GENERAL APTITUDE

Q. No. 1 – 5 Carry One Mark Each

1. Choosethemostappropriatewordfromtheoptionsgivenbelowtocompletethefollowing sentence.

A person suffering from Alzheimer's disease _____ short-term memory loss.

(A) experienced (B) has experienced

(C) is experiencing (D) experiences

Answer: (D)

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2. Choosethemostappropriatewordfromtheoptionsgivenbelowtocompletethefollowing sentence.

_____ is the key to their happiness; they are satisfied with what they have.

(A) Contentment (B) Ambition (C) Perseverance (D) Hunger

Answer: (C)

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3. Which of the following options is the closest in meaning to the sentence below?

"As a woman, I have no country."

(A) Women have no country.

(B) Women are not citizens of any country.

(C) Women's solidarity knows no national boundaries.

(D) Women of all countries have equal legal rights.

Answer: (C)

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4. In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is _____ years.

Answer: (25)

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5. The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

(A) 3-4 years (B) 4-5 years

(C) 5-6 years (D) 6-7 years

Answer: (A)

Q.No. 6 – 10 Carry Two Marks Each

6. In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?

Statements:

1. Shiv is younger to Riaz.

2. Shiv is elder to Som.

(A) Statement 1by itself determines the eldest child.

(B) Statement 2 by itself determines the eldest child.

(C) Statements 1 and 2 are both required to determine the eldest child.

(D) Statements 1 and 2 are not sufficient to determine the eldest child.

Answer: (A)

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7. Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis.

From "BIG DATA" Viktor Mayer-Schonberger and Kenneth Cukier

The main point of the paragraph is:

(A) The twenty-first century is a digital world

(B) Big data is obsessed with exactness

(C) Exactitude is not critical in dealing with big data

(D) Sparse data leads to a bias in the analysis

Answer: (C)

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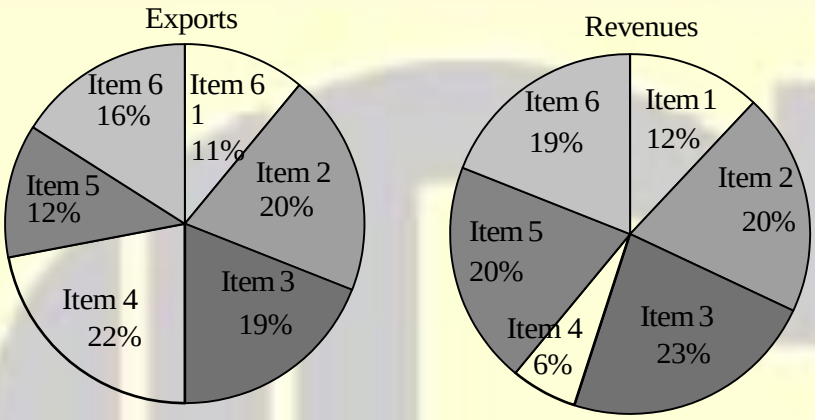
8. The total exports and revenues from the exports of a country are given in the two pie charts below.

The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?



(A) 1:2 (B) 2:1 (C) 1:4 (D) 4:1

Answer: (D)

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9. X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is1 km east of P. What is the distance between X and Q in km?

(A) 1 (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) 2

Answer: (C)

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10. 10% of the population in a town is HIV^+. A new diagnostic kit for HIV detection is available; thiskit correctly identifies HIV+ individuals 95% of the time, and HIV− individuals 89% of the time. Aparticular patient is tested using this kit and is found to be positive.The probability that the individual is actually positive is _____.

