ESE 2022

Preliminary Examination

Detailed Solution of

GENERAL STUDIES & ENGINEERING APTITUDE

Set-B

Scroll down

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General Studies and Engineering Aptitude Paper
Analysis of ESE 2022 Preliminary Examination

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UPSC ESE Prelims 2022 Paper-1
General Studies and Engineering Aptitude
by **MADE EASY Faculties**

https://www.youtube.com/watch?v=rvKLS_jF_w0&t=4215s

1. The Engineers for a Sustainable World (ESW) meant for using the professional talents to create a more sustainable world was founded in

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

Ans. (c)

Engineers for a Sustainable World (ESW) is an international non-profit network of students & professionals united by their shared passion for technical sustainability.

What is ESW's vision & mission?

It strives to empower students and professionals to tackle sustainability challenges. The ESW works towards a sustainable world supported by a network of passionate engineers. Its goals are as follows:

1. Design and implement hands-on sustainability projects across the globe.
2. Educate students and practicing engineers on sustainability best practices.
3. Unite those passionate about sustainability in a productive international network.

In 2001, Cornell Engineering Master's student Clewlow started work on the creation of a non-profit national organization she called Engineers Without Frontiers USA. By the spring of 2002, chapters of this new organization had formed at Cornell and Penn State. Before 2002 ended, there were chapters all around the country. Clewlow was the group's executive director for the first 6 years and oversaw rapid growth, along with a name-change to Engineers for a Sustainable World (ESW) in 2004.

End of Solution

2. 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)

ILO Declaration on Fundamental Principles and Rights at Work

Adopted in 1998, the Declaration commits Member States to respect and promote principles and rights in four categories, whether or not they have ratified the relevant Conventions. These categories are:

1. Freedom of association and the effective recognition of the right to collective bargaining,
2. The elimination of forced or compulsory labour,
3. The abolition of child labour and
4. The elimination of discrimination in respect of employment and occupation.

End of Solution

3. 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)
Business Ethics doesn't include Avoid Action, as it is essential pre-requisite for Ethics.

End of Solution

4. 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) Environmental restoration
(d) Risk reduction

Ans. (a)
Principle of safe product and service.
The principle focus on to make sure that no products are manufactured or distributed which pose unacceptable risks to humans or the environment. If unacceptable risks are identified, attempt is to provide comprehensive information to customers and all other stakeholders. Usually, the measures taken to reduce these risks to an appropriate level or to eliminate them sustainably.

End of Solution

5. 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)

End of Solution

6. Which one of the following is NOT correct regarding 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 lakh.
(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)
The Khel Ratna Award, renamed Major Dhyan Chand Khel Ratna award, is the highest sporting award given by the Ministry of Youth Affairs and Sports.
It is awarded for the spectacular and most outstanding performance in the field of sports by a sportsperson over a period of four years. It comes with a cash prize of Rs 25 lakh.
The Khel Ratna award was instituted in 1991-1992 and the first recipient was Chess legend Viswanathan Anand.

End of Solution

7. How many Indian companies have found a place in 2021 Fortune's Global 500 list?
(a) Three (b) Five
(c) Seven (d) Nine

Ans. (c)

Seven Indian companies have found a place in 2021 Fortune's Global 500 list. Indian Companies in the list are:

1. Reliance Industries (Rank: 155)
2. State Bank of India (205)
3. Indian Oil Corporation (212)
4. Oil & Natural Gas Corporation (243)
5. Rajesh Exports (348)
6. Tata Motors (357)
7. Bharat Petroleum (394)

End of Solution

8. 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)

EASE 4.0 reforms look after four key initiatives to be adopted by public sector banks:

1. **Smart lending backed by analytics:**
   - Dial-a-loan for doorstep lending
   - Credit@Click: End to End digital retail and MSME lending
   - Analytics based credit offers
2. **24×7 banking with resilient technology and cloud based IT systems**
   - Deeper penetration of Mobile & internet banking
   - Cloud-based IT Systems and improved cyber resilience
   - Process automation
3. **Data enabled agriculture financing**
   - Dial-a-loan for agri loans
   - Partnership with AgriTechs for data exchange
   - Automated Processing & sanctioning
4. **Collaborating with the financial ecosystem**
   - Digital Payments in semi-urban and rural areas
   - At scale delivery of doorstep banking services
   - Co-lending with NBFCs

End of Solution

9. 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. (a)

The Pension Fund Regulatory and Development Authority (PFRDA) has increased the entry age for the National Pension System (NPS) from 65 years to 70 years. Earlier the eligible age to invest in NPS was 18-65 years which has now been revised to 18-70 years.

End of Solution

10. World's largest star sapphire cluster has been found in
(a) Rajkot, India
(b) Ratnapura, Sri Lanka
(c) Pretoria, South Africa
(d) Brisbane, Australia

Ans. (b)

End of Solution

11. Which one of the following protocols is designed 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)

In SSC protocol, communication between applications i.e. client and server over a network remains secure. SSL works by using certificate for authentication of client and server and uses encryption/decryption with unique key.

End of Solution

12. 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 guess-work
(c) It is very expensive to provide so many audio-visual aids
(d) Revise/redesign at frequent intervals is difficult and expansive

Ans. (b)

In branching or intrinsic programming student is provided a piece of information, and a situation with multiple choice. A student who responds incorrectly will either be returned to the original frame and a student who responds correctly will advance to the next frame. Hence, there is a scope of guess work in it.

End of Solution

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

(a) Project-based learning
(b) Cooperative learning
(c) Collaborative learning
(d) Outcome based learning

Ans. (a)

Projects are organized around a driving question. A teaching method or approach that engages student in sustained, collaborative, real world investigation is project based learning.

End of Solution

14. 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)

A broadcasting method in radio where frequency modulation is used. In this method, each radio station has its own frequency.

End of Solution

15. 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 (140 bytes)

Ans. (b)

In AES key expansion algorithm a word key is taken to produce a linear array of 44 words. Each round uses 4 of these words and each word contains 32 bytes which means each subkey is 128 bit long.

End of Solution

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

1. It includes a conscientious commitment to live by moral values.
2. It 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. (c)

Responsible Experimentalists

1. **Conscientiousness:** Protect safety knowledge, respect right of consent of public
2. **Relevant Information or Comprehensive perspective:** Awareness of experimental nature of projects, forecasting, monitoring
3. **Moral autonomy:** Personally engaged, thoughtful, involvement in project
4. **Accountability:** Accept responsibility for results of a project (avoid fragmentation, diffusion, time pressures)

Hence, STATEMENT 3 i.e. It restricts free-personal involvement in all steps of the project or product development is wrong.

