DETAILED SOLUTIONS

MADE EASY

India's Best Institute for IES, GATE & PSUs

Test Centres: Delhi, Hyderabad, Bhopal, Jaipur, Pune, Kolkata

ESE 2025 : Prelims Exam | CLASSROOM TEST SERIES

GS & ENGINEERING APTITUDE

Test 17

Full Syllabus Test 1 : (Paper-I)

ANSWER KEY

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

1. (c)

- The Index of Industrial Production (IIP) is a statistical measure of industrial performance. It is compiled and published by the Central Statistical Organisation (CSO, now NSO), under MoSPI.
- It is published on a monthly basis with base year 2011-12.
- The United Nations Statistical Office (UNSO) has recommended to include mining, manufacturing, construction, electricity, gas and water supply in the scope of IIP.

2. (b)

Stand-By Arrangements (SBA) is a lending instrument associated with International Monetary Fund (IMF) which is designed to help countries address short-term balance of payments problems. The length of SBA is typically 12–24 months.

3. (a)

- Cash Reserve Ratio (CRR) refers to the percentage of deposits which a bank must keep as cash reserves. The RBI decides a certain percentage of deposits which every bank must keep as reserves. This is done to ensure that no bank is 'over lending'. This is a legal requirement and is binding on the banks.
- All banks in India (all Scheduled Commercial Banks (SCBs) (including RRBs), Small Finance Banks (SFBs), Payments Banks, Primary (Urban) Co-operative Banks (UCBs), State Co-operative Banks (StCBs) and District Central Co-operative Banks (DCCBs)) have to maintain CRR with RBI.
- Unlike banks, NBFCs do not accept demand deposits, and they operate under a different regulatory framework focused on asset financing and lending. Thus, Non-Banking Financial Companies (NBFCs) are not required to maintain a Cash Reserve Ratio (CRR) with the RBI.

4. (c)

- SHREYAS (Scholarships for Higher Education for Young Achievers) is an umbrella scheme, under the Ministry of Social Justice & Empowerment.
- SHREYAS aims for the Educational Empowerment of OBC & Economically Backward Class (EBC) students by way of awarding fellowships (financial assistance) in obtaining quality higher education and interest subsidy on educational loans for overseas studies.

5. (a)

Tax Expenditures does not relate to the expenditures incurred by the Government in the collection of taxes. Rather, it refers to the opportunity cost of taxing at concessional rates, or the opportunity cost of giving exemptions, deductions, rebates, deferrals credits etc. to the taxpayers.

6. (b)

- The Indian Space Research Organization (ISRO) refers to its heaviest and most powerful rocket LVM3 (previously called GSLV-Mk3) as Bahubali.
- LVM3 is configured as a three-stage vehicle with two solid strap-on motors (S200), one liquid core stage (L110), and a high-thrust cryogenic upper stage (C25).

7. (a)

Engineers are obligated to maintain confidentiality unless it conflicts with public safety. Protecting client data is also essential.

8. (a)
While cost optimization is important, it is not primarily an ethical concern. Environmental Ethics promotes sustainable practices like conserving resources and minimizing environmental impact.

9. (d)

10. (c)

11. (a)
Engineers must report negligence and protect intellectual property. Prioritizing profit above ethical duties violates professional ethics.

12. (d)

13. (c)
Micro-ethics involves individual or group-level ethical decisions within the workplace or project context.

14. (c)
Moral autonomy is the ability of engineers to make ethical decisions independently using critical thinking and moral principles.

15. (b)
Whistleblowing involves reporting wrongdoing, typically as a last resort. It may be anonymous, but that is not always the case.

16. (c)
- Coral reefs are commonly found in tropical shallow waters, such as the Great Barrier Reef, Indian Ocean, and Caribbean Sea.
- Deep-sea corals, also known as cold-water corals, exist at depths of 200–2,000 meters, where there is no sunlight.
- Coral reefs are composed of calcium carbonate ($CaCO_3$), secreted by coral polyps and coralline algae (red algae). Calcium phosphate is not a major component of coral reefs.
- Coral reefs thrive in warm waters (23-29°C), shallow depths (less than 50 meters), and clear waters that allow sunlight to reach zooxanthellae algae, which perform photosynthesis.

