

### Engineering Equipments

Q.1 Which of the following earth moving machines has the shortest cycle time?  
(a) Drag line (b) Hoe  
(c) Clam shell (d) Dipper shovel

Q.2 If the output of a dragline for 90° angle of swing at estimated depth of cut is X, then the output for 120° angle of swing at 120% of optimum depth of cut will be  
(a) equal to X (b) more than X  
(c) less than X (d) any of the above

Q.3 A machine is purchased for ₹ 10,00,00/- and has an estimate life of 10 years. The salvage value at the end of 10 years is ₹ 1,50,000/-. The book value of the machine at the end of 5 years using general straight line method of evaluation of depreciation is  
(a) ₹ 4,75,000/- (b) ₹ 5,75,000/-  
(c) ₹ 6,50,000/- (d) ₹ 8,50,000/-

Q.4 An excavator costs ₹ 20,000/- and has an estimated life of 8 years. It has no salvage value at the end of 8 years. The book value of the excavator at the end of 3 years using general double declining balance method is  
(a) ₹ 8437.50 (b) ₹ 8750.00  
(c) ₹ 10500.00 (d) ₹ 11562.50

Q.5 Match List-I (Material) with List-II (Coefficient of traction for wheeled tractors) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Loose sand	1. 0.45
B. Concrete	2. 0.25
C. Ice	3. 0.12
D. Loose earth	4. 0.90

Codes:

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

Q.6 Sinking fund is

- the fund for rebuilding a structure when its economic life is over
- raised to meet maintenance costs
- the total sum to be paid to the municipal authorities by the tenants
- a part of the money kept in reserve for providing additional structures and structural modifications

Q.7 Match List-I (Indications of terms) with List-II (Terms) and select the correct answer using the codes given below the lists:

List-I

- Used for recording instructions given by the Executive Engineer at site
- Used widely for civil engineering construction
- One of the principles of organizations
- One of the functions of management

List-II

- Coordination
- Unity of command
- Line organization
- Site order book

Codes:

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

Q.8 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.9 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- Translates policy into a method of achieving the objective set out
- Consists of defining the responsibilities of the employees
- Transmits all the information to the supervising staff
- The organizational set up is aided to operate efficiently with flow of information, decisions and results in all directions

List-II

- Coordinating
- Planning
- Organizing
- Directing

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.10 During the construction period, price variation clause in contracts caters to:

- increase in rates of only important materials
- variation in cost of materials, labour and petrol-oil-lubricant
- variation in total cost of the project on an adhoc basis
- rate of inflation

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

List-I

- Piece work contract
- Lump sum contract
- Item rate contract
- Labour contract

List-II

- Not practised in government
- Payment made by detailed measurement of different items
- Adopted for buildings, roads, bridges and electrical works
- Petty works and regular maintenance work

Codes:

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

Q.12 Capital recovery factor considers

- developing a predetermined sum at a future date at a uniform rate
- consuming a predetermined sum till a future date at a uniform rate
- developing a predetermined sum at a future date at a uniformly varying rate
- consuming a predetermined sum till a future date at uniformly varying rate

Q.13 The system of organization introduced by F.W. Taylor is known as

- Effective organization
- Functional organization
- Line and staff organization
- Line organization

Q.14 A tractor shovel has as purchase price of ₹ 4.7 lacs and could save the organization an amount of rupee one lac per year on operating costs. The salvage after the amortization period is 10% of the purchase price. The capital recovery period will be

- 3.7 years (b) 4.23 years
- 5 years (d) 7.87 years

- Q.15** Cost-benefit studies are essential to
- assess the total cost of the work
  - ascertain the relevant escalation in prices
  - monitor the expenditure
  - evaluate the viability and worthwhileness of taking up the project.

- Q.16** Match List-I with List-II and select the correct answer using the codes given below the lists:

**List-I**

- Self-loading scraper
- Narrow tread high pressure type
- Supercharger
- Gear ratios

**List-II**

- Reduce loss in power
- Rim pull management
- Lower rolling resistance
- Compromise between loading and hauling performances

**Codes:**

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

- Q.17** Payment allowance is selected keeping in mind
- overall cost
  - normal profit and total time
  - overall cost and total time
  - overall cost, normal profit and total time

- Q.18** Which one of the following statement applies to the declining balance method of depreciation accounting?

