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ESE 2021

Preliminary Examination

Detailed Solutions of

General Studies & Engineering Aptitude

Set-A

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Expected Cutoff of ESE 2021 Prelims Exam (Out of 500 Marks)				
Branch	Gen	OBC	SC	ST
CE	260-270	250-260	220-230	220-230
ME	280-290	270-280	230-240	220-230
EE	250-260	240-250	210-220	200-210
E&T	270-280	260-270	220-230	210-220

Actual Cutoff of ESE 2020 Prelims Exam (Out of 500 Marks)				
Branch	Gen	OBC	SC	ST
CE	238	238	202	227
ME	262	250	214	202
EE	238	229	187	194
E&T	245	245	205	202

General Studies and Engineering Aptitude Paper
Analysis of ESE 2021 Preliminary Examination

Sl.	Subjects	No. of Qs.	Level of Qs.
1	Current issues of national and international importance	17	Difficult
2	Reasoning & Aptitude	15	Easy-Moderate
3	Engineering Mathematics and Numerical Analysis	15	Difficult
4	General Principles of Design, Drawing, Importance of Safety	7	Easy
5	Standards and Quality Practices in Production	7	Difficult
6	Basics of Energy and Environment	7	Easy
7	Basics of Project Management	4	Easy
8	Basics of Material Science and Engineering	8	Difficult
9	Information and Communication Technologies (ICT)	10	Difficult
10	Ethics and values in Engineering profession	10	Easy

UPSC ESE/IES Prelims 2021 Paper-1
GS and Engg. Aptitude Analysis & Expected Cut-off
by MADE EASY Faculties
https://www.youtube.com/watch?v=Mx9REAAJc0c

1. Match the following:

I	II
A. Thompson	1. The concept of converting mechanical work into heat
B. James P. Joule	2. The theory of relativity
C. Max Planck	3. The energy characteristics of light
D. Albert Einstein	4. The energy equivalence between heat, work and electric power

Select the correct matching using the codes given below:

	A	B	C	D
(a)	3	4	1	2
(b)	1	4	3	2
(c)	3	2	1	4
(d)	1	2	3	4

Ans. (b)

End of Solution

---

2. According to UNEP, which of the following is/are the major component/s of air pollution?

1. SO_2
2. O_3
3. CO
4. NO_2

Select the correct answer using the codes given below:

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

Ans. (d)

According to UNEP, major components of air pollution are :

1. SO_2
2. O_3
3. CO
4. NO_2
5. Lead
6. Particulates

End of Solution

---

3. Which one of the following is a 'soft coal'?

(a) anthracite
(b) bituminous
(c) lignite
(d) magnetite

Ans. (c, b)

Based on Characteristics : Lignite

Based on Popular Nickname: Bituminous

Different Countries have different designations attributed to various types of coals. Generally, Anthracite coal is called as Hard Coal, Bituminous coal is often called as "soft coal and Lignite is often called as Brown Coal. But in many countries, both Bituminous and Lignite types of coal are referred to as "Soft Coal".

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However, based on their characteristics, in comparison to Bituminous, Lignite is quite soft. Hence, Lignite shall be the more preferred option.

End of Solution

4. Which one of the following is NOT correctly matched pair regarding the regional biodiversity?
(a) Point richness: The number of species that can be found at a single point in a given space.
(b) Alpha richness: The number of species found in a small heterogeneous area.
(c) Beta richness: The rate of change in species composition across different habitats.
(d) Gamma richness: The rate of change across large landscape gradients.

Ans. (b)

Explanation of Alpha richness is not correct because in case of Alpha richness the number of species found in a small "homogeneous area" but in question it is given "heterogeneous area" that's why it is incorrect.

End of Solution

5. Energy services for sustainable development are directly linked to:
1. Poverty
2. Lifestyles
3. Women
4. Deforestation

Select the correct answer using the codes given below:
(a) 1, 2 and 3 only
(b) 1, 2 and 4 only
(c) 2, 3 and 4 only
(d) 1 and 3 only

Ans. (a, d)

Energy services are directly linked to poverty and women. Energy services also directly have the impacts on the lifestyles, living conditions, income and livelihood, especially of poor people. So the preferred option shall be (a).
However, sometimes we have seen UPSC people do have some interpretations of their own.

End of Solution

6. Match the following:

I	II
A. Oligotrophic lakes	1. created due to construction of dams
B. Dystrophic lakes	2. low pH and high humic acid content
C. Meromictic lakes	3. low nutrient concentration
D. Impoundments	4. rich in salts and permanently stratified

Select the correct matching using the code given below:

	A	B	C	D
(a)	4	1	3	2
(b)	4	1	2	3
(c)	3	2	1	4
(d)	3	2	4	1

Ans. (d)

Oligotrophic lakes : Low nutrient concentration.
Dystrophic lakes : Low pH and high humic acid content.
Meromictic lakes : Rich in salts and permanently stratifies.
Impoundments : Created due to construction of dam.

End of Solution

7. Which one of the following is NOT included in the 27 principles issued at the Rio-92 UN Conference on the Environment and Development?
(a) The right to development that meets the needs of present and future generations
(b) Right to safety from natural disasters
(c) Protection to the environment in times of armed conflict
(d) Youth mobilization for a global partnership

Ans. (b)

End of Solution

8. What are the objectives and functions of state financial corporations?
1. The main function is to provide non-term loans for the acquisition of land, building, plant, machinery and other movable assets.
2. To finance expansion, modernization and upgradation of technology in the existing units.
3. To assist for the promotion of industry by the rural and urban artisans.
4. Providing seed capital assistance under the scheme of Industrial Development Bank of India.

Select the correct answer using the code given below:
(a) 1, 2 and 3 only (b) 2, 3 and 4 only
(c) 1, 2 and 4 only (d) 1, 3 and 4 only

8. (b)

The financial institution provide direct and indirect financial assistance.
Direct financial assistance like term loans, foreign currency loans, subscription to equity share and seed capital.
Indirect financial assistance like to obtain finance credit in form of deferred payment guarantee, guarantee for foreign currency loan etc.

End of Solution

9. From the following, which facilities are provided for units in the export processing zone?
1. Developed plots/ready-buildings to suit project requirements.
2. Second hand capital goods allowed to be exported.
3. Foreign equity participation up to 100% permissible.
4. Assured power supply, preferential power connection.

Select the correct answer using the code given below:

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

Ans. (c)

Second hand capital goods are not permitted for export to the export processing zone.

End of Solution

10. Which one of the following is NOT the purpose of the organization breakdown structure?
(a) To provide a framework to summarize organization unit work performance
(b) Do not tie the organizational unit to cost control accounts
(c) Identify organization units responsible for work packages
(d) How the firm has organized to discharge work responsibility

Ans. (b)

A project OBS is a depiction of the project organization arranged to indicate the reporting relationships within the project context. The OBS reflects the way the project is functionally organized. It is a direct representation and description of the hierarchy and organizations that will provide resources to plan and perform work identified in the Work Breakdown Structure (WBS). The OBS helps management focus on establishing the most efficient organization, by taking into consideration availability and capability of management and technical staff including subcontractors, to achieve project objectives. The OBS is depicted on the Responsibility Assignment Matrix (RAM), where it is used to identify the organization responsible and accountable for every element of the WBS and Scope of Work (SOW).

End of Solution

11. Phillip Kotlar argues that the 4 Ps which represent the seller's thinking more than buyer's thinking can be translated into the 4 Cs. Match the following:

4 Ps of marketing planning	4 Cs of marketing Planning
A. Product	1. Customer communication
B. Price	2. Customer value
C. Place	3. Customer costs
D. Promotion	4. Customer convenience

Select the correct matching using the code given below:

	A	B	C	D
(a)	2	3	4	1
(b)	2	3	1	4
(c)	1	4	3	2
(d)	1	4	2	3

Ans. (a)

THE FOUR P'S OF MARKETING:

Product: A product refers to an item that satisfies the consumer's needs or wants. Products may be tangible (goods) or intangible (services, ideas or experiences).

Price: Price refers to the amount a customer pays for a product. Price may also refer to the sacrifice consumers are prepared to make to acquire a product (e.g. time or effort), and includes considerations of customer perceived value.

Place describes giving the customer access to your product, traditionally at a brick-and-mortar place or through the mail.

Promotion refers to marketing communications (advertising, PR, or sales/promotions).

End of Solution

12. The Boston Consulting Group matrix classifies business in four categories as "STAR", "QUESTION MARK", "CASH COWS". Which one of the following is the fourth one?

(a) CATS (b) HORSES
(c) DOGS (d) HENS

Ans. (c)

The BCG growth-share matrix is a tool used internally by management to assess the current state of value of a firm's units or product lines.

The BCG growth-share matrix contains four distinct categories: "dogs", "cash cows", "stars", and "question marks".

End of Solution

13. Under which one of the following circumstances is the project accepted as worthwhile, keeping the principal non-discounting criteria?

(a) The payback period (PBP) > target period
(b) The payback period (PBP) < target period
(c) The payback period (PBP) = target period
(d) The payback period (PBP) = 0

Ans. (b)

Payback Period refers to the amount of time it takes to recover the cost of an investment. If it is less than the target period, investment is accepted as worthwhile. The lesser the Payback Period the more preferred is the investment.

