IES MASTER

Institute for Engineers (IES/GATE/PSUs)

ESE 2022 Prelims Exam

Paper - I

GENERAL STUDIES & ENGINEERING APTITUDE

Detailed Solution

(SET-A)

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1. Which of the following are the elements of TQM?

1. Teamwork and Employee empowerment
2. Feedback mechanisms
3. Strong division of labour
4. Result oriented management

Select the correct answer using code given below:

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

Ans. **(d)**

Sol. Feedback is required to monitor and control quality, Strong division of labour uses labour as their skills and always there is target oriented action.

2. The quality characteristics can be categorized in which of the following groupings?

1. Sensory characteristics
2. Structural characteristics
3. Statistical characteristics
4. Time oriented characteristics

Select the correct answer using the code given below:

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

Ans. **(a)**

Sol. Sensory quality involves an evaluation like taste, smell, appearance, and texture, among other attributes, Structural quality covers factors such as child-staff ratios, group size and staff training/ education, Statistical quality control covers control charts and time oriented characteristics covers improvement on product over time.

3. What are the major categories for quality costs?

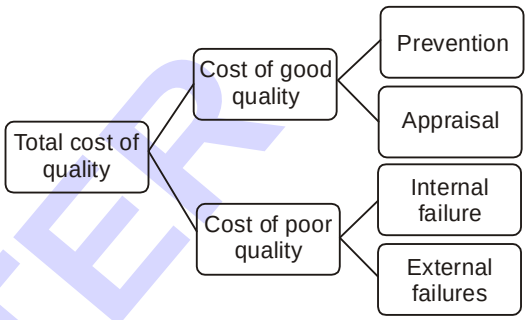
1. Prevention costs
2. Appraisal costs
3. Production costs
4. Internal failure costs

Select the correct answer using the code given below:

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

Ans. **(b)**

Sol.



4. Consider the following statements regarding evaluating sampling plans:

1. If rectifying inspection is conducted for lots rejected by the sampling plan is the average total inspection.
2. The average number of items inspected for a series of lots in order to make a decision is the average sample number.
3. The average quality level of a series of batches that leave the inspection station after coming in for inspection at a certain quality level is the average outgoing quality limit.

Which of the above statements are correct?

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

Ans. **(b)**

Sol. The average total inspection depends on the incoming quality, the probability that the lot will be accepted, and the sample and lot sizes. Statement 1 is incorrect.

5. Consider the following statements with reference to principal quality objectives:

1. The organization should achieve and sustain the quantity of the product so as to continually meet the purchaser' stated or implied needs.
2. The organization should provide confidence to its own management that the intended quality is being achieved and sustained.

3. The organization should provide confidence to the purchaser that the intended quality is being, or will be, achieved in the delivered product.

Which of the above statements are correct?

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

Ans. **(d)**

Sol. In TQM, objectives cover satisfaction of Employee, Customer, Organisation itself otherwise to sustain quality won't be possible

6. Trial runs are recommended for which of the following reasons?

1. Trial runs provide an opportunity to remedy the situation during the experiment.
2. Trial runs provide a final chance to fine-tune levels of a factor.
3. Trial runs provide a chance to make any needed changes in the experimental plan during the experiment.
4. Trial runs can help considerably in estimating the time to complete a run, the logistical support required for level changes, and total time needed to complete an experiment.

Select the correct answer using the code given below:

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

Ans. **(a)**

Sol. Trial runs to identify problems in the production line undiscovered during design. The team gathers data from the exercising of the line to adjust the line. Throughout the trial runs, we achieved positive safety and efficiency outcomes and uncovered several useful learnings around the need for early and close collaboration in a real environment, what constraints need to be addressed for commercial scale, and all of the operational elements involved beyond the actual idea/plan

7. Which one of the following is NOT a source of variation present in every process of construction?

(a) The equipment (b) The material
(c) The environment (d) The specifications

Ans. **(d)**

Sol. Specification is decided in design so can't be source of variation and as variation exist that's why tolerance given in specific limits.

8. The international dispute about modern environmental movement began with the publication of **silent spring** by

(a) Mary Daly (b) Rachel Carson
(c) Carolyn Merchant (d) Maria Mies

Ans. **(b)**

Sol. Silent spring is a book written by Rachel Carson indicating the usage of pesticides that led to depletion of flora along different ecosystems. This evidence based testimonial was the one that opened our eyes to the negative impacts of bio fertilizers on ecosystems and ecology.

9. Which one of the following is NOT a principle of CERES?

(a) Controlled production
(b) Energy conservation
(c) Informing the public
(d) Protection of the biosphere

Ans. **(a)**

Sol. The Ceres Principles require one to make investment decisions that **minimize risk to the environment and promote sustainable use of natural resources**.

Ten Ceres Principals are:

1. Protection of the biosphere
2. Sustainable use of Natural Resources
3. Reduction and Disposal of Wastes
4. Energy Conservation
5. Risk Reduction
6. Safe Products and Services

7. Environmental Restoration
8. Informing the Public
9. Management Commitment
10. Audits and Reports

10. The largest tidal range in the world is

(a) Bay of Fundy
(b) Ungava Bay
(c) Bristol Channel
(d) Turnagain Arm of Cook Inlet

Ans. **(a)**

Sol. The world's largest tidal range of **16.3 metres (53.5 feet)** occurs in Bay of Fundy, Canada, and the United Kingdom regularly experiences tidal ranges up to 15 metres.

11. Kyoto Protocol operationlizes the UN framework convention on

(a) Sustainable development
(b) Renewable energy
(c) Climate change
(d) Soil erosion

Ans. **(c)**

Sol. The Kyoto Protocol was adopted on 11 December 1997 and entered into force on 16 February 2005. Currently, there are 192 Parties to the Kyoto Protocol.

The Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets.

12. According to Carson, which one of the following approaches argues that nature has intrinsic value and we should protect it because of this value?

(a) Instrumental approach
(b) Axiological approach
(c) Eco-critical approach
(d) Anthropological approach

Ans. **(b)**

Sol. Axiology is the philosophical study of values and value systems, it is a branch of philosophy which concerns with determining factors associated with values specially moral values, Hence b is the correct answer.

a, c, d all indicate to the hypothesis that nature is a means to an end (instrument) for the objectives of human beings, Hence it is humans who can determine the value nature carries, therefore they are all incorrect.

13. The Gaia hypothesis, which suggested that the earth should be seen as a single organism, was devised by

(a) James Lovelock
(b) Francoise d' Eaubonne
(c) Earnest Haeckel
(d) Paul Ehrlich

Ans. **(a)**

Sol. The Gaia Hypothesis proposed by James Lovelock suggests that **living organisms on the planet interact with their surrounding inorganic environment to form a synergetic and self-regulating system** that created, and now maintains, the climate and biochemical conditions that make life on Earth possible.

14. Energy used by man does NOT originate from which one of the following sources?

(a) Radiant energy (b) Geothermal power
(c) Frictional energy (d) Gravitational energy

Ans. **(b)**

Sol. Man uses energy produced from Radiant Energy, Geo Thermal Energy and Gravitational Energy.

15. The term "Sacred Cow" is often used to denote a project that

(a) a powerful, high-ranking official is advocating
(b) facts are advocating
(c) sound reasoning is advocating
(d) less weaknesses are advocating

Ans. **(a)**

Sol. The sacred cow The senior and he powerful official in the company suggest the project in this case. No one questions it and agree to it.

16. Which one of the following is NOT a condition for preferring Top-Down Time and Cost Estimates?

(a) Strategic decision making

(b) Cost and time important

(c) High uncertainty

(d) Internal, small project

Ans. **(b)**

Sol. Estimates done by bottom to top approach have less variation as working people involved in that approach.

17. In Network Computation Process, which one of the following is correct for forward pass?

(a) It starts with the first project activity(ies) and traces each path (chain of sequential activities) through the network to the last project activity(ies).

(b) This is the longest path in the network, which will delay the project.

(c) It starts with the last project activity(ies) on the network.

(d) It starts with the last project activity(ies) and traces each path (chain of sequential activities) through the network to the first project activity(ies).

