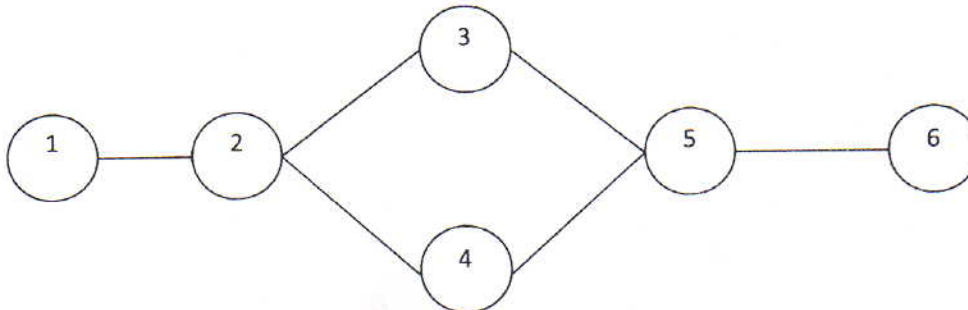




**Q1)** A site for a project consisting of 60 houses will become available for construction. A handover rate of 5 houses per week is required. The contractor will be working a 6-day week at 8 working hours per day. The following precedence network and table show the details for one unit (house).



Act. No.	Act. description	Man.hour/one (M)	Men/team (Q)	Min buffer (day)
1	Excavation and casting for foundation	95	5	3
2	Walls building and roof casting	400	7	15
3	Interior finishing	110	4	2
4	Exterior finishing	115	4	2
5	Roof and floor finishing	150	4	2
6	Painting and services	175	6	-

Determine the following:

- 1- Draw line of balance diagram, and pinpoint start and finish date for each activity on it and time of project completion.
- 2- Find expected date of roof casting completion for 40 houses.
- 3- When will the first team leave the activity no. 3
- 4- Which team will leave first, activity 3?
- 5- When 70% of the work was completed in activity 3, what is the total percentage of completion for the entire project?

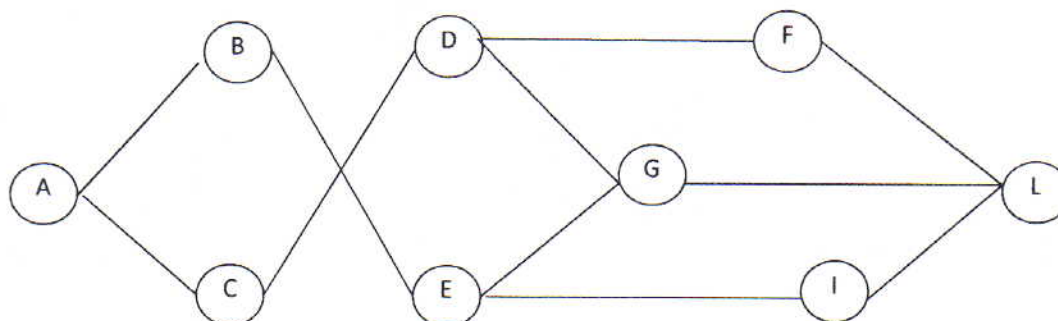
**Q2)** for the following table, draw the overlapped precedence network and calculate the project duration, total float, free float for each activity, and pinpoint critical path for the network.

activity	Duration (month)	Description and relationship
A	2	Begins the work
B	3	Should start after 4 months from start date of (A)
C	2	Can be finished after 6 months from the finish date of (A)
D	4	Can start after 2 months from the finish date of (A)
E	4	Can starts as soon as activities (B & D) finished, and requires 6 months to be finished after 2 months from the start date of activity (c)
H	2	Can start after 2 months from the finish date of (C) and requires 2 month to be finished after the finish date of activity (D) and required 3 months to be finished after 2 months from the start date of (B)
I	3	Can starts after the finish date of (H) and can be finished after 3 months form the finish date of (E).
J	2	Can starts as soon as (H) finished
F	3	Can starts as soon as (I) finished, and can be finished after 2 months from the finish date of (J) and can start after 1 month from the finish date of (J)

**Q3.)** A time-cost relationship must be done for the following project, the following table and precedence network represents the project data, if 20 million dinars was estimated as an indirect cost per month. Determine the followings:

- 1- Draw total cost curve.
- 2- What is the duration of the project to be completed with minimum total cost
- 3- What is the minimum total cost of the project when the project will be completed within minimum duration?