Hence, Correct Option is 1, 2 and 4 only.

End of Solution

17. 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)

Martha Nussbaum identified **an Aristotelian set of ten universal, normative capabilities** that act as freedoms that are **generally protected by law**. These may be viewed as needs, although they are also related to values.

1. **Life:** Being able to live a complete and satisfying life into old age. Not having life cut short or being made such that it hardly seems worth living.
2. **Bodily Health:** Living with good health, and not in a state where ill health seriously affects the quality of life. Having access to medical help as needed. To have good food and be able to exercise in ways that sustain health.
3. **Bodily Integrity:** Being able to go where you want to go. Being free from attack and abuse of any kind. Being able to satisfy healthy bodily needs.
4. **Senses, Imagination and Thought:** Being able to use all of one's senses. Being free to imagine, think and reason.

5. **Emotion:** Being able to become attached to other things and people outside of ourselves, loving and caring for them. Experiencing grief, longing, gratitude and justified anger.
6. **Practical Reason:** Being able to consider and develop understanding of good and evil, and to think critically about the world and one's own place in it.
7. **Affiliation:** Being able to associate with others, living with them and acting for them. Showing concern for people in general and interacting with others.
8. **Other Species:** Being able to live with the full range of creatures and plants that inhabit the world around us. To be able to enjoy nature and appreciate its beauty.
9. **Play:** Being able to laugh, play games and generally have fun. Not having one's enjoyment and recreation criticized or prevented.
10. **Control Over One's Environment:** Being able to participate in political activities, making free choice and joining with others to promote political views.

Hence, Option (d) i.e. Being able to earn livelihood and live peacefully is not included.

End of Solution

18. Which one of the following is NOT a type of virtue for responsible professionalism?
(a) Public-spirited virtue (b) Team work virtue
(c) Self-realization virtue (d) Self-direction virtue

Ans. (c)

Professionalism responsibility/ Types of virtues

1. Public spirited virtues
2. Team work virtue
3. Self-direction virtue
4. Proficiency virtue

Hence, Self-realization virtues is answer.

End of Solution

19. 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)

Michael Davis guide to ethical decision-making include following eight moral tests. Some of these include:-

(a) Harm test: Does this option do less harm than the alternatives?
(b) Publicity test: Would I want my choice of this option published in the newspaper?
(c) Defensibility test: Could I defend my choice of this option before a congressional committee or committee of peers?
(d) Reversibility test: Would I still think this option was a good choice if I were adversely affected by it?
(e) Colleague test: What do my colleagues say when I describe my problem and suggest this option as my solution?

(f) **Professional test:** What might my profession's governing body for ethics say about this option?

(g) **Organization test:** What does my company's ethics officer or legal counsel say about this?

Hence, **Acceptability test** is not mentioned by Michael Davis.

End of Solution

20. Arrange the following in 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)

CSR, in the form that we see today, became popular after it was defined by Archie Carroll's "Pyramid of Corporate Social Responsibility" in 1991. Its simplicity, yet ability to describe the idea of CSR with four areas, has made the pyramid one of the most accepted corporate theories of CSR since.

Carroll's pyramid suggests that corporate has to fulfil responsibility at four levels – Economic, Legal, Ethical and Philanthropic.

1. **Economic Responsibility:** The lowest level of the pyramid represents a business's first responsibility, which is to be profitable. Without profit, the company would not be able to pay their workers, employees will lose their jobs even before the company starts CSR activities.
2. **Legal Responsibility:** The second level of the pyramid is the business's legal obligation to obey the law. This is the most important responsibility out of the four levels as this will show how companies conduct their business in the marketplace.
3. **Ethical Responsibility:** A company should not only be obeying the law, but it should also do their business ethically. Unlike the first two levels, this is something that a company is not obligated to do.
4. **Philanthropic Responsibility:** At the top of the pyramid, occupying the smallest space is philanthropy.

Hence, option (d) i.e. 1,3,4,2 is correct order.

End of Solution

21. Kyoto Protocol operationalizes the UN framework convention on
(a) sustainable development
(b) renewable energy
(c) climate change
(d) soil erosion

Ans. (c)

End of Solution

22. 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. (c)

End of Solution

23. 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)

End of Solution

24. 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. (c)

End of Solution

25. 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)

End of Solution

26. 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)

End of Solution

27. 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)

End of Solution

28. 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)

End of Solution

29. 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)

End of Solution

30. 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)

End of Solution

31. 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 the 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. (a)

End of Solution

32. 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. (d)

End of Solution

33. 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)

End of Solution

34. 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. (a)

End of Solution

35. 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's stated or implied needs.
2. The organization should provide confidence to it 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. (c)

End of Solution

36. 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 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)

End of Solution

37. 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)

End of Solution

38. 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)

End of Solution

39. 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)

End of Solution

40. 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)

End of Solution

41. 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)

There are two types of diffusion :
1. Microscopic diffusion
2. Macroscopic diffusion

In micro diffusion primarily atoms move a fraction of atomic distance.

- **Vacancy Diffusion :** One vacancy position is shifting to another so there is no significant movement of atoms.
- **Surface diffusion :** Suppose two surfaces are in contact and still the atoms are moving from one surface to another, so there also diffusion is taking place from one or two atomic distances only.
- **Lattice diffusion:** It is taking place within the gain so here also the movement is not significant.
- **Inter-diffusion :** In case of bi-material alloys (such as Cu-Ni alloy) ; when we are mixing these materials atoms of one metal moves almost close to 100 to 200 atomic distances just to make the homogenization. Hence, in case of inter-diffusion, movement of atoms is quite significant so it will not fall under microscopic diffusion.

End of Solution

42. 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)

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; one of them, as found in natural rubber.

End of Solution

43. '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)

Positive ion (cation) and negative ion (anion) attract one another with electrostatic force (Coulombic force) of attraction to form ionic bond.

End of Solution

44. 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)

The process by which plastic deformation is produced by dislocation motion is termed **slip**; the crystallographic plane along which the dislocation line traverses is the **slip plane**.

