BPSC 2018
Bihar Public Service Commission
Assistant Engineer Examination

2700 MCQs
Fully solved multiple choice questions
with detailed explanations

Practice Book
General Engineering

MADE EASY Publications
PREFACE

With the announcement of vacancies by BPSC for the post of Assistant Engineer, it has given hope for many engineers who are aspiring for Govt. jobs. MADE EASY has always been a success partner for engineers right from the onset of engineering education up to they get a formal tag of engineer.

Owing to needs of students to utilise this opportunity in a fruitful way, it gives me great happiness to introduce the first edition of the General Engineering Practice book for Bihar Public Service Commission - Assistant Engineer Examination. While preparing this book utmost care has been taken to cover all the chapters and variety of concepts which may be asked in the exam. It contains more than 2700 multiple choice questions with answer key and detailed explanations, segregated in subject wise manner to disseminate all kind of exposure to students in terms of quick learning. Attempt has been made to bring out all kind of probable competitive questions for the aspirants preparing for Bihar Public Service Commission. This book also contains solved paper of BPSC 2012 to boost the exam time confidence level and help every student to perform in an extraordinary way.

Full efforts have been made by MADE EASY team to provide error free solutions and explanations. The book not only covers the syllabus of BPSC but is also useful for other examinations conducted by BPSC and various Public Service Commissions.

Our team has made their best efforts to make the book error-free. Nonetheless, we would highly appreciate and acknowledge if you find and share any printing/conceptual error. It is impossible to thank all individuals who helped us, but I would like to sincerely acknowledge all the authors, editors and reviewers for putting in their efforts to publish this book.

B. Singh (Ex. IES)
Chairman and Managing Director
MADE EASY Group
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</table>
Q.1 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.2 A serious limitation of interdependencies between various activities is generally observed in
(a) Bar charts
(b) Milestone charts
(c) Network analysis
(d) Job layouts

Q.3 Milestone charts is an improvement over
(a) Bar chart (b) CPM scheduling
(b) PERT scheduling (d) All of the above

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 Gantt charts indicate
(a) Comparison of actual progress with the scheduled progress
(b) Balance of work to be done
(c) Progressive cost of project
(d) Inventory costs

Q.6 Consider the following statements
In the bar chart planning
1. Interdependence of the operations cannot be portrayed
2. Progress of the work can be measured
3. Spare time of the activities can be determined
4. Schedule cannot be updated.
Which of these statements is/are correct?
(a) 1, 2 and 3 (b) 1 and 4
(c) 2, 3 and 4 (d) 1, 2 and 4

Q.7 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.8 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.9 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.10 Gantt chart provide information about
(a) Break even point analysis
(b) Production schedule
(c) Material handling layout
(d) Determining selling price

Q.11 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.12** The function of coping is to serve as a
(a) covering to the wall to throw off water
(b) ornamental course between lintel level and
roof level
(c) projection from a wall to support a structural
member
(d) shade against solar radiation

**Q.13** Activity ‘C’ follows activity ‘A’ and activity ‘D’
follows activities ‘A’ and ‘B’. The correct network
for the project is

(a)

(b)

(c)

(d)

**Q.14** Consider the following statements:
The critical path in a network plan 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.15** A network of seven activities is shown in the
error! Document image corrupted. could not be displayed. activity durations are shown beside the arrows. Which one of the following is the total float in $AB$, the
total float in $CE$ and free float in $EF$, respectively?

(a) 2, 2, 3   (b) 3, 3, 2
(c) 3, 2, 2   (d) 2, 3, 2

**Q.16** Activity on node type of network analysis
involves
(a) PERT scheduling
(b) OPST scheduling
(c) CPM scheduling
(d) Bar chart scheduling

**Q.17** $T^f_i - T^l_i - t_{ij}$ represent

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

**Q.18** There are four consecutive activities in a simple
linear network, each with mean duration $\mu$ 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.19** 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.20** 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.21** 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.22 The independent float affects only
(a) preceding activities
(b) succeeding activities
(c) the particular activity involved
(d) None of the above

Q.23 Match List-I with List-II and select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Total float</td>
<td>$T_L^i - T_E^i - t_{ij}$</td>
</tr>
<tr>
<td>B. Independent float</td>
<td>$T_L^i - T_E^i - t_{ij}$</td>
</tr>
<tr>
<td>C. Free float</td>
<td>$T_L^i - T_E^i - t_{ij}$</td>
</tr>
<tr>
<td>D. Interfering float</td>
<td>$S_j$</td>
</tr>
</tbody>
</table>

Codes:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(b)</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>(c)</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>(d)</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Q.24 From the network shown in the figure below (the number on each arrow denotes the time duration of activity in days), the earliest start time, in days for activity 5–6 is

(a) 8
(b) 7
(c) 9
(d) 11

Q.25 In the network shown in figure total float for the activity 2-4 will be

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

Q.27 The probability distribution taken to represent the completion time in PERT analysis is
(a) gamma distribution
(b) normal distribution
(c) Beta distribution
(d) Log normal distribution

Q.28 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.29 A critical path has
(a) zero slack
(b) minimum slack
(c) maximum slack
(d) infinite slack

Q.30 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.31 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.32 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

Q.33 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.26 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.34 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.35 If the value of variance is more
(a) certainty is more
(b) probability of certainty is more
(c) uncertainty is more
(d) probability distribution curve shall be having an unsymmetrical shape

Q.36 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.37 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.38 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.39 According to Fulkerson's rule, what are the correct event numbers corresponding to events A, B, C, D, E, F and G respectively 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.40 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.41 A 'merge event' is represented by

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

Q.42 Consider the following statements:
The critical path in a network plane of a project
1. help 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.43 Match List-I (Description of activity floats) with List-II (Names of the floats) and select the correct answer using the codes given below the lists:

**List-I**
A. Earliest start time of its successor activity minus earliest finish time of the activity in question minus the duration
B. Time available for an activity performance minus the duration of the activity
C. Excess of minimum available time over the required activity duration
D. Difference between total float and free float of an activity

**List-II**
1. Total
2. Free
3. Interfering
4. Independent

**Codes:**

\[
\begin{array}{cccc}
A & B & C & D \\
(a) & 1 & 2 & 3 & 4 \\
(b) & 1 & 2 & 4 & 3 \\
(c) & 2 & 1 & 3 & 4 \\
(d) & 2 & 1 & 4 & 3 \\
\end{array}
\]

Q.44 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 float
2. It has least cost slope
3. It maintains logic of network
4. It has no float

**Codes:**

\[
\begin{array}{cccc}
A & B & C & D \\
(a) & 1 & 2 & 4 & 3 \\
(b) & 3 & 1 & 2 & 4 \\
(c) & 2 & 4 & 3 & 1 \\
(d) & 4 & 3 & 2 & 1 \\
\end{array}
\]

Q.46 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.47 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.
5. Events have been established for planning.

For which of these features/factors PERT is preferred for planning?

(a) 1, 2 and 3
(b) 3, 4 and 5
(c) 1, 3 and 4
(d) 1, 2 and 5

Q.48 The flow net of activities of a project is given in the following figure. The duration of activities are indicated along the arrows. The critical path of the activities is along

\[
\begin{array}{cccc}
\text{(a)} & 1-2-4-7-9 & \text{(b)} & 1-3-5-7-9 \\
\text{(c)} & 1-3-6-8-9 & \text{(d)} & 1-3-5-6-8-9 \\
\end{array}
\]

Q.49 For the network shown in the below figure (the number on each arrow denotes the time duration of activity in days), the earliest start time, in days for activity 5-6 is
Q.50 The time estimates obtained from four contractors $P$, $Q$, $R$ and $S$ for executing a particular job are as under

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Optimistic time, $t_o$</th>
<th>Most likely time, $t_l$</th>
<th>Pessimistic time, $t_p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P$</td>
<td>5</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>$Q$</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>$R$</td>
<td>5</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>$S$</td>
<td>4</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

Which one of these contractors is more certain about completing the job in time?

