1
CHAPTER
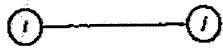
CPM & PERT

Q.1 Activity on node type of network analysis involves
(a) PERT scheduling
(b) OPST scheduling
(c) CPM scheduling
(d) Bar chart scheduling

Q.2 Mile stone chart is an improvement over
(a) Bar chart
(b) CPM scheduling
(b) PERT scheduling
(d) All of the above

**Q.3** $T_L^j - T_E^j - t_{ij}$ represent

(a) Total Float   (b) Free Float
(c) Independent Float   (d) Interfering Float

Q.4 Which of the following is not a weakness of bar chart?
(a) Suitable only for small job.
(b) Cost control can not be achieved.
(c) Optimum use of men and machines can not be done.
(d) None of these

Q.5 There are four consecutive activities in a simple linear network, each with mean duration μ and first two with '2K' as the standard deviation, third with 'K' as the standard deviation and fourth has 'zero' standard deviation. The overall project duration through these activities is likely to be in the range
(a) $4\mu \pm 2k$ (b) $4\mu \pm 3k$
(c) $4\mu \pm 5k$ (d) $4\mu \pm 9k$

Q.6 The total number of errors in the given A-O-A network are
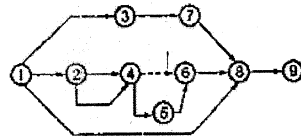
(a) 1   (b) 2
(c) 3   (d) zero

Q.7 The time by which a particular activity can be delayed without affecting the preceding and succeeding activities is known as
(a) Total Float
(b) Free Float
(c) Interfering Float
(d) Independent Float

Q.8 Which of the following is not a PERT event?
(a) Site investigation started.
(b) Sessional work completed.
(c) Bus starts from Jaipur.
(d) Class is being attended.

Q.9 Consider the following statements regarding AON diagram:
1. Each activity is represented by a circle.
2. The successor of the activity is connected by a directed arrow.
3. The number of the activity and the amount of time required for its completion are inserted in the job node.
4. An AON network contains a node for the start and a node for a finish of the project.
Which of these statements are correct?
(a) 1, 2 and 3
(b) 2, 3 and 4
(c) 1, 3 and 4
(d) 1, 2, and 4

Q.10 The independent float affects only
(a) preceding activities
(b) succeeding activities
(c) the particular activity involved
(d) none of the above

**Q.11** Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I	List-II
A. Total float	1. $T_E^j - T_E^i - t_{ij}$
B. Independent float	2. $T_L^i - T_E^j - t_{ij}$
C. Free float	3. $T_E^j - T_L^i - t_{ij}$
D. Interfering float	4. S_i

Codes:

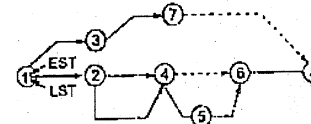|	A	B	C	D
(a)	1	2	3	4
(b)	2	4	1	3
(c)	2	3	1	4
(d)	2	1	3	4

Q.12 In the network shown in figure, total float for the activity 2-4 will be activity duration (in days) is shown in arrow.
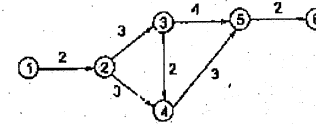
(a) 3   (b) 2
(c) 1   (d) zero

Q.13 Probability of finishing of a project earlier than expected time is
(a) 100%   (b) less than 50%
(c) more than 50%   (d) None of these

Q.14 The total number of errors in the given AOA network is

(a) 1   (b) 2
(c) 3   (d) 4

Q.15 Whenever an activity has zero total float, then
(a) free float of the activity must be zero but independent float need not be zero
(b) independent float need not be zero
(c) free float and independent float both must be zero
(d) free float and independent float both need not be zero

Q.16 A critical path has
(a) zero slack   (b) minimum slack
(c) maximum slack   (d) infinite slack

Q.17 Interfering float is the difference between
(a) total float and free float
(b) total float and independent float
(c) free float and independent float
(d) none of the above

Q.18 If the scheduled completion time for a particular project is 18 weeks and its earliest expected time is 20 weeks, then the slack time for the project is
(a) 2 weeks
(b) 0
(c) -2 weeks
(d) none of the above

Q.19 Slack time in PERT analysis
(a) is minimum for critical activities
(b) can never be less than zero
(c) can never be greater than zero
(d) is always zero for critical activity

