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CAT SOLVED PAPER-2018

SECTION : VERBAL ABILITY

DIRECTIONS for the questions: *Read the passage and answer the questions (1-5) based on it.*

"Everybody pretty much agrees that the relationship between elephants and people has dramatically changed," [says psychologist Gay] Bradshaw… "Where for centuries humans and elephants lived in relatively peaceful coexistence, there is now hostility and violence. Now, I use the term 'violence' because of the intentionality associated with it, both in the aggression of humans and, at times, the recently observed behavior of elephants."

Typically, elephant researchers have cited, as a cause of aggression, the high levels of testosterone in newly matured male elephants or the competition for land and resources between elephants and humans. But. . . Bradshaw and several colleagues argue… that today's elephant populations are suffering from a form of chronic stress, a kind of species-wide trauma. Decades of poaching and culling and habitat loss, they claim, have so disrupted the intricate web of familial and societal relations by which young elephants have traditionally been raised in the wild, and by which established elephant herds are governed, that what we are now witnessing is nothing less than a precipitous collapse of elephant culture.

Elephants, when left to their own devices, are profoundly social creatures. Young elephants are raised within an extended, multitiered network of doting female caregivers that includes the birth mother, grandmothers, aunts and friends. These relations are maintained over a life span as long as 70 years. Studies of established herds have shown that young elephants stay within 15 feet of their mothers for nearly all of their first eight years of life, after which young females are socialized into the matriarchal network, while young males go off for a time into an all-male social group before coming back into the fold as mature adults.

This fabric of elephant society, Bradshaw and her colleagues [demonstrate], ha[s] effectively been frayed by years of habitat loss and poaching, along with systematic culling by government agencies to control elephant numbers and translocations of herds to different habitats. As a result of such social upheaval, calves are now being born to and raised by ever younger and inexperienced mothers. Young orphaned elephants, meanwhile, that have witnessed the death of a parent at the hands of poachers are coming of age in the absence of the support system that defines traditional elephant life. "The loss of elephant elders," [says] Bradshaw . . . "and the traumatic experience of witnessing the massacres of their family, impairs normal brain and behavior development in young elephants."

What Bradshaw and her colleagues describe would seem to be an extreme form of anthropocentric conjecture if the evidence that they've compiled from various elephant researchers. weren't so compelling. The elephants of decimated herds, especially orphans who've watched the death of their parents and elders from poaching and culling, exhibit behavior typically associated with post-traumatic stress disorder and other trauma-related disorders in humans: abnormal startle response, unpredictable asocial behavior, inattentive mothering and hyperaggression.

[According to Bradshaw], "Elephants are suffering and behaving in the same ways that we recognize in ourselves as a result of violence. Except perhaps for a few specific features, brain organization and early development of elephants and humans are extremely similar."

1. In the first paragraph, Bradshaw uses the term "violence" to describe the recent change in the human-elephant relationship because, according to him:

(a) both humans and elephants have killed members of each other's species.

(b) elephant herds and their habitat have been systematically destroyed by humans.

(c) there is a purposefulness in human and elephant aggression towards each other.

(d) human-elephant interactions have changed their character over time.

2. Which of the following measures is Bradshaw most likely to support to address the problem of elephant aggression?

(a) The development of treatment programmes for elephants drawing on insights gained from treating post-traumatic stress disorder in humans.

(b) Studying the impact of isolating elephant calves on their early brain development, behaviour and aggression.

(c) Increased funding for research into the similarity of humans and other animals drawing on insights gained from human-elephant similarities.

(d) Funding of more studies to better understand the impact of testosterone on male elephant aggression.

3. Which of the following statements best expresses the overall argument of this passage?
(a) The brain organisation and early development of elephants and humans are extremely similar.
(b) The relationship between elephants and humans has changed from one of coexistence to one of hostility.
(c) Recent elephant behaviour could be understood as a form of species-wide trauma-related response.
(d) Elephants, like the humans they are in conflict with, are profoundly social creatures.

4. The passage makes all of the following claims EXCEPT:
(a) elephants establish extended and enduring familial relationships as do humans.
(b) elephant mothers are evolving newer ways of rearing their calves to adapt to emerging threats.
(c) the elephant response to deeply disturbing experiences is similar to that of humans.
(d) human actions such as poaching and culling have created stressful conditions for elephant communities.

5. In paragraph 4, the phrase, "The fabric of elephant society … has[s] effectively been frayed by . . ." is:
(a) a metaphor for the effect of human activity on elephant communities.
(b) an exaggeration aimed at bolstering Bradshaw's claims.
(c) an accurate description of the condition of elephant herds today.
(d) an ode to the fragility of elephant society today.

DIRECTIONS for the questions: *Read the passage and answer the questions (6-9) based on it.*

When researchers at Emory University in Atlanta trained mice to fear the smell of almonds (by pairing it with electric shocks), they found, to their consternation, that both the children and grandchildren of these mice were spontaneously afraid of the same smell. That is not supposed to happen. Generations of schoolchildren have been taught that the inheritance of acquired characteristics is impossible. A mouse should not be born with something its parents have learned during their lifetimes, any ore than a mouse that loses its tail in an accident should give birth to tailless mice.

Modern evolutionary biology dates back to a synthesis that emerged around the 1940s-60s, which married Charles Darwin's mechanism of natural selection with Gregor Mendel's discoveries of how genes are inherited. The traditional, and still dominant, view is that adaptations – from the human brain to the peacock's tail – are fully and satisfactorily explained by natural selection (and subsequent inheritance). Yet [new evidence] from genomics, epigenetics and developmental biology [indicates] that evolution is more complex than we once assumed.

In his book On Human Nature (1978), the evolutionary biologist Edward O Wilson claimed that human culture is held on a genetic leash. The metaphor [needs revision]. . . . Imagine a dog-walker (the genes) struggling to retain control of a brawny mastiff (human culture). The pair's trajectory (the pathway of evolution) reflects the outcome of the struggle. Now imagine the same dog-walker struggling with multiple dogs, on leashes of varied lengths, with each dog tugging in different directions. All these tugs represent the influence of developmental factors, including epigenetics, antibodies and hormones passed on by parents, as well as the ecological legacies and culture they bequeath.

The received wisdom is that parental experiences can't affect the characters of their offspring. Except they do. The way that genes are expressed to produce an organism's phenotype – the actual characteristics it ends up with – is affected by chemicals that attach to them. Everything from diet to air pollution to parental behaviour can influence the addition or removal of these chemical marks, which switches genes on or off. Usually these so-called 'epigenetic' attachments are removed during the production of sperm and eggs cells, but it turns out that some escape the resetting process and are passed on to the next generation, along with the genes. This is known as 'epigenetic inheritance', and more and more studies are confirming that it really happens. Let's return to the almond-fearing mice. The inheritance of an epigenetic mark transmitted in the sperm is what led the mice's offspring to acquire an inherited fear.

Epigenetics is only part of the story. Through culture and society, [humans and other animals] inherit knowledge and skills acquired by [their] parents… All this complexity. points to an evolutionary process in which genomes (over hundreds to thousands of generations), epigenetic modifications and inherited cultural factors (over several, perhaps tens or hundreds of generations), and parental effects (over single-generation timespans) collectively inform how organisms adapt. These extragenetic kinds of inheritance give organisms the flexibility to make rapid adjustments to environmental challenges, dragging genetic change in their wake – much like a rowdy pack of dogs.

6. Which of the following, if found to be true, would negate the main message of the passage?
(a) A study indicating the primacy of ecological impact on human adaptation.
(b) A study affirming the sole influence of natural selection and inheritance on evolution.
(c) A study highlighting the criticality of epigenetic inheritance to evolution.
(d) A study affirming the influence of socio-cultural markers on evolutionary processes.

7. The passage uses the metaphor of a dog walker to argue that evolutionary adaptation is most comprehensively understood as being determined by:
(a) ecological, hormonal, extra genetic and genetic legacies
(b) socio-cultural, genetic, epigenetic, and genomic legacies
(c) extra genetic, genetic, epigenetic and genomic legacies
(d) genetic, epigenetic, developmental factors, and ecological legacies

8. The Emory University experiment with mice points to the inheritance of:

(a) personality traits (b) acquired parental fears

(c) acquired characteristics (d) psychological markers

9. Which of the following best describes the author's argument?

(a) Darwin's and Mendel's theories together best explain evolution

(b) Darwin's theory of natural selection cannot fully explain evolution

(c) Wilson's theory of evolution is scientifically superior to either Darwin's or Mendel's

(d) Mendel's theory of inheritance is unfairly underestimated in explaining evolution

DIRECTIONS for the questions: *Read the passage and answer the questions (10-14) based on it.*

[The] Indian government [has] announced an international competition to design a National War Memorial in New Delhi, to honour all of the Indian soldiers who served in the various wars and counter-insurgency campaigns from 1947 onwards. The terms of the competition also specified that the new structure would be built adjacent to the India Gate – a memorial to the Indian soldiers who died in the First World War. Between the old imperialist memorial and the proposed nationalist one, India's contribution to the Second World War is airbrushed out of existence.

The Indian government's conception of the war memorial was not merely absent-minded. Rather, it accurately reflected the fact that both academic history and popular memory have yet to come to terms with India's Second World War, which continues to be seen as little more than mood music in the drama of India's advance towards independence and partition in 1947. Further, the political trajectory of the postwar subcontinent has militated against popular remembrance of the war. With partition and the onset of the India-Pakistan rivalry, both of the new nations needed fresh stories for self-legitimisation rather than focusing on shared wartime experiences.

However, the Second World War played a crucial role in both the independence and partition of India. . . . The Indian army recruited, trained and deployed some 2.5 million men, almost 90,000 of which were killed and many more injured. Even at the time, it was recognised as the largest volunteer force in the war.

India's material and financial contribution to the war was equally significant. India emerged as a major military-industrial and logistical base for Allied operations in south-east Asia and the Middle East. This led the United States to take considerable interest in the country's future, and ensured that this was no longer the preserve of the British government.

Other wartime developments pointed in the direction of India's independence. In a stunning reversal of its long-standing financial relationship with Britain, India finished the war as one of the largest creditors to the imperial power.

Such extraordinary mobilization for war was achieved at great human cost, with the Bengal famine the most extreme manifestation of widespread wartime deprivation. The costs on India's home front must be counted in millions of lives.

Indians signed up to serve on the war and home fronts for a variety of reasons. . . . [M]any were convinced that their contribution would open the doors to India's freedom. The political and social churn triggered by the war was evident in the massive waves of popular protest and unrest that washed over rural and urban India in the aftermath of the conflict. This turmoil was crucial in persuading the Attlee government to rid itself of the incubus of ruling India.

Seventy years on, it is time that India engaged with the complex legacies of the Second World War. Bringing the war into the ambit of the new national memorial would be a fitting – if not overdue – recognition that this was India's War.

10. The author claims that omitting mention of Indians who served in the Second World War from the new National War Memorial is:

(a) a reflection of misplaced priorities of the post-independence Indian governments

(b) a reflection of the academic and popular view of India's role in the War

(c) appropriate as their names can always be included in the India Gate memorial

(d) is something which can be rectified in future by constructing a separate memorial

11. In the first paragraph, the author laments the fact that:

(a) India lost thousands of human lives during the Second World War

(b) the new war memorial will be built right next to India Gate

(c) funds will be wasted on another war memorial when we already have the India Gate memorial

(d) there is no recognition of the Indian soldiers who served in the Second World War

12. The author suggests that a major reason why India has not so far acknowledged its role in the Second World War is that it:

(a) has been focused on building an independent, non-colonial political identity.

(b) wants to forget the human and financial toll of the War on the country

(c) views the War as a predominantly Allied effort, with India playing only a supporting role

(d) blames the War for leading to the momentous partition of the country

13. The phrase "mood music" is used in the second paragraph to indicate that the Second World War is viewed as:

(a) a part of the narrative on the ill-effects of colonial rule on India

(b) a backdrop to the subsequent independence and partition of the region

(c) setting the stage for the emergence of the India–Pakistan rivalry in the subcontinent
(d) a tragic period in terms of loss of lives and national wealth

14. The author lists all of the following as outcomes of the Second World War EXCEPT:
(a) the large financial debt India owed to Britain after the War
(b) independence of the subcontinent and its partition into two countries
(c) large-scale deaths in Bengal as a result of deprivation and famine
(d) US recognition of India's strategic location and role in the War

DIRECTIONS for the questions: *Read the passage and answer the questions (15-19) based on it.*

The only thing worse than being lied to is not knowing you're being lied to. It's true that plastic pollution is a huge problem, of planetary proportions. And it's true we could all do more to reduce our plastic footprint. The lie is that blame for the plastic problem is wasteful consumers and that changing our individual habits will fix it.

Recycling plastic is to saving the Earth what hammering a nail is to halting a falling skyscraper. You struggle to find a place to do it and feel pleased when you succeed. But your effort is wholly inadequate and distracts from the real problem of why the building is collapsing in the first place. The real problem is that single-use plastic—the very idea of producing plastic items like grocery bags, which we use for an average of 12 minutes but can persist in the environment for half a millennium—is an incredibly reckless abuse of technology. Encouraging individuals to recycle more will never solve the problem of a massive production of single-use plastic that should have been avoided in the first place.

As an ecologist and evolutionary biologist, I have had a disturbing window into the accumulating literature on the hazards of plastic pollution. Scientists have long recognized that plastics biodegrade slowly, if at all, and pose multiple threats to wildlife through entanglement and consumption. More recent reports highlight dangers posed by absorption of toxic chemicals in the water and by plastic odors that mimic some species' natural food. Plastics also accumulate up the food chain, and studies now show that we are likely ingesting it ourselves in seafood.

Beginning in the 1950s, big beverage companies like Coca-Cola and Anheuser-Busch, along with Phillip Morris and others, formed a non-profit called Keep America Beautiful. Its mission is/was to educate and encourage environmental stewardship in the public. At face value, these efforts seem benevolent, but they obscure the real problem, which is the role that corporate polluters play in the plastic problem. This clever misdirection has led journalist and author Heather Rogers to describe Keep America Beautiful as the first corporate green washing front, as it has helped shift the public focus to consumer recycling behavior and actively thwarted legislation that would increase extended producer responsibility for waste management.

[T] he greatest success of Keep America Beautiful has been to shift the onus of environmental responsibility onto the public while simultaneously becoming a trusted name in the environmental movement.

So what can we do to make responsible use of plastic a reality? First: reject the lie. Litterbugs are not responsible for the global ecological disaster of plastic. Humans can only function to the best of their abilities, given time, mental bandwidth and systemic constraints. Our huge problem with plastic is the result of a permissive legal framework that has allowed the uncontrolled rise of plastic pollution, despite clear evidence of the harm it causes to local communities and the world's oceans. Recycling is also too hard in most parts of the U.S. and lacks the proper incentives to make it work well.

15. It can be inferred that the author considers the Keep America Beautiful organisation:
(a) an innovative example of a collaborative corporate social responsibility initiative
(b) a sham as it diverted attention away from the role of corporates in plastics pollution
(c) a "greenwash" because it was a benevolent attempt to improve public recycling habits
(d) an important step in sensitising producers to the need to tackle plastics pollution

16. The author lists all of the following as negative effects of the use of plastics EXCEPT the:
(a) slow pace of degradation or non-degradation of plastics in the environment
(b) poisonous chemicals released into the water and food we consume
(c) adverse impacts on the digestive systems of animals exposed to plastic
(d) air pollution caused during the process of recycling plastics

17. Which of the following interventions would the author most strongly support:
(a) completely banning all single-use plastic bags
(b) passing regulations targeted at producers that generate plastic products
(c) recycling all plastic debris in the seabed
(d) having all consumers change their plastic consumption habits

18. In the first paragraph, the author uses "lie" to refer to the:
(a) understatement of the enormity of the plastics pollution problem
(b) understatement of the effects of recycling plastics
(c) fact that people do not know they have been lied to
(d) blame assigned to consumers for indiscriminate use of plastics

19. In the second paragraph, the phrase "what hammering a nail is to halting a falling skyscraper" means:
(a) relying on emerging technologies to mitigate the ill-effects of plastic pollution
(b) focusing on single-use plastic bags to reduce the plastics footprint
(c) encouraging the responsible production of plastics by firms
(d) focusing on consumer behaviour to tackle the problem of plastics pollution

DIRECTIONS for the questions: *Read the passage and answer the questions (20-24) based on it.*

Economists have spent most of the 20th century ignoring psychology, positive or otherwise. But today there is a great deal of emphasis on how happiness can shape global economies, or — on a smaller scale — successful business practice. This is driven, in part, by a trend in "measuring" positive emotions, mostly so they can be optimized. Neuroscientists, for example, claim to be able to locate specific emotions, such as happiness or disappointment, in particular areas of the brain. Wearable technologies, such as Spire, offer data-driven advice on how to reduce stress.

We are no longer just dealing with "happiness" in a philosophical or romantic sense — it has become something that can be monitored and measured, including by our behavior, use of social media and bodily indicators such as pulse rate and facial expressions.

There is nothing automatically sinister about this trend. But it is disquieting that the businesses and experts driving the quantification of happiness claim to have our best interests at heart, often concealing their own agendas in the process. In the workplace, happy workers are viewed as a "win-win." Work becomes more pleasant, and employees, more productive. But this is now being pursued through the use of performance-evaluating wearable technology, such as Humanyze or Virgin Pulse, both of which monitor physical signs of stress and activity toward the goal of increasing productivity.

Cities such as Dubai, which has pledged to become the "happiest city in the world," dream up ever-more elaborate and intrusive ways of collecting data on well-being — to the point where there is now talk of using CCTV cameras to monitor facial expressions in public spaces. New ways of detecting emotions are hitting the market all the time: One company, Beyond Verbal, aims to calculate moods conveyed in a phone conversation, potentially without the knowledge of at least one of the participants. And Facebook [has] demonstrated.. . that it could influence our emotions through tweaking our news feeds — opening the door to ever-more targeted manipulation in advertising and influence.

As the science grows more sophisticated and technologies become more intimate with our thoughts and bodies, a clear trend is emerging. Where happiness indicators were once used as a basis to reform society, challenging the obsession with money that G.D.P. measurement entrenches, they are increasingly used as a basis to transform or discipline individuals.

Happiness becomes a personal project, that each of us must now work on, like going to the gym. Since the 1970s, depression has come to be viewed as a cognitive or neurological defect in the individual, and never a consequence of circumstances. All of this simply escalates the sense of responsibility each of us feels for our own feelings, and with it, the sense of failure when things go badly. A society that deliberately removed certain sources of misery, such as precarious and exploitative employment, may well be a happier one. But we won't get there by making this single, often fleeting emotion, the over-arching goal.

20. From the passage we can infer that the author would like economists to:
(a) incorporate psychological findings into their research cautiously
(b) measure the effectiveness of Facebook and social media advertising
(c) work closely with neuroscientists to understand human behaviour
(d) correlate measurements of happiness with economic indicators

21. In the author's opinion, the shift in thinking in the 1970s:
(a) put people in touch with their own feelings rather than depending on psychologists
(b) was a welcome change from the earlier view that depression could be cured by changing circumstances
(c) reflected the emergence of neuroscience as the authority on human emotions
(d) introduced greater stress into people's lives as they were expected to be responsible for their own happiness

22. The author's view would be undermined by which of the following research findings?
(a) A proliferation of gyms that are collecting data on customer well-being
(b) There is a definitive move towards the adoption of wearable technology that taps into emotions
(c) Stakeholders globally are moving away from collecting data on the well-being of individuals
(d) Individuals worldwide are utilising technologies to monitor and increase their well-being

23. According to the author, wearable technologies and social media are contributing most to:
(a) making individuals aware of stress in their lives
(b) depression as a thing of the past
(c) happiness as a "personal project"
(d) disciplining individuals to be happy

24. According to the author, Dubai:
(a) is on its way to becoming one of the world's happiest cities
(b) incentivises companies that prioritise worker welfare
(c) develops sophisticated technologies to monitor its inhabitants' states of mind
(d) collaborates with Facebook to selectively influence its inhabitants' moods

DIRECTIONS for the question: *Identify the most appropriate summary for the paragraph.*

25. Artificial embryo twinning is a relatively low-tech way to make clones. As the name suggests, this technique mimics the natural process that creates identical twins. In nature, twins form very early in development when the embryo splits in two.

Twinning happens in the first days after egg and sperm join, while the embryo is made of just a small number of unspecialized cells. Each half of the embryo continues dividing on its own, ultimately developing into separate, complete individuals. Since they developed from the same fertilized egg, the resulting individuals are genetically identical.