Ans. **(a)**

Sol. Forward pass is used to find the earliest start of each activity in with maximum time among all possible paths from start node to the node at which earliest start is to be found taken as ES of the activity.

18. Consider the following statements regarding production:

The major aspects of production that may lead to sickness are:

1. Increase in the cost of production.
2. Decrease in the quantity of production.
3. Quality of product not meeting the standards/ customer expectation.
4. Producing more quantity than can be sold, leading to accumulation of stock.

Which of the above statements are correct?

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

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

Ans. **(b)**

Causes for sickness - Lack of Finance, Bad Production Policies, Marketing lack, Inappropriate Personnel Management. These may lead to any reason given in question.

19. Which one of the following projects are those which are to be completed within a stipulated time, even at the cost of ending up with a higher project cost?

(a) Normal projects (b) Business projects

(c) Crash projects (d) Research projects

Ans. **(c)**

Sol. Crashing in a project is an activity that will shorten the completion time of a project within the optimum cost

20. Which one of the following policies is concerned with changing the supply of money stock and the rate of interest, for the purpose of stabilizing the economy at full potential output level?

(a) Commercial policy (b) Fiscal policy

(c) Monetary policy (d) Social policy

Ans. **(c)**

Sol. Monetary policy is an economic policy that manages the size and growth rate of the money supply in an economy. It is a powerful tool to regulate macroeconomic variables such as inflation. **Increase in money supply reduces the rate of interest, which in turn, increases investment, and hence promotes economic activity, and vice versa**

21. Which one of the following is NOT a classification of microscopic diffusion?

(a) Inter-diffusion (b) Vacancy diffusion
(c) Surface diffusion (d) Lattice diffusion

Ans. **(a)**

Sol. Process, whereby atoms of one metal diffuse into another, is termed **inter-diffusion**, or **impurity diffusion**.

Inter-diffusion may be discerned from a macroscopic perspective by changes in concentration which occur over time, as in the example for the Cu-Ni diffusion couple.

22. Many bulk polymers that are crystallized from a melt, are semi crystalline and form which one of the following structures?

(a) Spherolite structure (b) Spherelite structure
(c) Spherulite structure (d) Spherilite structure

Ans. **(c)**

Sol. Many bulk polymers that are crystallized from a melt are semicrystalline and form a spherulite structure. As implied by the name, each spherulite may grow to be roughly spherical in shape. The spherulite consists of an aggregate of ribbon-like chain-folded crystallites (lamellae) approximately 10 nm thick that radiate outward from a single nucleation site in the center.

23. "Positive and negative ions by virtue of their net electrical charge, attract one another", these attractive bonding forces are

(a) Coulombic (b) Magnetic
(c) Electromagnetic (d) Non-magnetic

Ans. **(a)**

Sol. The bond formed, as a result of the electrostatic attraction between the positive and negative ions was termed as the electrovalent bond.

24. The process by which plastic deformation is produced by dislocation motion is termed as

(a) Plane slit (b) Seepage
(c) Slip (d) Twinning

Ans. **(c)**

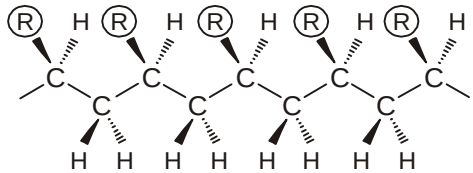
Sol. The process by which plastic deformation is produced by dislocation motion is termed as slip, and the crystallographic plane along which the dislocation line traverses is the slip planes. In addition to slip, plastic deformation in some metallic material occurs by formation of mechanical twins or twinning. This is due to shear force.

25. Stereoisomerism denotes the situation in which atoms are linked together

(a) In the different order and also differ in their spatial arrangement.
(b) In the different order but same in their spatial arrangement.
(c) In the same order (head-to-tail) but differ in their spatial arrangement.
(d) In the same order (head-to-tail) and also same in their spatial arrangement.

Ans. **(c)**

Sol. Stereoisomerism means the situation in which atoms are linked together in the same order (head-to-tail) but differ in their spatial arrangement. e.g. all the R groups lie on the same side of the chain as follows :



This is called an isotactic configuration. It has the zigzag pattern of the carbon chain atoms.

26. Some of the complex thermoplastic chains become to stiff that they act as rigid rods, even when heated above the melting point. These materials are

(a) Solid crystalline polymers
(b) Semi solid crystalline polymers
(c) Liquid crystalline polymers
(d) Copolymers

Ans. **(c)**

Sol. LCPs are composed of extended, rod-shaped, and rigid molecules. In terms of molecular arrangement, these materials do not fall within any of conventional liquid, amorphous, crystalline,

or semicrystalline Classifications, but may be considered as a new state of matter—the liquid crystalline state, being neither crystalline nor liquid. In the melt (or liquid) condition, whereas other polymer molecules are randomly oriented, LCP molecules can become aligned in highly ordered configurations. As solids, this molecular alignment remains, and, in addition, the molecules form in domain structures having characteristic intermolecular spacings.

27. Which one of the following are the well-known routing attacks on IoT?

(a) Clone Id and Sybil attacks

(b) Selective-reversing attacks

(c) Packet reversing attacks

(d) Frame selective wired attacks

Ans. **(a)**

Sol. Sybil attack is a type of attack seen in peer to peer networks in which a nod in the network operates multiple identities actively at the same time and undermines the authority in repetition systems, this is what makes it successful in IoT breaches.

28. Which one of the following layers in the OSI reference model is concerned with transmission of unstructed bit stream over physical medium; deals with the mechanical, electrical, functional, and procedural characteristics to access the physical medium ?

(a) Transport layer (b) Network layer

(c) Data link layer (d) Physical layer

Ans. **(d)**

Sol. Among the given options bit stream occurs over the physical layer. Hence option D is correct.

The Open Systems Interconnection (OSI) reference model is a conceptual model that characterizes and standardizes the communication functions of a telecommunication or computing system without regard to its underlying internal structure and technology.

29. Which one of the following systems is used when there are rigid time requirements on the operation of a processor or the flow of data, and thus is often used as a control device in a dedicated application ?

(a) A real-time system

(b) A distributed system

(c) A parallel system

(d) A serial system

Ans. **(a)**

Sol. A real time operating system (RTOS) is a special purpose operating system used in computers that has strict time constraints for any job to be performed. RTOS are used in environments where a large number of events, mostly external to the computer system must be accepted and processed in a short time or within certain deadlines.

30. Which one of the following servers is a tool that allows an information provided to prepare indexes of unstructed documents, and allows users to search these indexes with natural language questions ?

(a) Name server

(b) Terminal serve

(c) Wide area information server

(d) File server

Ans. **(c)**

Sol. Wide Area Information Server(WAIS) is an internet system in which specialized subject databases are created at multiple server locations, kept track of by a directory of servers at one location and made accessible for searching by users with WAIS client programs. The user of WAIS is provided with or obtains a list of distributed data bases.

31. Which one of the following protocols is desired to provide privacy between two communicating applications viz a client and a server ?

(a) Data link layer protocol

(b) Physical layer protocol

(c) Secure socket layer protocol

(d) Session layer protocol

Ans. **(c)**

Sol. Secure Socket Layer Protocol also known as SSLP is a standard protocol used for secure transmission of documents over a network. Developed by Netscape, SSL technology creates a secure link between a web server and browser to ensure private and integral data transmission. SSL users transport control protocol(TCP) for communication.

32. Which one of the following is an advantage of branched or Intrinsic programming type or style in ICT based teaching and learning process ?

(a) Large frames reduce the time of learning

(b) There is a possibility of guesswork

(c) It is very expensive to provide so many audiovisual aids

(d) Revise/redesign at frequent intervals is difficult and expensive

Ans. **(a)**

Sol. Option c and d, by their very language don't sound like advantages, option b mentions the possibility of guess work, which is based on chance and has little to do with teaching and learning processes. So the correct answer has to be option A which states that ICT based teaching and learning process launches large frames which reduce the time of learning.

33. Which one of the following learnings is a teaching approach that engages students is sustained, collaborative real-world investigations ?

