

GENERAL APTITUDE**Q. No. 1 - 5 Carry One Mark Each**

1. Inhaling the smoke from a burning _____ could _____ you quickly.
(A) tire / tier (B) tire / tyre (C) tyre / tire (D) tyre / tier

Answer: (C)

2. A sphere of radius r cm is packed in a box of cubical shape.
What should be the minimum volume (in cm^3) of the box that can enclose the sphere?
(A) $\frac{r^3}{8}$ (B) r^3 (C) $2r^3$ (D) $8r^3$

Answer: (D)

3. Pipes P and Q can fill a storage tank in full with water in 10 and 6 minutes, respectively. Pipe R draws the water out from the storage tank at a rate of 34 litres per minute. P, Q and R operate at a constant rate. If it takes one hour to completely empty a full storage tank with all the pipes operating simultaneously, what is the capacity of the storage tank (in litres)?
(A) 26.8 (B) 60.0 (C) 120.0 (D) 127.5

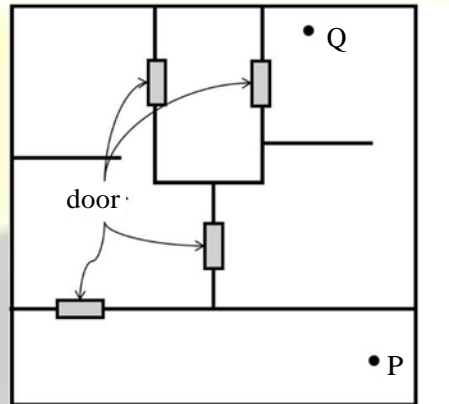
Answer: (C)

4. Six persons P, Q, R, S, T and U are sitting around a circular table facing the center not necessarily in the same order. Consider the following statements:
- P sits next to S and T.
 - Q sits diametrically opposite to P.
 - The shortest distance between S and R is equal to the shortest distance between T and U.
- Based on the above statements, Q is a neighbor of
(A) U and S (B) R and T (C) R and U (D) P and S

Answer: (C)

5. A building has several rooms and doors as shown in the top view of the building given below. The doors are closed initially.

What is the minimum number of doors that need to be opened in order to go from the point P to the point Q?



- (A) 4 (B) 3 (C) 2 (D) 1

Answer: (C)

Q. No. 6-10 Carry Two Marks Each

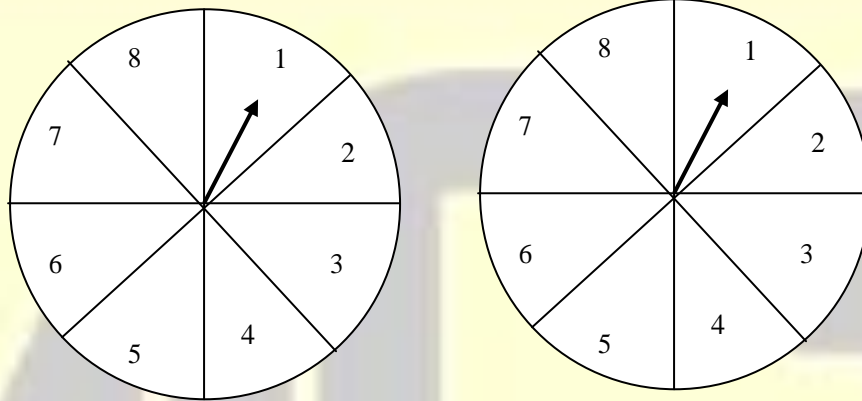
6. Rice, a versatile and inexpensive source of carbohydrate, is a critical component of diet worldwide. Climate change, causing extreme weather, poses a threat to sustained availability of rice. Scientists are working on developing Green Super Rice (GSR), which is resilient under extreme weather conditions yet gives higher yields sustainably.

Which one of the following is the CORRECT logical inference based on the information given in the above passage?

