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ESE 2024 : Prelims Exam | GS & ENGINEERING CLASSROOM TEST SERIES | APTITUDE

Test 19

Full Syllabus Test 3 : (Paper-I)

ANSWER KEY

1. (d)	21. (c)	41. (b)	61. (b)	81. (a)
2. (b)	22. (d)	42. (d)	62. (d)	82. (d)
3. (c)	23. (d)	43. (c)	63. (d)	83. (a)
4. (d)	24. (d)	44. (b)	64. (b)	84. (c)
5. (a)	25. (d)	45. (b)	65. (b)	85. (c)
6. (d)	26. (c)	46. (a)	66. (c)	86. (b)
7. (d)	27. (a)	47. (d)	67. (b)	87. (d)
8. (c)	28. (b)	48. (d)	68. (c)	88. (b)
9. (a)	29. (d)	49. (b)	69. (a)	89. (d)
10. (b)	30. (a)	50. (a)	70. (b)	90. (c)
11. (c)	31. (d)	51. (a)	71. (b)	91. (d)
12. (a)	32. (a)	52. (a)	72. (d)	92. (b)
13. (b)	33. (c)	53. (c)	73. (b)	93. (a)
14. (a)	34. (b)	54. (d)	74. (b)	94. (b)
15. (d)	35. (d)	55. (a)	75. (b)	95. (c)
16. (d)	36. (c)	56. (b)	76. (c)	96. (b)
17. (c)	37. (b)	57. (c)	77. (c)	97. (c)
18. (a)	38. (d)	58. (a)	78. (c)	98. (b)
19. (b)	39. (c)	59. (c)	79. (d)	99. (b)
20. (c)	40. (b)	60. (c)	80. (a)	100. (b)

DETAILED EXPLANATIONS

2. (b)
- PM Gati Shakti seeks to revolutionize infrastructure development through a 'whole of the government' approach: a digital Geographic Information System (GIS)-based platform and an institutional arrangement.
 - This initiative aims to develop plans for integrated multimodal infrastructure for the efficient transportation of goods and people
3. (c)
- The PM-PRANAM scheme was aimed at saving the soil and promote sustainable, balanced use of fertilizers and it involved the participation of State governments. The Centre would incentivise those States which would adopt alternative fertilizers with the subsidy that was saved by reducing the use of chemical fertilizers.
4. (d)
- The Vishaka Guidelines were a set of procedural guidelines for use in India in cases of sexual harassment. They were promulgated by the Supreme Court in 1997 and were superseded in 2013 by the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act.
5. (a)
- Centrally Sponsored Scheme 'Pradhan Mantri Poshan Shakti Nirman (PM POSHAN)' for providing one hot cooked meal in Government and Government – aided Schools from 2021-22 to 2025-26.
 - Under the Scheme, there is provision of hot cooked meal to children of pre-schools or Bal Vatika (before class I) in primary schools also in addition to the 11.80 crore children of classes I to VIII studying in 11.20 lakh schools.
 - The Scheme is implemented across the country covering all the eligible children without any discrimination of gender and social class.
6. (d)
- Open Network for Digital Commerce (ONDC) is an interoperable network based on the Beckn protocol that anyone can piggyback on. It seeks to break down silos in digital commerce by enabling platforms of varying configurations (big or small) to connect and operate seamlessly on it.
8. (c)
- India has introduced a draft to launch a global initiative to encourage the consumption and production of millet.
 - The acronym MIIRA stands for 'Millet International Initiative for Research and Awareness'.
10. (b)
- Cognitive empathy is the largely conscious drive to recognize accurately and understand other's emotional state.

