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Homework-02 CPM Exercise

Task-01 Construct a network diagram

Given tasks according to precedence

① No other task can start until preliminary design is completed

Preliminary design (A)	–	5	– no task

② When preliminary design (A) is completed, final design (B) preparation of assembly & test requirements (C) and parts procurement (D) can start.

Final design (B)	–	7	– A (only after completes (predecessor))
Prepare Assembly and test requirements (C)	–	5	– A
Procure parts (D)	–	10	– A

③ Assembly (E) cannot start until parts are procured (D), final design (B) is complete and assembly and test requirements (C) are completed

			Predecessor
Assembly (E)	–	8	– B, C, D

ie B, C, D starts only after E is completed

④ Procurement of test equipment (F) and preparation of test procedures (G) cannot start until requirements for assembly and test (C) are available

			Predecessor
Procure test equipment (F)	–	12	– C
Prepare test procedures (G)	–	7	– C

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ie Task F, G starts only after completion of task C

⑤ Preparation of test fixtures (H) cannot start until test procedures (G) are available

Prepare of test fixtures (H) ——— 3 ——— G

ie Task H starts only after completion of task G

⑥ Testing (I) cannot start until assembly (E) is complete, test equipment (F) has been procured, and test fixtures(H) are available

Test (I) ——— 3 ——— E, F, H

ie Task I starts only after completion of task E, F, H

So from above we can construct the ~~given~~ table

Symbolic (successor) Event representation	Project Task	Duration in weeks	Predecessor Event
A	Preliminary Design	5	-
B	Final Design	7	A
C	Prepare assembly and test requirement	5	A
D	Procure parts	10	A
E	Assembly	8	B, C, D
F	Procure test equipment	12	E
G	Procure test procedure	7	C
H	Prepare test fixtures	3	G
I	test	3	E, F, H

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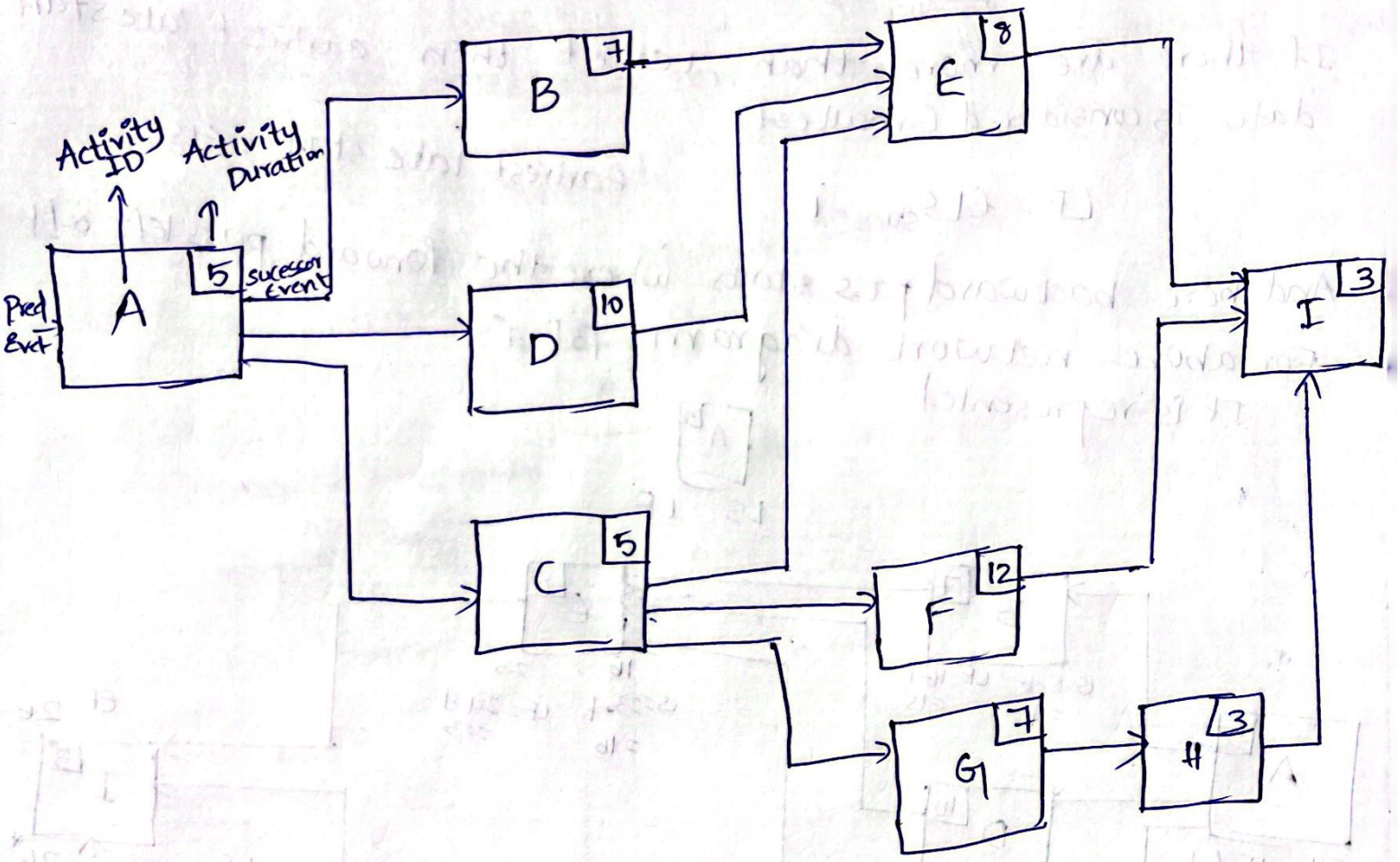
From the above table using the Activity ID and Activity Duration construct the linked nodes