- (A) GSR is an alternative to regular rice, but it grows only in an extreme weather
(B) GSR may be used in future in response to adverse effects of climate change
(C) GSR grows in an extreme weather, but the quantity of produce is lesser than regular rice
(D) Regular rice will continue to provide good yields even in extreme weather

Answer: (B)

7. A game consists of spinning an arrow around a stationary disk as shown below. When the arrow comes to rest, there are eight equally likely outcomes. It could come to rest in any one of the sectors numbered 1, 2, 3, 4, 5, 6, 7 or 8 as shown. Two such disks are used in a game where their arrows are independently spun. What is the probability that the sum of the numbers on the resulting sectors upon spinning the two disks is equal to 8 after the arrows come to rest?



- (A) $\frac{1}{16}$ (B) $\frac{5}{64}$ (C) $\frac{3}{32}$ (D) $\frac{7}{64}$

Answer: (D)

8. Consider the following inequalities.

(i) $3p - q < 4$

(ii) $3q - p < 12$

Which one of the following expressions below satisfies the above two inequalities?

- (A) $p + q < 8$ (B) $p + q = 8$ (C) $8 \leq p + q < 16$ (D) $p + q \geq 16$

Answer: (A)

9. Given below are three statements and four conclusions drawn based on the statements.

Statement 1: Some engineers are writers.

Statement 2: No writer is an actor.

Statement 3: All actors are engineers.

Conclusion I: Some writers are engineers.

Conclusion II: All engineers are actors.

Conclusion III: No actor is a writer.

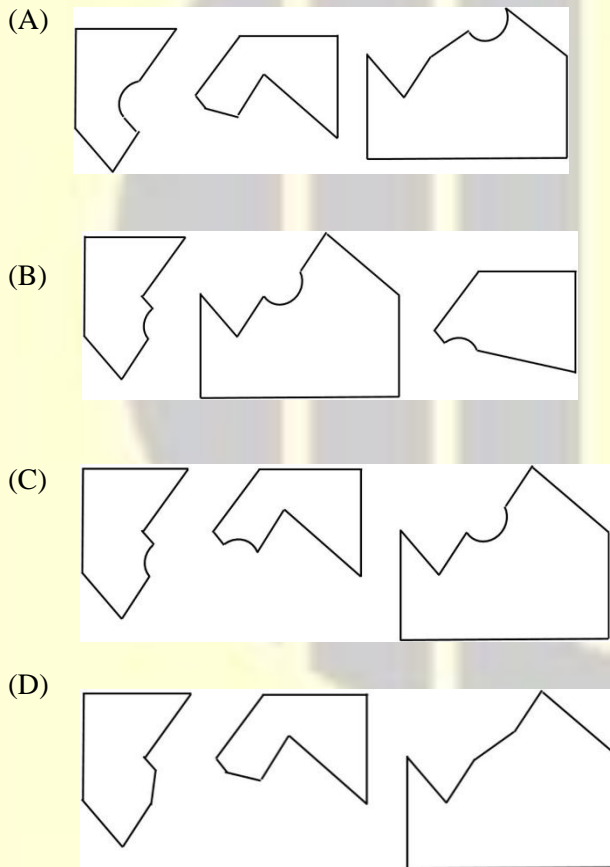
Conclusion IV: Some actors are writers.

Which one of the following options can be logically inferred?

- (A) Only conclusion I is correct
- (B) Only conclusion II and conclusion III are correct
- (C) Only conclusion I and conclusion III are correct
- (D) Either conclusion III or conclusion IV is correct

Answer: (C)

10. Which one of the following sets of pieces can be assembled to form a square with a single round hole near the center? Pieces cannot overlap.



Answer: (C)

15. Match the casting methods with products

| Casting method | | Products | |
|----------------|---------------------|----------|---|
| P. | Continuous casting | 1. | Thin and intricate shaped components |
| Q. | Investment casting | 2. | Hollow axisymmetric parts (such as pipes) |
| R. | Centrifugal casting | 3. | Slabs and strips |

(A) P-3, Q-1, R-2

(B) P-2, Q-3, R-1

(C) P-3, Q-2, R-1

(D) P-2, Q-1, R-3

Answer: (A)

16. In injection blow molding of plastic beverage bottles, the blowing is accomplished by

(A) hot water

(B) hot air

(C) hot oil

(D) alcohol

Answer: (B)