End of Solution

14. The purpose of oil in a transformer is to

(a) protect the transformer from rusting
(b) avoid wear and tear of the transformer
(c) transfer heat from winding and core to the cooling surfaces of the transformer
(d) avoid noise in a transformer

Ans. (c)

End of Solution

15. For a semiconductor to be called as p-type semiconductor, which one of the following element impurities are added to a pure semiconductor?
(a) Phosphorus (b) Arsenic
(c) Antimony (d) Boron

Ans. (d)

End of Solution

16. Impure semiconductor
(a) has more conductivity in contrast to pure semiconductor
(b) has less conductivity in contrast to pure semiconductor
(c) has electrons and holes in equal number
(d) has a fermi level which is in the centre of conduction and valence bands

Ans. (a)

End of Solution

17. Which one of the following is the disadvantages of ion-implantation over diffusion doping?
(a) It is a low temperature process
(b) Point imperfections are not produced
(c) Shallow doping is possible
(d) Gettering is possible

Ans. (d)

End of Solution

18. Which one of the following is correct in n-p-n transistor?
(a) Collector and emitter terminals can be exchanged
(b) Collector is heavily doped, base width is small and emitter area is large
(c) Emitter, base and collector regions are equally doped
(d) Emitter is heavily doped, base width is small and collector area is large

Ans. (d)

End of Solution

19. Which one of the following factors does NOT characterize the formation of non-crystalline structure?
(a) Presence of primary bonds in the directions
(b) Non-formation of three-dimensional primary bond
(c) Weak secondary bond
(d) Open network of the atomic packing

Ans. (a)

End of Solution

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20. Which one of the following protocols is used to address the true routing decisions problems?
(a) Exterior Gateway Protocol
(b) Border Gateway Protocol
(c) Open Shortest Path First Protocol
(d) Interior Gateway Routing Protocol

Ans. (c)
In packet switch network data is transmitted in the form of multiple smaller packets through multiple paths while routing is a process of selecting a path for traffic in a network but, in packet switching networks routing is the higher level decision making that directs network packets from source to destination. The protocol used to address the true routing decision problem is "Open Shortest Path First Protocol". Routing decisions are made by routing information exchange between routers.

End of Solution

21. Which one of the following standards is used in vehicular communication system?
(a) IEEE 802.11a
(b) IEEE 802.11p
(c) IEEE 802.11g
(d) IEEE 802.11h

Ans. (b)
802.11 is a WLAN (Wireless Local Area Network) standard developed by IEEE (Institute of Electrical and Electronics Engineers). 802.11 x refers to a family of specifications developed by the IEEE for wireless LAN technology where IEEE 802.11 P is used in vehicular communication system.

End of Solution

22. Which of the following network metrics are used to evaluate the performance of a network?
(a) Throughput and Delay
(b) Reliability and Security
(c) Topology and Type of connection
(d) Portability and Security

Ans. (a)
Performance of a network is the measurement of service quality of a network. The characteristics that measure the performance of a network are :
Bandwidth : Amount of bandwidth allocated to network.
Throughput : Data sent successfully per unit time.
Latency (Delay) : Time taken by data to reach from sender to receiver.
Jitter : Disturbance in the network.

End of Solution

23. Which of the following things are defined by uniform resource locator for specifying the information on the internet?
(a) protocol, host computer, throughput and delay
(b) host computer, destination computer and delay
(c) throughput, delay, port and path
(d) protocol, host computer, port and path

Ans. (d)

URL (Uniform Resource Locator) contains the name of the protocol needed to access a resource. Second part identifies IP address or domain name and subdomain. After this, URL also specifies path to a specific page or file within a domain. A network port to use to make the connection.

e.g. : https://upsc.gov.in/notification

protocol domain path

End of Solution

24. Which one of the following documents are created and handled by the Common Gateway Interface (CGI) technology?

(a) Dynamic documents (b) Static documents
(c) Tampered documents (d) Linked documents

Ans. (a)

Common Gateway Interface (CGI) that acts like a middleman that passes user's request to external databases and receives the processed data. Hence, in HTTP and www CGI handles 'Dynamic Documents'.

End of Solution

25. Which one of the following learnings uses web technology to conduct conventional classes with distant learners?

(a) Learner-led e-learning (b) Instructor-led e-learning
(c) Telementoring and e-coaching (d) Facilitated e-learning

Ans. (b)

e-Learning is a method where learner can learn from anywhere and anytime. Generally, e-learning does not require a presence of instruction. But in above question it is asking about conducting conventional, classes using web technology. Hence, presence of virtual instructor is there. Therefore, answer is (b).

End of Solution

26. Which one of the following frameworks is developed to assess the value of the increasing investments made on e-governance projects in terms of service orientation, technology architecture, replicability and sustainability in various states across the country?

(a) eTechnology Group@IMRB (b) e-Governance Assessment Framework
(c) Sustainable Access in Rural India (d) e-Governance Action Plan

Ans. (b)

In India there is 'National eGovernance Service Delivery Assessment Framework', globally too there is UN e-Government Assessment Framework for an assessment of e-Government readiness of the member countries. In India, in order to undertake assessment of projects and enable comparison of project performance projects are assessed on Assessment Framework.

End of Solution

27. Which one of the following services does NOT come under category of Cloud computing?
(a) IaaS (Infrastructure as a Service)
(b) Saas (Software as a Service)
(c) PaaS (Platform as a Service)
(d) BDaaS (Big data as a Service)

Ans. (d)

Cloud computing is primarily broadly categorised as: 1. Infrastructure-as-a-Service (IaaS), 2. Platform-as-a-Service (PaaS), and 3. Software-as-a-Service (SaaS). Even though Big Data as a Service (BDaaS) makes use of cloud computing infrastructure and services but as such it is not categorised as the three main categories of cloud computing models.

End of Solution

28. What is the key size of Data Encryption Standard algorithm in cryptography?
(a) 56 bit
(b) 62 bit
(c) 168 bit
(d) 128 bit

Ans. (a)

Data Encryption Standard (DES) is a type of block cipher that encrypts data in blocks of size 64 bits each. But key length is 56 bits because in DES process every 8th bit of key is discarded. In 64 bits a total of 8 bits are discarded.
Total key length in DES : 64 - 8 = 56 bits.

End of Solution

29. Which one of the following statements is NOT correct about the codes of conduct?
(a) These cover general guiding principles
(b) Their purpose is to regulate the conduct of members on various transactions
(c) These are the broader sets of principles that are designed to inform specific laws or government actions
(d) These translate the values into specific behavioral standards, keeping in mind the possible reflection on the stakeholders' interest

Ans. (a)

End of Solution

30. The famous statements "The weak can never forgive. Forgiveness is the attribute of the strong" is given by
(a) Swami Vivekananda
(b) Mahatma Gandhi
(c) Martin Luther
(d) Sri Aurobindo

Ans. (b)

End of Solution

31. Match the following:

List-I	List-II
A. Act Utilitarian Theory	1. John Locke
B. Rule Utilitarian Theory	2. Immanuel Kant
C. Duty Ethics Theory	3. Richard Brandt
D. The Rights Theory	4. J.S. Mill

Select the correct matching using code given below:

	A	B	C	D
(a)	4	3	1	2
(b)	4	3	2	1
(c)	1	2	3	4
(d)	1	2	4	3

Ans. (b)

End of Solution

32. Which philosopher suggested Wisdom, Courage, Temperance and Justice as four 'cardinal virtues'?

(a) Aristotle
(b) Aquinas
(c) Socrates
(d) Plato

Ans. (d)

End of Solution

33. 'Groupthink', a noteworthy feature of the organizational settings within which engineers work and deliberate in groups, has been suggested by

(a) Abraham Maslow
(b) Irving Janis
(c) B.F. Skinner
(d) Christopher Meyers

Ans. (b)

- This term was coined is 1952 by William.H. Whyle Jr. and most of the initial on Groupthink was conducted by Irving Janis.
- Groupthink is phenomenon that occurs when a group of individuals reaches a consensus w/o critical reasoning or evaluation of the consequences or alternatives.

End of Solution

34. Select inappropriate statement about integrity

(a) It involves the discovery and communication of the truth
(b) It leads to a concern for the whole situation in decision-making, including an awareness of the professional's own attitudes, standards and value systems
(c) It is simply truthfulness or avoidance of lying
(d) It ensures that the professional does not accept 'moral distance'

Ans. (a)

End of Solution

35. Whistleblowing in an organizational set up affects:
1. Peer professional relationships
2. Relationships with management
3. Family relations

Which of the above statement(s) is/are correct?
(a) 1 and 2 only (b) 2 only
(c) 1, 2 and 3 (d) 1 only

Ans. (a)

End of Solution

36. Carol Gilligan is associated with
(a) the natural justice (b) the responsibility
(c) the principle of loyalty (d) the ethics of care

Ans. (d)

End of Solution

37. Hooch & Bottlegging refers to
(a) the prohibition law on unethical practices related to liquor
(b) laws against giving money to beggars as a generous act
(c) food adulteration rules
(d) laws on checking the illegal business of duplicate goods

Ans. (a)

End of Solution

38. The Ministry of Sports and Youth Affairs has recently approved the inclusion of four indigenous games to be part of Khelo India Youth Games 2021. Which one of the following is NOT included?
(a) Thang-Ta (b) Lagori
(c) Kalaripayattu (d) Gatka

Ans. (b)
The Sports Ministry included four indigenous games to be a part of the Khelo India Youth Games 2021, which was conducted in Haryana. The games include Gatka, Kalaripayattu, Thang-Ta, and Mallakhamba.