17. (d)
- Autogenic succession is driven by biotic components of the ecosystem, like lichens.
- Allogenic succession is driven by the abiotic components of the ecosystem.
- Primary succession is the succession that starts in lifeless areas as deserts.
- Secondary succession is the succession that starts on a previously destructed habitat.

18. (a)
- The transfer of energy or food from a producer through a series of organisms is known as the food chain. It represents energy flow through an ecosystem along different trophic levels.
- Lindemann Law or 10% Law states that during the transfer of energy from one trophic level to another only about 10% is stored at higher levels, the remaining 90% is lost in respiration.

19. (d)

- The pyramid of biomass in the sea is also generally inverted because the biomass of fishes far exceeds that of phytoplankton.
- The pyramid of energy is always upright, and can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energy pyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area.
- Saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem.

20. (b)

- Beta Diversity or Between-habitat diversity refers to the response of organisms to spatial heterogeneity. High Beta Diversity implies low similarity between species composition of different habitats.
- Alpha Diversity or Within-habitat diversity refers to a group of organisms interacting and competing for the same resources or sharing the same environment.
- Gamma Diversity or Geographical diversity refers to the diversity of the habitat or the total landscape.

21. (d)

22. (c)

23. (c)

Renewable energy sources like solar and wind produce little to no harmful emissions, making them environmentally friendly and a key tool in fighting climate change.

24. (b)

A WiFi standard enabling devices to easily connect with each other without requiring a wireless access point is called as WiFi Direct which was initially called WiFi P2P (Peer to Peer).

25. (d)

Programming languages used in AI development: Python, Lisp, Java, C++, R, Julia, Prolog, Haskell.

26. (a)

- System software is a program designed to run a computer's hardware and applications and manage its resources, such as its memory, processors, and devices.
- Operating system manages the hardware and software resources in a computer system. Device Drivers help the operating system communicate with hardware devices. Thus, Device drivers and Operating system are system software.
- Video Editors are application software designed for video editing tasks.

27. (b)

An Internet Service Provider (ISP) is a company that provides individuals and organizations access to the internet and other related services.

28. (a)

During an SSL handshake, a client and server securely exchange encryption keys by using a public-key algorithms (usually RSA). The client and server establish a secure connection with this identity and key information. After the client and server establish a secure session, they transmit the data to each other, encrypting it with a symmetric algorithm, such as AES.

29. (d)

Artificial intelligence is the simulation of human intelligence in machines, enabling them to perform tasks associated with intelligent beings. The term "Artificial Intelligence" was coined by John McCarthy, an American computer scientist in 1956. Hence, all the given statements are correct.

30. (a)

- Saposhi Malware is capable of taking over electronic devices and turning them into bots which can then be used for any purpose, including DDoS attacks.
- Gravity RAT is a malware designed to steal sensitive information from infected devices.
- Pegasus is a malware designed for eavesdropping on mobile phones and harvesting their data.

31. (d)

- Non-impact printers form images on paper without physically striking the surface. Thermal, laser, and inkjet printers are non-impact printer.
- A drum printer is a type of impact printer that prints using a rotating metal drum. The drum has pre-formed characters on its surface. As the drum spins, a hammer strikes an ink ribbon against the paper, transferring the characters.

32. (c)

- Keyboard is an input device on which many shortcut options are also present like Caps Lock which helps to lock the font using capital letters, PrtSc helps to take screen shots and PgUp helps to scroll a document without using mouse.
- "Copy" is performed by using keyboard shortcuts (like Ctrl+C) that involve other keys. There isn't a dedicated key labeled "Copy" on a conventional QWERTY keyboard.

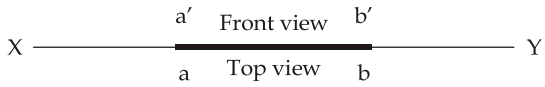
33. (a)

- When x axis, y axis and z axis of a solid are equally inclined to V.P then front view of the solid is called isometric projection.
- Isometric projection : (1) Drawn to isometric scale.
  (2) Lines drawn parallel to isometric axis are foreshortened to 0.816 times the actual length.

34. (a)

For a line contained in both the horizontal plane (HP) and vertical plane (VP).