(a) $P$  (b) $Q$  (c) $R$  (d) $S$

Q.51 Earliest Date = 20 weeks

Latest Date = 40 weeks

$T_e = 20$  $T_l = 25$  $T_u = 50$

Activity $E$ is connecting both the events and its duration is 10 weeks. The independent float of the activity is

(a) 5 weeks  (b) 10 weeks  (c) 15 weeks  (d) 20 weeks

Q.52 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.53 Match List-I (Item) and with List-II (Characteristic) and select the correct answer using the codes given below the lists:

List-I | List-II
---|---
A. Activity | 1. Resourceless element
B. Event | 2. Resource consuming element
C. Dummy | 3. Spare time
D. Float | 4. Instantaneous stage

Codes:

<table>
<thead>
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<th>D</th>
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</tr>
<tr>
<td>(d)</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Q.54 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.55 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.56 Match List-I (Activity type) with List-II (Representation by) and select the correct answer using the codes given below the lists:

List-I | List-II
---|---
A. Artificially introduced | 1. A single thick arrow
B. Critical | 2. A single arrow
C. Non-critical type | 3. An arrow emerging from an event but not entering into any event
D. Dangler | 4. A dotted arrow

List-I | List-II
---|---
A. Artificially introduced | 1. A single thick arrow
B. Critical | 2. A single arrow
C. Non-critical type | 3. An arrow emerging from an event but not entering into any event
D. Dangler | 4. A dotted arrow
Codes:

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

Q.57 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.58 Figure shows the network for a particular project which consists of four activities.

Normal duration time and crash time for each activity are given below:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Normal time days</th>
<th>Crash time day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2-3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2-4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3-4</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

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

Q.59 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.60 Consider the following statements:
1. Tests on cement paste to determine initial and final setting times are done at normal consistency condition.
2. Low heat cement has a high percentage of tricalcium aluminate.
3. High early strength portland cement contains a larger percentage of tricalcium silicate and a lower percentage of dicalcium silicate.

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

Q.61 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.62 The most likely time (m) is ‘mode’ of the
(a) Normal distribution
(b) Beta distribution
(c) Binomial distribution
(d) None of the above

Q.63 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.64 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.65 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.66 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.67 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.
(a) 1, 2 (b) 2, 4
(c) 4, 1 (d) 3, 2

Q.68 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 will be
(a) 11 (b) 13
(c) 18 (d) 24

Q.69 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.70 In time-cost optimization of a project, crashing is done
(a) on all the activities
(b) on all the activities lying on the critical paths
(c) only on activities lying on the original critical path and having flatter cost slopes
(d) on original critical activities and those that become critical

Q.71 Cost-benefit studies are essential to
(a) assess the total cost of the work
(b) ascertain the relevant escalation in prices
(c) monitor the expenditure
(d) evaluate the viability and worthwhileness of taking up the project.

Q.72 The optimum duration is the
(a) the summation of normal-durations of each activity in the project
(b) summation of the normal-duration of activities on critical path
(c) one, which gives the minimum total cost for completing the project
(d) summation of crash-time of activities on critical path

Q.73 Match List-I (Cost) with List-II (Feature) and select the correct answer using the codes given below the lists:
List-I
A. Optimal cost
B. Overhead cost
C. Direct cost
D. Indirect cost
List-II
1. Activity related
2. Developed by crashing process
3. Project-related
4. Contained in, or contributing exclusively to the related product

Codes:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>(b) 2</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>(c) 4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(d) 2</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Q.74 In cost time optimization of a project, the project can be crashed by expediting
(a) all activities on the critical path
(b) critical activities having minimum cost slope
(c) activities on sub critical path
(d) all activities of the network

Q.75 Which of the following represents the reduction in duration?
(a) Crashing (b) Negative slack
(c) Variance (d) All of the above

Q.76 Consider the following statements:
Crashing a project in terms of its duration would result in
1. an increase in the indirect cost
2. a decrease in the indirect cost
3. a decrease in the direct cost
4. an increase in the direct cost
Which of these statements are correct?
(a) 2 and 4 (b) 2 and 3
(c) 1 and 3 (d) 1 and 2
Q.77 IC engines usable for earthwork are calibrated under standard conditions (denoted by suffix ‘o’) relating its horse power \( H_o \), standard barometric pressure \( P_o \), and standard test temperature \( T_o \), all in absolute scales. \( H \), \( P \) and \( T \) refer to corresponding values when used under other than standard conditions. The ratio of \( \frac{H_o}{H} \) is

\[
\begin{align*}
(a) & \quad \frac{P}{P_o} \sqrt[3]{\frac{T}{T_o}} \\
(b) & \quad \frac{P_o}{P} \sqrt[3]{\frac{T}{T_o}} \\
(c) & \quad \frac{P_o}{P} \sqrt[3]{\frac{T}{T_o}} \\
(d) & \quad \frac{P_o}{P} \sqrt[3]{\frac{T}{T_o}}
\end{align*}
\]

Q.78 The reduction in project time normally results in

(a) decreasing the direct cost and increasing indirect cost
(b) increasing the direct cost and decreasing the indirect cost
(c) increasing the direct cost and indirect cost both
(d) decreasing the direct cost and indirect cost both

Q.79 Economic saving of time results by crashing

(a) cheapest critical activity
(b) cheapest noncritical activity
(c) costliest critical activity
(d) costliest noncritical activity

Q.80 Total project cost versus item curve is a/an

(a) S-shaped curve  (b) parabola
(c) U-shaped curve  (d) straight line

Q.81 The working range of a crane is limited horizontally for maximum lift only by

(a) boom length
(b) length of hoist cable
(c) length of jib
(d) counter weight

Q.82 A contractor has two options: I. Invest his money in project A or II. Invest his money in project B. If he decided to invest in B, he is assured of making his money 1.5 times in 5 years. If the contractor values his money at 10% interest rates, he

(a) should invest in neither of the two projects
(b) could invest in either of the two projects
(c) should invest in project A
(d) should invest in project B

Q.83 In a mass-housing project, break-even point indicates the

(a) amount of total money to be spent
(b) number of houses to be built
(c) number of houses to be built for the best cost/benefit ratio
(d) frequency of houses to be built for maximum profit

Q.84 When a CPM network is to be updated one considers

(a) only completed jobs to be outside the purview
(b) ongoing works to be outside the purview
(c) only substituted items
(d) ongoing works and any other substitutions

Q.85 Which one of the following is the base for resource levelling?

(a) Delaying the completion of critical activities
(b) Delaying the start of noncritical activities
(c) Reducing completion time of critical activities
(d) Not delaying the completion of critical activities

Q.86 The activity duration (days) and resource requirements (units) are shown in the figure below. What is the maximum resource required in a day?

![Resource Requirements Diagram](image)

(a) 14 units  (b) 11 units
(c) 19 units  (d) 18 units

Q.87 What is the process of incorporating changes and rescheduling or replanning called?

(a) Resource allocation
(b) Resource smoothing
(c) Resource levelling
(d) Updating

Q.88 Activities A and B can be started independently. Activity C follows activity A, and activity D follows activities B and C. Activity E follows activity B and precedes activity F. The activities D and F merge at the objective event. Which one of the following is the correct network of the project?
Q.89 Which of the following are the possible changes during the updating of the project network?
1. Change in the duration of an activity.
2. Addition or deletion of an activity.
3. Change in the logical relationship.
Select the correct answer using the codes given below:
(a) 1, 2, 3  (b) only 1  (c) 2 and 3  (d) 1 and 3

Q.90 The constraints in case of resource smoothing operation would be
(a) resources  (b) project duration time  (c) both resources and project duration time  (d) None of the above

Q.91 The resources in a construction project are made up of
(a) office staff  (b) construction materials like cement, bricks, etc.  (c) office space  (d) skilled and unskilled manpower

Q.92 The following table contains data on four activities, A, B, C and D:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Starts at Week number</th>
<th>Ends with Week number</th>
<th>Resource needed per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9th</td>
<td>16th</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>11th</td>
<td>20th</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>15th</td>
<td>22th</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>13th</td>
<td>24th</td>
<td>7</td>
</tr>
</tbody>
</table>

The maximum total resource load in any week will be
(a) 20  (b) 17  (c) 16  (d) 14

Q.93 Updating may result in
(a) change of critical path  (b) decrease of project completion time  (c) increase of project completion time  (d) all of the above

Q.94 In resources levelling
(a) total duration of project is reduced  (b) total duration of project is increased  (c) uniform demand of resources is achieved  (d) cost of project is controlled

Q.95 Which of the following rules should be followed while doing the resource scheduling?
1. CPM network logic must be maintained.
2. Activities on the critical path must use normal crew size.
3. Activities on the noncritical path must use minimum crew size.
Select the correct answer using the code given below:
(a) 1, 2 and 3  (b) 1 and 2  (c) 1 and 3  (d) 2 and 3

Q.96 Consider the following statements:
Resource levelling means
1. economical utilization of resources  
2. gradual increase in resources  
3. adjustment of resources to have the least variations.  
4. complete revamping of resources to suit the requirements  
5. validating network depending on resource constraints
Which of these statements are correct?
(a) 1 and 2  (b) 2, 3 and 4  (c) 3 and 5  (d) 1, 2, 3, 4 and 5
Q.97 The CPM network is updated
(a) At regular intervals
(b) At fixed times
(c) At any time
(d) Whenever there is difference in the planned and actual performance