- Uniform write-off of cost throughout the service is aimed
- Greater write-off in the early years is aimed
- Smaller write-off in early years is aimed
- A varying rate of depreciation is applied on the basis of market value of the asset

- Q.19** Assertion (A) : The salvage value is less in the initial period of the equipment and increases as the equipment ages.

**Reason (R) :** The salvage value of an equipment is the actual amount that can be realized on a trade-in for a replacement machine.

- both A and R are true and R is the correct explanation of A
- both A and R are true but R is not a correct explanation of A
- A is true but R is false
- A is false but R is true

- Q.20** A scraper is to haul earth from a pit to a fill 0.4 km away, working under average-fixed-time conditions of 2.2 minutes, with an average haul speed of 7 kmph. With operating factor of 0.8, the number of cycles which can effectively be performed per hour is nearly

- 5.4
- 6.4
- 8.5
- 9.6

- Q.21** When two different types of machines work in coordination as a team, which one of the following studies is required for the equipment performance?

- Inventory model
- Waiting-line model
- CPM
- PERT

- Q.22** In discrete rate of return computations, the single payment compound amount factors for 7% interest rate for 1, 2, 3, 4 and 5 years are respectively 1.0700, 1.1449, 1.2250, 1.3108, 1.4026. The uniform series compound amount factor for 7% discrete rate of return for 4 years will be nearly

- 5.25
- 5.10
- 4.68
- 4.44

- Q.23** The most versatile method used in appraising project profitability is

- pay back method
- accounting rate of return
- internal rate of return
- net present value index method

- Q.24** 800 units of a certain item of stock are needed over each yearly period. The unit cost is 400 and the cost of each order is ₹ 150. Carrying cost is 1.5%. The EOQ is

- 120
- 160
- 200
- 240

- Q.25** Consider the following statements:

Work breakdown structure formulation is based on the following considerations:

- Intended project duration.
- Clustering of activities in zone project area.
- Profitability of activities.

Which of these statement/s is/are correct?

- 1, 2 and 3
- 2 and 3
- 2 only
- 1 and 3

- Q.26** A construction equipment was tested at an ambient temperature of 18°C and at an ambient pressure of 750 mm of Hg and it indicated a power of 87 kW. Its power under standard conditions of 15°C and 760 mm of Hg will be

- < 87 kW
- = 87 kW
- > 87 kW
- determined by the speed of the prime mover

- Q.27** Assertion (A): The crawler-mounted bulldozers are suitable on soft footing compared to wheel-mounted type.

**Reason (R):** The rubber tyres in the wheel may get damaged very easily.

- both A and R are true and R is the correct explanation of A
- both A and R are true but R is not a correct explanation of A
- A is true but R is false
- A is false but R is true

- Q.28** Match List-I (Scope of Project/Construction Activity) with List-II (Aspects of Project Management Concepts to be Adopted) and select the correct answer using the codes given below the lists:

**List-I**

- Declogging, cleaning, maintenance, repairs and recommissioning of water filter unit
- Extension of HT system, placement of transformers and establishment of LT supply circuits for rural electrification
- Establishment of Export House by a manufacturer
- Final phases of testing and commissioning of a power house

**List-II**

- Dummy arrows and timed nodes
- Interfaces
- ATC and PTC trade-off
- Ladder network with interfaces
- PERT

**Codes:**

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

- Q.29** Over the project period, a total of 6000 times of a certain material would be needed at a uniform rate of consumption. The unit cost is ₹ 75, the carrying cost is 6% and the ordering cost is ₹ 100 per order. What is the best ordering lot for economic purchase?

- 11 times at 520 number each and then the balance
- 500 each time
- 600 each time
- 800 each time for 7 times and then the balance

- Q.30** Consider the following statements:

- Book value is the unamortized cost of the asset as it still appears on the accounting books of the business.
- Termination of economic life implies disposal of the equipment.

Which of the statement/s given above is/are correct?

