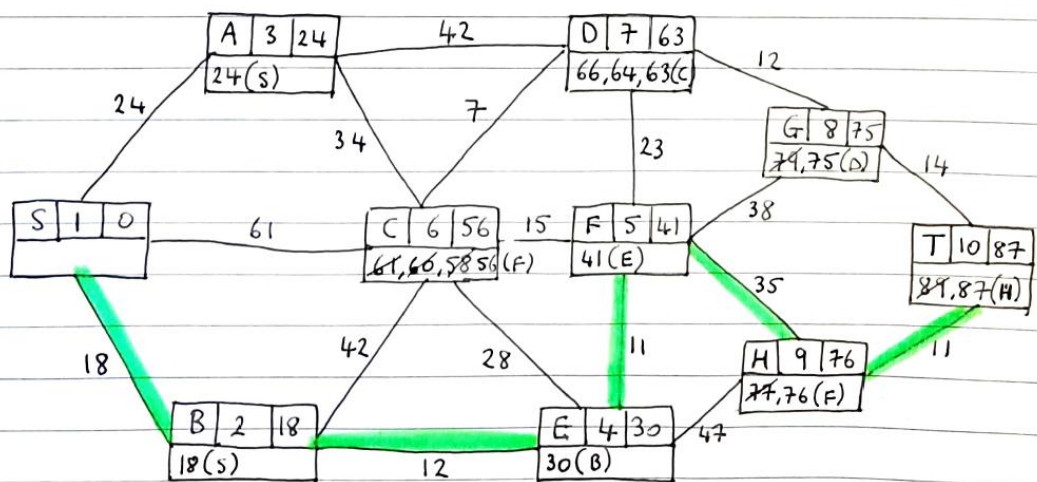


Shortest Path = **A C F E G J** Length = **53**

b)

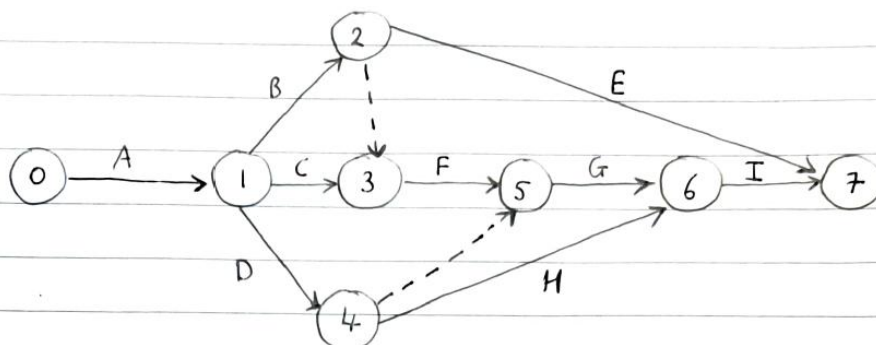
Path = **A D F E G J** Length = **54**
or **A C E G J**

ii)



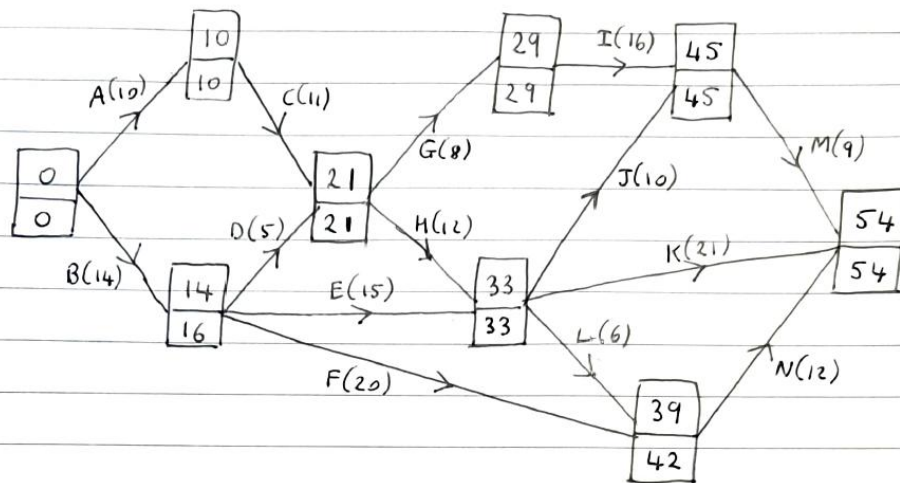
Shortest Path = **S B E F H T** Length = **87**

Q2.