Answer: (0.489)

PRODUCTION ENGINEERING

Q.No.1- 25 Carry One Mark Each

1. The system of equations, given below, has

$x + 2y + 4z = 2$

$4x + 3y + z = 5$

$3x + 2y + 3z = 1$

(A) a unique solution (B) two solutions

(C) no solution (D) more than two solutions

Answer: (A)

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2. Directional derivative of $\varphi = 2xz - y^2$, at the point (1, 3, 2), becomes maximum in the direction of

(A) $4i + 2j - 3k$ (B) $4i - 6j + 2k$

(C) $2i - 6j + 2k$ (D) $4i - 6j - 2k$

Answer: (B)

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3. A metallic sphere of 0.1 m diameter has a thermal conductivity of 10 W/m-K. If the fluid flowing around it has a heat transfer coefficient of 10 W/m^2-K and thermal conductivity of 0.4 W/m-K, the value of Biot number is _____

Answer: (0.1 to 0.1)

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4. A quantitative measure of maintainability is

(A) Downtime (B) Mean Time Between Failure

(C) Mean Time To Repair (D) System availability

Answer: (C)

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5. Which one of the following techniques is used to analyze the cause and effect of product failure?

(A) Quality Function Deployment (B) Fault Tree Analysis

(C) Value Analysis (D) Failure Mode and Effect Analysis

Answer: (D)

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6. As the product passes through different stages of product life cycle, the product variety

(A) increases (B) decreases and then increases

(C) remains the same (D) decreases

Answer: (D)

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7. A machine has been purchased for Rs.100,000 and its useful life is estimated to be 10 years. Its scrap value at the end of 10 years is estimated as Rs.20,000. If the depreciation is determined using the declining balance method, the value of depreciation (in Rs.) during the first year is _____

Answer: (14800 to 15000)

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8. A company wants to determine the proportion of time workers are idle. In a pilot study, the proportion of idle time was found to be 0.16. If the company wants to be 95% confident (z-value = 1.96) that the estimated value is within 0.03 of the true proportion, the number of observations required in the study should be _____

Answer: (574 to 574)

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9. A manufacturing plant, working in 2 shifts of 8 hrs each, produces 30,000 switch boards using a set of 7 workstations in series. The cycle time, in seconds, is _____.

Answer: (1.9 to 2.0)

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10. A simple random sample of 100 observations was taken from a large population. The sample mean and the standard deviation were determined to be 80 and 12, respectively. The standard error of mean is _____

Answer: (1.2 to 1.2)

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11. The diameter of a shaft must be within a tolerance of 0.02 of the nominal diameter. Which controlchart is useful to determine that the process is in statistical control?

(A) p chart (B) c chart (C) $\overline{X}$ and R chart (D) U chart

Answer: (C)

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12. Which one of the following is not a characteristic of JIT manufacturing system?

(A) Reduction of lot sizes (B) Efficient use of buffer inventory

(C) Small but frequent deliveries (D) Higher productivity

Answer: (B)

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13. Relationship between Young's Modulus (E), Shear Modulus (G), and Poisson's Ratio (μ), for a material obeying the Hooke's Law, is

(A) $E = \frac{G}{(2+\mu)}$ (B) $E = \frac{2G}{(1+\mu)}$

(C) $E = G(1+\mu)$ (D) $E = 2G(1+\mu)$

Answer: (D)

14. For a metal alloy, which one of the following descriptions relates to the stress-relief annealing process?

(A) Heating the workpiece material above its recrystallization temperature, soaking and then cooling in still air

(B) Heating the workpiece material below its recrystallization temperature, holding for some time and then furnace cooling

(C) Heating the workpiece material up to its recrystallization temperature and then rapid cooling

(D) Heating the workpiece up to its recrystallization temperature and cooling to room temperature alternately for a few cycles

Answer: (B)

15. Generative Approach of Computer Aided Process Planning is **NOT** based on

(i) part coding using Group Technology

(ii) part feature recognition and extraction

(iii) database of standard process plans for part families

(iv) geometric modelling of part

(A) (i) and (ii) (B) (i) and (iii) (C) (i),(ii) and (iii) (D) (i), (ii) and (iv)

Answer: (B)

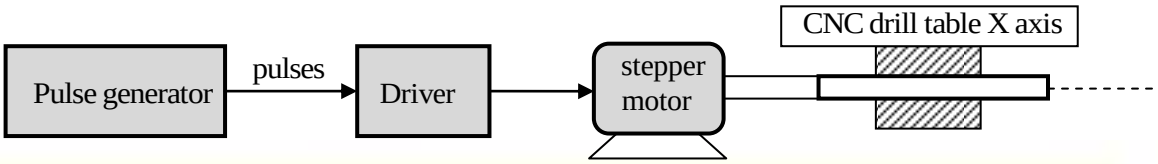
16. Which one of the following methods is **NOT** used for producing metal powders?

