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 19

Full Syllabus Test : (Paper-I)

ANSWER KEY

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

1. (b)

- The G20 or Group of 20 is an intergovernmental forum comprising 19 sovereign countries, the European Union (EU), and the African Union (AU).
- The Countries under G20 include: Argentina, Australia, Brazil, Canada, China, Germany, France, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom and the United States.

2. (d)

3. (b)

- The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) is a regional organization comprising seven Member States lying in the littoral and adjacent areas of the Bay of Bengal, constituting a contiguous regional unity.
- This organization came into being on 6 June 1997 through the Bangkok Declaration.
- It constitutes seven Member States: Bangladesh, Bhutan, India, Nepal, Sri Lanka, Myanmar and Thailand.
- A Permanent Secretariat of the organisation was set up in Dhaka in 2014 to expedite the implementation of the decisions taken at the summit and Ministerial meetings.
- India is the lead country for counterterrorism and transnational crime, transport and communication, tourism, and environment and disaster management.

4. (c)

5. (d)

- NeVA is a work-flow system deployed on NIC Cloud, MeghRaj which helps the Chair of the House to conduct the proceedings of the House smoothly.
- The aim of the project is to bring all the legislatures of the country together, in one platform thereby creating a massive data depository without having the complexity of multiple applications.

6. (b)

Sahaj is a digital initiative launched by oil marketing companies for the release of LPG connections with online payment.

7. (a)

- Failing to disclose a personal relationship that might influence professional decisions is a textbook case of conflict of interest.
- Recommending a vendor in which the engineer has a financial stake, without disclosure, is a clear conflict of interest.
- Declining a project due to lack of competence is ethical behavior, in line with professional responsibility.

8. (c)

- Engineering ethics guides professionals to act in ways that promote the welfare of society while respecting fairness, justice, and public safety.
- Engineers must balance the interests of employers with their responsibility to the public good. The public's welfare should not be compromised for employer interests.
- Professional ethics require engineers to avoid causing harm to people, property, and the environment, ensuring that their actions are safe and responsible.

9. (c)

10. (a)

- **Self-direction Virtues:** Self-understanding, humility, moral autonomy, courage, self-discipline, perseverance, self-respect, integrity, honesty
- **Public Spirited Virtues:** Beneficence, generosity, sense of community
- **Team Work Virtues:** Collegiality, cooperation, respect for authority, loyalty
- **Proficiency Virtues:** Competence, diligence, creativity.

11. (d)

12. (d)

13. (b)

14. (b)

- Geothermal energy uses the heat generated by the Earth's core to produce clean energy.
- Geothermal Energy is the only renewable energy source that is unaffected by day-night. The main advantage of geothermal energy is its low cost.

15. (a)

- Fundamental niche is the entire set of conditions under which an animal (population, species) can survive and reproduce itself.
- The fundamental niche represents the theoretical or potential ecological niche of a species, considering only the influence of abiotic (non-living) factors.
- It encompasses the full range of environmental conditions, such as temperature, humidity, light, and other abiotic factors, where a species could survive and reproduce without competition from other species.

16. (c)

Short-lived climate pollutants — methane, black carbon tropospheric ozone, and hydrofluorocarbons (HFCs), which are also sometimes known as "super pollutants" — remain in the atmosphere for less time than carbon dioxide but have a potent impact on near-term global warming.

17. (d)

18. (b)

- Ecological succession is the natural process of change in the structure and composition of a community over time.
- Nudation is the initial stage where an area becomes devoid of life and vegetation. Its causes include natural events (Volcanic eruptions, landslides, glacial retreats), and human activities (mining, deforestation).
- Nudation sets the stage for colonization by pioneer species.

19. (b)

- Biodiesel is produced from vegetable oils, yellow grease, used cooking oils, or animal fats. The fuel is produced by transesterification—a process that converts fats and oils into biodiesel and glycerin (a co-product).
- Saponification is a reaction that converts an ester into alcohol and soap using a strong base.

20. (b)

- An ecotone is a transitional area between two or more ecological communities, ecosystems, or regions.
- Ecotones can be narrow or wide and can occur at multiple spatial scales. They can be natural boundaries or human-generated.
- Examples of ecotones include:
  - Marshlands (between dry and wet ecosystems),
  - Mangrove forests (between terrestrial and marine ecosystems),
  - Grasslands (between desert and forest), and
  - Estuaries (between saltwater and freshwater).
- Tropical forests are not ecotones.

21. (c)

In Amensalism, one species is harmed whereas the other is unaffected.

22. (a)

- Loss of biodiversity refers to the disappearance or decline of the biological diversity on the planet. It is accelerated by a variety of factors. However, the accelerated rates of species extinctions that the world is facing nowadays are largely due to human activities.
- Four major causes have been identified for the same, which are referred to as The Evil Quartet. It includes – Habitat loss and fragmentation, over-exploitation, invasive alien species and co-extinctions.