- The line lies along the intersection of HP and VP, which is the XY line (reference line)
- Both plan and elevation are of true length and lie on the reference line.
- The vertical trace of the line is the XY line itself.



35. (c)

The Product Design Specification (PDS) is a document created during the problem definition activity very early in the design process. It details the requirements that must be met in order for the product or process to be successful. The activities and ensures that all relevant factors are accounted for and all stakeholders are heard from.

PDS is written after establishing engineering requirements and research.

36. (a)

- Pugh's concept selection method or datum method compares each concept relative to a reference or datum concept for each criterion determines whether the concept in question is better than, poorer than or about the same as the reference concept. Thus it is a relative comparison technique.

37. (c)

$$\text{Volume of actual object} = 1000\ m^3$$

$$\text{Volume of model} = 125 \times 10^{-6}\ m^3$$

$$\text{R.F.} = \left(\frac{\text{Volume of Model}}{\text{Volume of acual object}}\right)$$

$$= \left(\frac{125\times10^{-6}}{1000}\right)^{1/3} = \frac{1}{200}$$

Note:

(1) $$\text{R.F.} = \frac{\text{Length of object in drawing}}{\text{Actual length of the object}}$$

(2) $$\text{R.F.} = \sqrt{\frac{\text{Area of drawing}}{\text{Actual area}}}$$

38. (b)

Given: $\text{Major axis} = 100\ mm$

$\text{Distance between focus} = 80\ mm$

$$\left(\begin{matrix}\text{Focal}\\ \text{distance}\end{matrix}\right)^2 = \left(\begin{matrix}\text{Semi Major}\\ \text{axis}\end{matrix}\right)^2 - \left(\begin{matrix}\text{Semi Minor}\\ \text{axis}\end{matrix}\right)^2$$

Let semi minor axis be x

$$\left(\frac{80}{2}\right)^2 = \left(\frac{100}{2}\right)^2 - (x)^2$$

$$x^2 = 900$$

$$\text{Semi Minor axis} = \sqrt{900} = 30 \text{ mm}$$

$$\text{Minor axis} = 2 \times 30$$

$$= 60 \text{ mm}$$

39. (d)

- Sphere is double curved surface hence it is non-developable, meaning it cannot flattened into a 2-D plane without distortion.
- Only approximation methods are available for development of sphere. Two approximate methods available are:

(1) Luna method or poly cylindric method.
(2) Zone method or poly conic method.

40. (c)

- **Scale command :** It enlarges or reduces selected objects. Keeping the proportions of the same after scaling.
- **Chamfer command :** It bevels the edges of the objects. The distances and angles that you specify are applied in the order that you select the objects.
- **Fillet command :** It rounds and fillets the edges of objects.
- **Array command :** The command creates multiple copies of selected object in a pattern.

41. (b)

- Pareto diagram is a graphical tool used to identify and prioritize problems or defects in a process. It is based on pareto principle which states that approximately 80% of the problems are caused by 20% of the defects or issues.
- Scatter diagram is useful to identify a possible relationship between two process variables. The relation can be :

(1) Positive correlation
(2) Negative correlation
(3) Curvilinear correlation
(4) No-correlation

42. (b)

$$\text{MTTF for module in series connection} = \frac{1}{4\lambda} = \frac{1}{4 \times 0.0002} = 1250 \text{ hr.}$$

43. (d)

$$\Rightarrow \quad \text{Average}\left(\bar{X}\right) = \frac{22 + 25 + 28 + 24 + 26}{5} = \frac{125}{5} = 25 \text{ MPa}$$

$$\text{Standard deviation, } \sigma = \sqrt{\frac{\Sigma\left(X-\bar{X}\right)^2}{N-1}}$$