(A) Atomization (B) Compaction

(C) Machining and grinding (D) Electrolysis

Answer: (B)

17. In an open loop, point-to-point controlled CNC drilling machine, a stepper motor, producing 200 angular steps per revolution, drives the table of a drilling machine by one angular step per each pulse generated by a pulse generator (shown in figure). Each angular step moves the table by one Basic Length Unit (BLU) along X axis with a lead screw having a pitch of 4 mm. If the frequency of pulse generator is doubled, the BLU will



(A) become double of previous value
(B) become half of previous value
(C) remain the same
(D) become zero

Answer: (C)

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18. A spindle speed of 300 rpm and a feed of 0.3mm/revolution are chosen for longitudinal turning operation on an engine lathe. In finishing pass, roughness on the work surface can be reduced by

(A) reducing the spindle speed
(B) increasing the spindle speed
(C) reducing the feed of tool
(D) increasing the feed of tool

Answer: (C)

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19. Chills are used in casting moulds to

(A) achieve directional solidification
(B) reduce the roughness of top surface of the cast product
(C) increase the solidification time
(D) reserve excess molten metal

Answer: (A)

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20. A moving mandrel is used in

(A) wire drawing
(B) forging
(C) tube drawing
(D) bending

Answer: (C)

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21. Brazing and Soldering are

(A) plastic joining methods
(B) homogeneous joining methods
(C) autogenous joining methods
(D) heterogeneous joining methods

Answer: (D)

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22. Match the following:

Group I (Mechanism)	Group II (Machines)
P. Quick return	**1.** Lathe
Q. Apron	**2.** Shaping
R. Intermittent indexing	**3.** Gear hobbing
S. Differential mechanism	**4.** Milling

(A) P1-Q2-R4-S3
(B) P2-Q1-R4-S3
(C) P4-Q1-R2-S3
(D) P2-Q3-R1-S4

Answer: (B)

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23. Reaming is a process used for

(A) creating a circular hole in metals
(B) cutting a slot on the existing hole surface
(C) finishing an existing hole surface
(D) making non-circular holes in metals

Answer: (C)

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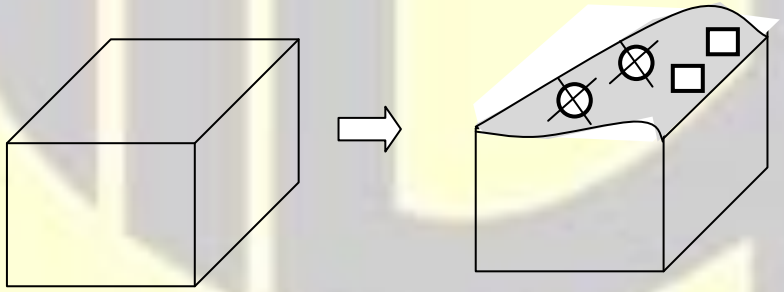
24. Find the correct combination of manufacturing processes to produce the part, shown in figure, from a blank (holes shown are with square and circular cross-sections).