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* Conduct forward pass

In this

$$EF = ES + (Dur - 1)$$

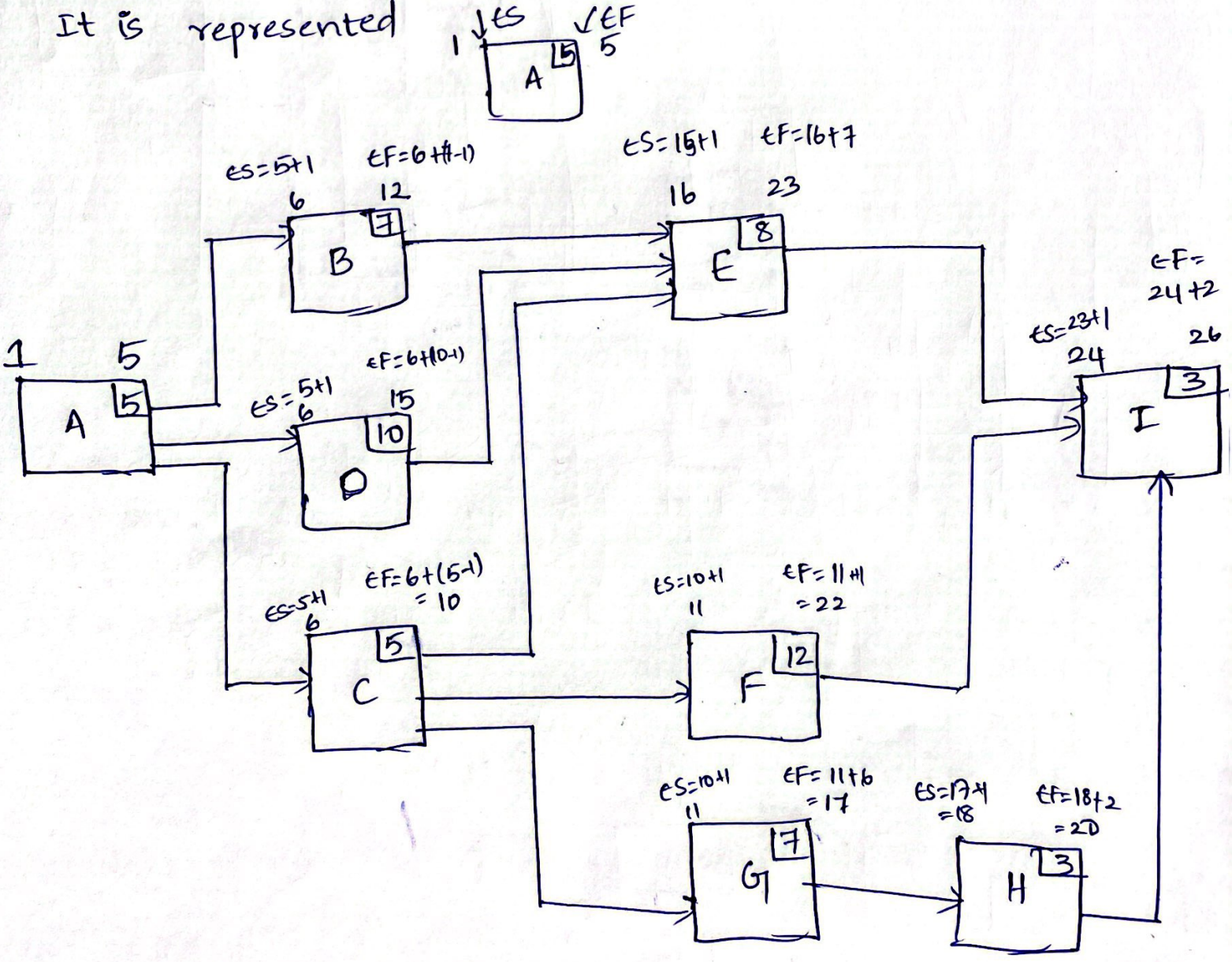
$$ES = EF_{pred} + 1$$

If there are more than 1 event then latest early finish (high) +1

$$ES = LEF_{pred} + 1$$

∴ For above network diagram the FP is