23. (c)

Ex-situ Conservation:

- In this approach, threatened animals and plants are taken out from their natural habitat and placed in special settings where they can be protected and given special care. Zoological parks, botanical gardens and wildlife safari parks serve this purpose.
- There are many animals that have become extinct in the wild but continue to be maintained in zoological parks.

24. (d)

- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989, and it came into force in 1992.
- As a result of the recently adopted amendments to the Basel Convention, starting January 1, 2025, international shipments of electrical and electronic waste (e-waste) and scrap, for recovery (including recycling) or disposal, are allowed only with the prior written consent of the importing country and any transit countries (i.e., countries shipments may pass through before arrival in the importing country). This marks the first time that non-hazardous e-waste and scrap is controlled under the Basel Convention.

25. (a)

- An assembly language is a type of low-level/middle level programming language that is intended to communicate directly with a computer's hardware. Unlike machine language, which consists of binary strings, Assembly language uses alphabetic (mnemonic) codes.
- High-level programming languages are designed to be more human-readable and closer to natural language, making it easier for programmers to write code. Thus, it is easier from programmers to write programmes in high level languages (C, C++, etc.) compared to assembly language.
- Assembly language must be translated into machine language using an assembler before execution.

26. (c)

Voice over Internet Protocol (VoIP) is a technology that allows voice communication over the internet. By converting voice signals into digital data packets, VoIP enables users to make calls from computers, smartphones, or VoIP phones.

27. (a)

The process of copying files to a CD-ROM is called "burning" because a laser in the CD-R drive uses heat to record the data on the disc.

28. (d)

- QR code, quick-response code, is an open source technology invented in 1994 by Masahiro Hara of Japanese company Denso Wave for labelling automobile parts.
- QR codes can act as markers or anchors in augmented reality (AR) applications. When a device's camera detects a QR code, the AR software can recognize its position and orientation in the real world, allowing it to overlay digital content accurately onto that location.

Thus, all the given statements are correct.

29. (c)

- AMOLED utilizes electroluminescent organic compounds that emit light when an electric current is passed through them. These compounds are deposited as thin films onto a substrate or base layer. The "active-matrix" refers to the use of thin-film transistors (TFTs) to individually control each pixel.
- Since pixels can be turned off completely, AMOLED displays can achieve true blacks and thus, have a higher contrast ratio.

- The active-matrix system allows for quick pixel state changes, resulting in a faster response time.

30. (d)

- Chrome is a free and open-source web browser project, primarily developed and maintained by Google. This codebase provides the vast majority of code for the Google Chrome browser, which is proprietary software with additional features.
- Microsoft Word developed by Microsoft and Acrobat Reader developed by Adobe are proprietary softwares. Their source code is not open to the public

31. (a)

- A logic bomb is a type of malicious code embedded in software that remains dormant until specific conditions are met.
- When triggered, a logic bomb virus executes a destructive action, such as deleting files or disrupting critical systems.
- Unlike traditional malware, a logic bomb does not propagate actively but rather lies in wait for its pre-defined activation event.

32. (d)

Given : $RF_1 = 1 : 50000$; $d_1 = 2$ cm; $RF_2 = 1:20000$

$$\text{Actual distance} = \text{Map distance} \times \frac{1}{RF_1}$$

$$\text{Actual distance} = 2 \times 50000 = 100000 \text{ cm}$$

$$\text{Actual distance} = 1 \text{ km}$$

For new map:

$$100000 = d_2 \times \frac{20000}{1}$$

$$d_2 = 5 \text{ cm}$$

33. (a)

- In case of fire only fireman shall operate the fire lift. In normal course, lift may be used by other persons.
- Fire lift should be provided with a ceiling hatch for use in case of emergency so that when the car gets stuck up, it shall be easily operable.
- Buildings 15 m in height and above shall be provided with fire lifts.
- Each fire lift shall be equipped with suitable intercommunication equipment for communicating with the control room.
- Automatic changeover from normal supply to generator supply because generator room may not be easily accessible in case of severe fire.

34. (a)

There are 6 methods available for drawing circle in Auto CAD:

1. Center radius method: Creates a circle using a center point and a radius.
2. Center diameter method: Creates a circle using a center point and a diameter.
3. 2-point method: Creates a circle using two end points of a diameter.

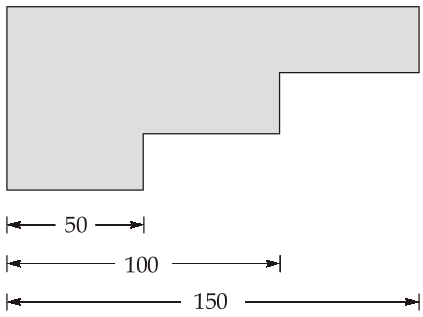
4. 3-Point method: Creates a circle using three points on the circumference.
5. Tan, Tan, Radius method: Creates a circle with a specified radius tangent to two objects.
6. Tan, Tan, Tan, method: Creates a circle tangent to three objects.