(a) Project-based learning

(b) Cooperative learning

(c) Collaborative learning

(d) Outcome based learning

Ans. **(a)**

Sol. Project based learning is a dynamic classroom approach in which students actively explore real world challenges and problems and acquire deeper knowledge. The 3 characteristics of meaningful project based learning are

1. They are inter disciplinary
2. They are rigorous
3. They are student centered.

34. Which one of the following schemes is used for radio stations within the same region, where each radio station has its own frequency ?

(a) Space division multiplexing

(b) Frequency division multiplexing

(c) Time division multiplexing

(d) Code division multiplexing

Ans. **(b)**

Sol. In frequency division multiplexing(FTM), multiple signals are combined for transmission on a single communications line or channel with each signal assigned to a different frequency within the main channel. It can use any amplitude modulation (AM) or frequency modulation (FM) technique, the methods used by radio stations.

35. The AES key expansion algorithm takes as input a 4-word (16-byte) key and produces a linear array of

(a) 50 words (200 bytes)

(b) 44 words (176 bytes)

(c) 40 words (160 bytes)

(d) 35 words (140bytes)

Ans. **(b)**

Sol. The AES key expansion algorithm takes as input a 4 word (16 byte) key and produces a linear array of 44 words (176 bytes). This is sufficient to provide a 4 word round key for the initial Add Round Key stage and each of the 10 rounds of the cipher.

36. Consider the following statements regarding engineers as responsible experimenters :

1. It includes a conscientious commitment to live by moral values.
2. I can be accountable for the results of the project.
3. It restricts free-personal involvement in all steps of the project or product development.

4. It includes constant awareness of the progress of the experiment and readiness to monitor the side effects, if any.

Which of the above statements are correct ?

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

Ans. **(d)**

Sol. All the options given above are relevant in terms of defining engineers as responsible experimenters. There must be a conscientious commitment to live by moral values and involves accountability for the results of the project(Teleological ethics). There cannot be free personal involvement in all steps of the project (avoiding extreme virtue ethics) and also includes the awareness of the progress of the experiment and readiness to monitor the side effects under deontological ethics.

37. Which one of the following is NOT included in Nussbaum's basic human functional capabilities?

(a) Being able to live a human life of normal length
(b) Being able to use senses, imagine, think and reason
(c) Being able to laugh, play and enjoy recreational activities.
(d) Being able to earn livelihood and live peacefully

Ans. **(d)**

Sol. Martha Nussbaum has proposed the capability approach in which she argues that a human life in order to reach its highest potential must include a number of "capabilities" – i.e, of actual possibilities that one can realize in one's life. Out of the options given a,b,c fall in the list of such capabilities but d, i.e, being able to earn a livelihood and live peacefully doesn't fall under this category.

38. Which one of the following is NOT a type of virtue for responsible professionalism.

(a) Public-spirited virtue
(b) Teamwork virtue
(c) Self-realization virtue
(d) Self-direction virtue

Ans. **(c)**

Sol. In professional ethics, self realisation cannot be a preferred virtue because it often comes at the cost of the public, the team and the project, instead a self directed a better virtue.

39. Which one of the following is NOT Davis' eight moral tests ?

(a) Harm test (b) Acceptability test
(c) Virtue test (d) Professional test

Ans. **(b)**

Sol. Acceptability implies social acceptability as a moral test and therefore it is possible that the society may accept some thing amoral or immoral under certain circumstances therefore acceptability cannot be a standard test.

40. Arrange the following is hierarchical order as suggested by Carroll in the four-part model of corporate social responsibility ?

1. Economic 2. Philanthropic
3. Legal 4. Ethical

Select the correct answer using the code given below :

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

Ans. **(d)**

Sol. Since Corporate Social Responsibility (CSR) is branching out of a core economic theory its primary stake holders are within the realm of economics, the economy functions within a legal framework and therefore it is a secondary stakeholder. Ethics, starts where law ends and therefore this system follows law in stake holding and finally philanthropy can be a part of the CSR but it is not the core of CSR.

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41. The Engineers for a Sustainable World (ESW) meant for using the professional talent to create a more sustainable world as founded in

(a) 1999 (b) 2000
(c) 2001 (d) 2002

Ans. **(c)**

42. Which one of the following is NOT covered under the International Labour Organization declaration on fundamental principles and rights at work (1998) ?

(a) Freedom of association and the right to collective bargaining
(b) The elimination of forced and compulsory labour
(c) The abolition of child labour
(d) the global compact on migration

Ans. **(d)**

43. Which one of the following does NOT come under business ethics ?

(a) Avoid breaking the law
(b) Avoid actions that are bad for one's image
(c) Avoid action
(d) Avoid conflict

Ans. **(c)**

Sol. Business ethics is a part of practical ethics and professional ethics which implies that there cannot be an avoidance of action by definition. Therefore c is the correct answer.

44. Which one of the following principles refers to whom may be affected by the actions of the company that affect health, safety, or the environment and refrain from taking reprisals against employees who report dangerous incidents to management or appropriate authorities ?

(a) Safe product and service
(b) Informing the public
(c) Environment, restoration
(d) Risk reduction

Ans. **(b)**

Sol. Informing the public implies the last and final recourse for an individual within a company that affect the health, safety or the environment. This is sometimes also known as whistle blowing.

45. The Defence Research and Development Organization (DRDO) has successfully test-fired medium-range subsonic cruise missile Nirbhay from the Integrated Test Range (ITR) at

(a) Chandipur, Odisha
(b) Cuddalore, Tamil Nadu
(c) Nellore, Andhra Pradesh
(d) Digha, West Bengal

Ans. **(a)**

46. Which one of the following is NOT correct regrading the Khel Ratna Award?

(a) The award was inaugurated in 1991-92
(b) The award comprises a medallion, a certificate, and a cash prize of Rs. 15 lakhs
(c) The first recipient of the Khel Ratna was chess legend, Viswanathan Anand
(d) The award renamed as Major Dhyan Chand Khel Ratna Award

Ans. **(b)**

47. How many Indian companies have found in place in 2021 Fortune's Global 500 list ?

(a) Three (b) Five
(c) Seven (d) Nine

Ans. **(c)**

48. Which one of the following is NOT important initiatives under EASE 4.0 ?

(a) Smart lending for aspiring India.
(b) New age 24×7 banking with resilient technology
(c) Collaborative banking for synergistic outcomes
(d) Parameters of FI-Index.

Ans. **(d)**

Sol. EASE 4.0 reforms enhanced access and service excellence 4.0 are reforms for the public sector banks to ensure smart banking. It includes the aspects of digital lending, mobile internet banking and customer service, data enabled agricultural financing and collaborating with financial ecosystems but does not mention parameters of FI index. Therefore d is the incorrect answer.

49. Which one of the following statements is NOT correct regarding the Pension Fund Regulatory and Development Authority (PFRDA) ?

(a) It has increased the entry age for the National Pension System (NPS) from 60 years to 65 years.

(b) Earlier the eligible age to invest in NPS was 18-65 years which has now been revised to 18-70 years.

(c) AS per the revised norms, any Indian citizen, resident or non-resident and Overseas Citizen of India (OCI) between the age of 65-70 years can join NPS.

(d) Subscribers can continue or defer their NPS. Account up to the age of 75 years.

Ans. **(b)**

50. World's largest star sapphire cluster has been found in

(a) Rajkot, India

(b) Ratnapura, Srilanka

(c) Pretoria, South Africa

(d) Brisbane, Australia

Ans. **(b)**

51. Consider the following statements regarding Cybersecurity Multi-Donor

Trust Fund:

1. The World Bank has launched a new 'Cybersecurity Multi-Donor Trust Fund', to better roll out cybersecurity development agenda in a systematic manner.
2. The new fund has been developed as an associated trust fund under the broader Digital Development Partnership (DDP) umbrella program.
3. World Bank has partnered with four countries, namely Estonia, Japan, Germany, and the Netherlands, to launch the fund.

Which of the above statements are correct?

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

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

Ans. **(d)**

Sol. All the above facts mentioned about cyber security multi donor trust fund are correct.

52. Consider the following statements regarding Hydrogen Breakthrough Ironmaking Technology:

1. Swedish green steel venture HYBRIT, which had made the 'world's first' customer delivery of steel produced with using coal.
2. The steel was made using Hydrogen Breakthrough Iron-making Technology, which uses 100% fossil-free hydrogen instead of coal and coke.
3. The venture has started delivering the fossil-free steel to the Volvo Group as part of its trial run.