It is represented



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* Conduct backward pass

In this

$LS = LF - (Dur - 1)$ late state = LS

Late Finish - LF

$LF = LS_{succ} - 1$

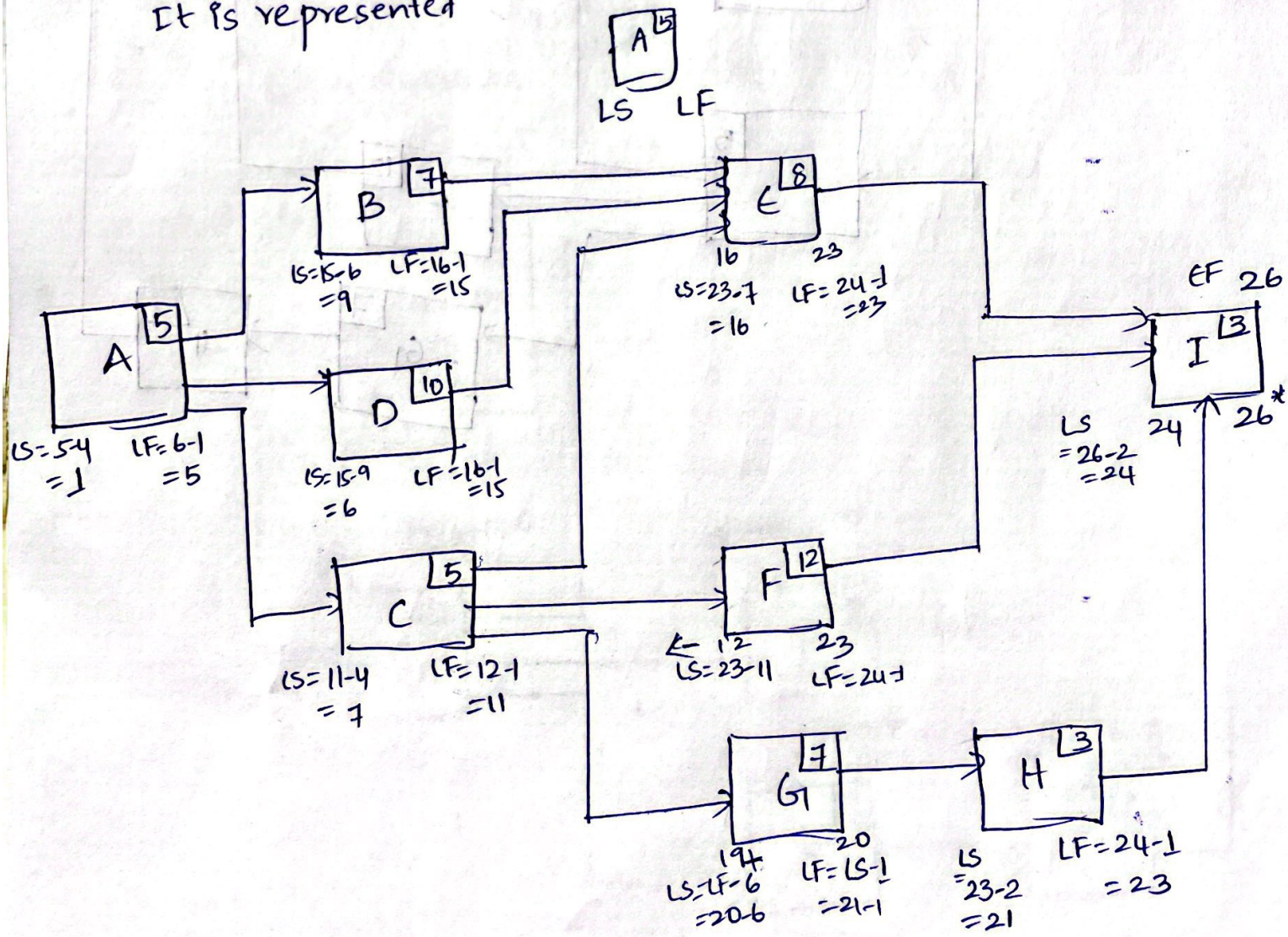
If there are more than 1 event then earliest late start date is considered (smallest)

