Class Test Solution (CPM) 01-09-2019

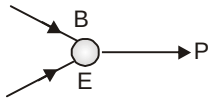
Answer key

1.	(c)	**16.**	(a)	**31.**	(a)	**46.**	(b)	**61.**	(d)
2.	(a)	**17.**	(b)	**32.**	(c)	**47.**	(c)	**62.**	(c)
3.	(c)	**18.**	(b)	**33.**	(d)	**48.**	(c)	**63.**	(c)
4.	(c)	**19.**	(c)	**34.**	(b)	**49.**	(b)	**64.**	(b)
5.	(d)	**20.**	(d)	**35.**	(a)	**50.**	(b)	**65.**	(d)
6.	(a)	**21.**	(c)	**36.**	(c)	**51.**	(d)	**66.**	(b)
7.	(a)	**22.**	(c)	**37.**	(a)	**52.**	(a)	**67.**	(c)
8.	(d)	**23.**	(c)	**38.**	(a)	**53.**	(a)	**68.**	(a)
9.	(b)	**24.**	(d)	**39.**	(c)	**54.**	(d)	**69.**	(a)
10.	(b)	**25.**	(b)	**40.**	(d)	**55.**	(b)	**70.**	(d)
11.	(d)	**26.**	(a)	**41.**	(c)	**56.**	(b)	**71.**	(a)
12.	(c)	**27.**	(c)	**42.**	(d)	**57.**	(c)	**72.**	(a)
13.	(c)	**28.**	(b)	**43.**	(d)	**58.**	(c)	**73.**	(d)
14.	(c)	**29.**	(a)	**44.**	(d)	**59.**	(b)	**74.**	(d)
15.	(c)	**30.**	(a)	**45.**	(d)	**60.**	(d)	**75.**	(a)

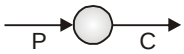
CLASS TEST-2 SOLUTIONS [CPM]

2. (a) In bar charts inter dependences between various activities is not shown.

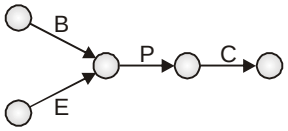
3. (c) We observe that task P can not begin until both B and E are complete i.e.



Also, task C follows P i.e.

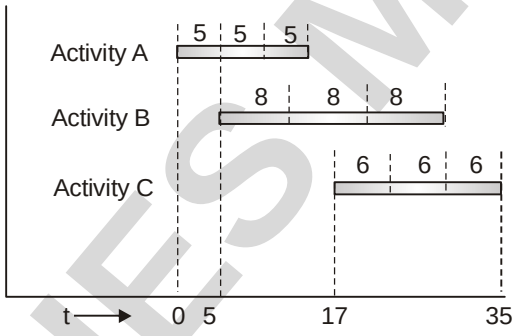


Therefore correct AOA representation will be-



Note: It is a partial Network diagram

6. (a) Laddering is multitaksing wherien the work continues uninterupted. Here in question it is mentioned ladder network with three equal subparts of each and it can be presented as below advantageously.



Total duration = 35 weeks

7. (a) Minimum number of resources are needed on 18^{th} day i.e. 6 Nos.

Maximum number of resources are needed on 20^{th} day.

i.e., 22 (6+7+9) Nos. *i.e.*, 22 (6+7+9) Nos.

8. (d) In PERT analysis it is assumed that the project cost is directly proportional to time.

Time cost study is based for CPM networks in which two parallel jobs can be performed.

In PERT analysis, critical path is affected by variance when two path have same project duration.

Linked barchart is drawn when technology is pre decided.

10. (b) According to central limit theorem in any project if there are n activities involved having its own β distribution of time estimates. Then if n is fairly large, the distribution of time for the completion of the project as a whole will be approximated as normal distribution.

11. (d) Given that the two events K and L can cause delay in the activity when occurring either each independently or both together but the two events are not independent of each other.