Which of the above statements is/are correct?

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

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

Ans. **(b)**

Sol. Swedish green steel venture HYBRIT, made the world's first customer delivery of steel without using the coal. The steel made using hydrogen breakthrough iron-making technology, which uses 100% fossil free hydrogen instead of coal and coke. It has started delivering the fossil free steel to the volvo group as a part of its trial run.

53. US-based Ohmium International has started India's first green hydrogen electrolyzer manufacturing unit at

(a) Pune, Maharashtra

(b) Hyderabad, Telangana

(c) Bengaluru, Karnataka

(d) Noida, Uttar Pradesh

Ans. **(c)**

54. Which one of the following ministries has repealed the Unmanned Aircraft Systems (UAS) Rules, 2021 and replaced the same with the liberalized drone Rules, 2021?

(a) Ministry of Home Affairs

(b) Ministry of Defence

(c) Ministry of Science and Technology

(d) Ministry of civil Aviation

Ans. **(d)**

Sol. The unmanned aircraft systems are generally known as the drones and they fall under the Ministry of Civil l Aviation who has released the rules 2021.

55. Consider the following statements regarding Forum for Decarbonizing Transport:

1. NITI Aayog and World Resources Institute (WRI), India, jointly launched the 'Forum for Decar-bonizing Transport' in India.
2. NITI Aaygo is the implementing partner for India.
3. The aim of the project is to bring down the peak level of GHG emission (transport sector) in Asia (in line with a well below 2-degree pathway), resulting in problems like congestion and air pollution.

Which of the above statements are correct?

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

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

Ans. **(d)**

Sol. NITI Aayog and World Resources Institute India(WRI) jointly launched 'Forum for Decarbonizing Transport' in India as part of the NDC-Transport Initiative for Asia (NDC-TIA) project. **NITI Aayog is** the implementing partner for the India component of the project.

About the Forum:

- It aims at bringing down the peak level of GHG emissions (transport sector) in Asia (below 2-degree pathway), resulting in problems like congestion and air pollution.
- The NDC-TIA India component focuses on developing a coherent strategy of effective policies and the formation of a multi-stakeholder platform for decarbonizing transport in the country.
- Through this forum, the WRI India team, along with NITI Aayog and other project partners, will work in close coordination with all these stakeholders to formulate strategies and develop **appropriate business models to accelerate electric mobility** in India.
- The forum will bring together CEOs, researchers, academics, multilateral agencies, financial institutions as well as the Central and state governments on a common platform

56. Which one of the following national parks has become the first national park in India to be equipped with satellite phones?

(a) Kaziranga National Park in Assam

(b) Sudarbans National Park in West Bengal

(c) Desert National Park In Rajasthan

(d) Indravati National Park in Chhattisgarh

Ans. **(a)**

Sol. Kaziranga National Park of Assam have become the first national park of India to be equipped with satellite phones.

57. Which one of the following cities has been named as the world's safest city from among 60 global cities, in Safe Cities Index 2021, released by the Economist Intelligence Unit (EIU)?

(a) Yangon (b) Copenhagen

(c) New York (d) Toronto

Ans. **(b)**

58. The First-ever G20 Ministerial Conference on Women's Empowerment was held at

(a) Vienna, Austria

(b) Hamburg, Berlin

(c) Geneva, Switzerland

(d) Santa Margherita Ligure, Italy

Ans. **(d)**

59. Which one of the following countries did the Indian Navy participate in the U.S. Navy-led Southeast Asia Cooperation and Training (SEACAT) military exercise, to demonstrate its maritime manoeuvres?

(a) Malaysia (b) Australia

(c) Singapore (d) New Zealand

Ans. **(c)**

60. Most serious students are happy students, and most serious students go to graduate school. Furthermore, all students who go to graduate school are overworked.

Which one of the following can be properly inferred from the statements above?

(a) Most overworked students are happy students

(b) Some happy students are overworked

(c) All overworked students are serious students

(d) Some unhappy students go to graduate school

Ans. **(b)**

61. Some environmentalists question the prudence of exploiting features of the environment, arguing that there are no economic benefits to be gained from forests, mountains, or wetlands that no longer exist. Many environmentalists claim that because nature has intrinsic value it would be wrong to destroy such features of the environment, even if the economic costs of doing so were outweighed by the economic costs of not doing so.

Which one of the following can be logically inferred from the passage?

(a) It is economically imprudent to exploit features of the environment.

(b) Some environmentalists appeal to a noneconomic justification in questioning the defensibility of exploiting features of the environment.

(c) Most environmentalists appeal to economic reasons in questioning the defensibility of exploiting features of the environment.

(d) Many environmentalists provide only a noneconomic justification in questioning the defensibility of exploiting features of the environment.

Ans. **(b)**

62. Some argue that laws are instituted at least in part to help establish a particular moral fabric in society. But the primary function of law is surely to help order society so that its institutions, organizations, and citizenry can work together harmoniously, regardless of any further moral aims of the law. Indeed, the highest courts have on occasion treated moral beliefs based on conscience or religious faith as grounds for making exceptions in the application of laws.

The statements above, if true, most strongly support which one of the following

(a) The manner in which laws are applied sometimes takes into account the beliefs of the people governed by those laws.

(b) The law has as one of its functions the ordering of society but is devoid of moral aims.

(c) Actions based on religious belief or on moral conviction tend to receive the protection of the highest courts.

(d) The way a society is ordered by law should not reflect any moral convictions about the way society ought to be ordered.

Ans. **(a)**

63. Unlike newspapers in the old days, today's newspapers and televised news programs are full of stories about murders and assaults in our city. One can only conclude from this change that violent crime is now out of control, and, to be safe from personal attack, one should not leave one's home except for absolute necessities.

Which one of the following, if true, would cast the most serious doubt on the conclusion?

(a) Newspapers and televised news programs have more comprehensive coverage of violent crime than newspapers did in the old days.

(b) National data show that violent crime is out of control every-where, not just in the author's city.

(c) Police records show that people experience more violent crimes in their own neighborhoods than they do outside their neighborhoods.

(d) Murder comprised a larger proportion of violent crimes in the old days than it does today.

Ans. **(a)**

64. Fact 1: Jessica has four children.

Fact 2: Two of the children have blue eyes and two of the children have brown eyes.

Fact 3: Half of the children are girls.

If the first three statements are facts, which of the following statements must also be a fact?

I. At least one girl has blue eyes.

II. Two of the children are boys.

III. The boys have brown eyes.

Select the correct answer using the code given below:

(a) II only

(b) I and III only

(c) II and III only

(d) None of the statements is a known fact

Ans. **(a)**

Sol. Let

Fact–1 and Fact–2

C_1	C_2	C_3	C_4
↓	↓	↓	↓
Blue	Blue	Brown	Brown

Fact–1, Fact–2 and Fact–3.

Case-I:

C_1	C_2	C_3	C_4
↓	↓	↓	↓
Blue	Blue	Brown	Brown
↓	↓	↓	↓
Girl	Girl	Boy	Boy

Case-II:

C_1	C_2	C_3	C_4
↓	↓	↓	↓
Blue	Blue	Brown	Brown
↓	↓	↓	↓
Boy	Boy	Girl	Girl

Case-III:

C_1	C_2	C_3	C_4
↓	↓	↓	↓
Blue	Blue	Brown	Brown
↓	↓	↓	↓
Girl	Boy	Boy	Girl

From Case-I, Case-II and Case-III Statement (I) and (III) can't be fact.

Since one-half of the four children are girls two must be boys, so (II) is fact.

65. Children are in pursuit of a dog whose leash has broken. James is directly behind the dog. Ruby is behind James. Rachel is behind Ruby. Max is ahead of the dog walking down the street in the opposite direction. As the children and dog pass, Max turns around and joins the pursuit. He runs in behind Ruby. James runs faster and is alongside the dog on the left. Ruby runs faster and is alongside the dog on the right. Which child is directly behind the dog?