$LF = ELS_{succ} - 1$ Earliest late start = ELS

And here backward pass starts where the forward pass left off

For above network diagram BP i's

It is represented



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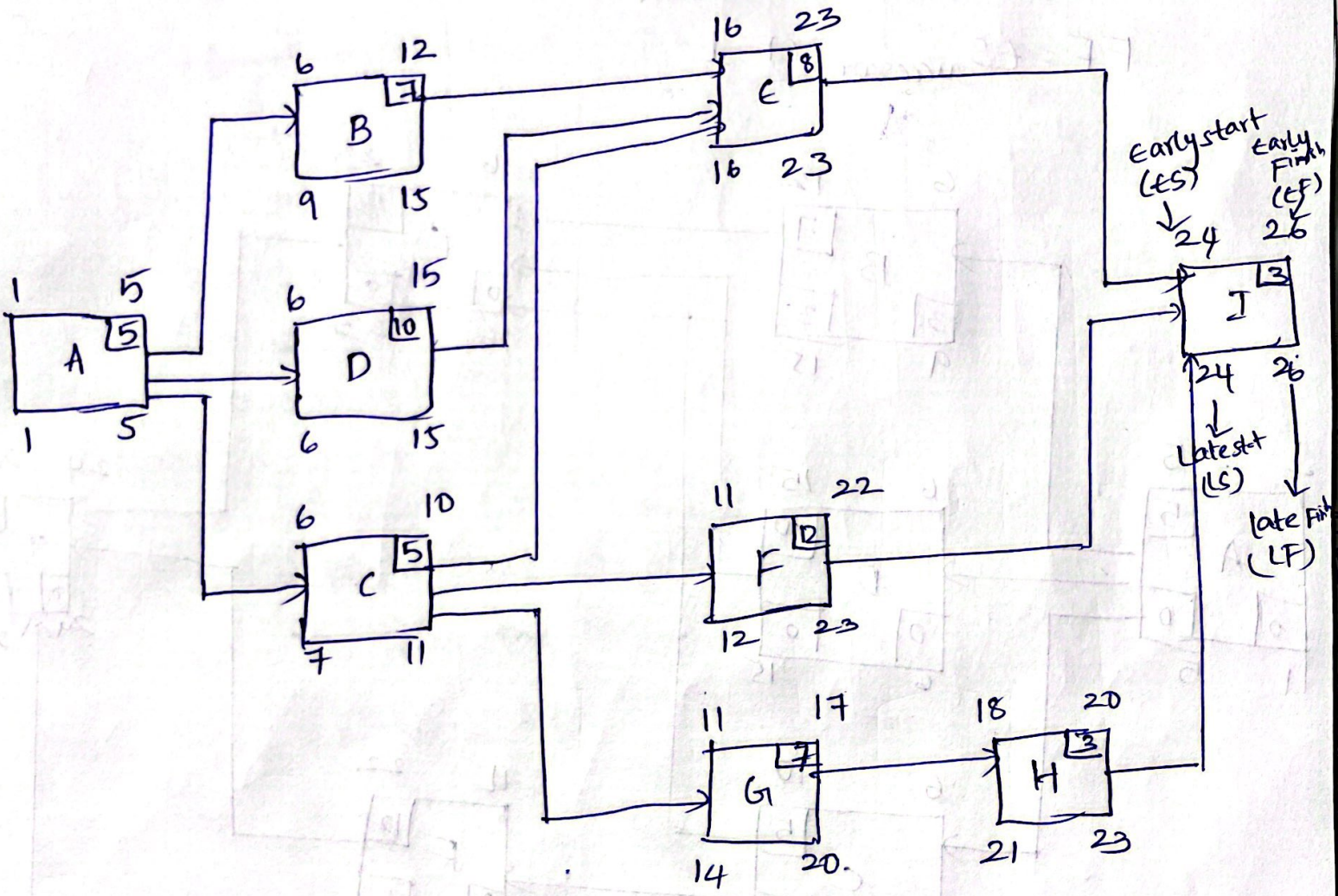
Representing Early and lates Dates



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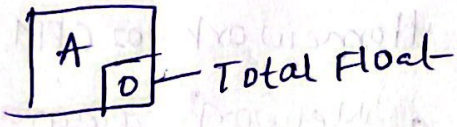
Calculating total float for

