IES MASTER

Institute for Engineers (IES/GATE/PSUs)

ESE 2024 Prelims Exam

Paper - I

GENERAL STUDIES & ENGINEERING APTITUDE

Detailed Solution

(SET-D)

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The colour of the Questions show the difficulty level of questions as per below mentioned colour code:

- Easy
- Moderate
- Hard

1. Match the following lists:

	List-I		List-II
P.	Lamarck	1.	Evolutionary theory
Q.	Lyell	2.	Gradual geological processes have gradually shaped Earth's surface
R.	Malthus	3.	Human population grow faster than the resources they depend on
S.	Wallace	4.	Inheritance of acquired characteristics

Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	1	4	3
(b)	4	2	3	1
(c)	1	4	3	2
(d)	4	3	1	2

Ans. **(b)**

Sol. Lamarck's thinking has long been characterized (and caricatured) through his examples of the inheritance of acquired characters. Hence, Lamarck is related to inheritance of acquired characters.

Charles Lyell's Theory of Uniformitarianism states that the processes by which current geological features were created were slow, steady, and constant. These forces, processes, and patterns have always been and will always be present on the earth.

Malthusian theory explained that the human population grows more rapidly than the food supply until famines, war or disease reduces the population. Hence, Malthus is related to Population growth.

S Wallace was the first person to conceive the theory of evolution through natural selection.

2. What is Chaparral?

(a) Chaparrals are plants that grow on other plants.

(b) Chaparral is a shrub forest biome dominated by densely-growing evergreen shrubs or small trees, such as scrub oak.

(c) Chaparrals are temperate biomes that consists mainly of grasses

(d) Chaparrals are aquatic organisms that live on the surface below a body of water

Ans. **(b)**

Sol. Chaparral is sclerophyllous vegetation that is tolerant of seasonal drought. It consists of small trees (Shrubs), woody grasses and oleose, xerophytic shrubs that form a nearly continuous cover of intertwined branches.

3. The expression of the ability of surfaces to reflect sunlight is known as

(a) the albedo effect

(b) the greenhouse effect

(c) the genshin effect

(d) the permafrost

Ans. **(a)**

Sol. Albedo is the reflectivity of a surface. A surface that has a high albedo reflects a lot of solar radiation from the sun back into the atmosphere.

4. Which one of the following refers to efforts to tailor thousands of items such as cars or hamburgers to specific customers' needs?

(a) Miniaturization

(b) Mass customization

(c) Reactive mode

(d) Fire-fighting

Ans. **(b)**

Sol. Mass customization is a business strategy that aims to produce goods and services that meet individual customer needs with near-mass production efficiency. It involves creating products or services that are tailored to the specific needs and preferences of individual customers. This means allowing customers to personalize various aspects of the product, such as design, features, colors, sizes and configurations.

5. Which one of the following is associated with developing a qualitative and/or quantitative evaluation of how changes to system inputs affect system outputs?

(a) Define (b) Measure
(c) Analyze (d) Control

Ans. **(c)**

Sol. In evaluation process we analyse the output of system for variable inputs.

6. Consider the following advantages of p-charting method:

1. Requires only go-no-go data, intuitive.
2. No requirement for pre-tested "standard" units.
3. Accounts for all errors including systematic errors.

Which of the above advantages is/are correct?

(a) 1 only (b) 2 only
(c) 1 and 2 (d) 2 and 3

Ans. **(c)**

Sol. Systematic errors are related to trends for which actual dimension is to be measured which we don't do in p chart.

7. Which one of the following is an example of discrete random variables?

(a) Triangular Distribution
(b) Normal Distribution
(c) Central Limit Theorem
(d) Negative Binomial Distribution

Ans. **(d)**

8. Almost all the quality control problems can be solved if the following conditions for manufacturing the product are met:

1. The quality characteristics are within the appropriate specification tolerance limits determined based on customers' requirements.
2. The variability of the quality characteristics is minimized as much as possible.
3. The mean of each quality characteristic is as close as possible to the target value of the characteristic.

Which of the above conditions are correct?

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Ans. **(d)**

9. The manufacturing cost of the components will decrease as a result of using the probabilistic relationship because

(a) manufacturing cost decreases as the tolerance on the quality characteristic decreases
(b) manufacturing cost decreases as the tolerance on the quality characteristic increases
(c) manufacturing cost remains constant as the tolerance on the quality characteristic increases
(d) manufacturing cost increases as the tolerance on the quality characteristic increases

Ans. **(b)**

10. It is important to carefully identify the needs and expectations of the customer prior to beginning the design of mechanical device. One of the step in formulating usually quantitative statements of expected performance levels, environmental conditions in which the device must operate, limitations on space or weight, or

available materials and components that may be used. These are part of which one of the following elements of design?

(a) Functions

(b) Evaluation criterias

(c) Design requirements

(d) Drawings

Ans. **(c)**

Sol. Design requirements are specifications or criteria that outline the desired characteristics, performance levels, and constraints of a mechanical device. These requirements serve as guidelines for the design process and help ensure that the final product meets the needs and expectations of the customer.

11. Why Delphi method of demand forecasting appeals to many organizations?

(a) The biases underlying are subjective, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings.

(b) It is intelligible to users, it is a fancy name, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings.

(c) It has immense appeal, the biases underlying are subjective, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings.

(d) It is an expedition's method, it has immense appeal, and it seems to be more accurate and less expensive than the traditional face-to-face group meetings.

Ans. **(c)**

12. Consider the following statements regarding metallic bonding:

1. The metallic sharing changes with time and the bonding electrons resonate between different atoms.
2. The metallic state can be visualized as an array of positive ions, with a common pool of electrons to which all the metal atoms have contributed their outer electrons.
3. These electrons have freedom to move anywhere within the crystal and act like an all-pervasive, mobile glue holding the ion cores together.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(d)**

Sol. The valence electrons are not bound to any particular atom in the solid and are more or less free to drift throughout the entire metal. They may be thought of as belonging to the metal as a whole or forming a "sea of electrons" or an "electron cloud."

These free electrons act as a 'glue' to hold the ion cores together.

13. Consider the following statements regarding phase diagram rules for the crystal:

1. According to the Gibbs phase rule, the degree of freedom, (F) = Number of components (C) + Number of phases (P) + 2.
2. The tie-line rule is applied to determine the compositions of two co-existing phases in a binary phase diagram.
3. In the lever rule, the tie-line at the temperature of interest is treated as a lever arm, with the fulcrum at the overall composition.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(c)**

Sol. According to the Gibbs phase rule, P + F = C + 2,

14. Consider the following statements regarding effect of minor elements on steel properties:

1. Sulphur is present in steel either as iron sulphide or manganese sulphide and during the rolling or forging of steel, iron sulphide present in steel gets cracked/teared.
2. Silicon, in the form of ferrosilicon, is used widely as a deoxidant due to its low cost and high efficiency.
3. Silicon opposes the presence of iron oxide (FeO) which is very much detrimental to properties of steel.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(d)**

Sol. During solidification, iron sulfide (FeS) can promote granular weaknesses and lead to cracks in the steel.

Silicon, in the form of ferrosilicon, is used widely as a deoxidant.

Silicon opposes the presence of iron oxide (FeO) which is very much detrimental to properties of steel.

15. Consider the following statements regarding cast iron:

1. Gray cast irons can be classified depending on the shape of graphite that may be present in the form of either flakes or globules.
2. A class of cast iron known as Malleable obtained by treating molten metal by calcium silicide.
3. Meehanite cast irons have graphite nodules but are produced by heat treating white cast irons.

Which of the above statements are NOT correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(a)**

Sol. Gray cast irons can be classified depending on the shape of graphite that may be present in the form of either flakes or globules.

Meehanite cast irons have graphite nodules but are NOT produced by heat treating white cast irons.

16. Consider the following statements regarding the characteristics of covalent compounds and covalent solids:

1. Covalent compounds are soluble in paraffins.
2. Covalent solids do not form closed-packet structures because the covalent bonds are very strong and rigid.
3. The simplest covalent structure is that of diamond which is fairly open and empty and far from close-packed.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(a)**

Sol. Non-polar Covalent compounds are soluble in paraffins.

Covalent solids do not form closed-packed structures because the covalent bonds are non-directional, very strong and rigid.

Structure of Diamond is three-dimensional tetrahedral lattice and hence it is NOT the simplest covalent structure. However, the structure is open and empty and far from close-packed.

17. Consider the following statements regarding the gas carburizing:

1. Case depth can be obtained accurately.
2. More floor space is required than pack carburizing.
3. Process is rapid as less time is required than in pack carburizing.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(d)**

Sol. In gas carburizing, compared to pack carburizing,

- Case depth can be obtained more accurately.
- More floor space is required.
- Process is rapid.

18. Which one of the following statements is NOT correct regarding thermal mass?

(a) In solar buildings, it reduces temperature variations between day and night
(b) It is useful in ordinary buildings as it serves as a reservoir or sink for both heating and cooling
(c) It provides a means of storing the solar energy that enters through the windows
(d) The heavier a material is available, then the less thermal mass is available.

Ans. **(d)**

Sol.

- In solar buildings, it reduces temperature variations between day and night.
- Useful in ordinary buildings as it serves as a reservoir or sink for both heating and cooling.
- Provides a means of storing the solar energy that enters through the windows.
- The heavier a material is available the more thermal mass is available.