(a) Artificial embryo twinning is low-tech unlike the natural development of identical twins from the embryo after fertilization

(b) Artificial embryo twinning is low-tech and is close to the natural development of twins where the embryo splits into two identical twins

(c) Artificial embryo twinning is low-tech and mimetic of the natural development of genetically identical twins from the embryo after fertilization

(d) Artificial embryo twinning is just like the natural development of twins, where during fertilization twins are formed

DIRECTIONS for the question: *Five sentences related to a topic are given below. Four of them can be put together to form a meaningful and coherent short paragraph. Identify the odd one out. Choose its number as your answer and key it in.*

26. 1. Translators are like bumblebees.

2. Though long since scientifically d isproved, this factoid is still routinely trotted out.

3. Similar pronouncements about the impossibility of translation have dogged practitioners since Leonardo Bruni's De interpretatione recta, published in 1424.

4. Bees, unaware of these deliberations, have continued to flit from flower to flower, and translators continue to translate.

5. In 1934, the French entomologist August Magnan pronounced the flight of the bumblebee to be aerodynamically impossible

DIRECTIONS for the question: *The four sentences (labelled 1,2,3 and 4) given in this question, when properly sequenced, form a coherent paragraph. Decide on the proper order for the sentence and key in this sequence of four numbers as your answer.*

27. 1. The woodland's canopy receives most of the sunlight that falls on the trees.

2. Swifts do not confine themselves to woodlands, but hunt wherever there are insects in the air.

3. With their streamlined bodies, swifts are agile flyers, ideally adapted to twisting and turning through the air as they chase flying insects – the creatures that form their staple diet.

4. Hundreds of thousands of insects fly in the sunshine up above the canopy, some falling prey to swifts and swallows

DIRECTIONS for the question: *Four of the five sentences (labelled 1,2,3,4 and 5) given in this question, when properly sequenced, from a coherent paragraph. Find the odd one out and key in your answer.*

28. 1. In many cases time inconsistency is what prevents our going from intention to action.

2. For people to continuously postpone getting their children immunized, they wo uld need to be constantly fooled by themselves.

3. In the sp ecific case of immunization, however, it is hard to believe that time inconsistency by itself would be sufficient to make people permanently postpone the decision if they were fully cognizant of its benefits.

4. In most cases, even a small cost of immunization was large enough to discourage most people.

5. Not only do they have to think that they prefer to spend time going to the camp next month rather than today, they also have to believe that they will indeed go next month.

DIRECTIONS for the question: *The four sentences (labelled 1,2,3 and 4) given in this question, when properly sequenced, form a coherent paragraph. Decide on the proper order for the sentence and key in this sequence of four numbers as your answer.*

29. 1. The eventual diagnosis was skin cancer and after treatment all seemed well.

2. The viola player didn't know what it was; nor did her GP.

3. Then a routine scan showed it had come back and sprea d to her lungs.

4. It started with a lump on Cathy Perkins' index finger.

DIRECTIONS for the question: *Five sentences related to a topic are given below. Four of them can be put together to form a meaningful and coherent short paragraph. Identify the odd one out. Choose its number as your answer and key it in.*

30. 1. Displacement in Bengal is thus not very significant in view of its magnitude.

2. A factor of displacement in Bengal is the shifting course of the Ganges leading to erosion of river banks.

3. The nature of displacement in Bengal makes it an interesting case study.

4. Since displacement due to erosion is well spread over a long period of ti me, it remains invisible.

5. Rapid displacement would have helped sensitize the public to its human costs.

31. 1. Impartiality and objectivity are fiendishly difficult concepts that can cause all sorts of injustices even if transparently implemented.

2. It encourages us into bubbles of people we know and like, while blinding us to different perspectives, but the deeper problem of 'transparency' lies in the words "… and much more".

3. Twitter's website says that "tweets you are likely to care about most will show up first in your timeline…based on accounts you interact with most, tweets you engage with, and much more."

4. We are only told some of the basic principles, and we can't see the algorithm itself, making it hard for citizens to analyse the system sensibly or fairly or be convinced of its impartiality and objectivity.

DIRECTIONS for the question: *Identify the most appropriate summary for the paragraph.*

32. The conceptualization of landscape as a geometric object first occurred in Europe and is historically related to the European conceptualization of the organism, particularly the human body, as a geometric object with parts having a rational, three-dimensional organization and integration. The European idea of landscape appeared before the science of landscape emerged, and it is no coincidence that Renaissance artists such as Leonardo da Vinci, who studied the structure of the human body, also facilitated an understanding of the structure of landscape. Landscape which had been a subordinate background to religious or historical narratives, became an independent genre or subject of art by the end of sixteenth century or the beginning of the seventeenth century.

(a) The Renaissance artists were responsible for the study of landscape as a subject of art.
(b) The study of landscape as an independent genre was aided by the Renaissance artists.
(c) Landscape became a major subject of art at the turn of the sixteenth century.
(d) The three-dimensional understanding of the organism in Europe led to a similar approach towards the understanding of landscape.

DIRECTIONS for the question: *The four sentences (labelled 1,2,3 and 4) given in this question, when properly sequenced, form a coherent paragraph. Decide on the proper order for the sentence and key in this sequence of four numbers as your answer.*

33. 1. But now we have another group: the unwitting enablers.
2. Democracy and high levels of inequality of the kin d that have come to characterize the United States are simply incompatible.
3. Believing these people are working for a better world, they are, actually, at most, chipping away at the margins, making slight course corrections, ensuring the system goes on as it is, uninterrupted.
4. Very rich people will always use money to maintain their political and economic power.

DIRECTIONS for the question: *Identify the most appropriate summary for the paragraph and write the key for most appropriate option.*

34. Production and legitimation of scientific knowledge can be approached from a number of perspectives. To study knowledge production from the sociology of professions perspective would mean a focus on the institutionalization of a body of knowledge. The professions approach informed earlier research on managerial occupation, business schools and management knowledge. It however tends to reify institutional power structures in its understanding of the links between knowledge and authority. Knowledge production is restricted in the perspective to the selected members of the professional community, most notably to the university faculties and professional colleges. Power is understood as a negative mechanism, which prevents the non-professional actors from offering their ideas and information as legitimate knowledge.

(a) Professions-approach aims at the institutionalization of knowledge but restricts knowledge production as a function of a select few.
(b) Professions-approach focuses on the creation of institutions of higher education and disciplines to promote knowledge production
(c) The study of knowledge production can be done through many perspectives
(d) The professions-approach has been one of the most relied upon perspective in the study of management knowledge production

SECTION: DI & REASONING

DIRECTIONS (Qs. 35-38) : *Read the information given below and answer the question that follows.*

You are given an n×n square matrix to be filled with numerals so that no two adjacent cells have the same numeral. Two cells are called adjacent if they touch each other horizontally, vertically or diagonally. So a cell in one of the four corners has three cells adjacent to it, and a cell in the first or last row or column which is not in the corner has five cells adjacent to it. Any other cell has eight cells adjacent to it.

35. What is the minimum number of different numerals needed to fill a 3×3 square matrix?

36. What is the minimum number of different numerals needed to fill a 5×5 square matrix?

37. Suppose you are allowed to make one mistake, that is, one pair of adjacent cells can have the same numeral. What is the minimum number of different numerals required to fill a 5×5 matrix?

(a) 9 (b) 25
(c) 4 (d) 16

38. Suppose that all the cells adjacent to any particular cell must have different numerals. What is the minimum number of different numerals needed to fill a 5×5 square matrix?

(a) 4 (b) 16
(c) 9 (d) 25

DIRECTIONS (Qs. 39-42) : *Go through the graph and the information given below and answer the question that follows.*

A company administers a written test comprising of three sections of 20 marks each – Data Interpretation (DI), Written English (WE) and General Awareness (GA), for recruitment. A composite score for a candidate (out of 80) is calculated by doubling her marks in DI and adding it to the sum of her marks in the other two sections. Candidates who score less than 70% marks in two or more sections are disqualified. From among the rest, the four with the highest composite scores are recruited. If four or less candidates qualify, all who qualify are recruited.

Then candidates appeared for the written test. Their marks in the test are given in the table below. Some marks in the table are missing, but the following facts are known:

1. No two candidates had the same composite score.
2. Ajay was the unique highest scorer in WE.
3. Among the four recruited, Geeta had the l owest composite score.
4. Indu was recruited.
5. Danish, Harini, and Indu had scored the same marks in the GA.
6. Indu and Jatin both scored 100% in exactly one section and Jat in's composite score was 10 more than Indu's.

Marks out of 20			
Candidate	**DI**	**WE**	**GA**
Ajay	8		16
Bala		9	11
Chetna	19	4	12
Danish	8	15	
Ester	12	18	16
Falak	15	7	10
Geeta	14		6
Harini	5		
Indu		8	
Jatin		16	14

39. Which of the following statements MUST be true?

1. Jatin's composite score was more than that of Danish.

2. Indu scored less than Chetna in DI.

3. Jatin scored more than Indu in GA.

(a) Both 1 and 2 (b) Only 2
(c) Both 2 and 3 (d) Only 1

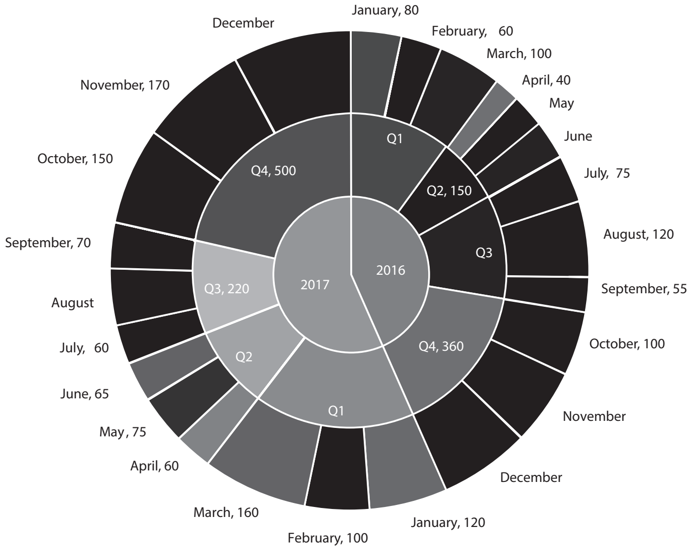
40. Which of the following statements MUST be FALSE?
(a) Harini's composite score was less than that of Falak
(b) Bala's composite score was less than that of Ester
(c) Chetna scored more than Bala in DI
(d) Bala scored same as Jatin in DI

41. If all the candidates except Ajay and Danish had different marks in DI, and Bala's composite score was less than Chetna's composite score, then what is the maximum marks that Bala could have scored in DI?

42. If all the candidates scored different marks in WE then what is the maximum marks that Harini could have scored in WE?

DIRECTIONS (Qs. 43-46) : *Go through the pie chart/s given below and answer the question that follows.*

The multi-layered pie-chart below shows the sales of LED television sets for a big retail electronics outlet during 2016 and 2017. The outer layer shows the monthly sales during this period, with each label showing the month followed by sales figure of that month. For some months, the sales figures are not given in the chart. The middle-layer shows quarter-wise aggregate sales figures (in some cases, aggregate quarter-wise sales numbers are not given next to the quarter). The innermost layer shows annual sales. It is known that the sales figures during the three months of the second quarter (April, May, June) of 2016 form an arithmetic progression, as do the three monthly sales figures in the fourth quarter (October, November, December) of that year.



43. What is the percentage increase in sales in December 2017 as compared to the sales in December 2016?
(a) 50.00 (b) 22.22
(c) 38.46 (d) 28.57

44. In which quarter of 2017 was the percentage increase in sales from the same quarter of 2016 the highest?
(a) Q4 (b) Q1
(c) Q2 (d) Q3

45. During which quarter was the percentage decrease in sales from the previous quarter's sales the highest?
(a) Q2 of 2017 (b) Q1 of 2017
(c) Q2 of 2016 (d) Q4 of 2017

46. During which month was the percentage increase in sales from the previous month's sales the highest?
(a) October of 2017 (b) March of 2017
(c) March of 2016 (d) October of 2016

DIRECTIONS (Qs. 47-50) : *Read the information given below and answer the question that follows.*

Fuel contamination levels at each of 20 petrol pumps P_1, P_2, …, P_{20} were recorded as either high, medium, or low.

1. Contamination levels at three pumps among $P_1 – P_5$ were recorded as high.
2. P_6 was the only pump among $P_1 – P_{10}$ where the contamination level was re corded as low.
3. P_7 and P_8 were the only two consecutively numbered pumps where the same levels of contamination were recorded.
4. High contamination levels were not recorded at any of the pumps $P_{16} – P_{20}$.
5. The number of pumps where high contamination levels were recorded was twice the number of pumps where low contamination levels were recorded.

47. Which of the following MUST be true?
(a) The contamination level at P_{10} was recorded as high
(b) The contamination level at P_{13} was recorded as low

(c) The contamination level at P_{12} was recorded as high
(d) The contamination level at P_{20} was recorded as medium

48. What best can be said about the number of pumps at which the contamination levels were recorded as medium?
(a) More than 4 (b) At least 8
(c) At most 9 (d) Exactly 8

49. If the contamination level at P_{11} was recorded as low, then which of the following MUST be true?
(a) The contamination level at P_{15} was recorded as medium
(b) The contamination level at P_{18} was recorded as low
(c) The contamination level at P_{12} was recorded as high
(d) The contamination level at P_{14} was recorded as medium

50. If contamination level at P_{15} was recorded as medium, then which of the following MUST be FALSE?
(a) Contamination levels at P_{13} and P_{17} were recorded as the same
(b) Contamination levels at P_{11} and P_{16} were recorded as the same
(c) Contamination levels at P_{10} and P_{14} were recorded as the same
(d) Contamination level at P_{14} was recorded to be higher than that at P_{15}

DIRECTIONS (Qs. 51-54) : *Read the information given below and answer the question that follows.*

1600 satellites were sent up by a country for several purposes. The purposes are classified as broadcasting (B), communication (C), surveillance (S), and others (O). A satellite can serve multiple purposes; however a satellite serving either B, or C, or S does not serve O. The following facts are known about the satellites:

1 . The numbers of satellites serving B, C, and S (though may be not exclusively) are in the ratio 2:1:1.
2. The number of satellites serving all three of B, C, and S is 100.
3. The number of satellites exclusively serving C is the same as the number of satellites exclusively serving S. This number is 30% of the number of satellites exclusively serving B.
4. The number of satellites serving O is the same as th e number of satellites serving both C and S but not B.

51. What best can be said about the number of satellites serving C?
(a) Must be between 450 and 725
(b) Must be at least 100
(c) Cannot be more than 800
(d) Must be between 400 and 800

52. What is the minimum possible number of satellites serving B exclusively?
(a) 500 (b) 250
(c) 200 (d) 100

53. If at least 100 of the 1600 satellites were serving O, what can be said about the number of satellites serving S?
(a) Exactly 475
(b) No conclusion is possible based on the given information
(c) At least 475
(d) At most 475

54. If the number of satellites serving at least two among B, C, and S is 1200, which of the following MUST be FALSE?
(a) The number of satellites serving B is more than 1000
(b) The number of satellites serving B exclusively is exactly 250
(c) All 1600 satellites serve B or C or S
(d) The number of satellites serving C cannot be uniquely determined

DIRECTIONS (Qs. 55-58) : *Read the information given below and answer the question that follows.*

An ATM dispenses exactly Rs. 5000 per withdrawal using 100, 200 and 500 rupee notes. The ATM requires every customer to give her preference for one of the three denominations of notes. It then dispenses notes such that the number of notes of the customer's preferred denomination exceeds the total number of notes of other denominations dispensed to her.

55. In how many different ways can the ATM serve a customer who gives 500 rupee notes as her preference?

56. If the ATM could serve only 10 customers with a stock of fifty 500 rupee notes and a sufficient number of notes of other denominations, what is the maximum number of customers among these 10 who could have given 500 rupee notes as their preferences?

57. What is the maximum number of customers that the ATM can serve with a stock of fifty 500 rupee notes and a sufficient number of notes of other denominations, if all the customers are to be served with at most 20 notes per withdrawal?
(a) 13 (b) 10
(c) 16 (d) 12

58. What is the number of 500 rupee notes required to serve 50 customers with 500 rupee notes as their preferences and another 50 customers with 100 rupee notes as their preferences, if the total number of notes to be dispensed is the smallest possible?
(a) 750 (b) 900
(c) 800 (d) 1400

DIRECTIONS (Qs. 59-62) : *Read the information given below and answer the question that follows.*

Twenty four people are part of three committees which are to look at research, teaching, and administration respectively. No two committees have any member in common. No two committees are of the same size. Each committee has three types of people: bureaucrats, educationalists, and politicians, with at least one from each of the three types in each committee. The following facts are also known about the committees:

1. The numbers of bureaucrats in the research and teaching committees are equal, while the number of bureaucrats in the research committee is 75% of the number of bureaucrats in the administration committee.
2. The number of educationalists in the teaching committee is less than the numbe r of educationalists in the research

committee. The number of educationalists in the research committee is the average of the numbers of educationalists in the other two committees.

3. 60% of the politician s are in the administration committee, and 20% are in the teaching committee.

59. Based on the given information, which of the following statements MUST be FALSE?
(a) The size of the research committee is less than the size of the teaching committee
(b) The size of the research committee is less than the size of the administration committee
(c) In the administration committee the number of bureaucrats is equal to the number of educationalists
(d) In the teaching committee the number of educationalists is equal to the number of politicians

60. What is the number of bureaucrats in the administration committee?

61. What is the number of educationalists in the research committee?

62. Which of the following CANNOT be determined uniquely based on the given information?
(a) The total number of bureaucrats in the three committees
(b) The size of the teaching committee
(c) The total number of educationalists in the three committees
(d) The size of the research committee

DIRECTIONS (Qs. 63-66) : *Read the information given below and answer the question that follows.*

Adriana, Bandita, Chitra, and Daisy are four female students, and Amit, Barun, Chetan, and Deb are four male students. Each of them studies in one of three institutes - X, Y, and Z. Each student majors in one subject among Marketing, Operations, and Finance, and minors in a different one among these three subjects. The following facts are known about the eight students:

1. Three students are from X, three are from Y, and the remaining two students, both female, are from Z.
2. Both the male students from Y minor in Finance, while the female student from Y majors in Operations.
3. Only one male student majors in Operations, while three female students minor in Marketing.
4. One female and two male students major in Finance.
5. Adriana and Deb are from the same institute. Daisy a nd Amit are from the same institute.
6. Barun is from Y and majors in Operations. Chetan is from X and majors in Finance.
7. Daisy minors in Operations.

63. Who are the students from the institute Z?
(a) Chitra and Daisy (b) Adriana and Daisy
(c) Bandita and Chitra (d) Adriana and Bandita

64. Which subject does Deb minor in?
(a) Finance
(b) Marketing
(c) Cannot be determined uniquely from the given information
(d) Operations

65. Which subject does Amit major in?
(a) Cannot be determined uniquely from the given information
(b) Marketing
(c) Finance
(d) Operations

66. If Chitra majors in Finance, which subject does Bandita major in?
(a) Marketing
(b) Cannot be determined uniquely from the given information
(c) Finance
(d) Operations

SECTION : QUANTITATIVE ABILITY

DIRECTIONS (Qs. 67-100) : *Solve the following questions and mark the best possible option.*

67. Let x, y, z be three positive real numbers in a geometric progression such that $x < y < z$. If 5x, 16y, and 12z are in an arithmetic progression then the common ratio of the geometric progression is
(a) 1/6 (b) 3/2
(c) 5/2 (d) 3/6

68. Humans and robots can both perform a job but at different efficiencies. Fifteen humans and five robots working together take thirty days to finish the job, whereas five humans and fifteen robots working together take sixty days to finish it. How many days will fifteen humans working together (without any robot) take to finish it?
(a) 45 (B) 36
(c) 40 (D) 32

69. A tank is fitted with pipes, some filling it and the rest draining it. All filling pipes fill at the same rate, and all draining pipes drain at the same rate. The empty tank gets completely filled in 6 hours when 6 filling and 5 draining pipes are on, but this time becomes 60 hours when 5 filling and 6 draining pipes are on. In how many hours will the empty tank get completely filled when one draining and two filling pipes are on?