(a) James (b) Ruby

(c) Rachel (d) Max

Ans. **(d)**

Sol. After all switches were made Max is directly behind the dog, james is alongside the dog on the left Ruby is alongside the dog on the right and Rachel is behind Max.

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66. At the baseball game, Henry was sitting in seat 253. Marla was sitting to the right of Henry in seat 254. In the seat to the left of Henry was George. Inez was sitting to the left of George.

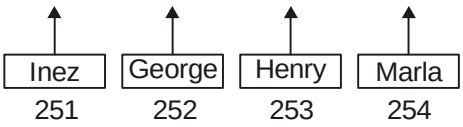
Which seat is Inez sitting in?

(a) 251 (b) 254

(c) 255 (d) 256

Ans. **(a)**

Sol.



67. The difference between simple interest and compound interest on a sum for 2 years at 8% when the interest is compounded annually is `16. If the interest were compounded half yearly the difference in two interests would be nearly

(a) `21.35 (b) `24.64

(c) `27.85 (d) `29.94

Ans. **(b)**

Sol. The difference between simple interest and compound interest for two years when compounded annually = $P\left(\frac{r}{100}\right)^2$

$$16 = P\left(\frac{8}{100}\right)^2$$

$$P = \text{`}2500$$

Now,

$$\text{S.I. for two years} = \frac{Prt}{100}$$

$$= \frac{2500 \times 8 \times 2}{100}$$

$$= \text{`}400$$

C.I. for two year when compounded semi-annually

$$= P\left(1+\frac{r}{2\times 100}\right)^{2\times 2} - P$$

$$= 2500\left(1+\frac{4}{100}\right)^4 - 2500$$

$$= \text{`}424.64$$

$$\text{Difference} = 424.64 - 400 = \text{`}24.64$$

68. A library has two books each having three copies and three other books each having two copies. In how many ways can all these books be arranged in a shelf so that copies of the same book are not separated?

(a) 80 (b) 100

(c) 120 (d) 140

Ans. **(c)**

Sol. Consider same copies as one book. Now, there are 5 books. n distinct books can be arrange in n! = 5!

$$= 5 \times 4 \times 3 \times 2 \times 1$$

$$= 120$$

69. 21 mango trees, 42 apple trees and 56 orange trees have to be planted in rows such that each row contains the same number of trees of one variety only. Minimum number of rows in which the above trees may be planted is

(a) 9 (b) 12

(c) 14 (d) 17

Ans. **(d)**

Sol. Maximum number of trees each row can have

$$= \text{H.C.F.}(21, 42, 56)$$

$$= 7$$

Minimum number of rows

$$= \frac{21}{7} + \frac{42}{7} + \frac{56}{7}$$

$$= 3 + 6 + 8$$

$$= 17$$

70. A general wishes to draw up his 36562 soldiers in the form of a solid square. After arranging them, he found that some of them are left over. How many are left?

(a) 81 (b) 75

(c) 61 (d) 52

Ans. **(a)**

Sol. As total soldiers are 36562 who are to be arranged in square that means no. of rows and columns will be same. Let number of rows and columns are x and left over is y.

$$x^2 + y = 36562$$
$$y = 36562 - x^2$$

(Now the maximum possible value of $x = \left[\sqrt{36562}\right] = 191$)

$$y = 36562 - (191)^2$$
$$= 81$$

71. A tank can be filled by 20 buckets each of capacity 13.5 litres. If the capacity of each bucket be 9 litres, how many bucket will fill the same tank?

(a) 30 (b) 25
(c) 20 (d) 15

Ans. **(a)**

Sol. Capacity of tank = 20 × 13.5 litres

= 270

Now, $n \times 9 = 270$

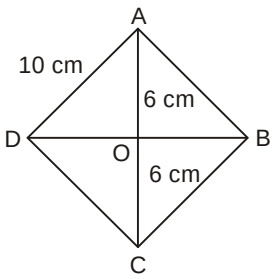
$$n = \left(\frac{270}{9}\right) = 30$$

72. One side of a rhombus is 10 cm and one of its diagonals is 12 cm. The area of the rhombus is

(a) 24 sq. cm (b) 48 sq. cm
(c) 72 sq. cm (d) 96 sq. cm

Ans. **(d)**

Sol.



In ΔAOD

$$OA^2 + OD^2 = AD^2$$
$$(6)^2 + OD^2 = (10)^2$$
$$OD^2 = 100 - 36$$
$$OD = 8$$

Area of rhombus = 4(Area ΔOAD)

$$= 4 \times \left(\frac{1}{2} \times 8 \times 6\right)$$
$$= 4 \times 24 = 96 \text{ sq.cm}$$

73. Two boys begin together to write out a booklet containing 817 lines. The first boy starts with first line, writing at the rate of 200 lines an hour and the second boy starts with the last line. He writes line 817 and so on backwards proceeding at the rate of 150 lines an hour. At what line will they meet?

(a) 469th (b) 467th
(c) 465th (d) 463rd

Ans. **(b)**

Sol. Writing ratio = 200 : 150 = 4 : 3

As equal work are taken in a given time, first boy will write line number

$$= \frac{4}{4+3} \times 817$$
$$= 466\frac{6}{7}$$

or 467th line

Means both of them will meet at line number 467.

74. Rohith spends 40% of his monthly income on food items and 50% of the remaining on clothes and conveyance. He saves one-third of the remaining amount after spending on food, clothes and conveyance. If he saves Rs. 19,200 every year, what is his monthly income ?

(a) ` 32,000 (b) ` 16,000
(c) ` 12,000 (d) ` 6,000

Ans. **(b)**

Sol. Let monthly income is x

Spend on food items = 0.4 x

Remaining = 0.6 x

Spend on cloth and conveyance

$$= \frac{1}{2}(0.6x) = 0.3x$$

$$\text{Remaining} = 0.3\ x$$

$$\text{Saving} = (0.3x)\times\frac{1}{3} = 0.1\ x$$

$$\frac{19200}{12} = 0.1x$$

$$\Rightarrow \quad x = \text{` } 16000$$

75. The value of $L^{-1}\left\{\frac{5s^2+8s+1}{(s+3)(s^2+1)}\right\}$ is

(a) $2e^{-3t}+3\cos t-\sin t$

(b) $2e^{-3t}-3\cos t+\sin t$

(c) $3e^{-3t}+2\cos t-\sin t$

(d) $3e^{-3t}-2\cos t+\sin t$

Ans. **(a)**

Sol.

$$L^{-1}\left[\frac{5s^2+8s-1}{(s+3)(s^2+1)}\right] = L^{-1}\left[\frac{2}{s+3}+\frac{3s-1}{s^2+1}\right]$$

[Partial Fractioning]

$$= L^{-1}\left[\frac{2}{s+3}+\frac{3s}{s^2+1}-\frac{1}{s^2+1}\right]$$

$$= 2L^{-1}\left[\frac{1}{s+3}\right]+3L^{-1}\left[\frac{s}{s^2+1}\right]-L^{-1}\left[\frac{1}{s^2+1}\right]$$

$$L^{-1}\left\{\frac{1}{s+3}\right\} = e^{-3t} \quad ...(a)$$

$$L^{-1}\left\{\frac{s}{s^2+1}\right\} = \cos t \quad ...(b)$$

$$L^{-1}\left\{\frac{1}{s^2+1}\right\} = \sin t \quad ...(c)$$

$$= 2e^{-3t}+3\cos t-\sin t$$

76. What is the Laplace transform of $2e^{3t}(4\cos 2t-5\sin 2t)$?

(a) $\frac{4s-44}{s^2+6s-13}$ (b) $\frac{4s-44}{s^2-6s+13}$

(c) $\frac{4s+44}{s^2+6s-13}$ (d) $\frac{8s-44}{s^2-6s+13}$

Ans. **(d)**

Sol.

$$L\{\cos 2t\} = \frac{s}{s^2+4}$$

$$L\{\sin 2t\} = \frac{2}{s^2+4}$$

$$L\{e^{3t}\cos 2t\} = \frac{s-3}{(s-3)^2+4}$$

$$= \frac{s-3}{s^2-6s+13}$$

$$L\{e^{3t}\sin 2t\} = \frac{2}{(s-3)^2+4}$$

$$= \frac{2}{s^2-6s+13}$$

$$L\{2e^{3t}(4\cos 2t-5\sin 2t)\}$$

$$= 8L\{e^{3t}\cos 2t\}-10L\{e^{3t}\sin 2t\}$$

$$= 8\times\frac{s-3}{s^2-6s-13}-10\times\frac{2}{s^2-6s+13}$$

$$= \frac{8s-24-20}{s^2-6s+13} = \frac{8s-44}{s^2-6s+13}$$

77. A batch of 100 capacitors contains 73 which are within the required tolerance values, 17 which are below the required tolerance values, an the remaining are above the required tolerance values. What is the probability that when randomly selecting a capacitor and then a second capacitor, if both are within the required tolerance values when selecting with replacement?