19. Consider the following statements about ethanol:

1. Ethanol is primarily produced from corn and sugarcane.
2. Ethanol provides a major part of the liquid fuel requirement in Brazil.
3. The production of ethanol accounts for around 90% of the production of biofuels in the world.

Which of the above statements is/are correct?

(a) 1, 2 and 3 (b) 2 and 3 only
(c) 3 only (d) 1 and 2 only

Ans. **(d)**

Sol. Statement 1 is true. Ethanol is indeed primarily produced from crops like corn and sugarcane, which are rich in sugars that can be fermented to produce ethanol.

Statement 2 is also true. Ethanol does provide a significant portion of Brazil's liquid fuel requirement, especially in the form of ethanol blended with gasoline in flex-fuel vehicles.

Statement 3, however, is not accurate. While ethanol production is a significant contributor to biofuel production globally, it does not account for around 90% of all biofuel production. Therefore, option a is incorrect.

20. Which one of the following statements is NOT correct regarding carbon dioxide?

(a) Carbon dioxide is given off when dead organisms and other organic materials decompose
(b) When volcanoes erupt, they give off carbon dioxide that is stored in the mantle
(c) Ocean water releases dissolved carbon dioxide into the atmosphere when water temperature rises.
(d) A good amount of carbon in the atmosphere is present as methane gas

Ans. **(d)**

Sol.

- Carbon dioxide is given off when dead organisms and other organic materials decompose.
- Burning organic material, such as fossil fuels, releases carbon dioxide.
- When volcanoes erupt, they give off carbon dioxide that is stored in the mantle.
- Carbon dioxide is released when limestone is heated during the production of cement.

- Ocean water releases dissolved carbon dioxide into the atmosphere when water temperature rises.

21. What are the functions of axles?

(a) Support the weight of the mower. Permit easy, rolling movement. Provide for mounting on an axle. Ensure safe operation on flat or sloped lawn surfaces.

(b) Support, safely enclose, and protect operating components, including the blade and motor. Accommodate the attachment of two axles and a handle. Permit cut grass to exit the cutting area.

(c) Cut blades of grass and weeds while rotating at high speed. Facilitate connection to motor shaft. Operate safely when foreign objects are encountered, such as stones, sticks, or metal pieces.

(d) Transfer the weight of mower from the housing to the wheels. Allow rotation of the wheels. Maintain location of the wheels relative to the housing.

Ans. **(d)**

22. Which one of the following is/are used for drawing curves which cannot be drawn with a compass?

(a) Scale (b) Protractor

(c) French curves (d) Set square

Ans. **(c)**

Sol. French curves are used for drawing curves having different radius and curvature at different points and therefore can be used for drawing curves which cannot be drawn with a compass.

23. A plane, extended if necessary, will meet the reference planes in lines, unless it is parallel to any one of them. These lines are called

(a) Projection lines (b) Traces of the plane

(c) Dimension lines (d) Imaginary lines

Ans. **(b)**

Sol. A plane when extended cuts the principal planes of projection in two different lines. These lines are called Traces of the planes, Horizontal trace (HT) and Vertical trace (VT).

24. Which of the following are the methods for determining the line of intersection between surfaces of two interpenetrating solids?

(a) Line method and cutting plane method

(b) Line method and box method

(c) Co-ordinate method and cutting plane method

(d) Co-ordinate method and box method

Ans. **(a)**

Sol. Line method and Cutting plane method are used for determining the line of intersection between surfaces of two interpenetrating solids.

25. Which one of the following is used for pyramids and cones in which the true length of the slant edge or the generator is used as radius?

(a) Parallel-line development

(b) Radial-line development

(c) Triangulation development

(d) Approximate method

Ans. **(b)**

Sol. Pyramids and Cones are developed using Radial line development method.

26. Consider the following statements regarding the Global peace Index 2023:

1. Iceland has retained its position as the most peaceful country since the inaugural study in 2008.
2. Five out of the top 10 most peaceful countries in the world are located in Europe.

Which of the above statements is/are NOT correct?

(a) Both 1 and 2 (b) 1 only
(c) 2 only (d) Neither 1 nor 2

Ans. **(a)**

Sol. **Global Peace Index 2023 Highlights:**

Iceland is the most peaceful country in the world – a title it has held since 2008. It is accompanied at the top by Denmark, Ireland, New Zealand, and Austria. The top 10 countries in the Index are Iceland, Denmark, Ireland, New Zealand, Austria, Singapore, Portugal, Slovenia, Japan.

Hence, both the statements are true.

27. Consider the following statements regarding Henley Passport Index 2023:

1. Japan holds the title of the world's most powerful passport, granting visa-free access to 192 out 227 global travel destinations.
2. Three European countries, namely Germany, Italy, and Spain, share the second position, with visa-free access to 190 destinations.

Which of the above statements are NOT correct?

(a) Both 1 and 2 (b) 1 only
(c) 2 only (d) Neither 1 nor 2

Ans. **(c)**

Sol. **Henley Passport Index:**

Runners-up: Germany, Italy, and Spain share the second position on the index.

Statement 1 is false as Singapore now holds the most powerful passport in the world, granting its citizens visa-free access to an impressive 192 travel destinations out of 227 worldwide. Japan previously held the top spot on the Henley Passport Index for five years.

Statement 2 is true as Germany, Italy, and Spain share the second position on the index.

28. Consider the following statements:

1. India's Goods and Service Tax collection for the month of June 2023 reached ` 1.61 trillion, according to the Ministry of Finance.
2. India received its highest-ever FDI inflow of US$83.57 billion in the fiscal year 2021-2022.
3. The net direct tax collection in the current fiscal year has withnessed a significant growth of 16%, reaching ` 4.75 lakh crore, indicating a surge in economic activity.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(a)**

Sol. India collected Rs 1.61 lakh crore Goods and Services Tax (GST) for the month of June, registering growth of 12%. Hence, Statement 1 is correct.

As per PIB: India gets the highest annual FDI inflow of USD 83.57 billion in FY21-22India rapidly emerges as a preferred investment destination; FDI inflows have increased 20-fold in last 20 years. Hence, Statement 2 is correct.

India's net direct tax collection grows 15.87% to Rs 4.75 lakh crore till July 9th. The statement is mentioning about the tax collection in the current financial year. As of Feb the net direct tax collection reached Rs 15.6 lakh crore. Hence, Statement 3 is Wrong.

29. Consider the following statements regarding Hemis Festival:

1. The Hemis Festival in Ladakh is a renowned religious celebration.
2. The Hemis Festival is dedicated to the birth anniversary of Lord Padmasambhava.
3. Hemis festival offers a mesmerizing experience of Tibetan Tantric Buddhism.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans. **(d)**

Sol. Hemis Festival in Ladakh is celebrated on the 10th day of the fifth month in the Tibetan calendar, usually falling in June or July of the Gregorian calendar. The festival honors the birth of Guru Padmasambhava, also known as Rinpoche, who played a crucial role in spreading Buddhism in the Himalayan region.

30. Ministry of Defence signed contract with which one of the following organizations for Upgraded Super Rapid gun Mount (SRGM) and other equipments for around 3000 crores?

(a) DRDO (b) BHEL

(c) ISRO (d) BEL

Ans. **(b)**

Sol. BHEL has signed a contract of Rs. 2956.89 Crore with the Ministry of Defence (MoD) for the supply of 16 Upgraded Super Rapid Gun Mounts (SRGM). These will be installed on both in-service and newly built ships of the Indian Navy and will be manufactured at the Haridwar unit.

31. Which of the following tests are suggested by Philosopher Michael Davis that rely on our commonsense morality, but also reflect some of the concepts in moral theories or approaches?

(a) Harm Test, Publicity Test, Defensibility Test, Reversibility Test, Virtual Test, Professional Test, Colleague Test and Organization Test

(b) Defensibility Test, Reversibility Test, Virtue Test, Professional Test, Colleague Test, Heat Test, Organism Test and Purity Test

(c) Purity Test, Defensibility Test, Reversibility Test, Professional Test, Colleague Test, Heat Test, Organism and Virtue Test

(d) Defensibility test, heat test principal test, reversibility test virtue test, professional test, Organism Test and Colleague Test

Ans. **(d)**

32. If a utilitarian approach requires that we maximize well-being, how should we go about determining the criteria we should use in seeking this maximization? One approach that has appeal from the engineering perspective is CBA, which holds that the course of action that produces the greatest benefit or utility relative to cost should be chosen. What is the full form of the term CBA?

(a) Cost Benefit Approach

(b) Competitive Benefit Approach

(c) Competitive Benefit Analysis

(d) Cost Benefit Analysis

Ans. **(d)**

33. Joshua B. Kardon presents "an engineer is not liable, or responsible, for damages for every error. Society has decided, through case law, that when you hire an engineer, you buy the engineers normal errors. However, if the error is shown to have been worse than a certain level of error, the engineer is liable". That level, the line between non-negligent and negligent error is called

(a) Engineering Judgement

(b) Normal Distribution

(c) Standard of Care

(d) Performance Relative Standard

Ans. **(c)**

34. According to Black's Law Dictionary, the law treats the corporation itself as a person which can

(a) monitor (b) maintain
(c) sue and be sued (d) give response

Ans. **(c)**

35. Those who drive automobiles are familiar with blind spots. Applying this term to organizational and business arenas, Dennis Moberg draws an analogy between business blind spots and those we experience when driving. Blind spot is one of the significant common impediments to responsibility. Which one of the following is NOT the method under Blind Spot?

