Critical Path Analysis: Changing a phone battery

To save time charging a phone, you can use a standalone battery charger and simply rotate two batteries between your phone and the charger. When one is nearly dead, take a fresh one from the charger and swap them over.

A student of critical path analysis is an advocate of the 2 battery system, and wonders how he can minimise the time taken to make the switch. The steps are:

Activity	Immediate Predecessors	Duration (seconds)	*Earliest start*	*Latest end*	*Slack time*
A: Get new battery from charger	-	3			
B: Turn off phone	-	10			
C: Remove cover	-	1			
D: Remove back	C	2			
E: Take out old battery	B,D	1			
F: Put in new battery	A,E	2			
G: Replace back	F	2			
H: Replace cover	G	1			
I: Put old battery in charger	E	3			
J: Turn on phone	F	10			

Note that tasks can be completed simultaneously provided one does not depend on the completion of the other. For instance, you can do C while B is taking place.

1. Add the *duration* to the middle box for each of the attached activity cards, and arrange in such a way as to demonstrate the predecessors for each task.

2. Using the Activity Network on the following page, calculate the earliest possible start time, then the latest possible end time for each activity. Use these to complete the last three columns of the table above.

3. Identify the critical path for your activity network, and state the minimum completion time.

4. How could our phone user potentially improve on this time?

5. Swapping batteries in the dark is not so quick. All activities except for B and J now take *four times as long*. What impact will this have on the critical path?

