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# IPMAT 2022 OFFICIAL PAPER

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**QUANTITATIVE ABILITY - (SA)****Questions: 15 (+4/-0)****Sectional Time: 40 Minutes**

- The 3rd, 14th and 69<sup>th</sup> terms of an arithmetic progression form three distinct and consecutive terms of a geometric progression. If the next terms of the geometric progression is the n<sup>th</sup> term of the arithmetic progression, then n equals\_\_\_\_\_.
- The area enclosed by  $2|x| + 3|y| \leq 6$  is\_\_\_\_\_ sq. units
- The number of triangles that can be formed by choosing points from 7 points on a line and 5 points on another parallel line is\_\_\_\_\_.
- If  $\sin \alpha + \sin \beta = \frac{\sqrt{2}}{\sqrt{3}}$  and  $\cos \alpha + \cos \beta = \frac{1}{\sqrt{3}}$ , then the value of  $\left(20 \cos \left(\frac{\alpha - \beta}{2}\right)\right)^2$  is.
- The sum of the coefficients of all the terms in the expansion of  $(5x - 9)^4$  is \_\_\_\_\_.
- Aruna purchases a certain number of apples for INR 20 each and a certain number of mangoes for INR 25 each. If she sells all the apples at 10% profit and all the mangoes at 20% loss, overall she makes neither profit nor loss. Instead, if she sells all the apples at 20% loss and all the mangoes at 10% profit, overall she makes a loss of INR 150. Then the number of apples purchased by Aruna is\_\_\_\_\_.
- If  $\log_{x^2} y + \log_{y^2} x = 1$  and  $y = x^2 - 30$ . Then the value of  $x^2 + y^2$  is\_\_\_\_\_.
- Let  $P(X)$  denote power set of a set X. If A is the null set, then the number of elements in  $P(P(P(P(A))))$  is\_\_\_\_\_.
- A new sequence is obtained from the sequence of positive integers (1, 2, 3,...) by deleting all the perfect squares. Then the 2022nd term of the new sequence is\_\_\_\_\_.
- If  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ , Then the absolute value of the determinant of  $(A^0 + A^6 + A^3 + A)$  is \_\_\_\_\_.
- The numbers -16,  $2^{x+3} - 2^{2x-1} - 16$ ,  $2^{2x-1} + 16$  are in an arithmetic progression. Then x equals \_\_\_\_\_.
- Given that  $f(x) = |x| + 2|x - 1| + |x - 2| + |x - 4| + |x - 6| + 2|x - 10|$ ,  $x \in (-\infty, \infty)$ , the minimum value of  $f(x)$  is\_\_\_\_\_.
- When Geeta increases her speed from 12 km/hr to 20 km/hr, she takes one hour less than the usual time to cover the distance between her home and office. The distance between her home and office is\_\_\_\_\_ km.
- Let 50 distinct positive integers be chosen such that the highest among them is 100, and the average of the largest 25 integers among them exceeds the average of the remaining integers by 50. Then the maximum possible value of the sum of all the 50 integers is \_\_\_\_\_.

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- Mrs and Mr Sharma, and Mrs and Mr Ahuja along with four other persons are to be seated at a round table for dinner. If Mrs and Mr Sharma are to be seated next to each other, and Mrs and Mr Ahuja are not to be seated next to each other, then the total number of seating arrangements is \_\_\_\_\_

**QUANTITATIVE ABILITY - (MCQ)****Questions: 30 (+4/-1)****Sectional Time: 40 Minutes**

16. The sum of the squares of all the roots of the equation  $x^2 + |x + 4| + |x - 4| - 35 = 0$  is  
 (a) 50 (b) 74  
 (c) 175 (d) 148
17. Let  $A = \{1, 2, 3\}$  and  $B = \{a, b\}$ . Assuming all relations from set A to set B are equally likely, what is the probability that a relation from A to B is also a function?  
 (a)  $\frac{1}{2}$  (b)  $\frac{3^2}{2^6}$   
 (c)  $\frac{1}{8}$  (d) 1
18. If the five-digit number abcde is divisible by 6, then which of the following numbers is not necessarily divisible by 6?  
 (a) edcba (b) eee  
 (c) bbadcaccede (d) cdbae
19. The set of real values of x for which the inequality  $\log_{27} 8 \leq \log_3 x < 9^{\frac{1}{\log_3 3}}$  hold  
 (a) [2,81] (b) [2,27]  
 (c) [2,81] (d) (2,27]
20. Suppose a, b and c are integers such that  $a > b > c > 0$ , and  $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ . Then the value of the determinant of A  
 (a) can be positive or negative  
 (b) is positive  
 (c) is negative  
 (d) is zero
21. The lengths of the sides of a triangle are x, 21 and 40, where x is the shortest side. A possible value of x is  
 (a) 16 (b) 18  
 (c) 20 (d) 19
22. If  $A = \begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 0 \end{bmatrix}$ , then  $A^{2022}$  is  
 (a)  $\begin{bmatrix} 1 & 0 \\ 2022 & 0 \end{bmatrix}$  (b)  $\begin{bmatrix} 1 & 0 \\ 2011 & 0 \end{bmatrix}$   
 (c)  $\begin{bmatrix} 1 & 0 \\ \frac{1}{2^{2022}} & 0 \end{bmatrix}$  (d) None of these
23. The sum of the first 15 terms in an arithmetic progression is 200, while the sum of the next 15 terms is 350. Then the common difference is  
 (a)  $\frac{7}{9}$  (b)  $\frac{1}{3}$   
 (c)  $\frac{4}{9}$  (d)  $\frac{2}{3}$
24. The cost of a piece of jewellery is proportional to the square of its weight. A piece of jewellery weighing 10 grams is INR 3600. The cost of a piece of jewellery of the same kind weighing 4 grams is  
 (a) INR 576 (b) INR 1220  
 (c) INR 1440 (d) INR 600
25. When the square of the difference of two natural numbers is subtracted from the square of the sum of the same two numbers and the result is divided by four, we get  
 (a) the HCF of the two numbers  
 (b) the LCM of the two numbers  
 (c) the square of the product of the two numbers  
 (d) the product of the LCM and HCF of the two numbers
26. In a 400-metre race, Ashok beats Bipin and Chandan respectively by 15 seconds and 25 seconds. If Ashok beats Bipin by 150 metres, by how many metres does Bipin beat Chandan in the race?  
 (a) 150 (b) 50  
 (c) 80 (d) 100
27. The set of all possible values of f(x) for which  $(81)^x + (81)^{f(x)} = 3$  is  
 (a)  $(-\infty, 0.25)$  (b) (3,4)  
 (c) (0.25,3) (d)  $(-\infty, 4)$
28. Let A and B be two sets such that the Cartesian product  $A \times B$  consists of four elements. If two elements of  $A \times B$  are (1, 4) and (4, 1), then  
 (a)  $\emptyset \in A \times B$  (b)  $A \times B = B \times A$   
 (c) None of these (d)  $A \times B \neq B \times A$
29. In a right-angled triangle ABC, the hypotenuse AC is of length 13 cm. A line drawn connecting the midpoints D and E of sides AB and AC is found to be 6 cm in length. The length of BC is  
 (a) 8 cm (b) 5 cm  
 (c)  $2\sqrt{3}$  cm (d) 12 cm

30. In a bowl containing 60 ml orange juice, 40 ml of water is poured. Thereafter, 100 ml of apple juice is poured to make a fruit punch. Madhu drinks 50 ml of this fruit punch and comments that the proportion of orange juice needs to be higher for better taste. How much orange juice should be poured into the fruit punch that remained, in order to bring up the level of orange juice to 50 percentage?  
 (a) 60 ml (b) 80 ml  
 (c) 40 ml (d) 100 ml
31. In a room, there are n persons whose average height is 160 cm. If m more persons, whose average height is 172 cm, enter the room, then the average height of all persons in the room becomes 164 cm. Then m : n is  
 (a) 1 : 3 (b) 2 : 1  
 (c) 1 : 2 (d) 3 : 1
32. For  $0 < \theta < \frac{\pi}{4}$ , let  $a = ((\sin\theta)^{\sin\theta})(\log_2 \cos \theta)$ ,  $b = ((\cos\theta)^{\sin\theta})(\log_2 \sin\theta)$ ,  $c = ((\sin\theta)^{\cos\theta})(\log_2 \cos\theta)$  and  $d = ((\sin\theta)^{\sin\theta})(\log_2 \sin\theta)$ . Then, the median value in the sequence a, b, c, d is  
 (a)  $\frac{c+d}{2}$  (b)  $\frac{a+d}{2}$   
 (c)  $\frac{a+c}{2}$  (d)  $\frac{b+c}{2}$
33. If  $f(x^2 + f(y)) = xf(x) + y$  for all non-negative integers x and y, then the value of  $[f(0)]^2 + f(0)$  equals \_\_\_\_\_.  
 (a) 0 (b) 6  
 (c) 2 (d) 1
34. The curve represented by the equation  $\frac{x^2}{\sin\sqrt{2}-\sin\sqrt{3}} + \frac{y^2}{\cos\sqrt{2}-\cos\sqrt{3}} = 1$   
 (a) a hyperbola with the foci on the x-axis  
 (b) an ellipse with the foci on the x-axis  
 (c) an ellipse with the foci on the y-axis  
 (d) a hyperbola with the foci on the y-axis
35. The number of four-digit integers which are greater than 1000 and divisible by both 2 and 3, but not by 5, is  
 (a) 1334 (b) 1500  
 (c) 1666 (d) 1200
36. Ayesha is standing atop a vertical tower 200m high and observes a car moving away from the tower on a straight horizontal road from the foot of the tower. At 11:00 AM, she observes the angle of depression of the car to be 45°. At 11:02 AM, she observes the angle of

depression of the car to be 30°. The speed at which the car is moving is approximately  
 (a) 6.3 km per hour (b) 4.39 km per hour  
 (c) 8.45 km per hour (d) 10.6 km per hour

37. If one of the factors of the number  $3^7 \cdot 2^8 \cdot 17^3$  is randomly chosen, then the probability that the chosen factor will be a perfect square is.  
 (a)  $\frac{5}{32}$  (b)  $\frac{5}{36}$   
 (c)  $\frac{3}{40}$  (d)  $\frac{1}{12}$
38. The value of k for which the following lines  $x-y-1 = 0$ ,  $2x+3y-12 = 0$ ,  $2x-3y+k = 0$  are concurrent is  
 (a) -1 (b) 12  
 (c) 0 (d) 1
39. A set of all possible values the function  $f(x) = \frac{x}{|x|}$ , where  $x \neq 0$ , takes is  
 (a) {1, -1} (b) {1,0}  
 (c) {1,0, -1} (d) {1}
40. In how many ways can the letters of the word **MANAGEMENT** be arranged such that no two vowels appear together?  
 (a) 21600 (b) 25200  
 (c) 37800 (d) 75600

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**Directions (Q.41-Q.45):** A showroom is open on all seven days of the week throughout the year. There are five employees Alex, Bhabha, Cathy, Dilip and Ethan who work



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**VERBAL ABILITY****Questions: 45 (+4/-1)****Sectional Time 40 Minutes**

**Passage (Q.46 – Q.51):** Bananas, apples, and avocados continue to ripen after they are picked. Cherries, blackberries, and grapes do not. The difference between climacteric fruits (the former) and non-climacteric fruits (the latter) matters to fruit growers and greengrocers, who must make sure their wares are in tip-top condition when they arrive at the marketplace. But how those differences originally came about remains unclear.