Q3.

Activity	Depends on	Activity	Depends on
A	-	H	C, D
B	-	I	E
C	-	J	F, H
D	A	K	G, J
E	A	L	G
F	B	M	L
G	B	N	L

Q4.
a)

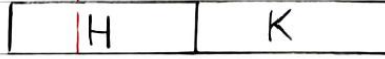
b) Total Floats:

A: $10 - 0 - 10 = 0$ ✓	H: $33 - 21 - 12 = 0$ ✓
B: $16 - 0 - 14 = 2$ ✓	I: $45 - 29 - 16 = 0$ ✓
C: $21 - 10 - 11 = 0$ ✓	J: $45 - 33 - 10 = 2$ ✓
D: $21 - 14 - 5 = 2$ ✓	K: $54 - 33 - 21 = 0$ ✓
E: $33 - 14 - 15 = 4$ ✓	L: $42 - 33 - 6 = 3$ ✓
F: $42 - 14 - 20 = 8$ ✓	M: $54 - 45 - 9 = 0$ ✓
G: $29 - 21 - 8 = 0$ ✓	N: $54 - 39 - 12 = 3$

c) Critical activities have float of 0 ⇒ A, C, G, H, I, K, M

d)

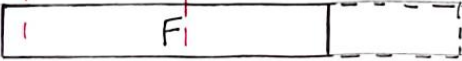
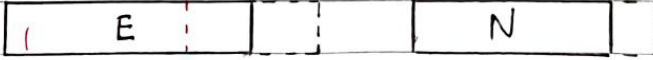
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60



e)

Day 15: C

Day 25: G, H, E, F



Day 15

Day 25

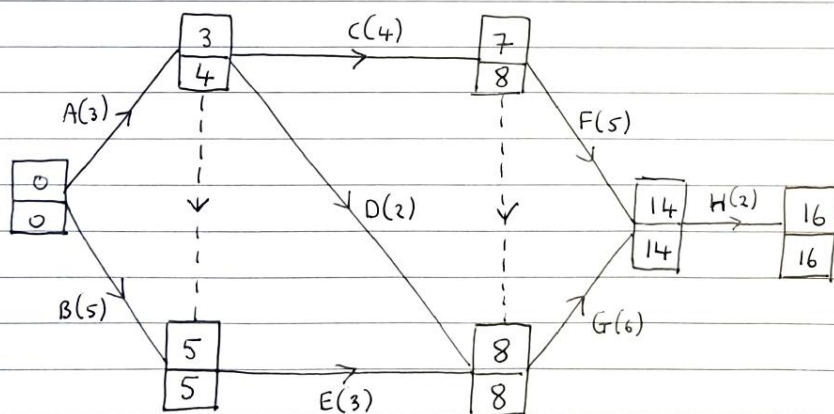
Q5.

a)

Activity	Depends on
A	-
B	-
C	A
D	A
E	A, B
F	C
G	C, D, E
H	F, G

b) These are dummy activities. They don't require any time to complete but ensure the correct precedence is maintained. e.g. E cannot take place until both A and B have completed.

c)

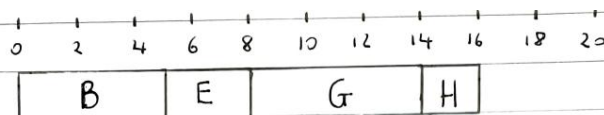


d) Total Floats : A: $4 - 0 - 3 = 1$ E: $8 - 5 - 3 = 0$
 B: $5 - 0 - 5 = 0$ F: $14 - 7 - 5 = 2$
 C: $8 - 3 - 4 = 1$ G: $14 - 8 - 6 = 0$
 D: $8 - 3 - 2 = 3$ H: $16 - 14 - 2 = 0$

⇒ Critical activities = **B, E, G, H**

Length of critical path = $5 + 3 + 6 + 2 = 16$

e)



A []

C []