Critical Path Analysis Cards

Cut out and arrange to show the activity network for this problem

A:
Get new battery from charger

B:
Turn off phone

C:
Remove cover

D:
Remove back

E:
Take out old battery

F:
Put in new battery

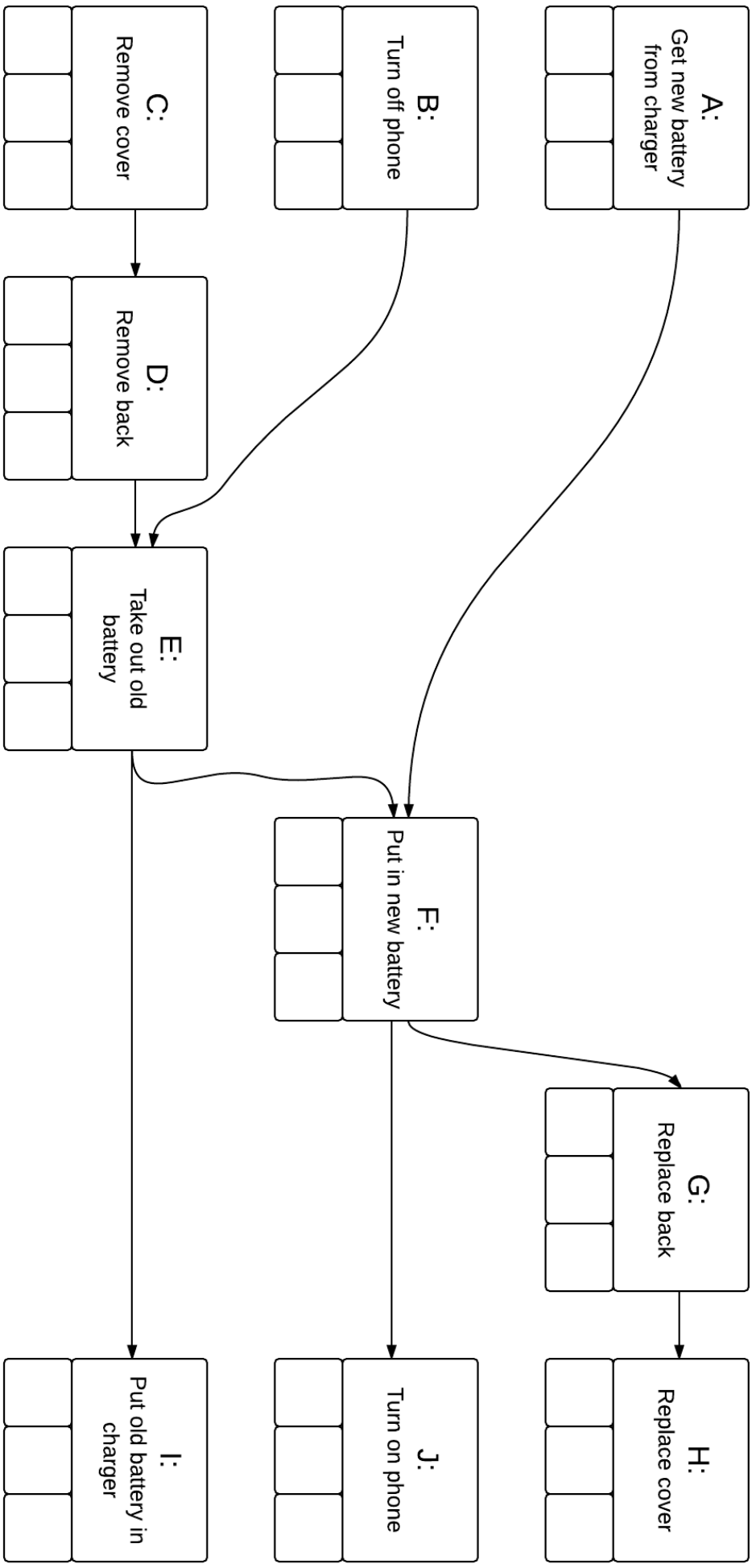
G:
Replace back

H:
Replace cover

I:
Put old battery in charger

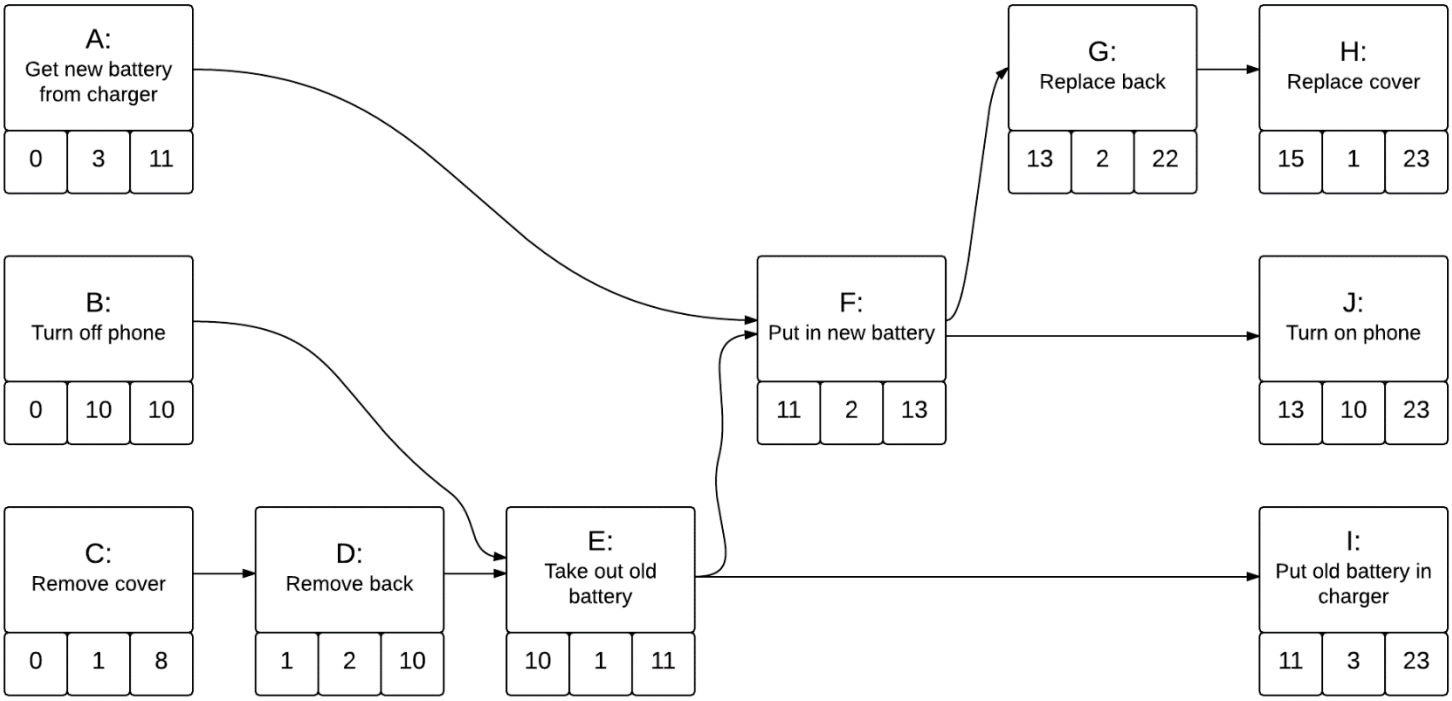
J:
Turn on phone

Activity Network



Critical Path Analysis: Changing a phone battery SOLUTIONS

1. & 2. Activity network with Earliest Start Time / Duration / Latest End Time:



3.

Activity	Immediate Predecessors	Duration (seconds)	*Earliest start*	*Latest end*	*Slack time*
A: Get new battery from charger	-	3	**0**	**11**	**8**
B: Turn off phone	-	10	**0**	**10**	**0***
C: Remove cover	-	1	**0**	**8**	**7**
D: Remove back	C	2	**1**	**10**	**7**
E: Take out old battery	B,D	1	**10**	**11**	**0***
F: Put in new battery	A,E	2	**11**	**13**	**0***
G: Replace back	F	2	**13**	**22**	**7**
H: Replace cover	G	1	**15**	**23**	**7**
I: Put old battery in charger	E	3	**11**	**23**	**9**
J: Turn on phone	F	10	**13**	**23**	**0***

*Critical path activities (those with no slack time): B, E, F, J. Total time: **23 seconds**.

4. We can't easily improve the phone's performance, so to improve on 23 seconds we would need to speed up **E or F**. All other activities are non-critical.

5. Slowing down all activities other than B and J by a factor of 4 actually changes the critical path to C, D, E, F, G, H. This gives an optimal completion time of 36 seconds. We are no longer limited by the phone's start up or shut down speed, but the speed with which we can remove and replace the cover and back (although the middle steps of switching the two batteries still forms part of our critical path).