Common Data for Q. 20 to Q. 23
For a small project with five jobs, the following data is given:

Job	Immediate Predecessor	Duration (Days)	Mean Standard
A	-	10	2
B	-	5	1
C	A	16	2
D	A	12	2
E	B,C	15	1
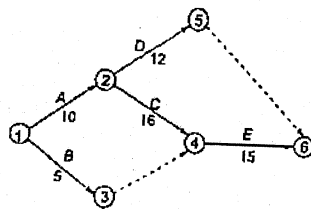
Q.20 The earliest expected time is
(a) 29 days
(b) 31 days
(c) 37 days
(d) 41 days

Q.21 The latest expected time is
(a) 29 days
(b) 31 days
(c) 37 days
(d) 41 days

Q.22 The critical path is
(a) 1 - 2 - 3 - 4
(b) 1 - 2 - 4 - 5
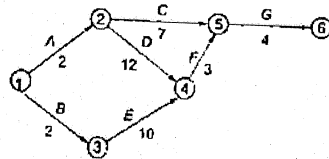(c) 1 - 2 - 5 - 6
(d) 1 - 2 - 4 - 6

Q.23 The variance of critical path is
(a) 6 days
(b) .7 days
(c) 8 days
(d) 9 days

Questions 24 and 25 are based on the data given below:

A project plan is given below:

Activity	Time Duration (in weeks)	Predecessors
A	2	None
B	2	None
C	7	A
D	12	A
E	10	B
F	3	D, E
G	4	C, F

A PERT network is shown in the figure below:

Q.24 The critical path is
(a) 1 - 2 - 4 - 5 - 6
(b) 1 - 3 - 4 - 5 - 6
(c) 1 - 2 - 5 - 6
(d) 1 - 2 - 3 - 4 - 5 - 6

Q.25 The project duration is
(a) 10 days
(b) 12 days
(c) 15 days
(o) 21 days

Q.26 If an activity has its optimistic, most likely and pessimistic times (in days) as 2, 3 and 7 respectively then its expected time and variance are respectively
(a) 3.5 and 5/6
(b) 5 and 25/36
(c) 3.5 and 25/36
(d) 4 and 5/6

Q.27 If the optimistic time, most likely time and pessimistic times for activity A are 8, 12 and 16 respectively and for activity B are 10, 11 and 18 respectively, then
(a) expected time of activity A is greater than the expected time of activity B
(b) expected time of activity B is greater than the expected time of activity A
(c) expected time of both activities A and B are same
(d) None of the above

Q.28 Free float is mainly used to
(a) identify the activities which can be delayed without affecting the total float of preceding activity
(b) identify the activities, which can be delayed without affecting the total float of succeeding activity
(c) identify the activities which can be delayed without affecting the total float of preceding activity
(d) establish priorities

Q.29 Slack is
(a) same as delay factor
(b) tolerance, in terms of time, for an activity
(c) earliest expected time – latest allowable time
(d) latest allowable time – earliest expected time

Q.30 Negative slack occurs when
(a) dummy activities do not exist
(b) dummy activities are large in number
(c) events stick to their schedule
(d) deficiency of resources occurs

Q.31 In PERT, the distribution of activity times is assumed to be
(a) Normal
(b) Gama
(c) Beta
(d) Exponential

Q.32 If the value of variance is more
(a) certainty is high
(b) probability of certainty is high
(c) uncertainty is high
(d) probability distribution curve shall be having an unsymmetrical shape

Q.33 CPM analysis presumes that
(a) activities are divided properly and carried out
(b) times are related to costs
(c) events are logically devised & stipulated
(d) all uncertainties involved have been accounted for

Q.34 Latest start of an activity is always
(a) greater than or equal to latest event time of preceding node
(b) less than or equal to latest event time of preceding node
(c) equal to latest event time of preceding node
(d) less than latest event time of preceding node

Q.35 In the network shown in the figure, the activity 4-5 can be started only when
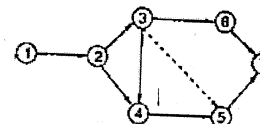
(a) activity 2-3 is completed
(b) activity 2-4 is completed
(c) activity 3-4 is completed
(d) activity 2-4 and 3-4 both are completed

Q.36 According to Fulkerson's rule, what are the correct event numbers corresponding to events A, B, C,