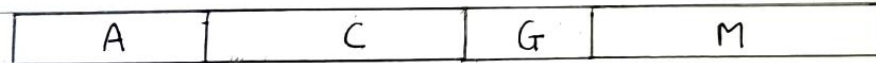
D []

F []

Q6. Line down through day 22 has 4 activities happening $\Rightarrow$ **4 workers**

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28

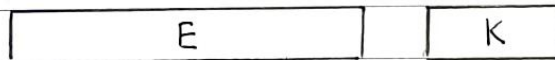
w1:



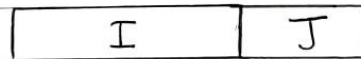
w2:



w3:



w4:



Q7.

i) **38 days**

ii) Total Floats:
 $A: 13 - 0 - 8 = 5$ $G: 20 - 9 - 8 = 3$
 $B: 20 - 0 - 9 = 11$ $H: 22 - 20 - 2 = 0$
 $C: 9 - 0 - 9 = 0$ $I: 32 - 13 - 3 = 16$
 $D: 20 - 8 - 7 = 5$ $J: 31 - 22 - 9 = 0$
 $E: 20 - 9 - 11 = 0$ $K: 31 - 20 - 11 = 0$
 $F: 29 - 8 - 5 = 16$ $L: 38 - 22 - 6 = 10$
 $M: 38 - 31 - 7 = 0$

$\Rightarrow$ Critical Paths = **CEHJM** and **CEHKM**

iii) Lower bound = $\frac{\text{sum of activity times}}{\text{critical time}}$

$$= \frac{8+9+9+5+7+11+2+8+3+9+11+6+7}{38}$$

$$= \frac{95}{38} = 2.5 \Rightarrow \text{3 workers}$$

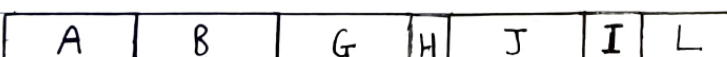
iv)

0 4 8 12 16 20 24 28 32 36 40 44 48 52

w1:

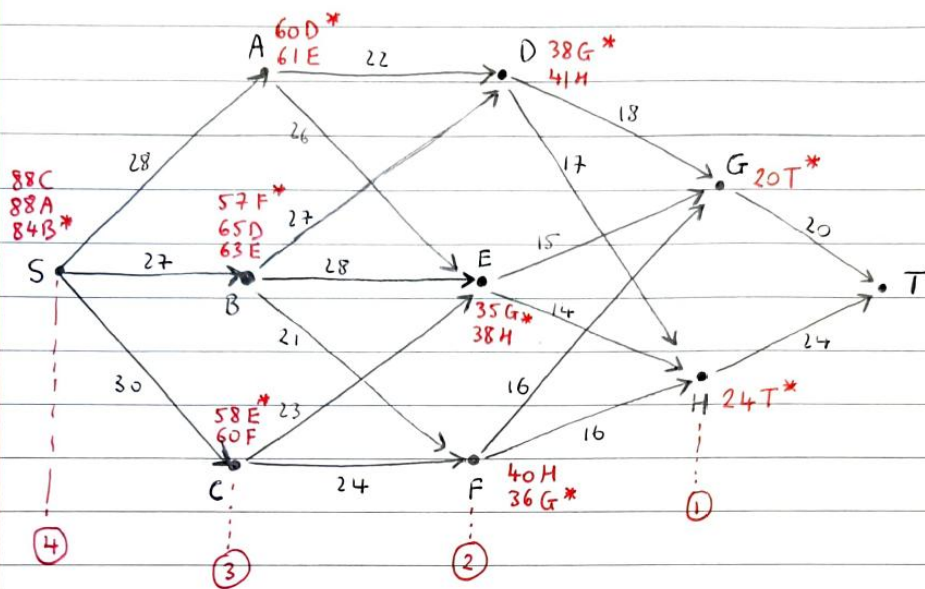


w2:



$\Rightarrow$ Shortest Time = **51 days**

Q8.