End of Solution

39. Which one of the following is the latest in series being organized as the largest virtual gathering to create dialogues, and accelerate innovation in agriculture?
(a) Agri-India Hackathon 2020
(b) National Agriculture Higher Education Project
(c) ENSURE
(d) National Mission for Sustainable Development

Ans. (a)

- Agri India Hackathon is the largest virtual gathering to create dialogues and accelerate innovations.
- Virtual Agri-hackathon 2020 is organised by the Department of Agriculture and Cooperation and Farmers' Welfare in association with IARI, Pusa, New Delhi.

End of Solution

40. Match the following:

List-I	List-II
A. Utkarsh Bangla Scheme	1. West Bengal
B. Placement Linked Skill Training Programme	2. Rajasthan
C. SURYA Scheme	3. Haryana
D. Employment Linked Skill Training Programme	4. Assam

Select the correct matching using the code given below:

	A	B	C	D
(a)	2	3	4	1
(b)	2	3	1	4
(c)	1	4	3	2
(d)	1	4	2	3

Ans. (c)

- Utkarsh Bangla Scheme: West Bengal
- Placement Linked Skill Training Programme: Assam
- SURYA Scheme: Haryana
- Employment Linked Skill Training Programme: Rajasthan

End of Solution

41. With a view to encourage and promote Indian artisans and their handicraft, Hunar Haat offers an effective platform. Where was the 22nd Hunar Haat held?

(a) Jaipur (b) Ferozpur
(c) Rampur (d) Bharatpur

Ans. (*)

21st Hunar Haat was organised in Feb., 2020 at Ranchi whereas 23rd was organised in December 2020 at Rampur. From 23rd October to 1st November 2020, Hunar Haat was proposed for Jaipur.

End of Solution

42. Which one of the following is NOT correct pair of Author-Book published in the year 2020?

(a) Arundhati Roy : Azadi (b) Jairam Ramesh : A Chequered Brilliance
(c) Zadie Smith : Intimations (d) Diane Cook : One Arranged Murder

Ans. (d)

One Arranged Murder book is written by the Indian author Chetan Bhagat.

End of Solution

43. Which one of the following statements is NOT correct regarding the National Education Policy 2020 in India?

(a) It proposes sweeping changes in the education system from pre-primary to PhD and skill development

(b) It states that universities from among top 100 in the world will be able to set up campuses in India

(c) It expects that India will achieve 60% GER by 2030.

(d) It suggests NAAC to be merged with UGC and AICTE

Ans. (c)

The National Education Policy 2020 has fixed target of :

- Universalization of education from preschool to secondary level with 100% Gross Enrolment Ratio (GER) in school education by 2030.
- Gross Enrolment Ratio in higher education to be raised to 50% by 2035.

End of Solution

44. According to the National Institutional Ranking Framework 2020, which institute was on the top in overall ranking?

(a) Indian Institute of Technology, Madras

(b) Indian Institute of Science, Bengaluru

(c) Indian Institute of Technology, Delhi

(d) Indian Institute of Technology, Bombay

Ans. (a)

Among educational institutions in the country, IIT Madras ranked 1st in the National Institutional Ranking Framework 2020, followed by IISc Bangalore.

The National Institutional Ranking Framework or NIRF is an annual ranking and was launched in 2015 and the first rankings were released in 2016. NIRF 2020 has ranked institutions across 10 categories: Overall, university, engineering, management, pharmacy, college, medical, law, architecture and dental.

End of Solution

45. Consider the following statements about ingenuity:

1. It is man's decades-long quest to fly a helicopter on Mars.
2. It is 0.6 metres tall and weigh less than 1.8 kg.
3. It aims to look for habitability.

Which of the above statements is/are correct?

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

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

Ans. (c)

Ingenuity is the first robot helicopter to fly on Mars.

The helicopter weighs 1.8 kilograms. It is a solar powered helicopter.

It aims to collect samples from the locations on Mars where the rover cannot reach.

End of Solution

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46. Name the NASA astronaut who after setting the record of 328-day stay on the International Space Station (ISS), returned through Earth's atmosphere and landed on the Kazakhstani desert on 6th Feb 2020.

(a) Josh Cassada
(b) Jeanette Epps
(c) Christina Koch
(d) Peggy Whitson

Ans. (c)

End of Solution

47. The Thirteenth Meeting of the Conference of the Parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS COP 13) in 2020 was held in

(a) Brazil
(b) India
(c) Indonesia
(d) Canada

Ans. (b)

CMS COP-13 was held in Gandhinagar, Gujrat from 17th to 22nd February 2020. The theme of CMS COP-13 was " Migratory species connect the planet and we welcome them home"

End of Solution

48. Consider the following statements with respect to the schemes initiated by the Government of India in 2020.

1. NISHTHA is a teachers training program.
2. SVANidhi is a scheme to facilitate artisans to access affordable working capital loan.
3. SATYABHAMA is a scheme to promote research and development in science and technology.
4. Manodarpan is a scheme to promote tourism in rural parts of India.

Which of the above statements is/are correct?

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

Ans. (a)

- PM SVANidhi stands for Prime Minister Street Vendor's AtmaNirbhar Nidhi. It is a central sector scheme launched in June 2020. It aims to provide micro-credit facilities to street vendors affected due to COVID-19 pandemic.
- The "SATYABHAMA (Science and Technology Yojana for AtmaNirbhar Bharat in Mining Advancement)" is a portal launched by the Ministry of Mines with an aim to promote research and development in the mining and minerals sector.

End of Solution

49. Which iconic figure set a Guinness World Record in 2020 for receiving 1 million followers for debut on instagram in just 4 hours and 44 minutes?

(a) Bong Joon-ho
(b) Amy Coney Barrett
(c) David Attenborough
(d) Sanna Marin

Ans. (c)

End of Solution

50. Which one of the following statements is NOT correct about the Atal Tunnel?
(a) It is the highest altitude tunnel in the world.
(b) It was inaugurated on 03 October 2020 in Rohtang.
(c) It connects Manali to Lahauli-Spiti valley.
(d) It is capable of handling 5000 cars and 2500 trucks per day with maximum speed of 80 kmph.

Ans. (a, d)
- The Atal Tunnel in Rohtang, Himachal Pradesh, India is the World's longest highway tunnel. It is constructed at an altitude of 3000 meters and is about 9.02 kilometers long, connecting Solang Valley near Manali to Sissu in Lahaul and Spiti district.
- The Atal Tunnel is constructed with a traffic density of approximately 1500 trucks and 3000 cars per day.

End of Solution

51. Who received the prestigious Abel Prize for the year 2020?
(a) Eric Adelberger and Blayne Heckel.
(b) Hillel Furstenberg and Gregory Margulis.
(c) Yvonne Farrell and Shelley McNamara.
(d) Nina Holden and Lisa Piccirillo.

Ans. (b)

End of Solution

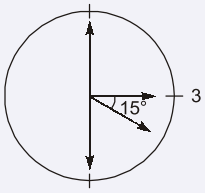
52. Select the incorrect pair of the 2020 Nobel Prize Winners with their respective areas of contribution:
(a) Louise Gluck - Literature
(b) Andrea Ghez - Physics
(c) Jennifer A. Doudna - Chemistry
(d) Harvey J. Alter - Economic Sciences

Ans. (d)
Harvey James Alter is an American medical researcher, virologist, physician and Nobel Prize laureate, who is best known for his work that led to the discovery of the hepatitis C virus.

End of Solution

53. What is the angle between the hour hand and minute hand of a clock at 3 : 30?
(a) 105° (b) 180°
(c) 75° (d) 90°

Ans. (c)



$$\left|\frac{11}{2}M - 30H\right| = \theta$$

$$\theta = \left|\frac{11}{2}\times 30 - 30\times 3\right| = |165 - 90| = 75^\circ$$

Alternate solution :

$$\left[5x \pm \frac{D}{6}\right]\times\frac{12}{11} = M$$

$$\left[5\times 3 \pm \frac{D}{6}\right]\times\frac{12}{11} = 30$$

$$\left[15 + \frac{D}{6}\right] = \frac{55}{2}$$

$$\frac{D}{6} = \frac{25}{2}$$

$$D = 75^\circ$$

End of Solution

54. Sum of the series $2^2 + 4^2 + 6^2 + ... + 20^2$ is

(a) 1040 (b) 1540

(c) 2540 (d) 3080

Ans. (b)

$2^2 + 4^2 + 6^2 + ... + 20^2$

$\Rightarrow 2^2(1^2 + 2^2 + 3^2 + ... + 10^2)$

$\because \quad \Sigma n^2 = \frac{n(n+1)(2n+1)}{6}$

$\Rightarrow 2^2 \times \frac{10\times 11\times 21}{6}$

$\Rightarrow 4\times\frac{10\times 11\times 21}{6} = 1540$

End of Solution

55. If A X B means $(A^2 + B^2)$, then the value of 5 X (4 X 3) is

(a) 60 (b) 300

(c) 650 (d) 710

Ans. (c)

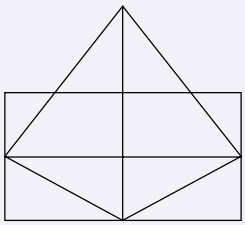
$\because$ $A \times B = A^2 + B^2$

$\therefore$ $5 \times (4 \times 3) = 5 \times (4^2 + 3^2) = 5 \times (25) = 5^2 + 25^2$

$= 25 + 625 = 650$

End of Solution

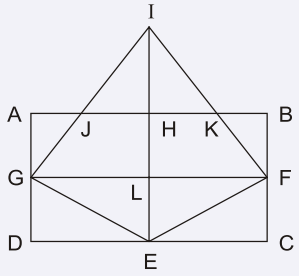
56. The number of triangles in the given figure is



(a) 11 (b) 13

(c) 15 (d) 17

Ans. (c)



Possible triangles are: IJH, IHK, IJK, IGL, ILF, IGF, IGE, IFE, GEL, EFL, GEF, AJG, BKF, ECF, GDE.