D, E, F and G of the network shown in the figure below?
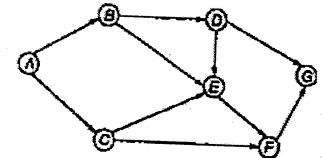
(a) 1, 2, 3, 4, 5, 6 and 7 respectively
(b) 1, 3, 2, 4, 5, 6 and 7 respectively
(c) 1, 2, 3, 5, 6, 4 and 7 respectively
(d) 1, 3, 2, 5, 6, 4 and 7 respectively

Q.37 The given figure shows the arrow diagram for a particular project. The arrow A is known as
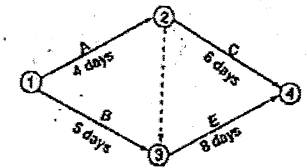
(a) critical activity
(b) logic arrow
(c) dummy activity
(d) subcritical activity

Q.38 A 'merge event' is represented by

(a)

(b)

(c)

(d)
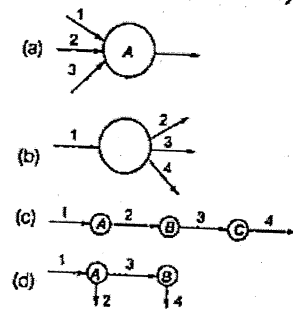
Q.39 For the path of a certain network shown in the given figure, the expected time and standard deviation will be respectively

(a) 15 and 1.5   (b) 20 and 1.75
(c) 15 and 1.62   (d) 20 and 1.93

Q.40 Consider the following statements:
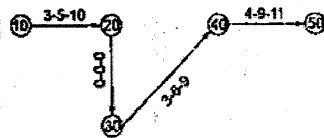The critical path in the network plane of a project
1. helps in planning efficient time schedule
2. indicates the shortest path in time
3. helps in crashing the project judiciously
4. helps in encouraging discipline in execution
Which of these statements are correct?
(a) 1, 3 and 4   (b) 1, 2, 3 and 4
(c) 1 and 4   (d) 2 and 3

Q.41 There are three parallel paths in a part of a network between a bursting node and the next merging node with only one activity in each path. The minimum number of dummy arrows needed will be
(a) zero   (a) 1
(c) 2   (d) 3

Q.42 Match List-I (Activity types) with List-II (Property of activity) and select the correct answer using the codes given below the lists:
List-I
A. Critical activity to be crashed first to reduce project duration
B. Critical activity
C. Dummy activity
D. Subcritical activity
List II
1. It has a float
2. It has least cost slope
3. It maintains logic of network
4. It has no float
Codes:

	A	B	C	D
(a)	1	2	4	3
(b)	3	1	2	4
(c)	2	4	3	1
(d)	4	3	2	1

Q.43 For an activity i-j, the early event times i, respectively are 5, 24, 9 and 29.(EST = 5, LST = 9, EFT = 24, LFT = 29). The activity duration is 6. Match List-I (Float) with List-II (Duration) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Free	1. 5
B. Total	2. 9
C. Interfering	3. 13
D. Independent	4. 18

Codes:

	A	B	C	D
(a)	4	3	1	2
(b)	3	4	1	2
(c)	3	4	2	1
(d)	4	3	2	1

Q.44 Consider the following statements:
CPM network helps an engineer to
1. concentrate his attention on critical activities
2. divert the resources from non-critical advanced activities to critical activities
3. be cautious in avoiding any delay in the critical activities in order to avoid delay of the whole project
Which of these statements are correct?
(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

Q.45 Consider the following features/factors:
1. Projects are of the non-repetitive type.
2. Time required need not be known.
3. Time required is known precisely.
4. Emphasis is given to activities of project.
For which of these features/factors PERT is preferred for planning?
(a) 1, 2 and 3   (b) 1, 3 and 4
(c) 1, 2 and 4   (d) 1, 2 and 3

Q.46 The network rules are common to all activity on-arrow networking systems. The use of computers for making computations may impose certain rules. Which of the following basic rules of network logic are correct?
1. Before an activity may begin, all the activities preceding it must be complete.
2. Any two events may be directly connected by not more than one activity.
3. Event numbers must not be duplicated in a network.
Select the correct answer using the codes given below:
(a) 1 and 2   (b) 2 and 3
(c) 1 and 3   (d) 1, 2 and 3