70. Points E, F, G, H lie on the sides AB, BC, CD, and DA, respectively, of a square ABCD. If EFGH is also a square whose area is 62.5% of that of ABCD and CG is longer than EB, then the ratio of length of EB to that of CG is
(a) 3 : 8 (b) 2 : 5
(c) 1 : 3 (d) 4 : 9

71. Given an equilateral triangle T_1 with side 24 cm, a second triangle T_2 is formed by joining the midpoints of the sides of T_1. Then a third triangle T_3 is formed by joining the midpoints of the sides of T_2. If this process of forming triangles is continued, the sum of the areas, in sq cm, of infinitely many such triangles T_1, T_2, T_3,... will be

(a) $248\sqrt{3}$ (b) $192\sqrt{3}$
(c) $188\sqrt{3}$ (d) $1164\sqrt{3}$

72. If x is a positive quantity such that $2^x = 3^{\log_5 2}$, then × is equal to
(a) $1+\log_3 5/3$ (b) $\log_5 9$
(c) $\log_5 8$ (d) $1+\log_5 3/5$

73. A trader sells 10 litres of a mixture of paints A and B, where the amount of B in the mixture does not exceed that of A. The cost of paint A per litre is Rs. 8 more than that of paint B. If the trader sells the entire mixture for Rs. 264 and makes a profit of 10%, then the highest possible cost of paint B, in Rs. per litre, is
(a) 20 (b) 22
(c) 16 (d) 26

74. Raju and Lalitha originally had marbles in the ratio 4:9. Then Lalitha gave some of her marbles to Raju. As a result, the ratio of the number of marbles with Raju to that with Lalitha became 5:6. What fraction of her original number of marbles was given by Lalitha to Raju?
(a) 6/19 (b) 7/33
(c) 1/4 (d) 1/4

75. When they work alone, B needs 25% more time to finish a job than A does. They two finish the job in 13 days in the following manner: A works alone till half the job is done, then A and B work together for four days, and finally B works alone to complete the remaining 5% of the job. In how many days can B alone finish the entire job?
(a) 16 (b) 20
(c) 18 (d) 22

76. Two types of tea, A and B, are mixed and then sold at Rs. 40 per kg. The profit is 10% if A and B are mixed in the ratio 3 : 2, and 5% if this ratio is 2 : 3. The cost prices, per kg, of A and B are in the ratio.
(a) 17 : 25 (b) 21 : 25
(c) 18 : 25 (d) 19 : 24

77. In an apartment complex, the number of people aged 51 years and above is 30 and there are at most 39 people whose ages are below 51 years. The average age of all the people in the apartment complex is 38 years. What is the largest possible average age, in years, of the people whose ages are below 51 years?
(a) 26 (b) 27
(c) 28 (d) 25

78. In a circle with center O and radius 1 cm, an arc AB makes an angle 60 degrees at O. Let R be the region bounded by the radii OA, OB and the arc AB. If C and D are two points on OA and OB, respectively, such that OC = OD and the area of triangle OCD is half that of R, then the length of OC, in cm, is
(a) $\left(\frac{\pi}{4}\right)^{\frac{1}{2}}$ (b) $\left(\frac{\pi}{3\sqrt{3}}\right)^{\frac{1}{2}}$
(c) $\left(\frac{\pi}{6}\right)^{\frac{1}{2}}$ (d) $\left(\frac{\pi}{4\sqrt{3}}\right)^{\frac{1}{2}}$

79. The number of integers x such that $0.25 < 2^x < 200$, and $2^x + 2$ is perfectly divisible by either 3 or 4, is

80. Let ABCD be a rectangle inscribed in a circle of radius 13 cm. Which one of the following pairs can represent, in cm, the possible length and breadth of ABCD?
(a) 25, 9 (b) 24, 12
(c) 24, 10 (d) 25, 10

81. In a parallelogram ABCD of area 72 sq cm, the sides CD and AD have lengths 9 cm and 16 cm, respectively. Let P be a point on CD such that AP is perpendicular to CD. Then the area, in sq cm, of triangle APD is
(a) $32\sqrt{3}$ (b) $18\sqrt{3}$
(c) $24\sqrt{3}$ (d) $12\sqrt{3}$

82. Given that $X^{2018}Y^{2017} = 1/2$ and $X^{2016}Y^{2019} = 8$, the value of $x^2 + y^3$ is
(a) 33/4 (b) 37/4
(c) 35/4 (d) 31/4

83. In an examination, the maximum possible score is N while the pass mark is 45% of N. A candidate obtains 36 marks, but falls short of the pass mark by 68%. Which one of the following is then correct?
(a) $243 \le N \le 252$ (b) $N \ge 253$
(c) $201 \le N \le 242$ (d) $N \le 200$

84. Let $f(x) = \min\{2x^2, 52-5x\}$, where x is any positive real number. Then the maximum possible value of f(x) is

85. Point P lies between points A and B such that the length of BP is thrice that of AP. Car 1 starts from A and moves towards B. Simultaneously, car 2 starts from B and moves towards A. Car 2 reaches P one hour after car 1 reaches P. If the speed of car 2 is half that of car 1, then the time, in minutes, taken by car 1 in reaching P from A is

86. John borrowed Rs.2,10,000 from a bank at an interest rate of 10% per annum, compounded annually. The loan was repaid in two equal installments, the first after one year and the second after another year. The first installment was interest of one year plus part of the principal amount, while the second was the rest of the principal amount plus due interest thereon. Then each installment, in Rs., is

87. A CAT aspirant appears for a certain number of tests. His average score increases by 1 if the first 10 tests are not considered, and decreases by 1 if the last 10 tests are not considered. If his average scores for the first 10 and the last 10 tests are 20 and 30, respectively, then the total number of tests taken by him is

88. Train T leaves station X for station Y at 3 pm. Train S, traveling at three quarters of the speed of T, leaves Y for X at 4 pm. The two trains pass each other at a station Z, where the distance between X and Z is three-fifths of that between X and Y. How many hours does train T take for its journey from X to Y?

89. A right circular cone, of height 12 ft, stands on its base which has diameter 8 ft. The tip of the cone is cut off with a plane which is parallel to the base and 9 ft from the base. With π = 22/7, the volume, in cubic ft, of the remaining part of the cone is

90. If $\log_{12}18 = p$, then $3\left(\frac{4-p}{4+p}\right)$ is equal to

(a) $\log_2 8$ (b) $\log_4 16$
(c) $\log_6 8$ (d) $\log_6 16$

91. A wholesaler bought walnuts and peanuts, the price of walnut per kg being thrice that of peanut per kg. He then sold 8 kg of peanuts at a profit of 10% and 16 kg of walnuts at a profit of 20% to a shopkeeper. However, the shopkeeper lost 5 kg of walnuts and 3 kg of peanuts in transit. He then mixed the remaining nuts and sold the mixture at Rs. 166 per kg, thus making an overall profit of 25%. At what price, in Rs. per kg, did the wholesaler buy the walnuts?

(a) 86 (b) 96
(c) 84 (d) 98

92. If f(x + 2) = f(x) + f(x + 1) for all positive integers x, and f(11) = 91, f(15) = 617, then f(10) equals

93. While multiplying three real numbers, Ashok took one of the numbers as 73 instead of 37. As a result, the product went up by 720. Then the minimum possible value of the sum of squares of the other two numbers is

94. The distance from A to B is 60 km. Partha and Narayan start from A at the same time and move towards B. Partha takes four hours more than Narayan to reach B. Moreover, Partha reaches the mid-point of A and B two hours before Narayan reaches B. The speed of Partha, in km per hour, is

(a) 5 (b) 6
(c) 4 (d) 3

95. In a circle, two parallel chords on the same side of a diameter have lengths 4 cm and 6 cm. If the distance between these chords is 1 cm, then the radius of the circle, in cm, is

(a) $\sqrt{13}$ (b) $\sqrt{14}$
(c) $\sqrt{11}$ (d) $\sqrt{12}$

96. If among 200 students, 105 like pizza and 134 like burger, then the number of students who like only burger can possibly be

(a) 93 (b) 26
(c) 96 (d) 23

97. How many numbers with two or more digits can be formed with the digits 1,2,3,4,5,6,7,8,9, so that in every such number, each digit is used at most once and the digits appear in the ascending order?

98. If $u^2 + (u-2v-1)^2 = -4v(u + v)$, then what is the value of u + 3v?

(a) 0 (b) –1/4
(c) 1/4 (d) 1/2

99. If $\log_2(5 + \log_3 a) = 3$ and $\log_5(4a + 12 + \log_2 b) = 3$, then a + b is equal to

(a) 40 (b) 67
(c) 59 (d) 32

100. Each of 74 students in a class studies at least one of the three subjects H, E and P. Ten students study all three subjects, while twenty study H and E, but not P. Every student who studies P also studies H or E or both. If the number of students studying H equals that studying E, then the number of students studying H is

Hints & Explanations

1. (a) There is a purposefulness in human and elephant aggression towards each other.

Refer to the last line of the first paragraph, 'Now, I use the term violence because of the intentionality associated with it....'

2. (a) The development of treatment programmes for elephants drawing on insights gained from treating post traumatic stress disorder in humans.

Refer to paragraph 5. Bradshaw and her colleagues have compiled compelling evidence from various researches to prove that young elephants who have witnessed the culling and poaching of their elders display trauma related stress disorders similar to those observed in humans. So, Bradshaw is most likely to support development of treatment programmes for these.

She has already scanned many researches to arrive at her conclusion; so, she wouldn't want more research into it. All the other options are therefore ruled out.

3. (c) Recent elephant behaviour could be understood as a form of species-wide trauma-related response.

The overall argument presented in the passage revolves around the theme of understanding the change in elephant behaviour observed in recent times as 'chronic stress' response to trauma experienced across the species as a result of witnessing killing of herd members.

While option B states the phenomenon observed in recent times, options A and D state facts about elephants; all the three supporting the main argument.

4. (b) elephant mothers are evolving newer ways of rearing their calves to adapt to emerging threats.

Refer to this sentence in paragraph 4: 'As a result of such social upheaval, calves are being born to and raised by ever inexperienced mothers.'

Option A draws upon paragraph 3, option C can be inferred from paragraph 5, and option D, from paragraph 4.

5. (a) a metaphor for the effect of human activity on elephant communities.

A metaphor is a figure of speech wherein an idea is explained in a symbolic manner by equating or comparing it with another, having similar features, for a heightened effect or picturesque description. Here, the disruption of elephant society has been compared to the fraying of a fabric.

6. (b) A study affirming the sole influence of natural selection and inheritance on evolution.

Refer to the 2nd sentence of paragraph 2: 'The traditional and dominant view is that adaptations...are fully and satisfactorily explained by natural selection (and subsequent inheritance)..... Yet [new evidence] from genomics, epigenetics and developmental biology [indicates] that evolution is more complex than we once assumed.' This is the main message of the passage. Option B proposes a study to affirm its opposite and hence it would negate this message. Each of the other three studies would support the message.

7. (d) genetic, epigenetic, developmental factors and ecological legacies.

Refer to paragraph 3: '...human culture is held on a genetic leash...dog-walker (i.e., genes) struggling with multiple dogs... these tugs represent the influence of developmental factors, including epigenetic, antibodies and hormones passed on by parents, as well as the ecological legacies and culture they bequeath...'

8. (c) acquired characteristics

Refer to paragraph 1: Emory University experiments proved that subsequent generations of mice trained to fear almonds acquired the fear. This was unusual for 'Generations of schoolchildren have been taught that the inheritance of acquired characteristics is impossible.'

9. (c) Wilson's theory of evolution is scientifically superior to either Darwin's or Mendel's

Refer to paragraph 2: 'Modern evolutionary biology ... married Charles Darwin's mechanism of natural selection with Gregor Mendel's discoveries of how genes are inherited. ...Yet [new evidence] from genomics, epigenetics and developmental biology [indicates] that evolution is more complex than we once assumed.'

Subsequent to the above observation, the author discusses how Wilson's work, *On Human Nature*, explains this complexity and proves that acquired characteristics too are inherited, thus scoring over the previous two dominant theories.

10. (b) a reflection of the academic and popular view of India's role in the War

Refer to paragraph 2: 'The Indian government's conception of the war memorial ... accurately reflected the fact that both academic history and popular memory have yet to come to terms with India's Second World War.'

11. (d) there is no recognition of the Indian soldiers who served in the Second World War

Refer to the last sentence of the first paragraph: 'Between the old imperialist memorial and the proposed nationalist one, India's contribution to the Second World War is airbrushed out of existence.' This reflects the author's dismay and disappointment at the apathy shown to the Indian martyrs of The Second World War.

12. (a) has been focused on building an independent, non-colonial political identity.

Refer to the last sentence of paragraph 2: 'With partition and the onset of the India-Pakistan rivalry, both of the new nations needed fresh stories for self-legitimisation rather than focusing on shared wartime experiences.'

13. (b) a backdrop to the subsequent independence and partition of the region

Mood music refers to the music that plays in the background of a presentation and is intended to create or induce a particular mood or feeling.

So, the Second World War set the mood or provided the backdrop in 'the drama of' India's advance towards independence and partition in 1947.

14. (a) the large financial debt India owed to Britain after the War

Refer to the 2nd sentence of paragraph 5: 'In a stunning reversal of its long-standing financial relationship with Britain, India finished the war as one of the largest creditors to the imperial power.' This shows that India was not in debt; she was the lender rather than the borrower.

The other three options contain the outcomes mentioned in the passage.

15. (b) a sham as it diverted attention away from the role of corporates in plastics pollution.

Refer to paragraph 4: It says that 'big beverage companies' through their initiative of Make America Beautiful embarked on a mission 'to encourage environmental stewardship in the public... At face value, these efforts seem benevolent, but they obscure the real problem, which is the role that corporate polluters play in the plastic problem.'

16. (d) air pollution caused during the process of recycling plastics

Refer to paragraph 3: It says that plastics 'biodegrade slowly', pose 'multiple threats to wildlife', endanger marine life by causing 'absorption of toxic chemicals in the water' and by 'plastic odours that mimic some species' natural food', accumulate up the food chain and may be ingested by humans in seafood. Thus, it includes all the negative effects mentioned in options A, B and C. Option D does not find mention anywhere in the passage.

17. (b) passing regulations targeted at producers that generate plastic products

The author highlights that 'corporate green washing front... has helped shift the public focus to consumer recycling behaviour and actively thwarted legislation that would increase extended producer responsibility for waste management.' So, he would most strongly support regulations targeted at corporates that generate plastic products.

18. (d) blame assigned to consumers for indiscriminate use of plastics

Refer to the last sentence of the 1st paragraph: 'The lie is that blame for the plastic problem is (on) wasteful consumers and that changing our individual habits will fix it.' The passage goes on to discuss that plastic products flooding the market are the real culprits of the plastic problem.

19. (d) focussing on consumer behaviour to tackle the problem of plastics pollution

The meaning of the sentence is stated later in the same paragraph that 'the effort is wholly inadequate and distracts from the real problem.' 'The real problem is that the very idea of producing plastic items like grocery bags... is an incredibly reckless abuse of technology'; so, blaming consumer behaviour is nothing but a grossly misdirected effort.

20. (a) incorporate psychological findings into their research cautiously

The author says in the 1st paragraph, 'today there is a great deal of emphasis on how happiness can shape global economies, or — on a smaller scale — successful business practice.'

After discussing the various trends and observations in this direction, he remarks in the last paragraph that fierce pursuit of happiness goals in fact escalates stress levels. Therefore, economists may monitor and remove sources of misery to make a society happy, but they won't get there by making this single, often fleeting emotion, the over-arching goal.'

This indicates that he would like economists to exercise caution in monitoring and using emotion indicators.

21. (d) introduced greater stress into people's lives as they were expected to be responsible for their own happiness.

Refer to these sentences in the last paragraph from which this inference can be drawn: 'Since the 1970s, depression has come to be viewed as a cognitive or neurological defect in the individual ... escalates the sense of responsibility each of us feels for our own feelings, and with it, the sense of failure when things go badly.'

22. (c) Stakeholders globally are moving away from collecting data on the well-being of individuals

The author opens the discussion saying that 20th century economists ignored psychology, and compares it with the present day economists' welcome pursuit of happiness as a variable statistic that can be measured, monitored and enhanced to meet economic goals; only cautioning them in the end to tread cautiously and not make it (happiness) 'the over-arching goal.'

So, moving away from collecting data on 'well being' would undermine the author's views.

23. (d) disciplining individuals to be happy

Refer to sentence 2, paragraph 5: 'Where happiness indicators were once used as a basis to reform society... they are increasingly used as a basis to transform or discipline individuals.'

24. (c) develops sophisticated technologies to monitor its inhabitants' states of mind

Refer to paragraph 4: 'Cities such as Dubai, dream up ever-more elaborate and intrusive ways of collecting data on well-being... New ways of detecting emotions are hitting the market all the time.'

25. (c) Artificial embryo twinning is low-tech and mimetic of the natural development of genetically identical twins from the embryo after fertilization

The paragraph says that artificial embryo twinning is low-tech which means use of technology in the process is minimum; and it 'is mimetic of' or mimics or exactly copies the natural process of the embryo splitting into two individuals after fertilisation. So, it is neither 'unlike' (option A) nor 'close to' (option B)the natural process, rather exactly like it. Option D is incorrect as it says the twinning takes place 'during' fertilisation rather than after.

26. (2)

Sentences 1534, in that order, form a paragraph on comparison between translators and bumblebees.

1. Translators are like bumblebees. 5. In 1934, the French entomologist August Magnan pronounced the flight of the bumblebee to be aerodynamically impossible. 3. Similar pronouncements about the impossibility of translation have dogged practitioners since Leonardo Bruni's De interpretatione recta, published in 1424. 4. Bees, unaware of these deliberations, have continued to flit from flower to flower, and translators continue to translate.

Sentence 1 states the intended comparison. 5 speaks of bumblebees, while 3, of translators, but its connecting phrase 'similar pronouncements' forms the link 5-3. Sentence 4 is a concluding remark.

A factoid is an unreliable information reported and repeated so often that it becomes accepted as a fact. Since, only a comparison is made here, it cannot be termed a factoid. So, sentence 2 is odd in the paragraph.

27. (1432)

The coherent paragraph forms as follows:

1. The woodland's canopy receives most of the sunlight that falls on the trees. 4. Hundreds of thousands of insects fly in the sunshine up above the canopy, some falling prey to swifts and swallows. 3. With their streamlined bodies, swifts are agile flyers, ideally adapted to twisting and turning through the air as they chase flying insects – the creatures that form their staple diet. 2. Swifts do not confine themselves to woodlands, but hunt wherever there are insects in the air.

The link of nouns is thus: woodland's canopy—insects—swifts. The next sentence states how swifts hunt insects, their staple diet; and the succeeding one is linked with the birds' general spot for hunting insects.

28. (4)

The coherent paragraph forms as follows:

1. In many cases, time inconsistency is what prevents our going from intention to action. 3. In the specific case of immunization, however, it is hard to believe that time inconsistency by itself would be sufficient to make people permanently postpone the decision if they were fully cognizant of its benefits.2. For people to continuously postpone getting their children immunized, they would need to be constantly fooled by themselves. 5. Not only do they have to think that they prefer to spend time going to the camp next month rather than today, they also have to believe that they will indeed go next month.

Sentence 1 opens the paragraph with the general term 'In many cases...' it is linked to the succeeding 'specific cases' of 3.

Sentences 1325, in that order, form a coherent paragraph. 'Time inconsistency' is the factor that prevents action; but, in the specific case of immunisation, this factor cannot be held sufficient for postponement if people were 'fully cognizant of' the benefits of immunisation. If people are continuously postponing immunisation despite knowing its benefits it would mean, they are 'fooled by themselves' about 'time inconsistency.'

Cost is not a factor considered here; so, sentence 4— In most cases, even a small cost of immunization was large enough to discourage most people — is odd.

29. (4213)

Sentence 4 introduces the subject Cathy Perkins; 2 goes on to say that neither she nor her GP (general practitioner) knew what that lump was; 1 says that it was finally diagnosed as skin cancer and treated successfully, 3 says that later, a routine scan showed it had returned and spread to her lungs.

30. (1)

The coherent paragraph 3245 runs thus:

3. The nature of displacement in Bengal makes it an interesting case study. 2. A factor of displacement in Bengal is the shifting course of the Ganges leading to erosion of river banks. 4. Since displacement due to erosion is well spread over a long period of time, it remains invisible. 5. Rapid displacement would have helped sensitize the public to its human costs.

Displacement is clearly the theme noun as it appears in all sentences. Sentence 3 is the opener as it mentions a case study to be brought up next. Sentence 2 follows as it mentions a factor of displacement—erosion of river banks. Sentence 4 is linked as it elaborates on the issue of erosion that it is spread over time. Sentence 5 is the logical follower offering the effect if erosion had been rapid. 'Thus' in sentence 1 suggests it might have been the concluding sentence, but it is in fact out of context as 'magnitude' of erosion is not being discussed here.

31. (1324)

The logical paragraph is formed thus:

1. Impartiality and objectivity are fiendishly difficult concepts that can cause all sorts of injustices even if transparently implemented. 3. Twitter's website says that "tweets you are likely to care about most will show up first in your timeline…based on accounts you interact with most, tweets you engage with, and much more." 2. It encourages us into bubbles of people we know and like, while blinding us to different perspectives, but the deeper problem of 'transparency' lies in the words "…

and much more". 4. We are only told some of the basic principles, and we can't see the algorithm itself, making it hard for citizens to analyse the system sensibly or fairly or be convinced of its impartiality and objectivity.