(a) 0.3319 (b) 0.5329

(c) 0.7239 (d) 0.9249

Ans. **(b)**

Sol. The probability of selecting a capacitor within required tolerance = $\left(\frac{73}{100}\right)$.

The first capacitor drawn is now replaced and second one is drawn from the batch of 100. Now, the probability of this capacitor being within the required tolerance limit = $\frac{73}{100}$.

Now, Required P(E) = $\frac{73}{100} \times \frac{73}{100} = 0.5329$

78. The value of $\int_0^4 \sqrt{(16 - x^2)}\,dx$ is

(a) π (b) 2π

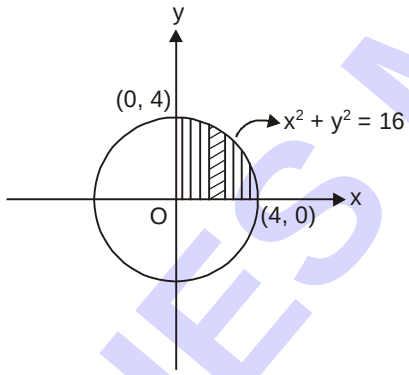
(c) 3π (d) 4π

Ans. **(d)**

Sol. Given function is

$$y = \sqrt{16 - x^2}$$
$$y^2 = 16 - x^2$$
$$y^2 + x^2 = 16$$

Circle centred at (0, 0) and radius = 4 unit



$$\int_0^4 \sqrt{16 - x^2}\,dx = \frac{\pi r^2}{4} = \frac{\pi(4)^2}{4} = 4\pi$$

79. The value of $\int_0^2 \frac{3x}{\sqrt{(2x^2+1)}}\,dx$ is

(take positive values of square roots only)

(a) 1 (b) 2

(c) 3 (d) 4

Ans. **(c)**

Sol. $$I = \int_0^2 \frac{3x}{\sqrt{2x^2+1}}\,dx$$

Assume

$$2x^2 + 1 = t \quad \text{...(i)}$$
$$\Rightarrow \quad 4x\,dx = dt$$
$$\Rightarrow \quad 3x\,dx = \frac{3}{4}dt \quad \text{...(ii)}$$

When $x = 0,\ t = 1$

$x = 2,\ t = 9$

Now integration using substitution

$$I = \frac{3}{4}\int_1^9 \frac{dt}{\sqrt{t}}$$
$$= \frac{3}{4}\left(\frac{t^{-\frac{1}{2}+1}}{-\frac{1}{2}+1}\right)_1^9$$
$$= \frac{3}{4} \times 2\left(\sqrt{t}\right)_1^9$$
$$= \frac{3}{4} \times 2 \times 2$$
$$= 3$$

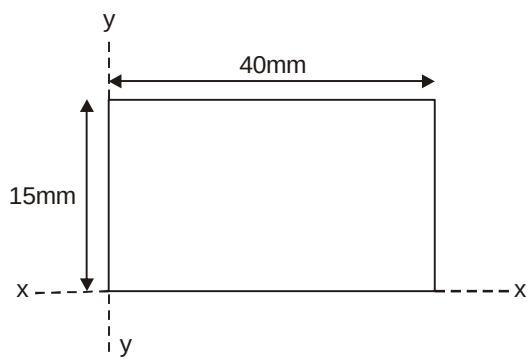
80. What is the radius of gyration of a rectangular lamina of length 40 mm and width 15 mm about an axis through one corner, perpendicular to the plane of the lamina ?

(a) 1.27 cm (b) 2.47 cm

(c) 3.67 cm (d) 4.87 cm

Ans. **(b)**

Sol.



radius of gyration = $\sqrt{\frac{I}{A}}$

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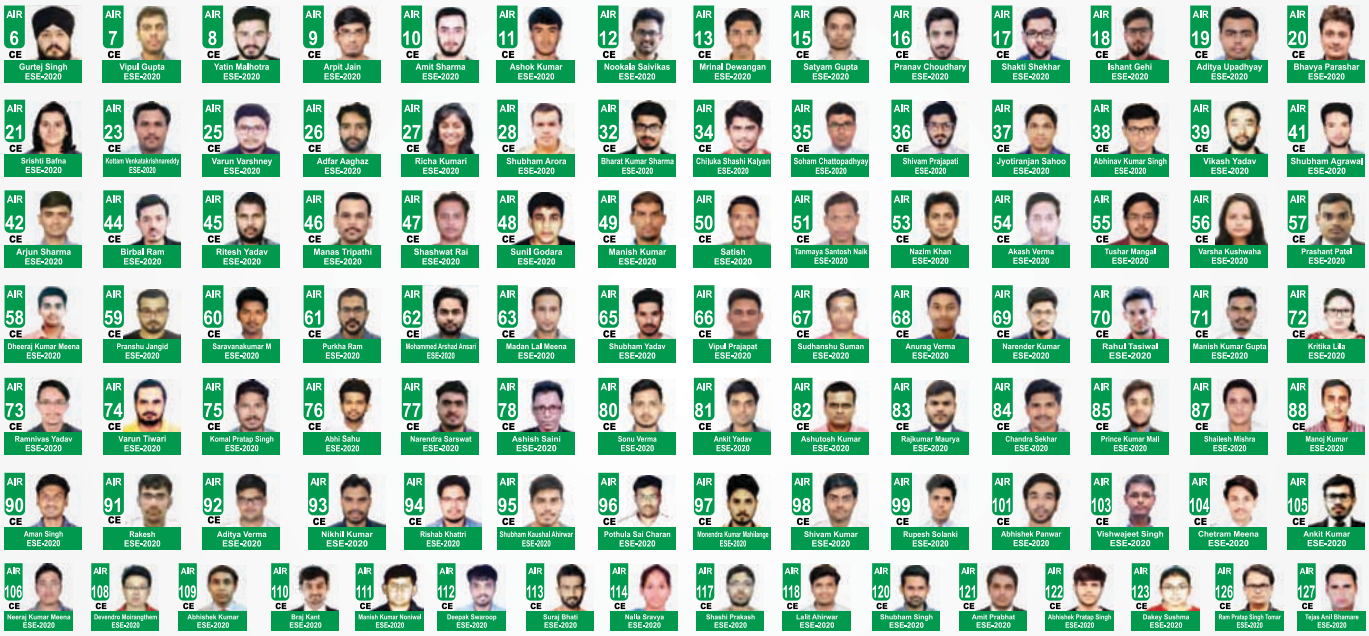

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$$I_{xx} = \frac{40\times(15)^3}{3}\text{mm}^4$$

$$I_{yy} = \frac{15\times(40)^3}{3}\text{mm}^4$$

$\Rightarrow$ Inertia about an axis through one corner.