(a) Self-deception
(b) Willful blindness
(c) In-attentional blindness
(d) Illusion of invulnerability of group

Ans. **(d)**

Sol. The method that is not typically associated with the concept of blind spot, as described in the analogy between business blind spot and driving blind spot is -

Illusion of invulnerability of group (member of group ignore obvious danger)

Option (d)

36. Which one of the following is NOT a factor for large scale diversification into unrelated areas by some of the industry Conglomerate in India?

(a) Restriction in growth in the existing line of business
(b) Policies with respect to imports, duties, pricing, and reservations
(c) Opening up of newer areas of investments
(d) Desire not to avail tax incentives

Ans. **(a)**

37. Boston Consulting Group, the BCG matrix classifies the various businesses in a firm's portfolio on the basis of

(a) Relative Share and Relative Growth Rate
(b) Relative Market Share and Sub-stantial Market Share
(c) Relative Market Share and Relative Market Growth Rate
(d) Substantial Growth Rate and Relative Market Growth Rate

Ans. **(c)**

Sol. The BCG Matrix is one of the most popular portfolio analysis methods. It classifies a firm's product and/or services into a two-by-two matrix. Each quadrant is classified as low or high performance, depending on the relative market share and market growth rate.

38. What are the factors that contribute to decline in unit cost with respect to the accumulated volume of production?

(a) Pioneering stage, Rapid growth stage, and Economies of scale stage
(b) Learning effects, Technological improvements, and Economies of scale
(c) Technological improvements stage, Maturity stage, and Decline stage
(d) Pioneering stage, Rapid growth stage, and Decline stage

Ans. **(b)**

Sol. The factor that contribute to a decline in unit cost with respect to the accumulated volume of production are -

(b) Learning effects, technological improvements and economics of scale.

39. Consider the following statements:

The broad areas of corporate appraisal and the few important aspects to be considered under them are

1. Marketing and Distribution
2. Production and Operation

3 Research and Development

4. Project Rating

Which of the above statements are correct?

(a) 1, 2, 3 (b) 2, 3, 4

(c) 1, 2, 4 (d) 1, 3, 4

Ans. **(a)**

Sol. Project rating is not typically considered as one of the broad areas of corporate appraisal, its more specific to evaluating individual projects rather than assessing overall corporate performance.

40. Which one of the following methods is an important qualitative method under demand forecasting?

(a) Jury of Executive Method

(b) Trend Projection Method

(c) Chain Ratio Method

(d) Bass Diffusion Method

Ans. **(a)**

Sol. The jury of executive method also known as the executive opinion method, is a qualitative for casting method where a group of experts or executive within an organization collectively provide their opinion and judgements regarding future demand.

41. Which of the following cities achieved the Guinness World Records by constructing Single Lane Bituminous Concrete Road and Longest Double Decker Viaduct with Highway Flyover & Metro Rail?

(a) Amravati and Nagpur

(b) Mumbai and Ahmedabad

(c) Hyderabad and Bangalore

(d) Gautam Buddha Nagar and Ghaziabad

Ans. **(a)**

Sol. Union Minister for Road Transport and Highways Shri Nitin Gadkari announced today New Guinness World Record created by NHAI in laying 75 km of bituminous concrete in a single lane on NH53 (between **Amravati and Akola**) in 105 hours and 33 minutes.

Guiness Records for World Longest Double Decker Viaduct - **Nagpur Metro** The longest double decker viaduct (metro) is 3,140 metres and was achieved on the Wardha Road in Nagpur, India, opened by the Maharashtra Metro Rail Corporation Limited on 30 November 2022.

42. Which one of the following Institutions launched Centre of Data for Public Good (CDPG) for multidisciplinary research, bringing together experts from academia, industry and Government to harness the power of data to benefit the public

(a) IISc (b) IIT Madras

(c) DRDO (d) NITI Aayog

Ans. **(a)**

Sol. In a significant move towards utilizing data for social benefit, the Foundation for Science Innovation and Development (FSID) at the Indian Institute of Science (IISc) has introduced the Centre of Data for Public Good (CDPG). This initiative is dedicated to advancing research, innovation, collaboration, and best practices in the domains of data science, analytics, and policy to tackle critical societal challenges.

43. Astrosat space telescope has crossed a major milestone by detecting 600th Gamma-Ray Burst launched by which one of the following countries?

(a) USA (b) Russia

(c) China (d) India

Ans. **(d)**

Sol. India's AstroSat space telescope has reached a significant milestone by detecting its 600th Gamma-Ray Burst (GRB), showcasing the sustained performance of its Cadmium Zinc Telluride Imager (CZTI) eight years post-launch.

44. Which one of the following ships does NOT come under Indian Navy's eight ASW Shallow Water Craft project?

(a) Mahanav (b) Mahe
(c) Malvan (d) Mangrol

Ans. **(a)**

Sol. The Cochin Shipyard unveiled the first three of eight Anti-Submarine Warfare (ASW) shallow watercrafts commissioned for the Indian Navy - **INS Mahe, INS Malvan, and INS Mangrol.** The ships were launched with invocations of the Atharvaveda**.**

45. Which Union Ministry announced '5G & beyond Hackathon 2023' aimed at shortlisting India-focused cutting-edge ideas workable beyond products and solutions?

(a) Ministry of Science and Technology
(b) Ministry of Communication
(c) Ministry of Micro, Small and Medium Enterprises
(d) Ministry of Electronics and Information Technology

Ans. **(b)**

Sol. Department of Telecommunications has been conducting Hackathons for the development of 5G products and solutions. This culminated in the development of 5G products/solutions in different technological verticals. DoT Comes under Ministry of Communication

46. "Scheme for expansion and Moderisation of Fire Services in the States" from the allocation of preparedness and Capacity Building Funding Window under the National Disaster Response Fund for stregnthering fire services in the states was introduced by which Union Ministry?

(a) Ministry of Family and Health Affairs
(b) Ministry of Youth Affairs and Sports
(c) Ministry of Defence
(d) Ministry of Home Affairs

Ans. **(d)**

Sol. The Government has launched a "Scheme for Expansion and Modernization of Fire Services in the States" on 04.07.2023 from the earmarked allocation of Rs. 5,000 Crore of Preparedness and Capacity Building Funding Window under the National Disaster Response Fund (NDRF) for strengthening fire services in the States for the period up to 2025-26. It is implemented by Ministry of Home affairs. Also, to note Disaster management division is under Ministry of Home affairs.

47. Aim of exercise "Normadic Elephant' is to build positive military relations, exchange best practices, develop inter operability, bonhomie, camaraderic and friendship between India and which one of the following countries?

(a) Bangladesh (b) Mongolia
(c) Botswana (d) Sourth Africa

Ans. **(b)**

Sol. India and Mongolia recently participated in 15th edition of the joint military exercise called 'Nomadic Elephant 2023.' This annual training event serves as a platform for India and Mongolia to enhance their military cooperation, foster bilateral relations, and strengthen regional security.

48. Which one of the following is associated with 'SPRINT Challenges' aimed at giving a boost to the usage of 75 new indigenous technologies/ products in collaboration with Innovations for Defence Excellence, NIIO and Technology Development Acceleration Cell?

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(a) India Coast Guard (b) Indian Air force
(c) Indian Army (d) Indian Navy

Ans. **(d)**

Sol. The 'SPRINT Challenges', are aimed at giving a boost to the usage of indigenous technology in the Indian Navy, and the Navy is committed to developing at least 75 technologies/ products as part of the 'Azadi ka Amrit Mahotsav'.

49. To increase the transparency and consumer awareness and handle the customer complaint a 'Centralised Receipt and Processing Centre' and 'Integrated Ombudsman Scheme' has been set up, these two schemes are related to which one of the following institutions?

(a) NITI Aayog (b) DPIIT
(c) ISRO (d) RBI

Ans. **(d)**

Sol. Reserve Bank of India has established the Centralised Receipt and Processing Centre (CRPC) at Chandigarh for receipt of the complaints Pan India.

50. These days V-CIP is simple, safe and secure. You can complete your V-CIP from wherever you are in India, you only need you PAN card and Aadhar card. Then, what is the full form of the term "V-CIP"?

(a) Venture Capital Identification Process
(b) Venture Capital Investment Process
(c) Voice based Customer Identification Process
(d) Video based Customer Identification Process

Ans. **(d)**

Sol. V-CIP(Video based customer Identification Process) is an alternate method of customer identification with facial recognition and customer due diligence by authorized official of bank. The procedure is approved by RBI. It is paperless, contactless online facility available to customers to complete KYC within just few minutes.

51. The standard deviation of the exponential distribution of

$$f_X(x) = \begin{cases} \lambda e^{-\lambda x}, & x \geq 0 \\ 0, & x < 0 \end{cases}$$ is

(a) $\frac{1}{\lambda}$ (b) $\frac{2}{\lambda^2}$
(c) $\frac{3}{\lambda^3}$ (d) $\frac{2}{\lambda^3}$

Ans. **(a)**

Sol. Standard deviation $= \sigma$

Variance $V(x) = \sigma^2$

$$\frac{1}{\lambda^2} = \sigma^2$$

$$\boxed{\sigma = \frac{1}{\lambda}}$$

52. Suppose that 0.1% of the people in a certain area have a disease D and that a mass screening test is used to detect cases. The test gives either a positive or a negative result for each person. Ideally, the test would always give a positive result for a person who has D, and would never do so for a person who has not. In practice the test gives a positive result with probability 99.9% for a person who has D, and with probability 0.2% for a person who has not. What is the probability that a person for whom the test is positive actually has the disease?