Q.47 Latest start of an activity is always
(a) greater than or equal to latest event time of preceding node
(b) less than or equal to latest event time of preceding node
(c) equal to latest event time of preceding node
(d) less than latest event time of preceding node

Q.48 A father notes that when his teenage daughter uses the telephone, she takes not less than 6 minutes for a call and some times as much as an hour. Fifteen minutes call are more frequent than calls of any other duration. If these phone calls were an activity in PERT project, then phone calls expected duration will be
(a) 15 minutes   (b) 20.143 minutes
(c) 21 minutes   (d) 27 minutes

Q.49 Slack time in PERT analysis
(a) can never be greater than zero
(b) is always zero for critical activities
(c) can never be less than zero
(d) is minimum for critical events

Q.50 The probability of completion of any activity within its expected time is
(a) 50%   (b) 84.1%
(c) 99.9%   (d) 100%

Q.51 Match List-I (Item) and with List-II (Characteristic) and select the correct answer using the codes given below the lists.
List-I
A. Activity
B. Event
C. Dummy
D. Float
List-II
1. Resourceless element
2. Resource consuming element
3. Spare time
4. Instantaneous stage
Codes:

	A	B	C	D
(a)	1	3	4	2
(b)	2	1	4	3
(c)	2	4	1	3
(d)	3	4	1	2

Q.52 When a CPM network is to be updated one considers
(a) only completed jobs to be outside the purviews
(b) ongoing works to be outside the purviews
(c) only substituted items
(d) ongoing works and any other substitutions

Q.53 Consider the following statements:
In the critical path method of construction planning, free float can be
1. greater than total float
2. greater than independent float
3. equal to total float
4. Less than independent float
Of these statements
(a) 1 and 4 are correct
(b) 2 and 3 are correct
(c) 3 and 4 are correct
(d) 1 and 2 are correct

Q.54 In a CPM network the activity is non critical if
(a) EST = LST & EPT = LFT
(b) EST < LST & EFT < LFT
(c) EST > LST & EPT > LFT
(d) EST < LST & EFT > LFT

Q.55 In a bar chart the vertical axis represents
(a) Time
(b) Types of activities
(c) Number of labours
(d) Various activities of the project

Q.56 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I	List-II
A. PERT	1. Activity based
B. Node	2. Imaginary activity
C. Dummy	3. End of job
D. CPM	4. Event oriented

Codes:

	A	B	C	D
(a)	1	2	3	4
(b)	4	3	2	1
(c)	1	3	2	4
(d)	4	2	3	1

Q.57 Match List-I (Activity type) with List-II (Representation by) and select the correct answer using the codes given below the lists:

List-I
A. Artificially introduced
B. Critical
C. Noncritical type
D. Dangler

List-II
1. A single thick arrow
2. A single arrow
3. An arrow emerging from an event but not entering into any event
4. A dotted arrow

Codes:

|	A	B	C	D
(a)	4	1	2	3
(b)	2	3	4	1
(c)	4	3	2	1
(d)	2	1	4	3

Q.58 Consider the following statements:
1. A dummy activity is artificially introduced in a network when necessary.
2. A dummy activity consumes some time.
3. A dummy activity is represented by a dotted arrow.
4. A dummy activity must necessarily be introduced in every network.

Which of the above statements are correct?
(a) 1, 2 and 3   (b) 1 and 3
(c) 2, 3 and 4   (d) 1 and 2

Q.59 An AOA network comprising of 8 activities, with 3 dummies, drawn between 8 event nodes is shown. A corresponding AON network will have other than a dummy notional node at the terminal side, K number of links between the activities represented as nodes, where K will be:
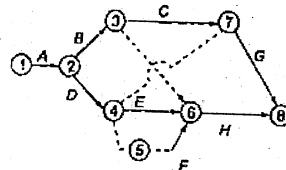
(a) 8   (b) 9
(c) 10   (d) 11

Q.60 Assertion (A): PERT is a deterministic model.
Reason (R): PERT makes the assumption that the optimistic and pessimistic times are about equally likely to occur.
(a) both A and R are true and R is the correct explanation of A.
(b) both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false
(d) A is false but R is true

Q.61 In drawing AOA network and making time computations, the following processes are involved:
1. Activity listing
2. Work breakdown structure
3. Activity time allotment
4. Consideration of available resources for each activity
5. Activity dependencies
6. Float computations
7. Backward path computation
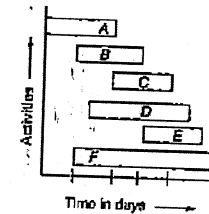8. Project duration
9. Forward path computation

What is the correct sequence of the processes given above?
(a) 1, 2, 4, 3, 9, 7, 5, 6, 8
(b) 2, 1, 4, 3, 5, 9, 8, 7, 6

(c) 4, 1, 3, 2, 9, 5, 7, 8, 6
(d) Any sequence can be followed but 6 and 7 will be last two ones.

