

رقم الشعبة:

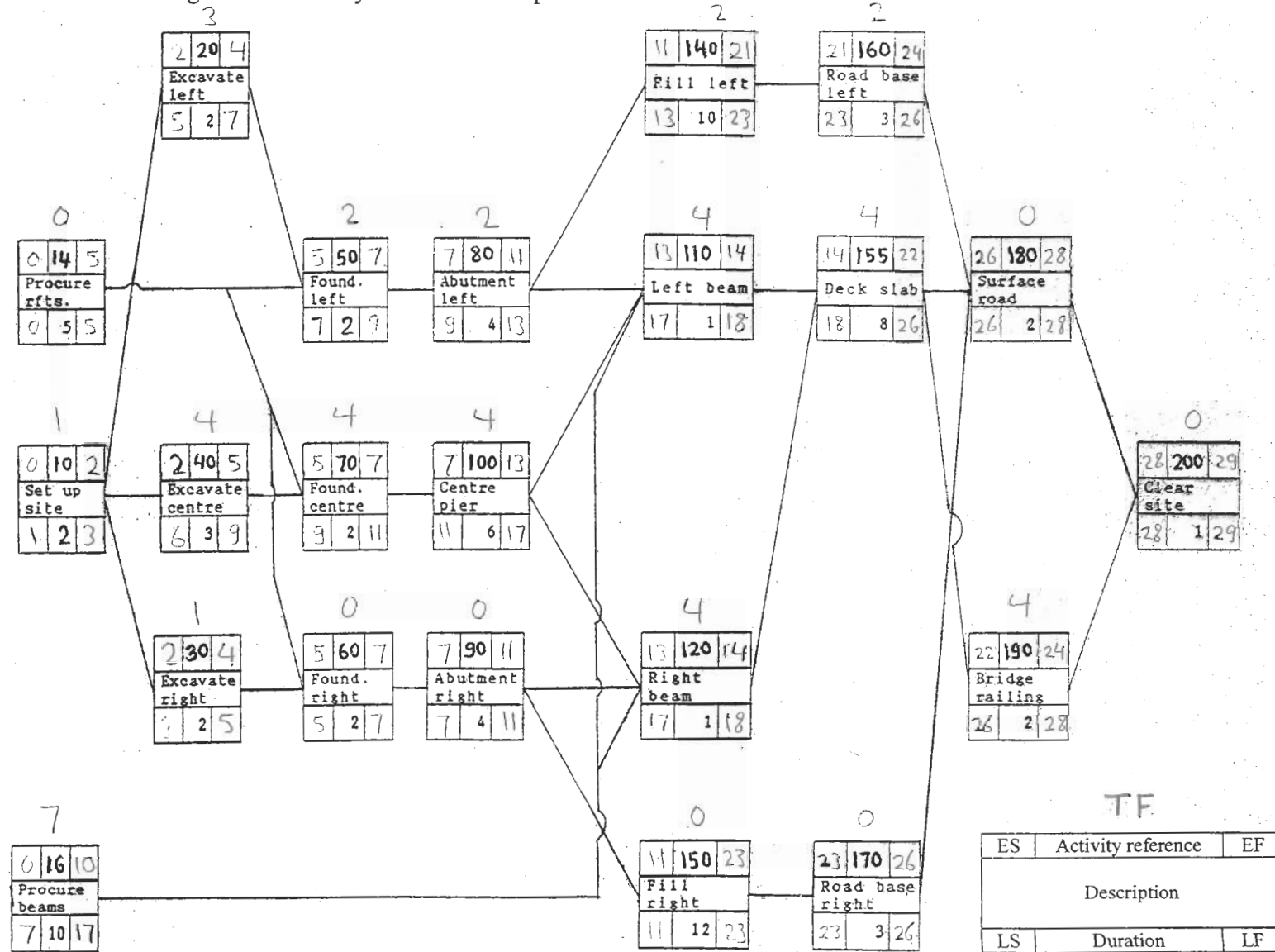
الرقم الجامعي:

اسم الطالب:

Question 1 (50% of max. credit)

Analyse the shown AON network. Determine degree of criticality of the network paths.