(a) $\frac{1}{3}$ (b) $\frac{5}{3}$
(c) $\frac{4}{3}$ (d) $\frac{2}{3}$

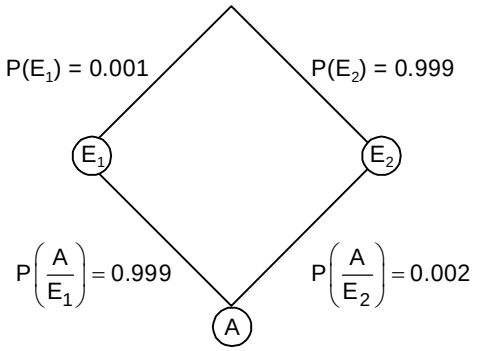
Ans. **(a)**

Sol. $E_1 \rightarrow$ Event of selected person have disease

$E_2 \rightarrow$ Event of selected person have not disease

A $\rightarrow$ The person tested positive

Flow diagram



$$P\left(\frac{E_1}{A}\right) = \frac{P(E_1)\times P\left(\frac{A}{E_1}\right)}{P(E_1)\times P\left(\frac{A}{E_1}\right)+P(E_2)}$$

$$= \frac{0.001\times 0.999}{0.001\times 0.999+0.999\times 0.002}$$

$$= \left(\frac{0.000999}{0.002997}\right)$$

$$= 0.3333$$

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

53. Let the random variables X and Y have joint density function given by

$$f_{X,Y}(x,y) = \begin{cases} c(1-y), & 0 \le x \le y \le 1 \\ 0, & \text{otherwise} \end{cases}$$

Then the marginal density function for X is

(a) $f_X(x) = 6\left(\frac{1}{2} - x - \frac{x^2}{2}\right)$ for $0 \le x \le 1$

(b) $f_X(x) = 6\left(\frac{1}{2} + x + \frac{x^2}{2}\right)$ for $0 \le x \le 1$

(c) $f_X(x) = 6\left(\frac{1}{2} + x - \frac{x^2}{2}\right)$ for $0 \le x \le 1$

(d) $f_X(x) = 6\left(\frac{1}{2} - x + \frac{x^2}{2}\right)$ for $0 \le x \le 1$

Ans. **(d)**

Sol. If f(x, y) is a valid distribution function then

$$\int_0^1\int_x^1 C(1-y)\,dydx = 1$$

$$\int_0^1 C\left(\int_x^1 (1-y)\,dy\right)dx = 1$$

$$\int_0^1 \left(y - \frac{y^2}{2}\right)_x^1 dx = 1$$

$$C\int_0^1\left(\frac{1}{2} - \left(x - \frac{x^2}{2}\right)\right)dx = 1$$

$$C\int_0^1\left(\frac{x^2}{2} - x + \frac{1}{2}\right)dx = 1$$

$$C\left(\frac{x^3}{6} - \frac{x^2}{2} + \frac{x}{2}\right)_0^1 = 1$$

$$C\left(\frac{1}{6} - \frac{1}{2} + \frac{1}{2}\right) = 1$$

C = 6

Marginal density function

$$f(x) = \int_{y=x}^1 6(1-y)\,dy$$

$$= 6\left(y - \frac{y^2}{2}\right)_x^1$$

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

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

54. The continuous-time signal $f(t) = e^{-2\omega t}$, where ω is the real constant, is sampled when $t \ge 0$ at intervals T. What is the z transform of the resulting sequence of samples?

(a) $\frac{z}{z - e^{-2\omega T}}$

(b) $\frac{z}{1 - e^{-2\omega T}}$

(c) $\frac{z}{z - e^{-\omega T}}$

(d) $\frac{z}{z - e^{2\omega T}}$

Ans. **(a)**

Sol. Given continuous time signal is

$$f(t) = e^{-2\omega t}u(t)$$

Laplace transform of f(t) is

$$f(s) = \frac{1}{s+2\omega}$$

According to impulse-invariant transformation

$$H(s) = \frac{1}{s+a} \Rightarrow H(z) = \frac{z}{z-e^{-aT}}$$

In given problem

$$f(s) = \frac{1}{s+2\omega} \Rightarrow f(x) = \frac{z}{z-e^{-2\omega}}$$

Option (a) is correct.

55. If $(z) = \frac{z}{z^2-z+1}$, then the inverse z transform of Y(z) is

(a) $\sqrt{\frac{1}{3}}\sin\frac{1}{3}k\pi$ (b) $2\sqrt{\frac{1}{3}}\sin\frac{1}{3}k\pi$

(c) $2\sqrt{\frac{1}{3}}\cos\frac{1}{3}k\pi$ (d) $2\sqrt{\frac{1}{3}}\sin k\pi$

Ans. **(b)**

Sol.

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

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

$$= \frac{\frac{1}{z}}{1-\frac{1}{z}+\frac{1}{z^2}}$$

$$= \frac{z^{-1}}{1-z^{-1}+z^{-2}}$$

$$= \frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{2}\left[\frac{z^{-1}}{1-z^{-1}+z^{-2}}\right]$$

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

$$= \frac{2}{\sqrt{3}}\left(\frac{\sin\frac{\pi}{3}z^{-1}}{1-2\cos\frac{\pi}{3}+z^{-2}}\right)$$

$$= \frac{2}{\sqrt{3}}\left(\sin\frac{\pi}{3}n\right)u(n)$$

$(U_n = 1)$

56. The temperature distribution T(x) at a distance x, measured from one end, along a bar of length L is given by $T(x) = Kx(L-x)(0 \le x \le L), K$ = constant. A Fourier series expansion consisting of sine terms only for T(x) is

(a) $\frac{8KL^2}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^3}\sin\frac{(2n-1)\pi x}{L}$

(b) $\frac{8KL^2}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}\sin\frac{(2n-1)\pi x}{L}$

(c) $\frac{8KL^3}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^3}\sin\frac{(2n-1)\pi x}{L}$

(d) $\frac{8KL^3}{\pi^3}\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}\sin\frac{(2n-1)\pi x}{L}$

Ans. **(a)**

Sol. T(x) = $T(x) = \{Kx(L-x) \quad (0 \le x \le L), K$

Fourier series expansion consisting since terms only

$$= \sum_{n=1}^{\infty} bn \sin\left(\frac{n\pi x}{L}\right)$$

$$bn = \frac{2}{L}\int_0^L f(x)\sin\left(\frac{n\pi x}{L}\right)dx$$

$$= \frac{2}{L}\int_0^L Kx(1-x)\sin\left(\frac{n\pi x}{L}\right)dx$$

$$= \frac{2K}{L}\left[\frac{-2L^3}{n^3\pi^3}\cos n\pi + \frac{2L^3}{n^3\pi^3}\right]$$

When n is odd (n = 2n – 1)

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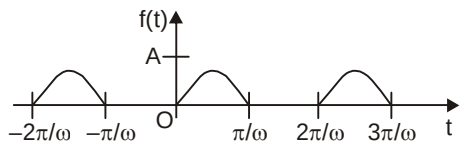
$$bn = K\left(\frac{8L^2}{(2n-1)^3\pi^3}\right)$$

So, Fourier is given by

$$= \sum_{n=1}^{\infty} \frac{K8L^2}{(2n-1)^2\pi^3}\sin\frac{(2n-1)\pi x}{L}$$

$$= \frac{K8L^2}{\pi^3}\sum_{n-1}^{\infty}\frac{1}{(2n-1)^3}\sin\frac{(2n-1)\pi x}{L}$$

57. Passing a sinusoidal voltage $A\sin\omega t$ through a half-wave rectifier produces the clipped sine wave shown in the following figure.



A Fourier series expansion of the rectified wave is

(a) $f(t) = \frac{A}{\pi}\left[1+\frac{\pi}{2}\sin\omega t + 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2-1}\right]$

(b) $f(t) = \frac{A}{\pi}\left[1+\frac{\pi}{2}\sin\omega t - 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2-1}\right]$

(c) $f(t) = \frac{A}{\pi}\left[1-\frac{\pi}{2}\sin\omega t - 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2-1}\right]$

(d) $f(t) = \frac{A}{\pi}\left[1-\frac{\pi}{2}\sin\omega t + 2\sum_{n=1}^{\infty}\frac{\cos 2n\omega t}{4n^2-1}\right]$

Ans. **(b)**

Sol. From given graph

$$f(t) = \begin{cases} A\sin\omega t & 0 < t < \frac{\pi}{\omega} \\ 0 & \frac{\pi}{\omega} < t < \frac{2\pi}{\omega} \end{cases}$$

$$2l = \frac{2\pi}{\omega} \Rightarrow l = \frac{\pi}{\omega}$$

According to Fourier transform

$$a_0 = \frac{1}{l}\int_0^{2l} f(t)\,dt$$

$$= \frac{1}{\frac{\pi}{\omega}}\int_0^{2\pi/\omega} A\sin\omega t\,dt$$

$$= \frac{\omega}{\pi}\left[\int_0^{\pi/\omega} A\sin\omega t + 0\right] = \left(\frac{2A}{\pi}\right)$$

$$b_1 = \frac{1}{l}\int_0^{2l} f(t)\sin\omega t\,dt$$

$$= \frac{1}{\pi/\omega}\int_0^{2\pi/\omega} A\sin\omega t\sin\omega t\,dt = \frac{A}{2}$$

$$a_n = \frac{1}{l}\int_0^{2l} f(t)\cos\omega t\,dt$$

$$a_n = \frac{1}{l}\int_0^{2l} f(t)\cos\left(\frac{n\pi t}{l}\right)dt$$

When n is even $a_n = 0$

When n is odd $a_n = -\frac{2A}{(n^2-1)\pi}$

Using above information we can rule act option (a) (c) and (d).