35. (b)

First Angle Projection		Third Angle Projection	
1.	Object is kept in first quadrant.	**1.**	Object is kept in third quadrant.
2.	Object lies between the observer and reference plane.	**2.**	Reference plane lies between the observer and object.
3.	Reference plane is considered to be opaque.	**3.**	Reference plane is considered to be transparent.
4.	In orthographic projection, left side comes on the right side of front view and above the horizontal reference line.	**4.**	In orthographic projection, left side comes on the left side of front view and below the horizontal reference line.

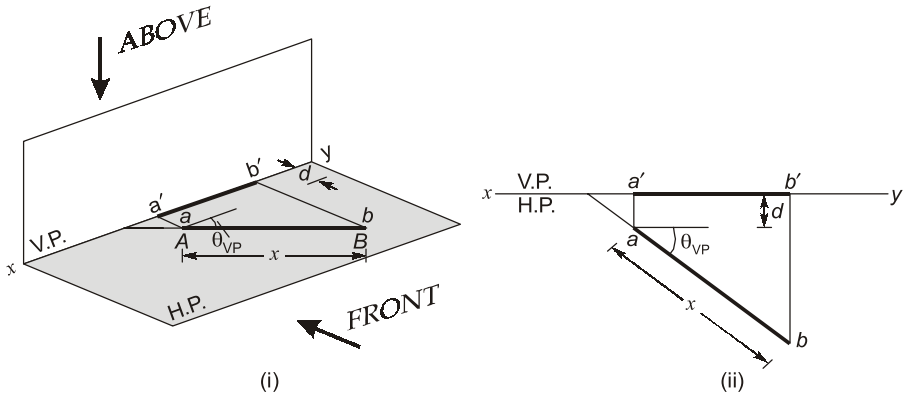
36. (c)

Parallel or progressive dimensioning is the placement of a number of single dimension lines parallel to one another from a common origin. It is used where a number of dimensions have a common origin. Cumulative errors is avoided by this method.



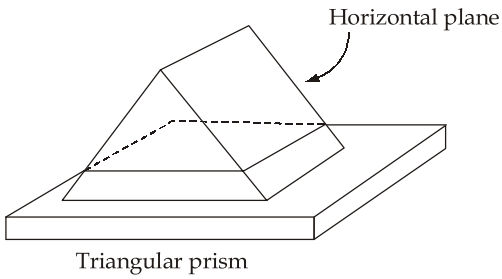
37. (b)

Example for this case is projection of a line contained in the H.P. and inclined to V.P.



Projection of a straight line contained in the H.P.

38. (a)



Sectional top view will be rectangle.

39. (a)

Given :

$$R(t) = e^{(-0.005t)}$$
$$\lambda = 0.005$$
$$\text{MTTR} = 35$$
$$\lambda = 0.005 = \frac{1}{MTBF}$$
$$MTBF = 200$$
$$\text{MTBF} = \text{MTTF} + \text{MTTR}$$
$$200 = \text{MTTF} + 35$$
$$\text{MTTF} = 165 \text{ hours}$$

40. (d)

Given : $\bar{P} = 0.06$; $n = 150$ units

$$\sigma_p = \sqrt{\frac{\bar{P}(1-\bar{P})}{n}} = \sqrt{\frac{0.06(0.94)}{150}}$$
$$\sigma_p = 0.0194$$
$$\text{UCL} = \bar{P} + 3\sigma_P = 0.06 + 3(0.0194)$$
$$\text{UCL} = 0.1182 \simeq 0.12$$

41. (a)

External failure cost : It refers to the costs that a business incurs when a product or service fails to meet quality standards after it has been delivered to the customer for example return goods, replacement cost, loss of good will, warranty cost etc.

42. (a)

Cost of conformance is the cost of providing products or services as per the required standards. Cost of conformance is further divided into two types:

(i) Prevention cost

(ii) Appraisal cost

- External failure cost : It is the defect detected by the customer while using the product. So it occurs after the delivery.
- Internal failure cost : The defect that is detected inside the production system.

43. (a)

- Concurrent engineering, also known as simultaneous engineering. It is a method of designing and developing products in which different stages run simultaneously rather than sequentially. It decreases the product development time and also the time to market, leading to improved productivity and reduced cost.
- Concurrent engineering encourages the cross-functional team collaboration for design, production, testing and operational work.

44. (c)

It defines the upper limit on the percentage of defects that a customer is willing to accept. The probability of accepting a lot of RQL represents a risk for the customer.

45. (d)

ISO 9000 determines the effectiveness of a companies quality system, it is a quality management system standard, based on the premise that certain genetic characteristics of management practices can be standardized and then a well designed and carefully managed quality system provides confidence that the outputs will meet customer expectations and requirements completely.

46. (c)

- As sigma level increases, cost of poor quality goes down, while profitability, productivity and customer satisfaction goes up.
- For six sigma DPMO should not be more than 3.4.
- Achieving six sigma does not guarantee zero defects.