17. In an electro-discharge machining process, the discharge voltage is V_b . The energy dissipated per spark across the inter-electrode gap is proportional to

(A) $V_b^{0.5}$

(B) V_b

(C) V_b^2

(D) V_b^3

Answer: (C)

18. Match the codes used in CNC part programming with their functions.

| Code | Function |
|--------|---|
| P. G91 | 1. End of program |
| Q. M02 | 2. Programming in incremental coordinates |
| R. G32 | 3. Spindle stop |
| S. M05 | 4. Thread cutting in turning |

(A) P-2, Q-3, R-4, S-1

(B) P-2, Q-1, R-4, S-3

(C) P-4, Q-1, R-2, S-3

(D) P-4, Q-2, R-3, S-1

Answer: (B)



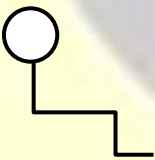

19. The control chart for a number of defects in a welded joint is
 (A) \bar{X} – chart (B) R – chart (C) c – chart (D) p – chart

Answer: (C)

20. Which one of the following statements is TRUE?
 (A) Concurrent engineering is a non-integrated approach for designing a product
 (B) Concurrent engineering carries out all product development functions in a sequential manner
 (C) Concurrent engineering reduces the lead time for the product development
 (D) Concurrent engineering increases the lead time for the product development

Answer: (C)

21. Match the therblig symbols with their meanings.

| Therblig symbol | Meaning |
|---|--------------------------------|
| P.  | 1. Rest for overcoming fatigue |
| Q.  | 2. Avoidable delay |
| R.  | 3. Inspect |
| S.  | 4. Search |

- (A) P-4, Q-3, R-1, S-2 (B) P-4, Q-3, R-2, S-1
 (C) P-3, Q-4, R-1, S-2 (D) P-3, Q-4, R-2, S-1

Answer: (A)

22. Match the types of layout with the types of production.

| Type of layout | Type of production |
|--------------------------|---------------------|
| P. Process layout | 1. Job production |
| Q. Product layout | 2. Batch production |
| R. Fixed position layout | 3. Mass production |

(A) P-2, Q-3, R-1

(B) P-3, Q-1, R-2

(C) P-2, Q-1, R-3

(D) P-3, Q-2, R-1

Answer: (A)

23. Matrix A as a product of two other matrices is given by

$$A = \begin{bmatrix} 3 \\ 2 \end{bmatrix} \begin{bmatrix} 1 & 4 \end{bmatrix}$$

The value of $\det(A)$ is _____. (round off to nearest integer)

Answer: (0 to 0)

24. The order of the following differential equation is _____ [in integer]

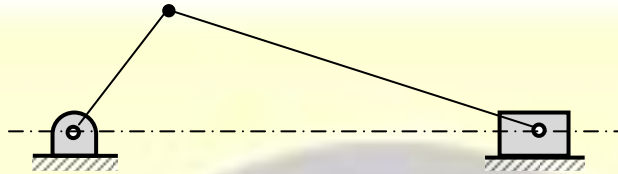
$$\left(\frac{dy}{dx}\right)^2 + 5\frac{dy}{dx} + 4y = 5x^3$$

Answer: (1 to 1)

25. An operator manufactures 10 identical spur gears in a lot. One spur gear is defective in the lot. Three spur gears are drawn at random without replacement. The probability of getting all three gears as non-defective is _____. [round off to two decimal places]

Answer: (0.69 to 0.71)

26. In a slider crank mechanism (schematic shown in the figure), the crank rotates at 60 revolutions per minute. The radius of the crank is 30 mm and the length of the connecting rod is 120 mm. The average speed (in mm/s) of the piston over one revolution of the crank is _____. [round off to nearest integer]



Answer: (119 to 121)

27. Water (kinematic viscosity $\nu = 1 \times 10^{-6} \text{ m}^2/\text{s}$) is flowing through a circular horizontal pipe of diameter 8 mm. If the flow is laminar and fully developed with a maximum axial velocity of 0.5 m/s, the Reynolds number is _____. (round off to nearest integer)