Activity	A	B	C	D	E	F	G	I	L
Normal duration (month)	2	5	3	2	4	2	3	1	2
Crashed duration (month)	2	3	1	2	2	1	2	1	1
Normal cost (million ID)	40	56	72	32	48	24	64	24	32
Crashed cost (million ID)	40	104	120	32	120	80	80	24	48



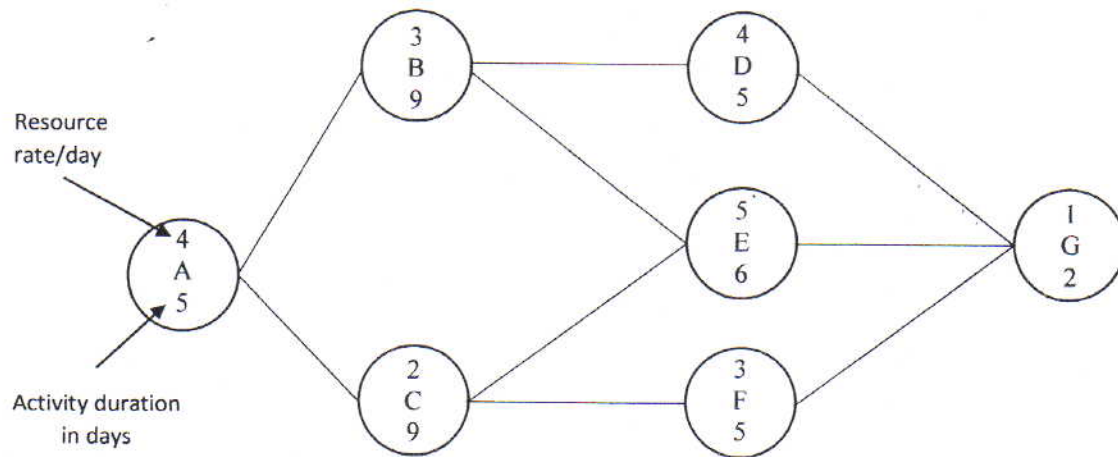
**Q4.)** The activities of a PERT project are given below together with their optimistic, most likely occur, and pessimistic duration estimates.

- 1- Determine the PERT critical path and the project mean and standard deviation.
- 2- Estimate the probability of completing the project in 30 days.
- 3- Estimate the probability of reaching event (8) in 19 days.

<i>i</i>	<i>j</i>	Time estimates (Days)		
		<i>a</i>	<i>m</i>	<i>b</i>
1	2	2	3	5
1	3	2	4	6
1	4	2	5	14
2	5	4	8	12
3	5	8	10	15
3	6	3	3	6
4	6	6	9	12
5	7	2	7	9
5	8	1	3	7
6	8	2	6	10
6	9	4	7	10
7	10	6	8	13
8	10	4	5	9
9	10	3	5	7



Q5.) The following precedence network shows the activities for a project, if the maximum recourse rate available for this project activities is 9 units / day, make a resource leveling for this project.