Optimal Path = **SBFGT**

Costs = **£84 000**

⇒ Average = $\frac{84000}{4} = \textbf{£21000}$

Q9.	Product	Kgs Available	Kgs Allocated	Kgs Left	Profit + OVD
	3	0	0	0	0*
	(Tartlets)	1	1	0	125*
		2	2	0	265*
		3	3	0	330*
		4	4	0	350*
		5	5	0	395*
	2	0	0	0	0*
	(Ice Cream)	1	0	1	0 + 125 = 125
			1	0	150 + 0 = 150*
		2	0	2	0 + 265 = 265
			1	1	150 + 125 = 275*
			2	0	185 + 0 = 185
		3	0	3	0 + 330 = 330
			1	2	150 + 265 = 415*
			2	1	185 + 125 = 310
			3	0	215 + 0 = 215
		4	0	4	0 + 350 = 350
			1	3	150 + 330 = 480*
			2	2	185 + 265 = 450
			3	1	215 + 125 = 340
			4	0	220 + 0 = 220
		5	0	5	0 + 395 = 395
			1	4	150 + 350 = 500
			2	3	185 + 330 = 515*
			3	2	215 + 265 = 480
			4	1	220 + 125 = 345
			5	0	255 + 0 = 255
	1	5	5	0	420 + 0 = 420
	(Jam)		4	1	315 + 150 = 465
			3	2	230 + 275 = 505
			2	3	145 + 415 = 560*
			1	4	75 + 480 = 555
			0	5	0 + 515 = 515

⇒ Optimum = 2 kgs for Jam, 1 kg for Ice Cream
and 2 kgs for Tartlets

= Profit of €560

Q10.

Month	March	April	May	June	July
a) No. ordered	2	3	7	3	4

STOCK CHECK: 0 2 3 0 1 0

~~1~~ ~~2~~

~~0~~ ~~1~~

~~0~~

Month	No. in Stock	No. made	No. left in stock	Costs = Storage + Overhead + Labour + OVD
July (4)	0	4	0	$= 0 + 1200 + 600 + 0 = 1800^*$
	1	3	0	$= 80 + 1200 + 0 + 0 = 1280^*$
June (3)	0	4	1	$= 0 + 1200 + 600 + 1280 = 3080$
		3	0	$= 0 + 1200 + 0 + 1800 = 3000^*$
May (7)	3	4	0	$= 240 + 1200 + 600 + 3000 = 5040^*$
April (3)	2	4	3	$= 160 + 1200 + 600 + 5040 = 7000^*$
March (2)	0	4	2	$= 0 + 1200 + 600 + 7000 = 8800^*$

⇒ Make 4 in March, 4 in April, 4 in May, 3 in June and 4 in July with costs of €8800

b) Materials = $120 \times 19 = €2280$

Optimal Costs = €8800

⇒ Total Costs = €11080

Income from 19 doghouses = $800 \times 19 = €15200$

⇒ Profit = $15200 - 11080$
 $= €4120$

Q11.	No of weeks left	Fair Visited	Where she travels	where she finishes	Value
	1	F	F → Home	Home	$= 400 - 70 + 0 = 330^*$
		G	G → Home	Home	$= 900 - 100 + 0 = 800^*$
		H	H → Home	Home	$= 500 - 80 + 0 = 420^*$
	2	C	CF	F	$= 900 - 210 + 330 = 1020$
			CG	G	$= 900 - 190 + 800 = 1510^*$
			CH	H	$= 900 - 180 + 420 = 1140$
		D	DF	F	$= 1200 - 220 + 330 = 1310$
			DG	G	$= 1200 - 150 + 800 = 1850^*$
			DH	H	$= 1200 - 140 + 420 = 1480$
		E	EF	F	$= 1100 - 180 + 330 = 1250$
			EG	G	$= 1100 - 110 + 800 = 1790^*$
			EH	H	$= 1100 - 130 + 420 = 1390$
	3	A	AC	C	$= 700 - 130 + 1510 = 2080$
			AD	D	$= 700 - 160 + 1850 = 2390^*$
			AE	E	$= 700 - 140 + 1790 = 2350$
		B	BC	C	$= 600 - 110 + 1510 = 2000$
			BD	D	$= 600 - 120 + 1850 = 2330^*$
			BE	E	$= 600 - 130 + 1790 = 2260$
	4	Home	Home → A	A	$= 0 - 150 + 2390 = 2240$
			Home → B	B	$= 0 - 70 + 2330 = 2260^*$