$$= \sqrt{\frac{(22-25)^2+(25-25)^2+(28-25)^2+(24-25)^2+(26-25)^2}{5.1}}$$

$$= \sqrt{\frac{3^2+0^2+3^2+1^2+1^2}{4}} = \sqrt{5} \text{ MPa}$$

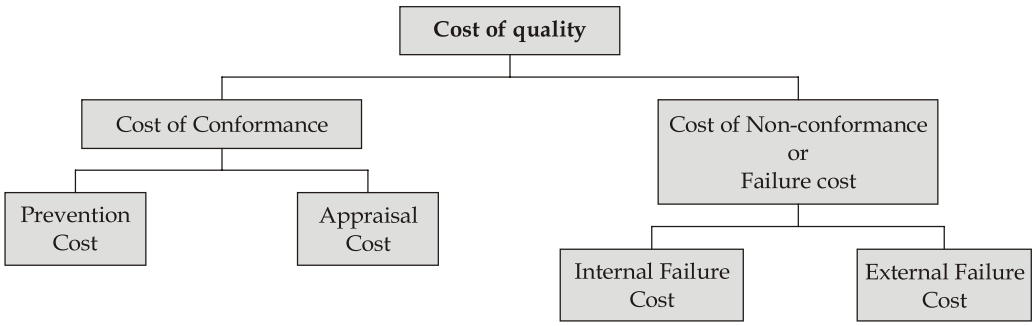
44. (c)

- DMAIC and DMADV both are 6σ methodology.
- DMAIC is a way to improve work processes by eliminating defects.
- DMADV is used when the process needs to be replaced by a new process rather than simplifying and improving the existing process.

45. (c)

QFD - Quality function deployment is the method of translating the voice of customer into design specifications of a product.

46. (c)



47. (c)

Upper specification limit = 20 + 3 = 23

Lower specification limit = 20 – 3 = 17

$$\text{Process capability index } (C_p) = \frac{USL - LSL}{6\sigma} = \frac{23-17}{6\times 2} = 0.5$$

48. (d)

- Six sigma is a set of techniques and tool for process improvement.
- 3.4 defects per million opportunities.

49. (b)

Cost variance = Earned value – Actual cost

50. (b)

Activity interrelationships are not clearly shown the Gantt chart. So it is useful for simple activity sequence.

51. (c)

A project charter serves as the official document that :

- Authorizes the project or phase to begin.
- Appoints the project manager.
- Outlines initial requirements that meet the stakeholder's needs.
- Provides a high-level understanding of the project objectives and constraints.

52. (a)

- **Feasibility study :** Determines if the project is technically, financially and operationally viable.
- **Detailed project appraisal :** Evaluates costs, benefits, risks and alignment with organizational goals after feasibility is confirmed.
- **Project approval :** Formal decision by stakeholders to proceed with the project based on appraisal outcomes.
- **Stakeholder negotiation :** Finalizes terms, agreements and resource allocation before execution begins.

53. (b)

54. (c)

Given : Variance = 36 days

Standard deviation (σ) = $\sqrt{36} = 6$ days

Now, $$z = \frac{x-\mu}{\sigma} = \frac{60-60}{6} = 0$$

z-factor of 0 corresponds to the mean of the normal distribution. In a symmetric normal distribution the probability of completing the project by the mean (60 days) is 50%.

55. (b)

In Project, risk is high at start as number of unknown and unpredictable elements are present while in operations risk is not high as it is repetition of activities.

56. (b)

57. (a)

To examine the likelihood of the proposed technology becoming obsolete in the near future falls under feasibility study.

58. (c)

In normalizing, steel is heated at austenizing temperature (much above the upper critical temperature-more than the temperature used for annealing and hardening), soaked at that temperature and then air cooled.

59. (d)

- In mixed dislocations, there are screw and edge dislocations present in the crystal.
- Edge dislocations are much more in number than screw dislocatons in metal.
- Burgers vector for edge dislocation is perpendicular to the dislocation line and for screw dislocation, it is parallel to the dislocation line.
- Edge dislocations travel much faster than screw dislocations (=50 times).
- Strain energy per unit length of dislocations $u = \frac{Gb^2}{2}$, where G is the shear modulus and b is Burgers vector.

60. (b)

- Steels that can be put to use at very low temperatures, approaching the temperatures of liquid hydrogen or liquid helium, are turmed as cryogenic steels.
- Invar steel is a nickel-iron alloy known for its low thermal expansion properties.
- Elinvar is a nickel–iron–chromium alloy notable for having a modulus of elasticity which does not change much with temperature changes.
- Manganese steel, also called Hadfield steel or mangalloy, is a steel alloy containing 12-14% manganese renowned for its high impact strength and resistance to abrasion in its hardened state.