So, number of triangles = 15.

End of Solution

57. Statement 1 : A has more coins than B.

Statement 2 : B has fewer coins than C.

Statement 3 : C has fewer coins than A.

If the statement 1 is true and statement 2 is false, then the statement 3 is

(a) True (b) False

(c) Uncertain (d) Insufficient data

Ans. (a)

$A > B$ is true

$B < C$ is false so $B \geq C$

Hence, $A > B \geq C$

So, statement 3 is true.

End of Solution

58. If $\frac{x+1}{x-1}=\frac{a}{b}$ and $\frac{1-y}{1+y}=\frac{b}{a}$, then the value of $\frac{x-y}{1+xy}$ is

(a) $\frac{2ab}{a^2-b^2}$ (b) $\frac{a^2-b^2}{2ab}$

(c) $\frac{a^2+b^2}{2ab}$ (d) $\frac{a^2-b^2}{ab}$

Ans. **(a)**

$\because \quad \frac{x+1}{x-1}=\frac{a}{b}$ and $\frac{1-y}{1+y}=\frac{b}{a}$

So, $x=\frac{a+b}{a-b}$ and $y=\frac{a-b}{a+b}$

and, $\frac{x+1}{x-1}=\frac{1+y}{1-y}$

$(x+1)(1-y)=(x-1)(1+y)$

$x-xy+1-y=x+xy-1-y$

$2xy=2$

$xy=1$

So, $\frac{x-y}{1+xy}=\frac{x-y}{1+1}=\frac{1}{2}(x-y)$

Putting value of x and y.

$$=\frac{1}{2}\left(\frac{a+b}{a-b}-\frac{a-b}{a+b}\right)$$

$$=\frac{1}{2}\left(\frac{(a+b)^2-(a-b)^2}{a^2-b^2}\right)=\frac{2ab}{a^2-b^2}$$

End of Solution

59. If $(2x+3y):(3x+5y)=18:29$, then the value of $x:y$ is

(a) 4 : 1 (b) 4 : 5

(c) 3 : 4 (d) 3 : 1

Ans. **(c)**

$\frac{2x+3y}{3x+5y}=\frac{18}{29}$

$58x+87y=54x+90y$

$4x=3y$

$\Rightarrow \quad \frac{x}{y}=\frac{3}{4}$

End of Solution

60. A is twice as good a workman as B and together, they finish a piece of work in 18 days. In how many days will A alone finish the work?

(a) 28 days (b) 30 days
(c) 27 days (d) 29 days

Ans. **(c)**

Let B finish the work in x days,

Then his one day work = $\frac{1}{x}$

$\because$ A is twice as good as B.

Then A's one day work = $\frac{2}{x}$

So, $\left(\frac{2}{x}+\frac{1}{x}\right)\times 18 = 1$

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

$$x = 54$$

A's one day work = $2\times\frac{1}{54}=\frac{1}{27}$

So, A will complete the work alone in 27 days.

End of Solution

61. In how many years will a sum ₹800 at 10% per annum compounded semi-annually become ₹926.10?

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

Ans. **(b)**

Let the number of year is n

Then, $A = P\left(1+\frac{\frac{R}{2}}{100}\right)^{2n}$

$$926.10 = 800\left(1+\frac{5}{100}\right)^{2n}$$

$$\frac{926.10}{800} = \left(\frac{21}{20}\right)^{2n}$$

$$\frac{92610}{80000} = \left(\frac{21}{20}\right)^{2n}$$

$$\left(\frac{21}{20}\right)^3 = \left(\frac{21}{20}\right)^{2n}$$

$$2n = 3$$

$$n = \frac{3}{2}$$

End of Solution

62. The diagonal of a rectangle is $\sqrt{41}$ cm and its area is 20 sq.cm. The perimeter of the rectangle is

(a) 9 cm (b) 18 cm

(c) 20 cm (d) 41 cm

Ans. **(b)**

Let the side of rectangle is l, b

Then, $l\,b = 20$

$l^2 + b^2 = 41$

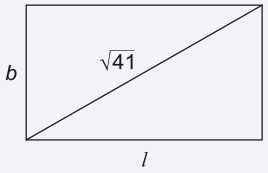
So, $(l + b)^2 = l^2 + b^2 + 2lb$

$(l + b)^2 = 41 + 2 \times 20$

$(l + b)^2 = 81$

$(l + b) = 9$

$2(l + b) = 18$



End of Solution

63. Four persons are chosen at random from a group of 3 men, 2 women and 4 children. The chance that exactly 2 of them are children, is

(a) $\frac{2}{9}$ (b) $\frac{4}{5}$

(c) $\frac{7}{12}$ (d) $\frac{10}{21}$

Ans. **(d)**

The chance that exactly 2 of them are children $= \frac{{}^4C_2 \times {}^5C_2}{{}^9C_4}$

$$= \frac{10 \times 6}{126} = \frac{60}{126} = \frac{10}{21}$$

End of Solution

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8 AIR Yatin Malhotra

9 AIR Arpit Jain

10 AIR Amit Sharma

ME 10 in top 10

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2 AIR K. S. Sharadrao

3 AIR Suraj Shaw

4 AIR Shubham B.

5 AIR Kamlesh Parwar

6 AIR Mohd. Zuhaib

7 AIR Prateek Srivastava

8 AIR V. Saikrishna R.

9 AIR Ganesh Adigaur

10 AIR Hemabh Trivedi

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4 AIR A. Samantaray

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10 AIR Rajat Dixit

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2 AIR Parth Batra

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4 AIR Shubham

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9 AIR Chhavi Jain

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6 AIR Tanmay Mahajan

8 AIR Rahul Pati

8 AIR Pranshu Jangid

10 AIR Govind Bairwa

ME 10 in Top 10

1 AIR Suyash Sharma

2 AIR Jay M. Chavda

3 AIR Munish Kumar

3 AIR Nukala Viswa Teja

5 AIR Abhisheka

6 AIR Abhishek Mewar

7 AIR Vatsal M Panchal

8 AIR Rohit Shankar P.

8 AIR Rajat Gupta

10 AIR Deepesh Agarwal

EE 6 in Top 10

1 AIR Aakash Dhill

1 AIR Amit Gupta

3 AIR Jayma H Khunti

5 AIR Deepesh

7 AIR Ketan Shukla

8 AIR Hemant Jindal

1 AIR XE Varun Kaushik ME Student

1 AIR ES Samarthya T. CE Student

EC 9 in Top 10

1 AIR Siddharth Sabharwal

2 AIR Poojasree M

3 AIR Manoj Kumar

4 AIR Polarpu Akhil

5 AIR Vaishnav K.V

8 AIR Ankur Lal Meena

9 AIR Sai V Dosapati

9 AIR Abhishek Singh

9 AIR Aleesha Rose

CS 7 in Top 10

1 AIR Jaydeep V Pawar

4 AIR Navneet Gangwar

5 AIR Sayanti Bhattacharjee

5 AIR Aishwarya Mishra

5 AIR Pankaj Lahkar

9 AIR Niranjan N Dhoot

10 AIR Liyana Sahir K

PI 9 in Top 10

1 AIR Ganesh Kumar Adigaur

2 AIR SH Gowtham Gudimella

3 AIR Rehan Anwar Desai

4 AIR Rohit Soni

5 AIR Subhanshu R Tiwari

6 AIR Akash Jaiswal

7 AIR Priyam Mehrotra

7 AIR Atulya Jyoti

7 AIR Sachin Duboliya

IN 11 in Top 10

1 AIR Himanshu Verma

1 AIR Pratik Prakash Shinde

3 AIR Ayan Saha

4 AIR Divakar Chaudhary

4 AIR Saurabh Jaiswal

6 AIR Raju Sharma

6 AIR Harshit Gupta

8 AIR Kunal Saurav

9 AIR Ramesh Kumar

10 AIR Pragya Kaushik

10 AIR Chotu Singh

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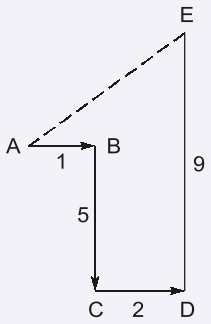
64. A man walks 1 km to East and then he turns to South and walks 5 km. Again, he turns to East and walks 2 km. After, he turns to North and walks 9 km. Now, how far he is from his station point?

(a) 3 km (b) 4 km
(c) 5 km (d) 7 km

Ans. (c)

The possible direction diagram is



$$H = |1 + 2| = 3$$
$$v = |-5 + 9| = 4$$

Hence, $AE = \sqrt{H^2 + v^2} = 5$

End of Solution

65. The population of a village is 5500. If the number of males increases by 11% and the number of females increases by 20% then the population becomes 6330. The population of female in the village is

(a) 2000 (b) 2500
(c) 3000 (d) 3500

Ans. (b)

Let the number of males $= x$
Then number of females $= (5500 - x)$

$$x(1 + 0.11) + (5500 - x) \times 1.2 = 6330$$
$$1.11x + 6600 - 1.2x = 6330$$
$$x = \frac{270}{9} \times 100$$
$$x = 3000$$

So, Number of females $= 5500 - 3000 = 2500$

End of Solution

66. *A*, *B*, *C*, *D* and *E* are five different integers. When written in the ascending order of values, the difference between any two adjacent integers is 4. *D* is the greatest and *A* is the least. *B* is greater than *E* but less than *C*. The sum of the integers is equal to *E*. What is the positive difference between the lowest and the highest integers?