The paragraph discusses that even transparency does not guarantee objectivity and impartiality. Sentence 1 is the opener as it introduces the topic. Link 3-2 is established as the former quotes Twitter website; and the latter expresses problem of 'transparency' with the words "… and much more" in it, because it leaves many things still under wraps. Sentence 4 elaborates this further.

32. (d) The three-dimensional understanding of the organism in Europe led to a similar approach towards the understanding of landscape.

The paragraph says that conceptualization of landscape as a geometric object in Europe was historically related to three-dimensional geometric conceptualization of the human body; and Renaissance artists such as Leonardo da Vinci contributed to the understanding of both of these. So, option D presents the best summary.

33. (2413)

The logical paragraph is formed thus:

2. Democracy and high levels of inequality of the kind that have come to characterize the United States are simply incompatible. 4. Very rich people will always use money to maintain their political and economic power. 1. But now we have another group: the unwitting enablers. 3. Believing these people are working for a better world, they are, actually, at most, chipping away at the margins, making slight course corrections, ensuring the system goes on as it is, uninterrupted.

The pronoun 'these people' in sentence 3, and connecting phrase 'But now' in 1 rule them out as opening sentence. Between the rest, 2 talks of inequality and 4 exemplifies how the rich who always enjoy power on account of their money, institutionalise this inequality. So, 2-4 link is established. Now, 1 follows 4 by mentioning about 'the unwitting enablers' of inequality.

34. (a) Professions-approach aims at the institutionalization of knowledge but restricts knowledge production as a function of a select few

The paragraph argues that **professions perspective** focuses on the institutionalization of a body of knowledge; but concretises institutional power structures with links between knowledge and authority wherein knowledge production is restricted to the select members of the professional community.

35. (4) As per the information, we have the following diagram for a 3 × 3 matrix to have minimum number of numerals.

1	2	1
3	4	3
1	2	1

So, we require 4 elements to have all different numerals.

36. (4) As per the information, we have the following diagram for a 5 × 5 matrix to have minimum number of numerals.

1	2	1	2	1
4	3	4	3	4
1	2	1	2	1
4	3	4	3	4
1	2	1	2	1

So, we require 4 elements to have all different numerals.

37. (c) Even if one mistake is allowed, then also we required 4 elements.

38. (c) Given that all the cells adjacent to any particular cell must have different numerals, which is satisfied only when there are at least 9 numerals.

Question. (39 to 42):

As Jatin scored 100% in exactly one section

∴ Jatin's scored are

DI	WE	GA
20	16	14

Composite score = 20 × 2 + 16 + 14 = 70

As Jatin's composite score was 10 more than Indu's.

Indu's score is 70 – 10 = 60

Indu was recruited and Indu scored 100% in exactly one section.

If Indu scores 20 in DI, Indu s's score in GA = 60 – 40 – 8 = 12

In this case, Indu will not qualify as score in two sections will become less than 70%. Hence, Indu's scored 20 in GA.

⇒ Score in DI = $\frac{60-20-8}{2} = \frac{32}{2} = 16$

⇒ Danish, Harini and Indu scored 2 0 in GA

Score of Danish is 2(8) + 15 + 20 = 51

Hence, Score of Ajay is 2(8) + 20 + 16 = 52

(∴ Ajay scores either 19 or 20 in DI, but the composite score of Ajay cannot be 51 as score of Danish has already 52 and no two candidates should have the same composite score).

Candidate	**DI**	**WE**	**GA**	**Total**
A	8	20	16	52
B		9	11	
C	19	4	12	54
D	8	15	20	51
E	12	18	16	58
F	15	7	10	47
G	>14	14	6	
H	5		20	
I	16	8	20	60
J	20	16	14	70

39. (a) Jatin's composite score was more than that of Danish and Indu scored less than Chetan in DI.

40. (d) If Bala scores 20 in DI, Score = 2(20) + 9 + 11 = 60, which is the same as that of Indu but it is not possible.

Hence, Bala scored same as Jatin in DI must be false.

41. (13) Bala's composite score < 54

Bala's score in D.I. may be 18, 17 or 13

If Bala's score in D.I. be 18, 17 and 13. then its composite scores are 56, 54 and 46 respectively.

Hence, the maximum marks that Bala scored in D.I. = 13

42. (14)

Question (43 to 46):

Since a the sales figures during the three months of the second quarter. i.e. April, May, June of 2016 form an arithmetic progression.

$\therefore$ 40 + (40 + x) + (40 + 2x) = 150 $\Rightarrow$ x = 10

Sales in April 2016 = 40

Sales in May 2016 = 50

Sales in June 2016 = 60

Also, the same case holds for October, November, December of 2016.

$\therefore$ 100 + (100 + x) + (100 + 2x) = 360 $\Rightarrow$ x = 20

Sales in October 2016 = 100

Sales in November 2016 = 120

Sales in December 2016 = 140

2016			2017		
Quarter	**Month**	**Sales Figures**	**Quarter**	**Month**	**Sales Figures**
Q_1(240)	January	80	Q_1(380)	January	120
	February	60		February	100
	March	100		March	160
Q_2(150)	April	40	Q_2(200)	April	60
	May	50		May	75
	June	60		June	65
Q_3(250)	July	75	Q_3(220)	July	60
	August	120		August	90
	September	55		September	70
Q_4(360)	October	100	Q_4(500)	October	150
	November	120		November	170
	December	140		December	180

43. (d) Sales in December 2017 = 180

Sales in December 2016 = 140

$\therefore$ Percentage increase = $\frac{40}{140} \times 100$ = 28.57%

44. (b)

Quarter	2017	2016	Percentage increase/Decrease
Q_1	380	240	$\frac{140}{240} \times 100 = 58.33$
Q_2	200	150	$\frac{50}{150} \times 100 = 33.33$
Q_3	220	250	Decrease
Q_4	500	360	$\frac{140}{360} \times 100 = 38.88$

So the percentage increase in the sales is highest for Q_1.

45. (a)

(a) Decrease in Q_2 of 2017 with compared with Q_1 of 2017

$= \frac{380-200}{380} \times 100$ = 47.36% decrease

(b) There is an increase in Q_1 of 2017 as compared with Q_4 of 2016.

(c) Decrease in Q_2 of 2016 compared with Q_1 of 2016

$= \frac{240-150}{240} \times 100$ = 37.5% decrease

(d) There is an increase Q_4 of 2017 compared with Q_3 of 2017

46. (a)

(a) Sales in October 2017 = 150, Sales in September 2017 = 70

Percentage Increase = $\frac{80}{70} \times 100$ = 114.2% increase

(b) Sales in March 2017 = 160, Sales in Feb. 2017 = 100

Percentage increase = $\frac{60}{100} \times 100$ = 60% increase.

(c) Sales in March 2016 = 100, Sales in Feb. 2016 = 60

Percentage increase = $\frac{40}{60} \times 100$ = 66.66% increase.

(d) Sales in October 2016 = 100,
Sales in September 2016 = 55

Percentage increase = $\frac{45}{55} \times 100$ = 81.81% increase.

$\therefore$ The highest percentage increase in this case is from September 2017 to October 2017.

Qs. (47 to 50): According to 1, 2 and 3, we get one case for P_1 to P_6 and 2 cases for P_7 and P_8.

P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8
H	M	H	M	H	L	H	H
						M	M

Also, from 4, we get 2 cases:

P_{16}	P_{17}	P_{18}	P_{19}	P_{20}
L	M	L	M	L
M	L	M	L	M

From (5), we get

If total number of low (L) pipes = 3, then

number of high (H) pipes = 6

and number of medium (M) pipes = 11

Also if number of low (L) pipes = 4, then

number of high (H) pipes = 8

and number of medium (M) pipes = 8

$\therefore$ Two cases arise for P_1 to P_{10}

1	2	3	4	5	6	7	8	9	10
H	M	H	M	H	L	H	H	M	H
H	M	H	M	H	L	M	M	H	M

On combining the above all results getting from (1), (2), (3), (4) and (5) we get the following possible cases for P_1 to P_{20}

Case 1: H M H M H L H H M H M H M H M L M L M L
No. of L = 4
No. of H = 8
No. of M = 8
Case 2: H M H M H L H H M H L M H M H M L M L M
No. of L = 4,
No. of H = 8,
and No. of M = 8
Case 3: H M H M H L H H M H M L H M H M L M L M
No. of L = 4
No. of H = 8
No. of M = 8

47. (a) The contamination level at P_{10} was recorded as high.

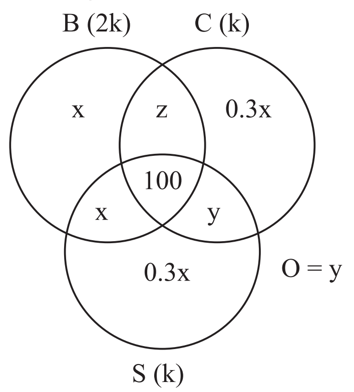
48. (d) At exactly 8 pumps contamination levels recorded as medium.

49. (d) If the contaminated level at P_{11} was recorded as low, then the contamination level at P_{14} was recorded as medium.

50. (b) If contamination level at P_{15} was recorded as medium, then contamination levels at P_{11} and P_{16} are recorded as medium and low respectively.

Questions (51 to 54):

It is given that the satellites serving either B, C or S do not serve O.
From (1), let the number of satellites serving B, C and S be 2K, K, K respectively.
Let the number of satellites exclusively serving B be x.
From (3), the number of satellites exclusively serving C and exclusively serving S will each be 0.3x
From (4), the number of satellites serving O is same as the number of satellites serving C and S but not B. Let the number be y.
Since the number of satellites serving C is same as the number of satellites serving S, we can say that (number of satellites serving only B and C) + 0.3x + 100 + y = (number of satellites serving only B and S) + 0.3x + 100 + y
$\therefore$ The number of satellites serving only B and C = the number of satellites serving only B and S = Z (let)
Therefore, the venn diagram will be as follows



Given that there are a total of 1600 satellites
$\therefore$ x + z + 0.3x + z + 100 + y + 0.3x + y = 1600
$\Rightarrow$ 1.6x + 2y + 2z = 1500 …(i)
Also k = 0.3x + z + y +100
and 2k = x + 2z + 100
$\Rightarrow$ 2(0.3x + z + y + 100) = x + 2z + 100
$\Rightarrow$ 0.4x = 2y + 100
$\Rightarrow$ x = 5y + 250 …(ii)
From equation (i) and (ii) we will get
1.6 (5y + 250) + 2y + 2z = 1500
Z = 550 – 5y … (iii)

51. (a) The number of satellites serving C
= z + 0.3x + 100 + y
= (550 – 5y) + 0.3(5y + 250) + 100 + y
= 725 – 2.5y
This number will be maximum when y is minimum.
Minimum value of y is 0.
$\therefore$ The maximum number of satellites serving C will be 725.
From (iii), z = 550 – 5y
Since the number of satellites cannot be negative,
$z \geq 0, \Rightarrow 550 - 5y \geq 0$
$y \leq 110$.
$\therefore$ Maximum value of y is 110.
When y = 110, the number of satellites serving C will be 725 – 2.5 × 110 = 450. This will be the minimum number of satellites serving C.
The number of satellites serving C must be between 450 and 725.

52. (b) From (ii), the number of satellites serving B exclusively = x = 5y + 250
This is minimum when y is minimum.
Minimum value of y = 0.
$\therefore$ The minimum number of satellites serving B exclusively = 5 × 0 + 250 = 250.

53. (d) Given that at least 100 satellites serve 0; we can say in this case that $y \geq 100$.
Number of satellites serving S
= Number of satellites serving C = 725 – 2.5y
Number of satellites serving S is minimum when y is maximum, i.e. 110
$\therefore$ Minimum number of satellites serving
S = 725 – 2.5 × 110 = 450.
Number of satellites serving S is maximum when y is minimum, i.e., 100.
$\therefore$ Maximum number of satellites serving
S = 725 – 2.5 × 100 = 475
Therefore, the number of satellites serving S is at most 475

54. (d) The number of satellites serving at least two of B, C or S = number of satellites serving exactly two of B, C or S
+ Number of satellites serving all the three
= z + z + y + 100
= 2(550 – 5y) + y + 100
= 1200 – 9y.

Given that this is equal to 1200

$\therefore 1200 - 9y = 1200 \quad \Rightarrow y = 0$

If y = 0, then x = 5y + 250 = 250

and z = 550 – 5y = 550

No. of satellites serving C k = z + 0.3x + 100 + y

= 550 + 0.3 × 250 + 100 + y = 725

No. of satellites serving B = 2k = 2 × 725 = 1450.

From the given options, we can say that the option "the number of satellites serving C cannot be uniquely determined" must be False.

55. (7) The ATM dispenses only 500, 200 and 100 notes and since 500 rupee notes is the preference, it has to dispense more 500 rupee notes than the other two notes combined. The following ways are possible:

500 rupee notes	200 rupee notes	100 rupee notes
10	0	0
9	2	1
9	1	3
9	0	5
8	5	0
8	4	2
8	3	4

Hence, a total of seven ways are possible.

56. (6) To serve the maximum number of customers with 500 rupee notes as preference, we need to minimize the number of 500 rupee notes that can be served to any person.

From the above solution, the minimum number of 500 rupee notes that the ATM can dispense to any person with 500 rupee notes as his/her preference is 8.

Hence, maximum number of customers who could have given 500 rupee notes as their preferences is 6.

57. (d) Since there are a limited number of 500 rupee notes, we can minimize the number of 500 rupee notes dispensed to each customer, while ensuring that each customer is served at most 20 notes.

If no 500 rupee notes is dispensed, the minimum number of notes that must be dispensed is 25 (all 200 rupee notes). This is not possible.

If one 500 rupee note is dispensed, the minimum number of notes is 24 (one 500 rupee note, twenty two 200 rupee notes and one 100 rupee note). This is also not possible.

If two 500 rupee notes are dispensed , the minimum number of notes is 22 (two 500 rupee notes and twenty 200 rupee notes).

If three 500 rupee notes are dispensed, the minimum number of notes is 21 (three 500 rupee notes, seventeen 200 rupee notes and one 100 rupee note).

If four 500 rupee notes are dispensed, the minimum number of notes is 19 (four 500 rupee notes and fifteen 200 rupee notes).

Hence, the minimum number of 500 rupee notes that can be dispensed to any person is 4.

With fifty 500 rupee notes, a maximum of 12 persons can be served.

58. (b) To dispense the smallest possible number of notes to a person with 500 rupee notes as his/her preference, the ATM should dispense all 500 rupee notes.

Hence, minimum number of notes required to serve any person with 500 rupee notes as his/her preference = 10 (all of 500 rupees).

Total number of 500 rupee notes required to serve 50 customers with 500 rupee notes as his/her preference = 10 × 50 = 500

To minimize the number of notes to be served to a person with 100 rupee notes as his/her preference, we can maximize the number of 500 rupee notes served to him, keeping the 100 rupee notes more than the sum of the other two denominations.

This is possible if the machine serves eight 500 rupee notes and ten 100 rupee notes.

Hence, the total number of 500 rupee notes required to serve 50 customers with 100 rupee notes as his/her preference = 8 × 50 = 400

Total number of 500 rupee notes required in the given scenario = 500 + 400 = 900

Qs. (59 to 52):

	Research	Teaching	Administration
Bureaucrats	3x	3x	4x
Educationalist	p	q	r
Politicians	y	y	3y

Total = 24

Bureaucrats are in the ratio 3 : 3 : 4 only value will be 3, 3, 4. So x = 1

Politicians are in ratio 1 : 1 : 3, only value will be 1, 1, 3.

$p + q + r = 9$

$p = \frac{q+r}{2} \Rightarrow q + r = 2p$

$q < p < r$

Possible value of p, q, r are 3, 2, 4 and 3, 1, 5.

Hence, educationalist

Case (i)					Case (ii)				
	R	T	A			R	T	A	
B	3	3	4	10	B	3	3	4	10
E	3	2	4	9	E	3	1	5	9
P	1	1	3	5	P	1	1	3	5
	7	6	11	24		7	5	12	24

59. (a) The size of the research committee is less than teaching committee is false.

60. (4)

61. (3)

62. (b) Size of the teaching committee cannot be determined uniquely.

Qs. (63 to 66):

Name	Gender	Institute	Major	Minor
Adriana	F	Y	O	M
Bandita	F	Z	F/O	M
Chitra	F	Z	F/O	M
Daisy	F	X	F/M	O
Amit	M	X	F	O/M
Barun	M	Y	O	F
Chetan	M	X	F	O/M
Deb	M	Y	M	F

63. (c) Chitra and Bandita

64. (a) Deb minors in finance.

65. (c) Amit majors in finance.

66. (d) Given one female student majors in finance. If chitra majors in finance, Bandita majors in operations.

67. (c) Since, 5x, 16y, 12z are in AP.

$\therefore$ 32y = 5x + 12z …(1)

$\because$ x, y, z are in GP

$\therefore$ $y^2 = xz$ …(2)

Squaring both sides of (1), we get

$1024y^2 = 25x^2 + 144z^2 + 120xz$

$\Rightarrow$ $1024xz = 25x^2 + 144z^2 + 120xz$

$\Rightarrow$ $25x^2 + 144z^2 - 904xz = 0$

$\Rightarrow$ $25x^2 - 900xz - 4xz + 144z^2 = 0$

$\Rightarrow$ $25x(x - 36z) - 4z(x - 36z) = 0$

$\Rightarrow$ $(25x - 4z)(x - 36z) = 0$

$\therefore$ $\frac{z}{x} = \frac{25}{4}$ or $\frac{z}{x} = \frac{1}{36}$

$\Rightarrow$ $r^2 = \frac{25}{4}$ or $r^2 = \frac{1}{36}$ [r is the common ratio]

$\Rightarrow$ $r = \frac{5}{2}$ or $\frac{1}{6}$

But $r \neq \frac{1}{6}$, because x, y, z > 0 and x < y < z

$\therefore$ common ratio = $\frac{5}{2}$

68. (d) Let the rates of work of each human and each robot be H units per day and R units per day respectively.

$\therefore$ $15H + 5R = \frac{1}{30}$ …(i)

and $5H + 15R = \frac{1}{60}$ …(ii)

$\Rightarrow$ 3 (i) – (ii) $\Rightarrow$ $40H = \frac{1}{12}$

$H = \frac{1}{480}$

In a day, 15 humans can complete 15H i.e. 1/32th of the job.

$\therefore$ 15 humans can complete the job in 32 days.

69. (10)Let the rates at which each filling pipe and each draining pipe works be F units/hr and D units/hr.

$\therefore$ $6F - 5D = \frac{1}{6}$ …(i)

and $5F - 6D = \frac{1}{60}$ …(ii)

on solving (i) and (ii), we get

$F = \frac{1}{12}$ and $D = \frac{1}{15}$

Now, $2F - D = 2\times\frac{1}{12} - \frac{1}{15} = \frac{1}{6} - \frac{1}{15} = \frac{1}{10}$

Hence one draining and two filling pipes can fill the tank in 10 hours.

70. (c) Let the area of ABCD be 100.

$\therefore$ Length of each side of ABCD = 10

Area of EFGH is 62.5,

Therefore length of each side of EFGH = $\sqrt{62.5}$.

Triangles AEH, BFE, CGF and DHG are congruent by ASA.

Let AE = BF = CG = DH = x, then EB = FC = DG = AH = 10 – x

In right triangle EAH,

$AE^2 + AH^2 = EH^2$

$x^2 + (10 - x)^2 = \left(\sqrt{62.5}\right)^2 \Rightarrow 4x^2 - 40x + 75 = 0$

$\Rightarrow$ $(2x - 5)(2x - 15) = 0$

$\therefore$ x = 2.5 or 7.5

Since it's given that CG is longer than EB, therefore CG = 7.5 and EB = 2.5.

$\therefore$ EB : CG = 1 : 3

71. (b) An equilateral triangle formed by joining the midpoints of the sides of a given equilateral triangle will have its side equal to half the side of the given equilateral triangle.

Now, side of T_1 = 24 cm

Side of T_2 = 12 cm

Side of T_3 = 6 cm

and so on.

Sum of the areas of all the triangles = $\frac{\sqrt{3}}{4}(24^2 + 12^2 + 6^2 + ...)$

$$\frac{\sqrt{3}}{4}\left(\frac{576}{1-\frac{1}{4}}\right) = 192\sqrt{3}\ \text{cm}^2$$

72. (d) $2x = 3\log_5 2$

Taking logarithms to base 5 on both sides, we have

$x(\log_5 2) = \log_5 2 \cdot \log_5 3$

$x = \log_5 3 = \log_5 (5 \times \frac{3}{5}) = \log_5 5 + \log_5(3/5) = 1 + \log_5 3/5$

73. (a) Let the quantities of the paints A and B in the mixture sold be a litres and b litres respectively.

Value at which the entire mixture is sold = 264

Profit percent made = 10%

Value at which the entire mixture is bought = 264 × (100/110) = 240

Let the cost of B be x per litre.