Hence, probability of occurrence of delay is equal to the probability of occurrence of event K (or L) given that the event L (Or K) has happened i.e. P(K/L) or P(L/K)

Since, $P(K \cup L) = P(K) + P(L) - P(K/L).P(L)$

or, $P(K \cup L) = P(K) + P(L) - P(L/K).P(K)$

Since, $P(L) = P(K)$ and

$P(L/K) = P(K/L)$

Given, $P(K \cup L) = 0.75$

and, $P(K) = P(L) = 0.45$

$$\Rightarrow \quad P(K/L) = \frac{-P(K \cup L)+P(K)+P(L)}{P(L)}$$

$$\therefore \quad P(K/L) = \frac{0.45+0.45-0.75}{0.45}$$

$$= \frac{2\times 0.45-0.75}{0.45}$$

12. (c) Project duration = 7+6+11+14+5 = 43 days

$$\sigma_{project} = \sqrt{2^2+2^2+3^2+4^2+1^2}$$

$$= 5.83 \text{ days.}$$

Possible range of project duration

$$= T_e \pm 3\sigma$$

((43 – 3×5.83), (43 + 3 × 5.83)) = (25.51, 60.49).

13. (c) $Z = \dfrac{T_S - 60}{3}$

As, $\sigma^2 = 9$

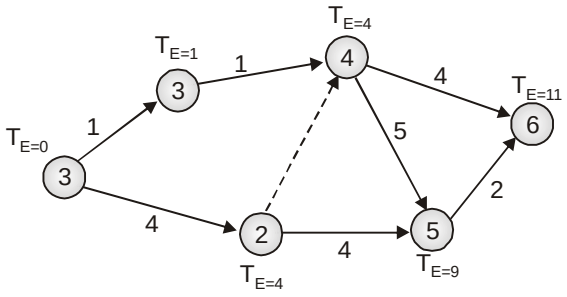
$\sigma = 3$

$1.647 = \dfrac{T_S - 60}{3}$

$T_S = 64.941$

14. (c) Calculation of EST of all the activities is done in network diagram below by using

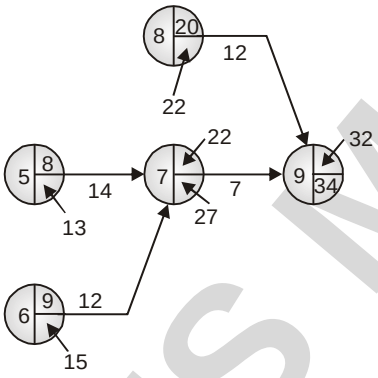
Forward pass rule i.e., $T_E^j = T_E^i + t^{ij}$



It is observed from network diagram above that

$EST_{5\text{-}6} = 9$ days

15. (c)



For activity 6–7

F_T = LST – EST = 15–9 = 6 unit

$F_F = F_T - S_j = 6 - 5 = 1$ unit

16. (a) Critical path is the longest path time wise in any network and also it is the shortest path timewise within which project can be completed.

Activities lying on the critical path are called as critical activities which has zero total float.

Total float of any activity is equal to difference between maximum available time and activity duration.

Max available time = LFT – EST

Total float, $F_T = (LFT - EST) - t^{ij}$

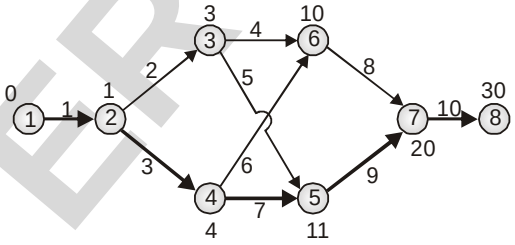
where t^{ij} is activity duration

For, $F_T = 0$

$LST - EST = t^{ij}$.

17. (b) Free float is the available time by which an activity can be delayed without delaying the early start time of succeding activity.