(a) 8 (b) 6

(c) 16 (d) 18

Ans. **(c)**

Let the value of integer *A* is x

max min

$D > C > B > E > A$

$x+16 \quad x+12 \quad x+8 \quad x+4 \quad x$

$$A + B + C + D + E = E$$

$$A + B + C + D = 0$$

$$x + (x + 8) + (x + 12) + (x + 16) = 0$$

So, $x = -9$

D	*C*	*B*	*E*	*A*
7	3	–1	–5	–9

So the difference between the highest and lowest integer is

$$= 7 - (-9) = 16$$

Alternate solution :

Max Min

D > C > B > E > A

∵ The difference between two adjacent integer is 4.

So, the difference between the highest and lowest integer will be = 4 × 4 = 16

End of Solution

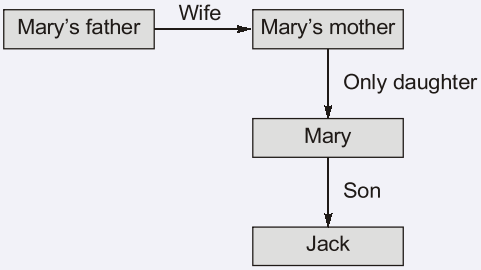
67. Mary introduces Jack as the son of the only daughter of my father's wife. How is Jack related to Mary?

(a) Brother (b) Son

(c) Husband (d) Father

Ans. **(b)**

The possible relationship diagram is



From the diagram it can be observed that Jack is son of Mary.

End of Solution

68. The value of $\int_0^1\int_0^x (x^2+y^2)\,dA$, where dA indicates small area in xy-plane, is

(a) $\frac{1}{2}$ sq. units (b) $\frac{1}{3}$ sq. units

(c) $-\frac{1}{2}$ sq. units (d) $-\frac{1}{3}$ sq. units

Ans. (b)

$$I = \int_0^1\int_0^x \left(x^2+y^2\right)dy\,dx$$

$$= \int_0^1 \left(x^2y + \frac{y^3}{3}\right)_0^x dx = \int_0^1 \frac{4x^3}{3}dx = \left[\frac{x^4}{3}\right]_0^1$$

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

End of Solution

69. If $x = uv$, $y = \frac{u+v}{u-v}$, then $\frac{\partial(u,v)}{\partial(x,y)}$ is

(a) $\frac{(u-v)^2}{4uv}$ (b) $\frac{(u+v)^2}{4uv}$

(c) $\frac{(u-v)}{4uv}$ (d) $\frac{(u+v)}{4uv}$

Ans. (a)

$x = uv,\ y = \frac{u+v}{u-v}$

$$\frac{\partial(x,y)}{\partial(u,v)} = \begin{vmatrix} x_u & x_v \\ y_u & y_v \end{vmatrix} = \begin{vmatrix} v & u \\ \frac{-2v}{(u-v)^2} & \frac{2u}{(u-v)^2} \end{vmatrix}$$

$$= \frac{4uv}{(u-v)^2}$$

$$\therefore \quad \frac{\partial(u,v)}{\partial(x,y)} = \frac{1}{\frac{\partial(x,y)}{\partial(u,v)}} = \frac{(u-v)^2}{4uv}$$

End of Solution

70. If $u = x^3 + y^3$ where $x = a\cos t$, $y = b\sin t$, then $\frac{du}{dt} =$

(a) $-3a^3\cos^2 t\sin t + 3b^3\sin^2 t\cos t$ (b) $3a^3\sin^2 t\cos t + 3b^3\cos^2 t\sin t$

(c) $3b\sin^2 t\cos t + 3a^3\sin^2 t\cos t$ (d) $-3a^3\sin t + 3b^3\cos^2 t\sin t$

Ans. **(a)**

$$\frac{du}{dt} = \frac{du}{dx}\times\frac{dx}{dt} + \frac{du}{dy}\times\frac{dy}{dt}$$
$$= 3x^2(-a\sin t) + 3y^2(b\cos t)$$
$$= -3a^3\cos^2 t\sin t + 3b^3\sin^2 t\cos t$$

End of Solution

71. Suppose that a book of 600 pages contains 40 printing mistakes. Assume that these errors are randomly distributed throughout the book and x, the number of errors per page has a Poisson distribution. What is the probability that 10 pages selected at random will be free of errors?

(a) $\frac{1}{3}e^{-1}$ (b) $2e^{-\frac{1}{3}}$

(c) $e^{-\frac{2}{3}}$ (d) $\frac{1}{3}e^{-2}$

Ans. **(c)**

$$p(\text{error per page}) = \frac{40}{600} = \frac{2}{30} = \frac{1}{15}$$

$$\lambda = np = 10\times\frac{1}{15} = \frac{2}{3}$$

Let, X = Number of errors per page

$$p[X = 0] = \frac{e^{-\lambda}\lambda^0}{0!} = e^{-\frac{2}{3}}$$

End of Solution

72. The highest Eigen value of the 2×2 matrix $\begin{bmatrix}1 & 2\\ 4 & 3\end{bmatrix}$ is

(a) -1 (b) -5

(c) 5 (d) 1

Ans. **(c)**

Characteristic equation $|A-\lambda I| = \begin{vmatrix}1-\lambda & 2\\ 4 & 3-\lambda\end{vmatrix} = 0$

$\Rightarrow \quad \lambda^2 - 4\lambda - 5 = 0$

$\Rightarrow \quad \lambda = 5, -1$

$\therefore \quad \lambda_{max} = 5$

End of Solution

73. If $\Delta = \begin{vmatrix} p & p^2 & (p^3-1) \\ q & q^2 & (q^3-1) \\ r & r^2 & (r^3-1) \end{vmatrix} = 0$, in which p, q, r are different. The value of pqr is

(a) 3 (b) 1
(c) 2.5 (d) 3.5

Ans. **(b)**

$$\Delta = \begin{vmatrix} p & p^2 & p^3 \\ q & q^2 & q^3 \\ r & r^2 & r^3 \end{vmatrix} - \begin{vmatrix} p & p^2 & 1 \\ q & q^2 & 1 \\ r & r^2 & 1 \end{vmatrix} = 0$$

$$= (pqr)\begin{vmatrix} 1 & p & p^2 \\ 1 & q & q^2 \\ 1 & r & r^2 \end{vmatrix} - \begin{vmatrix} 1 & p & p^2 \\ 1 & q & q^2 \\ 1 & r & r^2 \end{vmatrix} = 0$$

$$= (pqr-1)\begin{vmatrix} 1 & p & p^2 \\ 1 & q & q^2 \\ 1 & r & r^2 \end{vmatrix} = 0$$

$\Rightarrow$ $(pqr - 1) = 0$ or $(p - q)(q - r)(r - p) = 0$

$\therefore$ $pqr = 1$

End of Solution

74. If $A = \begin{bmatrix} -1 & 2 & 3 & -2 \\ 2 & -5 & 1 & 2 \\ 3 & -8 & 5 & 2 \\ 5 & -12 & -1 & 6 \end{bmatrix}$, then the rank of the matrix A is

(a) 2 (b) 5
(c) 4 (d) 3

Ans. **(a)**

$$R_1 \to -R_1$$

$$A = \begin{bmatrix} 1 & -2 & -3 & 2 \\ 2 & -5 & 1 & 2 \\ 3 & -8 & 5 & 2 \\ 5 & -12 & -1 & 6 \end{bmatrix}$$

$R_2 \to R_2 - 2R_1$; $R_3 \to R_3 - 3R_1$; $R_4 \to R_4 - 5R_1$

$$= \begin{vmatrix} 1 & -2 & -3 & 2 \\ 0 & -1 & 7 & -2 \\ 0 & -2 & 14 & -4 \\ 0 & -2 & 14 & -4 \end{vmatrix}$$

$R_4 \to R_4 - 2R_2;\ R_3 \to R_3 - 2R_2$

$$= \begin{vmatrix} 1 & -2 & -3 & 2 \\ 0 & -1 & 7 & -2 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{vmatrix}$$

So, $r[A] = 2$

End of Solution

75. If $A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix}$, then which one of the following is correct?

(a) $A^3 - 3A^2 - 4A + 11I = 0$ (b) $A^3 - 4A^2 - 3A + 11I = 0$

(c) $A^3 + 4A^2 - 3A + 11I = 0$ (d) $A^3 - 3A^2 + 4A + 11I = 0$

Ans. (b)

$$\because \quad |A - \lambda I| = \begin{vmatrix} 1-\lambda & 3 & 2 \\ 2 & -\lambda & -1 \\ 1 & 2 & 3-\lambda \end{vmatrix} = 0$$

$$(1 - \lambda)(-3\lambda + \lambda^2 + 2) - 3(6 - 2\lambda + 1) + 2(4 + \lambda) = 0$$

$$(1 - \lambda)(\lambda^2 - 3\lambda + 2) - 3(7 - 2\lambda) + 2(4 + \lambda) = 0$$

$$\lambda^3 - 4\lambda^2 - 3\lambda + 11 = 0$$

By C-H theorem replace λ by A

$$A^3 - 4A^2 - 3A + 11I = 0$$

End of Solution

76. The Maclaurin's series expansion of $e^{\sin x}$ is

(a) $1 + x - \frac{x^2}{2} + \frac{x^4}{12} - \ldots\ldots\ldots$ (b) $1 - x + \frac{x^2}{2} - \frac{x^4}{8} + \ldots\ldots\ldots$