Path	TF	Criticality
14-60-90-150-170-180-200	0	1
10-30	1	2
50-80-140-160	2	3
20	3	4
40-70-100-110-155-190	4	5
40-70-100-120-155-190	4	5
16	7	6



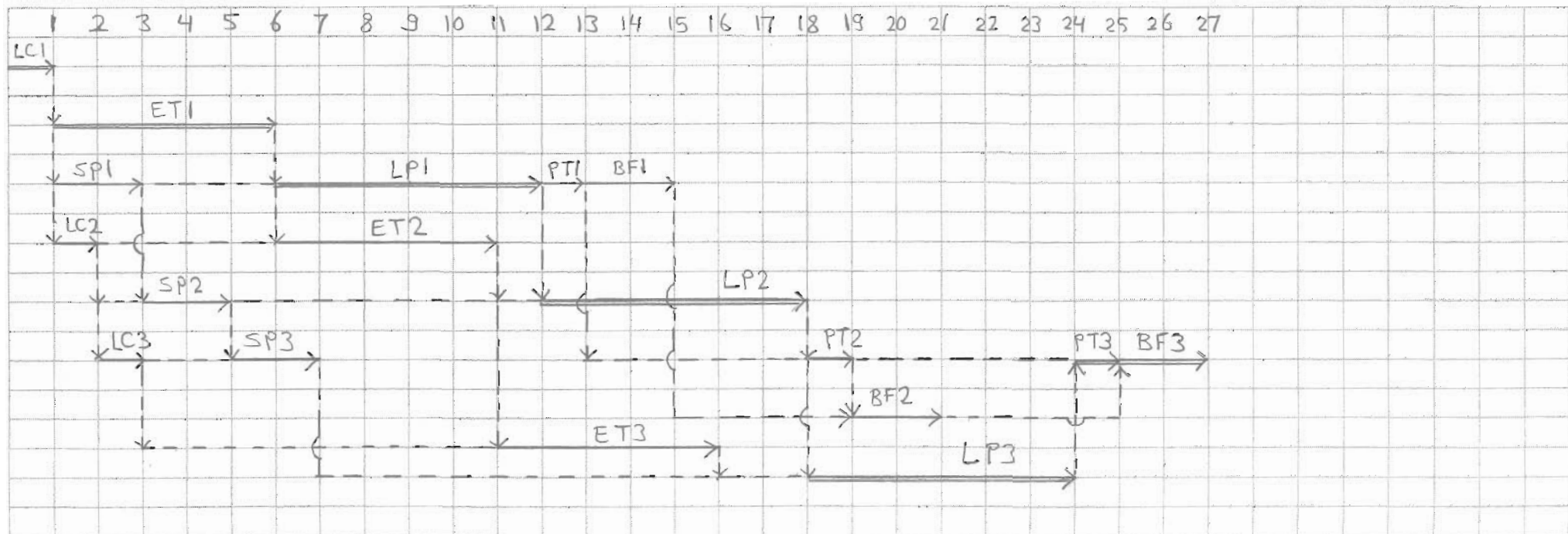
ES	Activity reference	EF
Description		
LS	Duration	LF

Question 2 (50% of max. credit)

Draw a time-scaled network for the given small project. Write down values of LS, TF, and FF of the activities.

Activity	Duration	Predecessor(s)
LC1	1	-
ET1	5	LC1
SP1	2	LC1
LP1	6	ET1, SP1
PT1	1	LP1
BF1	2	PT1
LC2	1	LC1
ET2	5	LC2, ET1
SP2	2	LC2, SP1
LP2	6	ET2, SP2, LP1
PT2	1	LP2, PT1
BF2	2	PT2, BF1
LC3	1	LC2
ET3	5	LC3, ET2
SP3	2	LC3, SP2
LP3	6	ET3, SP3, LP2
PT3	1	LP3, PT2
BF3	2	PT3, BF2

Activity	LS	TF	FF
LC1	0	0	0
ET1	1	0	0
SP1	4	3	0
LP1	6	0	0
PT1	20	8	0
BF1	21	8	4
LC2	6	5	0
ET2	7	1	0
SP2	10	7	0
LP2	12	0	0
PT2	22	4	0
BF2	23	4	4
LC3	12	10	2
ET3	13	2	2
SP3	16	11	11
LP3	18	0	0
PT3	24	0	0
BF3	25	0	0



رقم الشعبة :

الرقم الجامعي :

سم الطالب :

Question 1 (50% of max. credit)

Table 1 lists activities forming the critical path of a project network, together with their mean time and standard deviation. Project duration specified by the owner is 174 days. Table 2 gives area under the normal curve.