- 1 only
- 2 only
- Both 1 and 2
- Neither 1 nor 2

Q.31 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.32 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.33 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.34 The average investment value of an equipment over its 5-year life is ₹ 53,000 whereas the annual depreciation is ₹ 11,000. Cost of money is 15% p.a. and taxes are at 5% of investment value. The equipment is used for 1800 hours during each year. The hourly ownership cost for the equipment will be:

- (a) ₹ 37.77 (b) ₹ 21  
(c) ₹ 18 (d) ₹ 12

Q.35 A machine costing ₹ 8,500 will have a scrap value of ₹ 300. Machines of this class have a working hour average life of 25,000 hours. What will be the depreciation charge at the end of the first year, if the machine is operated for a total of 1500 hours? (use straight line method of depreciation)

- (a) ₹ 492.00 (b) ₹ 542.00  
(c) ₹ 548.50 (d) ₹ 692.00

Q.36 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.37 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.38 If the excavation of earth is done manually then it costs ₹ 10 per cum. A machine can excavate at a fixed cost of ₹ 4000 plus a variable cost of ₹ 2 per cum. The quantity of earth for which the cost of excavation by machine will be equal to the cost of manual excavation is

- (a) 500 cum (b) 1000 cum  
(c) 1500 cum (d) 200 cum

Q.39 A machine costs ₹ 20,000 and its useful life is 8 years. The money is borrowed at 8% interest per annum. The capital recovery factor at 8% interest per annum for 8 years is 0.174. The annual equipment cost of the machine will be

- (a) ₹ 1740 (b) ₹ 3480  
(c) ₹ 5220 (d) ₹ 6960

Q.40 If the expected time for completion of a project is 10 days with a standard deviation of 2 days, the expected time of completion of the project with 99.9% probability is ( $Z = 3$  for 99.9%)

- (a) 4 days (b) 6 days  
(c) 10 days (d) 16 days

Q.41 Match List-I (Nature of work) with List-II (Machine required) and select the correct answer using the codes given below the lists:

- |                          |                 |
|--------------------------|-----------------|
| List-I                   | List-II         |
| A. Excavation and moving | 1. Derrick      |
| B. Pure excavation       | 2. Dump truck   |
| C. Pure transportation   | 3. Power shovel |
| D. Pure hoisting         | 4. Drag line    |

Codes:

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

Q.42 Assertion (A): In the hydraulically-controlled bulldozers, the blade can be forced into the ground more accurately than in the cable-controlled bulldozers.

Reason (R): High friction on the blade is produced in addition to its weight in the hydraulically controlled bulldozers.

- (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.43 A construction equipment has a useful life of 4 years after which it is to be replaced by a new one. If the internal rate is 5%, the sinking fund factor will be [Take  $(1 + 0.05)^2 = 1.1025$ ]

- (a) 4.31 (b) 0.823  
(c) 0.232 (d) None of these

Q.44 The initial cost of an equipment is ₹ 2500 and salvage value is ₹ 500. If the life of equipment is 5 years then the depreciation in 4<sup>th</sup> year by sum of year digit method is

- (a) ₹ 400.00 (b) ₹ 266.67  
(c) ₹ 200.00 (d) ₹ 166.67

Q.45 A six wheel crane whose operating weight is 16000 kg is pulled along a level haul road at a uniform speed by another tractor. If the average tension in the toe cable is 720 kg then the rolling resistance of the haul road will be

- (a) 50 kg/t (b) 45 kg/t  
(c) 55 kg/t (d) 60 kg/t

Q.46 A machine costs ₹ 25,000 and its useful life is 10 years. The money is borrowed at 10% interest per annum. The capital recovery factor at 10%

interest per annum for 10 years is 0.163. The annual equipment cost of the machine will be

- (a) ₹ 4075 (b) ₹ 3267  
(c) ₹ 2691 (d) ₹ 1534

Q.47 Given that single payment compound amount factor for 10% for 1, 2 and 3 years are 1.10, 1.21 and 1.33 respectively. What is the capital recovery factor for 10% for 3 years?

- (a) 0.743 (b) 0.693  
(c) 0.521 (d) 0.403

Q.48 Find the output of 2 m<sup>3</sup> power shovel in m<sup>3</sup>/hr excavating material whose swell is 25%. It handles an average heaped loose volume of 2.50 m<sup>3</sup> with cycle time of 25 seconds.