Two biologists of the University of Tokyo offer a suggestion. Fruits, they observe, exist to solve a problem faced by all plants—how best to spread their progeny around. Wrapping their seeds in a sugary pulp to provide a tasty meal serves as a way to get animals to do this for them. They do, however, need to make sure that their fruits favour the animals most likely to do the distributing. The biologists propose that climacterism, or its absence, is a way to achieve this. If ground-dwelling animals are the main distributors, then the continuing ripening of fallen fruit (i.e., climacterism) is beneficial. If, by contrast, those distributors are arboreal or aerial, and so can feed on unfallen fruit, then non-climacteric fruits will do well.

To test their idea, the two researchers studied 80 varieties of fruits, and noted which animals each depended on for its propagation. 35 of these fruits, eaten by both ground-dwelling animals and arboreal or aerial animals, were non-climacteric. Further, 15 of the 19 varieties eaten principally by ground-dwellers were climacteric, while 21 of the 26 fed on by arboreal or aerial animals were non-climacteric.

That is a suggestively strong correlation. And the authors' hypothesis is fortified by other evidence. They point out that non-climacteric fruits tend to have vivid colours, especially reds and purples. This may help them to stand out amid the foliage of their parent plants, advertising their presence. Climacteric fruits are generally better camouflaged. That makes them harder to spot until they have fallen to the ground.

The main limitation of their work is that they looked at fruits eaten by people. This has probably contaminated the sample, for thousands of years of selective breeding for traits that human beings find appealing may have blurred any signal optimised by natural selection. The next step, therefore, should be the analysis of wild fruits.

- 46.** According to the passage, the interest in the difference between climacteric and non-climacteric fruits is in the
- public health context.
  - gastronomical context.
  - commercial context.
  - environmental context.
- 47.** The main point that the writer makes that fruit bearing plants:
- are better protected than other plant species and can propagate easily.
  - of all kinds need to be studied, not just those consumed by humans.
  - and other plant species' propagation can't be studied easily.
  - have same problem in propagation as other plants.
- 48.** Consider the following two Findings:
- Non-climacteric fruits tend to have vivid colours.
  - Thirty-six varieties of climacteric and non-climacteric fruits were eaten predominantly either by ground-dwellers, or by arboreal or aerial animals respectively. According to the passage,
- Finding (i) provides supplementary evidence and Finding (ii) provides main evidence confirming the hypothesis of the biologists.
  - Both Findings (i) and (ii) provide main evidence confirming the hypothesis of the biologists.
  - Finding (i) provides main evidence and Finding (ii) provides supplementary evidence confirming the hypothesis of the biologists.
  - Both Findings (i) and (ii) provide supplementary evidence confirming the hypothesis of the biologists.
- 49.** The study has been based on
- wild fruits consumed by animals.
  - fruits sourced by greengrocers.
  - fruits available at the University of Tokyo.
  - fruits that are consumed by humans.

50. The origins of the distinguishing characteristics between the two types of fruits, climacteric and non-climacteric are
- clear now as a result of this research.
  - nebulous in spite of research.
  - trivial at this stage.
  - dependent on researcher observation.
51. Which one of the following options means “arboreal” and “camouflage”?
- protected and fortified
  - tree-dwelling and disguised
  - covered and variegated
  - ground-dwelling and hidden

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**Passage (Q.52 – Q.57):** By 1798, Jenner had succeeded in demonstrating the protective quality of the cowpox virus against smallpox, by putting on record details of 23 cases, contracted either casually or by direct inoculation. Sixteen of these had occurred accidentally among dairy workers in the course of occupations connected with cows and horses; the rest were done under Jenner's direction. Among the persons inoculated was Jenner's own little second son, Robert Harding Jenner, an infant eleven months old. Jenner demonstrated conclusively that the cowpox protects the human constitution from the infection of smallpox.

After Dr. Jenner had made his tests, he prepared a pamphlet for publication. He also went to London, so that he might have the opportunity to introduce the subject personally to friends and demonstrate the truth of his assertion to them. He remained in London for nearly three months without being able to find anyone who would submit to vaccination. Jenner went back to Gloucestershire, disappointed. It happened, however, that soon after his return home, a distinguished London surgeon named Cline resolved to make a trial of the vaccine material which Jenner had left with his friends.

The patient was a child suffering from a form of chronic hip-joint disease. The vaccine material was inoculated, and the vaccine vehicle ran rather a normal course and healed fully. The little patient was afterward inoculated with smallpox virus and found to be incapable of acquiring that disease. This case attracted considerable attention. The child was in a run-down condition, and the vaccine material might very well have provoked a rather serious local reaction. In a way, the fate of vaccination hung in the balance and good luck was in its favour. Mr. Cline, however, after this, became a strong advocate of vaccination, and brought it very decidedly before the London physicians.

It was not long before the opposition to the practice of vaccination took definite form. One of the best-known London physicians of the time, Dr. Ingenhouz, became the leader of a strong faction of the medical profession of London, who not only would have nothing to do with vaccination, but proclaimed openly that it was a dangerous innovation, absolutely unjustifiable, and communicated a disease without protecting against any other. Dr. Watt from Glasgow blamed the vaccine for the increase in severe cases of measles and measles-related deaths among children.

Fortunately, only a few colleagues were so illogical, and an excellent idea of how much Jenner's discovery was appreciated by his contemporaries may be obtained from the number of honours, diplomas, addresses and communications from public bodies and distinguished individuals which he received. Most of the prominent medical and scientific societies of Europe elected him a member or sent him some special token of recognition.

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52. 'Local reaction' refers to
- encouraging reaction from local doctors.
  - adverse reaction caused by injections.
  - encouraging reaction from the people of the locality.
  - adverse comments and protests by people from that location.
53. Jenner received a lot of recognition from medical bodies because
- fortunately, only a few colleagues were illogical enough to reject him.
  - Dr. Watt could not prove that vaccination caused measles.
  - medical societies across Europe regularly engaged in tokenism.
  - most of his colleagues realised the effectiveness of his work.
54. Twenty-three cases were put on record with the objective to explain very clearly that
- it is beneficial to immunity if we work with cows and horses.
  - the cowpox vaccine protected the patients from another deadly disease.
  - Dr. Jenner was ready to go to any extent, even testing the vaccine on his own son.
  - accidental contraction of cowpox happens among dairy workers.
55. By calling the vaccine unjustifiable, Dr. Ingenhouz meant that vaccination
- was an injustice against those on whom it was tested.
  - made people sick and failed to provide general immunity.
  - was being carried out without any legal basis.
  - actually spread the disease to a large population.
56. According to the author, the main idea in the passage is
- scientific breakthroughs are more likely to happen in major urban centres.
  - documentation is key for disseminating science.
  - chance and risk play a part in the success of scientific experiments.
  - to explore the causes for vaccine hesitancy.
57. On returning from London, Dr. Jenner was disappointed because
- he was unsuccessful in replicating the experiment due to lack of volunteers.
  - his friends would not agree with his findings on the vaccine.
  - his friends responded negatively to the vaccine.
  - the vaccine did not receive any recognition, rewards, or a patent.
- Direction (Q.58-Q.64):** Complete the following sentences by choosing the most appropriate word/phrase from the options given below.
58. Flying this simple aeroplane is a \_\_\_\_\_ for the experienced pilot.
- left-handed game
  - left-handed sport
  - slice of cake
  - piece of cake
59. Leela is always nasty and inconsiderate with her colleagues; now that she has a rude superior, she is getting \_\_\_\_\_.
- a spoon of her own medicine
  - a taste of her own medicine
  - an unpleasant medicine dose
  - a dose of bitter medicine
60. I still have two more difficult exams left, but I'm trying to \_\_\_\_\_; after these I won't have any more for a year!
- think about the sunny side
  - think upon the sunny side
  - look on the bright side

(d) look forward to the bright side

61. For the past three decades, this chain of coffee shops has been committed to building a culture where everyone is welcome. They are an ally to the LGBTQ community, and this is just one instance of their \_\_\_\_\_.

- (a) mindfulness and objectivity  
(b) discriminatory practices  
(c) Inclusivity and diversity  
(d) discretionary practices

62. Ever since Girish won the prestigious Infosys prize, he has been behaving \_\_\_\_\_.

- (a) controversially (b) condescendingly  
(c) ambitiously (d) overly

63. Some of the best spies take the guise of innocuous secretaries or researchers and are able to send large amounts of information to their heads of espionage, as they are \_\_\_\_\_.

- (a) hiding within everyone's sight  
(b) hiding from watchful eyes  
(c) hiding documents very craftily

**Direction (Q.65-Q.69):** In each of the following sentences, the incorrect part of the sentence is underlined. Choose an alternative from the four given options so that the sentence is rendered correct.

65. His talk on heritage sites has picked up my interest.

- (a) brightened (b) aroused  
(c) adopted (d) caught

66. If I had known that you needed to go to the airport yesterday, I could drive you there.

- (a) should have driven you there.  
(b) should drive you there.  
(c) would have driven you there.  
(d) would drive you there.

67. He was having a difficult time, but never once he complained.

- (a) not once did he give the complaint.  
(b) not once he complained.  
(c) not once any complaining happened.  
(d) not once did he complain.

68. The Principal and professors are authorized to sanction leave to a student provided she will have a good attendance record.

- (a) provided she has a good attendance record.  
(b) provided she will have a good attendance record.  
(c) provided that a good attendance record is maintained by her.

(d) hiding in plain sight

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64. She \_\_\_\_\_ her classmates because she comes from a very rich, aristocratic family.

- (a) looks away from (b) looks up to  
(c) looks down on (d) looks towards  
(d) provided she had a good attendance record.

69. When all the words on the page got scrambled, she quickly pressed undo, after which the document reverted back to its original state.

- (a) document reverted to it's original state.  
(b) document reverted to its original state.  
(c) document reverted back to original state.  
(d) document reverted back to it's original state.

**Direction (Q.70-Q.73):** Each of the paragraphs given below has a sentence missing which is indicated by a blank. From the choices given below each paragraph, choose the sentence that seems most logically appropriate to complete the paragraph.


70. \_\_\_\_\_. In Southeast Asia, for example, climate and lifestyle factors mean that people spend much more time in shopping malls than Europeans do, who might go shopping once a fortnight. Then there are gender variations in the way we shop. As descendants of hunter-gatherers, accumulating is in our blood, but how you go about it depends on whether you are male or female.

- (a) Retail stores constantly offer promotional discounts to entice shoppers.  
(b) Culture plays an important role in shaping the shopping experience.  
(c) By and large, people enjoy shopping and comparing brands and prices.