16. (d)
Greenhouse gases in the atmosphere (such as water vapor and carbon dioxide) absorb most of the Earth's emitted longwave infrared radiation, which heats the lower atmosphere.
17. (c)
Biodiversity loss describes the decline in the number, genetic variability, and variety of species, and the biological communities in a given area.
18. (a)
Indicator species, organism—often a microorganism or a plant—that serves as a measure of the environmental conditions that exist in a given locale. Example - Lichens: Quality of air can be determined based on its presence.
19. (b)
Bioremediation is the use of living microorganisms to degrade the environmental contaminants into less toxic forms. Bioremediation can be effective only where environmental conditions permit microbial growth and activity.
20. (c)
 - Eco-Sensitive Zones (ESZs) or Ecologically Fragile Areas (EFAs) are areas notified by the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India around Protected Areas, National Parks and Wildlife Sanctuaries.
 - The purpose of declaring ESZs is to create some kind of “shock absorbers” to the protected areas by regulating and managing the activities around such areas. They also act as a transition zone from areas of high protection to areas involving lesser protection. ESZ are regulated by central government through Min. of Environment, Forests and Climate change (MoEFCC). Ministry came out with new guidelines for regulation of such areas in 2011. The Environment Protection Act, 1986 does not mention the word “Eco-sensitive Zones”.
21. (c)
The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement on biosafety as a supplement to the Convention on Biological Diversity effective since 2003. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology
22. (d)
AQI is a number, which is a measure of air quality. The colour-coded AQI index was launched in India in 2014, and it helps the public and the government understand the condition of the air and what subsequent measures are to be taken to combat the situation, based on its severity. There are six categories of AQI, namely ‘Good’ (0-50), ‘Satisfactory’ (50-100), ‘Moderately polluted’ (100-200), ‘Poor’ (200-300), ‘Very Poor’ (300-400), and ‘Severe’ (400-500).
23. (d)
The Aichi Targets, adopted during the 2010 CBD summit in Nagoya, located in Japan's Aichi prefecture, included goals such as reducing deforestation by at least half during the coming decade and curbing pollution so that it no longer harmed ecosystems. After parties adopted the Aichi

Targets, they were expected to devise their own national biodiversity strategies that would mimic the goals laid out by Aichi. Nearly all parties created these strategies, but most were never fully implemented

25. (d)

Water in usable condition is an exhaustible but renewable natural resource.

26. (c)

- Peatlands are formed due to the accumulation of partially decomposed plant remains over thousands of years under conditions of water-logging.
- Peatlands occur in different climate zones. While in tropical climate, they can occur in mangroves, in Arctic regions, peatlands are dominated by mosses. Some mangrove species are known to develop peatland soils under them.

27. (a)

Juran Trilogy or quality trilogy composed of three managerial processes as follows:

1. Quality planning
2. Quality control
3. Quality improvement

28. (b)

Activities associated with internal failure costs are scrap, rework, downgrading, design changes and corrective action.

29. (d)

A visionary leader should be willing to examine the vision from time to time in the perspective of changes in the external environment and ensure continuous support from everyone involved.

30. (a)

Operational availability is given by,

$$OA = \frac{OT + IT}{OT + IT + AD + RT}$$
$$= \frac{12 + 1}{12 + 1 + 3 + 4} = 0.65$$

31. (d)

- BIS hallmark : Purity of metal (Gold and Silver)
- ISI mark : Industrial product
- Non polluting vehicle mark : BS Norms
- Ecomark : Ecolabel
- Agmark : Agricultural products
- FPO mark : Processed fruit products order
- India organic: Organically farmed food product manufactured in India
- Silk mark : Silk textiles

32. (a)
Quality audits should not be directed in a way that results in a transfer of the responsibility to achieve quality from the operating staff to the auditing organization.
33. (c)
The SIPOC diagram consists of five columns-suppliers, inputs, process, output and customers. It also helps define a complex project that may not be well scoped.
34. (b)
Using the PDCA cycle in strategic planning ensure that:
- Plans are developed more systematically.
 - Progress on plans is carefully monitored.
 - Changes to plans are made where necessary.
 - The breakthrough objectives are attained.
 - The planning process is continuously improved.
 - Organizational learning occurs.
35. (d)
Chromoactive materials have very excellent property to change their colour when subjected to external impetus (temperature, light, electric field). It is further classified into (i) Thermo chromic materials (ii) Photo chromic materials and (iii) Halo chromic materials.
36. (c)
Gamma particles hold the highest power of penetration. They are the most penetrating but least ionizing and very difficult to resist from entering the body.
37. (b)
When a foreign atom replaces or substitutes a parent atom at the lattice site in the crystal, then this type of defect is called substitutional imperfection. Example : Boron and Antimony atoms are doped in Germanium crystal to form a Substitutional imperfection.
38. (d)
Glass is an amorphous substance. It is a vitreous silicate with a random arrangement of silicon oxygen tetrahedron (SiO_4^+) units
39. (c)
The given repeating unit structure is Styrene, which is a vinylarene i.e. a benzene carrying a vinyl group. Polystyrene is obtained from addition polymerisation of styrene monomers, a liquid petrochemical.
40. (b)
 - Martensite has body centered tetragonal (BCT) structure.
 - Martensite is formed in carbon steels by the rapid cooling (quenching) of the austenite form of iron at such a high rate that carbon atoms do not have time to diffuse out of the crystal structure. Therefore, the martensite phase consists of a metastable iron phase oversaturated in

carbon. Since the more carbon a steel has, the harder and more brittle it is, a martensitic steel is very hard and brittle.