**Q.62** Which are the critical activities of the bar chart shown below?

(a) Activities B and E
(b) Activities A, D and F
(c) Activities A, C and E
(d) Activities A and F

Q.63 What does higher standard deviation imply in cost analysis?
(a) Higher uncertainty
(b) Lower uncertainty
(c) Nothing to do with uncertainty
(d) Extra costs are likely.

Q.64 With reference to the network shown in figure, which statement is incorrect?
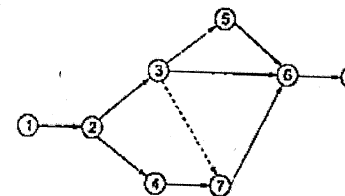
(a) Events 3 and 4 occur after event 2
(b) Event 7 can occur after event 4
(c) Event 7 precedes event 6
(d) Event 5 follows event 3

Q.65 Figure below shows the network for a particular project which consists of four activities.
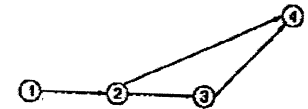
Normal duration time and crash time for each activity are given below:

Activity	Normal time days	Crash time days
1-2	3	2
2-3	4	2
2-4	5	4
3-4	7	5

The minimum time required for the completion of project is
(a) 9 days   (b) 13 days
(c) 14 days   (d) 19 days

Q.66 In PERT analysis, event means
(a) start or finish of a task
(b) time taken for a task
(c) end of an activity
(d) work involved in the project

Q.67 In PERT the span of time between the optimistic and pessimistic time estimates of an activity is
(a) 3σ (b) 6σ
(c) 12σ (d) None of these

Q.68 The most likely time (m) is 'mode' of the
(a) Normal distribution
(b) Beta distribution
(c) Bionomial distribution
(d) None of the above

Q.69 Fulkerson's rule is connected with
(a) numbering of event in PERT/CPM
(b) the simulating model
(c) queuing theory
(d) None of the above

Q.70 The variance of the completion time for a project is the sum of variance of
(a) all activity times
(b) non-critical activity times
(c) critical activity times
(d) activity times of first and last activities of the project

Q.71 In a PERT network, expected project duration is found to be 36 days from the start of the project. The variance is four days. The probability that the project will be completed in 36 days is:
(a) zero
(b) 34%
(c) 50%
(d) 84%

Q.72 Which of the following are the guidelines for the construction of a network diagram?
1. Each activity is represented by one and only one arrow in the network
2. Two activities can be identified by the same beginning and end events
3. Dangling must be avoided in a network diagram
4. Dummy activity consumes no time or resource
Select the correct answer the codes given below:
(a) 1, 2 and 3
(b) 1, 3 and 4
(c) 1, 2 and 4
(d) 2, 3 and 4

Q.73 Consider the following statements with respect to PERT:
1. It consists of activities with uncertain time phases.
2. This is evolved from Gantt chart.
3. Total slack along the critical path is not zero.
4. There can be more than one critical path in PERT network.
5. It is similar to electrical network.
The correct statements are:
(a) 1, 2
(b) 2, 4
(c) 4, 1
(d) 3, 2

Q.74 The earliest occurrence time for event '1' is 8 weeks and the latest occurrence time for event '1' is 26 weeks. The earliest occurrence time for event '2' is 32 weeks and the latest occurrence time for event '2' is 37 weeks. If the activity time is 11 weeks, then the total float (in weeks) will be
(a) 11
(b) 13
(c) 18
(d) 24

Q.75 Consider the following statements in respect of PERT and CPM:

1. PERT is event-oriented while CPM is activity-oriented.
2. PERT is probabilistic while CPM is deterministic
3. Levelling and smoothing are the techniques related to resource scheduling in CPM
Which of these statements are correct?
(a) 1, 2 and 3
(b) Only 1 and 2
(c) Only 2 and 3
(d) Only 1 and 3