Q.98 The most suitable type of equipment for compacting of cohesive soils is
(a) smooth-wheeled rollers
(b) vibratory rollers
(c) sheep foot rollers
(d) tampers

Q.99 During the construction period, price variation clause in contracts caters to:
(a) increase in rates of only important materials
(b) variation in cost in materials element, labour element and petrol-oil-lubricant element
(c) variation in total cost of the project on an adhoc basis
(d) rate of inflation

Q.100 Match List-I with List-II select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Piece work contract</td>
<td>1. Not practised in government</td>
</tr>
<tr>
<td>B. Lump sum contract</td>
<td>2. Payment made by detailed measurement of different items</td>
</tr>
<tr>
<td>C. Item rate contract</td>
<td>3. Adopted for buildings, roads, bridges and electrical works</td>
</tr>
<tr>
<td>D. Labour contract</td>
<td>4. Petty works and regular maintenance work</td>
</tr>
</tbody>
</table>

Codes:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 1 2 3 4</td>
<td>(b) 2 3 4 5</td>
<td>(c) 5 4 3 2</td>
<td>(d) 4 3 2 1</td>
</tr>
</tbody>
</table>

Q.102 Consider the following activities in a building construction:
1. Concreting of roof slabs.
2. Brick-jelly lime concrete terracing.
3. Erection of formwork for slab.
The correct sequence of these activities is
(a) 1, 3, 2, 4  
(b) 3, 1, 4, 2
(c) 3, 1, 2, 4  
(d) 1, 3, 4, 2

Q.103 Match List-I (Indications of terms) with List-II (Terms) and select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Used for recording instructions given by the Executive Engineer at site</td>
</tr>
<tr>
<td>B.</td>
<td>Used widely for civil engineering construction</td>
</tr>
<tr>
<td>C.</td>
<td>One of the principles of organization</td>
</tr>
<tr>
<td>D.</td>
<td>One of the functions of management</td>
</tr>
</tbody>
</table>

List-II
1. Co-ordination
2. Unity of command
3. Line organization
4. Site order book

Codes:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 4 3 2 1</td>
<td>(b) 4 2 3 1</td>
<td>(c) 2 4 1 3</td>
<td>(d) 4 1 2 3</td>
</tr>
</tbody>
</table>

Q.104 Match List-I with List-II and select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Self-loading scraper</td>
</tr>
<tr>
<td>B. Narrow tread scraper</td>
</tr>
<tr>
<td>C. Supercharger</td>
</tr>
<tr>
<td>D. Gear ratio</td>
</tr>
</tbody>
</table>

List-II
1. Reduce loss in power
2. Rim pull management
3. Lower rolling resistance
4. Compromise between loading and hauling performances

Codes:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 4 3 2 1</td>
<td>(b) 4 3 1 2</td>
<td>(c) 3 4 1 2</td>
<td>(d) 3 4 2 1</td>
</tr>
</tbody>
</table>
Q.105 The output $Q$ of the earth moving equipment like excavators, shovels, loaders (where ‘$q’$ is production per cycle in m$^3$ and ‘$c’$ is cycle time in seconds) is

(a) $q \times 3600 \times \text{efficiency} \times m^3/hr$
(b) $q \times 3600 \times \text{efficiency m}^3/hr$
(c) $qc \times 3600 \times \text{efficiency m}^3/hr$
(d) $qc \times 3600 m^3/hr$

Q.106 For a given load rating, the operating radius of crane can be increased by

(a) increasing weight of the machine
(b) increasing engine horse power
(c) increasing the length of boom or arm
(d) operating the crane slowly

Q.107 Which of the following are the disadvantages of non-tilting type concrete mixers?

1. They are not favoured when large sized aggregates are used.
2. Mixing of the concrete occurs through both rolling and pulling from buckets.
3. Content of fines is increased.
4. They are not easy to clean.

Select the correct answer using the codes given below.

Codes:
(a) 1, 2, and 3
(b) 1, 3 and 4
(c) 1, 2 and 4
(d) 2, 3 and 4

Q.108 Match List-I (Type of cranes) with List-II (Characteristic) and select the correct answer using the codes given below the lists:

List-I
A. Hydraulic crane
B. Electric overhead crane
C. Travelling bridge crane
D. Hammerhead crane

List-II
1. Has legs moving on tracks laid on the floor
2. Has cantilever arms on both sides
3. Has the unique advantage that the boom length and the angle can be changed during operation
4. Has three-way motion in mutually perpendicular directions

Codes:

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

Q.109 The profits and the associated probability of making the profits are given below in respect of four projects:

<table>
<thead>
<tr>
<th>Project</th>
<th>Profit</th>
<th>Probability of making the profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15%</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>10%</td>
<td>0.8</td>
</tr>
<tr>
<td>3</td>
<td>12%</td>
<td>0.7</td>
</tr>
<tr>
<td>4</td>
<td>11%</td>
<td>0.6</td>
</tr>
</tbody>
</table>

When the motive is maximization of expected profit, the correct order of preference of these projects would be

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

Q.110 The working range of a crane is limited horizontally for maximum lift only by

(a) boom length
(b) length of hoist cable
(c) length of jib
(d) counter weight

Q.111 Which one of the following statements is correct?

(a) Grade resistance is positive when the unit travels downgrade and negative when travelling upgrade.
(b) Grade resistance depends on the type of equipment or the haul surface and is in addition to rolling resistance.
(c) Grade resistance acts against the total weight of both wheel and track type units.
(d) Grade resistance for units moving on the road surface is greater than grade resistance for units moving on rails.

Q.112 The number of trips of a dumper per hour is given by

(a) $\frac{60 \text{ minutes}}{\text{Actual or effective cycle time in minutes}}$
(b) $\frac{60 \text{ minutes}}{\text{Ideal cycle time in minutes}}$
(c) $\frac{60 \text{ minutes}}{\text{Ideal running time + Loss time minutes}}$
(d) $\frac{60 \text{ minutes}}{\text{Running time in minutes}}$

Q.113 The vibrators are used for

(a) compacting concrete
(b) proper mixing of concrete
(c) removing excess water from concrete
(d) obtaining smooth surface
Q.114 Consider the following statements:
When acquiring a crane for a project work, the important aspects of the specifications will include information on
1. length of hoist line
2. length of boom line
3. tipping condition
4. bucket size
5. angle of swing in absolute terms
6. haul distance
Which of the statements given above are correct?
(a) 2, 3, 5 and 6  (b) 1, 2, 3, and 6
(c) 1 and 5    (d) 2, 4, 5 and 6

Q.115 Which of the following are taken into consideration in determining ultimate operating factor of a typical earthmoving equipment?
(a) Rated output at flywheel (or similar power smoothing fitting), maximum power consumption time factor and fuel consumption.
(b) Maximum power consumption time factor, idle running time proportion, overall shutdown time proportion.
(c) Total load/output of earthwork delivered as a proportion of rated capacity.
(d) Maximum power consumption time factor, cycle time as proportion of running time, idle running time between sites, overall shutdown time proportion.

Q.116 Match List-I with List-II and select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Translates policy into a method of achieving the objective set out</td>
<td>A. Power shovel</td>
</tr>
<tr>
<td>B. Consists of defining the responsibilities of employees</td>
<td>B. Hoe</td>
</tr>
<tr>
<td>C. Transmits all the information to the supervising staff</td>
<td>C. Clamshell</td>
</tr>
<tr>
<td>D. The organizational setup is aided to operate efficiently with flow of information, decisions and results in all directions</td>
<td>D. Bulldozer</td>
</tr>
</tbody>
</table>

List-II
1. Co-ordinating
2. Planning
3. Organizing
4. Directing

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

Q.117 Match List-I (Feasibility) with List-II (Emphasized on or calls for) and select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Social</td>
<td>1. Optimizing marginal costs and benefits</td>
</tr>
<tr>
<td>B. Economic</td>
<td>2. Forward and backward linkages</td>
</tr>
<tr>
<td>C. Input</td>
<td>3. Interfaces</td>
</tr>
<tr>
<td>D. Co-ordination</td>
<td>4. Improving wealth</td>
</tr>
</tbody>
</table>

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

Q.118 Match List-I (Earth Excavating Equipment) with List-II (Uses) and select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Power shovel</td>
<td>1. Excavation of earth in confined area or pit</td>
</tr>
<tr>
<td>B. Hoe</td>
<td>2. Rehauling of loose or excavated material from one place to another place</td>
</tr>
<tr>
<td>C. Clamshell</td>
<td>3. Clearing and scrubbing of worksite</td>
</tr>
<tr>
<td>D. Bulldozer</td>
<td>4. Excavation of trenches</td>
</tr>
</tbody>
</table>