Cost of A=(x + 8) per litre

$\therefore a(x+8)+bx=240 \Rightarrow (a+b)x+8a=240 \Rightarrow x=\dfrac{240-8a}{a+b}$

x will be maximum when a is minimum and b is maximum.

But $a \geq b$, $\therefore$ a = b

Since a + b = 10 $\Rightarrow$ a = b = 5

$\therefore$ (5 + 5)x + 8 × 5 = 240 $\Rightarrow$ x = 20

74. (b) Let the numbers of marbles with Raju and Lalitha be 4x and 9x respectively.

Let Lalitha gave y marbles to Raju.

$\therefore \dfrac{4x+y}{9x-y}=\dfrac{5}{6} \Rightarrow y=\dfrac{21}{11}x$

Fraction of original marbles that Lalitha gave to Raju

$=\dfrac{y}{9x}=\dfrac{7}{33}$

75. (b) Let the time taken by A to finish the job be "a" days.

Time taken by B to finish the job = $\dfrac{5}{4}$ a days.

Part of the job completed when A and B worked together for

4 days = $1-\dfrac{1}{2}-\dfrac{5}{100}=\dfrac{9}{20}$

$\therefore 4\left(\dfrac{1}{a}+\dfrac{1}{\frac{5a}{4}}\right)=\dfrac{9}{20} \Rightarrow a=16.$

Time taken by B alone to complete the entire job = 5a/4 = 20 days.

76. (d) Let the cost prices of A and B be C_a and C_b respectively.

Selling price of the mixture = 40 per kg.

The profit made is 10% if A and B are mixed in the ratio 3:2.

$\therefore (3C_a+2C_b)\times\dfrac{110}{100}=200$

$\Rightarrow 3C_a+2C_b=\dfrac{2000}{11}$ …(i)

The profit made is 5% if A and B are mixed in the ratio 2:3.

$\therefore (2C_a+3C_b)\times\dfrac{105}{100}=200$

$\Rightarrow 2C_a+3C_b=\dfrac{4000}{21}$ …(ii)

Divide equation (i) by (ii), we get

$\dfrac{3C_a+2C_b}{2C_a+3C_b}=\dfrac{21}{22}$

$\Rightarrow 24C_a=19C_b \Rightarrow C_a:C_b=19:24$

77. (c) Let the average age of people aged 51 years and above be A_1 years and the average age of people aged below 51 years be A_2 years. Let the number of people aged below 51 years be N_2.

The average age of all the people in the apartment complex is 38 years.

$\therefore 38=\dfrac{(A_1)(30)+(A_2)(N_2)}{30+N_2}$

$\Rightarrow A_2=\dfrac{1140-30A_1}{N_2}+38$

Clearly for A_2 to be maximum, A_1 should be minimum i.e. 51

$A_2=\dfrac{1140-30\times51}{N_2}+38$

$A_2=38-\dfrac{390}{N_2}$

Clearly for A_2 to be maximum, N_2 should be also maximum i.e. 39

Hence maximum value of A_2

$=38-\dfrac{390}{39}=28$

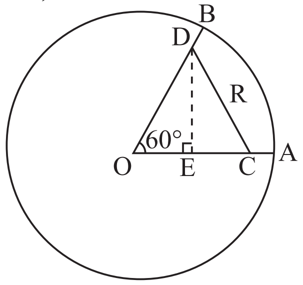
78. (b) Area of Δ OCD = $\dfrac{1}{2}$ (Area of region R)

$\Rightarrow \dfrac{1}{2}\times OC\times DE=\dfrac{1}{2}\times\pi\times(1)^2\times\dfrac{60}{360}$

$\Rightarrow OC\times OD\sin 60°=\dfrac{\pi}{6}$

$\Rightarrow OC^2\times\dfrac{\sqrt{3}}{2}=\dfrac{\pi}{6}$ [$\because$ OC = OD]

$\therefore OC=\left(\dfrac{\pi}{3\sqrt{3}}\right)^{1/2}$



79. (5) $0.25 \leq 2^x \leq 200.$

Possible values of x satisfying the above inequality are –2, –1,0, 1, 2, 3, 4, 5, 6, 7. When x = 0, 1, 2, 4 and 6, 2^x+2 is divisible by 3 or 4.

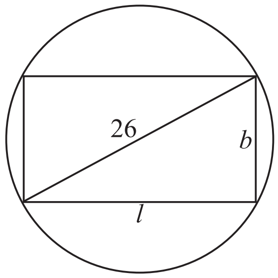
Hence, required number of values of x is 5.

80. (c) Let the length and the breadth of the rectangle be l and b respectively.

Diameter of the circle = Diagonal of the rectangle

$26=\sqrt{l^2+b^2}$, $\therefore l^2+b^2=676$

Hence, possible values of l and b are 24 and 10 respectively.

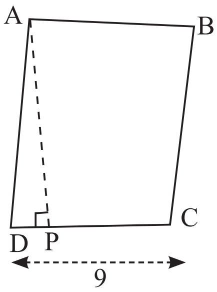


81. (a) Area of the parallelogram ABCD = (base) (height) = CD × AP = 72 sq.cm.

$\Rightarrow$ 72 = 9 × (AP) $\Rightarrow$ AP = 8cm

Now, DP = $\sqrt{AD^2 - AP^2} = \sqrt{16^2 - 8^2} = 8\sqrt{3}$

$\therefore$ Area of triangle APD = $\frac{1}{2}$(AP) (PD) = $32\sqrt{3}$



82. (a) $x^{2018}\, y^{2017} = 1/2$ and $x^{2016}\, y^{2019} = 8$

$\therefore \frac{x^{2018}\, y^{2017}}{x^{2016}\, y^{2019}} = \frac{1}{16}$

$\Rightarrow \frac{x^2}{y^2} = \frac{1}{16}$

$\Rightarrow \frac{x}{y} = \pm\frac{1}{4} \Rightarrow x = \pm\frac{1}{4}y$

Now $\left(\pm\frac{1}{4}y\right)^{2018} y^{2017} = \frac{1}{2}$

$\Rightarrow y^{4035} = 2^{4035}$

$\Rightarrow$ y = 2, $\therefore$ x = $\pm\frac{1}{2}$

$\therefore x^2 + y^3 = \frac{1}{4} + 8 = \frac{33}{4}$

83. (a) A got 36 marks but falls short of pass marks by 68%. Maximum possible score is N. Pass mark is 45% of N. $\therefore$ 32% of 45% of N = 36 $\Rightarrow$ N = 250

84. (32) The maximum value of f(x) will occur when $2x^2 = 52 - 5x$ i.e. when $2x^2 + 5x - 52 = 0$

$\Rightarrow 2x^2 + 13x - 8x - 52 = 0$

$\Rightarrow (2x + 13)(x - 4) = 0 \Rightarrow x = -13/2$ or 4. But x is any positive real number. So, x = 4.

Hence, maximum value of f (x) = $2(4^2)$ = 32

85. (12) Let the time taken for car 1 to reach P from A be x hours.

Speed of car 1=AP/x

BP = 3AP.

Car 2 starts from B to A and reaches P one hour after car 1 reaches P.

Speed of car 2 = $\frac{3AP}{x+1}$

Now speed of car 2 = $\frac{1}{2}$ (speed of car 1)

$\therefore \frac{3AP}{x+1} = \frac{1}{2}\left(\frac{AP}{x}\right)$, $x = \frac{1}{5}$ hr $= \frac{1}{5} \times 60$ min = 12 min.

$\therefore$ Time taken for car 1 to reach P from A is 12 min.

86. (121000) Let each installment be Rs. x.

Equating the present value of both the installments to the money borrowed,

$$\frac{x}{1+\frac{10}{100}} + \frac{x}{\left(1+\frac{10}{100}\right)^2} = 210000$$

$\frac{x}{1.1} + \frac{x}{1.1^2} = 210000 \Rightarrow x = 121000$

87. (60) Let the average score of the aspirant in all the tests be A. Let the number of tests be N.

The aspirant's average score for the first 10 tests and last 10 tests are 20 and 30 respectively.

$\frac{NA-200}{N-10} = A+1$ and $\frac{NA-300}{N-10} = A - 1$

$\Rightarrow$ 10A – N = 190 and N + 10A = 310

On subtracting,
we get, – 2N = – 120
$\Rightarrow$ N = 60.

88. (15) Let the time taken by S to reach Z be t hours.

Let the speed of T be S_t. Distance between X and Z is 3/5 of the distance between X and Y.

XZ : ZY = 3 : 2

$\frac{(t+1)S_t}{\frac{3}{4}\times S_t \times t} = \frac{3}{2}$

t = 8

S takes 8 hours to cover YZ.

T would take 8 × (3/4) i.e. 6 hours to cover ZY.

T would take t + 1 i.e. 9 hours to cover XZ.

T would take 15 hours to reach Y.

89. (198) The radius of the cone is 4 feet.

The tip of the cone is a cone of height 3 feet. By similarity, its radius is 1 foot.

The volume of the remaining part of the cone

= Volume of the cone – Volume of the tip of the cone

$= \frac{1}{3}\pi r_1^2 h - \frac{1}{3}\pi r_2^2 h = \frac{1}{3}\pi \times 16 \times 12 - \frac{1}{3}\pi \times 1 \times 3$

$= 64\pi - \pi = 63\pi = 63 \times \frac{22}{7} = 198$

90. (c) $\log_{12}81 = p \quad \Rightarrow \log_{12}3^4 = p$

$\Rightarrow \quad 4\log_{12}3 = p \quad \Rightarrow \frac{P}{4} = \log_{12}3$

Now, $3\left(\frac{4-p}{4+p}\right) = 3\left(\frac{1-\frac{p}{4}}{1+\frac{p}{4}}\right) = 3\left(\frac{1-\log_{12}3}{1+\log_{12}3}\right)$

$= 3\left(\frac{\log_{12}12-\log_{12}3}{\log_{12}12+\log_{12}3}\right)$

$= 3\left(\frac{\log(12/3)}{\log(12\times3)}\right) = 3\,\frac{\log 4}{\log 36} \quad = 3\log_{36}4 = \log_6 8$

91. (b) Let the cost price of peanuts for the wholesaler be x per kg then cost price of walnuts for the wholesaler is 3x per kg.

Total cost price to the shopkeeper = (8)(x) (1.1) + 16(3x)(1.2) = 66.4x

The shopkeeper lost 5 kg walnuts and 3 kg peanuts.

$\therefore$ The shopkeeper sold the mixture of 11 kg walnuts and 5 kg peanuts.

$\therefore$ Total selling price of the shopkeeper = 166(16) = 2656

Total cost price of the shopkeeper = $2656\left(\frac{100}{125}\right) = 2124.8$

66.4x = 2124.8

$\therefore \quad x = 32$

Price of which the wholesaler bought walnuts = 3x = Rs 96 per kg.

92. (54) $f(x + 2) = f(x) + f(x + 1)$

$f(11) = 91$

Let $f(12) = a$

$f(13) = 91 + a$

$f(14) = 91 + 2a$

$f(15) = 182 + 3a = 617$

$\Rightarrow \quad a = 145$

Now, $f(10) = f(12) - f(11) = 145 - 91 = 54$

93. (40) Let the other two numbers be y and z.

73yz – 37yz = 720

yz = 20

Minimum possible sum of the squares of the other two numbers would occur when y = z

If y = z, then $y^2 = 20 = z^2$

Hence, $y^2 + z^2 = 40$

94. (a) Let the speeds of Partha and Narayan be S_p and S_n respectively.

$$\frac{60}{s_p} = \frac{60}{s_n} + 4 \qquad \ldots(i)$$

$$\frac{30}{s_p} = \frac{60}{s_n} - 2 \qquad \ldots(ii)$$

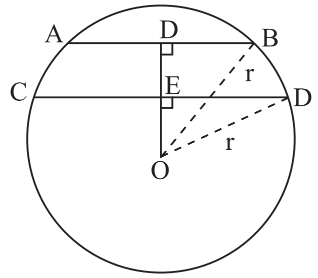
Subtraction, equation (ii) from (i), we get

$\therefore \quad \frac{30}{s_p} = 6 \quad \therefore S_p = 5$ kmph

95. (a) Let the 6 cm long chord be x cm away from the centre of the circle. Let the radius of the circle be r cm. The perpendiculars from the centre of the circle to the chords bisect the chords.

$r^2 = x^2 + 3^2 = (x + 1)^2 + 2^2$

On solving, x = 2 and r = $\sqrt{13}$



96. (a) List the number of students who neither like Pizza nor like Burger = x

$n(P \cup B) = n(P) + n(B) - n(A \cap B)$

$\therefore \quad 200 - x = 105 + 134 - n(A \cap B)$

$\Rightarrow \quad n(A \cap B) = 39 + x$

Number of students who like only burger

$= n(B) - n(P \cap B)$

$= 134 - (39 + x) = 95 - x$

Now $n(A \cup B) \geq 134$

If $n(A \cup B)$ be minimum i.e. 134, then x will be maximum i.e. 66 When x be maximum i.e. 66, then number of students who like only burger will be 95 – 66 = 29

Now minimum value of x = 0

If x be minimum i.e. 0, then number of students who like only burger will be 95 – 0 = 95

Hence $\quad 0 \leq \left(\begin{matrix}\text{Number of students} \\ \text{who like only burger}\end{matrix}\right) \leq 95$

Therefore, correct option is (a).

97. (502) As the digits appear in ascending order in the numbers, number of ways of forming a n-digit number using the 9 digits = ${}^9C_n$

Number of possible two-digit numbers which can be formed

$= {}^9C_2 + {}^9C_3 + {}^9C_4 + {}^9C_5 + {}^9C_6 + {}^9C_7 + {}^9C_8 + {}^9C_9$

$= (1+1)^9 - ({}^9C_0 + {}^9C_1) = 2^9 - ({}^9C_0 + {}^9C_1) = 512 - (1+9) = 502$

98. (b) $u^2 + (u - 2v - 1)^2 = -4v(u + v)$

$\Rightarrow \quad u^2 + u^2 + 4v^2 + 1 - 4uv + 4v - 2u + 4vu + 4v^2 = 0$

$\Rightarrow \quad 2u^2 - 2u + 8v^2 + 4v + 1 = 0$

$\Rightarrow \quad 2\left(u^2 - u + \frac{1}{4}\right) + 2\left(4v^2 + 2v + \frac{1}{4}\right) = 0$

$\Rightarrow \quad 2\left(u - \frac{1}{2}\right)^2 + 2\left(2v + \frac{1}{2}\right)^2 = 0$

$\Rightarrow \quad u-\frac{1}{2}=0;\ 2v+\frac{1}{2}=0 \quad \Rightarrow u=\frac{1}{2}$ and $v=-\frac{1}{4}$

$\therefore \quad u+3v=\frac{1}{2}-\frac{3}{4}=-\frac{1}{4}$

99. (c) $5+\log_3 a=2^3=8 \Rightarrow \log_3 a=3 \Rightarrow a=27$

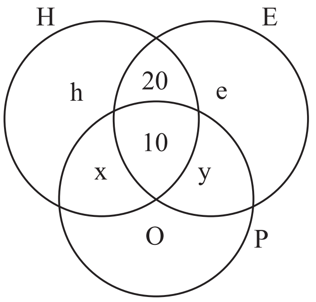
Similarly, $4a+12+\log_2 b=5^3=125$

Since $a=27$, $4(27)+12+\log_2 b=125$

$\Rightarrow \log_2 b=5 \Rightarrow b=32.$

$\therefore \ a+b=27+32=59$

100. (52) Let the number of students who studying only H be h, only E be e, only H and P but not E be x, only E and P but not H be y.



Given number of students who study only P = 0

Studying all three H, E and P = 10;

Studying only H and E but not P = 20

Given number of students studying H = Number of students studying E

$\Rightarrow \quad h+x+20+10=e+y+20+10$

$\therefore \quad h+x=e+y$

total number of students = 74

$\therefore \quad h+x+20+10+e+y=74$

$\Rightarrow \quad h+x+e+y=44$

$\Rightarrow \quad h+x+h+x=44 \quad (\because \quad e+y=h+x)$

$\therefore \quad h+x=22$

$\therefore$ The number of students studying H = h + x + 20 + 10 = 22 + 20 + 10 = 52

QUANTITATIVE ABILITY

1 CHAPTER NUMBER SYSTEM

1. What is the smallest number which when increased by 5 is completely divisible by 8, 11 and 24? *(1994)*
(a) 264 (b) 259 (c) 269 (d) None of these
2. Which is the least number that must be subtracted from 1856, so that the remainder when divided by 7, 12 and 16 will leave the same remainder 4 *(1994)*
(a) 137 (b) 1361 (c) 140 (d) 172
3. Two positive integers differ by 4 and sum of their reciprocals is 10/21. Then one of the number is *(1995)*
(a) 3 (b) 1 (c) 5 (d) 21
4. Three bells chime at an interval of 18, 24 and 32 minutes respectively. At a certain time they begin to chime together. What length of time will elapse before they chime together again? *(1995)*
(a) 2 hours 24 minutes (b) 4 hours 48 minutes (c) 1 hour 36 minutes (d) 5 hours
5. For the product $n(n+1)(2n+1)$, $n \in N$, which one of the following is not necessarily true? *(1995)*
(a) It is always even.
(b) Divisible by 3.
(c) Always divisible by the sum of the square of first n natural numbers
(d) Never divisible by 237.
6. The remainder obtained when a prime number greater than 6 is divided by 6 is *(1995)*
(a) 1 or 3 (b) 1 or 5 (c) 3 or 5 (d) 4 or 5
7. Cost of 72 hens is ₹ .....96.7..... Then, what will be the cost of hen, where two digits in place of " .... " are not visible or are written inillegible hand-writing? *(1995)*
(a) ₹ 3.23 (b) ₹ 5.11 (c) ₹ 5.51 (d) ₹ 7.22
8. Three consecutive positive even numbers are such that thrice the first number exceeds double the third number by 2 then the third number is *(1995)*
(a) 10 (b) 14 (c) 16 (d) 12
9. $5^6 - 1$ is divisible by *(1995)*
(a) 13 (b) 31 (c) 5 (d) None of these
10. If a number 774958A96B is to be divisible by 8 and 9, the values of A and B, respectively, will be *(1996)*
(a) 7, 8 (b) 8, 0 (c) 5, 8 (d) None of these
11. If n is any odd number greater than 1, then $n(n^2 - 1)$ is *(1996)*
(a) divisible by 48 always (b) divisible by 24 always (c) divisible by 6 always (d) None of these
12. Find the value of $\dfrac{1}{1+\dfrac{1}{3-\dfrac{4}{2+\dfrac{1}{3-\dfrac{1}{2}}}}}+\dfrac{3}{3-\dfrac{4}{3+\dfrac{1}{2-\dfrac{1}{2}}}}$ *(1996)*
(a) 13/7 (b) 15/7 (c) 11/21 (d) 17/28

Directions for questions 13 & 14 **: Read the information given below and answer the questions that follow :**

A salesman enters the quantity sold and the price into the computer. Both the numbers are two-digit numbers. Once, by mistake, both the numbers were entered with their digits interchanged. The total sales value remained the same, i.e. Rs 1148, but the inventory reduced by 54.