41. (b)

Critical shear stress is the minimum stress in the slip direction that is capable of producing the gliding of the atomic planes. Statement '2' is correct.

42. (d)

Piezoelectric materials have the following applications:

- (i) Frequency resonators
- (ii) Gramophone pickups
- (iii) Filters
- (iv) Ultrasonic flow detectors

43. (c)

As the temperature increases, the number of electron-hole pairs increases resulting in an increase in conductivity. Hence, semiconductor become better conductors as the temperature is raised. Therefore, statement 3 is incorrect.

44. (b)

Positive sign for the Hall coefficient indicates that the majority carriers are holes and semiconductor is p -type. A negative sign for the Hall coefficient indicates that the majority carriers are electrons and semiconductor is n -type.

45. (b)

Unit for flux density (B) is Wb/m² or Tesla.

$$\begin{aligned} \text{i.e.} \quad B &= \frac{\text{Flux (Wb)}}{\text{Area (m}^2\text{)}} \\ &= \frac{2.4 \times 10^{-3}}{60 \times (10^{-2})^2} = 0.4 \text{ Wb/m}^2 \text{ or Tesla} \end{aligned}$$

46. (a)

Dia-magnetic materials are materials and substances repelled by a magnetic field. That is because of the induced magnetic field created by the applied magnetic field in the opposite direction.

47. (d)

When a permanent magnet is heated, the atoms and in the magnet vibrate. The more the magnet is heated, the more the atoms vibrate. At some point the vibration of the atoms causes the domains to go from an aligned, ordered pattern to a nonaligned disordered pattern.

49. (b)

Let the 'x' be break even point (BEP)

$$\Rightarrow x \times 25 = 60000 + x \times 5$$

$$\Rightarrow x = 3000 \text{ units}$$

$$\text{Now, Margin of safety (\%)} = \frac{\text{Expected output} - \text{BEP}}{\text{BEP}} \times 100$$

where, Expected output = $\frac{200000}{25} = 8000$ units

\therefore Margin of safety = $\frac{8000 - 3000}{8000} \times 100\% = 62.5\%$

50. (a)

Depreciation factor for double declining balance method = $\frac{2}{n}$ i.e. $\frac{2}{5} = 0.4$

Now,

$$D_1 = 1100 \times 0.4 = \text{Rs.}440$$

$$B_1 = 1100 - 440 = \text{Rs.}660$$

$$D_2 = 660 \times 0.4 = \text{Rs.}264$$

$$B_2 = 660 - 264 = \text{Rs.}396$$

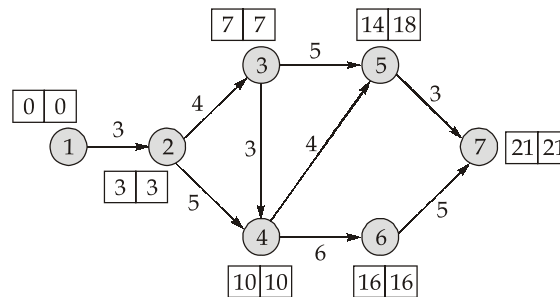
$$D_3 = 396 \times 0.4 = \text{Rs.}158.4$$

$$B_3 = 396 - 158.4 = \text{Rs.}237.6$$

51. (a)

Third statement is one of the demerits of 'item rate contract'.

55. (a)



$$\text{Total float for } 3 - 5 = 18 - 7 - 5 = 6 \text{ days}$$

56. (b)

Here $\text{rank}(A) = \text{rank}(AB) < \text{Number of variables}$

So, there will be many solutions possible.

57. (c)

Probability density function for a Poisson distribution is given by

$$f(x) = \frac{e^{-\lambda} \lambda^x}{x!} \quad \dots(i)$$

$$\text{Given, } f(x) = \frac{e^{-4} 4^x}{x!} \quad \dots(ii)$$

On comparing equation (i) and (ii), we get $\lambda = 4$.

58. (a)

We know that,

$$M X = \lambda X$$

The product of the Eigen values is given by the determinant of the matrix M . Since, determinant is zero, hence one of the Eigen values must also be zero.