List-II
1. Excavation of earth in confined area or pit
2. Rehauling of loose or excavated material from one place to another place
3. Clearing and scrubbing of worksite
4. Excavation of trenches

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

Q.119 Consider the following statements:
The salient features of a bar chart over network are that
1. it is simple to draw and easy to understand.
2. it is unable to depict interdependence of activities.
3. it clearly distinguishes between critical and non-critical activities.
4. it is not possible to crash activities to get optimum and minimum duration of the project.
Which of these statements are correct?
(a) 1, 2, 3 and 4  (b) 2 and 3  (c) 1, 2 and 4  (d) 1, 3 and 4

Q.120 Which of the following advantages accrue to the use of Articulate Dump Trucks (ADT) over Rigid Dump Trucks (RDT) for construction and earth moving work?
1. Higher maneuverability
2. Low turning radius
3. Lower fleet costs
Select the correct answer using the code given below.
Codes :
(a) 1 and 3     (b) 1 and 2     (c) 1 and 3     (d) 2 and 3

Q.121 Consider the following statements:
A mixer designated 400 NT indicates that
1. it is non-lifting type mixer
2. its nominal mix batch capacity is 400 litres
3. it requires 400 revolutions for proper mixing of the batch using one bag of cement
Which of the statements given above are correct?
(a) Only 1 and 3  (b) Only 1 and 2  (c) Only 2 and 3  (d) 1, 2 and 3

Q.122 Match List-I with List-II and select the correct answer using the code given below the lists:

List-I
A. To dig trenches, footings or basement where the precise control of depth is required
B. To handle loose materials such as sand, gravel, coal, etc.
C. To excavate all classes of earth except the rock and load it into the trucks
D. To excavate the earth from a canal and to be deposited on nearby banks
List-II
1. Clam shells
2. Power shovel
3. Back hoe
4. Scrapper
5. Drag line

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

Q.123 Which of the following are the advantages of crawler mounted bulldozer over wheel mounted bulldozers?
1. Higher travel speed
2. Able to travel over very soft soil
3. Able to travel over very rough surfaces having no haul roads
Select the correct answer using the code given below:
(a) 1, 2 and 3  (b) Only 1 and 2  (c) Only 1 and 3  (d) Only 2 and 3

Q.124 How are concrete mixers specified?
(a) By the number of cement bags used in a batch
(b) By the nominal volume of concrete that can be mixed in a batch
(c) By the volume of water used
(d) By the volume of aggregate used

Q.125 The tipping load of a crane refers to
(a) lifted weight together with all attached handling tackle and hoist rope, with grounded outriggers
(b) lifted weight together with all attached handling tackle but excluding hoist rope, with specifying the radius horizontally, with grounded outriggers
(c) lifted weight alone, with specifying the radius for the lifted weight and also for the counter weight without grounding the outriggers
(d) lifted weight alone, at specified horizontal radius without grounding the outriggers

Q.126 Which of the following earth moving machines has the shorter cycle time?
(a) Drag line  (b) Hoe
(c) Clam shell  (d) Dipper shovel

Q.127 Match List-I (Diagram based nomenclature) with List-II (Information capability) and select the correct answer using the codes given below the lists:
List-I
A. Work-breakdown structure
B. Bar chart
C. Linked bar chart
D. Time computations on network

List-II
1. Target dates for interface events can be stipulated
2. Can be hierarchical
3. Can include information on cost distribution over time
4. Best suited for monitoring including that for costs

Codes:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Q.128 Consider the following statements in work breakdown structure.
1. It is a graphical representation of entire programme.
2. The top-down approach to planning is adopted.
3. The down-top approach to planning is adopted.
4. It is suitable for complex projects.
Which of these statements is/are correct?
(a) 1 only
(b) 2 and 4
(c) 3 and 4
(d) 4 only

Q.129 Consider the following statements:
1. In work-breakdown structure top-down approach is adopted.
2. Bar-chart depicts interdependencies of activities.
3. Controlling can be better achieved in milestone chart.
Which of these statements is/are correct?
(a) 1 and 3 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

Q.130 Which one of the following rollers is suitable for soil cement stabilized road construction?
(a) Vibratory roller
(b) Sheepfoot roller
(c) Pneumatic roller
(d) Smooth wheel roller

Q.131 Sinking fund is
(a) the fund for rebuilding a structure when its economic life is over
(b) raised to meet maintenance costs
(c) the total sum to be paid to the municipal authorities by the tenants
(d) a part of the money kept in reserve for providing additional structures and structural modifications

Q.132 Match List-I (Indications of terms) with List-II (Terms) and select the correct answer using the codes given below the lists:

List-I
A. Used for recording instructions given by the Executive Engineer at site
B. Used widely for civil engineering construction
C. One of the principles of organizations
D. One of the functions of management

List-II
1. Coordination
2. Unity of command
3. Line organization
4. Site order book

Codes:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>d</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q.133 The basic action involved in sheep foot rolling is
(a) kneading
(b) pressing
(c) tamping
(d) vibration

Q.134 With the usual notations, sinking fund factor is given by
(a) \((1 + i)^n\)
(b) \(\frac{i}{(1 + i)^n - 1}\)
(c) \(\frac{i}{(1 + i)^n}\)
(d) \(\frac{i(1 + i)^n}{(1 + i)^n - 1}\)

Q.135 Match List-I (Crane) with List-II (Suitable for) and select the correct answer using the code given below the lists:

List-I
A. Tower crane
B. Floating crane
C. Mobile crane
D. Gantry crane

List-II
1. Hydraulic structures
2. High industrial plant
3. Longitudinal and lateral movements of load
4. Railway electrification
Code :
A B C D
(a) 2 1 4 3
(b) 3 4 1 2
(c) 2 4 1 3
(d) 3 1 4 2

Q.136 For three-dimensional movement of a weight, which one of the following is most suitable?
(a) Chain hoist (b) Winch
(c) Crane (d) Jack

Q.137 Consider the following features/actors:
1. Projects are the non-repetitive type.
2. Time requirement need not be known.
3. Time required is known precisely.
4. Events have been established for planning.
5. Emphasis given to activities of project.
PERT is preferred for planning because of
(a) 1, 2 and 4 (b) 3, 4 and 5
(c) 1, 3 and 4 (d) 1, 2 and 5

Q.138 Consider the following statements:
1. Book value is the unamortized cost of the asset as it still appears on the accounting books of the business.
2. Termination of economic life implies disposal of the equipment.
Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Q.139 For excavating utility trenches with precise control of depth, the excavation equipment used is
(a) hoe (b) shovel
(c) dragline (d) None of these

Q.140 Consider the following statements:
Wheeled tractors are replacing crawler tractors because
1. wheeled tractors travel faster
2. crawler tractors are more expensive
3. track parts of a crawler tractor wear out quickly
4. crawler tractors have stick control
Which of these statements are correct?
(a) 1, 3 and 4 (b) 2, 3 and 4
(c) 1, 2 and 3 (d) 1, 2 and 4

Q.141 A machine costs ₹ 16,000. By constant rate of declining balance method of depreciation, its salvage value after an expected life of 3 years is ₹ 2,000. The rate of depreciation is
(a) 0.25 (b) 0.30
(c) 0.40 (d) 0.50

Q.142 Given that
\[ t = \text{duration of various jobs} \]
\[ t_m = \text{mean time of different durations} \]
\[ n = \text{number of observations} \]
The standard deviation is given by
\[ \frac{\sum t}{n} \text{ (a)} \]
\[ t - t_m \text{ (b)} \]
\[ \frac{\sum (t - t_m)^2}{n} \text{ (c)} \]
\[ \sqrt{\frac{\sum (t - t_m)^2}{n}} \text{ (d)} \]

Q.143 Match List-I (Item) with List-II (Characteristic) and select the correct answer using the codes given below the lists:
List-I List-II
A. Activity 1. Resourceless element
B. Event 2. Resource consuming element
C. Dummy 3. Spare time
D. Float 4. Instantaneous stage
Codes :
A B C D
(a) 1 4 3 2
(b) 2 1 4 3
(c) 2 4 1 3
(d) 3 4 1 2

Q.144 Which of the following earth moving machines has the shortest cycle time?
(a) Drag line (b) Hoe
(c) Clam shell (d) Dipper shovel

Q.145 For which of the following materials, the output of power shovels for a fixed shovel size will be maximum
(a) Moist loam (b) Good common earth
(c) Well blasted rock (d) Wet sticky clay