(c) $1 + x + \frac{x^2}{2} - \frac{x^4}{8} + \ldots\ldots\ldots$ (d) $1 + x + \frac{x^2}{2} - \frac{x^4}{12} + \ldots\ldots\ldots$

Ans. (c)

$f(x) = e^{\sin x} \Rightarrow f(0) = e^0 = 1$

$f'(x) = e^{\sin x}(\cos x) \Rightarrow f'(0) = 1$

$f''(x) = e^{\sin x}\cos^2 x + e^{\sin x}(-\sin x)$

$f''(0) = 1$

$= e^{\sin x}[\cos^2 x - \sin x]$

$$f'''(x) = e^{\sin x}[-\sin 2x - \cos x] + e^{\sin x}[\cos^3 x - \sin x \cos x]$$
$$f'''(x) = -1 + 1 = 0$$
$$f^{iv}(x) = e^{\sin x}[-2\cos 2x + \sin x] + e^{\sin x}\cos x[-\sin 2x - \cos x]$$
$$+e^{\sin x}\left[3\cos^2 x(-\sin x) - \frac{\cos 2x}{2}\times 2\right]$$
$$+ e^{\sin x}[\cos^4 x - \sin x \cos^2 x]$$
$$f^{iv}(0) = -2 - 1 - 1 + 1 = -3$$
$$\vdots$$

Subsitute in Maclaurin Series

$$e^{\sin x} = 1 + x + \frac{x^2}{2} + \frac{x^3}{3!}(0) + \frac{x^4}{4!}\times(-3) + \ldots\ldots\ldots$$
$$= 1 + x + \frac{x^2}{2} - \frac{x^4}{8} + \ldots\ldots\ldots\ldots$$

End of Solution

77. The real root of $x^3 + x^2 + 3x + 4 = 0$ correct to four decimal places, obtained using Newton Raphson method is

(a) –1.3334 (b) 1.3221

(c) –1.2229 (d) 1.2929

Ans. (c)

Given, $f(x) = x^3 + x^2 + 3x + 4 = 0$

$f'(x) = 3x^2 + 2x + 3$

$\because$ $f(-1) = 1 > 0$ and $f(-2) = -6 < 0$

$\therefore$ $f(-1) \cdot f(-2) < 0$

$\Rightarrow$ $\exists$ a root lies in $[-1, -2]$

Let, $x_0 = -1$

By Newton Raphson method

First approximation

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$
$$= -1 - \frac{1}{4} = -1 - 0.25$$
$$x_1 = -1.25$$
$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)}$$
$$= -1.25 - \frac{(-1.25)^3 + (-1.25)^2 + 3(-1.25) + 4}{3(-1.25)^2 + 2(-1.25) + 3} = -1.2229$$

End of Solution

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78. The value of $\int_0^6 \frac{dx}{1+x^2}$ by Simpson's $\frac{1}{3}$ rule is

(a) 1.3111 (b) 1.3941
(c) 1.3735 (d) 1.3662

Ans. (d)

y_0	y_1	y_2	y_3	y_4	y_5	y_6
0	1	2	3	4	5	6
1	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{1}{10}$	$\frac{1}{17}$	$\frac{1}{26}$	$\frac{1}{37}$

$$h = \frac{b-a}{n} = \frac{6-0}{6} = 1$$

$$\int_0^6 \frac{dx}{1+x^2} = \frac{h}{3}\left[(y_0+y_6)+4\times(y_1+y_3+y_5)+2\times(y_2+y_4)\right]$$

$$= \frac{1}{3}\left[\left(1+\frac{1}{37}\right)+4\left(\frac{1}{2}+\frac{1}{10}+\frac{1}{26}\right)+2\left(\frac{1}{5}+\frac{1}{17}\right)\right]$$

$$= \frac{1}{3}\left(\frac{38}{37}+4\times\frac{83}{130}+2\times\frac{22}{85}\right)$$

$$= \frac{1}{3}\left(\frac{38}{37}+\frac{166}{65}+\frac{44}{85}\right)$$

$$= 1.36617 \simeq 1.3662$$

End of Solution

79. The value of $\sum_1^n \frac{1}{(x+3)(x+4)}$ is

(a) $\frac{n}{n+2}$ (b) $\frac{2n}{n+1}$
(c) $\frac{n}{4(n+4)}$ (d) $\frac{n}{2(n+2)}$

Ans. (c)

$$\sum_1^n \frac{1}{(x+3)(x+4)} = \left[\frac{1}{4.5}+\frac{1}{5.6}+\frac{1}{6.7}+\ldots+\frac{1}{(n+3)(n+4)}\right]$$

$$\Rightarrow \left(\frac{1}{4}-\frac{1}{5}\right)+\left(\frac{1}{5}-\frac{1}{6}\right)+\left(\frac{1}{6}-\frac{1}{7}\right)+\ldots+\left(\frac{1}{n+3}-\frac{1}{n+4}\right)$$

$$\Rightarrow \frac{1}{4}-\frac{1}{n+4} = \frac{n+4-4}{4(n+4)} = \frac{n}{4(n+4)}$$

End of Solution

80. The surface which intersects the surfaces of the system $z(x+y) = c(3z+1)$ orthogonally and which passes through the circle $x^2 + y^2 = 1$, $z = 1$, is given by

(a) $x^2 + y^2 = 2z^3 + z^2 - 2$ (b) $x^2 - y^2 = z^3 + z + 1$

(c) $x^2 - y^2 = z^2 + 4$ (d) $x^2 + y^2 = z^3 + z^2 + 4$

Ans. (a)

Given surface is $f = \dfrac{z(x+y)}{c(3z+1)}$

Lagrange's subsidiary equation are $\dfrac{dx}{\frac{\partial f}{\partial x}} = \dfrac{dy}{\frac{\partial f}{\partial y}} = \dfrac{dz}{\frac{\partial f}{\partial z}}$

$$\Rightarrow \quad \frac{dx}{\frac{z}{c(3z+1)}} = \frac{dy}{\frac{z}{c(3z+1)}} = \frac{dz}{\frac{x+y}{c(3z+1)^2}}$$

$$\Rightarrow \quad \frac{dx}{z} = \frac{dy}{z} = \left(\frac{3z+1}{x+y}\right)dz \qquad \ldots(i)$$

Taking 1st and 2nd : $\dfrac{dx}{z} = \dfrac{dy}{z}$

$$\Rightarrow \quad \int dx = \int dy + c_1$$

$$\Rightarrow \quad x - y = c_1 \qquad \ldots(ii)$$

Again using (i), $\dfrac{dx+dy}{2z} = \left(\dfrac{3z+1}{x+y}\right)dz$

$$\int (x+y)(dx+dy) = \int (6z^2+2z)dz + c_2$$

$$\Rightarrow \quad \frac{(x+y)^2}{2} = 2z^3 + z^2 + c_2$$

or $$(x+y)^2 = 4z^3 + 2z^2 + c_2$$

$$x^2 + y^2 + 2xy = 4z^3 + 2z^2 + c_2$$

$$1 + 2xy = 4(1)^3 + 2(1)^2 + c_2$$

$$\Rightarrow \quad 2xy = 5 + c_2 \qquad \ldots(iii)$$

Putting the value of $2xy$ from equation (ii) into equation (iii),

$\{\because (x-y)^2 = c_1^2 \Rightarrow 2xy = 1 - c_1^2\}$

By equation (iii),

$$1 - c_1^2 = 5 + c_2$$

$$\Rightarrow \quad c_1^2 + c_2 + 4 = 0$$

$$(x-y)^2 + (x+y)^2 - 4z^3 - 2z^2 + 4 = 0$$

$$2(x^2 + y^2) = 2(2z^3 - z^2 - 2) \quad \text{or} \quad x^2 + y^2 = 2z^3 - z^2 - 2$$

End of Solution

81. The surface area of that portion of the surface $z = \sqrt{4 - x^2}$ that lies above the rectangle R in the xy-plane whose coordinates satisfy $0 \le x \le 1$ and $0 \le y \le 4$ is equal to

(a) $4 - \pi$ (b) $\frac{3}{4}\pi^2$

(c) $\frac{\sqrt{3}}{5}\pi$ (d) $\frac{4}{3}\pi$

Ans. (d)

$$z = \sqrt{4 - x^2}$$

$$\frac{\partial z}{\partial x} = \frac{-x}{\sqrt{4 - x^2}}, \quad \frac{\partial z}{\partial y} = 0$$

$$\text{Required surface area} = \int_{x=0}^{1}\int_{y=0}^{4}\sqrt{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 + 1}\cdot dx\,dy$$

$$= \int_{x=0}^{1}\int_{y=0}^{4}\sqrt{\left(\frac{-x}{\sqrt{4-x^2}}\right)^2 + 0^2 + 1}\cdot dx\,dy$$

$$= \int_{x=0}^{1}\int_{y=0}^{4}\sqrt{\frac{4}{4-x^2}}\,dx\,dy = 2\int_{x=0}^{1}\frac{dx}{\sqrt{4-x^2}} \times \int_{y=0}^{4}(1)\,dy$$

$$= 2\times\left[\sin^{-1}\left(\frac{x}{2}\right)\right]_0^1 \times (4)$$

$$= 8\left[\sin^{-1}\left(\frac{1}{2}\right) - \sin^{-1}(0)\right]$$

$$= 8\cdot\left(\frac{\pi}{6} - 0\right) = \frac{4}{3}\cdot\pi = \frac{4\pi}{3}$$

End of Solution

82. The value of y at $x = 0.1$ to five places of decimals, by Taylor's series method, given that $\frac{dy}{dx} = x^2y - 1, y(0) = 1,$ is

(a) 0.68281 (b) 0.81122

(c) 0.90033 (d) 0.70127

Ans. (c)

$$\frac{dy}{dx} = x^2y - 1,\ y(0) = 1,\ y(0.1) = ?$$

Here, $x_0 = 0,\ y_0 = 1,\ h = 0.1$ so $y(0.1) = y_1 = ?$

Here, $y^{I}(x) = x^2y - 1$

$\Rightarrow$ $y^{I}(0) = -1$

$y^{II}(x) = 2xy + x^2y^{I}$

$\Rightarrow$ $y^{II}(0) = 0$

$y^{III}(x) = 2y + 2xy^{I} + 2xy^{I} + x^2y^{II}$

$\Rightarrow$ $y^{III}(0) = 2$

$y^{IV}(x) = 2y^{I} + 4(xy^{II} + y^{I}) + 2xy^{II} + x^2y^{III}$

$\Rightarrow$ $y^{IV}(0) = -6$ and so on .....