- (d) When it comes to shopping, men hunt, and women gather
71. This winter, I wish to go to the beaches for a holiday. I think I will go to Goa, India's most well-known beach holiday destination. It is about 600 km away from Mumbai, so reaching there is not a major problem. \_\_\_\_\_. The major Goan beaches are tourist attractions and have some good beach-view hotels and plenty of shops selling touristy things such as beach robes, hats, jewellery, bags, and more.
- (a) A great getaway place, it offers an interesting variety of food, sightseeing options, flea markets, and some wonderful Indo-Portuguese buildings.
- (b) There are buses that ply at night, there are both day and night trains, and one can always hire a car and reach there in comfort in about 10 hours.
- (c) Some major beaches are Baga, Bogmalo, Candolim, Calangute, and Dona Paula, where adventure sports activities like water skiing and scuba diving are organized.
- (d) One of the great things about a holiday in Goa is that we can be as lazy as we want, relaxing all day, sunbathing, sipping juice, and trying out different Goan tidbits.
72. Nowadays, many teenagers and young adults around the world have to spend most of their time studying in order to get top grades, a university place, and a good job. \_\_\_\_\_. There are several causes for this situation, one of the main ones being exams. These are stressful experiences, and most students take a huge number of them during their school career.
- (a) For this reason, the education system has to change for the welfare of the students.
- (b) For this reason, there is often little time left for hobbies or socializing.
- (c) Therefore, studying while you are exhausted is unproductive.
- (d) Therefore, it would be better to learn how to apply the knowledge gained
73. The people of the Indus Valley civilization wrote with a script. So far scholars have been unable to decipher that script. Archaeologists who have been excavating newly discovered sites in Mesopotamia hope to find a text that has scripts from both the Indus valley and Mesopotamia, the second of which has already been deciphered. \_\_\_\_\_.
- (a) They will then be able to decode the Indus valley language.
- (b) They can then prove that there was trade between the two.
- (c) They will then be able to decide which civilization was older.
- (d) The nature of relationships between the two will come to light.
- Direction (Q.74-Q.79):** The sentences below have words that are missing. Choose the best option from those given below to complete the sentence.
74. Achieving spaceflight enabled humans to begin to explore the solar system and the rest of the \_\_\_\_\_, to understand the many objects and \_\_\_\_\_ that are better observed from a space perspective, and to use for human benefit the resources and attributes of the space environment. All of these activities - discovery, scientific understanding, and the \_\_\_\_\_ of that understanding to serve human purposes - are elements of space \_\_\_\_\_.
- (a) galaxy; ideologies; enormity; visualisation
- (b) universe; phenomena; application; exploration
- (c) cosmos; materials; principles; identification
- (d) configuration; elements; functioning; vastness
75. Visually strong, \_\_\_\_\_ films of the 1920s are \_\_\_\_\_ preserved and suffer from censorship cuts, leading to the \_\_\_\_\_ that they were primitive and barely watchable.
- (a) monochrome; barely; observation
- (b) silent; poorly; misconception
- (c) action-packed; badly; accusation
- (d) classic; dispassionately; conclusion
76. Everyday more than 1 billion promotional messages are sent that are commercial and \_\_\_\_\_. Although \_\_\_\_\_ have used more technology to stop this, \_\_\_\_\_ find ways around it.
- (a) educational; firewalls; hackers
- (b) inescapable; governments; advertisers
- (c) informative; authorities; promoters
- (d) unsolicited; regulators; spammers
77. The investigators have \_\_\_\_\_ that he had leaked confidential \_\_\_\_\_ information about the acquisition, thereby allowing associates to profit \_\_\_\_\_ from the deal.
- (a) announced; financial; treacherously
- (b) discovered; internal; enormously
- (c) alleged; insider; illicitly
- (d) Accused ; important; dramatically

78. The beauty of \_\_\_\_ is that it poses thought-provoking questions and inspires us to think deeply about and life in general. Further, \_\_\_\_ about the ideas and perspectives outlined by different thinkers can help us to gain a better \_\_\_\_ of the world we live in.
- (a) philosophy; ourselves; pondering; understanding  
 (b) linguistics; language; cogitating; picture  
 (c) history; animals; mulling; acquaintance  
 (d) orthography; writing; speaking; perspective
79. In an anthropocentric \_\_\_\_, animals are no more than property to human beings. Therefore, the concepts of 'humane' treatment and 'necessary' \_\_\_\_ are economic in nature. The idea that killing animals is not a serious issue as long as animals are not made to suffer rests \_\_\_\_ on the widely accepted idea that animals do not have a right to life.
- (a) construct; comfort; somewhat  
 (b) belief; well-being; partially  
 (c) worldview; suffering; explicitly  
 (d) universe; gain; entirely
- Direction (Q.80-Q.85):** One of the statements below contains a word used incorrectly. Choose the option which has the incorrect or inappropriate usage of the word.
80. (a) She wanted to make a good impression but, at the last moment, she discovered a spot of ink on her collar.  
 (b) There was a scenic spot not very far from our cottage where we used to go for picnics.  
 (c) Such a spot on his career was difficult to ignore when deciding promotions.  
 (d) He was unsure if he could respond to the question asked; fortunately, his answer was spot on.
81. (a) Although he thinks he is the life of the party, his remarks are insensitive, and his jokes are vulgar, cross, and crude.  
 (b) It was a long journey by road, and they had yet to find a boat that would help them to cross the river.  
 (c) The mistakes of his youth are the cross that he has to bear for the rest of his life.  
 (d) We were told that she had lived through tough times which made her cross and cranky as she grew older.
82. (a) The problems caused by flouting rules are many, but some people do not care.  
 (b) Her fault was that she flouted the dress code and refused to wear the uniform.  
 (c) The orchestra decided to flout tradition and played their instruments wearing ordinary clothes.  
 (d) She flouted her designer wear and accessories in front of her classmates.
83. (a) The judicial magistrate asked the prosecuting lawyer to state the grounds on which the defendant had been arrested.  
 (b) The state of his grandfather's health was critical, but it was difficult for him to get in touch with all the members of the family.  
 (c) Uttar Pradesh, being the most densely populated state in India, has the highest number of representatives in Parliament.  
 (d) Her admirers considered her demeanour to be of great state and refinement, and most impressive.
84. (a) As he was very old, he didn't have the strength to draw water from the well near his house.  
 (b) He was lucky enough to win the draw in the lottery, where the prize was a rare painting.  
 (c) He used to keep all his important documents in the draw of his cupboard.  
 (d) The cricket match was heading for a draw, when the batsman hit a sixer and our team won.
85. (a) The policeman collaborated with the film makers who were shooting a crime thriller.  
 (b) Some treacherous relatives of Indian rulers collaborated with the British Empire.  
 (c) When the women were asked to join the protest, they refused to collaborate.  
 (d) She interviewed many teens to collaborate her thesis on their mental health issues.
- Direction (Q.86-Q.90):** The sentences given below, when properly sequenced, form a coherent paragraph. Each sentence is labelled with a number. Decide on the most logical order and enter the sequence of numbers in the space provided. Only numbers are to be entered in the space provided for the answer, and no other letters or characters should be entered. For example, a response such as 3412 or 25143 is valid, and a response such as 3412. Or 25143. is invalid.
86. 1. The Central African Republic has approved Bitcoin as an official currency.


2. Experts foresee that this will damage the environment as well as the economy.
  3. Others claim that this may make money laundering easy and also use up a lot of electricity.
  4. Economists criticised this move as a potential risk to the financial stability of the nation.
- 87.**
1. Located in the foothills of the Sion Fort, the lake is a Grade II-A heritage structure, dating back to the 17th century.
  2. Once home to several marine creatures, the lake is now surrounded by high-rise residential buildings.
  3. The Municipal Corporation is set to breathe life back into the city's Sion Talao (Lake) with the rejuvenation and beautification of the centuries-old lake.
  4. Over the years, the lake has lost its prominence.
  5. Earlier the Talao was a known natural water tank with the Sion hillock expanding around it like an enclosing wall.
- 88.**
1. A sub-par monsoon cuts farm yields, output, and farm incomes, increasing the country's dependence on food imports.
  2. A robust monsoon will help put a lid on food inflation by increasing domestic output of a variety of goods and commodities.
3. This is because half the Indian population depends upon farm-derived income.
  4. The June-to-September rain-bearing system is often called the lifeblood of the country's economy.
  5. Unfortunately, however, nearly 40% of India's net sown area does not have access to irrigation
- 89.**
1. The popularity of these creations grew along with that of the tea ceremony in the 16th century.
  2. However, savvy tourists find the best bargains for ceramics in Tokyo's Kitchen Town.
  3. Modern shops in touristy spots display thousands of them, both hand crafted and factory made.
  4. Japanese artisans have been making ceramics, known as Yakimono since prehistoric times.
- 90.**
1. This means the brain receives less input over the course of a day.
  2. Youthful eyes jiggle regularly to take in new or unfamiliar stimuli.
  3. As the person attached to those eyes ages, the eye muscles grow slower and the pathways between the eye and the brain grow longer, more complex, or, in some cases, get damaged.
  4. Our eyes quickly scan the surroundings and then send the data to the brain.
  5. Human eyes perform jiggles, more formally called saccades, in response to a change in the field of vision.



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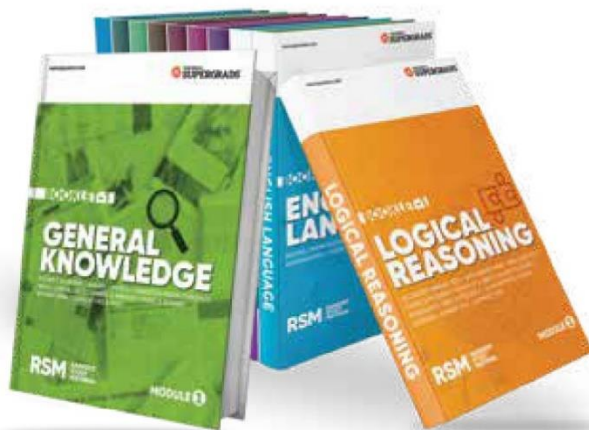
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**ANSWER KEY AND EXPLANATIONS**

1. (344) It is given that the 3<sup>rd</sup>, 14<sup>th</sup> and 69<sup>th</sup> terms of given AP is forming three distinct and consecutive terms of a G.P. By observation, we can say that position 3<sup>rd</sup>, 14<sup>th</sup> and 69<sup>th</sup> follow a certain sequence i.e.,

$$(3 \times 5) - 1 = 14$$

$$(14 \times 5) - 1 = 69$$

$$\text{Similarly, } (69 \times 5) - 1 = 345 - 1 = 344$$

So, next term in G.P. will be 344<sup>th</sup> term of the given AP.