Q.146 For a given size of bucket, the ideal output of a dragline will be least in
(a) Moist loam (b) Sand and gravel
(c) Good common earth (d) Wet sticky clay
Q.147 For a given activity, the optimistic time, pessimistic time and the most probable estimates are 5, 17 and 8 days respectively. The expected time is
(a) 8 days (b) 9 days (c) 10 days (d) 15 days

Q.148 Most accurate method of estimation is based on
(a) Building cost index estimate (b) Plinth area estimate (c) Detailed estimate (d) Cube rate estimate

Q.149 Consider the following pairs:
1. Difference between total float and free float: **Interfering float**
2. Sum of independent float and tail slack: **Free float**
3. Sum of independent float, tail slack and interfering float: **Total float**
Which of these pairs are correctly matched?
(a) 1, 2 and 3 (b) 1 and 2 (c) 2 and 3 (d) 1 and 3

Q.150 Which one of the following project management techniques is deterministic in nature?
(a) CPM (b) PERT (c) GERT (d) LCES

Q.151 Match **List-I** (Reporting feature) with **List-II** (Implication and/or possibility) and select the correct answer using the codes given below the lists:
**List-I**
A. PERT study
B. Time-cost study
C. Critical path identification
D. Linked bar chart

**List-II**
1. Cost build up on project over time can be depicted
2. Choice of technology can be concurrent
3. Choice of technology is predetermined
4. May be affected by probabilistic activity durations

Codes:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
</table>
(a) | 3 | 2 | 4 | 1 |
(b) | 1 | 4 | 2 | 3 |
(c) | 3 | 4 | 2 | 1 |
(d) | 1 | 2 | 4 | 3 |

Q.152 An estimate is
(a) cost of the structure using thumb rules
(b) random guess of cost of structure
(c) probable cost arrived at before construction
(d) actual cost of construction

Q.153 A work costing ₹ 20,000 is termed as
(a) Petty work (b) Minor work (c) Major work (d) Minor project

Q.154 Consider the following statements:
1. PERT is activity-oriented and adopts deterministic approach.
2. CPM is event-oriented and adopts probabilistic approach.
3. PERT is event-oriented and adopts probabilistic approach.
Which of these statements is/are correct?
(a) 1 only (b) 1 and 2 (c) 2 and 3 (d) 3 only

Q.155 Critical path moves along the activities having total float as
(a) Positive (b) Negative (c) Zero (d) Unity

Q.156 Slack time is associated with
(a) A real activity (b) An event (c) Both event and real activity (d) Dummy activity

Q.157 Total float in a planning network is
(a) Late start time – Early start time (b) Early start time – Late start time (c) Late start time – Late finish time (d) Late finish time – Early finish time

Q.158 Which system of network given below completely eliminates the use of dummy activities?
(a) A-O-A (Activity-on-Arrow) (b) A-O-N (Activity-on-Node) (c) PERT (d) CPM

Q.159 In the Critical Path Method of project planning, free float can be
(a) Greater than independent float (b) Greater than total float (c) Less than independent float (d) Equal to total float
Q.160 In the analysis of rates, the profit for the contractor is generally taken as
(a) 20%  (b) 15%  (c) 10%  (d) 5%

Q.161 Cost-benefit studies are essential to
(a) assess the total cost of the work
(b) ascertain the relevant escalation in prices
(c) monitor the expenditure
(d) evaluate the viability and worthwhileness of taking up the project

Q.162 The issue rate of an item stocked in stores is
(a) permanently fixed
(b) fixed at the beginning of each year
(c) a rate less than the market rate
(d) the rate revised during the year when there is an appreciable variation in the rates of the items

Q.163 Consider the following statements:
Crashing a project in terms of its duration would result in
1. an increase in the indirect cost
2. a decrease in the indirect cost
3. a decrease in the direct cost
4. an increase in the direct cost
Which of these statements are correct?
(a) 1 and 4  (b) 2 and 3  (c) 1 and 3  (d) 2 and 4

Q.164 With the usual notations, sinking fund factor is given by
(a) \((1 + i)^n\)  (b) \(\frac{i}{(1 + i)^n - 1}\)
(c) \(\frac{1}{(1 + i)^n}\)  (d) \(\frac{i(1 + i)^n}{(1 + i)^n - 1}\)

Q.165 In the time-cost optimization, using CPM method for network analysis, the crashing of the activities along the critical path is done starting with the activity having
(a) longest duration
(b) highest cost slope
(c) least cost slope
(d) shortest duration

Q.166 In the time-cost analysis, the cost slope is defined as
(a) \(\frac{\text{Crash cost} - \text{Normal cost}}{\text{Crash time} - \text{Normal time}}\)
(b) \(\frac{\text{Crash time} - \text{Normal time}}{\text{Crash cost} - \text{Normal cost}}\)
(c) \(\frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}\)
(d) \(\frac{\text{Normal cost} - \text{Crash cost}}{\text{Normal time} - \text{Crash time}}\)

Q.167 The optimum duration is the
(a) the summation of normal-duration of each activity in the project
(b) summation of the normal-duration of activities on critical path
(c) one, which gives the minimum total cost for completing the project
(d) summation of crash-time of activities on critical path

Q.168 Match List-I (Cost) with List-II (Feature) and select the correct answer using the codes given below the lists:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Optimal cost</td>
<td>1. Activity related</td>
</tr>
<tr>
<td>B. Overhead cost</td>
<td>2. Developed by crashing process</td>
</tr>
<tr>
<td>C. Direct cost</td>
<td>3. Project-related</td>
</tr>
<tr>
<td>D. Indirect cost</td>
<td>4. Contained in, or contributing exclusively to the related product</td>
</tr>
</tbody>
</table>

Codes:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(b) 2</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(c) 4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(d) 2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Q.169 Which one of the following is relevant to Activity on Node (AON)?
(a) Dummy activities may be many
(b) There will be no dummy activities
(c) It is used for quite complex project
(d) It is easier to associate with time flow of activities.
Q.170 Consider the following statements:
1. The resources are considered to be unlimited.
2. The resources are considered to be limited.
3. The start times of some of the activities are so shifted within their available floats that the uniform demand is created for the resources.
Which of these statements is/are correct?
(a) 1 only   (b) 1, 2 and 3   (c) 2 and 3 only   (d) 1 and 3 only

Q.171 Consider the following statements regarding tendering for a civil work:
1. Earnest money deposit (EMD) is a prerequisite to tender for a work.
2. It is not essential to call for the contractor's credentials when a tender is invited.
Which of the above statements is/are correct?
(a) 1 only   (b) 2 only   (c) Both 1 and 2   (d) Neither 1 nor 2

Q.172 A document containing detailed description of all the items of work (but their quantities are not mentioned) together with their current rates is called 
(a) tender   (b) schedule of rates   (c) analysis of rate   (d) abstract estimate

Q.173 The main function of the construction management is
(a) planning   (b) organising   (c) directing   (d) all of these

Q.174 Each work should be planned with respect to
(a) manner of execution of the work   (b) urgency of the work   (c) availability of resources   (d) all of these

Q.175 In construction work, the controlling function aims at
(a) keeping a watch over the physical progress of each activity of the work   (b) controlling the expenditure on each item of work   (c) controlling the use of machines and materials   (d) all of the above

Q.176 A golden rule for the procurement of construction stores is that
(a) half of the construction stores should be at work site and half under procurement   (b) two-third of the construction stores should be at work site and one-third under procurement   (c) three-fourth of the construction stores should be at work site and one-fourth under procurement   (d) whole of the construction stores should be at work site.