Considering Eigen value $\lambda = 0$, we get

$$\begin{bmatrix} 1 & -1 & 0 \\ 1 & -2 & 1 \\ 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$x - y = 0$$

$$x - 2y + z = 0$$

On solving,

$$\frac{x}{-1} = \frac{y}{-1} = \frac{z}{-1} = k$$

So,

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = k_1 \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

59. (c)

Given,

$$a = 0.6$$

X	0	1
P(X)	0.6	0.4

$$\text{Required value} = V(X) = E(X^2) - [E(X)]^2$$

$$E(X) = \sum_i X_i P_i = 0 \times 0.6 + 1 \times 0.4 = 0.4$$

$$E(X^2) = \sum_i X_i^2 P_i = 0^2 \times 0.6 + 1^2 \times 0.4 = 0.4$$

\therefore

$$V(X) = E(X^2) - [E(X)]^2$$

$$= 0.4 - 0.16 = 0.24$$

60. (c)

Let,

A = First drawn orange is good

B = Second drawn orange is good

C = Third drawn orange is good

The oranges are not replaced.

$$\text{Thus, } P(A) = \frac{12}{15}, P(B) = \frac{11}{14}, P(C) = \frac{10}{13}$$

The box is approved for sale, if all three oranges are good.

Thus, the probability of getting all the oranges good

$$= \frac{12}{15} \times \frac{11}{14} \times \frac{10}{13} = \frac{44}{91}$$

61. (b)

For binomial distribution, with n number of trials and p as the probability of getting success and q as the probability of failure, we have

$$\text{Mean} = np = 9 \quad \dots(i)$$

$$\text{Variance} = npq = \sigma^2 = 6 \quad \dots(ii)$$

From (i) and (ii),
$$q = \frac{6}{9} = \frac{2}{3}$$

$$\therefore p = 1 - q = \frac{1}{3}$$

$$\therefore np = n \times \frac{1}{3} = 9$$

$$n = 27$$

62. (d)

Newton's iterative formula is given by

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

It has a second order of quadratic convergence and is useful in cases of large values of $f'(x)$ i.e. when the graph of $f(x)$ while crossing the x -axis is nearly vertical.

All statements are correct.

63. (d)

In this case, $z = 1$ lies outside the circle $|z| = \frac{1}{2}$. Hence, $f(z)$ is analytic on c .

$$\therefore \text{By Cauchy's theorem } \int_c \frac{z^2 - z + 1}{z - 1} dz = 0$$

64. (b)

Given equation in symbolic form is

$$(D^2 + D)y = x^2 + 2x + 4$$

$$\begin{aligned} \text{P.I.} &= \frac{1}{D(D+1)}(x^2 + 2x + 4) \\ &= \frac{1}{D}(1+D)^{-1}(x^2 + 2x + 4) \\ &= \frac{1}{D}(1 - D + D^2 - \dots)(x^2 + 2x + 4) \\ &= \frac{1}{D}[x^2 + 2x + 4 - (2x + 2) + 2] \\ &= \int (x^2 + 4) dx = \frac{x^3}{3} + 4x \end{aligned}$$

65. (b)

$$\begin{aligned}
 \frac{d}{dx} \left(\frac{\sin^2 x}{x} \right) &= \frac{[2 \sin x \cdot \cos x]x - \sin^2 x}{x^2} \\
 &= \frac{x \sin 2x - \sin^2 x}{x^2} \\
 \lim_{x \rightarrow 0} \left(\frac{x \sin 2x - \sin^2 x}{x^2} \right) &= \lim_{x \rightarrow 0} \left(\frac{x \sin 2x}{x^2} - \frac{\sin^2 x}{x^2} \right) = \lim_{x \rightarrow 0} \frac{x \sin 2x}{x^2} - \lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^2 \\
 &= \lim_{x \rightarrow 0} \frac{\cos 2x \cdot 2}{1} - 1 \\
 &= 2[\cos 2(0)] - 1 \\
 &= 2(1) - 1 = 1
 \end{aligned}$$

66. (c)

Let given expression is x .

i.e.

$$x = \sqrt{56 + \sqrt{56 + \sqrt{56 + \dots}}}$$

 \Rightarrow

$$x = \sqrt{56 + x}$$

Squaring both sides

$$x^2 = 56 + x$$

$$x^2 - x - 56 = 0$$

$$(x - 8)(x + 7) = 0 \quad [x > 0 \text{ because square root is always positive}]$$

or

$$x = 8 \text{ is the answer.}$$

67. (b)