- a) Produce on a scale the project cumulative probability vs. duration curve.
- b) Determine using the curve produced above values of:
 - Project optimistic and pessimistic durations,
 - Probability that the project will be late,
 - Probability that project completion will be between 150 and 162 days, and
 - Project duration accepted by a risk-averse contractor who prefers probability of overrun equals 1/6.

Table 1

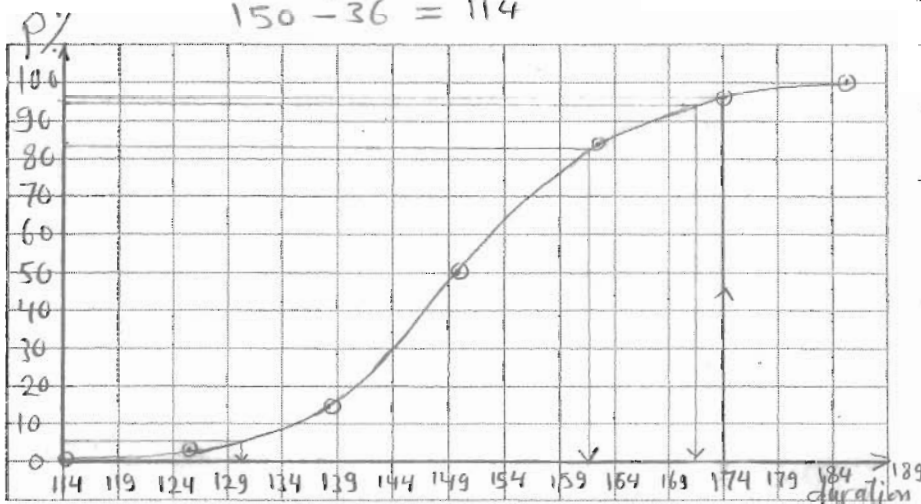
Activity	t_e	σ	ν
A	5	2	4
B	2	1	1
C	12	3	9
D	1	1	1
E	90	9	81
F	16	3	9
G	3	2	4
H	8	3	9
I	3	1	1
J	10	5	25

Table 2 Area under the Normal Curve

SD	area I	SD	area I
0.1	4.0	1.6	44.5
0.2	7.9	1.7	45.5
0.3	11.8	1.8	46.4
0.4	15.5	1.9	47.1
0.5	19.2	2.0	47.7
0.6	22.6	2.1	48.2
0.7	25.8	2.2	48.6
0.8	28.8	2.3	48.9
0.9	31.6	2.4	49.2
1.0	34.1	2.5	49.4
1.1	36.4	2.6	49.5
1.2	38.5	2.7	49.6
1.3	40.3	2.8	49.7
1.4	41.9	2.9	49.98
1.5	43.3	3.0	49.99

a) $\Rightarrow 150 \quad 144 \Rightarrow \sigma = 12$
 $2\sigma = 24$
 $3\sigma = 36$