61. (d)

White iron is used as an intermediary in the production of malleable cast iron. Heating white iron at temperature between 800°C and 900°C for prolonged time period, in a neutral atmosphere (to prevent oxidation) causes decomposition of cementite forming graphite, which exists in the form of clusters or rosettes surrounded by ferrite matrix on slow cooling or pearlite matrix on fast cooling.

62. (b)

The temperature at which the polymer experiences the transition from rubbery to rigid state is known as glass transition temperature, T_g. At temperature, T_g there are abrupt changes in Young's modulus E, heat capacity and coefficient of thermal expansion. Below T_g, polymer is hard, brittle and glassy and above T_g, it becomes soft and flexible.

63. (b)

- Vander Waals bonds join molecules or group of atoms by weak electrostatic attractions. PVC is a polymer obtained by combining vinyl chloride monomer units. The molecules are bonded to each other by Vander Waals forces, making it possible to reform PVC.
- Diamond is characterized by covalent bonding, Sodium chloride by ionic bonding and Iron by Metallic bonding.

64. (d)

Three basic factors are necessary to cause fatigue failure:

1. Maximum tensile stress of sufficiently high value.
2. Variation in applied stress.

3. Large number of cycles of applied stress.

In addition, stress concentration, corrosion, temperature, over load, metallurgical defects and residual stresses are responsible for fatigue failure.

65. (c)

Vanadium is a strong carbide-forming element that enhances the hardness, wear resistance and toughness of steels.

66. (a)

Class Y insulation : These are organic fibre material such as paper, pressboard, fabric etc. and are fabricated on cellulose base. They may also be natural silk when not impregnated. They usually contain thermoplastics having low operating temperatures such as polyvinyl chloride (PVC).

67. (c)

In a superconducting state, the resistance (R) is zero. Hence, the heat loss (I^2R loss) in a superconducting material is zero. Therefore, statement 2 is not correct.

68. (d)

Current flow in semiconductor is due to

(i) Drift current : Which is due to applied voltage. The applied voltage exerts a force on the charge carriers, causing them to move.

(ii) Diffusion current : Which is due to difference in concentration of charge carries in semiconductor causing diffusion of charge carriers.

69. (a)

Hall coefficient is negative for n-type semiconductors and positive for p-type semiconductors.

Hall coeffcient for metal is zero as $n \to \infty$

$$R_H = \frac{1}{nq} \to 0$$

70. (c)

In a p-type semiconductor, the fermi level lies closer to the valence band, not the conduction band.

71. (d)

There are four basic polarization mechanisms:

(i) Electronic or induced polarization : It is due to displacement of electrons relative to atomic nuclei.

(ii) Ionic polarization : It is due to displacement of positive and negative ions relative to each other within molecules.

(iii) Orientational polarization : It is due to orientation of molecular dipoles in the direction of applied field which would otherwise be randomly distributed due to thermal randomization.

(iv) Interfacial or space charge polarization : It is due to accumulation of charges at interfaces in dielectric materials when an electric field is applied.

72. (b)

Strong magnetic properties, especially in ferromagnetic materials like iron, cobalt, and nickel, arise due to the presence of unpaired electrons in their incomplete inner *d* or *f* shells. These unpaired electrons create magnetic moments that align in the same direction, producing a strong magnetic field.

73. (c)

Manganin, an alloy primarily composed of copper (Cu), manganese (Mn) and Nickel (Ni) is known for its extremely stable electrical resistance over a wide range of temperatures. This property makes it ideal for use in standard resistances and precision instruments where consistent resistance is crucial.

74. (a)

As A is unitary matrix,

So, $AA^{\theta} = I$, where $A^{\theta} = \left(\bar{A}\right)^{T}$

Also, $A^{-1} = A^{\theta}$

Conjugate of A i.e., $\bar{A} = \begin{bmatrix} \frac{1}{2}(1-i) & \frac{1}{2}(-1-i) \\ \frac{1}{2}(1-i) & \frac{1}{2}(1+i) \end{bmatrix}$

Transpose of $\bar{A}$, i.e., $A^{\theta} = \begin{bmatrix} \frac{1}{2}(1-i) & \frac{1}{2}(1-i) \\ -\frac{1}{2}(1+i) & \frac{1}{2}(1+i) \end{bmatrix} = A^{-1}$