[Assume idle time of 10 minutes for every one hour]

- (a) 240 (b) 230  
(c) 340 (d) 400

Q.49 The maximum rimpull in the first gear of a tractor while towing a load is 6300 kg. The tractor weighs 15 tonnes and is operating along a 2% upgrade and the rolling resistance is 50 kg/tonne. Pull available for towing the load (in kg) is

- (a) 3160 (b) 4085  
(c) 5250 (d) 5550

Q.50 In concrete mix design, allowance for bulking of sand is necessary in case of

- (a) weight batching (b) volume batching  
(c) hand mixing (d) all of the above

Q.51 The original cost of an equipment is ₹ 10,000 and its salvage value at the end of its useful life of five years is ₹ 1000. Its book value at the end of two years of its useful life (as per straight line method of evaluation of depreciation) will be

- (a) ₹ 8800 (b) ₹ 7600  
(c) ₹ 6400 (d) ₹ 5000

Q.52 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.53 Match List-I (Earth Excavating Equipment) with List-II (Uses) and select the correct answer using the codes given below the lists:

**List-I**

- A. Power shovel
- B. Hoe
- C. Clamshell
- D. Bulldozer

**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.54 Match List-I (Working Details) with List-II (Type of Pumps) and select the correct answer using the codes given below the lists:

**List-I**

- A. The water which has entered inside the pump is revolved at high speed by means of the impeller revolving in a tight casing.
- B. The pump gives constant discharge even under variable heads.
- C. Usable in pumping from crooked holes and for handling corrosive liquids
- D. Water can be lifted to large heights using the hydraulic ram

**List-II**

- 1. Air-lift pump
- 2. Impulse pump
- 3. Reciprocating pumps
- 4. Diesel engine driven pumps
- 5. Centrifugal pumps

Codes:

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

Q.55 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. Backhoe
- 4. Scraper
- 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.56 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/construction 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.57 Match List-I with List-II and select the correct answer using the codes given below the lists:

**List-I**

- A. Agitator truck
- B. Needle vibrator
- C. Concrete pump
- D. Tremie pipe

**List-II**

- 1. Placing of concrete
- 2. Underwater concreting
- 3. Compaction of concrete
- 4. Ready mixed concrete transport

Codes:

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

Q.58 Which of the following are the disadvantages of non-lifting 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.59 For cleaning and grubbing of construction site of 15000 m<sup>2</sup> area, a bulldozer is used which has effective width of 2 m of the blade and an average speed of 2.5 kmph. If hiring charges of bulldozer are ₹ 500/hr., then cost per m<sup>2</sup> is

- |          |          |
|----------|----------|
| (a) ₹ 10 | (b) ₹ 12 |
| (c) ₹ 15 | (d) ₹ 18 |

Q.60 A scraper of self weight 27 tonnes works on sandy clay soil weighing 1800 kg/m<sup>3</sup> of bank measure. Haul road rolling resistance is 3.5% and grade is 2% adverse for loaded unit. The earth carried per trip is 14m<sup>3</sup> (b.m.). What rim pull, in newton (approximately) is required when travelling loaded and empty, respectively?

- |                 |                 |
|-----------------|-----------------|
| (a) 35600, 5100 | (b) 32200, 4800 |
| (c) 30100, 4400 | (d) 28700, 4050 |

Q.61 Two centrifugal pumps work in parallel at a common delivery head of 18m. The first pump delivers 90 lps at an efficiency of 60% and the second pump delivers 60 lps at an efficiency of 50%. What is the overall efficiency of the system?

- |           |         |
|-----------|---------|
| (a) 62.5% | (b) 58% |
| (c) 55.6% | (d) 52% |

Q.62 A tractor-trailer assembly has a gross weight of 25 tonnes. When moving on a level road, its rolling resistance is 42 kg per tonne. It is moved up a road of 5% grade. What is the required tractive effort?