Answer: (1995 to 2005)

28. Yielding starts in a material when the principal stresses are 100 MPa, 100 MPa and 200 MPa. As per the von Mises criterion, yield stress (in MPa) of the material is _____. [round off to nearest integer]

Answer: (99 to 101)

29. A single-point cutting tool with zero rake angle is used for orthogonal machining. If the chip-compression ratio is 1.25, then the shear angle (in degree) during machining is _____. [round off to one decimal place]

Answer: (38.0 to 39.0)

30. It is required to cut a single-start thread of 2 mm pitch in a lathe machine with a single-start lead screw of 4 mm pitch. For one revolution of the workpiece, the number of revolution of the lead screw is _____. [round off to two decimal places]

Answer: (0.40 to 0.60)

31. The absolute deviations of 8 points from the datum line of a surface are 10, 15, 12, 10, 13, 12, 20 and 25 μm . The root mean square value of the surface roughness (in μm) is _____. [round off to one decimal place]

Answer: (15.0 to 16.0)

32. In a machine there are two motors, but only one motor is needed for the functioning of the machine. The reliabilities of the motors are 0.90 and 0.70. The overall reliability of the machine is_____. (round off to two decimal places)

Answer: (0.96 to 0.98)

33. If the interarrival time is exponential and 8 customers per hour arrive in a bank, then the probability of no arrival of customer during a period of 15 minutes is_____. (round off to two decimal places)

Answer: (0.12 to 0.15)

34. A company buys a machine worth ₹ 65000, which has a salvage value of ₹ 5000. The annual depreciation cost is ₹ 10000 based on the straight line depreciation method. The useful life (in year) of the machine is_____. (in integer)

Answer: (6 to 6)

35. A project comprises of seven activities. The expected durations of activities and their variances are as follows:

| Activity | Expected duration (minute) | Variance (minute) |
|----------|----------------------------|-------------------|
| A | 4 | 1 |
| B | 5 | 1 |
| C | 4 | 1 |
| D | 1 | 0 |
| E | 7 | 4 |
| F | 6 | 1 |
| G | 8 | 4 |

The critical path consists of activities B, E and G. The standard deviation (in minute) of the project duration is_____. (round off to two decimal places)

Answer: (2.90 to 3.10)

Q. No. 36–65 Carry Two Marks Each

36. If a matrix is squared, then
- (A) both eigenvalues and eigenvectors must change
 - (B) both eigenvalues and eigenvectors are retained
 - (C) eigenvalues get squared but eigenvectors are retained
 - (D) eigenvalues are retained but eigenvectors change

Answer: (C)

37. Consider the following ordinary differential equation:

$$4 \frac{d^2y}{dx^2} - 4 \frac{dy}{dx} + y = 0$$

Given that c_1 and c_2 are constants, the general solution of the differential equation is

- (A) $y = (c_1 + c_2x)e^x$
- (B) $y = c_1e^{x/2} + c_2e^x$
- (C) $y = c_1e^x + c_2e^{2x}$
- (D) $y = (c_1 + c_2x)e^{x/2}$

Answer: (D)

38. A market survey with a sample size of 1000 was conducted for a parameter that follows normal distribution. The confidence interval was estimated as [500, 700] with a mean of 600. It is now desired to reduce the confidence interval to [550, 650]. The sample size for achieving the desired interval at the same confidence level is
- (A) 1000
 - (B) 4000
 - (C) 9000
 - (D) 16000

Answer: (B)

39. A eutectoid steel with 100% austenite is cooled from a temperature of 750°C to a room temperature of 35°C. Match the cooling methods with transformed structures.

| Cooling method | Transformed structure |
|--------------------|-----------------------|
| P. Water quenching | 1. Coarse pearlite |
| Q. Oil quenching | 2. Fine pearlite |
| R. Air cooling | 3. Martensite |
| S. Furnace cooling | 4. Very fine pearlite |