Say $\quad I_{zz} = I_{xx} + I_{yy}$

$$= \frac{40\times(15)^3}{3} + \frac{15\times(40)^3}{3}$$

$$= \frac{40\times15}{3}(15^2+40^2)$$

$$= 365000\,\text{mm}^4$$

$$\Rightarrow \quad r = \sqrt{\frac{365000}{40\times15}} = 24.66\,\text{mm} \cong 2.47\,\text{cm}$$

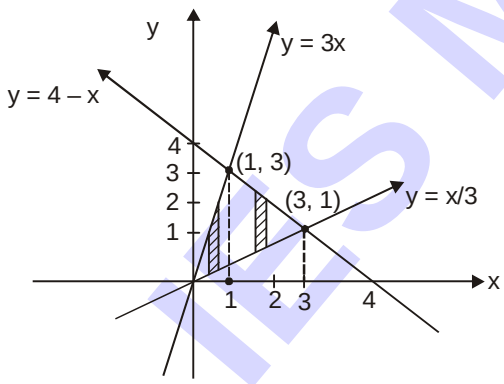
81. By integration the area bounded by the three straight lines y = 4 – x, y = 3x and 3y = x is

(a) 2 square units (b) 3 square units

(c) 4 square units (d) 5 square units

Ans. **(c)**

Sol. y = 4 – x, y = 3x, y = x/3



$$\text{Area} = \iint_R dy\,dx$$

$$= \int_0^1\int_{x/3}^{3x} dy\,dx + \int_1^3\int_{x/3}^{4-x} dy\,dx$$

$$= \int_0^1\left(3x - \frac{x}{3}\right)dx + \int_1^3\left(4 - x - \frac{x}{3}\right)dx$$

$$= \int_0^1 \frac{8x}{3}dx + \int_1^3\left(4 - \frac{4x}{3}\right)dx$$

$$= \frac{4}{3} + \frac{8}{3} = 4$$

82. The power series for $\ell n\left(\frac{1+x}{1-x}\right)$ is

(a) $\left(x + \frac{x^3}{3} + \frac{x^5}{5} + \ldots\right)$

(b) $2\left(x - \frac{x^3}{3} + \frac{x^5}{5} - \ldots\right)$

(c) $2\left(x + \frac{x^3}{3} + \frac{x^5}{5} + \ldots\right)$

(d) $\left(x - \frac{x^3}{3} + \frac{x^5}{5} - \ldots\right)$

Ans. **(c)**

Sol. $\ln\left(\frac{m}{n}\right) = \ln m - \ln n$

So, $\ln\left(\frac{1+x}{1-x}\right) = \ln(1 + x) - \ln(1 - x)$

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

$$= 2x + \frac{2x^3}{3} + \frac{2x^5}{5} + 2\frac{x^7}{7} + \ldots$$

$$= 2\left(x + \frac{x^3}{3} + \frac{x^5}{5} + \frac{x^7}{7} + \ldots\infty\right)$$

83. The mean value of $y = 3x^2 + 4x + 1$ between x = – 1 and x = 2 is

(a) 2 (b) 4

(c) 6 (d) 8

Ans. **(c)**

Sol. Mean value of f(x) from x = a to x = b is given by

$$= \frac{\int_a^b f(x)\,dx}{b-a}$$

$$= \int_{-1}^{2}\frac{3x^2+4x+1}{2-(-1)}dx$$

$$= \frac{1}{3}\int_{-1}^{2}(3x^2+4x+1)\,dx$$

$$= \frac{1}{3}(x^3 + 2x^2 + x)_{-1}^{2}$$

$$= \frac{1}{3} \times 18 = 6$$

84. What is the length of the curve $x = 2\cos^3\theta$, $y = 2\sin^3\theta$ between the points corresponding to $\theta = 0$ and $= \frac{\pi}{2}$?

(a) 2 units (b) 3 units

(c) 4 units (d) 5 units

Ans. **(b)**

Sol. Arc length $= \int \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$

$$dx = 2\cos^3\theta = 6\cos^2\theta(-\sin\theta)\, d\theta$$

$$\frac{dx}{d\theta} = -6\cos^2\theta\sin\theta \quad \text{...(i)}$$

$$dy = 6\sin^2\theta\cos\theta\, d\theta$$

$$\frac{dy}{d\theta} = 6\sin^2\theta\cos\theta \quad \text{...(ii)}$$

$$\frac{dy}{dx} = -\frac{\sin\theta}{\cos\theta} = -\tan\theta \quad \text{...(iii)}$$

$$S = \int_0^{\pi/2} \left(\sqrt{1 + (-\tan\theta)^2}\right) 6\cos^2\theta(-\sin\theta)\, d\theta$$

$$= -3\int_0^{\pi/2} \sin 2\theta\, d\theta = 3$$

85. What is the largest eigenvalue in modulus of the matrix $A = \begin{pmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{pmatrix}$ with an initial vector $(1, 1, 1)^T$ by power method?

(a) 11.84 (b) 12.84

(c) 13.84 (d) 14.84

Ans. **(a)**

Sol.

$$AX_0 = \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

$$AX_0 = \begin{bmatrix} 2+3+2 \\ 4+3+5 \\ 3+2+9 \end{bmatrix} = \begin{bmatrix} 7 \\ 12 \\ 14 \end{bmatrix}$$

$$AX_0 = 14\begin{bmatrix} \frac{1}{2} \\ \frac{6}{7} \\ 1 \end{bmatrix} = 14\begin{bmatrix} 0.5 \\ 0.86 \\ 1 \end{bmatrix}$$

$$AX_1 = \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 0.5 \\ 0.86 \\ 1 \end{bmatrix} = \begin{bmatrix} 5.58 \\ 9.58 \\ 12.22 \end{bmatrix}$$

$$= 12.22\begin{bmatrix} 0.46 \\ 0.78 \\ 1 \end{bmatrix}$$

$$AX_2 = \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 0.46 \\ 0.78 \\ 1 \end{bmatrix} = \begin{bmatrix} 5.26 \\ 9.18 \\ 11.94 \end{bmatrix}$$

$$= 11.94\begin{bmatrix} 0.44 \\ 0.76 \\ 1 \end{bmatrix}$$

$\lambda = 11.94 \simeq 11.84$ (After some more iterations)

86. Reduce the matrix $A = \begin{bmatrix} 1 & 3 & 4 \\ 3 & 2 & -1 \\ 4 & -1 & 1 \end{bmatrix}$ to the tridiagonal form.

(a) $\begin{bmatrix} 1 & -5 & 0 \\ -5 & \frac{2}{5} & \frac{1}{5} \\ 0 & \frac{1}{5} & \frac{13}{5} \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 & -5 \\ -5 & \frac{2}{5} & -\frac{1}{5} \\ 0 & -\frac{13}{5} & \frac{1}{5} \end{bmatrix}$

(c) $\begin{bmatrix} 1 & -5 & 0 \\ -5 & -\frac{2}{5} & -\frac{13}{5} \\ 0 & \frac{1}{5} & \frac{1}{5} \end{bmatrix}$ (d) $\begin{bmatrix} 1 & -5 & 0 \\ -5 & -\frac{2}{5} & \frac{1}{5} \\ 0 & \frac{13}{5} & \frac{1}{5} \end{bmatrix}$

Ans. **(a)**

Method-1: As we know that

Trace (A) = Trace (Tridiagonal form)

Trace (A) = 1 + 2 + 1 = 4

$$T(\text{option a}) = 1+\frac{2}{5}+\frac{13}{5}=4$$

$$T(\text{option b}) = 1+\frac{2}{5}+\frac{1}{5}=\frac{8}{5}\neq 4$$

$$T(\text{option c}) = 1-\frac{2}{5}-\frac{13}{5}=-2\neq 4$$

$$T(\text{option d}) = 1-\frac{2}{5}+\frac{1}{5}=\frac{4}{5}\neq 4$$

Method-2:

House Holder's Method:

Matrix must be symmetric

$$S_1 = \sqrt{a_{12}^2+a_{13}^2}=\sqrt{9+16}=5$$

$$x_2^2 = \frac{1}{2}\left[1+\frac{a_{12}(\text{sign } a_{12})}{S_1}\right]=\frac{4}{5}$$

$$x_3 = \frac{a_{13}(\text{sign } a_{12})}{2S_1x_2}=\frac{4\times\sqrt{5}}{2\times5\times2}=\frac{1}{\sqrt{5}}$$

$$1-2x_2^2=-\frac{3}{5},\ 1-2x_3^2=\frac{3}{5}$$

Transforming orthogonal matrix

$$B = \begin{bmatrix}1 & 0 & 0\\ 0 & 1-2x_2^2 & -2x_2x_3\\ 0 & -2x_2x_3 & 1-2x_3^2\end{bmatrix}$$

$$= \begin{bmatrix}1 & 0 & 0\\ 0 & -\frac{3}{5} & -\frac{4}{5}\\ 0 & -\frac{4}{5} & \frac{3}{5}\end{bmatrix}$$

Tridiagonal matrix = BAB^{-1} = BAB

$$= \begin{bmatrix}1 & -5 & 0\\ -5 & \frac{2}{5} & \frac{1}{5}\\ 0 & \frac{1}{5} & \frac{13}{5}\end{bmatrix}$$

87. From the Taylor series for y(x), what is the value of y(0.1) correct to four decimal places if y(x) satisfies $y' = x - y^2$ and y(0) = 1 ?