من 0 الى z



$z$	0	1	2	3	4	5	6	7	8	9
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0754
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2258	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2518	0.2549
0.7	0.2580	0.2612	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2996	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000



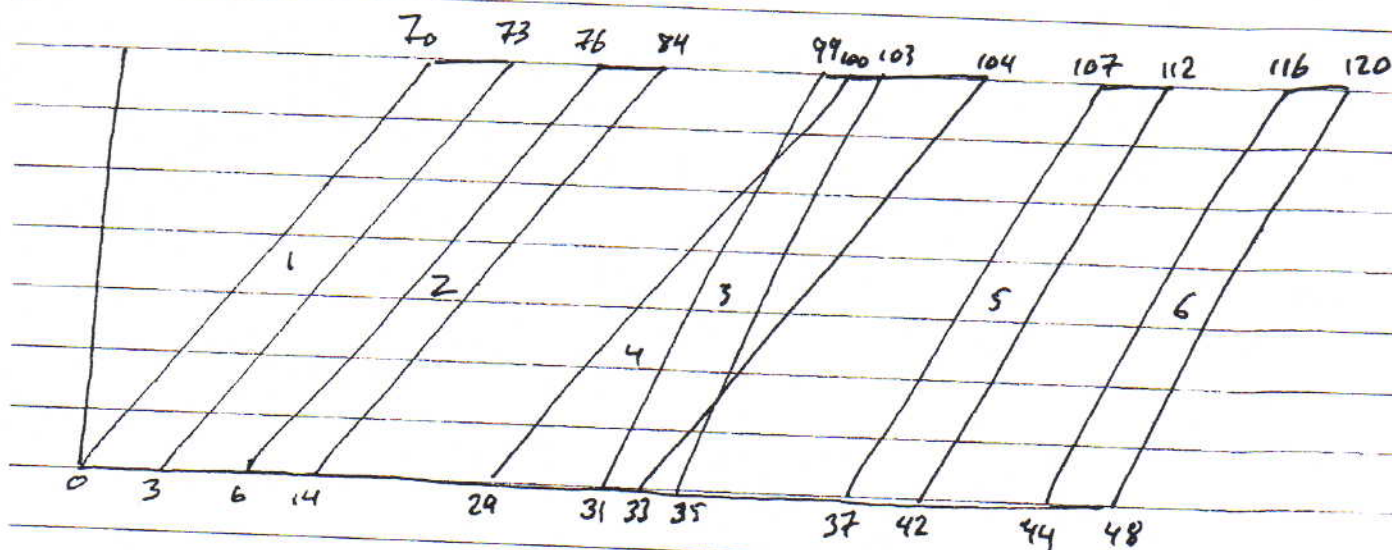
Q.1

إدارة وبيع - إداري

①

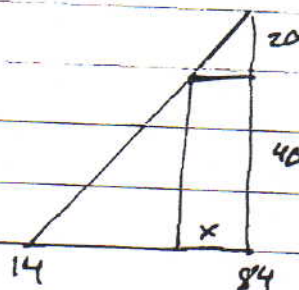
act	Q (5M/48)	Q	g	u $\frac{g}{Q} \times 5$	T $(\frac{14}{8Q})$	S $\frac{(n-1)6}{u}$
1	9.9	5	10	5.05	3	70
2	41.6	7	42	5.05	8	70
3	11.45	4	12	5.24	4	68
4	11.98	4	12	5.00	4	71
5	15.62	4	16	5.12	5	70
6	18.22	6	18	4.94	4	72