13. What is the actual price per piece ? *(1996)*
(a) 82 (b) 41 (c) 56 (d) 28
14. What is the actual quantity sold ? *(1996)*
(a) 28 (b) 14 (c) 82 (d) 41

15. If n is an integer, how many values of n will give an integral value of $(16n^2 + 7n + 6) / n$? ***(1997)***
(a) 2 (b) 3 (c) 4 (d) None of these

16. A student, instead of finding the value of 7/8th of a number, found the value of 7/18th of the number. If his answer differed from the actual one by 770, find the number. ***(1997)***
(a) 1584 (b) 2520 (c) 1728 (d) 1656

17. If m and n are integers divisible by 5, which of the following is not necessarily true? ***(1997)***
(a) m – n is divisible by 5 (b) $m^2 - n^2$ is divisible by 25
(c) m + n is divisible by 10 (d) None of these

18. Which of the following is true? ***(1997)***
(a) $7^{3^2} = (7^3)^2$ (b) $7^{3^2} > (7^3)^2$ (c) $7^{3^2} < (7^3)^2$ (d) None of these

19. P, Q and R are three consecutive odd numbers in ascending order. If the value of three times P is three less than two times R, find the value of R. ***(1997)***
(a) 5 (b) 7 (c) 9 (d) 11

20. A, B and C are defined as follows : ***(1997)***

$$A = (2.000004) \div [(2.000004)^2 + (4.000008)]$$

$$B = (3.000003) \div [(3.000003)^2 + (9.000009)]$$

$$C = (4.000002) \div [(4.000002)^2 \quad (4.000004)]$$

Which of the following is true about the value of the above three expressions?
(a) All of them lie between 0.18 and 0.20 (b) A is twice of C
(c) C is the smallest (d) B is the smallest

21. P and Q are two integers such that (PQ) = 64. Which of the following cannot be the value of P + Q? ***(1997)***
(a) 20 (b) 65 (c) 16 (d) 35

22. Five digit numbers are formed using only 0,1,2,3,4 exactly once. What is the difference between the maximum and minimum number that can be formed? ***(1998)***
(a) 19800 (b) 41976 (c) 32976 (d) None of these

23. n^3 is odd. Which of the following statements is/are true? ***(1998)***
I. n is odd II. n^2 is odd III. n^2 is even
(a) I only (b) II only (c) I and II only (d) I and III only

24. $(BE)^2$ = MPB, where B, E, M and P are distinct integers, then M = ? ***(1998)***
(a) 2 (b) 3 (c) 9 (d) None of these

25. Three wheels can complete respectively 60,36,24 revolutions per minute. There is a red spot on each wheel that touches the ground at time zero. After how much time, all these spots will simultaneously touch the ground again? ***(1998)***
(a) 5/2 seconds (b) 5/3 seconds (c) 5 seconds (d) 7.5 seconds

26. A certain number when divided by 899 leaves the remainder 63. Find the remainder when the same number is divided by 29. ***(1998)***
(a) 5 (b) 4 (c) 1 (d) Cannot be determined

27. A is the set of positive integers such that when divided by 2,3,4,5 and 6 leaves the remainders 1,2,3,4 and 5 respectively. How many integer(s) between 0 and 100 belongs to set A? ***(1998)***
(a) 0 (b) 1 (c) 2 (d) None of these

28. Number of students who have opted the subjects A, B, C are 60, 84, 108 respectively. The examination is to be conducted for these students such that only the students of the same subject are allowed in one room. Also the number of students in each room must be same. What is the minimum number of rooms that should be arranged to meet all these conditions? ***(1998)***
(a) 28 (b) 60 (c) 12 (d) 21

29. What is the digit in the unit place of 2^{51} ? ***(1998)***
(a) 2 (b) 8 (c) 1 (d) 4

30. A hundred digit number is formed by writing first 54 natural numbers in front of each other as 12345678910111213................5354. Find the remainder when this number is divided by 8 ***(1998)***
(a) 4 (b) 7 (c) 2 (d) 0

31. If n = 1 + x, where 'x' is the product of four consecutive positive integers, then which of the following statements is/are true?
I. 'n' is odd II. 'n' is prime III. 'n' is perfect square ***(1999)***
(a) I only (b) II only (c) III only (d) I & III only

32. $n^2 = 12345678987654321$, then, n = ? ***(1999)***
(a) 1246789 (b) 12345321 (c) 1111111 (d) 111111111

33. When 7^{84} is divided by 342, what is the remainder? ***(1999)***
(a) 0 (b) 1 (c) 49 (d) 341

34. A, B, C are three distinct digits. AB is a two digit number and CCB is a three digit number such that $(AB)^2 = CCB$ where CCB > 320. What is the possible value of the digit B? ***(1999)***
(a) 1 (b) 0 (c) 3 (d) 9

35. For the given pair (x, y) of positive integers, such that $4x - 17y = 1$ and $x \le 1000$, how many integer values of y satisfy the given conditions ***(1999)***
(a) 55 (b) 56 (c) 57 (d) 58

36. Convert 1982 in base 10 to base 12 ***(2000)***
(a) 1129 (b) 1292 (c) 1192 (d) 1832

37. Let D be a recurring decimal of the form $D = 0.a_1 a_2 a_1 a_2 a_1 a_2$............where a_1 and a_2 lie between 0 and 9. Further at most one of them is zero. Which of the following numbers necessarily produces an integer when multiplied by D? ***(2000)***
(a) 18 (b) 198 (c) 100 (d) 288

38. P is the product of all the prime numbers between 1 to 100. Then the number of zeroes at the end of P are ***(2000)***
(a) 1 (b) 24 (c) 0 (d) none of these

39. $N = 1421 \times 1423 \times 1425$ what is the remainder when N is divided by 12? ***(2000)***
(a) 0 (b) 1 (c) 3 (d) 9

40. x_n is either –1 or 1 & $n \ge 4$; If $x_1x_2x_3x_4 + x_2x_3x_4x_5 + x_3x_4x_5x_6 + ...x_nx_1x_2x_3 = 0$ then n can be ***(2000)***
(a) odd (b) even (c) prime (d) can't be determined

41. There are two integers 34041 and 32506, when divided by a three-digit integer n, leave the same remainder. What is the value of n? ***(2000)***
(a) 298 (b) 307 (c) 461 (d) can't be determined

42. If x, y and z are odd integers then which of the following is necessarily false? ***(2000)***
(a) xyz is odd (b) $(x - y)\,z$ is even (c) $(x - y)(z + y)\,x$ is even (d) $(x - y - z)(x + z)$ is odd

43. $55^3 + 17^3 - 72^3$ is divisible by ***(2000)***
(a) both 3 and 13 (b) both 7 and 17 (c) both 3 and 17 d) both 7 and 13

44. Out of 128 boxes of oranges, each box contains at least 120 and at most 144 oranges. The number of boxes containing the same number of oranges is at least ***(2001)***
(a) 5 (b) 103 (c) 6 (d) Cannot be determined

45. In a 4 - digit number, the sum of the first two digits is equal to that of the last two digits. The sum of the first and last digits is equal to the third digit. Finally, the sum of the second and fourth digits is twice the sum of the other two digits. What is the third digit of the number? ***(2001)***
(a) 5 (b) 8 (c) 1 (d) 4

46. Anita had to do a multiplication. Instead of taking 35 as one of the multipliers, she took 53. As a result, the product went up by 540. What is the new product? ***(2001)***
(a) 1050 (b) 540 (c) 1440 (d) 1590

47. In a number system the product of 44 and 11 is 3414. The number 3111 of this system, when converted to the decimal number system, becomes ***(2001)***
(a) 406 (b) 1086 (c) 213 (d) 691

48. Every ten years the Indian government counts all the people living in the country. Suppose that the director of the census has reported the following data on two neighbouring villages Chota Hazri and Mota Hazri ***(2001)***
Chota Hazri has 4,522 fewer males than Mota hazri. Mota Hazri has 4,020 more females than males.
Chota Hazri has twice as many females as males. Chota Hazri has 2,910 fewer females than Mota Hazri.
What is the total number of males in Chota Hazri?
(a) 11264 (b) 14174 (c) 5632 (d) 10154

49. Let x, y and z be distinct integers. x and y are odd positive, and z is even positive. Which one of the following statements can not be true? ***(2001)***
(a) $(x - z)^2 y$ is even (b) $(x - z)y^2$ is odd (c) $(x - z)y$ is odd (d) $(x - y)^2 z$ is even

50. Number S is obtained by squaring the sum of digits of a two digit number D. If difference between S and D is 27, then the two digit number D is ***(2002)***
(a) 24 (b) 54 (c) 34 (d) 45

51. When 2^{256} is divided by 17 the remainder would be ***(2002)***
(a) 1 (b) 16 (c) 14 (d) None of these

52. At a book store, "MODERN BOOK STORE" is flashed using neon lights. The words are individually flashed at intervals of $2\frac{1}{2}, 4\frac{1}{4}, 5\frac{1}{8}$ seconds respectively, and each word is put off after a second. The least time after which the full name of the bookstore can be read again is ***(2002)***
(a) 49.5 seconds (b) 73.5 seconds (c) 1742.5 seconds (d) 855 seconds

53. After the division of a number successively by 3, 4 and 7, the remainders obtained are 2, 1 and 4 respectively. What will be the remainder if 84 divides the same number? ***(2002)***
(a) 80 (b) 76 (c) 41 (d) 53

54. If u, v, w and m are natural numbers such that $u^m + v^m = w^m$, then one of the following is true **(2002)**

(a) $m \geq \min(u, v, w)$ (b) $m \geq \max(u, v, w)$ (c) $m < \min(u, v, w)$ (d) None of these

55. $7^{6n} - 6^{6n}$, where n is an integer > 0, is divisible by **(2002)**

(a) 13 (b) 127 (c) 559 (d) All of these

56. A positive whole number M less than 100 is represented in base 2 notation, base 3 notation, and base 5 notation. It is found that in all three cases the last digit is 1, while in exactly two out of the three cases the leading digit is 1. Then M equals **(2003C)**

(a) 31 (b) 63 (c) 75 (d) 91

57. How many even integers n, where $100 \leq n \leq 200$, are divisible neither by seven nor by nine? **(2003C)**

(a) 40 (b) 37 (c) 39 (d) 38

58. The number of positive integers n in the range $12 \leq n \leq 40$ such that the product $(n-1)(n-2)....3.2.1$ is not divisible by n is **(2003C)**

(a) 5 (b) 7 (c) 13 (d) 14

59. What is the remainder when 4^{96} is divided by 6? **(2003)**

(a) 0 (b) 2 (c) 3 (d) 4

Directions for Questions 60 to 62 : **Answer the questions on the basis of the information given below.**

The seven basic symbols in a certain numeral system and their respective values are as follow :

I = 1 , V = 5 , X = 10, L = 50, C = 100, D = 500, and M = 1000

In general, the symbols in the numeral system are read from left to right, starting with the symbol representing the largest value; the same symbol cannot occur continuously more than three times; the value of the numeral is the sum of the values of the symbols. For example , XXVII = 10 + 10 + 5 + 1 + 1= 27. An exception to the left to right reading occurs when a symbol is followed immediately by a symbol of greater value; then, the smaller value is subtracted from the larger.

For example, XLVI = (50 – 10) + 5 + 1 = 46.

60. The value of the numeral MDCCLXXXVII is **(2003)**

(a) 1687 (b) 1787 (c) 1887 (d) 1987

61. The value of the numeral MCMXCIX is **(2003)**

(a) 1999 (b) 1899 (c) 1989 (d) 1889

62. Which of the following can represent the numeral for 1995? **(2003)**

I. MCMLXXV II. MCMXCV III. MVD IV. MVM

(a) only I and II (b) only III and IV (c) only II and IV (d) only IV

63. What is the sum of all two-digit numbers that give a remainder of 3 when they are divided by 7? **(2004)**

(a) 666 (b) 676 (c) 683 (d) 777

64. Let x and y be positive integers such that x is prime and y is composite. Then **(2004)**

(a) y – x cannot be an even integer (b) xy cannot be an even integer.

(c) (x + y)/x cannot be an even integer (d) None of the above statements is true.

65. Let n(> 1) be a composite integer such that $\sqrt{n}$ is not an integer. Consider the following statements **(2004)**

I : *n* has a perfect integer-valued divisor which is greater than 1 and less than $\sqrt{n}$.

II : *n* has a perfect integer-valued divisor which is greater than $\sqrt{n}$ but less than *n*

Then,

(a) Both I and II are false (b) I is true but II is false (c) I is false but II is true (d) Both I and II are true

66. Let *a, b, c, d* and *e* be integers such that a = 6b = 12c, and 2b = 9d = 12e. Then which of the following pairs contains a number that is not an integer? **(2004)**

(a) $\left(\frac{a}{27}, \frac{b}{e}\right)$ (b) $\left(\frac{a}{36}, \frac{c}{e}\right)$ (c) $\left(\frac{a}{12}, \frac{bd}{18}\right)$ (d) $\left(\frac{a}{6}, \frac{c}{d}\right)$

67. If a, a + 2 and a + 4 are prime numbers, then the number of possible solutions for a is **(2004)**

(a) one (b) two (c) three (d) more than three

68. The remainder, when $(15^{23} + 23^{23})$ is divided by 19, is **(2004 - 2 marks)**

(a) 4 (b) 15 (c) 0 (d) 18

69. If $x = (16^3 + 17^3 + 18^3 + 19^3)$, then x divided by 70 leaves a remainder of **(2005)**

(a) 0 (b) 1 (c) 69 (d) 35

70. The digits of a three-digit number A are written in the reverse order to form another three-digit number B. If **B** > **A** and **B–A** is perfectly divisible by 7, then which of the following is necessarily true? **(2005 - 2 marks)**

(a) $100 < \mathbf{A} < 299$ (b) $106 < \mathbf{A} < 305$ (c) $112 < \mathbf{A} < 311$ (d) $118 < \mathbf{A} < 317$

71. The rightmost non-zero digit of the number 30^{2720} is **(2005 - 2 marks)**

(a) 1 (b) 3 (c) 7 (d) 9

72. If $R = \dfrac{30^{65} - 29^{65}}{30^{64} + 29^{64}}$, then **(2005)**

(a) $0 < R \le 0.1$ (b) $0.1 < R \le 0.5$ (c) $0.5 < R \le 1.0$ (d) $R > 1.0$

73. For a positive integer n, let p_n denote the product of the digits of n, and s_n denote the sum of the digits of n. The number of integers between 10 and 1000 for which $p_n + s_n = n$ is **(2005)**

(a) 81 (b) 16 (c) 18 (d) 9

74. If x = –0.5, then which of the following has the smallest value? **(2006)**

(a) $2^{\frac{1}{x}}$ (b) $\dfrac{1}{x}$ (c) $\dfrac{1}{x^2}$ (d) 2^x (e) $\dfrac{1}{\sqrt{-x}}$

75. Which one among $2^{1/2}$, $3^{1/3}$, $4^{1/4}$, $6^{1/6}$ and $12^{1/12}$ is the largest? **(2006)**

(a) $2^{1/2}$ (b) $3^{1/3}$ (c) $4^{1/4}$ (d) $6^{1/6}$ (e) $12^{1/12}$

76. Consider four digit numbers for which the first two digits are equal and the last two digits are also equal. How many such numbers are perfect squares? **(2007)**

(a) 1 (b) 3 (c) 2 (d) 4 (e) 0

77. How many pairs of positive integers *m, n* satisfy

$\dfrac{1}{m} + \dfrac{4}{n} = \dfrac{1}{12}$ where *n* is an odd integer less than 60? **(2007)**

(a) 3 (b) 6 (c) 4 (d) 7 (e) 5

78. The integers 1, 2, ..., 40 are written on a blackboard. The following operation is then repeated 39 times; In each repetition, any two numbers, say *a* and *b*, currently on the blackboard are erased and a new number a + b – 1 is written. What will be the number left on the board at the end? **(2008)**

(a) 820 (b) 821 (c) 781 (d) 819 (e) 780

79. How many integers, greater than 999 but not greater than 4000, can be formed with the digits 0, 1, 2, 3 and 4, if repetition of digits is allowed? **(2008)**

(a) 499 (b) 500 (c) 375 (d) 376 (e) 501

80. What are the last two digits of 7^{2008}? **(2008)**

(a) 21 (b) 61 (c) 01 (d) 41 (e) 81

81. How many numbers are there between 0 and 1000 which on division by 2, 4, 6, 8 leave remainders 1, 3, 5, 7 respectively? **(2009)**

(a) 21 (b) 40 (c) 41 (d) 39

82. N! is completely divisible by 13^{52}. What is sum of the digits of the smallest such number N? **(2009)**

(a) 11 (b) 15 (c) 16 (d) 19

83. If ‘x’ is a real number then what is the number of solutions for the equation $\sqrt{(x^4+16)} = x^2 - 4$? **(2009)**

(a) 0 (b) 1 (c) 2 (d) 3

84. If $S = 1^2 - 2^2 + 3^2 - 4^2 + ... - 2000^2 + 2001^2$, then what is the value of S? **(2009)**

(a) 2001300 (b) 2003001 (c) 2010301 (d) 2000031

85. If 7^{103} is divided by 25, then the remainder is **(2009)**

(a) 20 (b) 16 (c) 18 (d) 15

86. In a certain zoo, there are 42 animals in one sector, 34 in the second sector and 20 in the third sector. Out of this, 24 graze in sector one and also in sector two. 10 graze in sector two and sector three, 12 graze in sector one and sector three. These figures also include four animals grazing in all the three sectors are now transported to another zoo, find the total number of animals. ***(2009)***

(a) 38 (b) 56 (c) 54 (d) None of the above

87. A person closes his account in an investment scheme by withdrawing ₹ 10,000. One year ago he had withdrawn ₹ 6000. Two years ago he had withdrawn ₹ 5000. Three years ago he had not withdrawn any money. How much money had he deposited approximately at the time of opening the account 4 years ago, if the annual simple interest is 10% ? ***(2009)***

(a) ₹ 15600 (b) ₹ 16500 (c) ₹ 17280 (d) None of these

88. P, Q and R are three consecutive odd numbers in ascending order. If the value of three times P is three less than two times R, find the value of R. ***(2009)***

(a) 5 (b) 7 (c) 9 (d) 11

89. If 'n' is a natural number then the greatest integer less than or equal to $\left(5+\sqrt{19}\right)^n$ ***(2010)***

(a) even. (b) odd.
(c) even when 'n' is even and odd when 'n' is odd. (d) even when 'n' is odd and odd when 'n' is even.

90. If x and y are positive integers, then the last digit of which of the following is same as the last digit of the sum of x and y? ***(2010)***

(a) $x^7 + y^7$ (b) $x^{13} + y^{13}$ (c) $x^{20} + y^{20}$ (d) None of these

91. If 'a' is one of the roots of $x^5 - 1 = 0$ and $a \neq 1$, then what is the value of $a^{15} + a^{16} + a^{17} + \ldots\ldots. a^{50}$? ***(2010)***

(a) 1 (b) 5a (c) 35 (d) None of these

92. What is the number of non-negative integer solutions for the equation $x^2 - xy + y^2 = x + y$? ***(2010)***

(a) 3 (b) 4 (c) 1 (d) None of these

93. The last digit of $3^{3^{4n}} + 1$, is ***(2010)***

(a) 0 (b) 4 (c) 8 (d) 2

94. Mr. Mehra is planning for higher education expenses of his two sons aged 15 and 12. He plans to divide ₹ 15 lakhs in two equal parts and invest in two different plans such that his sons may have access to ₹ 21 lakhs each when they reach the age of 21. He is looking for plan that will give him a simple interest per annum. The rates of interest of the plans for his younger son and elder son should be ***(2010)***

(a) 5% and 7.5% respectively (b) 8% and 12% respectively
(c) 10% and 15% respectively (d) 20% and 30% respectively

95. Let S denote the infinite sum

$2 \quad 5x \quad 9x^2 \quad 14x^3 \quad 20x^4 \quad \ldots\ldots.$, where $|x| < 1$ and the coefficient of x^{n-1} is $\frac{1}{2}n(n \quad 3)$, $(n \quad 1, 2, \ldots.)$. Then S equals ***(2010)***

(a) $\frac{2-x}{(1-x)^3}$ (b) $\frac{2-x}{(1 \quad x)^3}$ (c) $\frac{2 \quad x}{(1-x)^3}$ (d) $\frac{2 \quad x}{(1 \quad x)^3}$

96. $\frac{(X+3)}{3}, \frac{(X+8)}{4}, \frac{(X+15)}{5}, \frac{(X+24)}{6} \ldots \frac{(X+80)}{10}$ is a sequence where $X \neq 1$ ***(2011)***

What is the least value of X for which HCF (Numerator, Denominator) = 1 for each term of the given sequence?

(a) 17 (b) 13 (c) 11 (d) None of these

97. A positive integer is equal to the square of the number of factors it has. How many such integers are there? ***(2011)***

(a) 1 (b) 2 (c) 3 (d) Infinite

98. $(x-1)(x-2)(x-3) = 6^y$. How many integer solutions exist for the given equation? ***(2011)***

(a) 0 (b) 1 (c) 2 (d) More than 2

99. All the two-digit natural numbers whose unit digit is greater than their ten's digit are selected. If all these numbers are written one after the other in a series, how many digits are there in the resulting number? ***(2012)***

(a) 90 (b) 72 (c) 36 (d) 54

100. There are five consecutive integers a, b, c, d and e such that $a < b < c < d < e$ and $a^2 + b^2 + c^2 = d^2 + e^2$. What is/are the possible value(s) of b? ***(2012)***

(a) 0 (b) 11 (c) 0 and – 11 (d) –1 and 11.