47. (b)

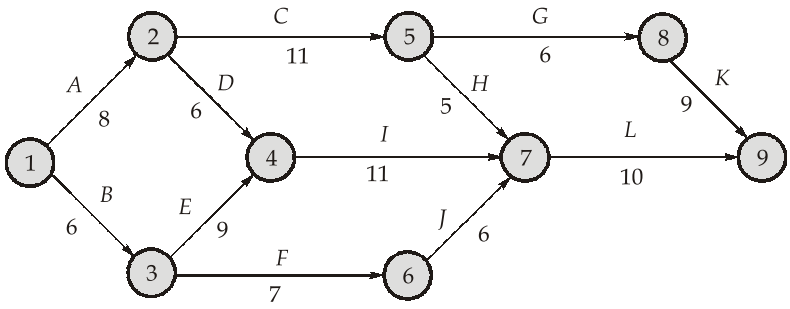
P - Planning
O - Organizing
S - Staffing
D - Directing
CO - Coordinating
R - Reporting
B - Budgeting

48. (c)

Very low $\Rightarrow$ < 10%
Low $\Rightarrow$ 10 – 25%
Moderate $\Rightarrow$ 25 – 50%
High $\Rightarrow$ 50 – 75%
Very high $\Rightarrow$ > 75%

49. (c)

50. (a)



Critical path $1 \rightarrow 3 \rightarrow 4 \rightarrow 7 \rightarrow 9$

$6 + 9 + 11 + 10 = 36$ weeks

51. (d)

→ Tuckman stage,

1. Forming
2. Stormng
3. Norming
4. Performing
5. Adjourning

52. (a)

$$P = \frac{F}{\left(1+\frac{i}{2}\right)^{2\times 5}}$$

$$P = \frac{50000}{(1.07)^{2\times 5}} = \frac{50000}{(1.4)^2} = \frac{50000}{1.96} = ₹25510$$

Note : Semi-annually means money is received two times (once in every 6 months) in a year and a total of 10 times in 5 years.

$\therefore$ $$1 + i_{eff} = \left(1+\frac{i}{12}\times 6\right)^{10} = \left(1+\frac{i}{2}\right)^{10}$$

53. (d)

54. (a)

Conflict resolution	Project Manager	Other Stakeholders
Collaborate/Problem solving	WIN	WIN
Forcing/Compelling	WIN	LOOSE
Accomodating/Smoothing	LOOSE	WIN
Reconcile/Compromise	LOOSE	LOOSE
Avoid/Withdraw	IGNORE	IGNORE

55. (b)

56. (a)

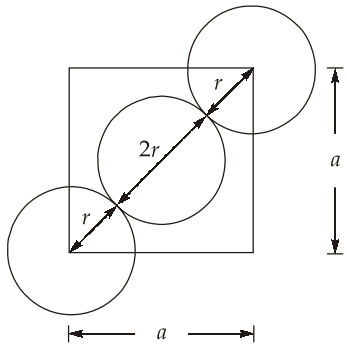
For FCC, number of atoms per unit cell $n = 4$ and $r = \frac{a\sqrt{2}}{4}$, where r is the atomic radius and a is the edge length of the unit cell.

$$\text{Volume of an atom} = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(\frac{a\sqrt{2}}{4}\right)^3$$

$$= \frac{\sqrt{2}\pi}{24}a^3$$

$$\text{APF} = \frac{\text{Volume of atoms}}{\text{Volume of unit cell}}$$

$$= \frac{4 \times \frac{\sqrt{2}\pi a^3}{24}}{a^3} = \frac{\sqrt{2}\pi}{6}$$



57. (c)

Silsbee's rule is related to the critical current in superconductors, which is the maximum current a superconductor can carry without losing its superconducting properties.

$$I_c = 2\pi r H_c$$

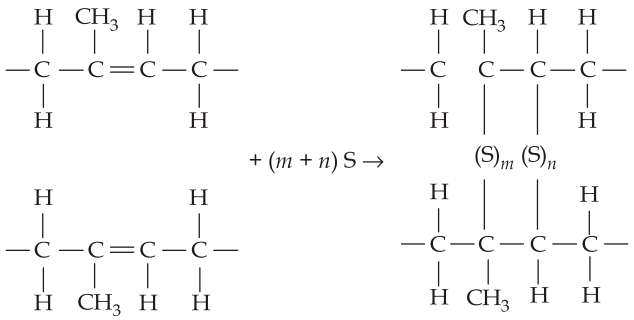
Where, I_c = Critical current

H_c = Critical magnetic field

When, $I > I_c \Rightarrow$ Superconductivity is destroyed.

58. (d)

Vulcanization : The crosslinking process in elastomers is called vulcanization, which is achieved by a nonreversible chemical reaction, ordinarily carried out at an elevated temperature. In most vulcanizing reactions, sulfur compounds are added to the heated elastomer; chains of sulfur atoms bond with adjacent polymer backbone chains and crosslink them, which is accomplished according to the following reaction:



in which the two crosslinks shown consist of m and n sulfur atoms. Crosslink main chain sites are carbon atoms that were doubly bonded before vulcanization but, after vulcanization, have become singly bonded. Unvulcanized rubber, which contains very few crosslinks, is soft and tacky and

has poor resistance to abrasion. Modulus of elasticity, tensile strength, and resistance to degradation by oxidation are all enhanced by vulcanization. The magnitude of the modulus of elasticity is directly proportional to the density of the crosslinks.