Q.177 The construction works costing below rupees twenty thousand are classified as
(a) minor works   (b) major works   (c) projects   (d) none of these

Q.178 The construction works costing above rupees one lac are classified as
(a) minor works   (b) major works   (c) projects   (d) none of these

Q.179 The construction of residential building is treated as
(a) light construction   (b) heavy construction   (c) industrial construction   (d) none of these

Q.180 The first stage of a large construction work to
(a) contract   (b) design   (c) conception   (d) study and evaluation

Q.181 The conception of idea of any construction work is the responsibility of
(a) owner   (b) engineer   (c) contractor   (d) all of these

Q.182 The field activities of an engineer includes
(a) estimation   (b) approval of construction plans by the local authority   (c) inspection and payment of work done by contractor   (d) all of the above

Q.183 The contractor is responsible for
(a) procuring material which is not supplied by the owner   (b) organising and planning the work as per drawing   (c) executing the work as per specifications laid down in the contract   (d) all of the above
Q.184 The resources in a construction project are made up of
(a) plant equipment and machinery required for the project
(b) construction materials such as cement, bricks, steel etc.
(c) skilled and unskilled manpower
(d) all of the above

Q.185 Technical planning is carried out for the
(a) preparation of detailed drawings
(b) preparation of detailed estimate
(c) planning resources and initiating procurement action
(d) all of the above

Q.186 The post-tender stage of construction consists of
(a) assessment of work
(b) finalisation of accounts
(c) assessment of expenditure during execution
(d) all of the above

Q.187 F.W. Taylor introduced a system of organisation known as
(a) line organisation
(b) functional organisation
(c) line and staff organisation
(d) none of these

Q.188 The salient feature of the organisation evolved by F.W. Taylor is
(a) strict adherence to specification
(b) separation of planning and design part for field work
(c) each individual maintains functional efficiency
(d) all of the above

Q.189 The major principle of an organisation is
(a) span of management
(b) unity of command
(c) delegation of authority
(d) all of these

Q.190 Time and progress chart are also known as
(a) bar chart
(b) modified milestone chart
(c) critical path method chart
(d) all of these

Q.191 The process of calculating the resource requirement of a project is known as
(a) scheduling
(b) co-ordinating
(c) resource aggregation
(d) all of these

Q.192 The use of bar chart is very popular in construction departments because
(a) it is very simple to prepare and interpret
(b) each item of work of activity is shown separately
(c) modification to the chart, if required, can be carried out easily
(d) all of the above

Q.193 Which of the following statement is correct in bar chart planning?
(a) The inter dependence of the operations cannot be portrayed.
(b) The progress of work can be measured.
(c) The spare time of the activities can be determined.
(d) The schedule cannot be updated.

Q.194 The earliest method used for planning of projects was
(a) CPM  (b) PERT
(c) bar chart  (d) milestone chart

Q.195 Travel charts are used to
(a) analyse material handling
(b) determine inventory control difficulties
(c) plan material handling procedure and routes
(d) all of the above

Q.196 An activity is
(a) the beginning or end of a specified job
(b) an element of work entailed in the project
(c) the movement of heavy vehicles from one place to another
(d) the progress of work up to a certain limit

Q.197 CPM requires
(a) single time estimate
(b) double time estimate
(c) triple time estimate
(d) none of these

Q.198 The optimistic time represents the
(a) shortest possible time in which an activity can be completed if everything goes exceptionally well
(b) time in which the activity is normally expected to complete under normal contingencies
(c) time in which an activity will take to complete in case of difficulty
(d) none of these
Q.199 Float or slack represents the difference between the
(a) earliest completion time and latest allowable time
(b) latest allowable time and earliest completion time
(c) earliest completion time and normal expected time
(d) latest allowable time and normal allowable time

Q.200 The amount of time by which the activity completion can be delayed without interfering with the start of succeeding activity, is known as
(a) earliest completion time
(b) total float
(c) free float
(d) none of these

Q.201 When float or slack of an activity is positive
(a) it represents a situation where extra resources are available and the completion of project is not delayed
(b) it represents that a programme falls behind schedule and additional resources are required to complete the project in time
(c) the activity is critical and any delay in its performance will delay the completion of whole project
(d) any one of the above

Q.202 Which of the following statement is correct?
(a) When float of an activity is zero, it falls only on critical path.
(b) CPM technique is useful to minimise the direct and indirect expenses.
(c) Critical path of a network represents the minimum time required for completion of project.
(d) all of the above

Q.203 When float of an activity is negative
(a) it represents a situation where extra resources are available and the completion of project is not delayed
(b) it represents that a programme falls behind schedule and additional resources are required to complete the project in time
(c) the activity is critical and any delay in its performance will delay the completion of whole project
(d) all of the above

Q.204 Which of the following statement is correct about the net work diagram?
(a) The events are represented graphically by circles or nodes at the beginning and the end of activity by arrows.
(b) The tail end of the arrow represents the start of an activity.
(c) The head of the arrow represents the end of an activity.
(d) all of the above

Q.205 The occurrence of the completion of an activity, is called its
(a) head event    (b) tail event
(c) dual role event (d) none of these

Q.206 Which of the following is a dummy activity?
(a) Excavation of foundations
(b) Laying the foundation concrete
(c) Awaiting the arrival of concrete material
(d) Curing the foundation concrete

Q.207 The essential condition for the decompression of an activity is that
(a) the project time should change due to decompression
(b) after decompression, the time of an activity invariably exceeds its normal time
(c) an activity could be decompressed to the maximum extent of its normal time
(d) none of the above

Q.208 Which of the following is an activity?
(a) Construction of foundation
(b) Construction of roof
(c) Construction of super-structure
(d) all of these
<table>
<thead>
<tr>
<th>Answers</th>
<th>Engineering Economy and Management Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (d)</td>
<td>2. (a)</td>
</tr>
<tr>
<td>9. (a)</td>
<td>10. (b)</td>
</tr>
<tr>
<td>17. (a)</td>
<td>18. (b)</td>
</tr>
<tr>
<td>25. (b)</td>
<td>26. (b)</td>
</tr>
<tr>
<td>33. (c)</td>
<td>34. (b)</td>
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<td>42. (a)</td>
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<td>49. (c)</td>
<td>50. (b)</td>
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<td>89. (b)</td>
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<td>145. (a)</td>
<td>146. (d)</td>
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<td>153. (a)</td>
<td>154. (d)</td>
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<td>161. (d)</td>
<td>162. (d)</td>
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<tr>
<td>169. (b)</td>
<td>170. (c)</td>
</tr>
<tr>
<td>177. (a)</td>
<td>178. (c)</td>
</tr>
<tr>
<td>185. (d)</td>
<td>186. (d)</td>
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<td>193. (a,d)</td>
<td>194. (c)</td>
</tr>
<tr>
<td>201. (a)</td>
<td>202. (d)</td>
</tr>
</tbody>
</table>
**Explanations**

1. **(d)**

A bar chart consists of two coordinates axes, one (usually horizontal axis) representing the time elapsed and the other (the vertical axis) represent the jobs or activities to be performed.

3. **(a)**

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

12. **(a)**

Coping is a covering placed on the exposed top of an external wall. It is essentially provided to prevent the seepage of water through the joints of the top most corner of the wall. It may be of concrete, stone, brick or terracotta.

15. **(c)**

Solving the network will give earliest occurrence time ($T_e$) and latest finish time ($T_l$) as below:

<table>
<thead>
<tr>
<th>Event</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_e$</td>
<td>0</td>
<td>5</td>
<td>6</td>
<td>12</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>$T_l$</td>
<td>0</td>
<td>8</td>
<td>6</td>
<td>12</td>
<td>11</td>
<td>18</td>
</tr>
</tbody>
</table>

Total float = $(T_e$ for head event – $T_l$ for tail event)
– duration of activity

Total float $AB = 8 - 0 - 5 = 3$
Total float $CE = 11 - 6 - 3 = 2$
Free Float = $T_e$ for head event
– $T_l$ for tail event
– duration of activity

Free float EF = 18 – 9 – 7 = 2

18. **(b)**

$\mu \quad \mu \quad \mu \quad \mu$

$1 \to 2 \to 3 \to 4 \to 5$

$2k \quad 2k \quad k \quad 0$

Over all project duration = $T_e$ + $\sigma$

$\sigma = \sqrt{(2k)^2 + (2k)^2 + k^2} = 3k$

$T_e = \mu + \mu + \mu + \mu = 4\mu$

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

19. **(d)**

Total float affects both preceding and succeeding activities.
Free float affects only succeeding activities.

20. **(d)**

Work is going on hence it is an activity.

25. **(b)**

Since $F_r = T_r^l - T_r^k - t_{ij}$

For activity 2 – 4

$F_r = 7 - 2 - 3 = 2$

26. **(b)**

Probability of finishing a project within expected time is 50%.
Probability of finishing the project earlier than expected time probability is less than 50%.

27. **(c)**

PERT analysis follows beta distribution.

29. **(b)**

Minimum slack gives more critical path.

30. **(a)**

$F_{id} = F_r - F_f$

$= S_r$ (Head event slack)

31. **(c)**

Slack = 18 – 20 = – 2 weeks

32. **(a)**

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

\[ t_e \text{ (for A)} = \frac{8 + 12 \times 4 + 16}{6} = 12 \]
\[ t_e \text{ (for B)} = \frac{10 + 11 \times 4 + 18}{6} = 12 \]

34. (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.

36. (b)

Activity (1) - (2) is subcritical
Activity (2) - (3) is dummy

40. (d)

A critical path is one which connects the events having zero or minimum slack times. All the events along the critical path are considered to be critical in the sense that any delay in their occurrence will result in the delay in the scheduled completion of the project.