**Alternate Method**

$$G_1 = A_3 = a + 2d,$$

$$G_2 = A_{14} = a + 13d, \text{ and}$$

$$G_3 = A_{69} = a + 68d \text{ are in G.P.}$$

We know that, if any three terms a, b, c are in G.P., then common ratio,

$$r = \frac{b}{a} = \frac{c}{b} \text{ or } ac = b^2$$

Applying the same,

$$(a + 2d)(a + 68d) = (a + 13d)^2$$

$$\Rightarrow a^2 + 68ad + 2ad + 136d^2 = a^2 + 26d + 169d^2$$

$$\Rightarrow 44ad = 33d^2$$

$$\Rightarrow \frac{a}{d} = \frac{3}{4}. \text{ Now let } a = 3x \text{ and } d = 4x$$

$$\text{Common ratio, } r = \frac{a+13d}{a+2d}$$

$$= \frac{3x+13 \times 4x}{3x+8x} = \frac{55x}{11x} = 5$$

$$\text{Next term of GP will be } G_4 = G_3 \times r = (a + 68d) \times 5$$

$$= (3x + 272x) \times 5$$

$$= 275x \times 5$$

$$= 1375x$$

Let G<sub>4</sub> be the n<sup>th</sup> term of given AP.

$$\text{Therefore, } a + (n - 1)d = 1375x$$

$$3x + (n - 1)4x = 1375x$$

$$n = 344.$$

2. (12)  $2|X| + 3|Y| \leq 6$

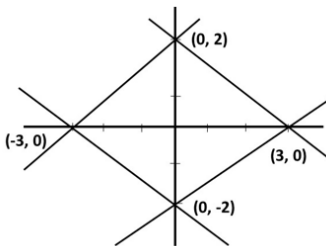
Above inequality represent an area bounded by 4 lines which are

$$(i) 2x + 3y = 6$$

$$(ii) 2x - 3y = 6$$

$$(iii) -2x + 3y = 6$$

$$(iv) -2x - 3y = 6$$



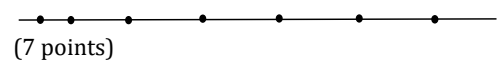
By drawing these 4 lines on graph, we get a rhombus.

$$\text{Area of rhombus} = \frac{1}{2} d_1 \cdot d_2$$

$$= \frac{1}{2} \times 4 \times 6$$

$$= 12 \text{ sq. units}$$

3. (175) is the correct answer



(5 point)

$$\text{Case I - Choosing 2 points from } L_1 \text{ and 1 point from } L_2 = {}^7C_2 \times {}^5C_1$$

$$\text{Case - II - Choosing 2 points from } L_2 \text{ and 1 point from } L_1 = {}^5C_2 \times {}^7C_1$$

$$\text{Total case} = ({}^7C_2 \times {}^5C_1) + ({}^5C_2 \times {}^7C_1)$$

$$= 35 \times 5 + 10 \times 7$$

$$= 105 + 70 = 175$$

4. (100) Given  $\sin \alpha + \sin \beta = \frac{\sqrt{2}}{\sqrt{3}}$

$$\text{Squaring both sides, we get } (\sin \alpha + \sin \beta)^2 = \left(\frac{\sqrt{2}}{\sqrt{3}}\right)^2$$

$$= \sin^2 \alpha + \sin^2 \beta + 2 \sin \alpha \sin \beta = \frac{2}{3} \text{ -----(1)}$$

&

$$\cos \alpha + \cos \beta = \frac{1}{\sqrt{3}}$$

$$(\cos \alpha + \cos \beta)^2 = \left(\frac{1}{\sqrt{3}}\right)^2$$

$$= \cos^2 \alpha + \cos^2 \beta + 2 \cos \alpha \cos \beta = \frac{1}{3} \text{ -----(2)}$$

Adding equations (1) and (2), we get

$$\sin^2 \alpha + \sin^2 \beta + 2 \sin \alpha \sin \beta + \cos^2 \alpha + \cos^2 \beta + 2 \cos \alpha \cos \beta = 1$$

$$\Rightarrow 1 + 1 + 2 [\sin \alpha \sin \beta + \cos \alpha \cos \beta] = 1$$

$$\Rightarrow 2 \cos (\alpha - \beta) = -1$$

$$\Rightarrow \cos (\alpha - \beta) = \frac{-1}{2}$$

$$\Rightarrow 2 \cos^2 \left(\frac{\alpha - \beta}{2}\right) - 1 = \frac{-1}{2} [\because \cos 2A = \cos^2 A - 1]$$

$$\Rightarrow 2 \cos^2 \left(\frac{\alpha - \beta}{2}\right) = \frac{1}{2}$$

$$\Rightarrow \cos^2 \left(\frac{\alpha - \beta}{2}\right) = \frac{1}{4}$$

We have to find the values of  $\left(20 \cos \left(\frac{\alpha - \beta}{2}\right)\right)^2$

$$\left(20 \cos \left(\frac{\alpha - \beta}{2}\right)\right)^2 = (20)^2 \cos^2 \left(\frac{\alpha - \beta}{2}\right)$$

$$= 400 \times \frac{1}{4}$$

$$= 100.$$

5. (256) Using Binomial Theorem,

$$(5x - 9)^4 = {}^4C_0(5x)^4(-9)^0 + {}^4C_1(5x)^3(-9)^1 + \dots + {}^4C_4(5x)^0(-9)^4$$

We can obtain sum of coefficients of all the terms in the expansion by substituting  $x = 1$  on the RHS.

As RHS equals to LHS, we can get the sum of coefficients even by substituting  $x = 1$  in LHS only.

$\therefore$  Put  $x = 1$  in L.H.S expression, we get

$$(5 \cdot 1 - 9)^4 = (-4)^4 = 256$$

6. (50) is the correct answer

	Unit Price of Apples (Rs. /kg.)	Quantity (in kg.)	Unit Price of Mangoes (Rs. /kg.)	Quantity (in kg.)
--	---------------------------------	-------------------	----------------------------------	-------------------

CP	20	A	25	M
SP (1)	22	A	20	M
SP (2)	16	A	27.5	M

In first case, there is no profit or loss, means

Total SP = Total CP  
 $22A + 20M = 20A + 25M$   
 $A:M=5:2$

Let  $A = 5x$  &  $M = 2x$

In second there is a loss of Rs.150

Total CP - Total SP = Rs.150  
 $20A + 25M - (16A + 27.5M) = Rs.150$   
 $4A - 2.5M = 150$   
 $20x - 5x = 150$   
 $x = Rs.10$

Number of apples purchased,  $A = 5x = 50$ .

7. (72) Given  $\log_x y + \log_y x = 1$  and  $y = x^2 - 30$

$\log_x y + \log_y x = 1$   
 $= \frac{1}{2} [\log_x y + \log_y x] = 1$   
 $= \log_x y + \log_y x = 2$   
 $= \log_x y + \frac{1}{\log_x y} = 2$  [∵  $\log_y x = \frac{1}{\log_x y}$ ] -----eqn.(1)

We know, if a is a positive number, then  $a + \frac{1}{a} = 2$ , only when  $a = 1$

Applying it in eq. (1), we can say

$\log_x y = 1$  or  $y = x$

So putting  $y = x$ , in the 2<sup>nd</sup> given eqn.  $y = x^2 - 30$

we get  $x = x^2 - 30$   
 $x^2 - x - 30 = 0$   
 $x^2 + 5x - 6x - 30 = 0$   
 $x(x + 5) - 6(x + 5) = 0$   
 $(x + 5)(x - 6) = 0$   
 $x = -5$  or  $6$

As x cannot be negative number,

∴  $x = y = 6$   
 ∴  $x^2 + y^2 = 6^2 + 6^2$   
 $= 36 + 36$   
 $= 72$

8. (16) Power set of A set is set of all the subsets of given set. If a set contains n elements, total no. of sub-sets will be equal  $2^n$ .

Set	No of elements	No. of sub-sets ( $2^n$ )
A	0	$2^0 = 1 =$ No. elements in $P(A)$
$P(A)$	1	$2^1 = 2 =$ No. of elements in $P(P(A))$
$P(P(A))$	2	$2^2 = 4 =$ No. of elements in $P(P(P(A)))$
$P(P(P(A)))$	4	$2^4 = 16 =$ No. of elements in $P(P(P(P(A))))$

9. (2067) is the correct answer.

Position from Left end	1	2	3	4	5	6	7	8	9	--	100	--	2022	--	2025
Old series	1	2	3	4	5	6	7	8	9	-	100	-	2022	--	2025
Perfect Square	1 <sup>2</sup>			2 <sup>2</sup>					3 <sup>2</sup>		10 <sup>2</sup>	--	--	--	45 <sup>2</sup>

New series	2 = 1+1	3	5	6 = 4+2	7	8	9	10	12 = 9					2067	2070 = 2025+45
------------	---------	---	---	---------	---	---	---	----	--------	--	--	--	--	------	----------------

So, in the new series the number at 2025<sup>th</sup> position will be  $2025 + 45 = 2070$

∴ The number at 2022<sup>nd</sup> position will be 2067.


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10. (32) Given  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$   
 $A^2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I$

∴ We can say that

$A^6 = A^2 \cdot A^2 \cdot A^2 = I \cdot I \cdot I = I$

$A^3 = A^2 \cdot A = I \cdot A = A$

$A^9 = A^3 \cdot A^3 \cdot A^3 = A \cdot A \cdot A = A^2 \cdot A = I \cdot A = A$

$A^9 + A^6 + A^3 + A = A \cdot A \cdot A + A^2 \cdot A = A$

Now,

$A^9 + A^6 + A^3 + A = A + I + A + A$

$= 3A + I$

$= 3 \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \end{bmatrix}$

$= \begin{bmatrix} 3 & 0 & 0 \\ 0 & 0 & 3 \\ 0 & 3 & 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$A^9 + A^6 + A^3 + A = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 1 & 3 \\ 0 & 3 & 1 \end{bmatrix}$

Determinant of above matrix =  $4(1 \times 1 - 3 \times 3)$

$= 4(1 - 9) = 4(-8)$

$= -32$

Absolute value of  $-32 = |-32| = 32$ .

11. (3) If a, b, c are 3 terms in A.P

then  $\frac{a+b}{2} = b$  or,  $a+c = 2b$

So,  $-16, 2^{x+3} - 2^{2x-1} - 16, 2^{2x-1} + 16$  are in A.P.