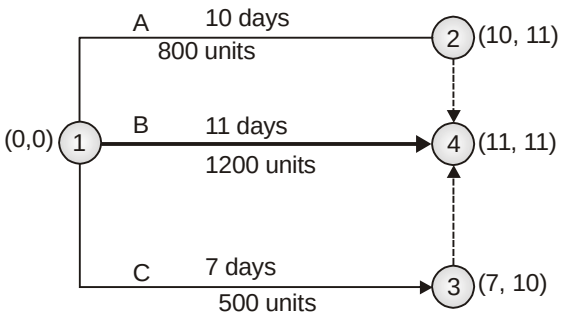
18. (b) Critical path is the longest path time wise in the network



$\therefore$ Critical path is

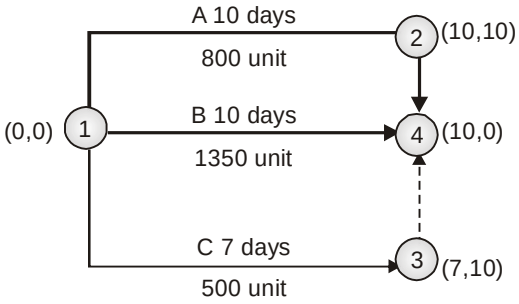
1 – 2 – 4 – 5 – 7 – 8

19. (c) As three activities are implemented in parallel the network diagram will be as below:



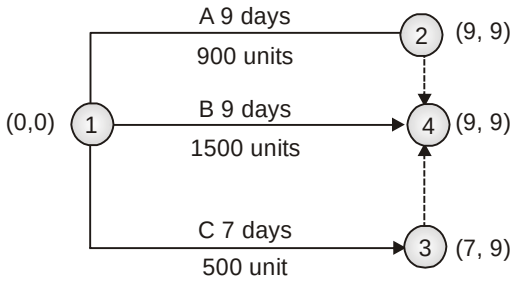
Total direct cost = 800 + 1200 + 500 = 2500 unit

Step I: Crashing activity B by 1 day as it is critical activity.



Total direct cost = 800 + 1350 + 500 = 2650 units

Step II: Crashing activity A & B by 1 day.



Total Direct cost = 900 + 15000 + 500 = 2900

∴ Feasible range is 2500 – 2900 units.

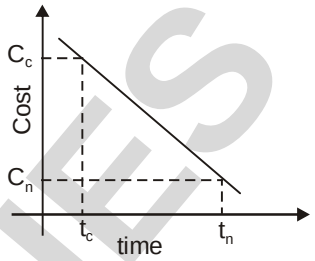
20. (d) Indirect cost of a project are those expenses which can not be associated or assigned to any individual activity of the project *e.g.*, establishment charges, insurance charges etc. Direct cost are those expenses which are directly chargeable and can be identified by activities *eg*., cost of material, machine, labour etc.

During crashing of an activity, the duration of activity is reduced due to which:

(1) Indirect cost decreases

(2) Direct cost increases

21. (c) Cost Slope = $\frac{C_C - C_n}{t_n - t_c}$



22. (c) From straight line method of depreciation

Depreciation, $D = \frac{C_i - C_s}{n}$

$$D = \frac{10000 - 1000}{5} = 1800$$

Book value, $B_m = C_i - mD$

$B_2 = 10000 - 2 \times 1800$

$B_2 = 6400$

23. (c) Expected profit = (profit) × probability of making the profit.

Project Order of preference	Expected profit
1. 0.5 × 15% = 7.5%	III
2. 0.8 × 10% = 8%	II
3. 0.7 × 12% = 8.4%	I
4. 0.6 × 11% = 6.6%	IV

24. (d) Payment allowance is selected keeping in mind the overall cost, profit and total time.

25. (b) Book value from declining balance method

$$B_n = C_i (1\text{-}FDB)^n$$

In this method there is large amount of write off i.e depreciation in the early year of utility period is more than in comparison to later years of utility period.

26. (a) Sinking fund method is useful in depreciation. The idea of this method is basically to have enough funds to be able to replace the asset at the end of its service life.