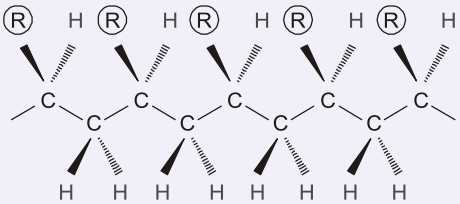
End of Solution

45. Stereiosomerism 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)

Stereiosomerism: It denotes the situation in which atoms are linked together in the same order (head-to-tail) but differ in their spatial arrangement. For one stereoisomer, all the *R* groups are situated on the same side of the chain as follows:



End of Solution

46. Some of the complex thermoplastic chains become so 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)

- The liquid crystal polymers (LCPs) are a group of chemically complex and structurally distinct materials that have unique properties and are utilized in diverse applications.
- LCPs are composed of extended, rod shaped, and rigid molecules.
- 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 characteristics intermolecular spacings.
- The principal use of liquid crystal polymers is in liquid crystal displays (LCDs) on digital watches, flat-panel computer monitors and televisions, and other digital displays.

End of Solution

47. 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)

Network attacks are those attacks that damage an entire system by orchestrating the IoT network.

Some well known routing attacks on IoT are: Selective forwarding attacks, sink hole attack Hellow flood attack, Wormhole attack, clone Id, etc.

End of Solution

48. Which one of the following layers in the OSI reference model is concerned with transmission of unstructured 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)

Physical layer is responsible for the communication of unstructured raw data streams over a physical medium. It defines a range of aspect that includes electrical, mechanical, and physical system and networking device that includes specifications such as cable size, signal frequency, voltage, etc.

End of Solution

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49. 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)

A real time system 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.

End of Solution

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

(a) Name server
(b) Terminal server
(c) Wide area information server
(d) File server

Ans. (c)

WAIS (Wide Area Information Server) is an internal 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 programme.

End of Solution

51. 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?

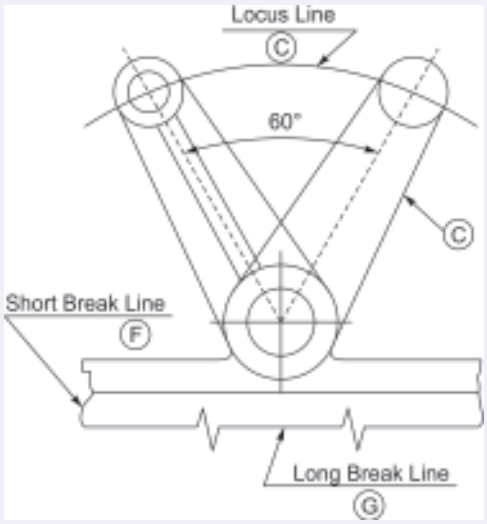
(a) Part number
(b) Material Name
(c) Cost
(d) Quantity

Ans. (b)

End of Solution

52. 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)

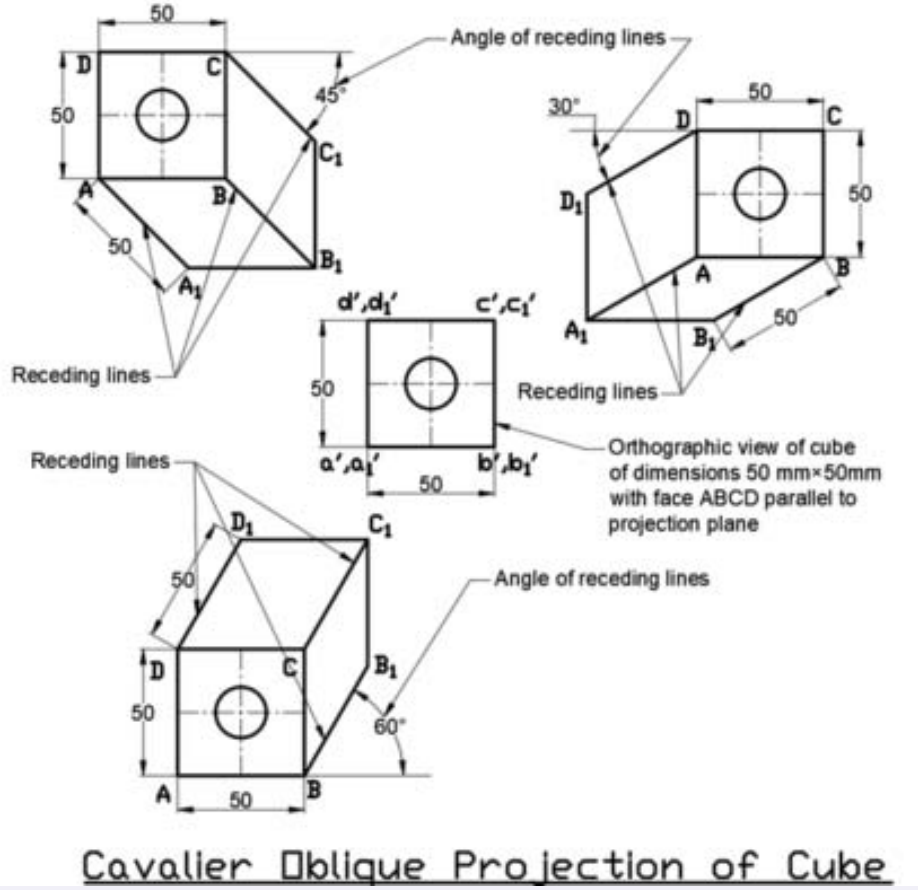


As shown in figure above, long break lines are continuous narrow lines with Zig Zag. Hidden line are represented by dashed wide line in general. Visible outline is generally represented by Continuous wide lines. Reference line is generally represented by continuous narrow line.