59. (c)

The main uses of dielectrics are as follows:
(i) Piezoelectric and electro-optic devices
(ii) In capacitors, resistors and strain gauges,
(iii) Thermionic valves, radiation detectors, electric devices.
(iv) Dielectrics are usually used as insulating materials in power cables, signal cables, electric motors etc.
(v) Dielectrics are used in transformers and various form of switch gear and generators where the dissipation problem of heat is active and a common way of getting rid of it is to insulate with a transformer oil i.e., insulating oil.

60. (a)

White cast iron		Grey cast iron	
1.	Carbon is present in combined from called cementite.	1.	Carbon is present in combined from called graphite.
2.	It is obtained on rapid cooling of molten cast iron.	2.	It is obtained by slow cooling of molten cast iron.
3.	It has low fluidity and it cannot be used in foundry work.	3.	It has high fluidity and is used for foundry work.
4.	It is hard and brittle. It can be machined by grinding.	4.	It can be easily machined.
5.	It has good wear resistance and it is used for ball mills, brakes, rollers and hammer.	5.	It has self-lubricating property and is used in the applications subjected to sliding.
6.	It has no damping capacity.	6.	It has excellent damping capacity.

61. (d)

- A Schottky defect is a type of point defect in a crystal lattice, where an equal number of cations and anions are missing from the lattice sites. It is common in ionic solids where the cations and anions are of similar size, such as alkali halides (e.g., NaCl, KCl, CsCl).
- Silver halides can show Frenkel defects more commonly due to the smaller size of Ag^+, allowing it to easily move into interstitial positions within the crystal lattice, leaving behind vacancies at its original lattice sites.

62. (b)

In *p*-type semiconductors, trivalent impurity atoms replace intrinsic semiconductor atoms, creating holes in the valence band and forming a new acceptor energy level just above it. Electrons from the valence band can easily jump into these acceptor levels with a small amount of energy, leaving behind a larger concentration of holes in the valence band. Thus, the Fermi level lies closer to the top of the valence band, indicating a higher probability of holes than electrons.

63. (d)

Hall coefficient is negative for n-type semiconductor and positive for *p*-type semiconductors. Hall coefficient for metals (eg. copper) is zero.

64. (c)

Addition 1% cadmimum (Cd) to copper improves the strength when used in telephone wires, while the electrical conductivity decreases slightly due to cadmium being an impurity, the improved strength often outweighs this loss.

65. (a)

The dielectric strength for different dielectric materials in decreasing order is given below:
Mica > Glass > Bakelite > Rubber > Polystyrene > Impregnated Paper > Mineral Oil > Air

66. (a)

- A piezoelectric material is a one which generates an electric charge when subjected to mechanical stress.
- All pyroelectric materials are also piezoelectric. not all piezoelectric materials are pyroelectric
- Pyroelectric materials possess a spontaneous electric polarization even in the absence of an external electric field. Thus, it is only found in non-centrosymmetric crystals.

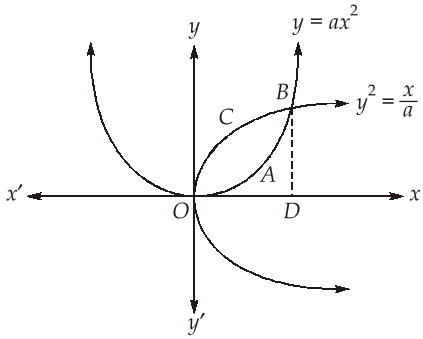
Thus, statements 1 and 2 are correct.

67. (c)

- Aluminium is non-ferrous, paramagnetic and light weight metal.
- It is ductile, making it ideal for cables and conductors.
- Although its conductivity is lower than copper, aluminium is cheaper and still widely used.
- The oxide layer of aluminium is insulator and can weaken soldered joints, and not strengthen them.

68. (b)

As from the figure, area enclosed between the curves is *OABCO*.
The point of intersection of the curves $y = ax^2$ and $x = ay^2$ will be,



$$x = a(ax^2)^2 = x(1 - a^3x^3) = 0$$

$$x = 0, \frac{1}{a}$$

$$\Rightarrow \quad y = 0, \frac{1}{a}$$

So, the points of intersection are (0, 0) and $\left(\frac{1}{a}, \frac{1}{a}\right)$

$$\therefore \quad \text{Required area} = OABCO$$
$$= \text{Area of curve } OCBDO - \text{Area of curve } OABDO$$

$$\Rightarrow \int_0^{\frac{1}{a}} \left(\sqrt{\frac{x}{a}} - ax^2\right) dx = 3$$

$$\left[\frac{1}{\sqrt{a}} \cdot \frac{x^{3/2}}{3/2} - \frac{ax^3}{3}\right]_0^{1/a} = 3$$

$$\frac{2}{3a^2} - \frac{1}{3a^2} = 3$$

$$\frac{1}{3a^2} = 3$$

$$a^2 = \frac{1}{3\times 3}$$

$$a = \frac{1}{3}$$

69. (b)