- |               |               |
|---------------|---------------|
| (a) 1050.5 kg | (b) 1060.5 kg |
| (c) 1085 kg   | (d) 1102.5 kg |

### Answers : Soil Types and Formation

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

### Explanations : Soil Types and Formation

2. (c)  
 By increasing angle of swing, the output of dragline will be reduced since output will be maximum at optimum depth of cut, so it will be further reduced if depth of cut is more or less than optimum depth of cut.
3. (b)  
 Cost price of machine = ₹ 10,000.00  
 Salvage value = ₹ 1,50,000  
 ∴ Depreciation per year  

$$= \frac{10,000.00 - 1,50,000}{10} = ₹ 85,000$$
 ∴ Book value after 5 years  

$$= 10,000.00 - 85,000 \times 5$$

$$= ₹ 5,75,000/-$$
4. (a)  
 Depreciation in 1<sup>st</sup> year using double declining balance method  

$$20000 \times \frac{2}{8} = ₹ 5000$$
 Book value after 1<sup>st</sup> year  

$$= 20000 - 5000 = ₹ 15000$$
 Depreciation in 2<sup>nd</sup> year  

$$= 15000 \times \frac{2}{8} = ₹ 3750$$
 ∴ Book value after 2<sup>nd</sup> year  

$$= 15000 - 3750 = ₹ 11250$$
 Depreciation in 3<sup>rd</sup> year

- $$= 11250 \times \frac{2}{8} = ₹ 2812.5$$
  
 So, book value after 3<sup>rd</sup> year  

$$= 11250 - 2812.5 = ₹ 8437.50$$
16. (b)  
 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 type and tread of tyre. 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

17. (d)  
 Wages or payment allowance shall be made on the basis of amount and quality of work. Wage payment plans can be classified under two groups:  
 (a) Non incentive plans like time or day rate system.  
 (b) Incentive Wage plans like piece rate or other schemes.

18. (b)  
 The straight line method of depreciation has uniform write-off of cost throughout the service. Declining balance method, double declining balance method and sum of the 'years' digits method are accelerated type of depreciation methods. The greater write-off of cost is taken in early years. Thus, the value of asset decreases at a decreasing rate.  
 The Sinking fund method assumes that the value of an asset decreases at an increasing rate i.e. smaller write-off of cost is aimed in early years and it increases in later years.

19. (d)  
 Salvage value is the value of the equipment at the end of the utility period without being dismantled. This may be due to its being worn out, dangerous, obsolete or inadequate. It is more in the initial period of equipment and decreases as the equipment ages.

20. (c)  
 Operating factor = Time ratio for which equipment actually works in one hour  
 ∴ Actual operating time = Operating factor × 60  

$$= 0.8 \times 60 = 48 \text{ minutes.}$$
 Cycle time = Hauling time + Returning time + Fixed time  

$$= \frac{0.1}{7} \times 60 + 2.2 = 5.63 \text{ minutes}$$
 Number of cycles =  $\frac{48}{5.63} = 8.5$

21. (b)  
 Waiting line model (by A.K. Erlang) is based on queuing theory. Its purpose is to determine the optimum amount of manpower, machinery etc working in coordination.

22. (d)  

$$USCAF_n = 1 + 1 + \sum_{k=1}^{n-1} SPCAF$$
 USCAF → Uniform Series Compound Amount Factor  
 SPCAF → Single Payment Compound Amount Factor  
 For  $n = 4$   

$$USCAF_4 = 1 + 1.0700 + 1.1449 + 1.2250$$

$$= 4.4399 = 4.44$$

24. (c)  

$$\frac{QC}{2} = \frac{DF}{Q}$$

$$Q \rightarrow EOQ$$

$$C \rightarrow \text{Carrying cost} = \frac{1.5}{100} \times 400 = 6$$

$$D \rightarrow \text{Demand} = 800 \text{ units}$$

$$F \rightarrow \text{Fixed cost} = 150$$

$$\therefore EOQ = \sqrt{\frac{2DF}{C}} = \sqrt{\frac{2 \times 800 \times 150}{6}} = 200 \text{ units}$$

25. (b)  
 Work breakdown structure involves identification of activities and event for completion of network diagram. In this, the top-down approach to planning is adopted.  
 The division and subdivision of the work breakdown structure is continued till the value and complex is reduced and end items become manageable for planning and controlling purpose. Thus the considerations are:  
 (i) Clustering of activities in zone project area.  
 (ii) Profitability of activities.  
 For intended project duration the process of crashing is followed.