$150 + 36 = 186$
 $150 - 36 = 114$



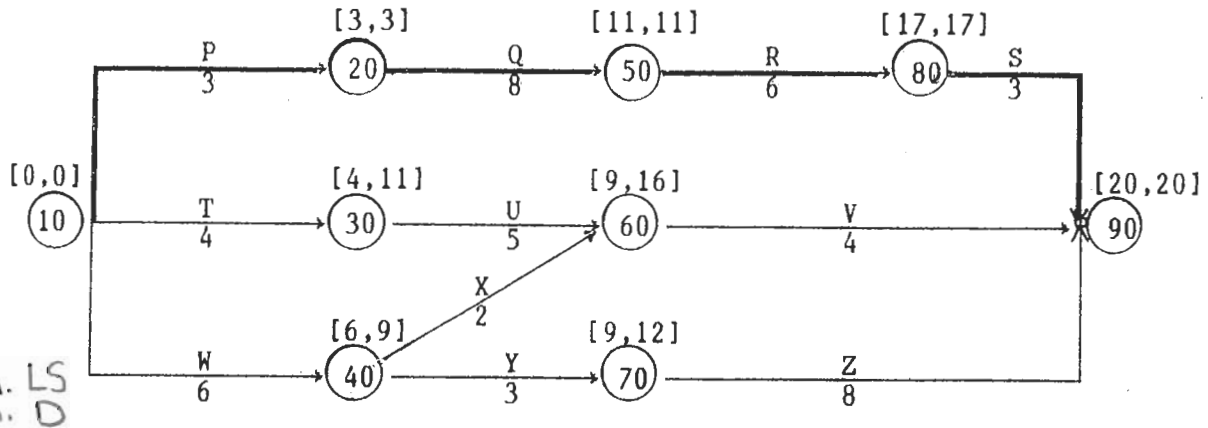
Cumulative probability vs. duration Curve

- b)
- optimistic duration = 130 days
 - Pessimistic = 171.5 "
 - P the project will be late = 2.3%
 - P project completion will be between 150 and 162 = 34.1%
 - duration of probability of overrun = $\frac{1}{6} \approx 16.666\%$ is ≈ 161.5 days

Question 2 (50% of max. credit)

The work of a small project is planned according to the arrow network shown below. Each activity requires continuous use of one crane. Because of space restrictions, only two such cranes can be made available for the work.

- a) What is the minimum project duration assuming that once an activity is started it must be completed without a break? (35%)
- b) Reproduce the project arrow network showing resource constraints. (Note that if this network is analysed, it will give early start project completion time equals the minimum project duration obtained in a) above.) (15%)

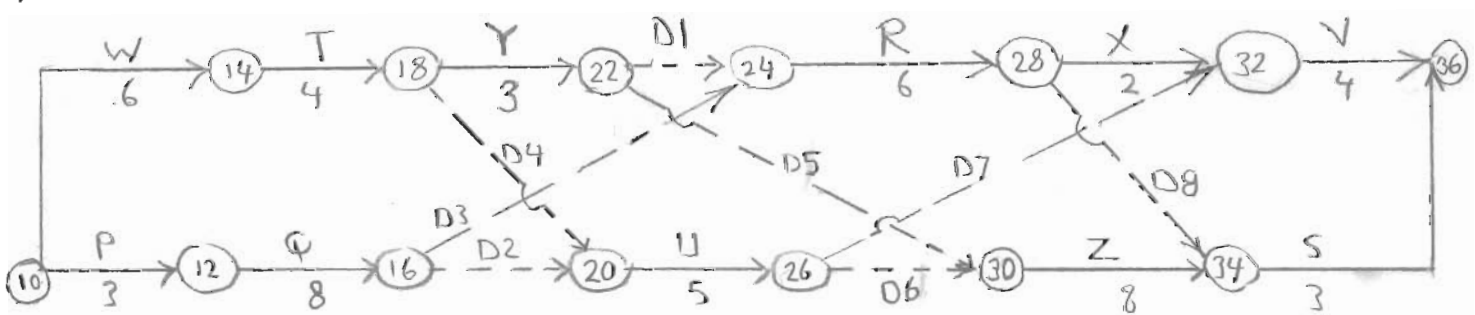


a) Min. LS
Min. D

EAS	P	Q	X	U	R	Z	Z	S	V	S
	T	T	Y	Y	U	R	X	X	S	
	W		T	X	X	X				
OSS	P	Q	T	Y	U	R	Z	X	V	S
	W	T	Y	U	R	Z	X	S	S	
	T		X	X	X	X				

P	[Bar from 3 to 6]																											
W	[Bar from 6 to 9]																											
T	[Bar from 4 to 11]																											
Y	[Bar from 7 to 10]																											
U	[Bar from 9 to 16]																											
R	[Bar from 11 to 17]																											
Z	[Bar from 17 to 20]																											
X	[Bar from 9 to 12]																											
V	[Bar from 20 to 24]																											
S	[Bar from 20 to 25]																											