75. (d)

We have, $\sin^2 x = \left(x - \frac{x^3}{3!} + \frac{x^5}{5!} - - -\right)^2$

$= \left[x - \left(\frac{x^3}{3!} + \frac{x^5}{5!} - - -\right)\right]^2$

$= x^2 - 2x\left(\frac{x^3}{6} - \frac{x^5}{120} + - - - -\right) + \left(\frac{x^3}{6} - \frac{x^5}{120} + - - -\right)^2$

$= x^2 - \frac{x^4}{3} + \frac{x^6}{60} + \frac{x^6}{36} + - - - -$

$= x^2 - \frac{x^4}{3} + \frac{2x^6}{45} + - - - - = t$ (say)

Now, $\log(1 + \sin^2 x) = \log(1 + t)$

$$= t - \frac{t^2}{2} + \frac{t^3}{3} - \frac{t^4}{4} + - - - -$$

Substituting the value of t, we get

$$\log(1 + \sin^2 x) = x^2 - \frac{x^4}{3} + \frac{2x^6}{45} + - - - - - \frac{-1}{2}\left(x^2 - \frac{x^4}{3} + - - - -\right)^2 + \frac{1}{3}\left(x^2 - - -\right)^3 - - -$$

$$= x^2 - \frac{x^4}{3} + \frac{2x^6}{45} - \frac{1}{2}\left(x^4 - \frac{2x^6}{3} + - - -\right) + \left(\frac{1}{3}\left(x^6 + - - -\right) + - -\right)$$

$$= x^2 - \frac{5}{6}x^4 + \frac{32}{45}x^6 + - - - -$$

76. (a)

We have, $\dfrac{\partial z}{\partial x} = f'(x+ct)\dfrac{\partial}{\partial x}(x+ct) + \phi'(x-ct)\dfrac{\partial}{\partial x}(x-ct)$

$$= f'(x+ct) + \phi'(x-ct)$$

and $\dfrac{\partial^2 z}{\partial x^2} = f''(x+ct) + \phi''(x-ct)$ ...(i)

Again $\dfrac{\partial z}{\partial t} = f'(x+ct)\dfrac{\partial}{\partial t}(x+ct) + \phi'(x-ct)\dfrac{\partial}{\partial t}(x-ct)$

$$= cf'(x-ct) - c\phi'(x-ct)$$

$$\frac{\partial^2 z}{\partial t^2} = c^2 f''(x+ct) + c^2\phi''(x-ct)$$

$$= c^2\left[f''(x+ct) + \phi''(x-ct)\right] \quad \text{...(ii)}$$

From (i) and (ii), it follows that

$$\frac{\partial^2 z}{\partial t^2} = c^2\frac{\partial^2 z}{\partial x^2}$$

77. (c)

$$I_n = \int \sec^n x\,dx = \int \sec^{n-2} x \cdot \sec^2 x\,dx$$

Integrating by parts, we have

$$= \sec^{n-2} x \tan x - \int \{(n-2)\sec^{n-3} x \sec x \tan x\} \tan x\,dx$$

$$= \sec^{n-2} x \tan x - (n-2)\int \sec^{n-2} x \cdot \tan^2 x\,dx$$

$$= \sec^{n-2} x \tan x - (n-2)I_n + (n-2)I_{n-2}$$

Using $1 + \tan^2 x = \sec^2 x$, we get

$$(n-1)I_n = \sec^{n-2} x \tan x + (n-2)I_{n-2}$$

Thus, $$I_n = \frac{\sec^{n-2} x \tan x}{n-1} + \frac{n-2}{n-1} I_{n-2}$$

Putting $n = 4$ in the reduction formula for $\int \sec^n x\,dx$,

We get, $$I_4 = \frac{\sec^2 x \tan x}{3} + \frac{2}{3} I_2$$

$$\therefore \int_0^{\pi/4} \sec^4 x\,dx = \left| \frac{\sec^2 x \tan x}{3} \right|_0^{\pi/4} + \frac{2}{3} \int_0^{\pi/4} \sec^2 x\,dx$$

$$= \frac{2}{3} + \frac{2}{3} |\tan x|_0^{\pi/4} = \frac{2}{3}(1+1) = \frac{4}{3}$$