'A' = LF - EF
= 5 - 5 = 0



'B' = ~~LF - 15~~ = 15 - 12 = 3

'C' = 11 - 10 = 1

'D' = 15 - 15 = 0

'E' = 23 - 23 = 0

'F' = 23 - 22 = 1

'G' = 20 - 17 = 3

'H' = 23 - 20 = 3

I = 26 - 26 = 0

Calculating Free Float for

'I' = 0 As it is the last one

'E' = ES suc - EF - 1 = 24 - 23 - 1 = 0

'B' = 16 - 12 - 1 = 3

'H' = 24 - 20 - 1 = 3

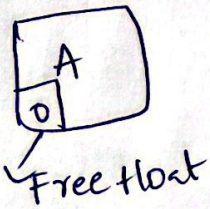
'G' = 18 - 17 - 1 = 0

'F' = 24 - 22 - 1 = 1

'C' = 11 - 10 - 1 = 0

'D' = 16 - 15 - 1 = 0

'A' = 6 - 5 - 1 = 0



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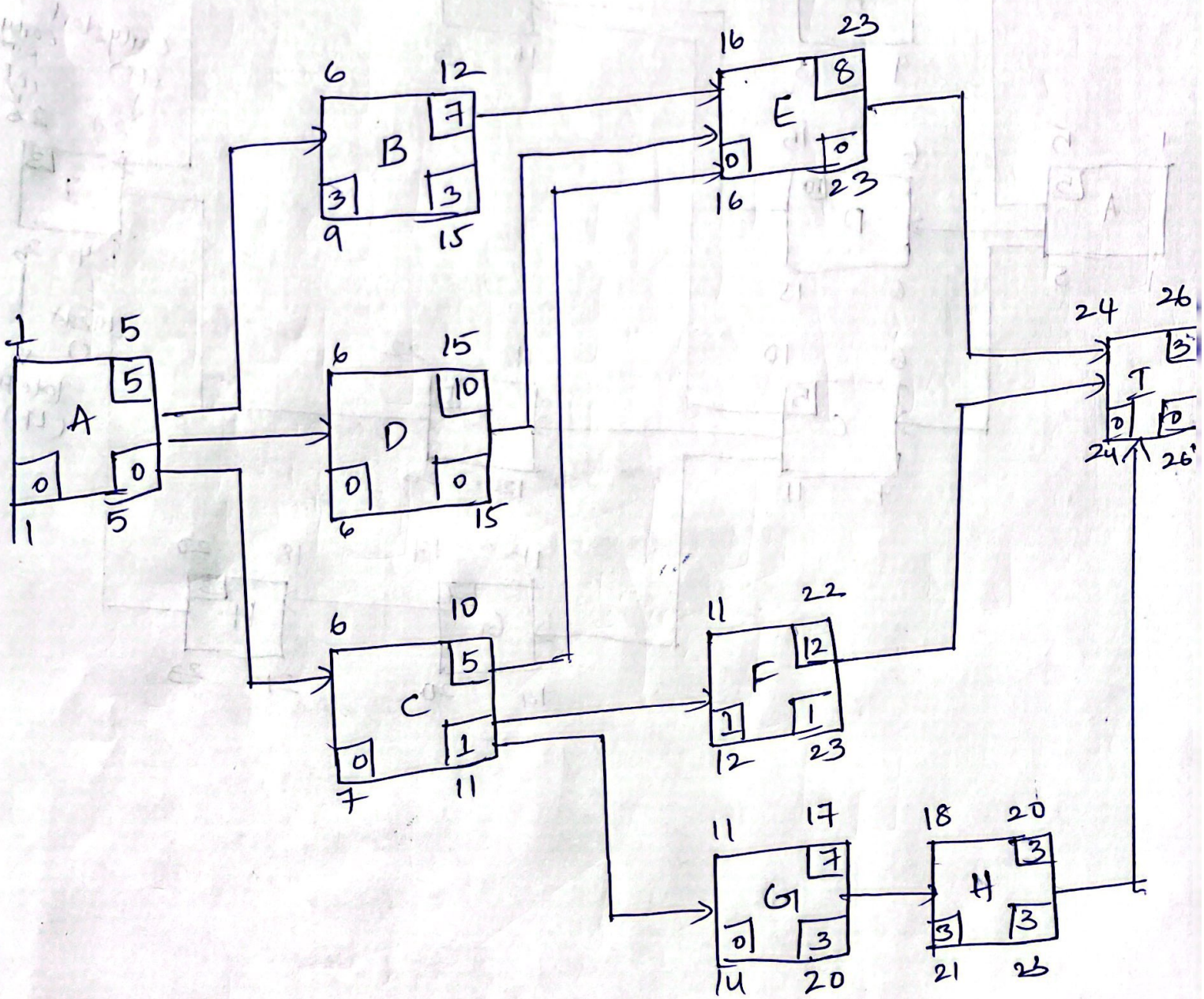
Total Float and Free Float