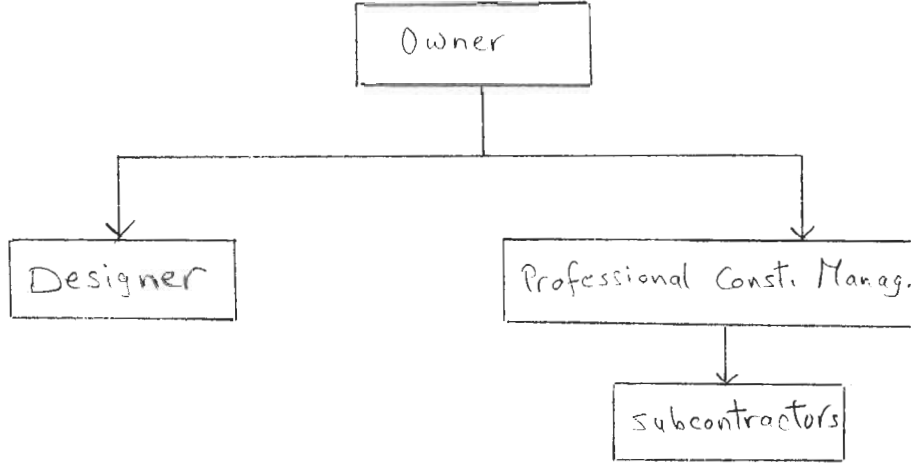
b)



Final Exam

Question 1 (10% of max. credit)

- a) Draw a simple figure to show contractual relationships in case of Professional Construction Manager approach.



- b) A cost-plus contract has unlimited flexibility for introducing design changes during construction while a lump sum contract has no such flexibility. Explain why this is the case.

This is because the owner pays actual site costs in a cost-plus contract where in a lump sum contract, the contractor chooses a fixed price to cover specified items of work.

- c) Differentiate between economic feasibility and financial feasibility of a project.

Economic feasibility of a project determines the most economical alternative for the project while financial feasibility determines sources of finance of the project.

د) وضع سببا واحدا يؤدي إلى عدم قبول ديوان المظالم لعقد المقاول.