78. (c)

Using integration by parts,

$$\int f(x)g(x)dx = f(x)\int g(x)dx - \int \left(\frac{d}{dx}[f(x)] \int g(x)dx \right) dx$$

We get, $$I = \int_0^1 4x^3 \frac{d^2}{dx^2}\left(1-x^2\right)^5 dx$$

$$= \left[4x^3 \frac{d}{dx}\left(1-x^2\right)^5 \right]_0^1 - \int_0^1 12x^2 \frac{d}{dx}\left(1-x^2\right)^5 dx$$

$$= \left[4x^3 \times 5\left(1-x^2\right)^4 (-2x) \right]_0^1 - 12\left[\left[x^2\left(1-x^2\right)^5 \right]_0^1 - \int_0^1 2x\left(1-x^2\right)^5 dx \right]$$

$$= 0 - 0 - 12(0-0) + 12\int_0^1 2x\left(1-x^2\right)^5 dx$$

$$= 12 \times \left[-\frac{\left(1-x^2\right)^6}{6} \right]_0^1 = 12\left[0 + \frac{1}{6} \right] = 2$$

79. (c)

The divergence of the vector is given as

$$\nabla \cdot \vec{A} = \frac{\partial F_x}{\partial x} + \frac{\partial F_y}{\partial y} + \frac{\partial F_z}{\partial z}$$

$$= \frac{\partial(2xy)}{\partial x} + \frac{\partial(z)}{\partial y} + \frac{\partial(yz^2)}{\partial z}$$

$$= 2y + 2yz = 2 \times (-1) + 2 \times (-1) \times 3$$

$$= -8$$

80. (b)

$4 + 3 \div 2 \div 1 - 5$

Breaking it down;

$4 + 3 \rightarrow 4$ is the mother of 3

$3 \div 2 \rightarrow 3$ is the father of 2

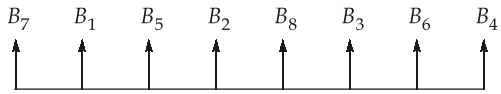
$2 \div 1 \rightarrow 2$ is the father of 1

$5 - 1 \rightarrow 1$ is the brother of 5

4 is the mother of 3 and 3 is the father of 2. This means 4 is the paternal grand mother of 2 or we can say, 4 is 2's father's mother.

81. (b)

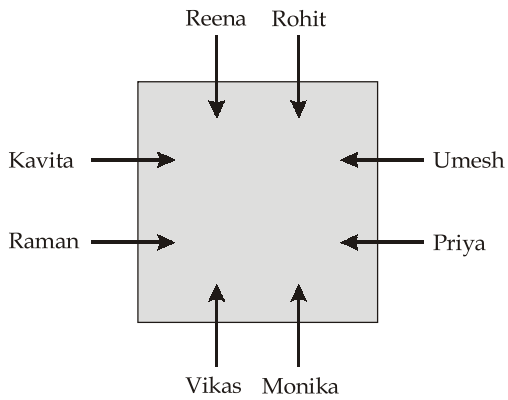
Based on the given information, the sitting arrangement is



Thus, B_7 is sitting immediate left of B_1.

82. (b)

According to the given information the final arrangement is as below:



We can see, Reena sits second to the left of Raman.

83. (a)

Since $14.28\% = \frac{1}{7}$, thus the ratio of initial length to final length = 7 : 8

As Length × Breadth = Area = Constant

$\therefore$ The ratio of initial breadth to final breadth = 8 : 7

$\therefore$ Percentage reduction in breadth $= \frac{1}{8} \times 100 = 12.5\%$

84. (b)

Number of signals using one flag = ${}^6P_1 = 6$

Number of signals using two flags = ${}^6P_2 = 30$

Number of signals using three flags = ${}^6P_3 = 120$

Number of signals using four flags = ${}^6P_4 = 360$

Number of signals using five flags = ${}^6P_5 = 720$

Number of signals using six flags = ${}^6P_6 = 720$

Therefore, the total number of signals using one or more flags at a time is

$6 + 30 + 120 + 360 + 720 + 720 = 1956$

85. (c)

Total annual expenditure = $1100 \times 3 + 1000 \times 5 + 1200 \times 4 = ₹13100$