Q.76 Consider the following statements
In the bar chart planning
1. interdependence of the operations cannot be portrayed
2. progress of work can be measured
3. spare time of the activities can be determined
4. schedule cannot be updated.
Which of these statements are correct?
(a) 1, 2 and 3
(b) 1 and 4
(c) 2, 3 and 4
(d) 1, 2 and 4

Q.77 The process of inspiring the subordinates to do a work or achieve an objective is called as
(a) Management
(b) Supervision
(c) Motivation
(d) Communication

Q.78 The problem of developing low cost housing for economically backward people in undeveloped region should be analyzed by
(a) Gantt chart
(b) CPM technique
(c) PERT technique
(d) Milestone chart

Q.79 Gantt chart provides information about
(a) break even point analysis
(b) production schedule
(c) material handling layout
(d) determining selling price

Q.80 Match List-I (Bar, chart) with List-II (Highlights : and is adapted for) and select the correct answer using the codes given below the lists:
List-I
A. milestone bar chart
B. Linked bar chart
C. Gantt bar chart
D. Resource-based bar chart

List-II
1. Computation of resources histograms
2. Activity relationships
3. Updating and realigning
4. Activity duration
5. Monitoring and interfaces.
Codes :

	A	B	C	D
(a)	3	2	4	1
(b)	5	2	4	1
(c)	3	4	2	5
(d)	5	4	3	1

Q.81 Assertion (A) : In analysing a construction project using PERT, even though the type of distribution may vary from one activity to another, the distribution function for the completion of the whole project will be approximately of a bell-shaped distribution curve.
Reason (R) : This assumption is in accordance with central theorem.
(a) both A and R are true and R is the correct explanation of A.
(b) both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false
(d) A is false but R is true

Q.82 The optimistic, likely and pessimistic time estimates for the PERT network of a project are shown in the given figure,

(3, 4, 8)   (4, 6, 8)   (7, 7, 9)
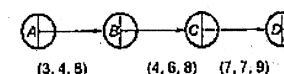
The expected duration of the project is :
(a) 14 days
(b) 17 days
(c) 17.83 days
(d) 18.67 days

Q.83 In arriving at a resource-based schedule bar-chart for a construction project, the following stages for planning of the work are involved :
1. Finalising a network of activities.
2. Determing the optimal activity durations, and considering the relevant parameters.

3. Computation at time.
4. Developing the resource-based bar-chart and the corresponding histograms and mass curves of resources.
5. Identification of the critical constraining resource.
6. Deciding the criteria for optimisation.
The correct sequence of these stages in planning of the work will be
(a) 1, 6, 2, 3, 5, 4
(b) 6, 2, 1, 3, 4, 5
(c) 1, 2, 3, 6, 5, 4
(d) 2, 1, 3, 5, 6, 4

Q.84 In a project logic, four activities M, N, O and P are required to be completed before starting activity Q. If the finish times of M, N, O and P are 12 days, 14 days, 15 days and 17 days respectively, the earliest event occurrence time for the activity Q is
(a) 12 days
(b) 14 days
(c) 15 days
(d) 17 days

Q.85 Assertion (A) : The delay in the performance of a critical activity will delay the completion of the project.
Reason (R) : The float of critical activity is negative.
(a) both A and R are true and R is the correct explanation of A.
(b) both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false
(d) A is false but R is true

Q.86 Assertion (A) : A project consists of three main paths (through activities) running from start event to end event-through there may be subpaths in any or all of these main paths. In such a case, the probability of completion by the expected project duration is 1/3.
Reason (R) : The probability of completion by the expected duration is directed by the three main paths. as they exist.

(a) both A and R are true and R is the correct explanation of A.

(b) both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false

(d) A is false but R is true

Q.87 Which one of the following statements is correct for every activity in a network?

(a) Interference float can never be negative

(b) Independent float can exceed free float

(c) Total float can exceed free float.

(d) Interference float and independent float may be equal to each other in magnitude.

Q.88 Two alternative proposals A and B having the following features are available for implementing a project:

Project	A	B
Mean project duration	150	160
Standard deviation of project duration	15	12

Which are of the following is correct in reference to the preference between the proposals A and B?

(a) The decision cannot be made for lack of sufficient information.

(b) Any one of them can be chosen

(c) A is preferred to B.

(d) B is preferred to A.