Hence by Taylor series;

$$y_1 = y_0 + hy^{I}(0) + \frac{h^2}{2!}y^{II}(0) + \frac{h^3}{3!}y^{III}(0) + \frac{h^4}{4!}y^{IV}(0) + \ldots$$

$$= 1 + 0.1(-1) + \frac{(0.1)^2}{2!}(0) + \frac{(0.1)^3}{3!}(2) + \frac{(0.1)^4}{4!}(-6) + \ldots$$

$= 1 - 0.1 + 0 + 0.00033 + \ldots$

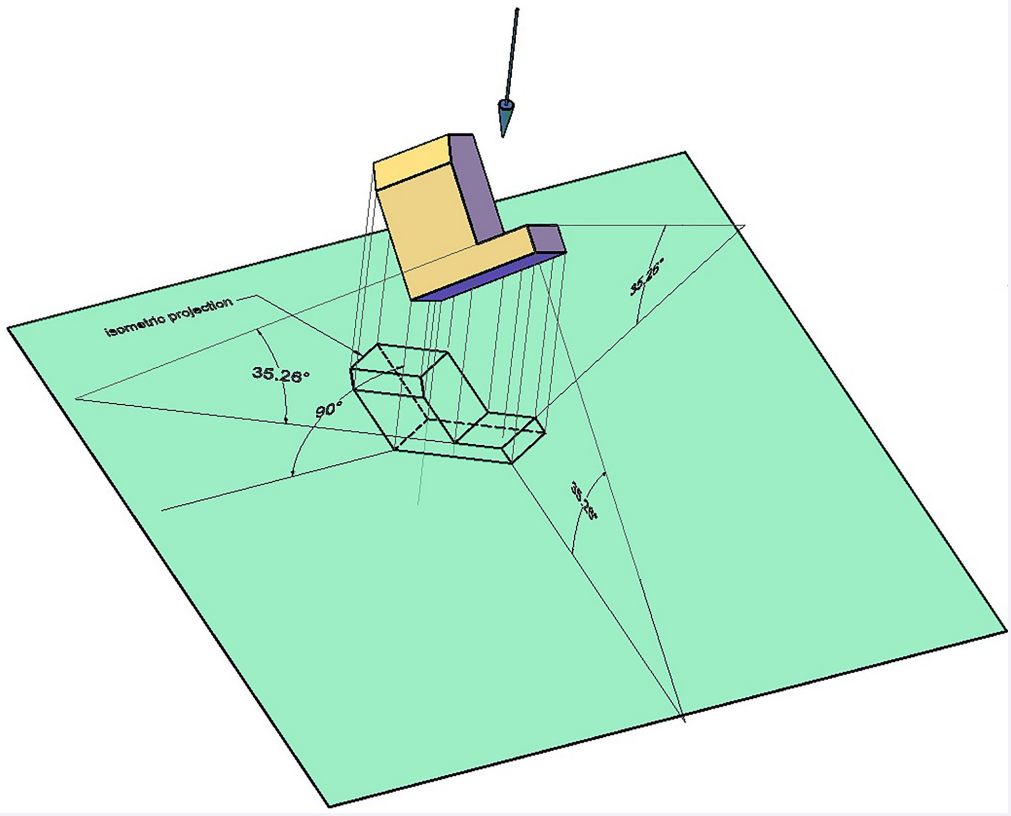
$= 0.90031 \approx 0.90033$

End of Solution

83. In which one of the following projection types, the object is kept in such a way that its three mutual perpendicular edges make equal angles with the plane of projection and the object stands on one of its corners?

(a) Non Isometric projection (b) Oblique projection

(c) Isometric projection (d) Point projection



As shown in pictorial diagram above, when all three-coordinate axis of solid are equally inclined to plane of projection, then the single view orthographic projection obtained is called isometric projection.

End of Solution

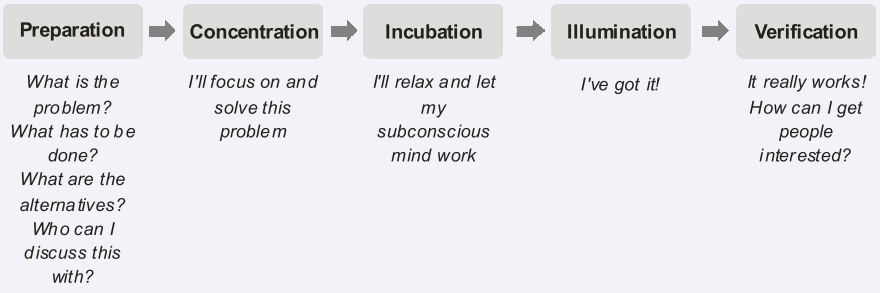
84. The creative design routes are practised by adopting following steps:

1. Concentration
2. Illumination
3. Preparation
4. Verification
5. Incubation

Arrange the above steps in correct sequence:

(a) 3, 1, 5, 2, 4 (b) 3, 5, 2, 1, 4
(c) 3, 2, 1, 5, 4 (d) 3, 1, 2, 5, 4

Ans. (a)



End of Solution

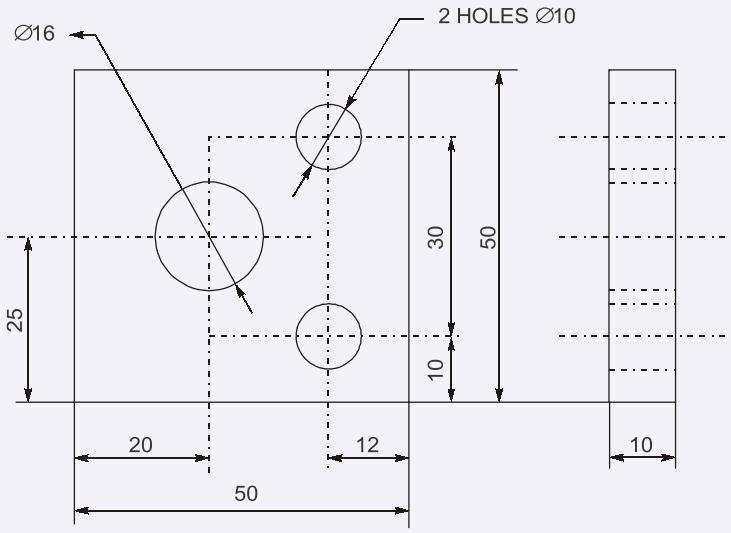
85. Points to be remembered while dimensioning

1. Dimensions are to be placed on the view which clearly express the relevant features.
2. Once dimension is marked in one view, it should not be repeated in another view.
3. Dimensions are to be drawn from hidden lines.
4. Dimensions should be given from the base line or centre line of a hole.

Which of the above statements are correct?

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

Ans. (b)



You can observe that dimensioning between hidden lines is avoided. In side view holes are appearing as hidden lines and hence distance between holes and their diameter is not dimensioned in side view.

Dimensions are always placed in view which clearly express relevant features. In front view all width and height dimensions are placed whereas in side view the remaining depth dimension is marked.

Repetition of dimensions is avoided. Height dimension is visible in side view also but since it is dimensioned in front view repetition is avoided.

You can observe that in the front view hole locations are dimensioned from their center lines.