(A) P-1, Q-2, R-3, S-4

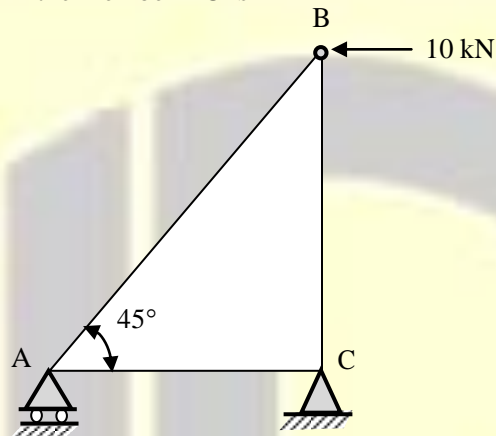
(B) P-2, Q-3, R-4, S-1

(C) P-3, Q-4, R-2, S-1

(D) P-3, Q-4, R-1, S-2

Answer: (C)

40. In the three-member truss shown in the figure, $AC = BC$. An external force of 10 kN is applied at B, parallel to AC. The force in the member BC is



(A) zero

(B) 10 kN (tensile)

(C) 10 kN (compressive)

(D) 7.07 kN (tensile)

Answer: (B)

41. Match the processing steps related to production of powder metallurgy parts with their descriptions.

| Processing step | Description |
|-----------------|---|
| P. Atomization | 1. Blended powders are pressed into shapes using dies and pressure |
| Q. Sintering | 2. A process for producing metal powder |
| R. Compaction | 3. Metal powders are heated below their melting points to allow bonding |
| S. Infiltration | 4. Metal powders are heated significantly above their melting point for bonding |

(A) P-1, Q-5, R-2, S-3

(B) P-3, Q-2, R-1, S-5

(C) P-2, Q-3, R-1, S-4

(D) P-2, Q-5, R-1, S-4

Answer: (C)

42. In an assembly comprising shaft and hole, the nominal sizes with tolerances are specified as

Hole: $25.000_{-0.001}^{+0.002}$ mm,

Shaft: $25.000_{-0.003}^{+0.001}$ mm.

The type of fit is

- (A) Clearance fit (B) Interference fit (C) Transition fit (D) Running fit

Answer: (C)

43. In a manufacturing system, four different types of products (P, Q, R and S) are produced. The batch size of each product is 2×10^7 . The numbers of defective units are 60, 71, 80 and 55, for P, Q, R and S, respectively. Which one of the following statements is TRUE?

- (A) All products conform to six sigma standard.
 (B) Only product S conforms to six sigma standard.
 (C) Except R, all other products conform to six sigma standard.
 (D) Products P and S conform to six sigma standard.

Answer: (D)

44. Match the processes of product development with their characteristics.

| Process | Characteristics |
|----------------------------|--|
| P. Product synthesis | 1. Process of conversion of conceptual design into engineering science based model |
| Q. Product simplification | 2. Process related to design conceptualization |
| R. Product analysis | 3. Process of maintaining uniformly and consistency |
| S. Product standardization | 4. Process of reducing the number of parts without losing the functionalities. |

- (A) P-2, Q-4, R-1, S-3 (B) P-2, Q-3, R-1, S-4
 (C) P-4, Q-3, R-1, S-2 (D) P-4, Q-3, R-2, S-1

Answer: (A)

45. The value of

$$\lim_{x \rightarrow 1} \frac{x^3 - 3x + 2}{x^3 - x^2 - x + 1}$$

is _____ (round off to one decimal place)

Answer: (1.4 to 1.6)

46. A thick-cylinder has inner diameter of 20 mm and outer diameter of 40 mm. It is subjected to an internal pressure of 100 MPa. Follow the convention of taking tensile stress as positive and compressive stress as negative. The sum of radial and hoop stresses (in MPa) at a radius of 15 mm is _____. (round off to two decimal places)

Answer: (66.00 to 67.00)

47. A shaft is used to transmit a power of 10 kW. The shear yield stress of the material is 150 MPa and factor of safety is 2. The shaft rotates at 1440 revolutions per minute. The diameter of the shaft (in mm) based on static strength is _____. (round off to two decimal places)

Answer: (16.00 to 17.00)

48. Air at initial temperature and pressure of 15°C and 1 bar, respectively is heated in and 1 bar, respectively is heated in an irreversible process. The final temperature and pressure are 303°C and 2 bar, respectively. Take gas constant for air as $R = 287 \text{ J/kg-K}$, the ratio of the specific heats as $\gamma = 1.4$, and treat air as a calorically perfect gas. The change of entropy (in J/kg-K) in the process is _____ (round off to nearest integer).