We can say,  $-16 + 2^{2x-1} + 16 = 2 [2^{x+3} - 2^{2x-1} - 16]$

⇒  $2^{2x} - 2^{-1} = 2^{x+4} - 2^{2x} - 16 \times 2$

$$\Rightarrow \frac{2^{2x}}{2} = 2^x \cdot 2^4 - 2^{2x} - 32 \text{ -----eqn.(1)}$$

put  $2^x = t$  &  $2^{2x} = t^2$

the eqn. becomes

$$\frac{t^2}{2} = 16t - t^2 - 32$$

$$\Rightarrow t^2 = 32t - 2t^2 - 32 \times 2$$

$$\Rightarrow 3t^2 - 32t + 32 \times 2 = 0$$

$$\Rightarrow 3t^2 - 32t + 64 = 0$$

$$\Rightarrow t = 8 \text{ or } \frac{8}{3}$$

As  $t = 2^x$ , it can not be a fraction

$$\therefore t = 2^x = 8 \text{ (only)}$$

$$\therefore x = 3$$

12. (26)  $F(x) = |x| + 2|x - 1| + |x - 2| + |x - 4| + |x - 6| + 2|x - 10|$ ,  
 $x \in (-\infty, \infty)$

Minimum value of  $f(x)$  will be obtained at one of the six critical points, which are  $x = 0, 1, 2, 4, 6, 10$ .

$$\text{So, } f(0) = 2 + 2 + 4 + 6 + 20 = 30$$

$$f(1) = 1 + 1 + 3 + 5 + 18 = 28$$

$$f(2) = 2 + 2 + 2 + 4 + 16 = 26$$

$$f(4) = 4 + 6 + 2 + 0 + 2 + 12 = 26$$

$$f(6) = 6 + 10 + 4 + 2 + 8 = 30$$

$$f(10) = 10 + 18 + 8 + 6 + 4 = 46$$

Thus, minimum value  $f(x) = 26$

13. (30) Let the distance between his home and office is 'd' km

$$\text{Usual time taken} = \frac{d}{12} \text{ km}$$

$$\text{New time taken} = \frac{d}{20} \text{ km}$$

As per the question, difference between these two times is 1 hour.

$$\frac{d}{12} - \frac{d}{20} = 1$$

$$d \left( \frac{5-3}{60} \right) = 1$$

$$d = \frac{60}{2} = 30 \text{ km}$$

14. (3150) We have to find maximum value of the sum of 50 numbers.

Highest of all the distinct 50 numbers, is 100.

So, in order to maximum the sum of all 50 numbers, highest 25 numbers should be 76, 77, 78, ..., 100.

There average of these 25 numbers will be 88.

According to the question, rest of the 25 numbers should have their average  $88 - 50 = 38$

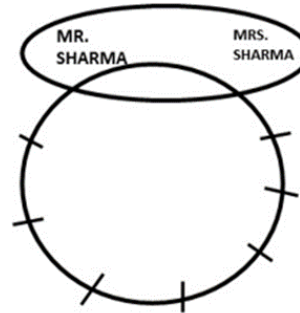
Thus, the sum of those 25 numbers will be  $38 \times 25$ .

$$\text{Sum of all these 50 nos.} = 25 \times 88 + 25 \times 38$$

$$= 25 \times 126$$

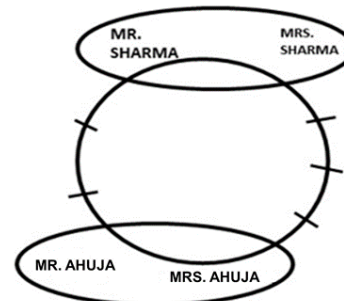
$$= 3150$$

15. (960) Number of ways in which Mr. and Mrs Sharma are always seated together



$$= 6! \times 2 = 720 \times 2$$

$$= 1440 \text{ ways}$$



Number of ways in which Mr. & Mrs. Sharma as were as Mr. & Mrs. Ahuja both couples are seated such that their spouse is next to each other.

$$= 5! \times 2 \times 2 = 480$$

$\therefore$  The total no. of ways in which Mr. and Mrs Sharma are seated next to each other but Mr Ahuja and Mrs. Ahuja does not sit next to each other

$$= 1440 - 480 = 960$$

16. (a)  $x^2 + |x + 4| + |x - 4| - 35 = 0$

Case I: if  $x \geq 4$

$$\text{Then, } x^2 + (x + 4) + (x - 4) - 35 = 0$$

$$x^2 + 2x - 35 = 0$$

$$x^2 + 7x - 5x - 35 = 0$$

$$x(x + 7) - 5(x + 7) = 0$$

$$(x - 5)(x + 7) = 0$$

$$x = 5 \text{ or } x = -7$$

Only  $x = 5$  satisfies the assumption.

Case II: If  $x < -4$ .

$$\text{Then } x^2 - (x + 4) - (x - 4) - 35 = 0.$$

$$x^2 - 2x - 35 = 0$$

$$x^2 + 5x - 7x - 35 = 0$$

$$x(x + 5) - 7(x + 5) = 0$$

$$(x - 7)(x + 5) = 0$$

$$x = 7 \text{ or } x = -5$$

Only  $x = -5$  satisfies the assumptions.

Case III: If  $-4 < x \leq 4$

$$\text{Then, } x^2 + (x + 4) - (x - 4) - 35 = 0$$

$$x^2 + x + 4 - x + 4 - 35 = 0$$

$$x^2 - 27 = 0$$

$$x = \sqrt[3]{27} \text{ or } x = -\sqrt[3]{27}$$

None of these values of 'x' satisfies the assumption.

∴ only 2 roots i.e. 5 and -5 will be there  
Their sum =  $5^2 + (-5)^2 = 25 + 25 = 50$

17. (c) If Set A = {1, 2, 3 ..... 'm' elements}  
and Set B = {a, b, c ..... 'n' elements}  
Then total number of relations =  $2^{mn}$   
& Total no. of all possible functions =  $n^m$   
(From set A to set B)  
& Total number of all possible functions =  $m^n$   
(From set B to set A)  
As per the question,  
A = {1, 2, 3} = 3 elements.  
B = {a, b} = 2 elements.  
∴ Total number of functions from set A to set B =  $2^3$   
& Total number of relations =  $2^{2 \times 3} = 2^6$   
∴  $P(E) = \frac{2^3}{2^6} = \frac{1}{2^3} = \frac{1}{8}$ .
18. (a) Given abcde is divisible by 6  
Means, abcde is divisible by both 2 & 3.  
It mean (a+b+c+d+e) is always divisible by 3 (using divisibility rule of 3)  
And the value of 'e' is certainly 0, 2, 4, 6 or 8.  
Now going by options,  
Options (b)  
eee ⇒ this no. be divisibly by 3 & 2 both (means by 6 as well) because sum of digit is 3e & unit digit is same as that of original number.  
Option (c)  
bbadccade ⇒ again the sum of digit = 2 (b+a+d+e+c) & unit digit is again 'e' same as that of the original no.  
Options (d)  
cdbae is also divisible by 3 and 2 both (thus by 6) for the same reasons.  
Unit digit in above 3 options is 'e' which is same as that of the original number.  
Option 1. Unit digit is 'a' and we are not sure whether it is even or odd, so edcba is not necessarily divisible by 2 & thus not by 6.
19. (a)  $\log_{27} 8 \leq \log_3 x < 9^{\frac{1}{\log_2 3}}$   
 $\log_{3^3} 8 \leq \log_3 x < 9^{\frac{1}{\log_2 3}}$  [Using  $\log_m a = \frac{1}{n} \cdot \log_n a$  &  $\frac{1}{\log_n a} = \log_a n$ ]  
 $\frac{1}{3} \cdot \log_3 8 \leq \log_3 x < 3^{2 \cdot \log_2 3}$   
 $\log_3 (8)^{\frac{1}{3}} \leq \log_3 x < 3^{\log_2 3}$   
 $\log_3 2 \leq \log_3 x < 4$  [Using  $a^{\log_a x} = x$ ]  
 $\log_3 2 \leq \log_3 x < 4 \cdot \log_3 3$   
 $\log_3 2 \leq \log_3 x < \log_3 (3)^4$   
 $\log_3 2 \leq \log_3 x < \log_3 81$   
⇒  $2 \leq x < 81$  or {2, 81}
20. (c) Suppose a, b and c are integers such that  $a > b > c > 0$ ,  
and  $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$  Then the value of the determinant of A  
Determinant  $\Delta = a(bc - a^2) - b(b^2 - ac) + c(ab - c^2)$   
 $= 3abc - a^3 - b^3 - c^3$   
Assuming  $a = 3, b = 2$  and  $c = 1$  (As given that  $a > b > c > 0$ )

$\Delta = (3 \times 3 \times 2 \times 1) - 3^3 - 2^3 - 1^3 = 18 - 38 = -20$ , which is negative  
So,  $\Delta$  will always be negative.

21. (c) Three sides of the triangle are x, 21 and 40, where the shorter side is x.  
We know, in a triangle the sum of any two sides is always greater than the third side.  
Using it, we get  
 $x + 21 > 40$   
Or,  $x > 40 - 21$   
As  $x > 19$   
∴ Possible value of x will be 20.
22. (b) Note - Above question had typo error in **IPMAT Indore-2022**. Objection was raised by the students, which was accepted by IIM authorities and bonus marks were awarded to all the students who attempted this question. We have amended the question to provide the solution.  
**Amended Question:**  
 $A = \begin{bmatrix} 1 & 0 \\ 1011 & 0 \end{bmatrix}$ ,  $A^{2022}$  is \_\_\_\_\_  
Let us find  $A^2 = A \cdot A = \begin{bmatrix} 1 & 0 \\ 1011 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 1011 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1011 & 0 \end{bmatrix} = A$   
Similarly,  $A^n = A$   
∴  $A^{2022} = A$
23. (b) Sum of first 'n' term of an AP,  
 $S_n = \frac{n}{2} [2a + (n - 1)d]$   
Sum of first 15 terms =  $\frac{15}{2} [2a + 14d] = 200 \Rightarrow a + 7d = \frac{40}{3}$  -----(1)  
Sum of next 15 terms = Sum of first 30 terms - Sum of first 15 terms  
 $= \frac{30}{2} [2a + 29d] - \frac{15}{2} [2a + 14d] = 350$   
 $\Rightarrow 4a + 58d - 2a - 14d = \frac{140}{3}$   
 $\Rightarrow 2a + 44d = \frac{140}{3} \Rightarrow a + 32d = \frac{70}{3}$  -----(2)  
Solving equation (1) and equation (2), we get  $d = \frac{2}{3}$
24. (a) Cost  $\propto$  (Weight)<sup>2</sup> (given)  
 $C \propto w^2$   
∴  $\frac{C_1}{C_2} = \frac{W_1^2}{W_2^2}$   
 $\frac{3600}{C_2} = \frac{10^2}{4^2}$   
 $= \left(\frac{10}{4}\right)^2 = \left(\frac{5}{2}\right)^2$   
 $\frac{3600}{C_2} = \frac{25}{4}$   
 $C_2 = 3600 \times \frac{4}{25}$   
 $= 36 \times 16 = 576$   
 $C_2 = 576$ .
25. (d) Let the two numbers be a and b.  
As per the questions,  $\frac{(a+b)^2 - (a-b)^2}{4}$   
 $= \frac{a^2 + 2ab + b^2 - (a^2 - 2ab + b^2)}{4}$   
 $= \frac{4ab}{4} = a \cdot b =$  Product of the numbers.  
We also know,

Product of 2 number is always equal to product of their HCF and LCM.

26. (c) Let the speed of Ashok, Bipin and Chandan be a, b and c m/s.

As per the question,

Bipin can cover 150m in 15 sec.

$$\therefore \text{His speed, } b = \frac{150}{15} = 10 \text{ m/s.}$$

Also, difference in the time taken by Bipin and Ashok to reach the finishing line is 15 sec.

$$\therefore \frac{400}{10} - \frac{400}{a} = 15$$

$$\therefore a = 16 \text{ m/s}$$

$$\text{Also } \frac{400}{c} - \frac{400}{16} = 25$$

$$\therefore c = 8 \text{ m/s}$$

Now, the ratio of distance travelled by Bipin and Chandan will be in the ratio of their speeds, as the distance travelled by them is same.

$$\text{So, } \frac{400}{x} = \frac{10}{8} \Rightarrow x = 320$$

Therefore, Bipin will beat Chandan by 80m.