48. (c)

Path 1-2-4-7-9 = 6 + 9 + 14 + 12 = 41
Path 1-3-5-7-9 = 8 + 9 + 14 + 12 = 43
Path 1-3-6-8-9 = 8 + 10 + 13 + 15 = 46
Path 1-3-5-6-8-9 = 8 + 9 + 10 + 13 + 15 = 45

49. (c)

The earliest start time of each activity in days is calculated as shown in the squares on the Network Diagram of various activities.
Therefore from network diagram the earliest start time in days for activity 5-6 is 9 days.

50. (b)

Certainty is known by calculating the standard deviation,
\[ \sigma = \frac{t_p - t_0}{6} \]
\[ \therefore \sigma_p = \frac{13 - 5}{6} = 1.33 \]
\[ \sigma_p = \frac{12 - 6}{6} = 1 \]
\[ \sigma_p = \frac{14 - 5}{6} = 1.5 \]
\[ \sigma_p = \frac{13 - 4}{6} = 1.5 \]
\[ \therefore Q \text{ is more certain about completing the job in time.} \]

51. (b)

Independent float
\[ = \left[ T^e_e - T^l_i \right] - t_{ij} = [45 - 25] - 10 \]
\[ = 20 - 10 = 10 \text{ weeks} \]

54. (c)

\[ t_0 = 6 \text{ minutes} \]
\[ t_p = 60 \text{ minutes} \]
\[ t_n = 15 \text{ minutes} \]
\[ \therefore t_e = \frac{t_0 + 4t_m + t_p}{6} = \frac{6 + 4 \times 15 + 60}{6} \]
\[ = 21 \text{ minutes} \]

55. (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.

56. (a)

A-4, B-1, C-2, D-3
Artificially introduced activity is dummy and it is shown by a dotted arrow.
Critical activity is represented by a single thick arrow.
Non-critical activity is represented by a single arrow. Dangler does not enter into any event.

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

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

65. (c)
Standard deviation (σ):
\[
\sigma = \sqrt{\text{Variance}} = \sqrt{4} = 2
\]
\[
Z = \frac{X - \bar{X}}{\sigma} = \frac{36 - 36}{2} = 0
\]
\[
P(0) = 0.5
\]
\[\therefore\text{the probability that the project will be completed in 36 days is 50%}.
\]

66. (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?

68. (c)
\[
\begin{array}{c|c}
E_i & E_i \\
\hline
8 & 32 \\
26 & 37 \\
\end{array}
\]
Total float = \(L_j - E_i - d_{ij}\)
\[\therefore L_j = 37\]
\[E_i = 8\]
\[d_{ij} = 11\]
T.F = 37 - 8 - 11 = 18

69. (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).

72. (c)
The direct cost increases with decrease in duration while the indirect cost decreases with decrease in duration. The optimum duration in the crashing of activities will correspond to minimum total cost (direct + indirect) of project completion.

73. (d)
Fixed indirect cost is independent of the progress of project. It includes initial expenditure for purchase of equipment, installation and storage charge required for different activities.

76. (a)
Crashing reduces duration and therefore indirect cost decreases while direct cost increase.

77. (b)
The combined effect of pressure and temperature on IC engine is determined from the test carried out under conditions \((P, T)\) different from the standard conditions \((P_o, T_o)\).
\[
\text{Horse power, } H = H_o \frac{P}{P_o} \sqrt{\frac{T}{T_o}}
\]
\[\Rightarrow \frac{H_o}{H} = \frac{P}{P_o} \sqrt{\frac{T}{T_o}}
\]

81. (a)
The working range of crane is limited horizontally for maximum lift by boom length. Boom length is the straight-line distance from the centerline of boom foot-pin to the centerline of the boom-point load.

82. (a)
Since interest in compound yearly.
In resource levelling the activities are rescheduled so that the maximum or peak demand for the resources does not exceed the available resources. Thus in resource levelling the main constraint is on the resources. However, the resources cannot be less than the maximum amount needed for any activity of the project.

Sheepfoot rollers compact by tamping and kneading. Therefore they are suitable for tamping and cohesive soils.

First for work is erected and steel is placed over formwork. Then concrete is poured and compacted in formation of slab. After that brick-jelly lime concrete is provided over casted slab for water proofing and thermal insulation. Lastly parapet wall is constructed.

Site order book is register maintained by contractor to record instructions given by executive engineer. Line organization is oldest and simplest form of organization adopted in construction projects specifying line of authority and responsibilities. Unity of command is one of the principles of organization. Co-ordination, planning, organizing etc are the function of organization.

Scrapers can be used in a wide range of material types (including shot rock) and are economical over a wide range of haul lengths and haul conditions. They are a compromise between machines designed exclusively for either loading or hauling. The rolling resistance varies with size of, pressure on tire and tread of tire. A narrow tread gives high pressure and lower rolling resistance than a broad tread, low pressure tire on a hard surface road due to small area of contact between the tire and road surface.
The effect of the loss in power due to altitude can be eliminated by the installation of a supercharger. This is a mechanical unit that will increase the pressure of the air supplied to the engine, thus enabling sea-level performance at any altitude. Rimpull designate the tractive force between the rubber tires of driving wheels and the surface on which they travel. If the coefficient of friction is high enough to eliminate tire slipping, the maximum rimpull is a function of the power of the engine and the gear ratios between the engine and the driving wheels.

The non-tilting type of mixer is suitable for small works and aggregate size not greater than 7.5 cm. With large sized aggregates, segregation may take place.

Both the probability and profit should be considered for evaluating the preference. The ranking should be decided by multiplying profit and probability.

<table>
<thead>
<tr>
<th>Project</th>
<th>Profit x probability</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0.075</td>
<td>Third</td>
</tr>
<tr>
<td>2.</td>
<td>0.080</td>
<td>Second</td>
</tr>
<tr>
<td>3.</td>
<td>0.084</td>
<td>First</td>
</tr>
<tr>
<td>4.</td>
<td>0.066</td>
<td>Fourth</td>
</tr>
</tbody>
</table>

So the correct order is 3 – 2 – 1 – 4

Grade resistance is measured in percent slope. Uphill grades are normally referred to as adverse grade expressed as positive percentage while downhill grades are referred to as favourable grades expressed as negative percentage. Grade resistance does not depend on the type of equipment or the condition or type of road.

Productive capacity of a hauling unit

\[
\text{Cycle time in minutes} \times \text{Hauler’s payload per cycle in tonnes or cum.}
\]

Where payload is the maximum recommended load for a hauling unit as prescribed by the manufacturer. Cycle time = Loading time + hauling time + dumping and turning time + return time + spotting and waiting time.

Vibrators develop vibrations with help of electric motor with an unbalanced mass on its drive shaft and compact the concrete. The entrapped air and excess water is removed resulting in better finish.

Operating factor = Engine factor x Time factor

Engine factor accounts for operating at rated H.P. during maximum output and below rate H.P. for balance of cycle time.

Time factor accounts for shut down time proportion.

In planning phase, strategies are set-out while considering company’s policies and rules. Organizing is dividing work and assigning task to people. Directing is transferring all information to supervising staff. Coordinating is making people work together with flow of information, decisions and results in all directions.

Power Shovel is used in excavation of earth in confined area or pit. Hoe is used in excavation of trenches because trenches need precise control of dimensions and Hoe is suitable for this purpose. Clamshell is used in rehandling of loose or excavated material. Bulldozer is used in clearing and scrubbing of worksite.

The salient features of bar chart are:

(i) Simple to draw and easy to understand
(ii) Unable to depict interdependencies
(iii) Cannot distinguish critical and non-critical activities
(iv) Not possible to crash activities

Advantages of ADT over RDT are:

(i) Higher Maneuverability
(ii) Lower turning radius
(iii) Higher tractive effort
(iv) Better operator comfort
(v) Faster cycle times and therefore low fleet costs
122. (c) **Back hoe** or hoe can be used for digging trenches where precise control of depth is needed. **Power shovels** can be used to excavate the earth and load it into the trucks or other hauling equipments waiting nearby. They are capable of excavating all classes of earth except the solid rocks without loosening. A dragline is designed to excavate below the level of the machine and need not go into a pit or hole for excavating the earth. When the excavated earth is to be deposited on nearby banks or dams, it is better to use dragline with a long boom enough to dispose of the earth in one operation, eliminating the need of hauling units thereby reducing the cost of handling the earth. A dragline is excellent for excavating trenches without shoring. The clamshell bucket is designed to excavate material in vertical direction and it is primarily used for handling loose materials such as sand, gravel, crushed stone, coal, etc.