(a) 0.9138 (b) 0.7254

(c) 0.5286 (d) 0.3524

Ans. **(a)**

Sol.

$$y = y_0+(x-x_0)y_0'+\frac{(x-x_0)^2}{2!}y_0''+$$

$$y' = x-y^2 \text{ and } x_0=0,\ y_0=1$$

$$y_0' = 0-1=-1$$

$$y'' = 1-2yy'$$

$$y_0'' = 1-2\times1\times-1=3$$

$$y''' = -2\left[yy''+y'^2\right]$$

$$y_0''' = -2\left[1\times3+(-1)^2\right]$$

$$= -2[4]=-8$$

$$y = 1+x\times(-1)+\frac{x^2\times3}{2!}+\frac{x^3}{3!}\times-8+....$$

$$y = 1-x+\frac{3}{2}x^2-8\frac{x^3}{3!}+..$$

$$y(0.1) = 0.9137$$

$$\simeq 0.9138$$

88. What is the shape of the curve represented by $\frac{x}{5}=\sqrt{\left[1+\left(\frac{y}{2}\right)^2\right]}$?

(a) Hyperbola

(b) Rectangular hyperbola

(c) Parabola

(d) Ellipse

Ans. **(a)**

Sol.

$$\frac{x}{5} = \sqrt{1+\left(\frac{y}{2}\right)^2}$$

$$\frac{x^2}{25} = 1+\frac{y^2}{4}$$

$$\left(\frac{x^2}{25}\right)-\frac{y^2}{4} = 1$$

$$\left(\frac{x}{5}\right)^2 - \left(\frac{y}{2}\right)^2 = 1$$

Which is a hyperbola whose standard equation is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$.

89. What is the particular solution of the differential equation $5\frac{dy}{dx} + 2x = 3$ if the boundary conditions are $y = \frac{7}{5}$ and x = 2?

(a) $y = \frac{3x}{5} - \frac{x^2}{5} + 1$ (b) $y = \frac{3x}{5} + \frac{x^2}{5} - 2$

(c) $y = \frac{5x}{3} - \frac{x^2}{3} + 1$ (d) $y = \frac{5x}{3} + \frac{x^2}{3} - 2$

Ans. **(a)**

Sol. Complete solution y = C.F. + y_P

C.F. $\rightarrow$ Complementary Function

$y_P \rightarrow$ Particular Internal

Auxiliary Equation F(D) = 0

$$\Rightarrow \quad 5D = 0$$

$$D = 0$$

So, $\quad C.F. = Ce^{0x} \Rightarrow C$

$$y_P = \left[\frac{1}{F(D)}\right]x$$

$$= \left[\frac{1}{5D}\right](-2x+3)$$

$$= \frac{1}{5}(-x^2+3x)$$

$$y = C.F. + y_P$$

$$= -\frac{x^2}{5} + \frac{3x}{5} + C$$

Put x = 2 and y = 7/5 then you will get C = 1

Complete solution,

$$y = -\frac{x^2}{5} + \frac{3x}{5} + 1$$

90. Which of the following factors are included in product realization process ?

1. Marketing functions to assess customer requirements
2. Documentation of the design
3. Legal requirements

Select the correct answer using the code given below:

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

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

Ans. **(d)**

91. In general, which one of the following is NOT included in the list of parts or the bill of materials in an engineering drawing sheet ?

(a) Part number (b) Material Name

(c) Cost (d) Quantity

Ans. **(c)**

Sol. In an engineering drawing sheet, the list of parts or the bill of materials does not have the information on cost of the parts. These have:

1. Part number
2. Material Name
3. Quantity

92. Continuous thin (narrow) with zigzags (straight) lines are generally used to represent

(a) long-break line (b) hidden outline

(c) visible outline (d) reference line

Ans. **(a)**

Sol. Continuous thin (narrow) with zigzag lines are generally used to represent long break line.

93. When the receding lines are drawn to full size scale and the projectors inclined at an angle of 30° or 45° or 60° to the plane of projection, such oblique projection is known as

(a) Cabinet projection

(b) Vertical projection

(c) Cavalier projection

(d) Horizontal projection

Ans. **(c)**

Sol. When the receding lines are drawn to fall size scale and the projectors inclined at an angle of 30°, 45° or 60° to the plane of projection, such oblique projection is known as **Cavalier Projection** and in cabinet projection to reduce the distortion, the dimension and depth of the object is drawn half of the scale.

94. Which one of the following statements is correct about oblique projection ?

(a) The object is drawn with the reduced (about 82%) dimensions

(b) All the faces of the object are distorted in the shape and size

(c) Projectors from an object are parallel to each other and perpendicular to the plane of picture

(d) The faces of object which are perpendicular to the plane of projection will be distorted in the shape and size

Ans. **(d)**

Sol. In oblique projection, the face which is parallel to plane of projection, is projected in its true shape and size whereas the faces which are perpendicular to the plane of projection are distorted in shape and all the faces of the object are distorted in the shape and size in isometric projection.

95. Which one of the following methods is used when the non-isometric lines or their ends lie in isometric planes ?

(a) Intersection method

(b) Box method

(c) Co-ordinate method

(d) Offset method

Ans. **(b)**

Sol. **Box method** is used when the non-isometric lines or their ends lie in isometric planes.

Offset: In this inclined surfaces are located by offset or co-ordinate measurement along the isometric lines.

96. If a line is perpendicular to the V.P. and its V.T. coincides with its front view which is a point, then

(a) V.T. is a point on H.P.

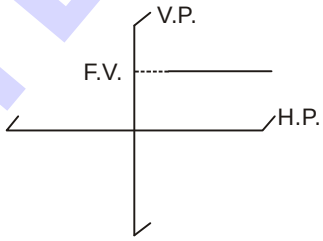
(b) H.T. is a point on V.P.

(c) It has no V.T.

(d) It has no H.T.

Ans. **(d)**

Sol. Line to perpendicular to vertical plane (V.P.) and its front view is a point.



Hence, the line is parallel to horizontal plane and therefore has no horizontal trace (H.T.)

Directions:

Each of the next **Four (04)** items consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below:

Codes:

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **NOT** the correct explanation of Statement (I).

(c) Statement (I) is true but Statement (II) is false.

(d) Statement (I) is false but Statement (II) is true.

97. **Statement (I):** The drawings and machining processes can be automated using CAD/CAM change the primary function of these drawings and processes.

Statements (II): The primary function is to provide information about the product to the designer and production people.

Ans. **(a)**

Sol.
- CAD is the use of computers designing means computers are used to aid in creating the design modifying and analyzing the designing activities.
- CAD/CAM applications are used to both design product and program manufacturing processes. Specially CNC machining. CAD/CAM software is used to design and manufacture prototypes, finished parts and production runs. The primary function is to provide information about the product of the designer and production people.

98. **Statement (I):** Environmental pollution has become global problem.

Statement (II): The rapidly growing human population, rapid urbanization, intensive agriculture and industrialization together with human activities resulted in the environmental pollution.

Ans. **(b)**

99. **Statement (I):** Content is the heart of any IT project.

Statement (II): Implementation and maintenance of e-government projects through IT professional hired from the market is likely to result in failure of the project as the organization is bound to disown such outsiders.

Ans. **(d)**

Sol. Statement 2 is incorrect because a lot of e-governance project are actually working in PPP model very successfully. Example the GSTN.

Statement 1 is correct because it is indeed content is the heart of IT project.

100. **Statement (I):** Social involvement discourages additional government regulation and intervention.

Statement (II): Social involvement car create a weakened international balance of payments situation.

Ans. **(c)**

Sol. It is hard to infer that social involvement can create a balance of payment situation. It could be the case that in certain scenarios social involvement discourages additional government regulations and intervention.