Answer: (495 to 499)

49. During a hot-working process, the homologous temperature is 0.8. The melting point of the work metal is 800°C. The temperature (in °C) during hot-working is _____ (round off to nearest integer)

Answer: (584 to 586)

50. A workpiece of 30 mm diameter and 40 mm height is compressed between two platens in an open die forging process. Assume a perfectly plastic material with a flow stress of 300 MPa. The ideal forging load (in kN) at 30% reduction (in height) is _____ (round off to nearest integer).

Answer: (300 to 306)

51. In a gas tungsten arc welding process under steady state condition, the input voltage and current are measured as 18V and 160A, respectively. Heat loss during creation of arc is 40% of the input power. Heat loss through convection and radiation from the work piece is 800 W. The effective power (in W) utilized to melt the work piece is _____ (round off to nearest integer)

Answer: (926 to 930)

52. During straight turning of a 20 mm diameter steel bar at a spindle speed of 400 revolutions per minute (RPM) with an HSS tool, a tool life of 10 minute was observed. When the same bar was turned at 200 RPM, the tool life increased to 40 minute. The tool life (in minute) while machining the bar at 300 RPM is _____. (round off to nearest integer)

Answer: (16 to 19)

53. A cylindrical work piece is turned using two different tools. Tool 1 has zero nose radius; side and end cutting edge angles are 20° and 10° , respectively. Tool 2 has 0.5 mm nose radius. Both the tools machine at a feed of 0.2 mm/rev. The ratio of ideal maximum height of unevenness on the surface produced by Tool 1 to that produced by Tool 2 is _____ (round off to one decimal place).

Answer: (2.9 to 3.7)

54. For an electrochemical machining process

$$\frac{dy}{dt} = \frac{\lambda}{y} - f,$$

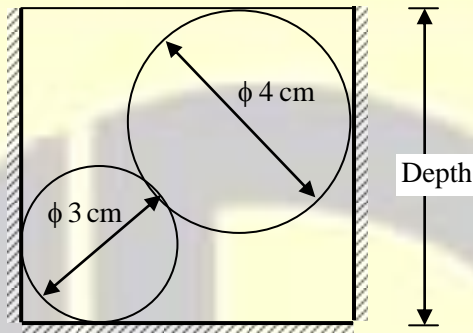
Where y is the inter-electrode gap in mm at time t in minute, and f is the feed of the tool in mm/minute. The value of λ is $6 \times 10^{-3} \text{ cm}^2/\text{minute}$. For maintaining a constant inter-electrode gap of 0.1 mm, the feed (in mm/minute) should be _____ (round off to one decimal place).

Answer: (5.9 to 6.1)

55. The worktable of an open loop positioning system is driven by a lead screw with a pitch of 4 mm. The lead screw is connected to the shaft of a stepper motor. A gear of 80 teeth mounted on the stepper motor shaft meshes with a gear of 20 teeth mounted on the lead screw. The step angle of the stepper motor is 9° . The number of pulses required to move the table by 200 mm is _____. (in integer).

Answer: (498 to 502)

56. The diameter of a cylindrical cavity is measured by using two spherical steel balls of diameters 3 cm and 4 cm. The balls are placed inside the cavity such that the bigger ball is above the smaller one as shown in the figure. If the depth of cavity is 6 cm, then the diameter (in cm) of cavity is _____ (round off to two decimal places)



Answer: (5.93 to 5.97)

57. In a mobile screen manufacturing process on a mass scale basis, 5 samples of size 80 are inspected. Consider a p-chart with $\pm 3\sigma$ limits (σ is the standard deviation). The numbers of defective items are given in the table.