26. (c)

$$\frac{H_0 \sqrt{F_0}}{P_0} = \frac{H \sqrt{F}}{P} \Rightarrow H_0 = \frac{P_0}{P} \sqrt{\frac{F}{F_0}} H$$

Given  $H = 87 \text{ kW}$   
 $T = 18^\circ\text{C}$   
 $P = 750 \text{ mm of Hg}$   
 $T_0 = 15^\circ\text{C}$   
 $P_0 = 760 \text{ mm of Hg}$   
 Thus,  $H_0 > (H = 87 \text{ kW})$

27. (b)

Crawler mounted dozers have greater floating because of low pressure under the tracks. Therefore they are suitable on soft soil compared to wheel mounted type. The wheel mounted dozers have rubber tires. They may get damaged easily on a rocky formation. Thus both statements are true but R does not provide correct reason for A.

28. (b)

Water filter unit recommissioning is a regular project so PERT is not needed for it. For rural electrification, overlapping activity can be planned with ladder network.

29. (b)

$$\text{Economic Order Quantity (Q)} = \sqrt{\frac{2DF}{C}}$$

$D = 6000$   
 $F = 100$   
 $C = 0.06 \times 75 = 4.5$

$$Q = \sqrt{\frac{2 \times 6000 \times 100}{4.5}} = 516$$

30. (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.

31. (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.

32. (d)

Wheeled tractor has speed up to 3 to 4 times higher than a crawler tractor. A wheeled 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 wheeled tractors. Operation, maintenance and repair cost is less in wheeled tractor than in crawler tractor.

33. (d)

Rate of depreciation

$$r_D = 1 - \left( \frac{C_s}{C_i} \right)^{1/n}$$

Initial cost,  $C_i = 16000$   
 Salvage value,  $C_s = 2000$   
 $n = 3$

$$r_D = 1 - \left( \frac{2000}{16000} \right)^{1/3} = 0.50$$

34. (d)

Average investment = ₹ 53,000  
 Annual depreciation = ₹ 11,000  
 Money cost @ 15% of average investment  
 $= 0.15 \times 53,000 = ₹ 7950$   
 Taxes @ 5% of average investment  
 $= 0.05 \times 53,000 = ₹ 2650$   
 Total annual fixed cost  
 $= 11,000 + 7950 + 2650 = ₹ 21,600$   
 Hourly ownership cost =  $\frac{21,600}{1800} = ₹ 12$

35. (a)

$$\begin{aligned} \text{Annual depreciation} \\ &= \frac{(8500 - 300) \times 1500}{25000} = ₹ 492 \end{aligned}$$

36. (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 that in wet sticky clay.

37. (d)

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

38. (a)

If  $Q$  is the quantity of earth, then cost of excavation by machine =  $4000 + 2Q$   
 Cost of manual excavation =  $10Q$   
 $\therefore 10Q = 4000 + 2Q$   
 $Q = 500 \text{ cum}$

For quantity of earth more than 500 cum, machine excavation will be economical.

39. (b)

It is given by  $20000 \times 0.174 = ₹ 3480$

40. (d)

Normal deviate ( $Z$ ) for 99.9% probability is 3.  
 $\therefore T_s = \sigma Z + T_E$   
 $= 2 \times 3 + 10 = 16 \text{ days}$

43. (c)

$$\begin{aligned} \text{Sinking Fund Factor} \\ &= \frac{i}{(1+i)^n - 1} = \frac{0.05}{(1+0.05)^4 - 1} = 0.232 \end{aligned}$$

44. (b)

$$\begin{aligned} D_m &= C_i - C_s \times \frac{(n-m+1)}{n(n+1)} \\ &= (2500 - 500) \times \frac{(5-4+1)}{5(5+1)} = ₹ 266.67 \end{aligned}$$

45. (b)

$$\begin{aligned} \text{Operating weight of 6 wheel tractor in tonnes} \\ &= \frac{16000}{1000} \text{ tonnes} = 16 \text{ tonnes} \end{aligned}$$