Blank Final part

(A) Drilling and milling on column and knee type universal milling machine
(B) Die-sinking and CNC Wire-cut EDM process
(C) Die-sinking and CNC drilling
(D) CNC Wire-cut EDM process only

Answer: (B)

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25. In an open die forging, a circular disc is gradually compressed between two flat platens. The exponential decay of normal stress on the flat face of the disc, from the center of the disc towards its periphery, indicates that

(A) there is no sticking friction anywhere on the flat face of the disc

(B) sticking friction and sliding friction co-exist on the flat face of the disc

(C) the flat face of the disc is frictionless

(D) there is only sticking friction on the flat face of the disc

Answer: (A)

Q.No.26-55 Carry Two Marks Each

26. If $\varphi = 2x^3y^2z^4$ then $\nabla^2\varphi$ is

(A) $12xy^2z^4 + 4x^2z^2 + 20x^3y^2z^3$

(B) $2x^2y^2z + 4x^3z^4 + 24x^3y^2z^2$

(C) $12xy^2z^4 + 4x^3z^4 + 24x^3y^2z^2$

(D) $4xy^2z + 4x^2z^4 + 24x^3y^2z^2$

Answer: (C)

27. Using the Simpson's 1/3rd rule, the value of $\int ydx$ computed, for the data given below, is _____

x	1	3	5
y	2	6	4

Answer: (20 to 20)

28. If the equation $\sin(x) = x^2$ is solved by Newton Raphson's method with the initial guess of x = 1, then the value of x after 2 iterations would be _____

Answer: (0.86 to 0.88)

29. If 2 kg mass of water, with a specific heat of 4.18 kJ/kg-K, is heated from 20°C to 40°C in an open container, then the change in entropy of water, in kJ/K, is _____

Answer: (0.54 to 0.56)

30. A gas at a pressure of 500 kPa and volume of 0.75 m^3 is contained in a cylinder-piston assembly. When the piston moves slowly in the cylinder, the pressure inside the cylinder varies as $V^{-1.2}$. If the final volume of gas becomes doubled, then the work done by the gas, in kJ, is _____

Answer: (240 to 250)

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31. Two geometrically identical metallic bars are joined end to end (as shown in Fig.). Bars P and Q have thermal conductivities of 5 W/m-K and 10 W/m-K respectively. The free end of the Bar P is kept at 40°C, while that of Bar Q is at 10°C.

The junction temperature (in °C) for steady state heat flow is _____.

Answer: (20 to 20)

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32. A metallic sphere of 1 kg mass, with surface area of 0.0314 m^2, is maintained at an initial temperature of 50°C. The fluid circulating around the sphere is maintained at a temperature of 10°C. Specific heat of metallic sphere is 314 J/kg-K and the heat transfer coefficient between the fluid and the sphere is 10W/m^2-K. The time taken (in seconds) for the sphere to cool down to 20°C is _____

Answer: (1382 to 1390)

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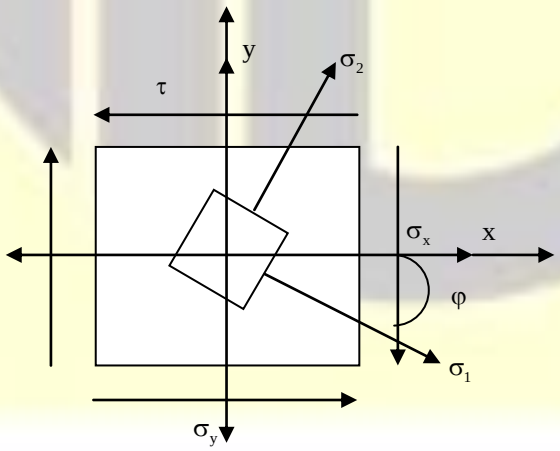
33. An element, shown below, is subjected to stresses: $\sigma_x = 5\,kN/mm^2$, $\sigma_y = 3\,kN/mm^2$ and $\tau = 1\,kN/mm^2$. The magnitudes and direction of principal stresses σ_1, σ_2 (in kN/mm^2) and φ (in degrees) are



(A) 5.41, 2.58, –22.5 (B) 5.41, 2.58, –45

(C) 5.0, 3.0, –22.5 (D) 4.0, 4.0, –22.5

Answer: (A)