| Sample No. | Number of defective items |
|------------|---------------------------|
| 1 | 4 |
| 2 | 10 |
| 3 | 5 |
| 4 | 6 |
| 5 | 5 |

The upper control limit of the defective item (in fraction defective) is _____. (round off to two decimal places)

Answer: (0.15 to 0.18)

58. In a factory, 100 bulbs are in use. The table lists the cumulative probability of the failure of a bulb for various durations.

| Duration (month) | Cumulative probability |
|------------------|------------------------|
| 1 | 0.10 |
| 2 | 0.25 |
| 3 | 0.47 |
| 4 | 0.68 |
| 5 | 1.00 |

The factory follows the individual replacement policy. If the cost of replacing a bulb is ₹ 300, then the expected cost (in ₹) of replacement per month is _____. (round off to nearest integer)

Answer: (8570 to 8701)

59. A company procures 384 parts annually. The annual holding cost per part is ₹ 30. If the ordering cost is ₹ 1000, then the economic order quantity is _____. (in integer)

Answer: (160 to 160)

60. A time study engineer recorded the cycle time (in minute) for machining of a component. The recorded time study data is provided in the table. The performance rating of the worker is 110%. The standard time for machining (in minute) the component by assuming 10% allowance is _____. (round off to nearest integer)

| Time study data | |
|---------------------|-----------|
| Cycle time (minute) | Frequency |
| 42 | 1 |
| 43 | 2 |
| 44 | 3 |
| 45 | 2 |
| 46 | 1 |

Answer: (53 to 54)

61. A machine component is to be processed at 5 workstations sequentially. The table provides the cycle time (in second) of each workstation. In mass production, the number of components produced per hour (in steady state) is _____. (in integer)

| Workstation | Cycle time of each workstation (second) |
|-------------|---|
| WS-1 | 85 |
| WS-2 | 55 |
| WS-3 | 90 |
| WS-4 | 65 |
| WS-5 | 70 |

Answer: (40 to 40)

62. A vaccine has to be distributed from two warehouses to three hospitals. The supplies at warehouses W_1 and W_2 are 200 and 150, respectively. The demands at hospitals H_1 , H_2 , and H_3 are 100, 150 and 125, respectively. The transportation cost (in ₹) per vaccine is as follows:

| | H_1 | H_2 | H_3 |
|-------|-------|-------|-------|
| W_1 | 5 | 7 | 3 |
| W_2 | 4 | 6 | 7 |

The initial basic feasible solution using the Northwest-corner method provides the total transportation cost (in ₹) as _____. (round off to nearest integer)

Answer: (2190 to 2210)

63. Consider the linear programming problem:

$$\text{Maximize } z = 20x_1 + 6x_2 + Px_3,$$

Subject to

$$8x_1 + 2x_2 + 3x_3 \leq 250, \quad (C_1)$$

$$4x_1 + 3x_2 \leq 150, \quad (C_2)$$

$$2x_1 + x_3 \leq 50, \quad (C_3)$$

$$x_1, x_2, x_3 \geq 0,$$

The optimal solution is given as $x_1^* = 0$, $x_2^* = 50$ and $x_3^* = 50$. The dual variables of constraints C_1, C_2 and C_3 are y_1, y_2 and y_3 , respectively. The optimal values of dual variables are $y_1^* = 0$, $y_2^* = 2$ and $y_3^* = 8$. The value of parameter P in the objective function is _____ (round off to one decimal place).

Answer: (7.9 to 8.1)

64. A company is planning to produce 24 electric cars per day. The setup cost of the plant is estimated as ₹ 19476 million and the variable cost is ₹ 0.6 million per car. The car will be sold at a price of ₹ 1.5 million. The number of days required for achieving the breakeven is _____. (round off to nearest integer)

Answer: (900 to 905)

65. A company forecasts the weekly demand of oxygen cylinders using exponential smoothing method with smoothing constant $\alpha = 0.2$. The actual demands in Week 1, Week 2, Week 3 and Week 4 were 375, 412, 592 and 439 units, respectively. The forecasted demand for Week 3 was 500 units. The forecast (in unit) for the Week 5 is _____ (in integer).

Answer: (500 to 505)