27. (c) $$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

$$CRF = \frac{0.06 \times 1.06^8}{1.06^8 - 1}$$

CRF = 0.1610

28. (b) Available pull = Maximum Rimpull – Rolling Resistance – Grade resistance

Rolling Resistance = 12×45 = 540 kg

∵ Grade Resistance = 10kg for 1% grade for 1 tonne

∴ Grade resistance = 2 × 10 × 12 = 240 kg

Available pull = 6300 – 540 –240 =5520 kg

29. (a) Tipping load is the load that produces a toppling condition at a specified radius.

Tipping load includes the weight of the item being lifted plus the weight of hoist rope, hooks, hook blocks, slings and any other items used in hoisting the load.

30. (a) Order of preference from best to worst for compacting reinforced concrete door and window frames is as follows.

(1) **Plate vibrator:** It is used for compaction of prefabricated roof elements, door & window frames and railway sleeper etc.

(2) **Form Vibrator:** Form vibrators are used for compacting columns, thin walls and precast units. The efficiency of these vibrators is generally low.

(3) **Tamping:** This method of compaction can be used for small and unimportant jobs. But, this method is useful for thin elements and for member with congested reinforcements.

(4) **Needle vibrator:** These will create problem due to congested reinforcement, hence these should be avoided as far as possible.

31. (a) In general, a hoe may be used to dig trenches, footings or basements and general grading work which requires precise control of depth.

32. (c) Brake horse power,

$$BHP = \frac{\rho QH}{75\eta}$$

Where,

ρ = density of water ; Q = discharge

H = Total head ; η = efficiency

$$\therefore \quad BHP = \frac{1000 \times 2.8 \times (7.5 + 0.25)}{75 \times 0.8}$$

$$BHP = \frac{1000 \times 2.8 \times 7.75}{0.8 \times 75}$$

33. (d) $\text{Density} = \frac{\text{Weight}}{\text{Volume}}$

$\text{Volume} = 6\ m^3 - 1.5\%\ \text{of}\ 6m^3$

$= 5.91\ m^3$

$\text{Weight} = 1875 + 5120 + 6060 + 865$

$= 13920$

$$\text{Density} = \frac{13920}{5.91} = 2355\ kg/m^3$$

34.(b) Cost of cum of excavation when manual means are used = 3 × 8 = Rs. 24 per cum.

When mechanical means are used = 0.2 × 200 = Rs. 40 per cum.

Total cost for complete job when manual means are used = 24 × 4000 = Rs. 96,000

When mechanical means are used = 40 × 4000 = Rs. 1,60,000

By use of combination of manual and mechanical means of excavation cost can lie between 96,000 to 1, 60,000.

Ist option - Rs. 1,20,000

Check:

$$24x + 40(4000 - x) = 1,20,000$$

$$\Rightarrow \quad 24x + 1,60,000 - 40x = 1,20,000$$

$$\Rightarrow \quad x = 40,000/16$$

$$= 2500$$

So, it is feasible

Therefore minimum total cost = 1,20,000.

35.(a) $\text{Output} = \frac{\text{Production} \times \text{time in seconds} \times \eta}{\text{Cycle time in seconds}}$

36. (c) Sheep's foot compactor is used to compact cohesive soils.

Steel tandem compactor with 2 or 3 axles are most effective on granular soil ranging from large rocks to fine sand. They can be used on semicohesive soil with up to 10% clay binder.

Steel drum rollers are used to compact granular soil.

Pneumatic large tyre compactor is suitable for compacting fine grained soil and well graded sand.

37. (a) Power shovel are mainly used to excavate all types of earth except solid rock without prior loosening and load them into tractor drawn wagons. They have better control while doing excavations because of rigid dipper stick.

Dragline is an excavating equipment in which bucket is dragged against the material to be excavated. It does not have to go into the pit the excavate hence it may operate on natural firm ground. If can excavate below its level and underwater.