TF = LF - EF
= late Finish - Early Finish

FF = $ES_{successor}$ - EF - 1



This is the new diagram with complete label on each node

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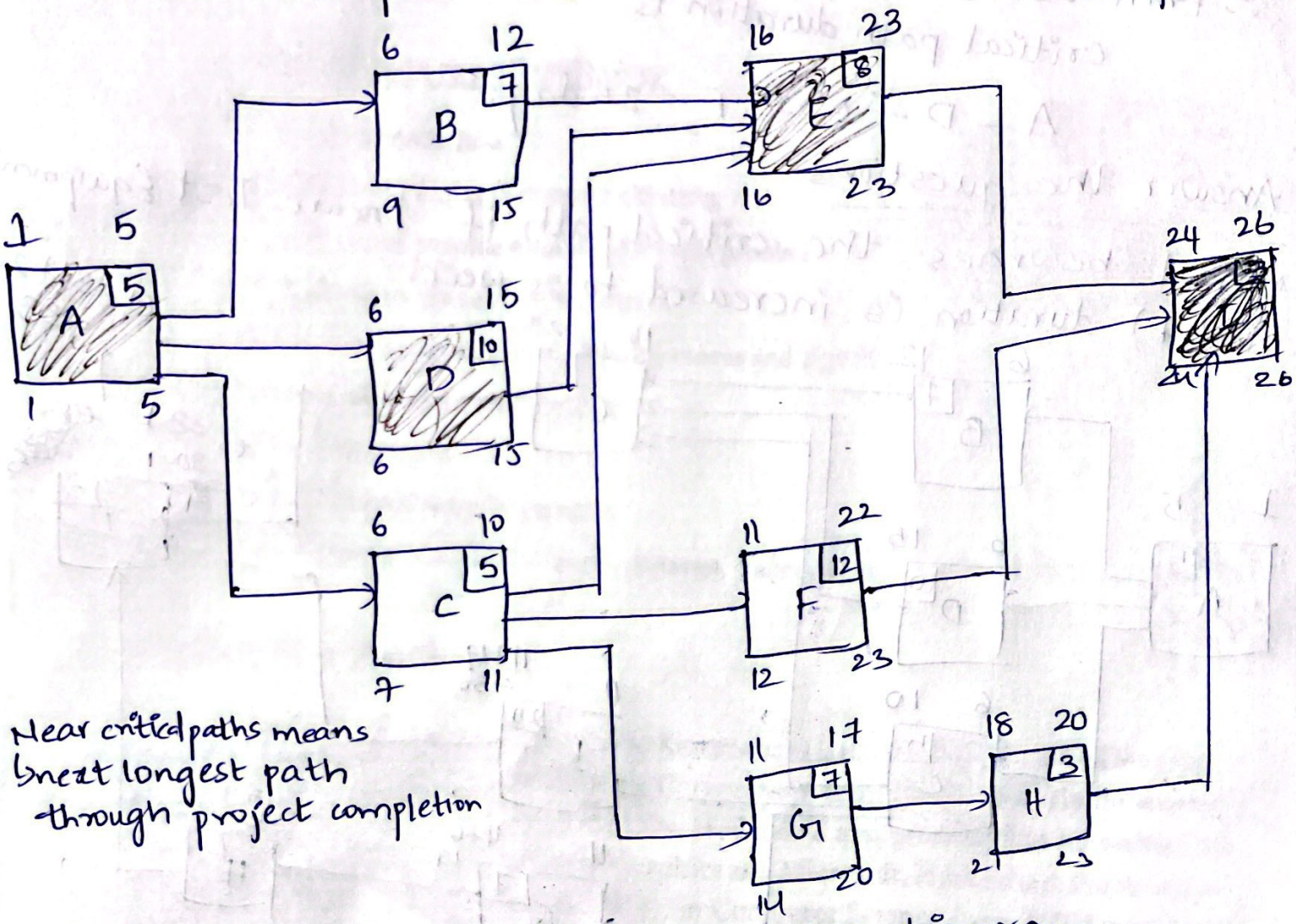
Critical path - longest continuous sequence of task for project completion



Near critical paths means next longest path through project completion

To find critical path for above nlw diagram we should start at the end of the critical path and ask "why". So here

Q1 Why does task "I" starts on day 24?

Ans "I" starts on day 24, because "E" finishes on day 23

Q2 Why does "E" starts on day 16?

Ans "E" starts on day 16, because "D" finishes on day 15.

Q3 Why does "D" starts on day 6?