Optimal schedule = Home → B → D → G → Home

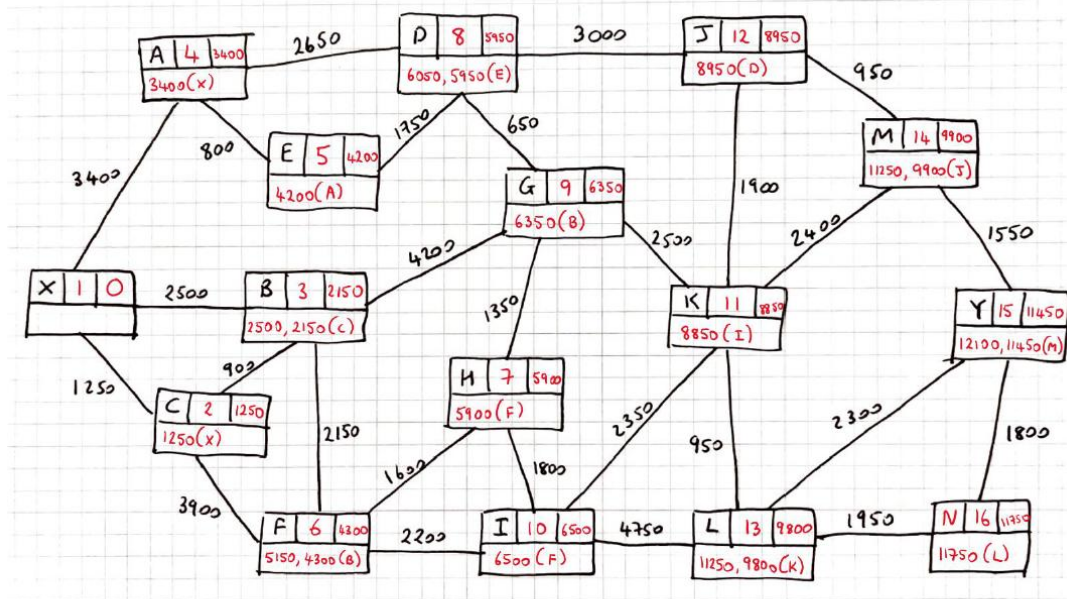
Optimal profit = €2260

Q12.

Year	No of yrs left when buy	Keep yrs for	No of yrs left when sell	Cost = New + maintenance - resale + ovd
0	0	0	0	= 0*
1	1	1	0	= 5000 + 4000 - 37000 + 0 = 17000*
2	2	2	0	= 5000 + 7000 - 30000 + 0 = 27000*
3	3	1	1	= 5000 + 4000 - 37000 + 17000 = 34000
		3	0	= 5000 + 11000 - 18000 + 0 = 43000*
		2	1	= 5000 + 7000 - 30000 + 17000 = 44000
4	4	1	2	= 5000 + 4000 - 37000 + 27000 = 44000
		4	0	= 5000 + 16000 - 0 + 0 = 66000
		3	1	= 5000 + 11000 - 18000 + 17000 = 60000
		2	2	= 5000 + 7000 - 30000 + 27000 = 54000*
		1	3	= 5000 + 4000 - 37000 + 43000 = 60000
5	5	4	1	= 5000 + 16000 - 0 + 17000 = 83000
		3	2	= 5000 + 11000 - 18000 + 27000 = 70000*
		2	3	= 5000 + 7000 - 30000 + 43000 = 70000*
		1	4	= 5000 + 4000 - 37000 + 54000 = 71000
		4	2	= 5000 + 16000 - 0 + 27000 = 93000
6	6	3	3	= 5000 + 11000 - 18000 + 43000 = 86000
		2	4	= 5000 + 7000 - 30000 + 54000 = 81000*
		1	5	= 5000 + 4000 - 37000 + 70000 = 87000