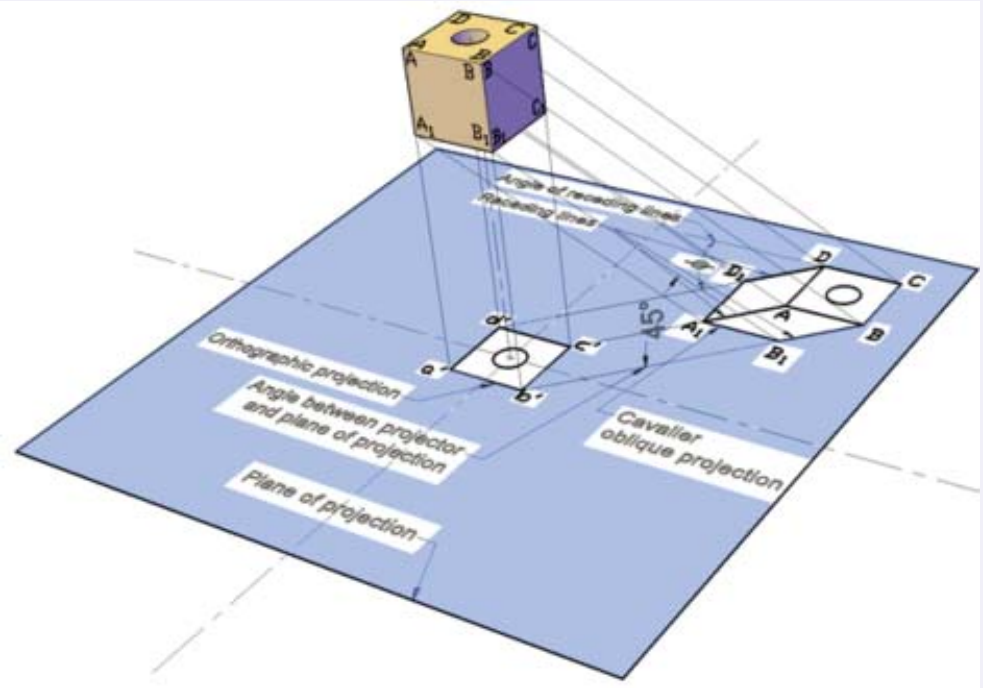
End of Solution

53. 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)



As shown in above figure, cavalier oblique projection receding lines are drawn to full size scale. Figure below gives the 3-Dimensional concept of cavalier oblique projection. In 3-dimensions when obtaining cavalier oblique projection most important face of solid is kept parallel to projection plane and parallel projectors dropped from corner point of solid make 45° angle with plane of projection. In 3-dimensions lines AA_1, BB_1, CC_1 & DD_1 of cube are perpendicular to projection plane and their oblique projection is called receding lines. As angle between projectors and plane of projection is 45° in Cavalier oblique projection, by geometry we reach the conclusion that receding lines will be of true length.

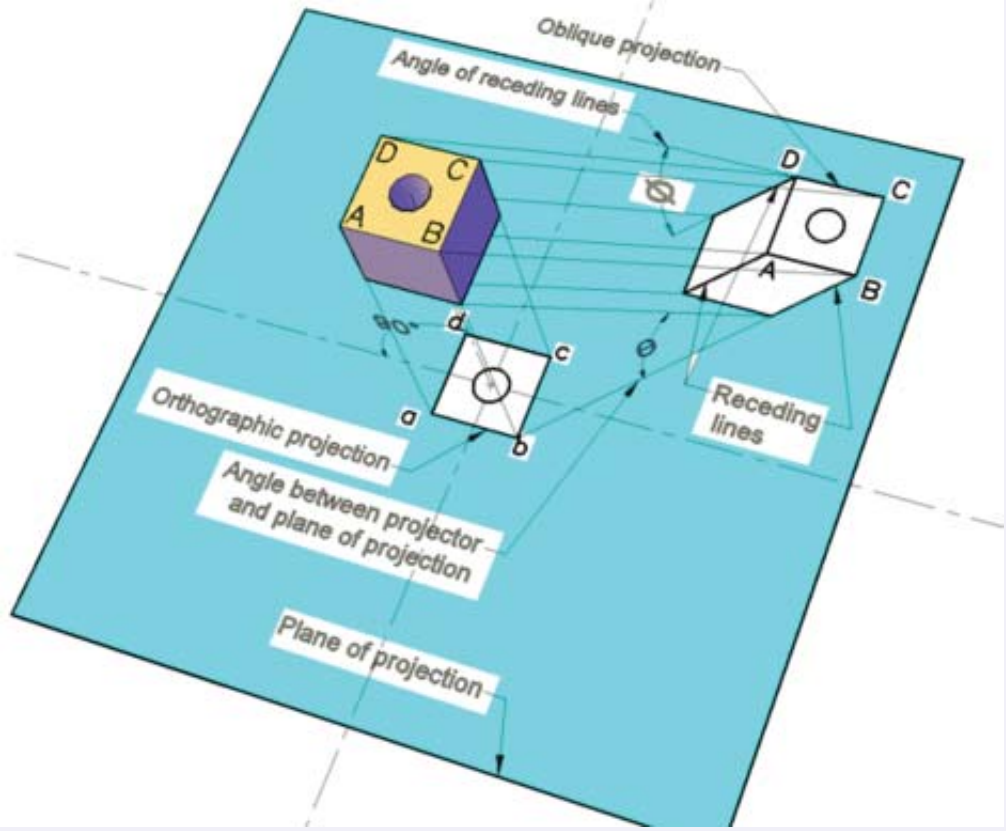


End of Solution

54. 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)

Diagram below gives 3D concept of oblique projection



While obtaining oblique projection, most important face of solid is kept parallel to plane of projection and appears to be of true shape and size in the oblique drawing. Hence option (a) and (b) are wrong. Oblique projection is a type pf parallel projection, hence when obtaining oblique projection of a solid, projectors are parallel to each other but oblique/inclined to plane of projection. Hence, option (c) is wrong. From figure below is clear that face of solid perpendicular to projection plane get distorted in oblique projection. Hence option (d) is the right answer.

End of Solution

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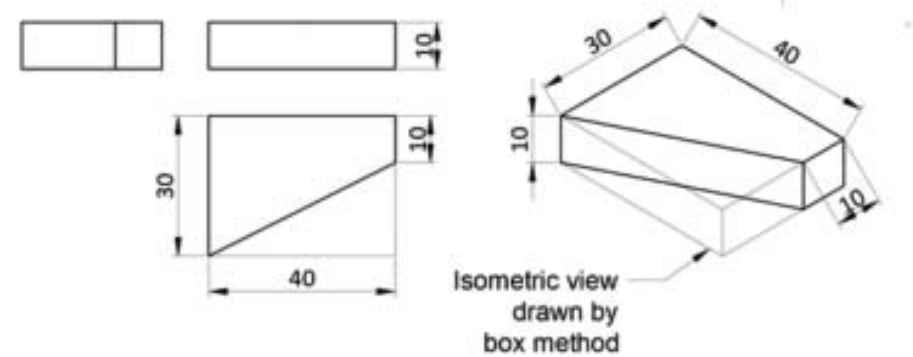
55. Which one of the following methods is used when the non-isometric lines or their ends lie in isometric planes?

(a) Intersection method
(b) Box method
(c) Co-ordinate method
(d) Offset method

Ans. (b)



As shown in figure below, when the non-isometric lines or their ends, lie in isometric planes then box method is used for making isometric view. Box method is simpler compared to Coordinate method, hence in above case use of Box method is preferred.