①



$$\frac{x}{84-14} = \frac{20}{60} \therefore x = 23.3$$

$$\text{date} = 84 - 23.3 = 61$$

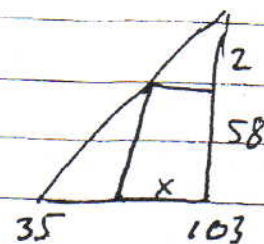


$$\frac{60}{3} = 20$$

60	3
59	2
58	1

$$\frac{x}{13-35} = \frac{2}{60} \therefore x = 2.26$$

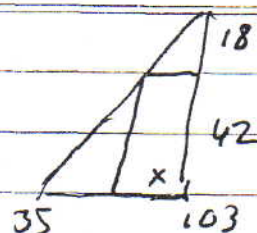
$$\text{date} = 103 - 2.26 = 101$$



$$5- \quad 70\% \times 60 = 42$$

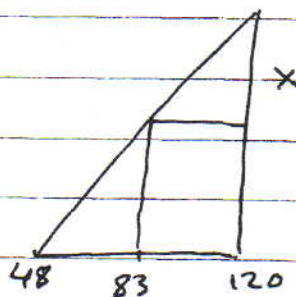
$$\frac{x}{103-35} = \frac{18}{60} \quad \therefore x = 20.4$$