Strategy : Sell every 2 years Min Cost = €81000

2023 Q2



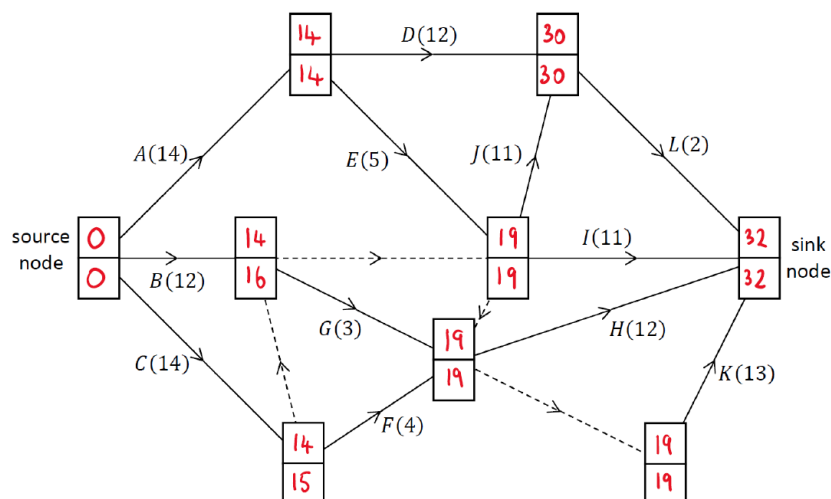
Cheapest Route = **XAEDJMY** Cost = **€11,450**

2023 Q9

(i)

Activity	Depends directly on ...	Activity	Depends directly on ...
A	-	G	B, C
B	-	H	B, C, E, F, G
C	-	I	B, C, E
D	A	J	B, C, E
E	A	K	B, C, E, F, G
F	C	L	D, J

(ii)



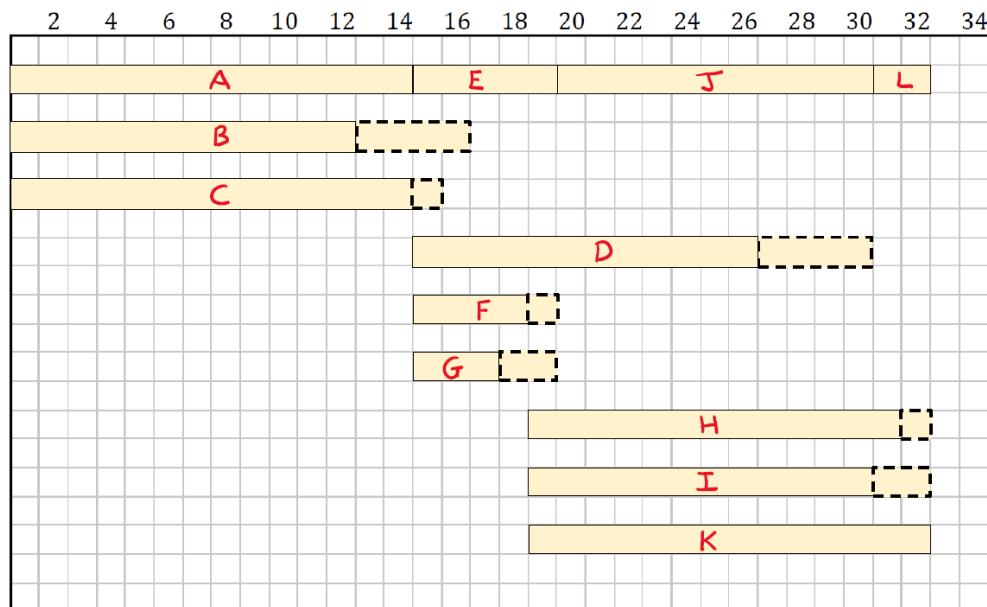
Activity	Total Float	Activity	Total Float
A	14 - 0 - 14 = 0	G	19 - 14 - 3 = 2
B	16 - 0 - 12 = 4	H	32 - 19 - 12 = 1
C	15 - 0 - 14 = 1	I	32 - 19 - 11 = 2
D	30 - 14 - 12 = 4	J	30 - 19 - 11 = 0
E	19 - 14 - 5 = 0	K	32 - 19 - 13 = 0
F	19 - 14 - 4 = 1	L	32 - 30 - 2 = 0

(iii)

From table on previous page: Critical Activities = A, E, J, K, L

=> Critical Paths = **AEJL** or **AEK including 2 dummies**

(iv)



(v)

Activities D, E, F and G may be happening.