Backhoe is primarily used to excavate below the ground level or below the

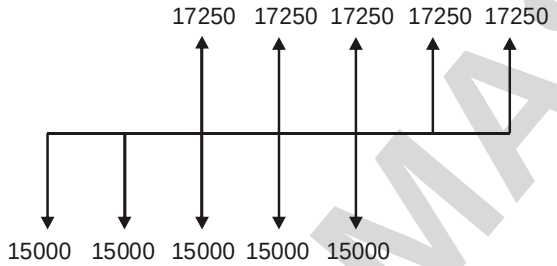
machine track level. Because of the direct pull on the dipper they exert greater tooth pressure, therefore they are adopted to dig trenches, pits and basements.

Clamshell has a bucket divided into two parts which are hinged at top. These are especially suited to vertical lifting of material.

38. (a) Production of shovel depends on following factors

1. Class of material 2. Height of cut
3. Angle of swing 4. Operation skill
5. Condition of shovel 6. Haul-unit exchange
7. Size of hauling units
8. Handling of materials
9. Clean up of loading area.

39. (c)

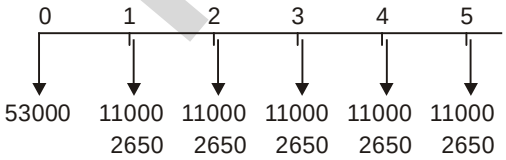


Bill raised = Investment × (1 + i)

= 15000 × 1.15 = 17250

From cash flow diagram we can observe that 15000 is needed for starting two months then after that working capital can be obtained from bill raised.

40. (d)



Initial investment fo the equipment,

P = Rs. 53,000/-

∴ Annual equivalent cost of the equipment, A

= P × i = 53000 × 0.15

= Rs. 7,950/-

Annual depreciation = Rs. 11,000/-

Annual paid tax = 53,000× 0.05 = Rs. 2,650/-

∴ Annual total cost of the equipment

= 7950 + 11000 + 2650

= Rs. 21,600/-

As the equipment is used for 1800 hrs during each year.

∴ Lonly ownership cost for the equipment

$$= \frac{21600}{1800} = 12/-$$

43. (d)

An arrow cannot have any shape. Its direction on the network diagram is from left to right although the length of the arrow is indicative only.

46. (b)

The milestone chart is a modification over the original bar chart. In every activity, there are certain key events which are to be carried out for the completion of the activity. Such key events are called milestones and they are represented by a square or circle.

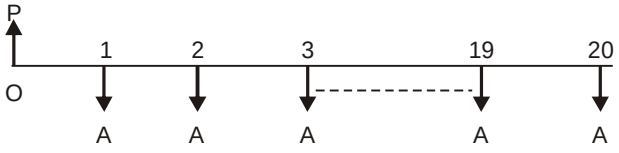
47. (c)

Time required in ladder network =

$$36 + \frac{24}{3} + \frac{21}{3} = 51 \text{ days}$$

51. (d)

Capital recovery factor (CRF) – Finding A given P



$$\because \quad P = A\left[\frac{(1+i)^{25}-1}{i(1+i)^{25}}\right]$$

Where i = 10% = rate of annual interest.

$$\therefore \quad \frac{A}{P} = \left[\frac{i(1+i)^{20}}{(1+i)^{20}-1}\right] = CRF$$

Here, if amount is withdrawn equally each year, the amount = CRF × P = 0.11746 × 1,00,000 = Rs. 11,746/-

As the withdrawal is at the end of 2nd, 4th, 6th ... 18th, 20th years (ie. at the interval of two years each), Rs. 11,746/- and its interest for one year will be added to give the required withdrawal at the interval of 2 years each

$\therefore$ each instalment of withdrawal

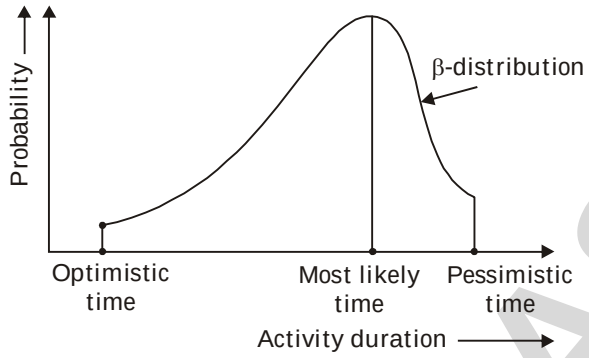
$= 11,746 + 11,746 \times (1 + 0.1)$

$=$ Rs. 24,667/-

$\simeq$ Rs. 24,667/-

53. (a)

Each activity in a PERT network is assumed to follow β-distribution.