Hence option (b) is correct.

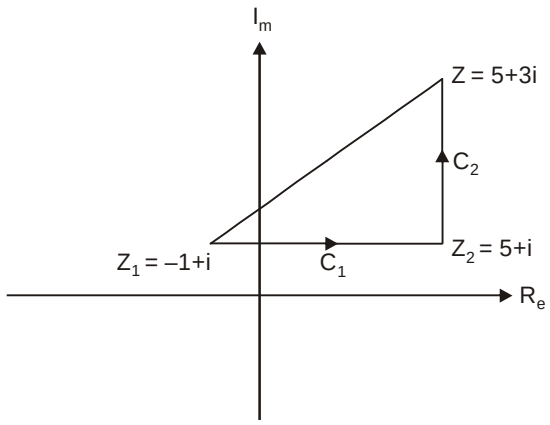
58. What is the contour integral $\int_C z^2 dz$ along the path C from –1+j to 5+3j and composed of two straight line segments, the first from –1+j to 5+j and second from 5+j to 5+3j ?

(a) $-4+\frac{196}{3}j$ (b) $-4-\frac{196}{3}j$

(c) $4-\frac{196}{3}j$ (d) $4+\frac{196}{3}j$

Ans. **(a)**

Sol. $f(z) = z^2$ always analytic function



$$\int_c f(z)dz = \int_{c_1} z^2dz + \int_{c_2} z^2dz$$

$$= \int_{-1+i}^{5+i} z^2dz + \int_{5+i}^{5+3i} z^2dz$$

$$= \left(\frac{z^3}{3}\right)_{-1+i}^{5+i} + \left(\frac{z^3}{3}\right)_{5+i}^{5+3i}$$

$$= \frac{1}{3}\left((5+i)^3 - (-1+i)^3 + (5+3i)^3 - (5+i)^3\right)$$

$$= -4 + \frac{196i}{3}$$

59. The image in the w plane of the circle $\left|z + \frac{3}{4} + j\right| = \frac{7}{4}$ under the inversion mapping w = 1/z is

(a) a circle centre (1/2, 2/3) and radius 7/6

(b) a circle centre (1/2, –2/3) and radius 7/6

(c) a circle radius (–1/2, 2/3) and radius 7/6

(d) a circle centre (–1/2, –2/3) and radius 7/6.

Ans. **(c)**

60. The plane x = 1 intersects the paraboloid $z = x^2 + y^2$ in a parabola. The slope of the tangent line to the parabola at (1, 2, 5) is

(a) 2 (b) 6

(c) 4 (d) 5

Ans. **(c)**

Sol. Given paraboloid

$\Rightarrow$ $z = x^2 + y^2$

Equation of plane x = 1

Putting equation of plane in paraboloid we get

$$z = 1 + y^2$$

$$\frac{dz}{dy} = 2y$$

$$\left.\frac{dz}{dy}\right|_{(1,2,5)} = 2 \times 2 = 4$$

61. Nothing is known about the personal life of the ancient Greek mathematician Diophantus except for the information in the following :

"Diophantus passed 1/6 of his life in childhood, 1/12 in youth, and 1/7 more as a bachelor. Five years after his marriage was born a son who died four years before his father, at 1/2 his father's (final) age." How old as Diophantus when he died?

(a) 64 (b) 54

(c) 74 (d) 84

Ans. **(d)**

Sol. Let the final age of Diophantus = x

$$\text{Final age} = \frac{x}{6} + \frac{x}{12} + \frac{x}{7} + 5 + \frac{x}{2} + 4$$

$$x = \frac{14x + 7x + 12x + 420 + 42x + 336}{84}$$

$$84x = 75x + 756$$

$$9x = 756$$

$$x = 84$$

62. Select a two-digit number between 50 and 100. Add 83 to your number. From this number form a new number by adding the digit in the hundreds place to the number formed by the other two digits (the digits in the tens place and the ones place). Now subtract this newly formed number from your original number, to arrive at the final result. What is the final result ?

(a) 16 (b) 26

(c) 36 (d) 46

Ans. **(a)**

Sol. Let the number N_1 between 50 and 100 be '57'. If 83 is added then N_2 = 57 + 83 = 140

New number N_3 after adding the digit in the hundred place to number formed by other two digit, N_3 = 40 + 1 = 41

$N_1 - N_3 \Rightarrow 57 - 41 = 16$

The correct option is (a).

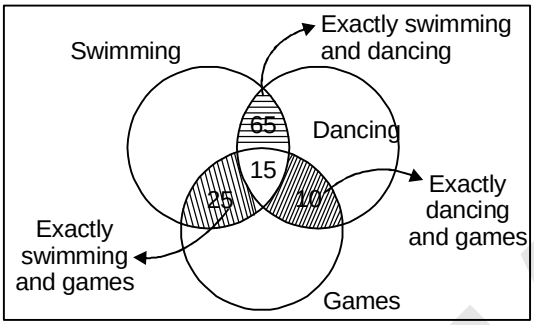
63. An activities director for a cruise ship has surveyed 240 passengers. Of the 240 passengers, 135 like swimming 80 like swimming and dancing, 150 like dancing, 40 like swimming and games, 65 likes games, 25 like dancing and games, 15 like all three activities. How many passenger like exactly two of the three types of activities ?

(a) 220 (b) 20

(c) 30 (d) 100

Ans. (d)

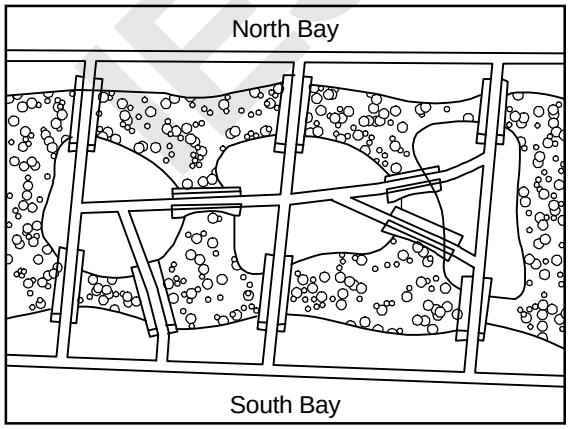
Sol.



n (passengers who like exactly two activities)

= 65 + 25 + 10 = 100

64. The following map shows the 10 bridges and 3 islands between the suburbs of North Bay and South Bay. During your morning workout, you decide to jog over each bridge exactly once. Which one of the following statements is correct ?



(a) You want to start from North Bay and that your workout concludes after you jog over the 'D' bridge.

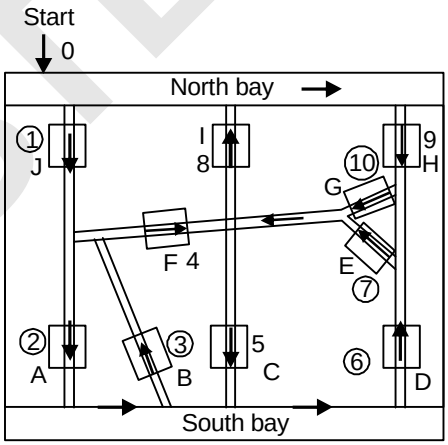
(b) You want to start from North Bay and that your workout concludes after you jog over the 'E bridge.

(c) You want to start from North Bay and that you workout concludes after you jog over the 'H' bridge.

(d) You want to start from North Bay and that your workout concludes after you jog over the 'G' bridge.

Ans. (d)

Sol.



65. Fifty people were asked to rank their preferences of five varieties of chocolate candy, using 1 for their favorite and 5 for their least favorite. The results are shown in the table below.

	Rankings					
Caramel center	5	4	4	4	2	4
Vanila center	1	5	5	5	5	5
Almond center	2	3	2	1	3	3
Toffee center	4	1	1	3	4	2
Solid chocolate	3	2	3	2	1	1
Number of voters	17	11	9	8	3	2

According to the table (see the column in grey), three voters ranked solid chocolate first, caramel centers second, almond centers third, toffee centers fourth, and vanilla centers fifth. According to this table, which variety of candy would win the taste test using the plurality voting system ?

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(a) Almond centers (b) Vanilla centers
(c) Toffee centers (d) Caramel centers

Ans. **(a)**

Sol. From the table, the candy which wins the taste whose Rankine's is least.

1. Almond centers

$= 17\times1+11\times3+9\times2+8\times1+3\times3+2\times3$

$= 108$

2. Vanilla centers

$= 17\times1+11\times5+9\times5+8\times5+3\times5+2\times5$

$= 182$

3. Toffee centers

$= 17\times4+11\times1+9\times1+8\times3+3\times4+2\times2$

$= 128$

4. Caramel center

$= 17\times5+11\times4+9\times4+8\times4+3\times2+2\times4$

$= 211$

Almond center gets least Rankine points so, option (a) is correct.

66. The members of a club are going to elect a president from four nominees. In each first-place vote receives 4 points, each second-place vote receives 3 points, each third-place vote receives 2 points, and each last place vote receives 1 point. If the 100 members of the club mark their ballots as shown in the table below, who will be elected president ?