End of Solution

56. 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)

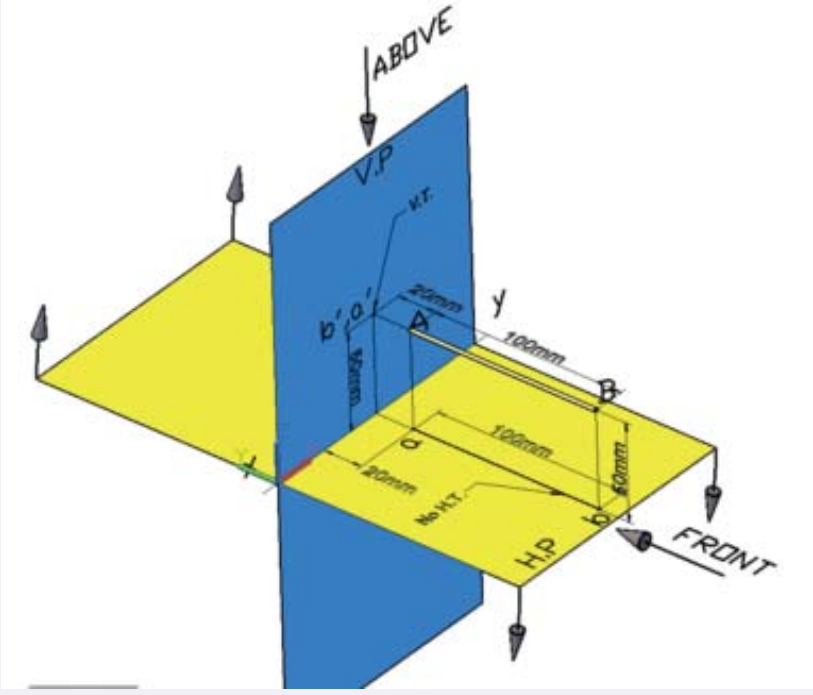


Figure above shows a line perpendicular to V.P. From 3-D model. It is clear that Vertical trace is on V.P. hence statement (a) & (c) are wrong. A line perpendicular to V.P. is always parallel to H.P. and it never intersects H.P. & has no H.T. hence statement (d) is correct.

End of Solution

Directions : Each of the next Four (4) items consists of two statements, one labelled as the 'Statement (I) and the other labelled 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

57. **Statement (I) :** The drawings and machining processes can be automated using CAD/CAM change the primary function of these drawings and processes.
Statement (II) : The primary function is to provide information about the product to the designer and production people.

Ans. (d)

- Once the automation starts, the primary function can not be changed. Hence statement (I) is wrong.
- To provide information about the product to the designer and production people is the primary function.

End of Solution

58. **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. (a)

End of Solution

59. **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. (c)

End of Solution

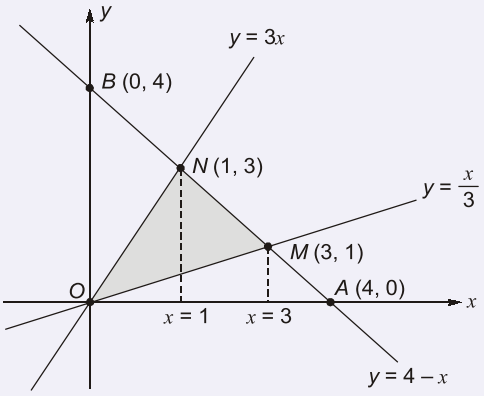
60. **Statement (I) :** Social involvement discourages additional government regulation and intervention.
Statement (II) : Social involvement can create a weakened international balance of payments situation.

Ans. (c)
Statement 2 is wrong, Hence correct option will be (c).

End of Solution

61. 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)



Points of intersection:

N:– $3x = 4 - x$
$4x = 4 \Rightarrow x = 1$

M:– $\frac{x}{3} = 4 - x$
$x = 12 - 3x$
$4x = 12 \Rightarrow x = 3$

$$\text{Area of OAB} = \frac{1}{2} \times 4 \times 4 = 8$$

$$\text{Area of OAM} = \frac{1}{2} \times 4 \times 1 = 2$$

$$\text{Area of ONB} = \frac{1}{2} \times 4 \times 1 = 2$$

$$\text{Area of OMN} = 8 - 2 - 2 = 4$$

End of Solution

62. The power series for $\ln\left(\frac{1+x}{1-x}\right)$ 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)

Power series for $\ln(1 + x)$ is given by

$$\ln(1+x) = x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\frac{x^5}{5}\ldots.$$

Power series for $\ln(1 - x)$ is given by

$$\ln(1-x) = -x-\frac{x^2}{2}-\frac{x^3}{3}-\frac{x^4}{4}-\frac{x^5}{5}\ldots.$$

Thus expansion of $\ln\left(\frac{1+x}{1-x}\right)$ can be written as

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

$$= \left(x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\frac{x^5}{5}\ldots.\right)-\left(-x-\frac{x^2}{2}-\frac{x^3}{3}-\frac{x^4}{4}-\frac{x^5}{5}\ldots.\right)$$

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

End of Solution

63. 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)

Given function, $y = 3x^2 + 4x + 1$

Mean value of function is given by, $\frac{1}{b-a}\int_a^b y\,dx$

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

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

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

End of Solution

64. 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)

Given curve, $x = 2\cos^3\theta$
$y = 2\sin^3\theta$

Here, $\frac{dx}{d\theta} = 6\cos^2\theta(-\sin\theta)$ and $\frac{dy}{d\theta} = 6\sin^2\theta(\cos\theta)$

Length of curve within $\theta \in \left(0, \frac{\pi}{2}\right)$

$$L = \int_0^{\pi/2} \sqrt{\left(\frac{dx}{d\theta}\right)^2 + \left(\frac{dy}{d\theta}\right)^2}\, d\theta$$

$$L = \int_0^{\pi/2} \sqrt{36\cos^4\theta\sin^2\theta + 36\sin^4\theta\cos^2\theta}\, d\theta$$

$$= \int_0^{\pi/2} \sqrt{36\cos^4\theta\sin^2\theta(\cos^2\theta + \sin^2\theta)}\, d\theta$$

$$= 6\int_0^{\pi/2} \cos\theta\cdot\sin\theta\, d\theta$$

$$= 3\int_0^{\pi/2} \sin 2\theta\, d\theta = -\frac{3}{2}[\cos 2\theta]_0^{\pi/2}$$

$$= \frac{-3}{2}(\cos\pi - \cos 0) = 3$$

End of Solution

65. What is the largest eigen value in modulus of the matrix $A = \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}$ 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)