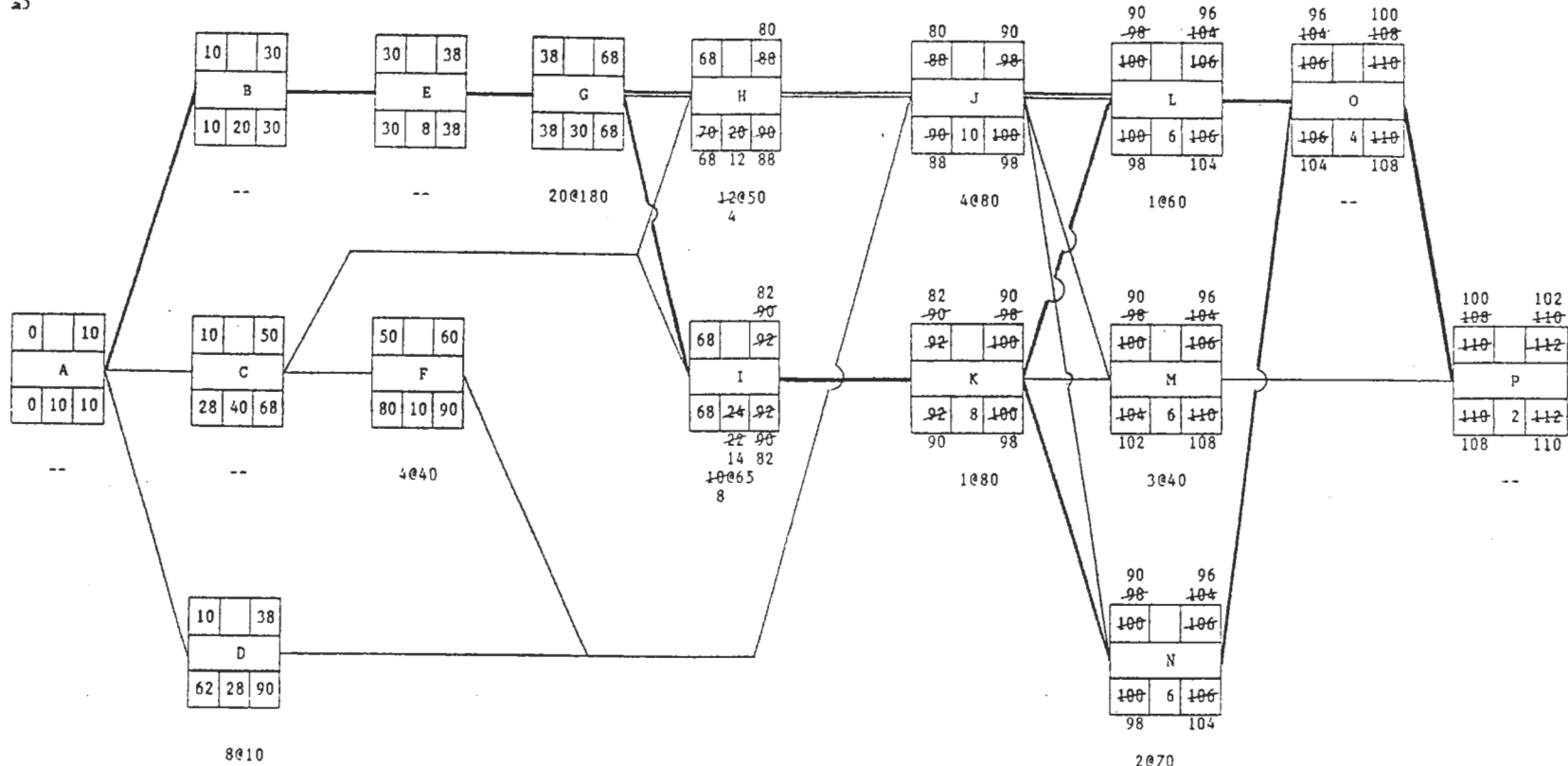
أن يتضمن العقد ما يخالف الشريعة الإسلامية أو ما يخالف عقد الأشغال العامة.

هـ) ناقش باختصار العلاقة بين الانتهاء الجوهري للأعمال وقيمة غرامة التأخير التي تطبق على المقاول.

تطبق غرامة التأخير فقط على الجزء الذي لا يستطيع المالك الانتفاع به أي الأعمال التي لم يتم الانتهاء الجوهري منها.