The characteristic equation is

$$\begin{vmatrix} 2-\lambda & 0 & 1 \\ 0 & 2-\lambda & 0 \\ 1 & 0 & 2-\lambda \end{vmatrix} = 0$$

$$(2-\lambda)^3 - (2-\lambda) = 0$$

$$\Rightarrow \quad (2-\lambda)((2-\lambda)^2 - 1) = 0$$

$$\Rightarrow \quad \lambda = 2 \text{ and } 2-\lambda = \pm 1$$

$$\lambda = 1, 2, 3$$

70. (c)

$$\int_0^1 \frac{dx}{x^{1/3}} = \frac{3}{2}\left[x^{2/3}\right]_0^1 = \frac{3}{2}(\text{Finite})$$

$\therefore$ The integral is convergent.

$$\int_0^\infty x^3 e^{-x} dx = \left[x^3\left(-e^{-x}\right) - 3x^2\left(e^{-x}\right) + 6x\left(-e^{-x}\right) - 6e^{-x}\right]_0^\infty$$

$$= \left[-e^{-x}\left(x^3 + 3x^2 + 6x + 6\right)\right]_0^\infty$$

$$= 6 \text{ (Finite)}$$

$\therefore$ The integral is convergent.

$$\int_1^{\infty} \frac{1}{\sqrt{x}}dx = 2\left[\sqrt{x}\right]_1^{\infty} = \infty$$

$\therefore$ The integral is divergent.

$$\int_1^{\infty} \frac{1}{x^2}dx = -\left[\frac{1}{x}\right]_1^{\infty} = +1 \text{ (Finite)}$$

$\therefore$ The integral is convergent.

71. (d)

We have, $f(x) = [x^4(1-x)]^{1/5}$

LHD, $f'(0^-) = \lim\limits_{h\to 0}\dfrac{f(0)-f(0-h)}{h}$

$$= \lim_{h\to 0}\frac{-\left[h^4(1-h)\right]^{1/5}}{h} = \lim_{h\to 0}\frac{-(1-h)^{1/5}}{h^{1/5}} = -\infty$$

RHD, $f'(0^+) = \lim\limits_{h\to 0}\dfrac{f(0+h)-f(0)}{h}$

$$= \lim_{h\to 0}\frac{\left[h^4(1-h)\right]^{1/5}}{h} = \lim_{h\to 0}\frac{(1-h)^{1/5}}{h^{1/5}} = \infty$$

Here, $f(x)$ is not differentiable at $x = 0$

$\therefore$ Lagrange's mean value theorem cannot be applied and 'c' does not exist.

72. (a)

Rank for 10 participants by two judges as follows:

x	2	7	4	10	3	2	4	9	7	8
y	7	5	8	8	1	2	3	10	5	7

x	y	$d = x - y$	d^2
2	7	–5	25
7	5	2	4
4	8	–4	16
10	8	2	4
3	1	2	4
2	2	0	0
4	3	1	1
9	10	–1	1
7	5	2	4
8	7	1	1
			$\Sigma d^2 = 60$

Rank correlation coefficient is

$$\rho = 1-\frac{6\sum d^2}{n\left(n^2-1\right)}$$

$$= 1-\frac{6\times 60}{10\times\left(10^2-1\right)} = 1-\frac{360}{10\times 99}$$

$$= \frac{21}{33} = 0.636$$

73. (a)

Given : $(D^5 + 1)y = x^6$

$$\text{P.I.} = \frac{1}{\left(D^5+1\right)}x^6 = \left(1+D^5\right)^{-1}x^6$$

$$= (1 - D^5)x^6 = x^6 - 6 \times 5 \times 4 \times 3 \times 2 \times 1x$$

$$= x^6 - 720x$$

74. (b)

Let, $f(t) = L^{-1}\left\{\log\left(\frac{s+1}{s-1}\right)\right\} = L^{-1}\left\{\log(s+1)-\log(s-1)\right\}$

Using multiplication by 't' property

$$tf(t) = L^{-1}\left[-\frac{d}{ds}\left[\log(s+1)-\log(s-1)\right]\right]$$

$$tf(t) = L^{-1}\left[-\frac{1}{s+1}+\frac{1}{s-1}\right]$$

$$tf(t) = \frac{e^t - e^{-t}}{t} = \frac{2\sin ht}{t}$$

75. (a)

Singular points are obtained by putting

$z^2 + 2z + 5 = 0$

$z = -1 + 2i,\ -1 - 2i$ are singular points

But both are lying outside c : $|z| = 1$

$\therefore$ By Cauchy's integral theorem,

$$\int_C \frac{(z+4)}{\left(z^2+2z+5\right)}dz = 0$$

76. (a)