By power method

$$AX = \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 7 \\ 12 \\ 14 \end{bmatrix} = 14\begin{bmatrix} 0.5 \\ 0.857 \\ 1 \end{bmatrix}$$

$$\text{Now, } \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 0.5 \\ 0.857 \\ 1 \end{bmatrix} = \begin{bmatrix} 5.571 \\ 9.571 \\ 12.214 \end{bmatrix} = 12.214\begin{bmatrix} 0.456 \\ 0.786 \\ 1 \end{bmatrix}$$

$$\text{Now, } \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 0.456 \\ 0.786 \\ 1 \end{bmatrix} = \begin{bmatrix} 5.270 \\ 9.182 \\ 11.940 \end{bmatrix} = 11.94\begin{bmatrix} 0.441 \\ 0.769 \\ 1 \end{bmatrix}$$

$$\text{Again, } \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 0.441 \\ 0.769 \\ 1 \end{bmatrix} = \begin{bmatrix} 5.189 \\ 9.071 \\ 11.861 \end{bmatrix} = 11.86\begin{bmatrix} 0.437 \\ 0.764 \\ 1 \end{bmatrix}$$

$$\text{Again, } \begin{bmatrix} 2 & 3 & 2 \\ 4 & 3 & 5 \\ 3 & 2 & 9 \end{bmatrix}\begin{bmatrix} 0.437 \\ 0.764 \\ 1 \end{bmatrix} = \begin{bmatrix} 5.166 \\ 9.040 \\ 11.839 \end{bmatrix} = 11.839\begin{bmatrix} 0.436 \\ 0.7635 \\ 1 \end{bmatrix}$$

Hence,Largest eigen value = 11.839 ≈ 11.84

End of Solution

66. 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) $\begin{bmatrix} 1 & -5 & 0 \\ -5 & -\frac{2}{5} & -\frac{13}{5} \\ 0 & \frac{1}{5} & \frac{1}{5} \end{bmatrix}$

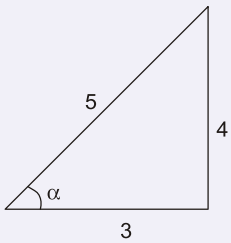
(d) $\begin{bmatrix} 1 & -5 & 0 \\ -5 & -\frac{2}{5} & \frac{1}{5} \\ 0 & \frac{13}{5} & \frac{1}{5} \end{bmatrix}$

Ans. (a)

$$A = \begin{bmatrix} 1 & 3 & 4 \\ 3 & 2 & -1 \\ 4 & -1 & 1 \end{bmatrix}$$

Here, $a_{12} = 3,\ a_{13} = 4$

so, $\tan\alpha = \dfrac{a_{13}}{a_{12}} = \dfrac{4}{3}$



$\Rightarrow \quad \sin\alpha = \dfrac{4}{5}, \qquad \cos\alpha = \dfrac{3}{5},$

So, Orthogonal matrix is $P = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -\cos\alpha & -\sin\alpha \\ 0 & -\sin\alpha & \cos\alpha \end{bmatrix}$

i.e. $P = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -3/5 & -4/5 \\ 0 & -4/5 & 3/5 \end{bmatrix}$

and $P^{-1} = P^T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -3/5 & -4/5 \\ 0 & -4/5 & 3/5 \end{bmatrix}$

Now, $P^{-1}AP = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -3/5 & -4/5 \\ 0 & -4/5 & 3/5 \end{bmatrix}\begin{bmatrix} 1 & 3 & 4 \\ 3 & 2 & -1 \\ 4 & -1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 & 0 \\ 0 & -3/5 & -4/5 \\ 0 & -4/5 & 3/5 \end{bmatrix}$

$$= \frac{1}{25}\begin{bmatrix} 5 & 0 & 0 \\ 0 & -3 & -4 \\ 0 & -4 & 3 \end{bmatrix}\begin{bmatrix} 1 & 3 & 4 \\ 3 & 2 & -1 \\ 4 & -1 & +1 \end{bmatrix}\begin{bmatrix} 5 & 0 & 0 \\ 0 & -3 & -4 \\ 0 & -4 & 3 \end{bmatrix}$$

$$= \frac{1}{25}\begin{bmatrix} 5 & 15 & 20 \\ -25 & -2 & -1 \\ 0 & -11 & 7 \end{bmatrix}\begin{bmatrix} 5 & 0 & 0 \\ 0 & -3 & -4 \\ 0 & -4 & 3 \end{bmatrix}$$

$$= \frac{1}{25}\begin{bmatrix} 25 & -125 & 0 \\ -125 & 10 & 5 \\ 0 & 5 & 65 \end{bmatrix} = \begin{bmatrix} 1 & -5 & 0 \\ -5 & 2/5 & 1/5 \\ 0 & 1/5 & 13/5 \end{bmatrix}$$

Which is in tridiagonal form, hence option (a) will be the answer.

End of Solution

67. 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)

Given: $x = 0$, $y(0) = 1$

$y' = x - y^2 \Rightarrow y'(0) = 0 - [y(0)]^2 = -1$

$y'' = 1 - 2yy' \Rightarrow y''(0) = 1 - 2\,y(0)\,y'(0) = 1 - 2(1)(-1) = 3$

$y''' = -2\,[yy'' + (y')^2] \Rightarrow y'''(0) = -2\,[y(0)y''(0) + [y'(0)]^2]$

$= -2\,[1 \times 3 + (-1)^2] = -8$

Taylor series expansion about $x = 0$ is given as,

$$y(x) = y(0) + xy'(0) + \frac{x^2}{2!}y''(0) + \frac{x^3}{3!}y'''(0) + ...$$

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

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

Hence, $y(0.1) = 1 - 0.1 + \frac{3}{2}(0.1)^2 - \frac{4}{3}(0.1)^3 + ...$ [Neglecting higher power]

$= 1 - 0.1 + 1.5 \times 0.01 - 1.3333 \times 0.001$

$= 1 - 0.1 + 0.015 - 0.0013$

$= 1.015 - 0.1013 = 0.9137$

End of Solution

68. 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)

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

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

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

$$\Rightarrow \quad \frac{x^2}{25}-\frac{y^2}{4} = 1$$

$$\frac{x^2}{a^2}-\frac{x^2}{b^2} = 1$$

[General equation of hyperbola]

End of Solution

69. 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)

$$5\frac{dy}{dx}+2x = 3$$

$$\Rightarrow \quad 5\frac{dy}{dx} = 3-2x$$

$$\int 5dy = \int(3-2x)dx$$

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

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

At $x = 2,\ y = \frac{7}{5}$

$$\frac{7}{5} = \frac{3\times 2}{5}-\frac{2^2}{5}+C = \frac{6}{5}-\frac{4}{5}+C$$

$$\frac{7}{5} = \frac{2}{5}+C$$

$$C = \frac{5}{5} = 1$$

$$C = 1$$

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

End of Solution

70. 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)

End of Solution

71. 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. (d)

End of Solution

72. 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 belief of the people governed by those laws.