Q.89 Consider the following statements:
Total float is:

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

2. difference between maximum time available and the actual time required to perform the activity.

3. difference between its earliest finish time and the earliest start time of its successor activity.

Which of these statement/s is/are correct?

(a) 2 and 3

(b) 1, 2 and 3

(c) 1 only

(d) 1 and 2

Q.90 Values of standard Normal Distribution functions are extracted as under:

| Z	Value
0.20	0.58
0.25	0.60
0.30	0.62
0.35	0.64
0.40	0.655
0.45	0.674
0.50	0.69
0.55	0.71
0.60	0.726
0.65	0.742
0.70	0.758
0.75	0.773
0.80	0.788
0.85	0.803

In a given PERT network, there are two parallel paths A and B from beginning to end with the following characteristics

	Path A	Path B
Expected duration, D days	85	84
Standard deviation, D days	12.5	19

What is the expectation of the project being completed in 80 days?

(a) 0.080

(b) 0.102

(c) 0.345

(d) 0.138

Q.91 Consider the AOA diagram as below
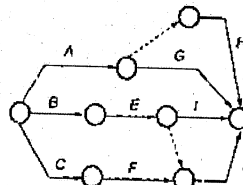
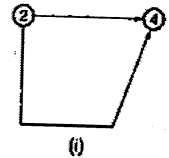What is the number of dummy links required to convert it into a most concise AON diagram.

(a) 8

(b) 7

(c) 6

(d) 5

■■■■

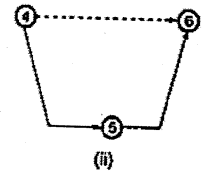**Explanations** CPM & PERT

2. **(a)**
Milestone chart is a modification over the original Gantt chart. When a particular activity, represented by a bar on bar chart is very long, the details lack. If however, the activity is broken or subdivided into a number of subactivities each one of which can be easily recognized during the progress of the project, controlling can easily be done and interrelationships between other similar activities can easily be established.

5. **(b)**

$$1 \xrightarrow{\mu}{2k} 2 \xrightarrow{\mu}{2k} 3 \xrightarrow{\mu}{k} 4 \xrightarrow{\mu}{0} 5$$

Over all project duration $= T_E \pm \sigma$

$$\sigma = \sqrt{(2k)^2 + (2k)^2 + k^2}$$

$$\sigma = 3k$$

$$T_E = \mu + \mu + \mu + \mu = 4\mu$$

Hence overall project duration is $4\mu \pm 3k$

6. **(b)**
(i) Two activities can not start and end at the same nodes.

(i)

(ii) Dummy is not required because the relation is maintained by real activities.

(ii)

7. **(d)**
Total float affects both preceding and succeeding activities.
Free float affects only succeeding activities.

8. **(d)**
Work is going on hence it is an activity

12. (b)
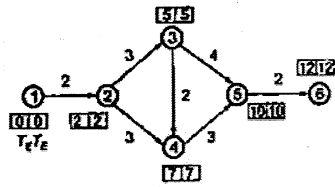
Since $F_T = T_L^j - T_E^i - t_{ij}$

F_T for activity 2 - 4 is

$F_t = 7 - 2 - 3 = 2$ days.

13. (b)
Probability of finishing of project at expected time is 50%. Therefore, probability of finishing the project earlier than expected time is less than 50%.

16. (b)
Minimum slack gives most critical path

17. (a)
$F_{ID} = F_T - F_F = S_j$ (Head event slack)

18. (c)
Slack = 18 − 20 = − 2 weeks

19. (a)
When slack is zero for one path and negative for other, then path with minimum slack is more critical.

20. (d)
Earliest expected time

$E_1 = 0$

$E_2 = E_1 + t_{12} = 0 + 10 = 10$ days

$E_3 = E_1 + t_{13} = 0 + 5 = 5$ days

$E_4 = E_2 + t_{24} = 10 + 16 = 26$ days

$E_5 = E_2 + t_{25} = 10 + 12 = 22$ days

$E_6 = E_4 + t_{46} = 26 + 15 = 41$ days

21. (d)
$T_E = T_L$ for last event

22. (d)
Slack is zero along A - C - E

23. (d)
Variance of project = $2^2 + 2^2 + 1^2 = 9$ days

24. (a)
Path 1 - 2 - 4 - 5 - 6 is timewise longest path.