Ans "D" starts on day 6, because 'A' finishes on day 5

we can stop when the project start ∴ A → D → E → I critical path

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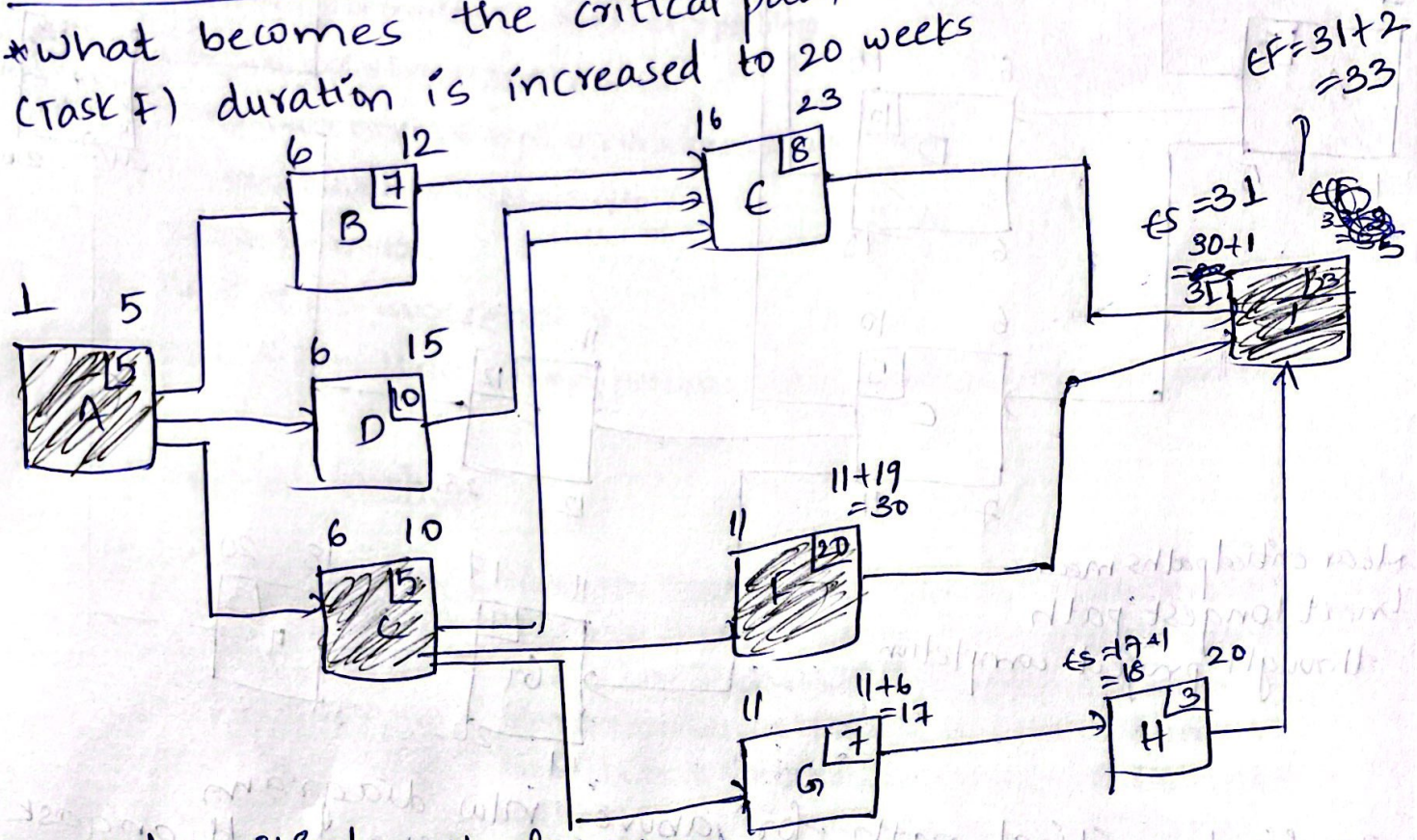
∴ From above

Critical path duration is

A - D - E - F = 26 days

Answer the questions

*What becomes the critical path if 'Procure Test Equipment (Task F) duration is increased to 20 weeks



To find critical path for above

(Q1) Why does task 'I' starts on day 31?

A "I" starts on day 31, because 'F' Finishes on day 30

(Q2) Why does task "F" starts on day 11?

(A) 'F' starts on day 11, because 'd' finishes on day 10

(Q3) Why does task 'd' starts on day 6?

(A) 'd' starts on day 6, because 'A' finishes on day 5

∴ Total critical path is

A - C - F - I = 33 weeks.