27. (a)  $81^x + 81^{f(x)} = 3$

Let  $f(x) = y$ ,

$$81^x + 81^y = 3$$

$$\text{Or, } 81^x = 3 - 81^y$$

Now,  $81^x$  will always be a positive number.

$$\text{Means } 81^x > 0$$

$$\therefore 3 - 81^y > 0$$

$$\Rightarrow 3 > 81^y$$

$$\Rightarrow 3 > 3^{4y}$$

$$\Rightarrow 1 > 4y$$

(Property: If a is positive number &  $a^x > a^y$ , then  $x > y$ )

$$\Rightarrow 4y < 1$$

30. (a) After adding 100 ml. of apple juice to the bowl containing 60 ml. orange juice & 40 ml water,

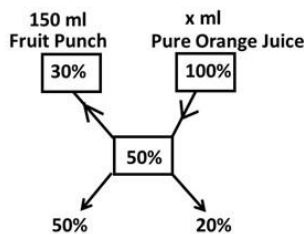
$$\% \text{ orange juice in 200 ml fruit punch} = \frac{60}{200} \times 100 = 30\%$$

(Madhu drinks 50 ml. from this 200 ml fruit punch.

This will not change the percentage of orange juice in the remaining 150 ml fruit punch. It will remain 30%)

Let say in order to increase the taste Madhu adds 'x' ml of pure orange juice (100%) in this 150 ml of remaining fruit punch so as to make percentage of orange juice equal to 50%.

Applying the rule of alligation, we get



The ratio in which remaining fruit punch & pure orange juice should be mixed is 50 : 20 or 5 : 2

$$\text{Or } y < \frac{1}{4}.$$

$$\therefore \left(-\infty \frac{1}{4}\right) \text{ or, } (-\infty 0.25)$$

28. (b) It is given that the cartesian product of  $A \times B$  consists of 4 elements, the set A and B can have 2 elements each. Looking into the given 2 elements, (1, 4) & (4, 1), we can determine the two sets.

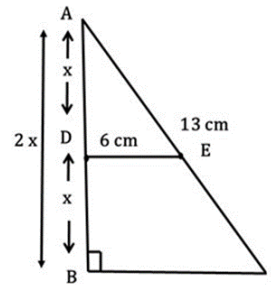
$$A = \{1,4\} \text{ \& } B = \{4,1\}$$

$$A \times B = \{(1,4), (1,1), (4,4), (4,1)\}$$

$$B \times A = \{(4,1), (4,4), (1,1), (1,4)\}$$

$$\therefore A \times B = B \times A$$

29. (d) is the correct answer.



Given  $AD : DB = AE : EC = 1:1$ .

Using Thale's theorem, we can say that the line DE will be parallel to BC.

It means  $\triangle ADE$  &  $\triangle ABC$  are two right angled similar triangles.

Answer for the two similar triangles, the ratio of corresponding sides is equal.

$$\therefore \frac{BC}{DE} = \frac{AB}{AD}$$

$$\frac{BC}{6} = \frac{2x}{x} \Rightarrow BC = 12 \text{ cm}$$

$$\therefore \frac{150}{x} = \frac{5}{2} \Rightarrow x = 60 \text{ ml.}$$

31. (c)  $\text{Average} = \frac{\text{Sum of observaitons}}{\text{Number of observations}}$

Sum of heights of n persons = Average height  $\times$  Number of persons

$$= 160 \times n.$$

Similarly, sum of heights of 'm' persons =  $172 \times m$

Average height of all persons

$$= \frac{\text{Sum of height all the persons}}{\text{Total number of persons}}$$

$$164 = \frac{160n+172m}{m+n}$$

$$\Rightarrow 164(m+n) = 160n + 172m$$

$$= 4n = 8m$$

$$\Rightarrow \frac{m}{n} = \frac{4}{8} = \frac{1}{2}$$

$$m : n = 1:2$$

32. (b) Given  $0 < \theta < \frac{\pi}{4}$ , or  $0 < \theta < 45^\circ$

$$a = \sin\theta^{\sin\theta} \log_2 \cos\theta$$

$$b = \cos\theta^{\sin\theta} \log_2 \sin\theta$$

$$c = \sin\theta^{\cos\theta} \log_2 \cos\theta$$

$$d = \sin\theta^{\sin\theta} \log_2 \sin\theta$$

In order to find median of a, b, c, d, we need to arrange them in increasing or decreasing order. Then the

mean value of middle two numbers will be the median of all four values.

Let us take  $\theta = 30^\circ$

Then  $\sin 30^\circ = \frac{1}{2} = 0.5$

$\cos 30^\circ = \frac{\sqrt{3}}{2} = \frac{1.732}{2} = 0.866 = 0.87$

$\log_2 \sin 30^\circ = \log_2 \frac{1}{2} = \log_2 1 - \log_2 2 = 0 - 1 = -1$

$\log_2 \cos 30^\circ = \log_2 \frac{\sqrt{3}}{2} = \log_2 \sqrt{3} - \log_2 2 = \frac{1}{2} \log_2 3 -$

$1 = \frac{1}{2} \times 1.5 - 1$

$= 0.75 - 1$

$= -0.25$

(We Assume  $\log_2 2 < \log_2 3 < \log_2 4$ )

(Or,  $1 < \log_2 3 < 2$ )

So, the 4 numbers comes out as,

$a = 0.5^{0.5} \log_2 \cos 30^\circ = 0.5^{0.5} (-0.25)$

$b = 0.87^{0.5} \log_2 \sin 30^\circ = 0.87^{0.5} (-1)$

$c = 0.5^{0.87} \log_2 \cos 30^\circ = 0.5^{0.87} \times (-0.25)$

$d = 0.5^{0.5} \log_2 \sin 30^\circ = 0.5^{0.5} \times (-1)$

All the numbers are negative.

So, the number with greatest magnitude (value) will be the least and the number with least magnitude (value) will be highest.

e.g.  $-100 < -2$

Now comparing 'a' and 'd' clearly  $[a > d]$

Now comparing 'a' and 'c',

We know,  $0.5^{0.87} < 0.5^{0.5}$

$\therefore 0.5^{0.87} \times (-0.25) > 0.5^{0.5} \times (-0.25)$

$\therefore c > a$

Now comparing 'd' and 'b', we get

We know  $0.87^{0.5} > 0.5^{0.5}$

$0.87^{0.5} \times (-1) < 0.5^{0.5} \times (-1)$

$b < d$

or,  $d > b$

Combining all inequalities, we get  $c > a > d > b$

Thus, median  $= \frac{a+d}{2}$ .

33. (a) If  $f(x^2 + f(y)) = xf(x) + y$  for all non-negative integers  $x$  and  $y$ , then the value of  $[f(0)]^2 + f(0)$  equals\_\_\_\_\_.

Sol. Given  $f(x^2 + f(y)) = xf(x) + y$

Put  $x = 1$  and  $y = 0$  we get,

$f(1 + f(0)) = 1 \times f(1) + 0$

$\Rightarrow f(1 + f(0)) = f(1)$

It means  $1+f(0) = 1$  or  $f(0) = 0$

Therefore,  $[f(0)]^2 + f(0) = 0$ .

34. (c) Equation of ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

& Equation of hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

The equation of the given curve is  $\frac{x^2}{\sin\sqrt{2}-\sin\sqrt{3}} +$

$\frac{y^2}{\cos\sqrt{2}-\cos\sqrt{3}} = 1$

We know, foci always lies on major axis.

Also,

If  $a > b \Rightarrow x - axis$  will be the major axis &

If  $b > a \Rightarrow y - axis$  will be the major axis in both ellipse & hyperbola.

Here, we need to figure out which expression is greater between

$\sin\sqrt{2} - \sin\sqrt{3}$  and  $\cos\sqrt{2} - \cos\sqrt{3}$ .

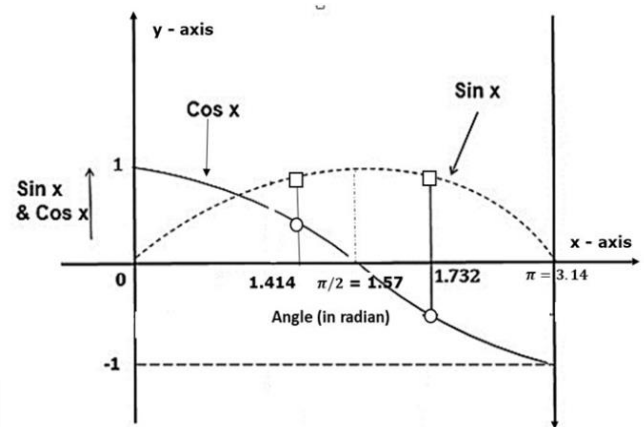
Note: Here  $\sqrt{2}$  And  $\sqrt{3}$  are the angles in radian and not degree.

Also, we know

$\sqrt{2} = 1.414$

$\frac{\pi}{2} = \frac{3.14}{2} = 1.57$

$\sqrt{3} = 1.732$



From the graph, it is visible that,

$\sin\sqrt{2} > \sin\sqrt{3}$

$\therefore \sin\sqrt{2} - \sin\sqrt{3}$  is always positive, but it will have a very small value.

(Because, 1.732 is farther from 1.57 compared to 1.414, which makes  $\sin 1.732$  lesser than  $\sin 1.414$ .)

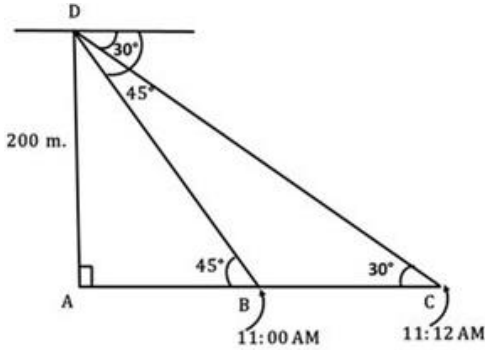
Also from the graph, we can see that  $\cos\sqrt{3}$  will be a negative value.

It means,  $\cos\sqrt{2} - \cos\sqrt{3}$  will be always be a positive value & will have larger magnitude compared to  $\sin\sqrt{2} - \sin\sqrt{3}$ .

Thus, we can say that major axis, of given curve is  $y - axis$  & foci will be on this only.

35. (d) Number of 4-digit numbers divisible by both 2 and 3 = Number of 4-digit numbers divisible by the LCM (2 & 3) i.e. 6.  
 $= \left[ \frac{9999}{6} \right] - \left[ \frac{1000}{6} \right] = 1666 - 166 = 1500$   
 Number of 4-digit numbers divisible by 2,3 and 5 = Number of 4-digit numbers divisible by LCM (2,3,5) = i.e. 30.  
 $= \left[ \frac{9999}{30} \right] - \left[ \frac{1000}{30} \right] = 333 - 33 = 300$   
 $\therefore$  Number of 4-digit numbers divisibly by 2 & 3 but not 5 = (Number of 4-digit divisibly by 2 & 3 i.e. 6) - (Number of 4-digit nos. divisibly by 2,3 & 5) =  $1500 - 300 = 1200$ .