Total annual income = Total annual expenditure + Total annual savings

$= 13100 + 1300 = ₹14400$

$\therefore$ Average monthly income = $\frac{14400}{12} = ₹1200$

86. (a)

Let the two digit number is $10x + y$. It is given that

$10x + y - (10y + x) = 36$

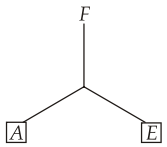
$x - y = 4$

i.e. the difference in the digits of the number is 4. Hence, the possible numbers are 62, 73, 84 and 95. Hence, the number can be prime (73) or composite (62, 84, 95). So, statements 3 and 4 are not correct.

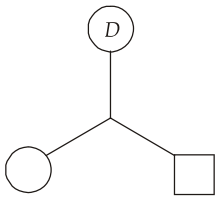
87. (b)

(i) Number of males = Number of females = 3

(ii)

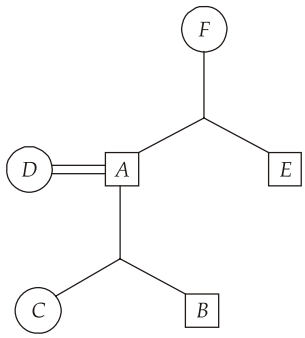


(iii)



(iv)

(v)



Therefore, A is husband of D.

88. (b)

Let Number of boys = x

Number of girls = $2x$

$\therefore$ $x + 2x = 90$

$\Rightarrow$ $3x = 90$

x (Boys) = 30

$2x$ (Girls) = 60

Number of students behind Shridar = 90 – 14 = 76

Number of girls behind Shridar = 60 – 10 = 50

Number of boys behind Shridar = 76 – 50 = 26

89. (b)

- Statement (I) is true because evaluating large projects through direct observation is often impractical due to their scale and complexity.
- Statement (II) is also true small projects can be effectively evaluated using inputs from field staff and subject matter specialists.
- Statement (II) does not explain why large projects may not be evaluated by direct.

90. (d)

There are always errors associated with 100% inspection [Type I and II errors] when the inspection procedure is performed by human inspectors, because of this 100% inspection using manual methods has no guarantee of 100% good quality product.

91. (c)

Self-esteem is a psychological concept.

92. (d)

Wisdom is the ability to make CORRECT judgements and decisions.

93. (d)

Most Favoured Nation (MFN) principle allows for exceptions like Free Trade Agreements (FTAs) or customs unions, which apply only to specific trading partners within the agreement.

94. (d)

- Stagflation presents a unique economic challenge, combining stagnant economic growth with inflation, complicating policy responses.
- Stagflation is a situation where high inflation coexists with high unemployment, defying traditional economic theories. It is characterized by stagnant growth, high inflation, and high unemployment rates. Thus, it contradicts the Phillips Curve, which posits an inverse relationship between inflation and unemployment.
- The Phillips curve states that inflation and unemployment have an inverse relationship; higher inflation is associated with lower unemployment and vice-versa.
- The Phillips curve was a concept used to guide macroeconomic policy in the 20th century, but was called into question by stagflation in the 1970s.

95. (a)

CBA is an effective tool because it helps us in decision making by assigning monatery value to costs and benefit, enabling a structured comparison benefits of using CBA :

(1) Ease of use and understand.
(2) Educates the business.
(3) Provides objectivity
(4) Establishes organisational support and buy-in.

96. (b)

ROM is a combinational circuit that is generally used as a firmware chip on any digital device to permanently store data. It is a non-volatile memory, i.e. the data is not erased when the power is turned off.

97. (c)

Despite occupying about 70 percent of the surface, the productivity of the oceans are only 55 billion tons.

98. (b)

99. (b)

100. (b)

Given, $f(x) = 2 + \cos x, \forall\ x \in R$

We have, $f'(x) = -\sin x$

$\therefore$ $f'(x) = 0$ for $x = n\pi$, where n is an integer.

Thus, there exists a point 'c' in $[t, t + \pi]$. such that $f'(c) = 0$

Hence, statement I is true.

$f(x)$ is periodic with period 2π.

Hence, $f(t) = f(t + 2\pi)$

Hence, statement II is true but it is not correct explanation for statement I.

❍❍❍❍