	Rankings					
Avalon	2	2	2	2	3	2
Branson	1	4	4	4	2	1
Columbus	3	3	1	3	1	3
Dunkirk	4	1	3	1	4	4
Number of voters	30	24	18	12	10	6

(a) Avalon (b) Branson
(c) Columbus (d) Dunkirk

Ans. **(a)**

Sol. The person who gets maximum point will be elected as president.

1. Avalon gets

$= 30\times3+24\times3+18\times3+12\times3+10\times2+6\times3$

$= 90+72+54+36+20+18$

$= 290$ points

2. Branson gets

$= 30\times4+24\times1+18\times1+12\times1+10\times3+6\times4$

$= 228$ points

3. Columbus gets

$= 30\times2+24\times2+18\times4+12\times2+10\times4+6\times2$

$= 256$ points

4. Dunkirk gets

$= 30\times1+24\times4+18\times2+12\times4+10\times1+6\times1$

$= 226$ points

Avalon gets maximum points so, option (a) is correct.

67. Study the given information carefully and answer the question :

There are seven books, one each of Psychology, Hindi, English, Sociology, Economics, Education and Accountancy lying on a table one above the other. Sociology is on the top of all books. Accountancy is immediately below Education which is immediate below Sociology. Economics is immediately above Psychology but not in the middle. Hindi is immediately below Psychology.

Which three books are between Accountancy and Hindi ?

(a) English, Economics and Psychology
(b) Economics, Psychology and Education
(c) Economics, Psychology and Hindi
(d) Cannot be determined

Ans. **(a)**

Sol. From the given information in the question.

Sociology is on the top so we will assign number '1' to it.

Education is immediately below sociology, so it is on 2nd number.

Accountancy is immediately below education, so it is on 3rd number.

Economics is immediately above psychology but not in middle so it 5th number and simultaneously psychology is 6th number.

Hindi is immediately below psychology. So it is 7th number.

English is left so it is middle hence 4th number.

Arranging the seven books in order from 1st to 7th Sociology, Education, Accountancy, English, Economics, Psychology, Hindi.

Three books between Accountancy and Hindi are English, Economics and Psychology.

So, option (a) is correct.

68. Read the information give below and answer the question:

There is a group of five girls. Hasini is second in height but younger than Madhavi. Pooja is taller than Pranati but younger in age. Madhavi and Pranati are of the same age but Madhavi is tallest among them. Neelam is taller than Pooja and elder to Madhavi.

If they are arranged in the descending order of their ages who will be in fourth position ?

(a) Neelam (b) Hasini

(c) Pranati (d) Data inadequate

Ans. **(d)**

Sol. 1. Hasini is younger than Madhavi

Madhavi > Hasini

2. Pooja is younger than Pranati

Pranati > Pooja

3. Madhavi and Pranati are of same age

Madhavi = Pranati > Pooja

4. Neelam is elder to Madhavi

Neelam > Madhavi = Pranati > Pooja

We are not able to determine using given data who is elder among Hasini and Pooja. So, 4th position has two possibility Hasini and Pooja.

69. Read the following information and answer the questions :

Seven students P, Q, R, S, T, U and V take a series of tests. No two students get similar marks. V always scores more than P. P always scores more than Q. Each time either R scores the highest and T gets the least, or alternatively S scores the highest and U or Q scores the least.

If V is ranked fifth, which one of the following is correct ?

(a) S scores the highest

(b) R is ranked second

(c) T is ranked third

(d) Q is ranked fourth

Ans. **(a)**

Sol. **Case-1:** (R is highest)

1	2	3	4	5	6	7
R				V		T

R > V > P > Q not satisfied.

However at 7th place is T.

Case-2: (S is highest)

1	2	3	4	5	6	7
S				V	P	Q

S > P > V > Q

It means S scores the highest.

70. A man has a certain number of small boxes to pack into parcels. If the packs 3, 4, 5 or 6 in a parcel, he is left one, if the packs 7 in a parcel, none is left over. What is the number of boxes, he may have to pack ?

(a) 106 (b) 301

(c) 309 (d) 400

Ans. **(b)**

Sol. L.C.M. (3, 4, 5, 6) = 60

No. of small boxes = 60K + 1

K = 1 N = 60 × 1 + 1 = 61 (not divisible by 7)

K = 2 N = 60 × 2 + 1 = 12 (not divisible by 7)

K = 3 N = 60 × 3 + 1 = 181 (not divisible by 7)

K = 4 N = 60 × 4 + 1 = 24 (not divisible by 7)

K = 5 N = 60 × 5 + 1 = 301 (divisible by 7)

So, no. of boxes = 301.

71. Suppose we do not know the path of a hang glider, but only its acceleration vector a(t) = –3(cos t)i – (3 sin t)j + 2k. We also know the initially (at time t = 0) the glider departed from the point (4, 0, 0) with velocity v(0) = 3j. What is the glider's position as a function of t ?

(a) $r(t) = (1+3\cos t)i - 3\sin t j + t^2 k$

(b) $r(t) = (-1+3\cos t)i + 3\sin t j + t^2 k$

(c) $r(t) = (1-3\cos t)i + 3\sin t j + t^2 k$

(d) $r(t) = (1+3\cos t)i + 3\sin t j + t^2 k$

Ans. **(d)**

Sol. $\vec{a} = -3\cos t\hat{i} - 3\sin t\hat{j} + 2\hat{k}$

$$\frac{d\vec{v}}{dt} = -3\cos t\hat{i} - 3\sin t\hat{j} + 2\hat{k}$$

Integrating both side

$$V = (-3\sin t + b_1)\hat{i} + (3\cos t + b_2)\hat{j} + (2t + b_3)\hat{k}$$

$$V(0) = 3\hat{j}$$

$$3\hat{j} = b_1\hat{i} + (3 + b_2)\hat{j} + b_3\hat{k}$$

$$b_1 = b_2 = b_3 = 0$$

$$V = -3\sin t\hat{i} + 3\cos t\hat{j} + 2t\hat{k}$$

$$\frac{ds}{dt} = -3\sin t\hat{i} + 3\cos t\hat{j} + 2t\hat{k}$$

Integrating both side

$$\vec{r} = (3\cos t + c_1)\hat{i} + (3\sin t + c_2)\hat{j} + (t^2 + c_3)\hat{k}$$

at t = 0 $\vec{r} = 4\hat{i}$

$$4\hat{i} = (3 + c_1)\hat{i} + c_2\hat{j} + c_3\hat{k}$$

$3 + c_1 = 4 \Rightarrow c_1 = 1,\ c_2 = 0,\ c_3 = 0$

$$\vec{r} = (1 + 3\cos t)\hat{i} + 3\sin t + t^2\hat{k}$$

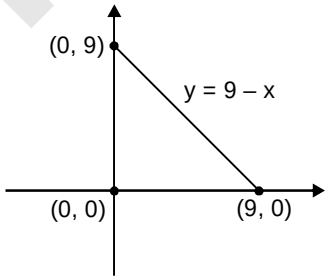
72. What is the absolute minimum value of f(x,y) = 2 + 2x + 4y – x^2 – y^2 on the triangular region in the first quadrant bounded by the lines x =0, y = 0 and y = 9 – x ?

(a) –11 (b) –43

(c) –61 (d) –41

Ans. **(c)**

Sol.



f(x, y) = 2 + 2x + 4y – x^2 – y^2

p = fx = 2 – 2x

q = fy = 4 – 2y

p = 0 ⇒ x = 1

q = 0 ⇒ y = 2

(1, 2) ∈ triangular region

(x, y)	f(x, y)
(0, 0)	2
(0, 9)	–43
(9, 0)	–61
(1, 2)	7

Absolute minimum occurs at (q_0) and f(q_0) = –61.

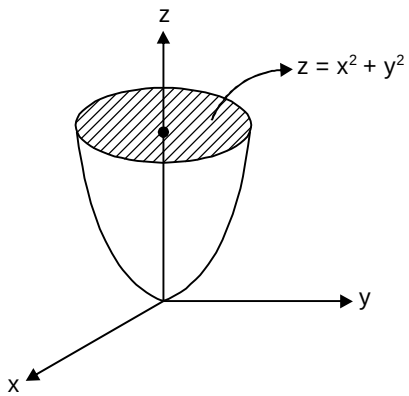
73. What is the centroid $(\delta = 1)$ of the solid enclosed by the cylinder $x^2 + y^2 = 4$, bounded above by the paraboloid $z = x^2 + y^2$, and bounded below by the xy-plane ?