36. (b)



In  $\triangle DAB$ ,  $\tan 45^\circ = \frac{P}{B} = \frac{200m}{AB}$   
 $\Rightarrow AB = 200m$ .

In  $\triangle DAC$ ,  $\tan 30^\circ = \frac{200}{AC} = \frac{200}{200+BC}$

$\frac{1}{\sqrt{3}} = \frac{200}{200+BC}$

$\Rightarrow BC = 200(\sqrt{3} - 1)$

$= 200 \times 0.72$

$= 144m$  (approx.)

This distance 144m is travelled by the car in 2 min.

$\therefore$  speed of car  $= \frac{144m}{2 \text{ min}} = \left(\frac{144}{1000}\right) \left(\frac{60}{2}\right)$

$= 4.39 \text{ km/h}$ .

Thus, speed of car is 4.39 km/h.

37. (b) Let the number is  $N = 3^7 \cdot 2^8 \cdot 17^3$

Total number of factors of  $N = (7+1)(8+1)(3+1)$   
 $= 8 \times 9 \times 4 = 8 \times 36 = 288$

In order to find total number of perfect square factors, we need to find the number of perfect square factors of  $3^7, 2^8$  &  $17^3$ , which when multiplied in combinations will produce all possible perfect square factors.

$\Rightarrow \binom{3^0}{3^2} \binom{2^0}{2^2} \times \binom{17^0}{17^2}$

$= 4 \times 5 \times 2 = 40$

$\Rightarrow P(E) = \frac{40}{288} = \frac{5}{36}$

38. (c) It is given that the equations represent 3 straight lines.

Concurrent lines pass through a single point.

So let us find the coordinates of the point from which first two lines pass.

It can be obtained by solving, equations of first two lines.

$$\begin{array}{r} x-y-1=0 \dots\dots(1) \times 2 \\ 2x-3y+2=0 \dots\dots(2) \times 1 \\ \hline 2x-2y-2=0 \dots\dots(3) \\ 2x+3y-12=0 \dots\dots(4) \\ \hline \end{array}$$

solving equations (3) and (4) we let

$y = 2; x = 3$

So, the point (3, 2) should also satisfy the questions of

third line, i.e.,  $2x - 3y + k = 0$

Putting the values of  $x = 3$  &  $y = 2$  in it, we put

$2 \times (3) - 3(2) + k = 0$

$6 - 6 + k = 0$

$\therefore k = 0$ .

39. (a)  $f(x) = \frac{x}{|x|}$

Case I : If  $x \geq 0$ ,  $|x| = +x \therefore f(x) = \frac{x}{x} = 1$

Case II : if  $x < 0$ ,  $|x| = -x \therefore f(x) = \frac{x}{-x} = -1$

$\therefore$  Solution set will be  $\{1, -1\}$ .

40. (c) MANAGEMENT.

This word has 4 vowels (2A's and 2E's).

and 6 consonants (2M's, 2N's one G & one T).

\_ M \_ N \_ G \_ M \_ N \_ T \_

We will arrange all the consonants first.

It can be arranged in  $\frac{6!}{2! \times 2!} = \frac{720}{4} = 180$  ways

Now 4 vowels can be arranged in the 7 spaces (blanks) as shown by the figure.

That way, no two vowels will come together.

This can be done in  $\frac{7P_4}{2! \times 2!} = \frac{7!}{3! \times 2! \times 2!} = \frac{7 \times 6 \times 4 \times 5 \times 3!}{3! \times 2 \times 2}$

$= 7 \times 6 \times 5$

$= 210$  ways

Total ways =  $180 \times 210 = 37800$ .

In which no two vowels will come together.

**Hint [41-45]:**

Statement number 4 in the common data, actually tells us that Cathy does not work on Monday and Saturday.

So, arranging the given data in the table, we get

Let us denote Alex  $\Rightarrow$  A | Bhabha  $\Rightarrow$  B | Cathy  $\Rightarrow$  C | Dilip  $\Rightarrow$  D | Ethan  $\Rightarrow$  E

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
A	× 1	✓ 1	✓ 1	× 1	× 4	✓ 5	× 4
B	✓ 6	× 1	× 1	✓ 8	× 7	× 5	✓ 8
C	× 2	× 1	× 1	✓ 3	✓ 3	× 2	× 3
D	× 1	✓ 1	✓ 1	× 1	× 7	× 5	✓ 8
E	✓ 6	× 1	× 1	× 7	✓ 7	✓ 5	× 7

Also note, in this question, we need to consider Sun - Mon as pair of consecutive days because the showroom is open on all 7 days of the week.

**Step 1:** A and D works together on Tue & Wednesday. It means no other person will work on these 2 days.

Also, they both must not be working on Monday & Thursday.

**Step 2:** C does not work on either on Monday or Saturday.

Means she will not work on Monday and Saturday.

**Step 3:** C is left with only 3 days. Thus she will work on these days i.e. Thursday & Friday (consecutive) & (third working day)

**Step 4:** It is given that C does not work with A on any day. It means A will not be working on Friday and Sunday as C is working.

**Step 5:** A must be working on Saturday as third day. B and D will not be working with him (Given). Thus E will definitely work on Saturday.

**Step 6:** On Monday A, C & D are not working means B & E will definitely & work on Monday.

**Step 7:** As E is working on Monday and Saturday, he cannot work on Thursday, because in that case he will not be working on 2 consecutive days.

Also he cannot work on Sunday because in that case he will work on 3 consecutive days.

So the only option left for him is Friday along with Monday & Saturday.

**Step 8:** It is evident from the table that only B, C and D will be working on Sunday.

This way the table is completed and we can answer all the questions.

41. **(d)** Bhabha and Cathy work together for 2 days.
42. **(d)** The consecutive days Ethan works on Friday & Saturday.
43. **(c)** Dilip and Ethan do not work together at all.
44. **(b)** Bhabha, Cathy and Ethan work on Sunday.
45. **(a)** One of the days Alex work on is Saturday.
46. **(c)** option C. The difference between climacteric and non-climacteric fruits is referred to in the third line of the first paragraph. Since this difference matters to fruit either by ground-dwellers, or by arboreal or aerial animals respectively) is clearly the main evidence and finding I (Non-climacteric fruits tend to have vivid colours) is the 'other' or secondary evidence. Hence the correct answer is option a.
49. **(d)** option (d). Refer to the first line of the last paragraph. It is clearly stated that they looked at the fruits eaten by the people (for the study).
50. **(b)** option (b). Refer to the last line of the first paragraph It clearly states that how those differences (between climacteric and non-climacteric originally came about remains unclear.
51. **(b)** On the 14th of May 1796, vaccine matter was taken from the hand of a dairy maid, Sarah Nelmes, and inserted by two superficial incisions in the arms of James Phipps, a healthy boy of about eight years of age. The boy went through an attack of cowpox as expected. After this, however, it was necessary to determine whether he was protected from smallpox. After waiting two months Jenner inoculated him with material from a smallpox patient. He was delighted to note that the boy was not affected by smallpox.
52. **(b)** Local reaction means a reaction occurring at the point of stimulation of injection of foreign substances.
53. **(d)** Refer to the first line of the last paragraph. The paragraph clearly states that Jenner's discovery was much appreciated by his contemporaries because of which he was given many honours and diplomas.
54. **(b)** Refer to the first line of the second paragraph, "By 1798, Jenner had succeeded in demonstrating the protective quality of the cowpox virus against smallpox, by putting on record details of 23 cases, contracted either casually or by direct inoculation."
55. **(b)** Refer to the third and fourth line of the fourth paragraph, "Dr. Ingenhouz, became the leader of a

growers and greengrocers who must make sure their wares are in tip-top condition when they arrive at the marketplace, it can be safely said that commercial aspect of the interest is being discussed here.

47. **(d)** option 4. First line of the second paragraph clearly states that fruits exist to solve a problem faced by all plants – how to spread their progeny around. Hence, option 4.
48. **(a)** option A. Let's understand the demand of the question here. The third para clearly suggests that two researchers studied 80 varieties of fruits. The second last line of the third paragraph shows that 15 varieties of these fruits were eaten by ground dwellers and 21 varieties were eaten by arboreal animals. This was the first finding of that study. Now, the first line of the next paragraph suggests that their hypothesis was fortified by **other evidence** that is non climacteric fruits have vivid colours.

So finding II (Thirty-six varieties of climacteric and non-climacteric fruits were eaten predominantly strong faction of the medical profession of London, who not only would have nothing to do with vaccination, but proclaimed openly that it was a dangerous innovation, absolutely unjustifiable, and communicated a disease without protecting against any other."

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56. **(c)** The entire passage talks about how Dr. Jenner went that extra mile to test his discovery and make it known. Option (a) – the passage doesn't talk about likelihood of scientific breakthroughs happening in major urban centers. Therefore, this option can be eliminated. Option (b) – The central idea of the passage is clearly the discovery of Dr. Jennings and his struggle to demonstrate it assertion to his contemporaries. The

passage doesn't talk about importance of documentation for disseminating Science.

Option (d) – can be eliminated for the same reasons. The reluctance to accept the vaccine isn't the central idea of the passage either.

57. (a) Refer to the third line of the third paragraph, "He remained in London for nearly three months without being able to find anyone who would submit to vaccination. Jenner went back to Gloucestershire, disappointed."
58. (d) The phrase 'Piece of Cake' is used to describe something that is very easy to complete. The other options are not valid phrases to be used in this context.
59. (b) Option (b). A taste of one's own medicine means harsh or unpleasant treatment that is like the treatment someone has given other people.
60. (c) option (c). look on the bright side means to be optimistic or cheerful in spite of difficulties.
62. (b) **condescendingly** – showing or characterized by a superior attitude toward others  
Ambitiously – with the intention of meeting high aspirations  
Overly – excessively  
Controversially - in a way that causes disagreement or discussion  
Option a fits the context best.
63. (d) *Hidden in plain sight* means to be unnoticeable, by staying visible in a setting that masks presence; camouflage  
The given information is about spies, sending information to their heads, disguised as harmless looking secretaries or researchers. So they hide in plain sight which means blend in with their surroundings so well that it goes by unnoticed. The other options are irrelevant.
64. (c) looks down on - regard someone with a feeling of superiority  
Looks up to - admire and respect someone  
Looks towards - To glance, gaze, or turn one's face in the direction of someone or something  
Looks away from - To turn one's face away (from someone or something)  
Since she's rich, she probably regards others with a feeling of superiority. Hence option C.
65. (b) Pick up - take hold of and lift or move someone or something; raise or arouse
66. (c) This is a third conditional sentence. To make a sentence in the third conditional, we use,  
If + past perfect, would/wouldn't have + past participle.  
If you had told me about the meeting, I would have come.  
Hence only option c fits the given requirement. Besides, the other options are grammatically wrong.

Options a and b are wrong because the correct expression is 'Look on the bright side'. Option d is not a valid phrase to be used here.