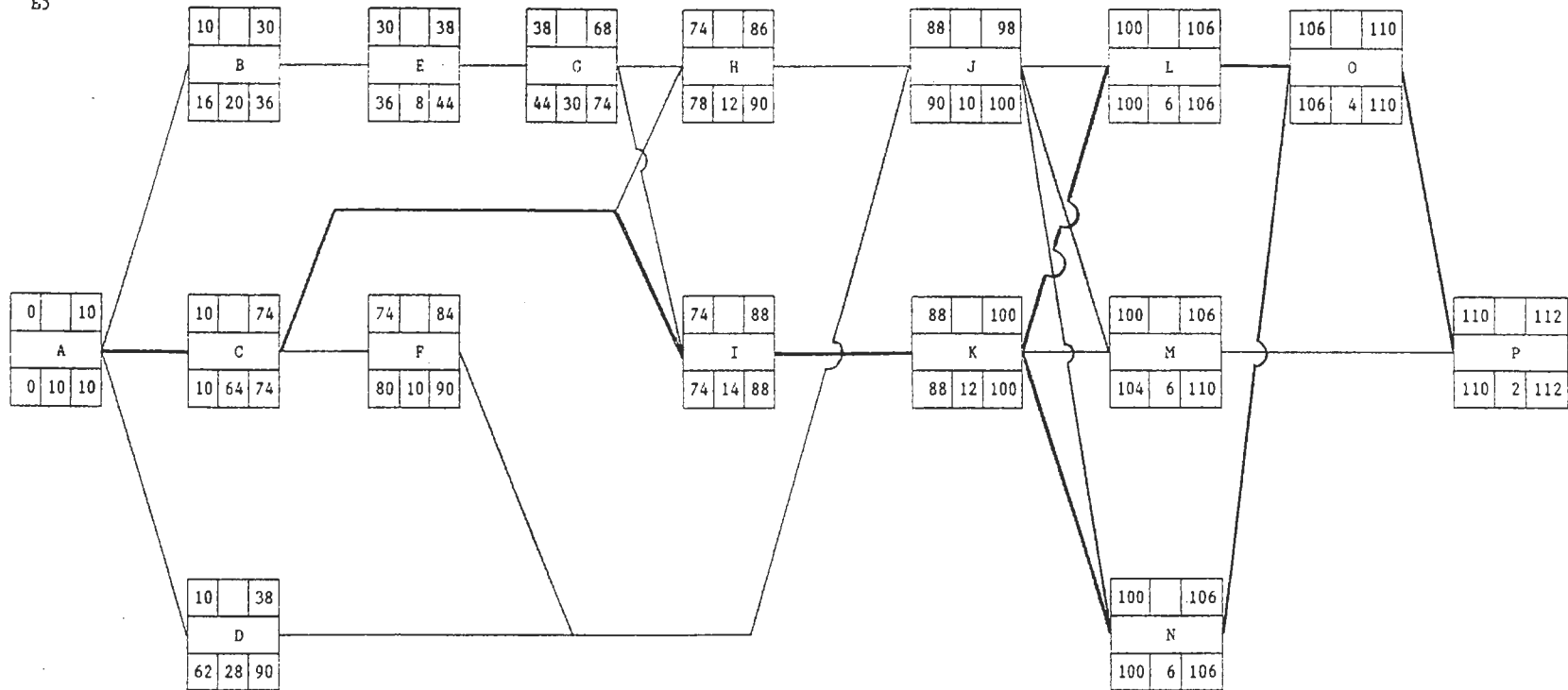
Q2

a)



- Critical paths ABEGIKLOP
ABEGIKNOP
either crash G 180
I 65 → Crash I by 2 days. cost increase = 130.
K 80
L & N 130
- Critical paths ABEGHJLOP
ABEGIKLOP
ABEGIKNOP
either crash G 180
H & I 115 → Crash H & I by 8 days. cost increase = 920.
H & K 130
J & I 145
J & K 160
L & N 130
- Contract duration = 102 days, minimum cost = 11720 + (130 + 920) + 102 (120) = SR25 010.

b3



- Total delay = 112 - 102 = 10 days

- Critical paths ACIKLOP
ACIKNOP

Delayed activities are C & K, they are on the same critical path.