54. (d)

Slack may be simply defined as the difference the latest allowable time and the earliest expected time of an event.

$\therefore$ $S = T_L - T_E$

57. (c)

Standard deviation =

$$\sqrt{\left(\frac{t_p - t_0}{6}\right)^2} = \left(\frac{21-5}{6}\right) = 2.67$$

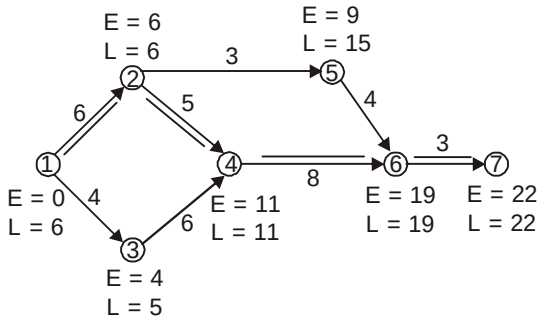
Expected time =

$$\frac{t_p + 4t_m + t_0}{6} = \frac{21 + 4 \times 10 + 5}{6} = 11$$

58. (c)

CPM is activity oriented and deterministic in nature.

60. (d)



Critical path 1-2-4-6-7

Option (d) is correct.

61. (d)

Total float is the time span by which the starting (or finishing) of an activity can be delayed without delaying the completion of the project.

Consider an activity i-j. The time duration available for this activity is equal to the difference between its earliest start time (T_E^i) and the latest finish time (T_L^j):

$\therefore$ Max. time available = $T_L^j - T_E^i$

Activity time required = t^{ij}

$\therefore$ Total float (F_T) = max available time available – time required

62. (c)

Sub-critical activities: When float is +ve. The activity needs normal attention and has some flexibility.

64. (b)

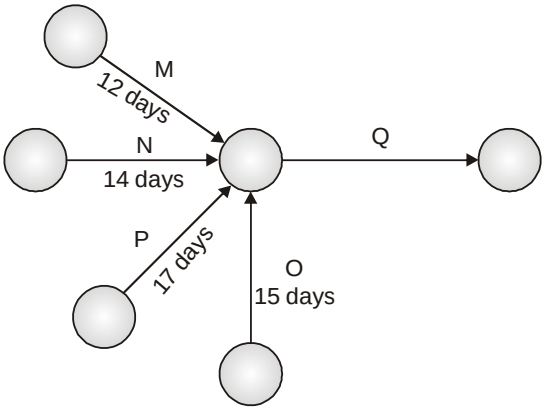
$$S.F.F = \frac{i}{(1+i)^n - 1}$$

$$= \frac{0.04}{(1+0.04)^5 - 1} = 0.184.$$

65. (d)

The earliest expected time is the time when an event can be expected to occur. The earliest

expected time is computed by adding the expected times of all the activities along an activities path leading to that event. If more than one activity paths lead to that event, then the maximum of the sum of expected time along the various paths will give the earliest expected time.



74. (d)

Value of an asset at the end of its utility period is called as its Salvage value i.e. Resale value at the end of a particular time.

Salvage value implies that asset has further utility, but due to some reason it is for resale.

75. (a)

Economic order quantity is the order quantity that minimizes total inventory holding costs.

ABC analysis is an inventory categorization technique, depending on their relative requirements.

Before any of this analysis, time-cost study is must to get planning on material requirement and procurement.