127. (d) Work-breakdown structure can be Hierarchical. In multiple project scheduling, for sub-projects of a large project, there are events common to more than one sub-project. Such common events are known as interface events because they act as linking elements between the sub-project. For time computations on such networks, target dates for interface events are stipulated.

128. (b) Work breakdown structure is a pictorial representation of major and minor objectives of a project. It is not a network. Instead it is a preliminary diagram of the way in which all the minor objectives go together to ensure the attainment of the major objective.

129. (a) The bar chart does not show clearly the interdependencies between the various activities.

130. (a) Smooth wheel rollers are useful for finishing operations after compaction of fills and for compacting granular base course. Vibratory rollers: The roller compacts the soil primarily by kneading action. These rollers are effective for compacting cohesive as well as cohesionless soils. The sheep-foot rollers are ideally suited for compaction of cohesive soils. The rollers compact the soil by a combination of tamping and kneading action. Soil-cement should be properly compacted. For good results, fine-grained soils should be compacted wet of optimum and coarse-grained soils, dry of optimum.

137. (a) **PERT** is probabilistic in nature and it is event based. It is used for non-repetitive type of projects. **CPM** is activity based and time for completion is known precisely.

138. (a) Economic life is defined as the age of replacement that maximizes the profit returns from the equipment or minimizes the cumulative hourly owning and operating cost. The termination of economic life does not mean disposal of the equipment.

139. (a) Hoe may be used to
   (i) excavate below the natural surface of the ground on which the machine rests.
   (ii) dig trenches, footings or basements and general grading work which requires precise control of depths.
   (iii) penetrate easily into toughest materials to be dug.

140. (d) **Wheel tractor** possesses speed upto 3 to 4 times higher than a crawler tractor. A wheel tractor has steering wheel which is easy to operate and control while a crawler tractor is provided with stick control which is not easy to control. **Crawler tractors** are more costly initially than wheel tractors. Operation, maintenance and repair cost is less in wheel tractor than in crawler tractor.

141. (d) Rate of depreciation,
\[
D = 1 - \left( \frac{C_s}{C_t} \right)^{1/n}
\]
Initial cost, \( C_t = 16000 \)
Salvage value, \( C_s = 2000 \)
\[ n = 3 \]
\[ r_D = 1 - \left( \frac{2000}{16000} \right)^{1/3} = 0.50 \]

**Activity:** It is resource consuming element of the project

**Event:** It is stage or instant of time at which some milestone of project is achieved.

**Dummy:** Special type of activity which does not consume any resource and time.

**Float:** Time by which finish or start of activity can be delayed without affecting project completion time.

145. (a)

The output of power shovel in decreasing sequence will be for a, b, c and d. However, the output in poorly blasted rock will be even less than in wet sticky clay.

146. (d)

For a given size of dragline, the output in increasing order will be for d, c, b and a.

147. (b)

Expected time, 
\[ t_e = \frac{t_o + 4t_m + t_p}{6} \]
\[ = \frac{5 + 4 \times 8 + 17}{6} = 9 \text{ days} \]

148. (c)

In detailed estimates, a complete schedule of all the possible items which are likely to occur, is prepared and prepared unit costs are applied to these items. Thus, a detailed estimate provides an amount which is very near to the final amount of the structure. Thus the detailed estimates are accurate estimates and they are prepared mainly for the following two purposes viz. Execution processes and obtaining technical sanction.

149. (a)

Time scale for an activity:

\[ (EOT) \rightarrow \text{Minimum Available Time} \rightarrow (LOT)_i \rightarrow \text{Head slack} \rightarrow (LOT)_i \rightarrow \text{Tail slack} \rightarrow (EOT) \]

Independent Float (IF) is the excess of minimum available time over activity time.

Free Float (FF) is the excess of available time over the activity time when all jobs start as early as possible.

So \[ FF = IF + \text{Tail slack} \]

Interfering Float = \[ TF = FF = \text{Head slack} \]

\[ TF = IF + \text{Tail slack} \]

Or \[ TF = IF + \text{Head slack} + \text{Tail slack} \]

150. (a)

PERT \rightarrow \text{Programme Evaluation and Review Technique}

GERT \rightarrow \text{Graphical Evaluation Review Technique.}

151. (d)

The PERT study is used for non-repetitive type of projects. To achieve more realistic estimate of the cost of the project and to have better control against the original estimate, cumulative project cost versus time is depicted. For a research work or any new type of project technology cannot be pre-decided.

In time cost study, the durations of activities on critical path can be reduced by

(i) deploying more resources for the early completion of such activities

(ii) relaxing the technical specifications for such activities i.e. choice of technology becomes concurrent with duration reduction.

In critical path identification for PERT network, the critical events may have positive/zero/negative slack depending upon the project scheduled completion time. If there are more than one critical path of a PERT network, then find the variance along each critical path and select the greatest value. Thus the process is affected by probabilistic activity durations.

152. (c)

An estimate is a rough calculation of the quantity of something.

153. (a)

 Petty work ≤ ₹ 20,000
 Minor work = ₹ 20,000 to 100,000
 Major work ≥ ₹ 100,000
154. (d)

PERT is event-oriented and adopts probabilistic approach where as CPM is activity-oriented and adopts deterministic approach.

155. (c)

Total float is the amount of time that an activity can be delayed without delaying the project completion date. Total float is often known as the slack. On a critical path, the total float is zero as critical path already gives longest sequence of activities in a project plan which must be completed on time for the project to complete on due date.

156. (b)

Slack denotes the flexibility range within which an event can occur.

Slack of an event = (LOT – EOT) of the event. In the CPM network the minimum value of slack is zero and the zero slack event is called the critical event.

157. (a, d)

Total float is calculated by subtracting the Early Start date of an activity from its Late Start date (Late Start date – Early Start date), or Early Finish date from its Late Finish date (Late Finish date – Early Finish date).

\[
F_T = LST - EST = LFT - EFT \quad \text{...}(i)
\]

\[
F_F = F_T - S_j \quad \text{...}(ii)
\]

\[
F_{ID} = F_F - S_i \quad \text{...}(iii)
\]

\[
F_{IN} = S_j - F_T - F_F \quad \text{...}(iv)
\]

where,

\[
F_T = \text{Total float}
\]

\[
F_F = \text{Free float}
\]

\[
F_{ID} = \text{Independent float}
\]

\[
F_{IN} = \text{Interfering float}
\]

\[
S_j = \text{Tail event slack}
\]

\[
S_i = \text{Head event slack}
\]

From eq. (iii)

\[
F_F > F_{ID}
\]

From eq. (ii)

\[
F_F < F_T
\]

Thus free float \((F_F)\) is greater than independent float.

160. (c)

Obtaining the cost of unit amount of an item is called rate analysis. In analysis of rates contractor profit is taken at the rate of 0.1 times of total cost of material and labour.

162. (d)

Issue rate denotes cost per unit fixed on the article of stock for the purpose of calculating the amount creditable to the subhead concerned of stock account when issued from stock. An issue rate is fixed for each article of stock on the basis of actual cost plus other expenses including storage charges. So this rate should be revised when there is variation in the rates of the item.

163. (d)

Crashing reduces duration and therefore indirect cost decreases while direct cost increase.

164. (b)

The various factors used in calculation of depreciation are:

(i) Uniform series present worth factor = \(\frac{(1+i)^n - 1}{i(1+i)^n}\)

(ii) Capital recovery factor = \(\frac{i(1+i)^n}{(1+i)^n - 1}\)

(iii) Uniform series compound amount factor = \(\frac{(1+i)^n - 1}{i}\)

(iv) Sinking fund factor = \(\frac{i}{(1+i)^n - 1}\)

166. (c)

Cost slope = \(\frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}\)

167. (c)

The direct cost increases with decrease in duration while the indirect cost decreases with decrease in duration. The optimum duration in the crashing of activities will correspond to minimum total cost (direct + indirect) of project completion.

168. (d)

Fixed indirect cost is independent of the progress of project. It includes initial expenditure for purchase of equipment, installation and storage charge required for different activities.
169. (b) Activity on Node (AON) system of the network completely eliminates the use of dummy activities.

170. (c) It is not given that what is the method of resource allocation. For resource smoothening (d) is correct option but for resource levelling, (c) is correct option.

171. (a) Earnest money deposited (EMD) is deposited with submission of tender document only. Contractor is approved by government before bidding only, and credentials are given to him and it is required while tender is invited.

172. (b) Schedule of rates is a list containing detailed description of components of work and their current rates. It is a table within a Lump sum contract that breaks the job up into component parts so that the completion of discrete tasks can be quantified and invoiced separately.