25. (d)
Project duration = 2 + 12 + 3 + 4 = 21 days

26. (c)

$t_e = \dfrac{t_c + 4t_L + t_p}{6} = \dfrac{2 + 4 \times 3 + 7}{6} = 3.5$

Variance = $\left(\dfrac{7-2}{6}\right)^2 = \dfrac{25}{36}$

27. (c)

t_e (for A) = $\dfrac{8 + 12 \times 4 + 16}{6} = 12$

t_e (for B) = $\dfrac{10 + 11 \times 4 + 18}{6} = 12$

28. (b)
The free float for activity i - j is the difference between its earliest finish time and the earliest finish time for its successor activity.

29. (d)
Latest allowable time – Earliest expected time = Slack

48. (c)

$T_E = \dfrac{t_0 + 4t_m + t_p}{6}$

$= \dfrac{6 + 4 \times 15 + 60}{6} = 21$ minutes

55. (d)
A bar chart consists of two co-ordinates axes, one (usually horizontal axis) representing time elapsed and vertical axis represents the activities to be performed.

56. (b)
PERT is event oriented and CPM is activity based.

Dummy is an imaginary activity.
Node represents end of job.

57. (a)
Artificially introduced activity is dummy and it is shown by a dotted arrow.
Critical activity is represented by a single thick arrow.
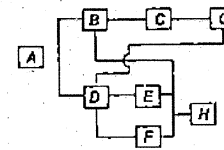Noncritical activity is represented by a single arrow.
Dangler does not enter into any event.

58. (b)
A dummy is introduced artificially and it is shown by a dotted arrow. It does not consume any time. It is not necessary to introduce a dummy always. Thus statements 1 and 3 are correct.

59. (c)
The activity on node (AON) network will be:

It consist of 10 links.
Alternatively links can be calculated in a backward manner by identifying the activities preceding a particular activity.

Activity	Links
G	2
H	3
E	1
F	1
D	1
C	1
B	1
Total	10

60. (d)
PERT is a probabilistic model so Assertion (A) is wrong. Therefore answer will be (d).

64. (b)
Because dummy activity between events 3 and 7 imposes a restriction on the occurrence of event 7 unless event 3 also occurs.

65. (a)
This is the sum of crash times along the critical path.

71. (c)
Standard deviation (σ):

$\sqrt{\text{Variance}} = \sqrt{4} = 2$

$Z = \dfrac{X - \bar{X}}{\sigma} = \dfrac{36 - 36}{2} = 0$

$P(0) = 0.5$

∴ The probability that the project will be completed in 36 days is 50%.

72. (b)
Rules for drawing Network Diagram:
(i) Each activity is represented by one and only one arrow in the network.
(ii) No two activity can be identified by the same end events.
(iii) In order to ensure the correct precedence relationship in the arrow diagram, following question must be checked whenever any activity is added to network.
(a) What activity must be completed immediately before this activity can start?
(b) What activity must follow this activity?
(c) What activity must occur simultaneously with this activity?

74. (c)

E_i	E_j		L_i	L_j
8	32		26	37

Total float = $(L_j - E_i) - d_{ij}$

∵ $L_j = 37$ weeks

$E_i = 8$ weeks

$d_{ij} = 11$ weeks

T.F = 37 − 8 − 11 = 10 weeks

75. (b)

1. PERT is event-oriented while CPM is activity-oriented.
2. PERT is probabilistic while CPM is deterministic.
3. Levelling and smoothing are the techniques related to forecasting (Simple Exponential Smoothing).

82. (c)

$A - B$

$$t_E = \frac{3 + 4 \times 4 + 8}{6} = \frac{27}{6} \text{ days}$$

$B - C \qquad t_E = \frac{4 + 24 + 8}{6} = \frac{36}{6} \text{ days}$

$C - D \qquad t_E = \frac{7 + 28 + 9}{6} = \frac{44}{6} \text{ days}$

$\therefore \qquad t = \frac{27}{6} + \frac{36}{6} + \frac{44}{4} \text{ days}$

$$= \frac{107}{6} = 17.83 \text{ days}$$

90. (c)

$T_E \Rightarrow$ Maximum of two = 85 days

$$Z = \frac{T_S - T_E}{\alpha} = \frac{80 - 85}{12.5} = -0.4$$

$\therefore \quad P(-0.4) = 1 - P(0.4)$
$= 1 - 0.655$
$= 0.345$