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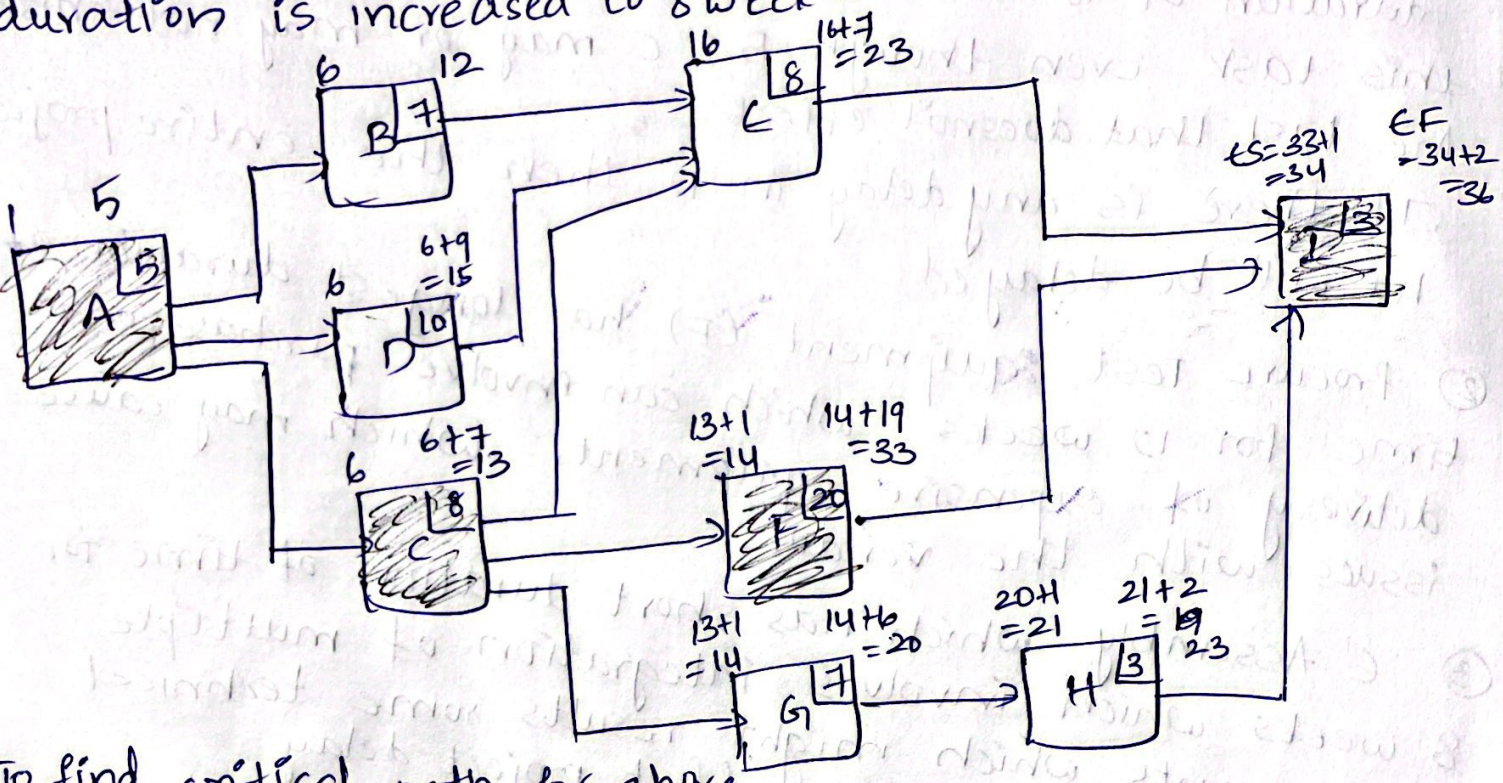
② Based on modified CPM nlw from the first question (Task I is 20 weeks) what becomes the critical path if 'prepare assembly and test requirements task(s) duration is increased to 8 weeks.



To find critical path for above

Q1 why does task 'I' starts on day 34?

A 'I' starts on day 34, because 'F' finishes on day 33.

Q2 why does task 'F' starts on day 14?

A 'F' starts on day 14, because C finishes on day 13.

Q3 why does task 'C' starts on day 6?

A 'C' starts on day 6, because A finishes on day 5.

∴ Total critical path is

A - C - F - I = 36 weeks.

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* What activities would you consider to be risky and why?

① If we look at the nlw diagram procure parts 'D' has duration of 10 weeks, where it is necessary to complete this task even though B & C may or may not finishes the task that doesnot effect 'E'.
If there is any delay in D then the entire project ha will be delayed.

② Procure Test equipment (F) has longest duration of time for 12 weeks which can involve purchase and delivery of expensive equipments which may cause issues with the vendors.

③ 'E' Assembly which has short duration of time for 8 weeks which involves integration of multiple components which might results some technical difficulties which may effect project delay.

④ Even 'I' which is a testing phase has short duration of time for 3 weeks which involves testing the entire system which may not be sufficient

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