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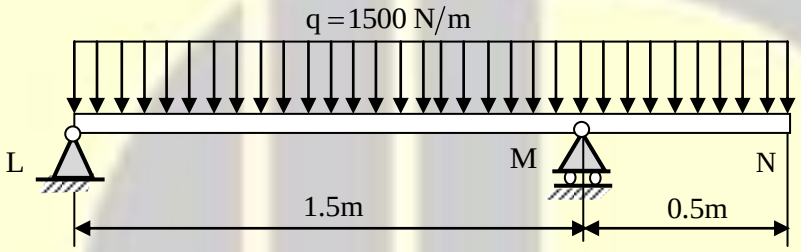
34. Each axis of NC machine is driven by a stepper motor drive with a lead screw. The pitch of lead screw is p mm. The step angle of stepper motor per pulse input is α degrees/pulse. The ratio of gear drive in stepper motor drive is g (number of turns of the motor for each single turn of the lead screw). The number of pulses required to achieve a linear movement of x mm is

(A) $\frac{\alpha g}{360p}x$ (B) $\frac{360g}{p}x$ (C) $\frac{g}{360p}x$ (D) $\frac{360g}{p\alpha}x$

Answer: (D)

35. A uniformly distributed load (q) of 1500 N/m is applied on a simply supported beam LMN with an overhang of 0.5 m. Which one of the following statements is FALSE?



(A) Reaction forces at L and M are 1 kN and 2 kN

(B) Bending moment is zero at the points L, N and at a point in between L and M

(C) The bending moment is zero at points L and N only

(D) The shear force is zero at points L, N and at a point in between L and M

Answer: (C)

36. A CNC instruction G91G01X30Y40F100 commands the movement of tool along the path at a feed rate of 100 mm/min (G91- incremental format and G01- linear interpolation). The feed rate of the tool (in mm/min) along the X axis will be _____

Answer: (60 to 60)

37. Elastic moduli of a fibre reinforced plastic composite and fibres are 200 GPa and 400 GPa, respectively. The longitudinal fibres are taking up 50% of the load. Assuming the area fraction equal to the volume fraction, the volume fraction of the fibres will be _____

Answer: (0.30 to 0.34)

38. The processing times and the due dates of 4 independent jobs processed by a single machine in a shop are given in the table.

Job	Processing Time (in days)	Due date (in days)
1	4	6
2	7	9
3	2	18
4	8	15

The average lateness of the jobs (in days) following the Shortest Processing Time (SPT) rule is _____

Answer: (2.5 to 2.5)

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39. The annual requirement of a raw material item is 10,000 units. The holding cost of inventory for the item is 80 paise per unit per year and the ordering cost is Rs. 40 per order. The order quantity presently is 800 units per order. Assume that there are no other costs. Which one of the following observations is CORRECT?

(A) The order quantity is optimal and total ordering cost is equal to total holding cost

(B) The order quantity is optimal and total ordering cost is more than total holding cost

(C) The order quantity is not optimal and total ordering cost is equal to total holding cost

(D) The order quantity is not optimal and total ordering cost is more than total holding cost

Answer: (D)

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40. In a single-server queuing system, arrivals are Poisson distributed with a mean of 16 per hour and the exponential service time is 3 minutes per person on the average. What would be the expected number of persons in the queue (Lq) for the queue disciplines of First-come-first-serve (FCFS) and Last-come-first serve (LCFS)?

(A) 4.0, 4.0 (B) 4.0, 3.2 (C) 3.2, 4.0 (D) 3.2, 3.2

Answer: (D)

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41. A project consisting of five activities needs crashing. The details of crashing that was carried out are given in the table

Activity	Normal Time (days)	Shortest Time (days)	Cost in Rs. For Reduction/day	Actually Crashed by (days)
1-2	6	4	100	1 day
1-3	7	5	100	2 days
1-4	10	7	100	1 day
2-4	4	3	200	Not Crashed
3-4	5	4	200	1 day

If the overhead cost of the project is Rs. 200 per day, then the net change in project cost (in Rs.) because of crashing is _____

Answer: (0 to 0)