61. (a) Mindfulness - the quality or state of being conscious or aware of something  
Inclusivity - creating an environment where all people are truly welcomed, valued and respected  
Diversity is a group of people who are different in the same place  
Discretionary - used as desired or needed  
Discriminatory – unfair  
According to the given context the chain of coffee shops has been committed to building a culture where everyone is welcome. So, the option that fits this best is inclusivity and diversity which means creating an environment where all people are truly welcomed, valued and respected
67. (d) This is a case of inversion which means a reversal of position, order, form, or relationship: the placement of a verb before its subject for example, little did they know about me.
68. (a) Provided can emphasize a condition. Follows the same structure as 'if' conditional sentence.  
Provided + simple present, (followed by) simple present
69. (b) Revert – return to former state or activity  
Its – shows possession  
It's – contracted form of it is  
The word 'back' after the word 'reverted' is redundant.
70. (b) The central idea of the paragraph is shopping. Since the first line is missing, we need to find something that can work as a passage opener. Option B fits the context better as it talks about how culture plays an important role in the shopping experience and the next sentence talks about how climate and culture affect the shopping experience of people of SE Asia and Europeans.  
Option (a) – is about promotional discounts to entice shoppers. Doesn't relate to the theme of the passage.  
Option (b) – talks about role of culture in shaping the shopping experience.  
Options (c) – is about how people enjoy shopping and comparing brands. But this sentence doesn't relate to the next sentence which shows the difference in the shopping habits of people of Southeast Asia and Europeans. So this one should be ruled out.  
Option (d) – related to the last sentence of the passage more than the first sentence.
71. (b) The paragraph talks about Goa and how reaching there is not a major problem. The sentence that best fits the missing part that follows is option B (There are buses that ply at night, there are both day and night trains, and one can always hire a car and reach there in comfort in about 10 hours).

Option (a) though talks about a variety of things that one can do in Goa won't be a good fit here as the line preceding the missing part talks about reaching Goa and the line that follows is about its beaches.

Option (c) – It looks like a good choice as it talks about popular Goan beaches but the following line starts with “the major Goan beaches” instead of “these Goan beaches”. This shows that the missing line is not connected to the Goan beaches.

Option (d) – can be the last line of the given paragraph.

72. **(b)** options (a) and (d) can be ruled out because these do not relate to the next statement that discusses ‘the causes for this situation’. Between options (b) and (c), option (b) is a better answer choice as it relates to the given information perfectly.

73. **(a)** The entire paragraph is about the script which the scholars have been unable to decipher. Keeping this in mind, option (b), (c) and (d) should be ruled out as these are about trade, nature of relationship and age of civilization. Only option (a) is about decoding the language.

74. **(b)** Universe (n)– cosmos

Ideologies - a set of ideas which form the basis for a political or economic system

Phenomenon (singular) - an observable fact or event;  
Phenomena (plural)

Configuration (n) - the way in which the parts of something, or a group of things, are arranged

Option (d) can be ruled out as the word configuration would be a misfit in the first blank.

Option (a) can be ruled out as achieving spaceflights helps observe objects and ‘ideologies’ that are better observed from a space perspective, probably not; it won't be parallel.

Option (c) can be ruled out as the aforementioned activities aren't the elements of space ‘identification’.

Let's place option B in the blanks and see its impact  
Achieving spaceflight enabled humans to begin to explore the solar system and the rest of the universe, to understand the many objects and phenomena that are better observed from a space perspective, and to use for human benefit the resources and attributes of the space environment. All of these activities - discovery, scientific understanding, and the application of that understanding to serve human purposes - are elements of space exploration.

75. **(b)** Monochrome (adj)- using only black, white and shades of grey

Barely (adv)- only just; almost not  
Misconception (n) - wrong idea or understanding of something.

Accusation (n)- a charge of wrong doing.

Classic (adj)- typical

Dispassionately (adj) - in an unemotional, rational, and impartial manner

Option (d) can be ruled out as the movies can't be preserved ‘dispassionately’.

Option (c) will be ruled out as accusation will be a misfit in the third blank. If the films aren't preserved well, it will probably lead to some conclusion not accusation.

Option (a) will be ruled out as barely won't fit as beautifully and meaningfully as poorly in the second blank.

76. **(d)** Educational (adj) – providing or relating to education  
Firewall - A firewall is a network security device that monitors incoming and outgoing network traffic and decides whether to allow or block specific traffic based on a defined set of security rules  
hackers (n) - a person who uses a computer to look at and/or change information on another computer without permission  
Inescapable (adj) – that can't be avoided.

Unsolicited – not asked for; uninvited

Regulators – a person or thing that regulates/controls something

Spammer (n) - a person or organization that sends irrelevant or unsolicited messages over the internet, typically to large numbers of users, for the purposes of advertising, phishing, spreading malware, etc.

Let's evaluate the options for the first blank. The messages are promotional (done to advertise your products) that means these won't be educational or informative so we can rule out options (a) and (c). unsolicited (not asked for) looks like a better answer choice than inescapable (something that can't be avoided). Hence, option (d) is the perfect answer choice for this question.

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77. **(c)** Treacherously (adv) – in a disloyal and faithless manner

Enormously (adv)- to a great degree or extent  
 Alleged (adj)- accused but not proven or convicted  
 Insider (n) - a person who knows a lot about a group or an organization because he's a part of it.  
 Illicitly (adv)- in a way that is contrary or forbidden by law, rules or custom  
 Accused (n)- a person who has been arrested for or formally charged with a crime  
 Dramatically (adv) - something done with great flare or done in an overly exaggerated or theatrical manner.  
 Though grammatically all the options look alright, we need to carefully evaluate them. Now, instead of announcing, the investigator would probably allege or even accuse that someone has leaked the information. Hence, options (a) and (b) can be eliminated. If we look at the third blank, the associate made profits illicitly (illegally) not dramatically.

78. (a) Orthography - the system of spelling in a language  
 Linguistics - **the scientific study of language**  
**Cogitate** - think deeply about something; meditate or reflect.  
 Ponder/Mull - to think about something carefully or for a long time  
 Options (b), (c), and (d) can be ruled out because the words language, animals and writing won't fit in the second blank. One wouldn't want to think deeply about these and life in general.  
 Option (a) looks like a good answer choice. The beauty of philosophy is that it poses thought-provoking questions and inspires us to think deeply about ourselves and life in general. Further, pondering about the ideas and perspectives outlined by different thinkers can help us to gain a better understanding of the world we live in.  
 The sentences below have words that are missing. Choose the best option from those given below to complete the sentence.
79. (c) Belief - a firm thought that something is true, often based on revelation  
 Worldview - a comprehensive conception or apprehension of the world especially from a specific standpoint  
 The paragraph begins with an anthropocentric view where humankind is the central or most important element of existence. Since, this can't be a construct (something that is created, often with a complex form) or universe (cosmos), option a and d can be eliminated. So we're left with option b and c. Now, let's take a look at the third blank. The idea about killing animals painlessly can be 'explicitly' (clearly stated) and not 'partially' on some widely accepted idea.
80. (c) Spot (n) - a small dirty mark on something  
 Spot - location  
 Stain on career - **something bad that someone has done that spoils their reputation**  
 Spot on (adj)- exactly right  
 Sentences (a), (b), and (d) have used the words correctly.

Stain on career would be a better fit instead of spot on his career in sentence (c).

81. (a) crass (adj) - stupid, showing that you do not understand something  
 Cross - to go from one side of something to the other  
 Bear the cross - a problem that causes trouble or worry for someone over a long period of time  
 Cross - angry or annoyed  
 Sentence (b), (c), and (d) have used the word cross appropriately. Crass should be used instead of cross in sentence a.
82. (d) flout - to refuse to obey or accept something  
 Flaunt - to show something that you are proud of so that other people will admire it  
 Sentence (a), (b) and (c) have used the word flout correctly. Flaunt should be used in sentence 4 to give the sentence its correct meaning.
83. (d) State (v) - to say or write something, especially formally  
 State (n) - a condition or way of being  
 State (n) - a division under the Indian constituency  
 The word state is correctly used in the first three sentences. The demeanour (behaviour towards others) can't be of great 'state'. Hence, the word state has been inappropriately been used in option D.
84. (c) Draw as used in sentence (a) means to pull something out of its resting place  
 Draw as used in sentence (b) means an act of deciding something by chance by pulling out names or numbers from a bag, etc.  
 Draw as used in sentence (d) means a result of a game or competition in which both players and teams get the same score so that neither of them wins.  
 Drawer - a container which forms part of a piece of furniture such as a desk that you can pull out to put things in.  
 The word drawer should be used in place of draw in sentence (c) to give the sentence its correct meaning.
85. (d) Collaborate - to work together (with somebody), especially to create or produce something  
 Corroborate - to support a statement, idea, etc. by providing new evidence  
 Sentence (a), (b) and (c) have used the word collaborate correctly. The word, however, to be used in sentence (d) should be corroborate.
86. (1432) Sentence 1 introduces the Central African Republic which has approved Bitcoin as an official currency. Sentence 4 builds on it as 'this move' is criticized by the economists. Sentence 3 further talks about the opinion of the experts. Sentences 2 will follow sentence 3 as it states what the others claim about the overall impact of this move.
87. (31542) Sentence 3 clearly works as a passage opener as it introduces the city's Talao (Lake). Sentence 1 is a connected statement as it describes its location. Sentence 3 gives more information about the lake which was known natural water tank with the Sion hillock expanding around it like an enclosing wall. Sentence 4 states that the lake has lost its prominence over the years and sentence 2 is about the present day

state of the lake which is now surrounded by high-rise residential buildings.

88. **(43512)** Sentence 4 and 3 are paired sentence, sentence 4 being the passage opener as it introduces the June-to-September rain-bearing system which is the lifeblood of the country's economy. This is because the Indian population depends upon farm-derived income as stated in sentence 3. Sentence 5 and 1 are connected statements as these talk about 40% of India's net sown area which does not have access to irrigation and how a subpar (below a usual or normal level) monsoon cuts farm yields, output, and farm incomes thereby increasing the country's dependence on food imports. Sentence 2, however, gives a solution to the aforementioned.
89. **(4132)** Sentence 4 opens the passage as it talks about the ceramics, known as Yakimono, made by Japanese artisans. Sentence 1 is connected to sentence 4 as it

talks about the popularity of 'these creations' i.e. the ceramics referred to in the first sentence. Sentence 3 and 2 are mandatory pairs as sentence 3 refers to the ceramics displayed in the touristy shops and sentence 4 talks about savvy tourists who find the best bargains in Tokyo's Kitchen Town.

90. **(54321)** Sentence 5 works as the passage opener when it talks about how human eye performs jiggles i.e moves quickly from side to side. Sentence 4 builds on it as it talks about how our eyes quickly scan the surroundings and sends the data to the brain. Sentence 2 and 3 are paired sentences as these talk about how youthful eyes jiggle regularly to take in new or unfamiliar stimuli and how the eye muscles grow slower and the pathways between the eye and the brain grow longer, more complex, or, in some cases, get damaged when the person attached to those eyes ages. This is connected to sentence 1 as it talks about its impact on the brain.

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