(b) The law has an 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. (c)

Actions based on religious beliefs or on moral conviction tend to receive the protection of the highest courts.

End of Solution

73. 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 the 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 everywhere, 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. (d)

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

End of Solution

74. 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.

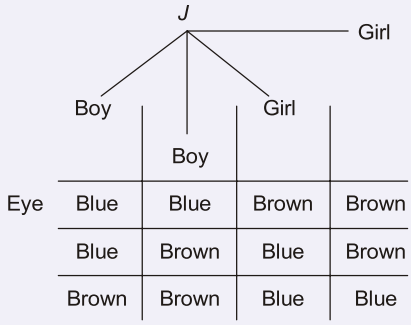
III. The boys have brown eyes.

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)



Eye				
	Blue	Blue	Brown	Brown
	Blue	Brown	Blue	Brown
	Brown	Brown	Blue	Blue

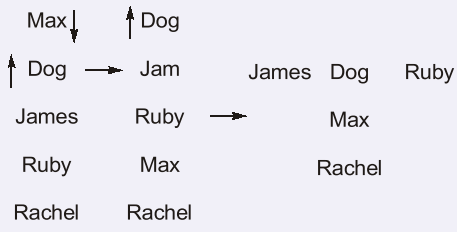
End of Solution

75. 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)



End of Solution

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76. 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)

251	252	253	254
I	G	H	M

End of Solution

77. 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)

For interest compounded annually

$$\left[P\left(1+\frac{R}{100}\right)^2 - P\right] - \frac{P\times R\times 2}{100} = 16$$

$$\Rightarrow P(1.08)^2 - P - P(0.16) = 16$$
$$\Rightarrow P(1.1664) - P - P(0.16) = 16$$
$$\Rightarrow P(0.0064) = 16$$
$$P = \frac{16}{0.0064} = 2500$$

For compounded half yearly

$$= P\left(1+\frac{R/2}{100}\right)^{2\times 2} - \frac{P\times R\times 2}{100} - P$$
$$= P(1.04)^4 - P(0.16) - P$$
$$= ₹24.6464$$

End of Solution

78. 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)

(3) B_1 (3) B_2 (2) B_3 (2) B_4 (2) B_5
Arrange in shelf so that copies of the same book are not separates

$= 5! = 120$

End of Solution

79. 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)

Minimum number of row contain same number of tree of one variety

$$= \frac{\text{Total}}{\text{HCF}(21,42,56)}$$

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

$= 3 + 6 + 8$
$= 17$

End of Solution

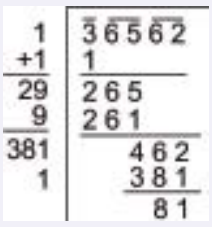
80. A general wishes to draw up his 36562 soldiers in the form of a solid square. After arranging them, he found that some of them are left over. How many are left?

(a) 81 (b) 75
(c) 61 (d) 52

Ans. (a)

$(191)^2 + 81 = 36562$

81 soldiers are left.



End of Solution

81. 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)

End of Solution

82. Consider the following statements regarding Hydrogen Breakthrough Iron-making 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)

Swedish green steel venture 'HYBRIT' had made the 'world's first' customer delivery of steel produced without using coal.

The steel was made using Hydrogen Breakthrough Ironmaking Technology, which uses 100% fossil-free hydrogen instead of coal and coke.

The venture has started delivering the fossil-free steel to the Volvo Group as part of its trial run.

End of Solution

83. 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)

End of Solution

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84. 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)

End of Solution

85. Consider the following statements regarding Forum for Decarbonizing Transport:
1. NITI Aayog and World Resources Institute (WRI), India, jointly launched the 'Forum for Decarbonizing Transport' in India.
2. NITI Aayog is the implementing partner for India.
3. The aim of the project is to bring down the peak level of GHG emissions (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)

- NITI Aayog and World Resources Institute(WRI), India, jointly launched the 'Forum for Decarbonizing Transport' in India as part of the NDC-Transport Initiative for Asia (NDC-TIA) project.
- The launch was held virtually and inaugurated by NITI Aayog.
- The project aims at bringing down the peak level of GHG emissions (transport sector) in Asia (in line with a well below 2-degree pathway), resulting in problems like congestion and air pollution.

End of Solution

86. 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) Sundarbans National Park in West Bengal
(c) Desert National Park In Rajasthan
(d) Indravati National Park in Chhattisgarh

Ans. (a)

Kaziranga National Park (KNP) of Assam state has become the first national park in India to be equipped with satellite phones.

This first-of-its-kind move was taken to provide assistance to prevent poaching and ensure coordinated functioning.

End of Solution

87. 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)

Copenhagen, the capital city of Denmark, 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).

Safe Cities Index 2021 report ranks 60 cities across 76 indicators covering digital, health, infrastructure, personal and environmental security.

Delhi ranks 48 according to the index.

End of Solution

88. 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)

First ever G20 Ministerial Conference on Women's Empowerment Conference was held at Santa Margherita Ligure, Italy in a hybrid format.

End of Solution

89. 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 a maritime manoeuvres?

(a) Malaysia
(b) Australia
(c) Singapore
(d) New Zealand

Ans. (c)

End of Solution

90. 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)

End of Solution

91. 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 buckets will fill the same tank?

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

Ans. (a)

Total volume of the tank = $13.5 \times 20 = 270$ litres

Volume of the tank will remain same.

Let number of buckets = x

$\therefore \quad 9x = 270$

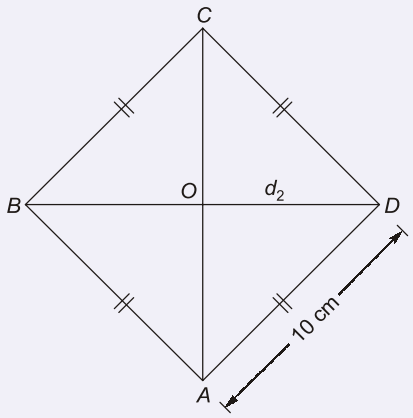
$\therefore \quad x = \dfrac{270}{9} = 30$ litres.