$$103 - 20.4 = 83$$

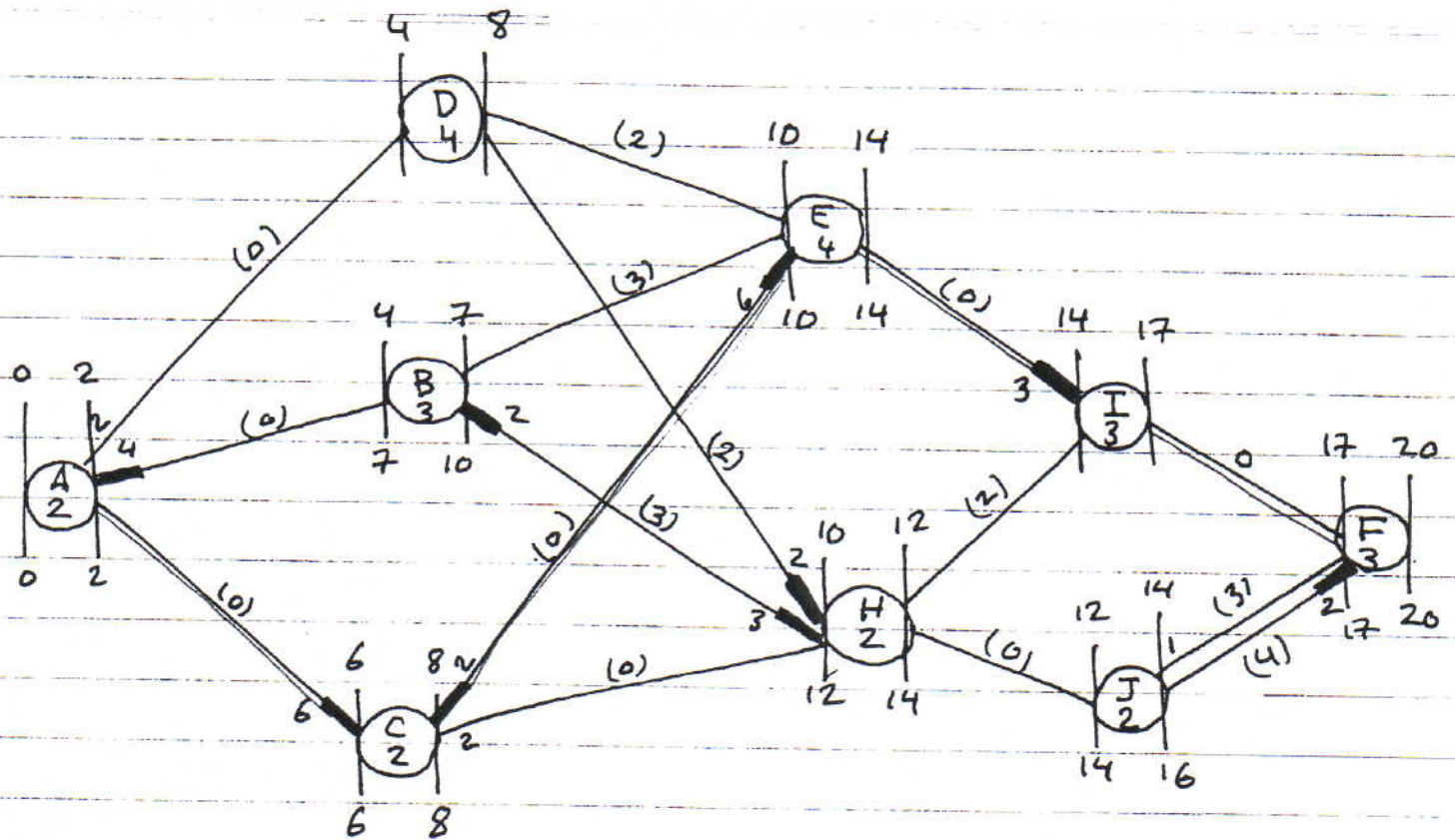


$$\frac{x}{60} = \frac{120-83}{120-48} \quad \therefore x = 29$$

$$\frac{20}{60} = 48.3\% = 48.3\%$$



Q.2



Act	EF	TF
D	2	2
B	3	3
H	0	2
J	2	2



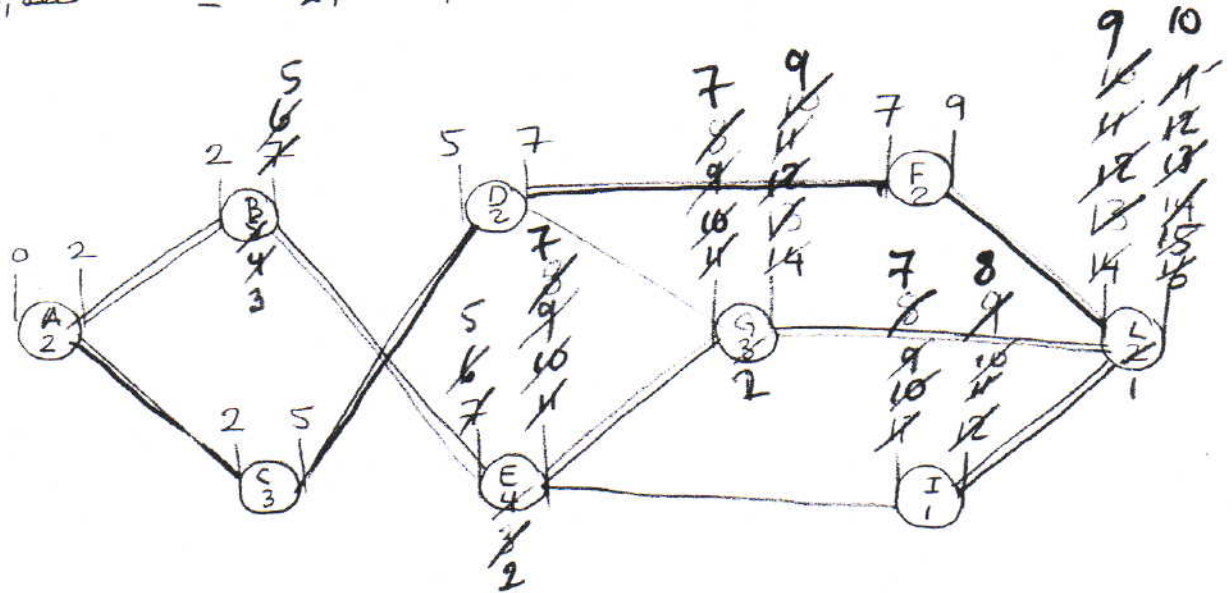
Q.3:

Time-Cost K.