Total combinations are $= 5 \times 6 = 30$

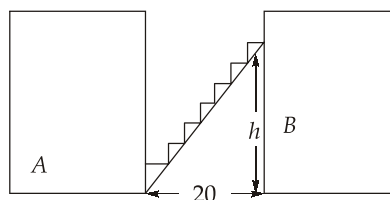
Out of which the (1, 15), (3, 13), (5, 11), (7, 9) and (9, 7) are favorable combinations according to question.

$$\text{So, the desired probability} = \frac{5}{30} = \frac{1}{6}$$

68. (c)

Let number of steps $= x$ If each step is $\frac{4}{3}$ m wide, we have

$$\frac{4}{3} \times x = 20$$



$$x = 20 \times \frac{3}{4} = 15 \text{ steps}$$

In 15 steps, this stair will go till the height of 15 feet for a step height of 1 feet.

So, both statements are mandatory to find the height of building where stair touches.

69. (a)

Given: $\left(x + \frac{1}{x}\right) = 12$

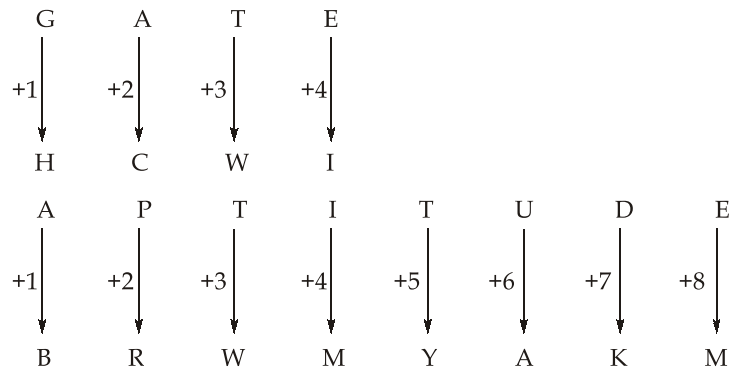
Squaring both sides, $\left(x + \frac{1}{x}\right)^2 = 12^2$

$$x^2 + \frac{1}{x^2} + 2 \times x \times \frac{1}{x} = 144$$

$$x^2 + \frac{1}{x^2} + 2 = 144$$

$$x^2 + \frac{1}{x^2} = 144 - 2 = 142$$

70. (b)



71. (b)

Total students in the class = 45 i.e. obtained from adding any row elements from last three columns.

i.e. $18 + 19 + 18 = 45, 17 + 21 + 7 = 45, 11 + 29 + 5 = 45$

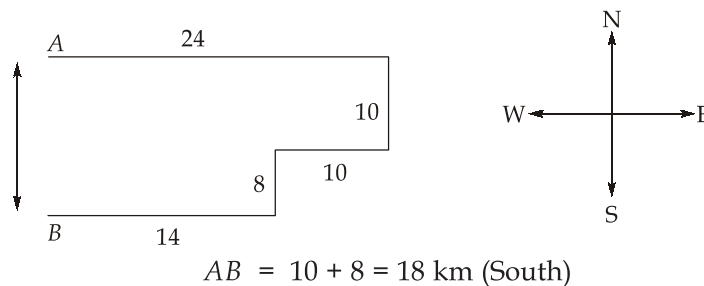
and total marks = $2 \times 18 + 3 \times 17 + 4 \times 11 + 5 \times 27 + 6 \times 10 = 326$

So, average marks = $\frac{326}{45} = 7.24$

72. (d)

$$\text{Required ratio} = \frac{75 + 65}{85 + 95} = \frac{140}{180} = \frac{7}{9}$$

73. (b)



74. (b)

Let the total distance covered by rabbit = D

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\text{Total time in journey} = \frac{D}{2} \times \frac{1}{40} + \frac{D}{4} \times \frac{1}{20} + \frac{D}{4} \times \frac{1}{10} = \frac{D}{20}$$

So, average speed = Total distance/total time

$$= \frac{D}{(D/20)} = 20 \text{ km/h}$$

75. (b)

In the question, it is given that

$$(x + 3) : (6x + 3) : (11x + 3) = 2 : 7 : 12$$

$$\Rightarrow \frac{x + 3}{6x + 3} = \frac{2}{7}$$

$$\Rightarrow 7x + 21 = 12x + 6$$

$$\Rightarrow 5x = 15$$

$$\Rightarrow x = 3$$

So, total number of students initially in the classes were $1 \times 3 + 6 \times 3 + 11 \times 3 = 3 + 18 + 33 = 54$