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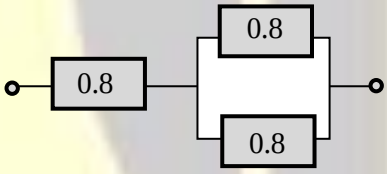
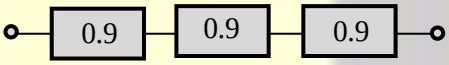
42. Two systems, P and Q, contain 3 components each. Reliability of the components is measured for 1000hours operations and time-to-failure distributions for all the components are found to be exponential. System P components are connected in a series parallel structure with each component having a reliability of 0.8. System Q components, on the other hand, are connected in series with each component having a reliability of 0.9. See the configuration of the systems below.



System P



System Q

The reliabilities of System P and System Q will be respectively

(A) 0.768, 0.729 (B) 0.512, 0.729 (C) 0.5, 0.271 (D) 0.232, 0.271

Answer: (A)

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43. Marks obtained by 100 students in an examination are given in the table.

Sl.No	Marks Obtained	Number of Students
1.	25	20
2.	30	20
3.	35	40
4.	40	20

What would be the mean, median, and mode of the marks obtained by the students?

(A) Mean 33; Median 35; Mode 40 (B) Mean 35; Median 32.5; Mode 40

(C) Mean 33; Median 35; Mode 35 (D) Mean 35; Median 32.5; Mode 35

Answer: (C)

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44. In a given day in the rainy season, it may rain 70% of the time. If it rains, chance that a village fair will make a loss on that day is 80%. However, if it does not rain, chance that the fair will make a loss on that day is only 10%. If the fair has not made a loss on a given day in the rainy season, what is the probability that it has not rained on that day?

(A) 3/10 (B) 9/11 (C) 14/17 (D) 27/41

Answer: (D)

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45. For the linear programming problem given below, find the number of feasible corner point solutions. Is the optimal solution degenerate?

Maximize $z = 2x_1 + 3x_2$

Subject to: $x_1 + 2x_2 \le 60;$

$2x_1 + x_2 \le 30$

$x_1 - x_2 \ge -10;$

$x_1 \ge 0; x_2 \ge 0$

(A) 4; No (B) 4; Yes (C) 5; No (D) 5; Yes

Answer: (A)

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46. A manufacturing company must select a process for its new product, VS-5, from among two alternatives. The following cost data have been gathered.

Cost	Process X	Process Y
Fixed	Rs. 10,000	Rs. 40,000
Variable	Rs. 5/unit	Rs. 2/unit

If the objective is to select a process with the least total cost for a given demand, which one of the following is the most appropriate choice?

(A) Below 10,000 units, Process X; Above 10,000 units, Process Y

(B) Below 10,000 units, Process Y; Above 10,000 units, Process X

(C) Below 20,000 units, Process X; Above 20,000 units, Process Y

(D) Below 20,000 units, Process Y; Above 20,000 units, Process X

Answer: (A)

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47. The following data refers to a manufacturing plant.

	Current Year	Previous Year
Revenue generated (in Rs.)	200, 000	220, 000
Number of units produced	1000	1200
Piece rate of workers (in Rs)	22	18

Assuming the previous year to be the base year, the labor productivity index for this plant is _____

Answer: (0.89 to 0.90)

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48. A manufacturing company producing ball bearings has conducted a time study for 10 cycles of a job consisting of three elements. The details are shown in the table below.

Job elements	Average elemental time (in minutes)	Performance rating factor
1	0.12	0.8
2	0.34	1.1
3	0.48	1.2

If the permissible allowance is 15%, then the standard time (in minutes) is _____

Answer: (1.20 to 1.21)

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49. A control chart for number of non-conformities per unit is to be constructed for a manufacturing process. Sixteen non-conformities were recorded while inspecting 30 units. How should the Upper Control Limit (UCL) and the Lower Control Limit (LCL) be set for this control chart?