(a) $\left(0, 0, \frac{3}{4}\right)$ (b) $\left(0, 0, \frac{4}{3}\right)$

(c) $\left(0, 0, \frac{5}{4}\right)$ (d) $\left(0, 0, \frac{4}{5}\right)$

Ans. **(b)**

Sol.



$$\text{Mass} = \iiint_R (\delta)\, dV \text{ \{Density × Volume\}}$$

$$\text{Mass} = \iiint dV \qquad (\delta = 1)$$

$x = r\cos\theta$

$y = r\sin\theta$ (Cylindrical coordinate system

$z = z$

$z = 0$ to $z = x^2 + y^2 = r^2$

$$\text{Mass} = \int_0^{2\pi}\int_{r=0}^{2}\int_{z=0}^{r^2} r\,dz\,dr\,d\theta$$

$$\text{Mass} = \int_0^{2\pi}\int_{r=0}^{2} r(r^2)\,dr\,d\theta$$

$$\text{Mass} = \int_0^{2\pi}\left(\frac{r^4}{4}\right)_0^2 d\theta$$

$$\text{Mass} = 8\pi$$

Center of mass $(\bar{x}, \bar{y}, \bar{z})$

$$\bar{x} = \frac{1}{\text{Mass}}\iiint_R x\delta\, dV$$

$$= \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2}\int_0^{r^2} r\cos\theta\, r\,dz\,d\theta\,dr = 0$$

$$\bar{y} = \frac{1}{\text{Mass}}\iiint_R y\delta\, dV$$

$$= \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2}\int_0^{r^2} r\sin\theta\, r\,dz\,d\theta\,dr = 0$$

$$z = \frac{1}{\text{Mass}}\iiint_R z\delta\, dV$$

$$= \frac{1}{8\pi}\int_0^{2\pi}\int_0^{2}\int_0^{r^2} z\,r\,dz\,d\theta\,dr$$

$$= \frac{1}{8\pi}\times\frac{64}{12}\times 2\pi = \frac{4}{3}$$

$$(\bar{x}, \bar{y}, \bar{z}) = \left(0, 0, \frac{4}{3}\right)$$

74. What is the integral $\int_1^2\int_{1/y}^{y} \frac{y}{x} e^{\sqrt{xy}}\, dx\, dy$?

(a) 2e(e + 2) (b) 2e(1 – e)

(c) 2e(e – 2) (d) 2e(1 + e)

Ans. **(c)**

Sol.

$$\text{D.I.} = \int_1^2\int_{1/y}^{y}\sqrt{y/x}\, e^{\sqrt{xy}}\,dx\,dy$$

$$\text{D.I.} = \int_1^2\int_{1/y}^{y}\frac{\sqrt{y}}{x} e^{\sqrt{x}\cdot\sqrt{y}}\,dx\,dy$$

$$\text{D.I.} = \int_1^2\sqrt{y}\int_{1/y}^{y}\left(e^{\sqrt{x}\cdot\sqrt{y}}\,dx\right)dy$$

Let $\sqrt{x} = t$ $\frac{1}{2\sqrt{x}}dx = dt$

When $x = \frac{1}{y} \Rightarrow t = \frac{1}{\sqrt{y}}$

$x = y \Rightarrow t = \sqrt{y}$

$$\text{D.I.} = \int_1^2\sqrt{y}\left(\int_{\frac{1}{\sqrt{y}}}^{\sqrt{y}} e^{\sqrt{y}\,t}\,2dt\right)dy$$

$$= \int_1^2 2\sqrt{y}\left(\frac{e^{\sqrt{y}\cdot t}}{\sqrt{y}}\right)_{1/\sqrt{y}}^{\sqrt{y}} dy$$

$$\text{D.I.} = 2\int_1^2 (e^y - e)\,dy$$
$$= 2(e^4 - ey)_1^2$$
$$= 2\left(\left(e^2 - 2e\right) - (e - e)\right)$$
$$= 2e(e - 2)$$

75. Fourier transform of $f(t) = \begin{cases} \sin at, & |t| \le \pi/a \\ 0, & |t| > \pi/a \end{cases}$ is

(a) $\dfrac{2j\sin \pi\omega/a}{-a^2 - \omega^2}$ (b) $\dfrac{j\sin \pi\omega/a}{-a^2 - \omega^2}$

(c) $\dfrac{j\sin \pi\omega/a}{a^2 - \omega^2}$ (d) $\dfrac{2aj\sin \pi\omega/a}{\omega^2 - a^2}$

Ans. **(d)**

Sol. $f(t) = \begin{cases} \sin at & \dfrac{\pi}{-a} \le t < \dfrac{\pi}{a} \\ 0 & t > \dfrac{\pi}{a}, t < -\dfrac{\pi}{a} \end{cases}$

Fourier transform is given by

$$f(t) = \int_{-\infty}^{\infty} e^{-\omega t} f(t)\,dt$$
$$= 0 + \int_{-\pi/a}^{\pi/a} e^{-i\omega t} \sin at\,dt$$
$$f(t) = \int_{-\pi/a}^{\pi/a} e^{-i\omega t} \sin at\,dt$$

$$\int e^{ax} \sin bx\,dx = \frac{e^{ax}}{a^2 + b^2}(a\sin bx - b\cos bx)$$

$$\int_{-\pi/a}^{\pi/a} e^{-i\omega t} \sin at = \frac{2ai}{\omega^2 - a^2}\sin\left(\frac{\pi\omega}{a}\right)$$

76. Brianna, Ryan, Tyler and Ashley were recently elected as the new class officers (president), vice president secretary, treasurer) of the sophomore class at Summit College. From the following clues, determine which position each holds.

1. Ashley is younger than president but order than the treasurer.
2. Brianna and the secretary are both the same age, and they are the youngest members of the group.
3. Tyler and the secretary are next door neighbours.

(a) Tyler is the president, Ashley is the vice president, Ryan is the secretary, and Brianna is the treasurer.

(b) Tyler is the president, Ashley is the vice president, Brianna is the secretary, and Ryan is the treasurer.

(c) Tyle is the president, Ryan is the vice president, Ashley is the secretary, and Brianna is the treasurer.

(d) Tyler is the president, Ryan is the vice president, Briana is the secretary, and Ashley is the treasurer.

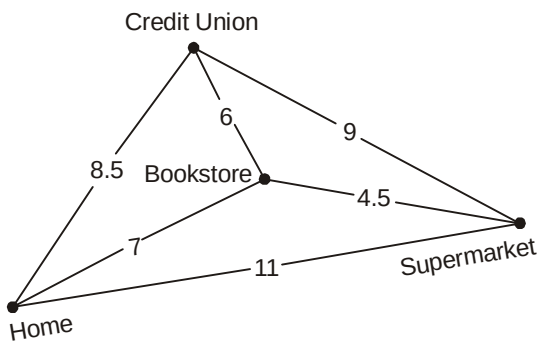
Ans. **(a)**

Sol. From clue no. 2, we can conclude that Brianna is not the secretary so option (b) and (d) is incorrect.

From clue no. 1, Ashley is older than treasurer so he cannot be secretary as Brianna who is treasurer is of same age as secretary. So, option (c) is incorrect.

	P	VP	S	T
Brianna			×	✓
Ryan			✓	
Tyler	✓		×	
Ashley	×	✓		×

77. You need to buy groceries at the supermarket, deposit is a cheque at the credit union, and purchase a book at the bookstore. You can complete the errands in any order; however, you must start and end at your home. The driving time, in minutes, between each of these locations is given in the following figure.



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What is the route whose total driving time is less than 30 minutes ?

(a) home, bookstore, credit union, supermarket, home

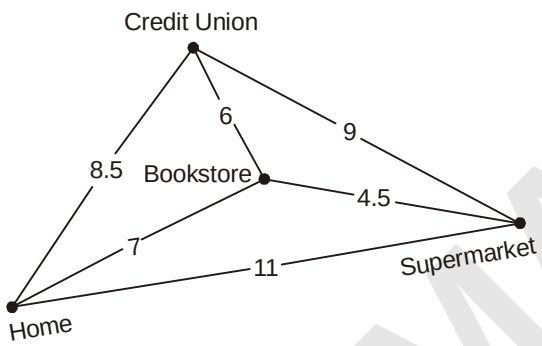
(b) home, supermarket, bookstore, credit union, home

(c) home, bookstore, supermarket, credit union, home

(d) home, supermarket, credit union, bookstore, home

Ans. **(c)**

Sol.



Select the least numbered root at each stop to move forward.

Minimum driving time

$$= 7 + 4.5 + 9 + 8.5$$

$$= 29 \text{ min}$$

Route $\Rightarrow$ Home $\rightarrow$ Book store $\rightarrow$

Supermarket $\rightarrow$ Credit union $\rightarrow$ Home

78. Each of four siblings (Anita, Tony, Maria and Jose) is given Rs. 5000 to invest in the stock market. Each choose a different stock. One chose a utility stock, another an automotive stock, another a technology stock, and the other an oil stock.

1. Anit and the owner of the utility stock purchased their shares through an on-line brokerage, whereas Tony and the owner of the automotive stock did not.
2. The gain in value of Maria's stock is twice the gain in value of the automotive stock.
3. The technology stock is traded on NASDAQ, whereas the stock that Tony brought is traded on the New York Stock Exchange

From the above clues, match the name of the sibling and stock bought.

(a) Maria : The utility stock; Jose : The automotive stock; Anita : The technology stock; Tony ; The oil stock

(b) Maria : the utility stock; Anita : the automotive stock; Jose : the technology stock; Tony : The oil stock

(c) Maria : the utility stock; Tony : the automotive stock; Anita : the technology stock; Jose : The oil stock

(d) Jose : the utility stock; Maria the automotive stock; Anita : the technology stock; Tony :the toil stock.

Ans. **(a)**

Sol. From Point 1, we can conclude that Anita and Tony does not own utility stocks as well as automotive stocks. So, option (b) and (c) is incorrect.

From Point 2, we can conclude that Maria does not own automotive stock. So, option (d) is incorrect.

From Point 3, we can conclude that technology stock traded on NASDAQ was purchased through online brokerage hence it must be Anita who bought it.

	U	A	T	O
Anita	$\times_1$	$\times_1$	✓	$\times_3$
Tony	$\times_1$	$\times_1$	$\times_3$	✓
Maria	✓	$\times_2$	$\times_1$	$\times$
Jose	$\times_2$	✓	$\times_1$	$\times_1$

Option (a) is correct.