The Newton-Raphson iteration formula is

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

$f(x) = x^2 - N = 0$, where $N = 2$

$$f'(x) = 2x$$

Substituting in equation (i),

$$x_{n+1} = x_n - \frac{(x_n^2 - N)}{2x_n}$$

$$x_{n+1} = \frac{1}{2}\left(x_n + \frac{2}{x_n}\right)$$

77. (d)

$$f(z) = \frac{1}{z-1} - \frac{1}{z-2} \text{ and } |z| > 2$$

Now, $|z| > 2 > 1$

$|z| > 2$ and $|z| < 1$

$\therefore \quad \left|\frac{2}{z}\right| < 1$ and $\left|\frac{1}{z}\right| < 1$

$$f(z) = \frac{1}{z}\left[1-\frac{1}{z}\right]^{-1} - \frac{1}{z}\left[1-\frac{2}{z}\right]^{-1}$$

$$= \frac{1}{z}\left[1+\frac{1}{z}+\frac{1}{z^2}+----\right] - \frac{1}{z}\left[1+\left(\frac{2}{z}\right)+\left(\frac{2}{z}\right)^2+----\right]$$

$$f(z) = (1-1)\frac{1}{z} + (1-2)\frac{1}{z^2} + \left(1-2^2\right)\frac{1}{z^3} + ---$$

$\therefore$ The coefficient of $\frac{1}{z^3} = 1 - 2^2 = -3$

78. (b)

We note that there are 3 consonants *M*, *C* and *T* and 3 vowels E, A and O, Since no two vowels have to be together the possible choice for vowels are the places marked as '□'.

□*M*□*C*□*T*□,

These vowels can arranged in ${}^4P_3$ ways and 3 consonants can be arranged in 3! ways.

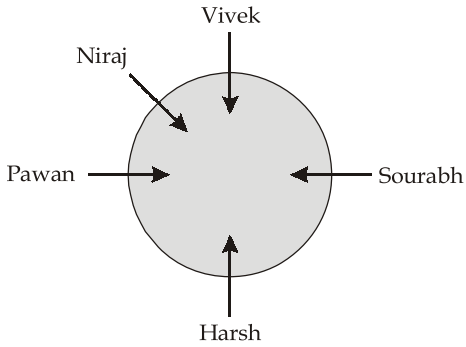
Hence, the required number of ways

$$= 3! \times {}^4P_3 = 3! \times \frac{4!}{1!}$$

$$= 144$$

79. (b)

According to the given information, the final sitting arrangement is as:



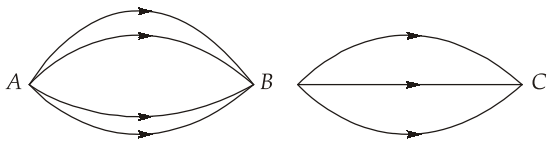
Thus, Vivek is sitting to the immediate right of Sourabh.

80. (c)

The HCF of 44, 121 and 11 is 11.

$\therefore$ The minimum number of rows $= \frac{44}{11}+\frac{121}{11}+\frac{11}{11}=4+11+1=16$

81. (a)



There are 4 bus routes from A to B and 3 routes from B to C. Therefore there are $4 \times 3 = 12$ ways to go from A to C. It is round trip so the man will travel back from C to A via B. It is restricted that man cannot use same bus routes from C to B and B to A more than once. Thus, there are $2 \times 3 = 6$ routes for return journey. Therefore, the required number of ways $= 12 \times 6 = 72$

82. (c)

Rakhi can complete the whole work in $8\times\frac{100}{10}=80$ days

$\therefore$ The efficiency of Rakhi $= \frac{1}{80}$ unit

Since Poonam is 20 percent more efficient than Rakhi, thus

The efficiency of Poonam $= \frac{1}{80}\times\frac{120}{100}=\frac{3}{200}$ unit

$\therefore$ The total efficiency of Rakhi and Poonam together $= \frac{1}{80}+\frac{3}{200}=\frac{11}{400}$

Remaining work $= 1-\frac{1}{10}=\frac{9}{10}$

$\therefore$ Together they can complete the remaining work in $\frac{9}{10}\times\frac{400}{11}=\frac{360}{11}$ days

83. (a)

Given : Both Sourabh and Niraj sell their watch at ₹5000

$$\text{The cost price of Sourabh's watch} = 5000 \times \frac{100}{125} = 4000$$

$$\text{The cost price of Niraj's watch} = 5000 \times \frac{100}{90} = 5000 \times \frac{10}{9}$$

The required ratio, $4000 : \frac{50000}{9}$

$36 : 50$

$18 : 25$

84. (a)

If a number n has exactly three factors, those factors must be 1, some prime number x, and $x^2 = n$.

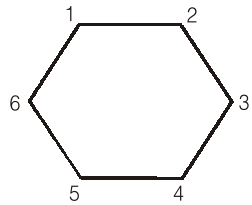
- For $x = 5$ and $x = 7$, we get n as the two digit number, given by 25 and 49. Since $q > p$, hence $p = 25$ and $q = 49$.
- For $x = 2$ and $x = 3$, we get n as the one digit number, given by 4 and 9. Since $r > s$, hence $r = 9$ and $s = 4$.