End of Solution

92. 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)



$d_1 = 12$ cm

For ΔODA, $OA^2 + OD^2 = AD^2$

$$\left(\frac{d_1}{2}\right)^2 + OD^2 = AD^2$$

$$= 6^2 + OD^2 + 10^2$$

$\Rightarrow \quad OD = 8$ cm

$\Rightarrow \quad d_2 = 2(OD) = 16$ cm

$\therefore$ Area of $ABCD = \dfrac{1}{2} d_1 \times d_2 = \dfrac{1}{2} \times 12 \times 18 = 96$ sq. cm.

End of Solution

93. 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) 469^{th} (b) 467^{th}
(c) 465^{th} (d) 463^{th}

Ans. (b)

Total lines 817 litres.

Time to complete by both

$$= \frac{817}{200+150} = \frac{817}{350} \text{ hours}$$

$$\text{Both meet at line} = \frac{817}{350}\times 200 \text{ or } 817 - \frac{817}{350}\times 150$$

$$= 466.857 \approx 467^{th} \text{ line}$$

End of Solution

94. 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 ₹19,200 every year, what is his monthly income?

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

Ans. (b)

$$\text{Let Income} = 100k \text{ per month}$$

$$\text{Spend on food} = \frac{40}{100}\times 100k = 40k$$

Spend on cloth and conveyance

$$= \frac{60}{100}\times\frac{50}{100}\times 100k = 30k$$

$$\text{Saving} = \left(\frac{1}{3}\right)\times(100 - 40k - 30k)$$

$$= \frac{1}{3}\times 30k = 10k$$

$$\text{Monthly saving} = \frac{19200}{12} = ₹\ 1600 = 10k$$

$$\Rightarrow \quad k = 160$$

$$\therefore \quad \text{Monthly income} = 100k = 100 \times 160$$

$$= ₹\ 16{,}000$$

End of Solution

95. 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)

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

$$\frac{5s^2+8s-1}{(s+3)(s^2+1)} = \frac{A}{(s+3)}\ \frac{Bs+C}{(s^2+1)}$$

$\Rightarrow A = 2$
$\Rightarrow B = 3$
$\Rightarrow C = -1$

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

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

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

End of Solution

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

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

$$L(4\cos 2t - 5\sin 2t) = 4L[(\cos 2t) - 5L(\sin 2t)]$$

$$= 4\left(\frac{s}{s^2+4}\right)-5\left(\frac{2}{s^2+4}\right) = \frac{4s-10}{s^2+4}$$

Using first shifting theorem,

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

$$= 2\left[\frac{4(s-3)-10}{(s-3)^2+4}\right] = 2\left[\frac{4s-12-10}{s^2-6s+9+4}\right]$$

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

End of Solution

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97. A batch of 100 capacitors contains 73 which are within the required tolerance values, 17 which are below the required tolerance values, and 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)**

Probability of selecting the first capacitor which is within the required tolerance values

$$= \frac{73}{100}$$

Since, this capacitor is replaced before taking out the second capacitor, the probability of getting the second one within the required is also $\frac{73}{100}$.

Thus, the required probability is

$$\frac{73}{100} \times \frac{73}{100} = 0.5329$$

End of Solution

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

(a) π (b) 2π
(c) 3π (d) 4π

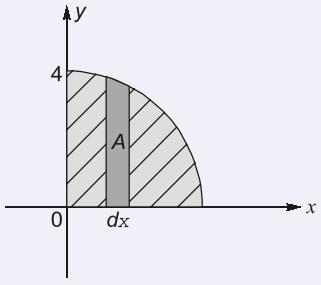
Ans. **(d)**

Comparing with $\int_a^b y dx$, for given integral, $y = \sqrt{16 - x^2}$

It can also be written as

$$x^2 + y = 16$$

This is equation of a circle of radius 4 centred at origin as shown below.



Thus, $\int_0^4 \sqrt{16-x^2}\,dx$ = Area of circle in I quadrant

$$= \frac{1}{4}\left[\pi(16)\right] = 4\pi$$

End of Solution

99. 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)

$$\int_0^2 \frac{3x}{\sqrt{2x^2+1}}\,dx$$

Let, $2x^2 + 1 = t$

$\Rightarrow$ $4x\,dx = dt$

$$x\,dx = \frac{dt}{4}$$

$\therefore$ $$\int_0^2 \frac{3x}{\sqrt{2x^2+1}}\,dx = \int_1^9 \frac{3}{\sqrt{t}}\left(\frac{dt}{4}\right) = \frac{3}{4}\int_1^9 \frac{1}{\sqrt{t}}dt = \frac{3}{4}\left[\frac{\sqrt{t}}{1/2}\right]_1^9$$

$$= \frac{3}{2}\left(\sqrt{9}-\sqrt{1}\right) = 3$$

End of Solution

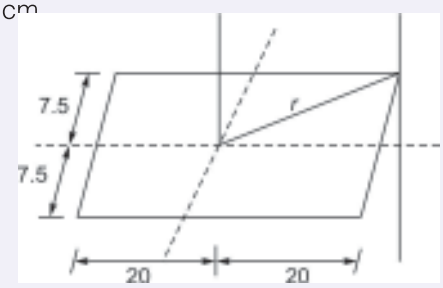
100. What is the radius of gyration of a rectangular lamina of length 40 mm and width 15 mm about an axis through one corner, perpendicular to the plane of the lamina?

(a) 1.27 cm (b) 2.47 cm
(c) 3.67 cm (d) 4.87 cm

Ans. (b)

As we know,

$I = A \cdot r^2_{min}$
A = Area of lamina
r_{min} = Radius of gyration
I = Moment of inertia



$\Rightarrow$ $$r_{min} = \sqrt{\frac{I}{A}}$$

Here, moment of inertia about one corner of the lamina is given by

$$I = \frac{bd^3}{12} + \frac{db^3}{12} + Ar^2$$

$$\Rightarrow \quad I = \frac{15\times 40^3}{12} + \frac{40\times 15^3}{12} + 40\times 15\times 21.36^2$$

$$r = \sqrt{20^2 + 7.5^2} = 21.36$$

Hence, $r_{min} = \sqrt{\frac{365000}{40\times 15}} = 24.66 \text{ mm} = 2.466 \text{ cm} \simeq 2.47 \text{ cm}$

End of Solution

■■■■