Average tension in the toe cable = 720 kg

$$\therefore \text{Rolling resistance} = \frac{720}{16} = 45 \text{ kg/h}$$

46. (a)

Cost of machine = ₹ 25000  
 Capital recovery factor = 0.163  
 $\therefore$  The annual equipment cost  
 $= 25000 \times 0.163 = ₹ 4075$

47. (d)

SPCAF for 10% for 3 years = 1.33  
 [SPCAF - Single Payment Compound Amount Factor]  
 [CRF - Capital Recovery Factor]  
 $\text{CRF for 10\% for 3 years} = \frac{i \times \text{SPCAF}}{\text{SPCAF} - 1}$   
 $= \frac{0.1 \times 1.33}{1.33 - 1} = 0.403$

48. (a)

In one cycle, volume of material excavated  
 $= 2.50 \text{ m}^3 \text{ loose}$   
 Due to swelling of 25%, bank measure volume  
 of one cycle =  $\frac{2.50}{1.25} = 2.0 \text{ m}^3$   
 Actual time per hour = 50 minutes =  $50 \times 60 \text{ sec}$   
 $\therefore$  Number of cycles being performed per hour  
 $= \frac{50 \times 60}{25} = 120 \text{ cycles}$   
 $\therefore$  Output of the shovel = Bank measure volume in one cycle in  $\text{m}^3 \times$  Number of cycles per hour  
 $= 2 \times 120 = 240 \text{ m}^3/\text{hour}$

49. (c)

Rolling resistance =  $15 \times 50 = 750 \text{ kg}$   
 Grade resistance =  $15000 \times \frac{2}{100} = 300 \text{ kg}$   
 $\therefore$  Pull available for towing the load  
 $= \text{Maximum rimpull} - \text{Rolling resistance} - \text{Upgrade resistance}$   
 $= 6300 - 750 - 300 = 5250 \text{ kg}$

53. (a)

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 rehauling of loose or excavated material.

Bulldozer is used in clearing and scrubbing of worksite.

54. (b)

A centrifugal pump is based on forced vortex flow and water is revolved at a high speed by impeller.

Reciprocating pumps can give constant low discharge under varying head.

55. (c)

Backhoe 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 to 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.

58. (b)

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

60. (d)

When loaded the grade resistance will be 5.5% and when empty the grade resistance will be 1.5%.

Total resistance = rolling resistance + grade resistance.

When travelling loaded the weight

$$= 27 + \frac{1800 \times 14}{1000} = 52.2 \text{ t}$$

When travelling empty the weight = 27 t

Thus rimpull

$$(i) \text{ when loaded} = \frac{5.5}{100} \times 52.2 \times 1000 \times 10 = 28710 \text{ N}$$

$$(ii) \text{ when empty} = \frac{1.5}{100} \times 27 \times 1000 \times 10 = 4050 \text{ N}$$

61. (c)

Efficiency

$$(\eta_o) = \frac{\text{Power delivered to the fluid}}{\text{Power input into the shaft}} = \frac{\gamma Q H}{B P}$$

$$B P = \frac{\gamma Q H}{\eta_o} \text{ delivery head } H = 18 \text{ m}$$

Pump discharge (Q)	Efficiency ( $\eta_o$ )	BP
90 lps	60%	$\frac{90 \times 18 \gamma}{0.6}$
60 lps	50%	$\frac{60 \times 18 \gamma}{0.5}$

Total discharge delivered = 90 + 60 = 150 lps at delivery head of 18m.

The pumps work in parallel

$$\therefore \eta_{\text{overall}} = \frac{150 \times 18 \gamma}{\frac{90 \times 18 \gamma}{0.6} + \frac{60 \times 18 \gamma}{0.5}} \times 100 = 55.6\%$$

For pumps in series

$$\eta_{\text{overall}} = \frac{\Sigma Q}{\frac{Q_1}{\eta_1} + \frac{Q_2}{\eta_2} + \dots}$$

$$\eta_{\text{overall}} = \frac{\Sigma H}{\frac{H_1}{\eta_1} + \frac{H_2}{\eta_2} + \dots}$$

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