من قوال

الفعالة

	A	B	C	D	E	F	G	I	L
المدة الطبيعية	2	5	3	2	4	2	3	1	2
المدة المقلصة	2	3	1	2	2	1	2	1	1
الطاقة الطبيعية	40	56	72	32	48	24	64	24	32
الطاقة المقلصة	40	104	120	32	120	80	80	24	48
خلفه، التقليل	-	24	24	-	36	56	16	-	16



Action	Proj. Dur	D.C	In.C	total Cost
normal st	16	392	320	712
Act L ←	15	408	300	708
Act G ←	14	424	280	704
Act B ←	13	448	260	708
Act B ←	12	472	240	712
Act E ←	11	508	220	728
Act E ←	10	544	200	744
All crash	10	648	200	848

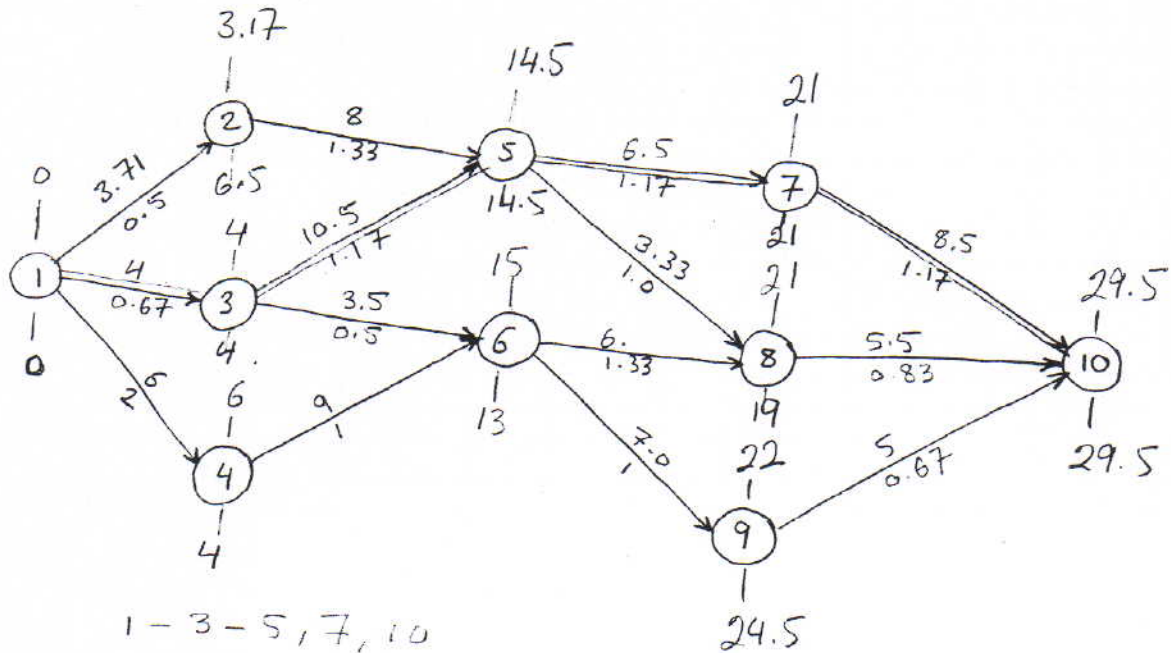
2- 14 month → 704.

3- 744 → 10 months.



Q.4

# PERT SLD



$$\sigma_e = \sqrt{0.67^2 + 1.17^2 + 1.17^2 + 1.17^2} = 2.127$$

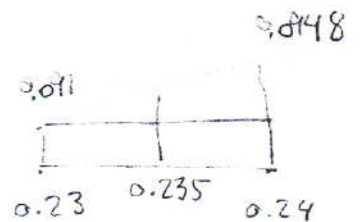
① 1-3-5-7-10 Critical Path

Project Mean = 29.5

Project St. Dev. = 2.127

②  $Z = \frac{T_s - T_e}{\sigma_e} = \frac{30 - 29.5}{2.127} = 0.235$

$$P = 0.5 + 0.0929 = 0.5929 = 59.29\%$$



③  $Z = \frac{21 - 19}{2.127} = 0.940$

$$P = 0.5 + 0.3264 = 82.64\%$$

[illegible]



Q.5

Allocation Diagram