79. If six people greet each other at a meeting by shaking hands with one another, how many handshakes will take place ?

(a) 14 (b) 16

(c) 15 (d) 18

Ans. **(c)**

Sol. **Method-1:**

No. of handshakes = $^{n}C_2 = {}^{6}C_2 = \frac{6!}{4!\,2!} = 15$

Method-2:

No. of handshakes = $\frac{n(n-1)}{2} = \frac{6\times(6-1)}{2} = 15$

80. Anuhya picks a number. She doubles the number, squares the result, divides the square by 3, subtracts 30 from the quotient, and gets 18, What are the possible numbers that Anuhya could have picked ?

(a) 6 or –6
(b) 16 or –16
(c) 26 or –26
(d) 36 or –36

Ans. **(a)**

Sol. Let Anuhya picks number n

According to question

$$\frac{(2n)^2}{3} - 30 = 18$$

$$(2n)^2 = 48 \times 3$$

$$4 \times n^2 = 4 \times 36 \Rightarrow n = \pm 6$$

81. Which one of the following is a set of programs that enables its user to gain administrator-level access to a computer without the end user's consent or knowledge ?

(a) Distributed Denial-of-Service
(b) Phishing
(c) Smishing
(d) Rootkit

Ans. **(d)**

Sol. Rootkit is a set of programs that enables the users to gain the administrative access to the computer without the end users knowledge or consent.

82. Which one of the following is software and/or hardware that monitor system and network resources and activities, and notify network security personnel when it detects network traffic that attempts to circumvent the security measures of a networked computer environment ?

(a) An intrusion detection system
(b) A protection of evidence and activity logs system
(c) A critical internet security threats system
(d) An illusion detection system

Ans. **(a)**

Sol. An intrusion detection system is a system that monitors traffic for suspicious activity and alerts when such activity is discovered.

83. Which one of the following involves for the examination of Internet records to track down the identity of someone who posted in a discussion forum on one Website might search for clues to the poster's identity on Facebook, Twitter and other on-line sources ?

(a) Pornography
(b) Internet filter
(c) Doxing
(d) Internet censorship

Ans. **(c)**

Sol. Reavealing the personal identity online.

84. Which one of the following Acts mandates schools and libraries in India to use some form of technological protection to block computer access to obscene material, pornography, and anything else considered harmful to minors ?

(a) Telecommunications Act
(b) Child Online Protection Act
(c) Children's Internet Protection Act
(d) Communications Decency Act

Ans. **(c)**

Sol. This act concern about children's access to obscene or harmful content over the internet.

85. Which of the following Acts is required for the commercial emailers in sending out messages that advertise a commercial product or service ?

(a) Controlling the Assault of Non-Solicited Pornography and Marketing Act

(b) Communications Assistance for Law Enforcement Act

(c) Communications Act of 1934

(d) Communications Decency Act

Ans. **(a)**

Sol. This act establishes requirement for those who send unsolicited commercial email.

86. What are the three stages in the Development of Professional Identity ?

(a) Possessing Knowledge, Professional Services, Self-Defining or Integrated Professional

(b) Independent Operator, Professional Services, Self-Defining or Integrated Professional

(c) Possessing Knowledge, Team-Oriented Idealist, Self-Defining or Integrated Professional

(d) Independent Operator, Team-Oriented Idealist, Self-Defining or Integrated Professional.

Ans. **(d)**

87. The first of the Fundamental Canons of the code of the National Society of Professional Engineers says that engineers shall hold.

(a) paramount the safety, health and welfare of the public.

(b) devotion to clients as the first responsibility

(c) devotion to his employer

(d) devotion to the public

Ans. **(a)**

88. A very compassionate man, Engineer Bernard Amadei in 2001 was profoundly affected by the poor living conditions in underdeveloped countries, such as the absence of clean water. He founded EWB-USA in 2001 for improving the living condition of the poor. Engineering students in EWB are responsible for many projects throughout the world that have enhanced human well-being. What is the full form of the term EWB ?

(a) Economically Water Boys

(b) Engineers Well to do Boys

(c) Engineers Without Borders

(d) Engineers Water Boys

Ans. **(c)**

89. Consider the following statements :

The philosopher W.D. Ross, who constructed a list of basic duties or obligations, which he called prima facie duties. His lists of prima facie duties are given below :

1. Duties resting on previous acts
2. Duties of gratitude, Duties of justice.
3. Duties of beneficence, Duties of self-improvement
4. Duties to injure others, unexceptional to be widely practiced.

Which of the above statements are correct ?

(a) 1, 2 and 4 (b) 1, 3 and 4

(c) 1, 2 and 3 (d) 2, 3 and 4

Ans. **(c)**

90. What are the types of Moral Judgements ?

(a) Permissible, Intent, Obligatory, Standpoint

(b) Professional Impermissible, Obligatory, Supererogatory

(c) Permissible, Impermissible, Obligatory, Supererogatory

(d) Professional, Impermissible, Obligatory, Standpoint

Ans. **(b)**

91. Which one of the following transmission media is/are used for the remote control communication for televisions, VCRs, and stereos etc. ?

(a) Fiber optics

(b) Fiber cables

(c) The electromagnetic spectrum

(d) Unguided infrared and millimeter waves

Ans. **(d)**

Sol. Infrared is a wireless technology that uses infrared radiation for wireless transmission between computer devices as well as many handheld remotes for TV and Video and Stereo equipment.

92. Which one of the following protocols is used to wrap IP packets with the additional feature of multiplexing and de-multiplexing multiple process using a single IP address ?

(a) User Datagram Protocol

(b) Transport Control Protocol

(c) Internet Protocol

(d) Point-to-Point Protocol

Ans. **(a, b)**

Sol. Multiplexing and de-multiplexing are the services provided by the transport layer. TCP/IP is designed to allow many different applications to send and receive data simultaneously using the same internet protocol. It multiplex transmitted data from many source as it passed down to the IP layer.

And in demultiplexing, when IP datagram is received, it is demultiplexed and the appropriate data passed to each application instance on the receiving host.

93. Which one of the following code modules is/are used where the browser fetches from a special directory on the disk and installs as an extension to itself ?

(a) Uniform Resource Locators

(b) Browser

(c) Plug-in

(d) Client server

Ans. **(c)**

Sol. A browser plug-in is a software component that user can install to handle content that the browser can't support natively.

94. Which one of the following features is/are used when a website is complex, consisting of many pages produced by multiple authors working for the same company, often desirable to have a way to prevent a different page from having a different appearance ?

(a) Checkbox (b) Style sheets

(c) Table (d) Forms

Ans. **(b)**

Sol. A stylesheet is a set of CSS rule used to control the layout and design of a webpage or document.

95. Which one of the languages is used to develop the web pages in the structured and for automated processing ?

(a) Extensible Markup Language

(b) Hypertext Markup Language

(c) Extended Hyoper Text Markup Language

(d) Markup Language

Ans. **(b)**

Sol. Hypertext markup language (HTML) is the standard markup language used for creating web pages and applications on the internet. It defines the structure and layout of web content.

96. Which one of the following interfaces is used to allow web servers to talk to back-end programs and scrips that can accept input and generate HTML pages in response ?

(a) Application Programming Interface
(b) User Interface
(c) Application Interface Marker
(d) Common Gateway Interface

Ans. **(d)**

Sol. Common Gateway Interface (CGI) is an interface specification that enables web servers to execute an external program to process HTTP or HTTPs user request. Such programs are often written in a scripting language and are commonly referred to as CGI scripts.

97. Which one of the following status code responses gives the internal server error ?

(a) 200 (b) 500
(c) 100 (d) 300

Ans. **(b)**

Sol. The HTTP status code 500 is a generic error response, it means that the server encountered an unexpected condition that prevented it from fulfilling the request.

98. Which of the following issues were addressed while establishing an IT Policy ?

1. Respect of the intellectual rights of others, including trade secrets, copyrights, patents, and trademarks.
2. Inappropriate use of IT resources, such as Web surfing, blogging, personal emailing, and other use of computers for purposes other than business.
3. The need to protect the security of IT resources through adherence to good security practices, such as not sharing user IDs and passwords, using hard-to-guess passwords, and frequently changing passwords.
4. The use of the computer to intimidate, harass, or insults others through abusive language in emails and by other means.

Select the correct answer using the code given below :

(a) 1 and 3 only (b) 2 and 3 only
(c) 2, 3 and 4 only (d) 1, 2, ,3 and 4

Ans. **(c)**

Sol. IT policy establish guidelines for the use of information technology within an organization. Policies mainly focus on communicating on organizations values, culture and phitosophy with regard to it.

99. Which one of the following is a harmful program that resides in the active memory of the computer and duplicates itself without human intervention, often sending copies of themselves to other computers by emails ?

(a) Worms (b) Viruses
(c) Bugs (d) Spam

Ans. **(a)**

Sol. Worm is a self-replicating viruses that does not alter files but resides in active memory and duplicates itself.

100. Which of the following attacks is one in which a malicious hacker takes over computers via the Internet and causes them to flood a target site with demands for data and other small tasks ?

(a) Rootkits
(b) Distributed Denial-of-Service
(c) Phishing
(d) smishing

Ans. **(b)**

Sol. In a distributed denial-of-service (DDOS) attack multiple compromised computer system attack a target and cause a denial of service for users of the targeted resource.