So, $$\frac{(p-q-1)}{r-s} = \frac{25-49-1}{9-4} = \frac{-25}{5}$$

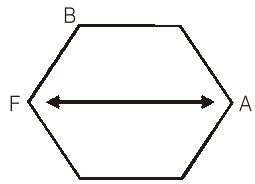
$$= -5 = -4 - 1 = -s - 1$$

85. (a)

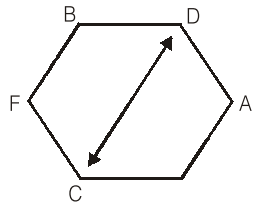
Consider the sitting arrangement as,



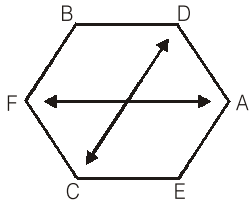
- From the second statement, it is clear that F and A are sitting opposite to each other and F is to the immediate right of B.
  The sitting arrangement can be like this



- From the third statement, it is clear that D is sitting between A and B and is opposite to C.
  The sitting arrangement can be like this



- There is only one vacant position for E, so the overall sitting arrangement will be like this



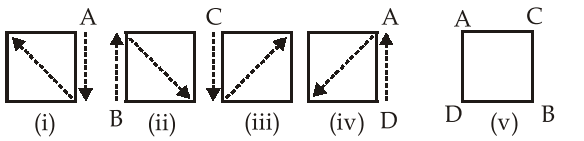
Thus, B and E do not form a group as they are separated by two positions and cannot form a group of three sitting together.

86. (c)

Friends	Colour	Liking
Amar	Yellow	Writing
Kapil	Blue/White/Green	Singing
Servesh	Red	Travelling
Rohan	Blue/White	Reading
Nagesh	White/Green	Playing

87. (a)

The below figures, (i), (ii), (iii) and (iv) show the movements of A, B, C, and D respectively while the new arrangement so obtained is shown in (v). So, the congiruration changes to CBDA.



Final position

88. (d)

W I S K → D R H P
23 9 19 11 → 4 18 8 16

L E N T → O V M G
12 5 14 20 → 15 22 13 7

B A N G → Y Z M T
2 1 14 7 → 25 26 13 20

The alphabetical position of WISK left to right (from A to Z) match with DRHP right to left (from Z to A).

Applying the same logic to BANG, we get YZMT.

89. (d)

mRNA vaccines do not use a live or weakened virus. Instead, they use synthetic messenger RNA that instructs cells to produce a protein (like the spike protein of the coronavirus) to trigger an immune response.

90. (c)

- The Rural Infrastructure Development Fund (RIDF) was set up by the Government in 1995-96 to finance ongoing rural Infrastructure projects.
- The Fund is maintained by the National Bank for Agriculture and Rural Development (NABARD).

91. (b)

92. (d)

Human desire is the fundamental motivation for all human action.

93. (c)

- Biodiversity Coldspots are areas with relatively low species richness compared to biodiversity hotspots, but contain unique species and ecosystems that are important for global biodiversity.
- These regions may support specialized or isolated species adapted to particular conditions and can serve as reservoirs for genetic diversity. For example, The Antarctic region, with its extreme cold and isolation, has unique biodiversity such as penguins, seals, and krill, along with cold-adapted microorganisms and algae.
- Despite its low species diversity, these organisms play a critical role in global ecosystems, especially in carbon cycling, and are highly adapted to their frigid environment.

94. (d)

- The Greenhouse effect is a process where greenhouse gases absorb infrared radiation from the sun and re-emit it in all directions. This process warms the Earth's surface and lower atmosphere Greenhouse gases.
- Water vapour is the most abundant greenhouse gas in the atmosphere. Carbon dioxide is the second most abundant greenhouse gas, playing a major role in human-induced climate change due to fossil fuel burning and deforestation.

95. (a)

96. (c)

- Every smart card has an operating system (OS). The OS is the hardware-specific firmware that provides basic functionality as secure access to on-card storage, authentication and encryption.
- A chip card's operating system (COS) is a sequence of instructions permanently embedded in the Read-Only Memory (ROM) of the smart card.
- COS instructions are frequently used by on-card processes and applications. They provide functions for data and command exchange, data storage, data processing, cryptographic processes and more.

97. (d)

FDMA allocates a dedicated frequency band to each user and TDMA allows multiple users to share the same frequency band by allocating them different time slots. Thus, Time Division Multiple Access (TDMA) can accommodate more users in the same spectrum space than an FDMA system. Thus, statement (II) is false.

98. (d)

Adaptive design : This is a form of design occurs when a known solution is applied to satisfy a different need and a completely new application is produced.

Redesign : This type of design is employed much more frequently. This engineering design is used to improve existing design.

99. (c)

Questionnaires are mainly focussed on the execution part because the quality of construction is majorly misplaced in the execution part.

100. (c)

In a metallic bond, the valence electrons of metal atoms are delocalized and are free to move throughout the entire metallic lattice. After the metal atoms lose their valence electrons (which become delocalized), they become positively charged ions. The metallic bond arises from the electrostatic attraction between this sea of negatively charged delocalized electrons and the lattice of positively charged metal ions.