101. A sequence of terms is defined such that $2a_n = a_{n+1} + a_{n-1}; a_0 = 1; a_1 = 3$. What is the value of $a_0 + a_1 + a_2 +_3 +......+ a_{50}$? ***(2012)***

(a) 2551 (b) 2753 (c) 2601 (d) 2451

102. 500! + 505! + 510! + 515! is completely divisible by 5^n, where n is a natural number. How many distinct values of n are possible? ***(2012)***

(a) 120 (b) 121 (c) 124 (d) 125

103. The number 44 is written as a product of 5 distinct integers. If 'n' is the sum of these five integers then what is the sum of all the possible values of n? ***(2012)***

(a) 11 (b) 23 (c) 26 (d) 32

104. Arrange the numbers $2^{\frac{7}{6}}, 3^{\frac{3}{4}}$ and $5^{\frac{2}{3}}$ in ascending order. ***(2013)***

(a) $2^{\frac{7}{6}} > 3^{\frac{3}{4}} > 5^{\frac{2}{3}}$ (b) $3^{\frac{3}{4}} > 2^{\frac{7}{6}} > 5^{\frac{2}{3}}$ (c) $5^{\frac{2}{3}} > 3^{\frac{3}{4}} > 2^{\frac{7}{6}}$ (d) None of these

105. If $E = 3 + 8 + 15 + 24 + \ldots + 195$, then what is the sum of the prime factors of E? ***(2013)***

(a) 29 (b) 31 (c) 33 (d) 23

106. 'ab' is a two-digit prime number such that one of its digits is 3. If the absolute difference between the digits of the number is not a factor of 2, then how many values can 'ab' assume? ***(2013)***

(a) 5 (b) 3 (c) 6 (d) 8

107. The number of factors of the square of a natural number is 105. The number of factors of the cube of the same number is 'F'. Find the maximum possible value of 'F'. ***(2013)***

(a) 208 (b) 217 (c) 157 (d) 280

108. How many natural numbers divide exactly one out of 1080 and1800, but not both? ***(2013)***

(a) 20 (b) 42 (c) 24 (d) 36

109. If $f(n) = 1^4 + 2^4 + 3^4 + ... + n^4$, then how can $1^4 + 3^4 + 5^4 + ... + (2n-1)^4$ be expressed? ***(2014)***

(a) $f(2n-1) - 16 \times f(n)$ (b) $f(2n-1) - 8 \times f(n)$ (c) $f(2n) - 16 \times f(n)$ (d) $f(2n) - 8 \times f(n)$

110. The number of APs with 5 distinct terms that can be formed from the first 50 natural numbers is ***(2014)***

(a) 325 (b) 300 (c) 375 (d) 288

111. The ratio of two numbers whose sum is 600 is 7 : 8. What is the LCM of the given two numbers? ***(2014)***

(a) 1120 (b) 560 (c) 2240 (d) 1152

112. The sequence $P_1, P_2, P_3, ...$ is defined by $P_1 = 211, P_2 = 375, P_3 = 420, P_4 = 523$, and $P_n = P_{n-1} - P_{n-2} + P_{n-3} - P_{n-4}$ for all $n \geq 5$. What will be the value of $P_{531} + P_{753} + P_{975}$? ***(2014)***

(a) 898 (b) 631 (c) 364 (d) 544

113. Find the number of ways in which a batsman can score 100 runs by scoring runs in 2's, 4's and 6's, such that he hits at least one double, one boundary and one six. ***(2014)***

(a) 184 (b) 185 (c) 192 (d) 208

114. A set 'P' is formed from the set of first 'N' natural numbers by deleting all the perfect squares and all the perfect cubes. If the numbers are arranged in an ascending order then, what is the 476th number of the set 'P'? ***(2014)***

(a) 500 (b) 501 (c) 502 (d) 503

115. If $7^a = 26$ and $343^b = 676$ then what is the relation between a and b? ***(2014)***

(a) a = b (b) a = 2b (c) 2a = 3b (d) 3a = 2b

116. 'P' is the product of ten consecutive two-digit natural numbers. If 2^a is one of the factors of P, then the maximum value that 'a' can assume is ***(2014)***

(a) 11 (b) 12 (c) 13 (d) 14

117. From a vessel completely filled up with pure wine, 140 litres of content is removed and replaced with equal quantity of water. The process is repeated one more time. In a 98 litres sample of the resulting solution 80 litres is water. Find the capacity (in litres) of the vessel. ***(2015)***

118. x is the smallest positive integer such that when it is divided by 7, 8 and 9 leaves remainder as 4, 5 and 6 respectively. Find the remainder when $x^3 + 2x^2 - x - 3$ is divided by 132. ***(2015)***

(a) 49 (b) 76 (c) 94 (d) 15

119. An amount borrowed at simple interest gets tripled in 24 years. How many years does it take to get doubled, if the interest rate is same. ***(2015)***

120. P is the product of the first 100 multiples of 15 and Q is the product of the first 50 multiples of 25^{20}. Find the number of consecutive zeroes at the end of $\frac{P^2}{Q} \times 10^{1767}$ ***(2015)***

(a) 1968 (b) 1914 (c) 3 (d) 2024

121. A four-digit number is divisible by the sum of its digits. Also, the sum of these four digits equals the product of the digits. What could be the product of the digits of such a number? ***(2015)***

(a) 6 (b) 8 (c) 10 (d) 12

122. Let P be the set of all odd positive integers such that every element in P satisfies the following conditions.

I. $100 \le n < 1000$

II. The digit at the hundred's place is never greater than the digit at tens place and also never less than the digit at units place.

How many elements are there in P? ***(2015)***

(a) 93 (b) 94 (c) 95 (d) 96

123. Which of the following will completely divide $(106^{90} - 49^{90})$? ***(2015)***

(a) 589 (b) 186 (c) 124 (d) None of these

124. How many ordered triplets (a, b, c) exist such that LCM (a, b) = 1000, LCM (b, c) = 2000, LCM (c, a) = 2000 and HCF (a, b) = $k \times 125$? ***(2015)***

(a) 32 (b) 28 (c) 24 (d) 20

125. Out of 4 numbers a, b, c, and d, each pair of numbers has the same highest common factor. Find the highest common factor of all the four numbers if the least common multiple of a and b is 310 and that of c and d is 651. ***(2015)***

126. What is the remainder when 7^{700} is divided by 100? ***(2016)***

(a) 1 (b) 61 (c) 41 (d) 21

127. A sequence of 4 digits, when considered as a number in base 10 is four times the number it represents in base 6. What is the sum of the digits of the sequence? ***(2016)***

(a) 7 (b) 6 (c) 9 (d) 8

128. If N = 888…up to 100 digits, what is the remainder when N is divided by 625? ***(2016)***

(a) 128 (b) 138 (c) 338 (d) 388

129. A natural number n is such that 120 $n \le 240$. If HCF of n and 240 is 1, how many values of n are possible? ***(2016)***

(a) 24 (b) 32 (c) 36 (d) 40

130. The number of girls appearing for an admission test is twice the number of boys. If 30% of the girls and 45% of the boys get admission, the percentage of candidates who do not get admission is ***(2017)***

(a) 35 (b) 50 (c) 60 (d) 65

ANSWERS WITH SOLUTIONS

1. (b) Required no. = LCM of (8, 11, 24) –5 = 264 – 5 = 259
2. (d) Suppose least no. be x
$1856 - x = n(\text{LCM of } 7,12,16) + 4$
or $1856 - x = n(336) + 4$
we should take n = 5 so that n(336) is nearest to 1856 and n (336)< 1856
$1856 - x = 1680 + 4 = 1684$
$x = 1856 - 1684 = 172$
3. (a) Let two positive integers be x and y.
$\therefore\ x - y = 4$ .....(i)
and $\frac{1}{x}+\frac{1}{y}=\frac{10}{21}$ or $\frac{x+y}{xy}=\frac{10}{21}$ .....(ii)
It is clear from second equation that x and y will be 3 and 7.
4. (b) L.C.M of 18, 24 and 32 = 288
Hence they would chime together after every 288 min. or 4 hrs. 48 min.
5. (d) It is clear that for n = 237 the expression n(n + 1) (2n + 1) is divisible by 237.
Hence option (d) is not necessarily true.
6. (b) It is clearly 1 or 5
Example : 7 divided by 6 leaves remainder 1
11 divided by 6 leaves remainder 5
13 divided by 6 leaves remainder 1.
7. (c) Multiply each option by 72 and find out the result which matches the visible digits.
Clearly we see $72 \times 5.51 = 396.72$
8. (b) Let $x-2, x, x+2$ be the 3 consecutive numbers
then, $3(x-2) = 2(x+2) + 2$ (according to the question)
or $3x - 6 = 2x + 6 \Rightarrow x = 12$
Hence, the 3rd no. is 14.
9. (b) $5^6 - 1 = (5^3)^2 - 1 = 125^2 - 1 = (125-1)(125+1)$
$= 124 \times 126 = 15624$
which is divisible by 31
10. (b) According to the question, the number is divisible by 8 and 9. For the number to be divisible by 8, its last three digits have to be divisible by 8.
This 96<u>0</u> and 96<u>8</u> can be the possibilities. For the number to be divisible by 9, the sum of the digits of the number should be divisible by 9.
Hence, it can be possible if B = 8 and A = 9 and if B = 0 and A = 8.
Hence, (8, 0) is the possible values of A and B.
11. (b) n is an odd no. > 1
$\therefore$ The minimum possible value of n = 3
$n(n^2 - 1) = 3 \times 8 = 24$
Hence, $n(n^2 - 1)$ is divisible by 24 always
12. (b) $\dfrac{1}{1+\dfrac{1}{3-\dfrac{4}{2+\dfrac{1}{3-\dfrac{1}{2}}}}}+\dfrac{3}{3-\dfrac{4}{3+\dfrac{1}{2-\dfrac{1}{2}}}}$

$$=\frac{1}{1+\dfrac{1}{3-\dfrac{4}{2+\dfrac{2}{5}}}}+\frac{3}{3-\dfrac{4}{3+\dfrac{2}{3}}}=\frac{1}{1+\dfrac{1}{3-\dfrac{20}{12}}}+\frac{3}{3-\dfrac{12}{11}}$$

$$=\frac{1}{1+\dfrac{12}{16}}+\frac{33}{21}=\frac{1}{1+\dfrac{3}{4}}+\frac{33}{21}=\frac{4}{7}+\frac{33}{21}=\frac{45}{21}=\frac{15}{7}$$

For Qs. 13-14.
Let quantity sold = q ; price = p and p',
q' be the wrong price and quantity respectively and
$q' = q + 54$
$pq = \text{sales} = \text{Rs } 1148 = p'q'$
$\Rightarrow q = \frac{1148}{p} = \frac{1148}{p'} - 54$ .....(i)

13. (b) As q is an integer, both p and p' must divide 1148. Now checking the options :
(a) 1148 is divisible by 82 and 28 but does not satisfy (i)
(b) 1148 is divisible by 41 and also by 14. It gives q = 28 and satisfies (i)
(c) 1148 is divisible by 56 and not by 65 and does not satisfy (i).
(d) 1148 is also divisible by 28 and 82 but does not satisfy (i).
14. (a) From option (b) of previous question, 28 is the quantity sold and the price is Rs 41.
Alternatively : q' = q + 54, which is only possible in case of 28 and 82 as given in options.
$\Rightarrow$ q = 28 and q' = 82. Therefore $p = \frac{1148}{28} = 41$.
15. (c) $\frac{16n^2 + 7n + 6}{n}$; (n is an integer)
$= \underbrace{16n + 7}_{\text{Integer}} + \frac{6}{n}$
Hence, to become the entire expression an integer $\left(\frac{6}{n}\right)$ should be an integer and $\left(\frac{6}{n}\right)$ can be an integer for n = 1, n= 2, n= 3 and n = 6
Hence, n will have only four values.
16. (a) Let the number be x
$\therefore \frac{7x}{8} - \frac{7x}{18} = 770 \Rightarrow \frac{x}{2}\left[\frac{1}{4} - \frac{1}{9}\right] = 110$
$\Rightarrow \frac{x}{2} \times \frac{5}{36} = 110 \Rightarrow x = \frac{110}{5} \times 36 \times 2$
$\therefore\ x = 1584$
17. (c) If m & n are integers divisible by 5.
Then, (m + n) might be or might not be divisible by 10.
For example: If m = 5 and n = 10 then m + n = 15 which is not divisible by 10.
But if m = 5, n = 25 then m + n = 30 which is divisible by 10.

18. (b) $7^{3^2} = (7)^{3^2} = 7^9$ while $(7^3)^2 = 7^6 < 7^9$

Hence, $7^{3^2} > (7^3)^2$

19. (c) Let P, Q and R be n, n + 2 and n + 4 respectively in ascending order.
According to the Question
$3n = 2(n + 4) - 3 = 2n + 5$
$\therefore \quad n = 5$
Thus, $R = 5 + 4 = 9$

20. (d) $A \approx \frac{2}{8} \quad \frac{1}{4}$; $B \approx \frac{3}{18} = \frac{1}{6}$; $C \approx \frac{4}{20} \quad \frac{1}{5}$
$\therefore$ B is the smallest.

21. (d) Given $PQ = 64 = 1 \times 64 = 2 \times 32 = 4 \times 16 = 8 \times 8$.
Corresponding values of P + Q are 65, 34, 20, 16.
Therefore, P + Q cannot be equal to 35.

22. (c) Maximum no. = 43210
Minimum no. = 10234
Hence, difference = 43210 – 10234 = 32976

23. (c) If n^3 is odd then n and n^2 will also be odd.

24. (b) $(BE)^2 = MPB$
If LHS has square, then according to question unit's digit of RHS can be 0, 1, 4, 5, 6, 9
If B = 0, then $(BE)^2$ cannot be a three digit number
If $B \neq 1$ then LHS exceeds 3 digits and is not compatible with RHS.
So B = 1
$\therefore$ E = 1 or 9
1 is rejected since B & E are distinct integers
hence BE = 19 $\therefore$ M = 3

25. (c) 1st wheel makes 1 rev. per sec

2nd wheel makes $\frac{6}{10}$ rev. per sec

3rd wheel makes $\frac{4}{10}$ rev. per sec

In other words 1st, 2nd and 3rd wheel take 1, $\frac{5}{3}$ and $\frac{5}{2}$ seconds respectively to complete one revolution.

L.C.M of 1, $\frac{5}{3}$ and $\frac{5}{2} = \frac{\text{L.C.M. of 1,5,5}}{\text{H.C.F. of 1,3,2}} = 5$

Hence, after every 5 seconds the red spots on all the three wheels touch the ground.

26. (a) Dividend = Divisor × Quotient + Remainder
= 899 Q + 63
Dividend = 29 × 31Q + 29 × 2 + 5
= 29(31Q + 2) + 5
Hence, remainder = 5 when same no. is divided by 29.

27. (b) Note that, $2 - 1 = 3 - 2 = 4 - 3 = 5 - 4 = 6 - 5 = 1$
Hence, the required number will be of the form LCM of (2, 3, 4, 5, 6) n – 1 where n is any integer.
LCM of 2, 3, 4, 5, 6 is 60. Hence the elements of A will be of the form 60n – 1, where n is any integer.
Only for n is equal to 1 the number (60 – 1= 59) will be between 0 and 100.
Hence, only one integer between 0 and 100 belongs to A.

28. (d) For Subject A – 60 students; Subject B – 84 students; Subject C – 108 students
HCF of 60, 84 and 108 is 12.
So, each room contain 12 students at minimum.
But each room contains students of only 1 subject
So, number of rooms $= \frac{60}{12} + \frac{108}{12} + \frac{84}{12} = 21$

29. (b) The digit in the unit's place of 2^{51} is equal to the remainder when 2^{51} is divided by 10.
$2^5 = 32$ leaves the remainder 2 when divided by 10.
Then $2^{50} = (2^5)^{10}$ leaves the remainder $2^{10} = (2^5)^2$ which in turn leaves the remainder $2^2 = 4$.
Then $2^{51} = 2^{50} \times 2$, when divided by 10, leaves the remainder $4 \times 2 = 8$.
Alternatively:

$2^{51} \quad 2^{4\ 12} .2^3$

$16^{\ 12} .2^3$

$(16)^{12}$ gives one's digit 6
$2^3 = 8$
$\therefore \quad (16)^{12} \times 2^3$ = one's digit 6 × 8 = one's digit = 8.

30. (c) Given number $= (1234...51525) \times 1000 + 354$
Since 1000 = 8 × 125
So, remainder when 354 divided by 8 be 2
Required remainder = 2.

31. (d) Let the four consecutive number be (a – 2), (a – 1), a, (a + 1).
Multiplying these, we get
$(a^4 - 2a^3 - a^2 + 2a)$, which will always be even.
By the problem we add 1.
Thus the expression becomes $(a^4 - 2a^3 - a^2 + 2a + 1)$, which is odd.
This is also the perfect square of $(a^2 - a - 1)$.
You can also take any four consecutive numbers and check for the validity.

32. (d) Square root of given number = 111111111
Alternatively:
Using Pattern
As $11^2 = 121$
$111^2 = 12321$
$1111^2 = 1234321$
$(111111111)^2 = 12345678987654321$

33. (b) $\frac{7^{84}}{342} \quad \frac{(7^3)^{28}}{(7^3 - 1)} \quad \frac{\{(7^3)^{28} - 1 \quad 1\}}{(7^3 - 1)}$

$\frac{\{(7^3)^{28} - 1\}}{(7^3 - 1)} \quad \frac{1}{(7^3 - 1)}$

$\frac{\{(7^3)^{28} - 1\}}{(7^3 - 1)}$ is always divisible as it is in the form of $\frac{(x^n - y^n)}{(x - y)}$.

Hence, the remainder is 1.

34. (a) $(AB)^2 = CCB$.
The only number satisfying the given condition $21^2 = 441$.
So, B = 1.

35. (d) $4x - 17y = 1$, and given that $1000 \geq x$

Hence we can say that $17y + 1 = 4x \leq 4000$

i.e., $y \leq 235$

Further also note that every 4th value of y (e.g. 3, 7, 11, ...) will give an integer value of x.

So, number of values of $y = \frac{235}{4} = 58$

36. (c)

12	1982	2
	165	9
	13	1
	1	1

Thus, 1982 (10) = 1192 (12)

37. (b) $D = 0.\overline{a_1a_2}$

Multiplied by 100 on both side

$100D = a_1a_2.\overline{a_1a_2}$

$100D = a_1a_2 . D$

$\therefore\ 99D = a_1a_2 \Rightarrow D = \frac{a_1a_2}{99}$

Required number should be the multiple of 99. So we can get an integer when multiplied by D.

Hence, 198 is the required number.

38. (a) There are only 2 prime numbers 5 & 2 between 1 & 100 which when multiplied will give zero in the end.

Thus there will be only one zero at the end of the product of given number.

39. (c) $N = 1421 \times 1423 \times 1425$, when these numbers are divided by 12 we have remainders as 5, 7, 9.

The product of remainders when divided by 12 gives 3 as its remainder. Thus when N divided by 12 remainder is 3

40. (b) Every term in the question is either 1 or –1. In order to have zero the number of terms must be even. Note that there are n number of terms. (since the first term in each product varies from x_1 to x_n).

So n has to be even.

41. (b) Let the common remainder be x. Then numbers (34041 – x) and (32506 – x) would be completely divisible by n.

Hence the difference of the numbers (34041 – x) and (32506 – x) will also be divisible by n

or (34041 – x – 32506 + x) = 1535 will also be divisible by n.

Now, using options we find that 1535 is divisible by 307.

42. (d) Consider $(x - y - z)(x + z)$ in which first term is odd and second term is even and the product of even and odd is always even.

$\therefore$ It is necessarily false.

43. (c) $N = 55^3 + 17^3 - 72^3 = (54 + 1)^3 + (18 - 1)^3 - 72^3$

or $N = (51 + 4)^3 + 17^3 - (68 + 4)^3$

These two different forms of given expression is divisible by 3 and 17 both.

Alternatively:

Let a = 55, b = 17, c = –72

$\therefore$ $a + b + c = 55 + 17 - 72 = 0$

$\therefore$ $a^3 + b^3 + c^3 = 3abc = 3(55)(17)(-72)$

Hence it is divisible by 3 and 17 both.

44. (a) 128 boxes of oranges each has 120 $\leq$ 144 oranges

Since we have only 25 options of number of oranges i.e. oranges can count from 120, 121....144, and total boxes are 128.

So the boxes with same number of oranges will be $\frac{128}{25} = 5.1 \approx 5$ boxes.

45. (a) Let ABCD be the 4-digit number

According to the question, we have

$$A + B = C + D \quad .....(1)$$

$$A + D = C \quad .....(2)$$

$$B + D = 2(A + C) \quad .....(3)$$

(1) – (2) gives $B - D = D \Rightarrow B = 2D$

Putting in (3), $3D = 2(A + C) = 2(A + A + D)$

or $3D = 4A + 2D$ or $D = 4A$ & $B = 8A$

Putting these values in (2),

$C = A + 4A = 5A$

This can only be true for A = 1, hence C = 5.

46. (d) Let the other multiplier be x

$\therefore\ 53x - 35x \quad 540 \Rightarrow x = 30$

$\therefore$ New product = $(53 \times 30) = 1590$

47. (a) The product of 44 and 11 is 484.

But given product of 44 and 11 = 3414 (in number system)

Here, $3x^3 + 4x^2 + 1x^1 + 4 \times x^0 = 484$

$\Rightarrow 3x^3 + 4x^2 + x = 480$

This equation is satisfied only when x = 5.