(A) UCL = 1.81, LCL = 0.70

(B) UCL = 2.71, LCL = 0.00

(C) UCL = 0.533, LCL = – 0.533

(D) UCL = 3.10, LCL = – 1.46

Answer: (B)

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50. For a given volume of a riser, if the solidification time of the molten metal in riser needs to be quadrupled, the surface area of the riser should be made

(A) one-fourth (B) half (C) double (D) four times

Answer: (B)

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51. A 80 mm thick steel plate with 400 mm width is rolled to 40 mm thickness in 4 passes with equal reduction in each pass, by using rolls of 800 mm diameter. Assuming the plane-strain deformation, what is the minimum coefficient of friction required for unaided rolling to be possible?

(A) 0.111 (B) 0.158 (C) 0.223 (D) 0.316

Answer: (B)

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52. In an arc welding operation, carried out with a power source maintained at 40 volts and 400 amperes, the consumable electrode melts and just fills the gap between the metal plates to be butt-welded. The heat transfer efficiency for the process is 0.8, melting efficiency is 0.3 and the heat required to melt the electrode is 20 J/mm^3. If the travel speed of the electrode is 4 mm/s, the cross-sectional area, in mm^2, of the weld joint is _____

Answer: (48 to 48)

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53. A hardceramic marble, having density (ρ) of 3000 kg/m^3 and diameter (d) of 0.025 m, is dropped accidentally from a static weather balloon at a height of 1 km above the roof of a greenhouse. The flow stress of roof material (σ) is 2.5 GPa. The marble hits and creates an indentation on the roof. Assume that the principle of creation of indentation is the same as that in case of abrasive jet machining (AJM). The acceleration due to gravity (g) is 10 m/s^2. If V is the velocity, in m/s, of the marble at the time it hits the greenhouse, the indentation depth $\left(\delta = 1000 \times \sqrt{\frac{\rho}{6\sigma}} \times d \times V\right)$. in mm is _____.

Answer: (1.56 to 1.60)

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54. An HSS drill of 20 mm diameter with 5 mm cone height is used to drill a through hole in a steel work-piece of 50 mm thickness. Cutting speed of 10 m/min and feed rate of 0.3 mm/rev are used. The drilling time, in seconds, neglecting the approach and over travel, is _____

Answer: (68 to 70)

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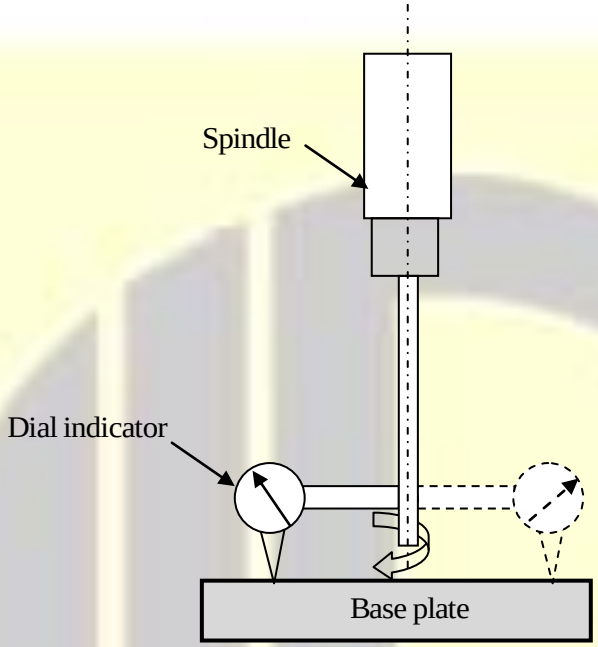
55. The alignment test "Spindle square with base plate" is applied to the radial drilling machine. A dial indicator is fixed to the cylindrical spindle and the spindle is rotated to make the indicator touch the base plate at different points. This test inspects whether the



(A) spindle vertical feed axis is perpendicular to the base plate

(B) axis of symmetry of the cylindrical spindle is perpendicular to the base plate

(C) axis of symmetry, the rotational axis and the vertical feed axis of the spindle are all coincident

(D) spindle rotational axis is perpendicular to the base plate

Answer: (D)