76. (c)

The volume of milk is continuously decreasing by 10% successively. The pure milk left in the container after

$$\text{First replacement} = 40 (1 - 0.1) = 36 \text{ litres}$$

$$\text{Second replacement} = 40 (1 - 0.1)^2 = 32.4 \text{ litres}$$

$$\text{Third replacement} = 40 (1 - 0.1)^3 = 29.16 \text{ litres}$$

77. (c)

CCTNS is a project under the National e-Governance Pan of Govt. of India. It aims at creating a comprehensive and integrated system for enhancing the efficiency and effectiveness of policing through adopting of principle of e-Governance and creation of a nationwide networking infrastructure for evolution of IT enabled-state-of-the-art tracking system around 'Investigation of crime and detection of criminals' in real time.

84. (c)

When the line is parallel to VP and perpendicular to HP, then its top view it becomes a point and in its front view perpendicular to XY and equal to true length.

85. (c)

Steps involved in Developing Product Architecture

- (i) **Create a Schematic Diagram of the Design:** The schematic diagram ensures that the team understands the basic elements of the product needed to produce an operating design.
- (ii) **Cluster the Elements of the Schematic Diagram:** The purpose of this step is to arrive at an arrangement of design elements (clusters) that will become modules.
- (iii) **Create a Rough Geometric Layout:** Making a geometric layout allows the designer to investigate whether there is likely to be geometrical, thermal, or electrical interference between elements and modules.
- (iv) **Define Interactions and Determine Performance Characteristics:** The most critical task in determining a product's architecture is accurately modelling the interactions between the modules and setting the performance characteristics for the modules. Function happens primarily at the interfaces between modules, and unless modules are carefully thought out, complexity can build up at these interfaces.

86. (b)

- Statement 2 comes under details design phase.
- Statement 4 comes under conceptual design phase.

87. (d)

People in general and many engineers in particular are uncomfortable with highly unstructured situations. Unease with chaos comes under emotional blocks.

88. (b)

Given : $R = 24$ cm; $H = 69$ cm

$$\text{Slant height, } L = \sqrt{R^2 + H^2} = \sqrt{24^2 + 69^2} = 73.05 \text{ cm}$$

$$\therefore \text{Angle of development sector, } \theta = 360^\circ \times \frac{R}{L} = 360^\circ \times \frac{24}{73.05} = 118.27^\circ$$

89. (d)

The minimum safety and health requirements for the use of work equipment by workers at work as applicable to scaffolds are:

- Scaffold must be sound, rigid and sufficient to carry its own weight plus four times the maximum intended load without settling or displacement. It must be erected on solid footing.
- Scaffold must not be erected, moved, dismantled or altered except under the supervision of a competent person.
- Scaffold must be equipped with guardrails, midrails and toeboards.
- Scaffold platforms must be tightly planked with scaffold plank grade material or equipment.
- A "competent person" must inspect the scaffolding and, at designated intervals, re-inspect it.

- Synthetic and natural rope used in suspension scaffolding must be protected from heat-producing sources.
- Scaffold can be accessed by using ladders and stairwells.
- Scaffolds must be at least 10 feet from electric power lines at all times.

90. (c)

Safety rules taken care while carrying demolition of Steel Structures are:

- When a derrick is used, care shall be taken to see that the floor on which it is supported is amply strong for the loading so imposed.
- Overloading of equipment shall not be allowed.
- Tag lines shall be used on all materials being lowered or hoisted up and a standard signal system shall be used.
- No beams shall be cut until precautions have been taken to prevent it from swinging freely and possibly striking any worker or equipment to any part of the structure being demolished.
- All structural steel members shall be lowered from the building and shall not be allowed to drop.

91. (d)

- Archimedean spiral is used in cam design and lathe chucks.
- Logarithmic spiral is used in the construction of loud speakers, audio amplifiers, etc.
- Helical grooves of square shape is used on cylindrical cams, screw conveyors, etc.

93. (a)

Whistleblowing means calling attention to wrongdoing that is occurring within an organization. A whistleblower is a person who exposes any kind of information or activity that is deemed illegal, unethical, or not correct within an organization that is either private or public.

97. (c)

Design processes apply to both products and services.

100. (b)

An embedded system is a microprocessor or microcontroller based computer hardware system with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system