End of Solution

86. The design of highway interchanges involves the application of the geometry of
(a) circle arcs (b) semi ellipse
(c) hyperbola (d) semi-circle

Ans. (a)

End of Solution

87. On a multi view drawing a visible or invisible line represses the following
1. Intersection of two surfaces
2. Edge view of surface
3. Limiting elements of a surface

Which of the above points are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Ans. (d)

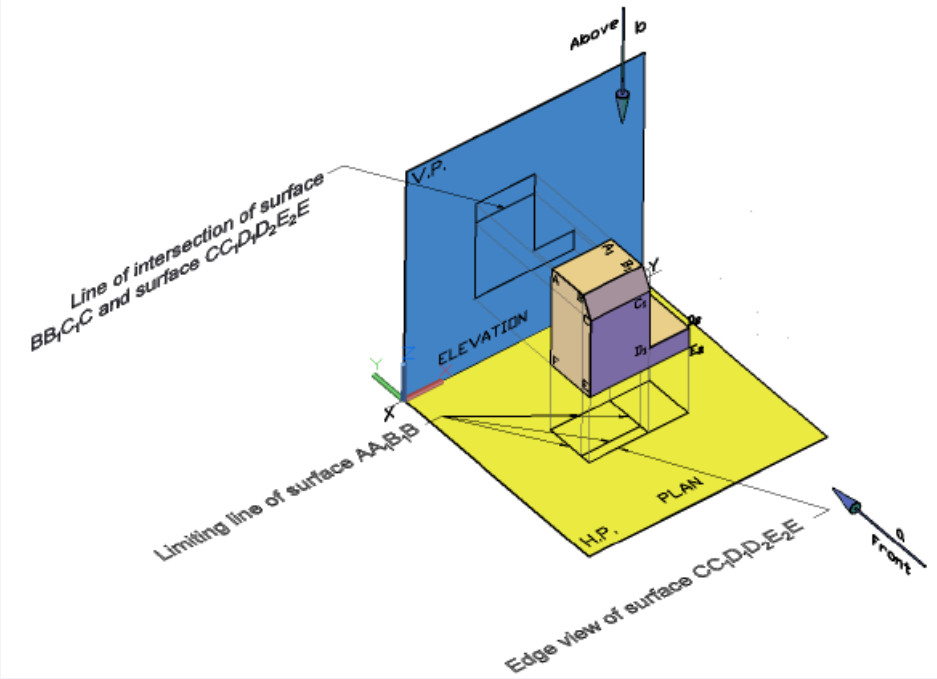


Figure above shows all three conditions.

End of Solution

88. On a view showing assembled parts, section line on adjacent pieces are drawn in
(a) same directions usually at an angle of 90°
(b) opposite directions usually at an angle of 45°
(c) opposite directions usually at an angle of 30°
(d) same directions usually at an angle of 60°

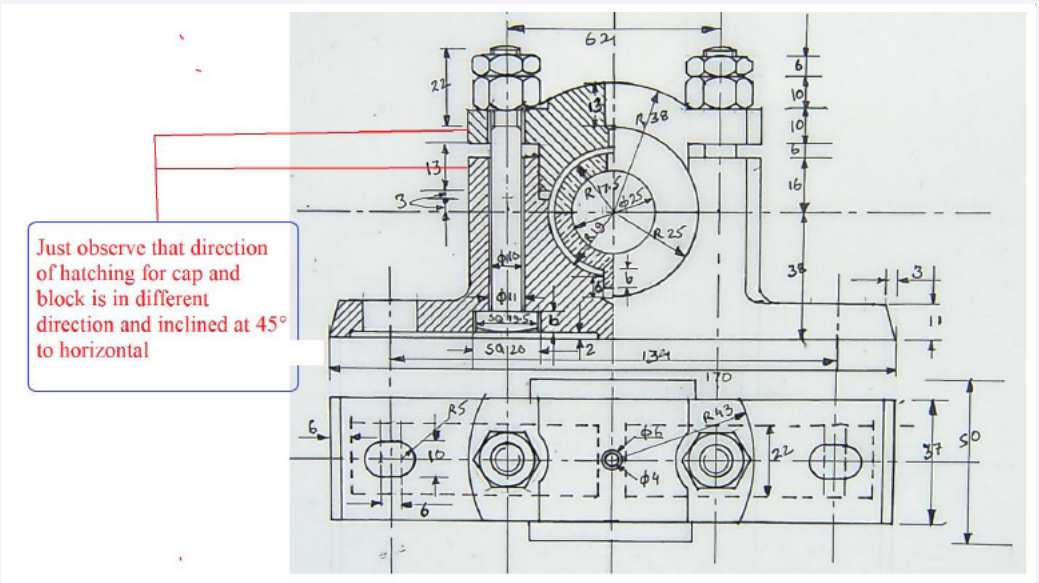
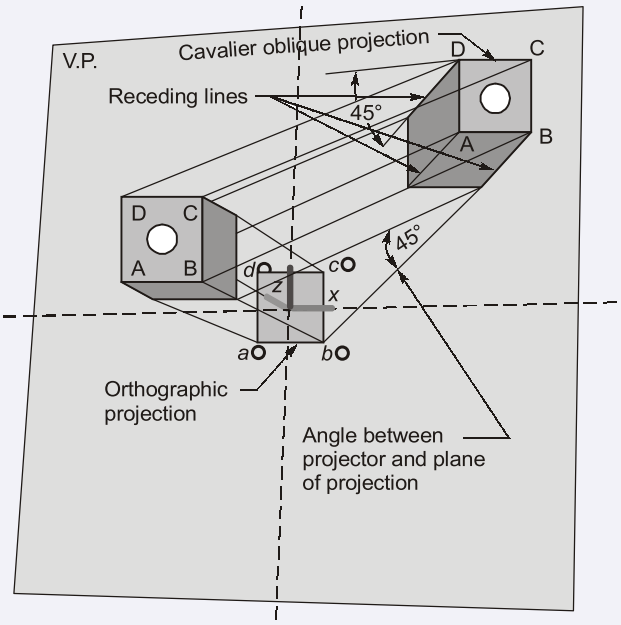


Figure above clearly shows that in front view left half in section of the Plummer block, Cap and Block which are in contact, are hatched in mutually perpendicular direction and at 45° to horizontal.

End of Solution

89. Oblique drawing has the following advantage over isometric drawing:
(a) Distortion can be increased by foreshortening measurements along the receding axis
(b) A greater choice is permitted in orthographic top view
(c) Circular or irregular outlines on the front face show in their true shape
(d) Oblique drawing is often less flexible

Ans. (c)



Single view parallel projection when projectors are inclined to the projection plane at angle other than 90° is called oblique projection. While obtaining oblique projection face containing maximum information is kept parallel to plane of projection. Figure above clearly shows that since front face is kept parallel to plane of projection & circle on front face is appearing of true shape in oblique projection.

End of Solution

90. Most of Deming's deadly diseases involve
(a) immobility of management
(b) a long term orientation
(c) a lack of understanding of variation
(d) high degree of constancy of purpose

Ans. (c)

End of Solution

91. Which one of the following rules is NOT used for identifying an out-of-control process?
(a) A process is assumed to be out-of-control if a single point plots outside the control limits
(b) A process is assumed to be out-of-control if there is a run of six or more consecutive points steadily increasing or decreasing
(c) A process is assumed to be out-of-control if nine or more consecutive points fall to one side of the center line
(d) A process is assumed issued to be out-of-control if two or more consecutive points fall beyond the 1 σ limit on the same side of the center line

Ans. (d)

End of Solution

92. Which one of the following is NOT a major quality control method?
(a) Inspection
(b) Testing
(c) Loading
(d) Sampling

Ans. (c)

End of Solution

93. Which one of the following is the responsiveness to business issues in commercial performances?
(a) Frequency of overshipments
(b) Quotations
(c) Timely reconciliation of cumulative shipments
(d) Timely supplier response to problems

Ans. (d)

End of Solution

94. Which one of the following is NOT a component of total variability of measured observations?
(a) Variation between operators
(b) Variability due to operators
(c) Variability between parts dimensions
(d) Variation due to interaction between operators and parts

Ans. (c)

End of Solution

95. Which one of the following unique characteristics of the construction process makes TQM difficult to implement?
(a) The construction process is relatively short in duration
(b) A low percentage of the labour at a construction project only work for the construction firm for a short time period
(c) Project owners take a long term view to control projects
(d) Construction projects are multiple, each project being somewhat same

Ans. (a)

End of Solution

96. Rearrange the following steps involved in construction of pareto diagram in the proper order.

1. Determine how relative importance is to be judged.
2. Decide on the data categorization system.
3. Rank the categories from most important to least important.
4. Plot a bar graph.
5. Compute the cumulative frequency of the data categories in their chosen order.

Select the correct answer using the code given below:

(a) 1, 3, 2, 4, 5 (b) 2, 3, 1, 5, 4
(c) 2, 1, 3, 5, 4 (d) 1, 2, 3, 4, 5

Ans. (c)

End of Solution

Directions: Each of the next **Four (4)** items consists of two statements, one labelled as '**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 code given below:

Code:

(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):** Issue of shares is the most common method especially to raise long-term funds.

Statement (II): The equity shareholders are residual owners who have restricted claim on income as dividend.

Ans. (a, b)

End of Solution

98. **Statement (I):** The slip mode of deformation is the common mode in only one crystal at ambient and elevated temperature.

Statement (II): A slip plane and a slip direction that lies on it together constitute a slip system.

Ans. (a)

End of Solution

99. **Statement (I):** Major e-Governance projects bear fruit only when application of IT is preceded by process re-engineering.

Statement (II): Initiatives which save the citizens' time, money and effort are able to succeed even when back-end computerization is not done.

Ans. (b)

Second Administrative Reforms Commission (SARC) - set up in 2005 - brought out Fifteen Reports, and its Eleventh Report (brought in December 2008) is on e-Governance (Promoting e-Governance - The SMART Way Forward).

Both the statements given in this question are given in this Report.

The Main aim of Process Reengineering is removing unnecessary process and modernising and simplifying essential ones making use of modern technology for better efficiency and service delivery.

The Report also observes that for complete transformation of governance there has to be an end-to-end ICT enablement coupled with process re-engineering.

End of Solution

100. **Statement (I):** Moral pluralists maintain that there are moral truths, but they do not form a body of coherent and consistent truths in the way that one finds in science or mathematics.

Statement (II): Moral truth are real, but partial.

Ans. (a)

End of Solution

■■■■