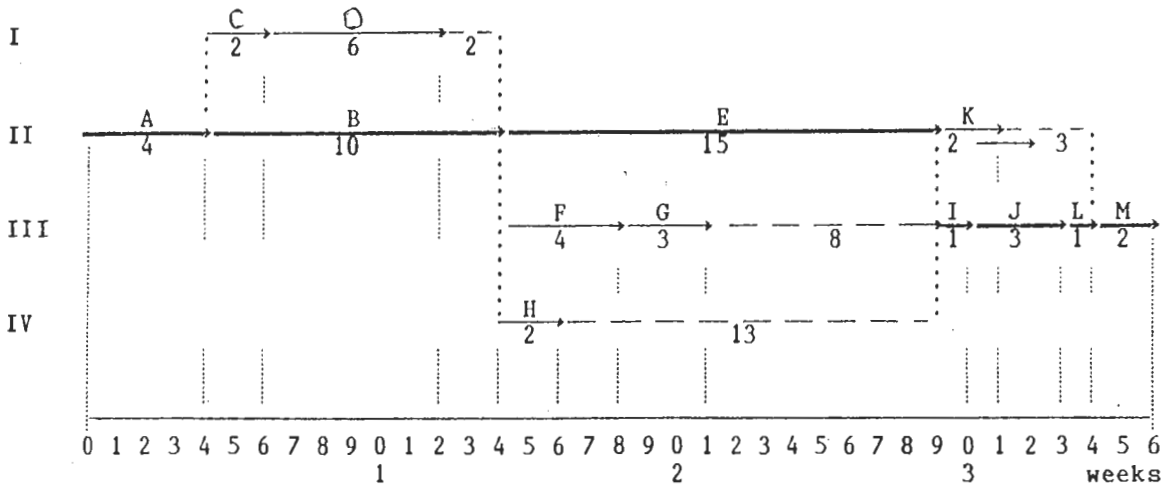
- Contractor responsibility = 6 days

He will pay liquidated damages = 6 (100) = SR 600

- Owner responsibility = 4 days, extension of time = 4 days

He will pay 260 + 4 (120) = SR 740.

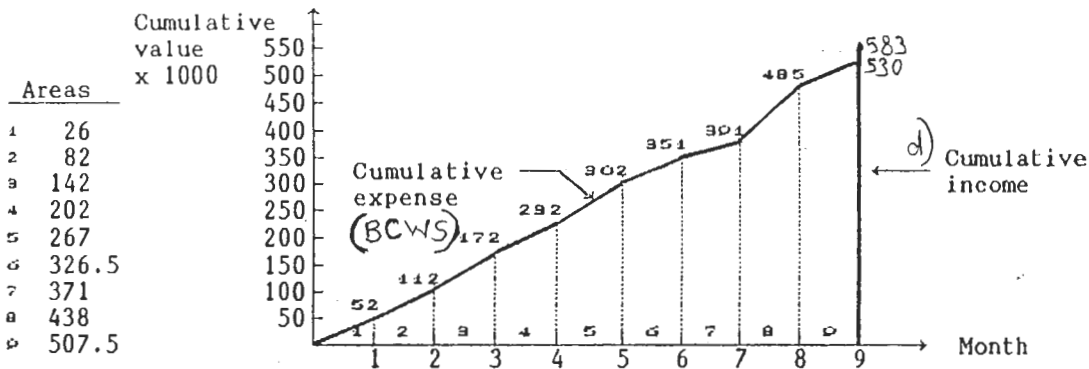
Q3



a) Cash required

I				9	9	9	9	9	9	9	9																							
II	13	13	13	13	6	6	6	6	6	6	6	6	6	6	10	10	10	10	10	10	10	10	10	10	10	10	10	11	11					
III															6	6	6	6	9	9	9							24	19	19	8	9	9	
IV															8	8																		
Σ	13	13	13	13	15	15	15	15	15	15	15	15	6	24	24	16	19	19	19	10	10	10	10	10	10	10	10	35	30	19	19	8	9	9

b) Cum. Mon. 52 112 172 232 302 351 391 485 530



c)

Act	Budget/wk	Weeks																	
		1	2	3	4	5	6	7	8	9	10	11	12						
A	13	████████████████																	
B	5				████████████████████														
C	6				████████████														
D	9						████████████████												
Σ		13	13	13	13	11	11	11	14	14	14	14	14	14	14	14	14	155	

ACWP = SR 160 000
 BCWS = SR 172 000
 BCWP = SR 155 000

SV = BCWP - BCWS = 155000 - 172000 = - 17000 → behind schedule
 CV = BCWP - ACWP = 155000 - 160000 = - 5000 → cost overrun

e) Area between expense & income curves = 2362000 SR. Month

Financial charges = $\frac{2362000}{12} \cdot 0.12 = \text{SR } 23620$

f) See figure above for calculation of weekly cost. Activity K will be shifted one week so that the weekly cost of the contract will not exceed LE 30 000. The scheduled timings of the activities will be as follows:

Activity	SS	SF
A	0	4
B	4	14
C	4	6
D	6	12
E	14	29
F	14	18
G	18	21
H	14	16
I	29	30
J	30	33
K	30	32
L	33	34
M	34	36

Q4