In decimal system, the number 3111 can be written as $406 = [3 \times 5^3 + 1 \times 5^2 + 1 \times 5^1 + 1 \times 5^0]$

48. (c) Let the total no. of males in Chota Hazri be x.

According to the question,

No. of female in Chota Hazri = 2x

Village	Male	Female
Chota Hazri	x	2x
Mota Hazri	x 4522	x 8542

According to the question,

$2x + 2910 = x + 8542 \Rightarrow x = 5632$

49. (a) x, y, z > 0; x and y are odd, z is even

Note : [odd – Even is odd], [odd – odd is even], [odd × odd is odd]

Since, (x – z) is odd

$\therefore (x - z)^2$ is also odd and $(x - z)^2 y$ is odd

$\therefore (x - z)^2 y$ can not be even.

50. (b) Suppose $D = 24\ \therefore S = (2 + 4)^2 = 36$

According to the Question

$S - D = 27 \Rightarrow 36 - 24 = 12 \neq 27 \therefore D \neq 24$

If $D = 54$ then $(5 + 4)^2 - 54 = 81 - 54 = 27$

therefore D is 54

51. (a) Consider $2^{256} = (2^4)^{64} = (16)^{64} = (17 - 1)^{64}$

$= 17^{64} - {}^{64}C_1.17^{63}.1 + {}^{64}C_2\,(17)^{62}\,1^2 + ... + {}^{64}C_{64}.1^0.1$

(Using binomial theorem)

= K + 1, where K contains all the multiple terms of 17.
Therefore when 2^{256} is divided by 17, remainder would be 1.

Alternatively:

$2^{256} \quad 2^{4\;64} \quad (16)^{64} \div 17$

When $x^n \div (x \quad 1)$
(i) Remainder is 1 if n is even.
(ii) Remainder is x if n is odd.

$\therefore \quad 2^{256} \div 17$, Remainder is 1.

52. (c) Full name of the bookstore can be read again by taking LCM of the times $\frac{5}{2}, \frac{17}{4}, \frac{41}{8}$

$$\frac{\text{LCM of } (5, 17, 41)}{\text{HCF of } (2, 4, 8)} \quad \frac{3485}{2} \quad 1742.5 \text{ seconds}$$

53. (d) According to the question the required no. is
$3[4(7x+4)+1]+2 = 84x+53$
So the remainder is 53, when the same number is divided by 84.

Alternatively:
Let no. be x
$x = 3m + 2$
$m = 4n + 1$
$n = 7P + 4$
Let last quotient = P = 1
$x = 3 \times 45 + 2 = 137$
$\therefore$ $137 \div 84 = R(53)$
Hence remainder = 53.

54. (c) We have $u^m + v^m = w^m$
where u, v, w, m are natural numbers
Take $u = 2, v = 4, w = 6$; then $2^m + 4^m = 6^m$
This will be true if m = 1
and $1 < \min(2, 4, 6) = 2$
Hence, $m < \min(u, v, w)$

55. (d) $7^{6n} - 6^{6n}$, where n is integer > 0
Let n = 1, then $7^{6n} - 6^{6n} = 7^6 - 6^6 = (7^3)^2 - (6^3)^2$
$= (7^3 - 6^3)(7^3 + 6^3) = (127)(7^3 + 6^3) = (127)(559)$
This number is divisible by 127, 559 and 13.

56. (d) 63 and 75 are ruled out as their last digit can't be 1.
Converting to base 2, 3, and 5, we get
$31 = (11111)_2 = (1011)_3 = (111)_5$.
Taking $91 = (1011011)_2 = (1010)_3 = (331)_5$.
In 2 out of 3 cases, the first digit is 1, hence (d).

57. (c) Total even nos. between 100 and 200 (including 100 and 200) = 51
Even nos. divisible by 7 = 7
Even nos. divisible by 9 = 6
There is a common no. divisible both by 7 and 9 = 126
Hence total nos. which are divisible neither by 7 nor by 9 $= 7 + 6 - 1 = 12$
$\therefore$ Even integers n, $(100 \le n \le 200)$ are divisible neither by 7 nor by 9 = 51 – 12 = 39

58. (b) Consider the prime numbers between 12 and 40, which are 13, 17, 19, 23, 29, 31 and 37.
Given product is not divisible by these 7 prime numbers.

59. (d) $\frac{4^{96}}{6}$; to find the remainder
Let us divide the different powers of 4 by 6 and find the remainder.
So remainder for $4^1 = 4$, $4^2 = 4$, $4^3 = 4$, $4^4 = 4$, $4^5 = 4$, $4^6 = 4$ and so on.
From this we know that remainder for any power of 4 will be 4 only.

60. (b) M D C C L X X X V I I
= 1000 + 500 + 100 + 100 + 50 + 10 + 10 + 10 + 5 + 1 + 1
= 1787

61. (a) $\underbrace{\text{M}}_{1000}\ \underbrace{\text{CM}}_{900}\ \underbrace{\text{XC}}_{90}\ \underbrace{\text{IX}}_{9}$
1000 + 900 + 90 + 9 = 1999

62. (c) M C M L X X V = 1975, M C M X C V = 1995,
M V D = 1000 + (500 – 5) = 1495, M V M = 1995
Clearly II and IV can represent the numeral for 1995

63. (b) Number is of the form = 7n + 3; n = 1 to 13
$$\text{So, } S = \sum_{n=1}^{13}(7n+3) = 7 \times 13 \times 7 + 39 = 676$$

Alternatively:
No. are = 10, 17, 24, ..., 94
94 = 10 + (n – 1) × 7
$\frac{84}{7} = n - 1, n \quad 13$
$S_{13} \quad \frac{13}{2}[10 \quad 94] \quad \frac{13}{2} \times 104$
= 676

64. (d) x is prime say 7
y is not prime but composite no. say 8, 9, 21
(a) 9 – 7 = 2 (b) 7 × 8 = 56 (c) $\frac{21+7}{7} = 4$
Put x = 2 and y = 6 and check for the options.
By hit and trial all the 3 options can be proved wrong

65. (d) Let n = 6
Therefore $\sqrt{n} = \sqrt{6} \approx 2.4$
Now, the divisor of 6 are 1, 2, 3
If we take 2 as divisor then $\sqrt{n} > 2 > 1$.
Statement I is true.
If we take 3 as divisor then $6 > 3 > 2.4$, i.e. $n > \sqrt{n}$
Therefore statement II is true

66. (d) Given a = 6b = 12c = 27d = 36e
Multiplied and Divide by 108 in whole expression
$$\frac{108a}{108} \quad \frac{108b}{18} \quad \frac{108c}{9} \quad \frac{108d}{4} \quad \frac{108e}{3}$$
$$\frac{1}{108}a = \frac{1}{18}b = \frac{1}{9}c = \frac{1}{4}d = \frac{1}{3}e = 1 \text{ (say)}$$
$\Rightarrow$ a = 108, b = 18, c = 9, d = 4, e = 3
So it is clear that $\left(\frac{a}{6}, \frac{c}{d}\right)$ contains a number $\frac{c}{d} = \left(\frac{9}{4}\right)$ which is not an integer

67. (a) a, a + 2, a + 4 are prime numbers.
Put value of 'a' starting from 3, we will have 3, 5 and 7 as the only set of prime numbers satisfying the given relationships.

68. (c) The expression becomes $(19-4)^{23}+(19+4)^{23}$. All the terms except the last one contains 19 and the last terms get cancelled out. Hence the remainder obtained on dividing by 19 will be 0.
Alternatively : $a^n + b^n$ is always divisible by (a + b), if n is odd
Here n is odd (23).
So the given expression is divisible by 15 + 23 = 38, which is a multiple of 19.

69. (a) Remember that, $a^3+b^3=(a+b)(a^2+b^2-ab)$
$$x=(16^3+17^3+18^3+19^3)$$
$$x=(16^3+19^3)+(17^3+18^3)$$
$$x=(16+19)(16^2+19^2-16\times19)+(17+18)(17^2+18^2-17\times18)$$
$$x=35[16^2+19^2-16\times19+17^2+18^2-17\times18]$$
$$x=35\times(\text{Even number})$$
Hence, x is divisible by 70 and leaves remainder as zero.

70. (b) Let the 3 digits of number A be x, y and z
Hence A = 100x + 10y + z
On reversing the digits of number A, we get the number B i.e., z y x.
$\therefore$ B = 100z + 10y + x
As B > A $\Rightarrow$ z > x ...(i)
B – A = 99z – 99x = 99(z – x)
As 99 is not divisible by 7
so (z – x) has to be divisible by 7. ...(ii)
Using (i) & (ii), the only possible values of z and x are (8, 1) and (9, 2)
So the minimum and maximum range of A are 108 and 299, which $\in 106 < A < 305$

71. (a) The number 30^{2720} will have 2720, zero's.
For the right most non-zero digit we have to check the power cycle of 3 and find when their multiplication again leads to a 3 as the right most digit.
$$3^1=3;\ 3^2=9;\ 3^3=27;\ 3^4=81;\ 3^5=243$$
Hence, 3 will appear after every fourth power of 3.
Hence, $30^{2720}=3^{2720}\times10^{2720}=(3^4)^{680}\times10^{2720}$
As the number 2720 is an exact multiple of 4, hence the last digit will be 1 similar to what we find in 3^4.

72. (d) As x^n-y^n is divisible by x – y if n is odd.
$x^n-y^n=(x-y)(x^{n-1}y^0+x^{n-2}y^1+\dots\dots+x^0y^{n-1})$
Hence numerator becomes
$$=(30-29)(30^{64}+\dots\dots+29^{64})$$
$$=30^{64}+\dots\dots+29^{64}$$
$$\therefore\ R=\frac{30^{64}+\dots\dots+29^{64}}{30^{64}+29^{64}}$$
Clearly the numerator is greater than the denominator.
Hence R > 1.0

73. (d) The no. can be 2 or 3 digit.
Firstly let n be the two digit no.
Therefore, n = 10x + y
$p_n+s_n=n\Rightarrow xy+x+y=10x+y\Rightarrow xy-9x=0$
$\Rightarrow y=9$ as $x\neq0$
So the numbers can be 19, 29.........99, i.e., 9 values.
For 3 digits n = 100x + 10y + z
$\Rightarrow\ xyz+x+y+z=100x+10y+z$
$\Rightarrow\ xyz=99x+9y$ or $xz=\dfrac{9(11x+y)}{y}$
It can be verified using various values of y that this equation do not have any solution.
E.g. : For y = 9, x(z – 11) = y which is not possible.
So in all 9 integers.

74. (b) Putting the value of x = – 0.5 in all the options.
(a) $2^{1/-0.5}=2^{-2}=\dfrac{1}{4}$ (b) $\dfrac{1}{-0.5}=-2$
(c) $\dfrac{1}{(-0.5)^2}=4$ (d) $2^{-0.5}=\dfrac{1}{\sqrt{2}}$
(e) $\dfrac{1}{\sqrt{-(-0.5)}}=\sqrt{2}$
So, clearly (b) is smallest.

75. (b) In this question it is advisable to raise all the numbers to the power of 12, so the numbers become,
$$(2^{1/2})^{12},(3^{1/3})^{12},(4^{1/4})^{12},(6^{1/6})^{12},(12^{1/12})^{12}$$
or $2^6,3^4,4^3,6^2,12$ or 64, 81, 64, 36, 12
So, $3^{1/3}$ is the largest.

76. (a) Since in the four digits number first two digits are equal and the last two digits are also equal, therefore we can suppose that the digit at the thousand and hundred place each be x and the digit at the tenth and unit place each be y.
Hence, the four digits number = $1000x+100x+10y+y$ $=11(100x+y)$
This number $11(100x+y)$ will be perfect square, if $100x+y$ is of the form $11n$, where n is a perfect square
Now $100x+y=11n\Rightarrow y=11n-100x$
On checking, we get for the value n = 64 (a perfect square) only, $y=704-100x$, for which a single digit positive integral value 7 of x, the value of y = 4, which is the single digit positive integer.
There is no single digit positive integral value of y for any other single positive integral value of x for the equation $y=704-100x$
Hence, 7744 is the only for digits number.

77. (a) $\dfrac{1}{m}+\dfrac{4}{n}=\dfrac{1}{12}$
$\Rightarrow\ 12n+48m-mn-576=-576$
$$m-12=\frac{576}{n-48} \quad ...(i)$$
Since n is an odd, therefore, $(n-48)$ is an odd.
Also – 576 is an even, therefore $(m-12)$ is definitely even.
Now n is an odd integer less than 60. Hence, on checking, we get all possible value of n are 49, 51 and 57.
Therefore, there are three value of n

78. (c) $1+2+3+\dots..+40==\dfrac{40\times41}{2}=820$
Since at each time any two numbers a and b are erased and a single new number (a + b – 1) is writen. Hence, each one is subtracted and this process is repeated 39 times. Therefore, number left on the board at the end = 820 – 39 = 781.

79. (d) All the numbers greater than 999 but not greater than 4000 are four digits number.
The number of numbers between 999 and 4000
$= 3 \times 5 \times 5 \times 5 = 375$
Since one number 4000 will also be included. Hence number of toal number greater than 999 but not greater than $4000 = 375 + 1 = 376$

80. (c) $7^0 = 01$
$(7)^1 = 07$
$(7)^2 = 49$
$(7)^3 = 243$
$(7)^4 = 2401$
$(7)^5 = 16807$
$(7)^6 = 117649$
$(7)^7 = 823543$
$(7)^8 = 5764801$
Here we see last two digit 01 is repeated when power of $(7)^0$ is increased by 4 each time.
Now $2008 \div 4 = 502$
Hence when power of $(7)^0$ increases 502 times by 4 (each time), then we get that 01 is the last two digits in the number $(7)^{2008}$.

81. (c) We can see that the difference between the divisor and the respective remainder is the same in each division i.e. $2 - 1 = 4 - 3 = 6 - 5 = 8 - 7 = 1$
Hence the general form of such numbers will be LCM(2, 4, 6 and 8) K – 1 = 24K – 1, where 'K' is any natural number.
Hence the numbers are $23, 23 + 1 \times 24, 23 + 2 \times 24, ..., 23 + 40 \times 24$
A total of 41 such numbers are there between 0 and 1000.

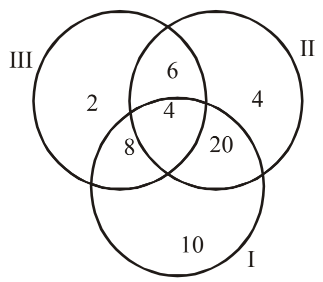
82. (c) The number needs to be less than $13 \times 52 = 676$. The highest power of 13 in 676! is 56.
The power of 13 in the smallest such number needs to be exactly 52. If we subtract $13 \times 3 = 39$ from 676, we get 637. The number 637! will be the smallest number of type N! that is completely divisible by 13^{52}.
The sum of the digits of 637 is 16.

83. (a) $x^4 + 16$ is always greater than x^4 and x^2 is always greater than $x^2 - 4$. Hence, $\sqrt{x^4}$ will always be greater than $x^2 - 4$. So $\sqrt{(x^4 + 16)}$ is greater than $x^2 - 4$.
So the given two expressions can never be equal for any real value of x.

84. (b) $S = 2001^2 - 2000^2 + 1999^2 - 1998^2 + ... + 3^2 - 2^2 + 1^2$
$= (2001 + 2000)(2001 - 2000) + (1999 + 1998)$
$(1999 - 1998) ..... + (3 + 2)(3 - 2) + 1$
$= 2001 + 2000 + 1999 + 1998 + ... + 3 + 2 + 1$
$$\Rightarrow \quad S = \frac{2001 \times 2002}{2} = 2001 \times 1001 = 2003001$$

85. (c) We have, $7^{103} = 7\,(49)^{51} = 7\,(50 - 1)^{51}$
$= 7\,(50^{51} - {}^{51}C_1\, 50^{50} + {}^{51}C_2\, 50^{49} - ... - 1)$
$= 7\,(50^{51} - {}^{51}C_1\, 50^{50} + {}^{51}C_2\, 50^{49} - ...) - 7 + 18 - 18$
$= 7\,(50^{51} - {}^{51}C_1\, 50^{50} + {}^{51}C_2\, 50^{49} - ...) - 25 + 18$
$= k + 18$ (say) where k is divisible by 25,
$\therefore$ remainder is 18.

86. (c) From the Venn diagram, it follows that
n (sector I) = 42, n (sector II) = 34,
n (sector III) = 20
$n(I \cap II) = 24$, $n(II \cap III) = 10$,



$n(I \cap III) = 12$, $n(I \cap II \cap III) = 4$
Now using the formula, we get $n(I \cup II \cup II)$
$= 42 + 34 + 20 - 24 - 10 - 12 + 4 = 54$.

87. (a) Let the money be deposited at the time of opening the account be m.
So after 1 year (i.e. 3 years ago) it would amount to $1.1m$.
Since no money was withdrawn at this point, after 2 years i.e. 2 years ago) it would amount to $1.2m$.
At this point, the person withdraws Rs. 5000.
Hence his principal for the next year = (1.2m – 5000).
Next year, he earns 10% interest on this, which will amount of 1.1 (1.2m – 5000) = (1.32m – 5500).
At this point, he withdraws Rs. 6000.
Hence his principal for the next year would be
(1.32m – 11500).
He earns 10% interest on this, which amounts to
1.1 (1.32m – 11500) = (1.452m – 12650).
But this is equal to Rs. 10000. Hence m = Rs. 15600.

88. (c) Let P, Q and R be n, $n + 2$ and $n + 4$ respectively in ascending order.
According to the Question
$3n = 2(n + 4) - 3 = 2n + 5$
$\therefore\ n = 5$
Thus, $R = 5 + 4 = 9$

89. (b) Putting n = 1, we get $5 + \sqrt{19}$ whose integral part is 9.
Putting n = 2, we get $25 + 19 + 10\sqrt{19}$ whose integral part is 25 + 19 + 43 which is again an odd number. Now, through the options it can be judged that the greatest integer must always be an odd number.

90. (b) The cyclicity of each digit from 0 to 9 is a factor of 4. Hence any digit raised to a power of the type 4k + 1 will always end in the same digit. Hence the answer is $x^{13} + y^{13}$.

91. (a) $a^{15} + a^{16} + a^{17} + ... + a^{50}|$
Sum $= a^{15}\,\{1 + a + a^2 + ... a^{35}\}$
$$= a^{15}\left\{\frac{a^{36} - 1}{a - 1}\right\} \text{ where } a \neq 1$$
Since a is the root of equation $x^5 - 1 = 0$,
$a^5 - 1 = 0 \Rightarrow a^5 = 1$
$$\text{So, Sum} = a^{15}\left\{\frac{(a^5) \times a - 1}{a - 1}\right\} = 1$$

92. (d) $(x^2 - xy + y^2) = (x + y)$
Multiplying both sides by 2:
$2(x^2 - xy + y^2) = 2(x + y) \Rightarrow 2x^2 - 2xy + 2y^2 = 2(x + y)$
$(x - y)^2 + x^2 + y^2 = 2x + 2y$

$(x - y)^2$ +	$(x - 1)^2$ +	$(y - 1)^2$	=	2
$\downarrow$	$\downarrow$	$\downarrow$		
0	1	1	$\rightarrow$	(A)
1	0	1	$\rightarrow$	(B)
1	1	0	$\rightarrow$	(C)

Integer solutions for (x, y):

Case 1: (0, 0) and (2, 2)
Case 2: (1, 2) and (1, 0)
Case 3: (2, 1) and (0, 1)
So there are six non-negative integer solutions.

93. (b) Consider $3^{4n} = (81)^n = (1 + 80)^n = 1 + 80q, q \in N$

$\therefore \quad 3^{3^{4n}} = 3^{80q+1} = (81)^{20q} . 3$

Since the last digit of $(81)^{20q}$ is 1, so the last digit of

$3^{3^{4n}} + 1$ is $1 \times 3 + 1 = 4$

94. (d) For the younger child ₹ 7.5 lakh should become 21 lakhs in 9 years.
Hence,
Amount = Principal + Simple Interest

$$21 = P + \frac{P \times R_1 \times T}{100}$$

$$21 = 7.5\left[1 + \left(\frac{R_1}{100}\right)^9\right]$$

$21 \times 100 = 7.5 \times 100 + 7.5 \times R_1 \times 9$
$7.5 \times R_1 \times 9 = (21 - 7.5)\ 100$

$$R_1 = \frac{13.5 \times 100}{7.5 \times 9} = 20\%$$

Similarly, for the elder son, ₹ 7.5 lakh should become in 6 years.
Hence, Amount = Principal + Simple Interest

$$21 = 7.5\left[1 + \left(\frac{R_2}{100}\right)^6\right]$$

$21 \times 100 = 7.5 \times 100 + 7.5 \times R_2 \times 6$
$7.5 \times R_2 \times 6 = (21 - 7.5) \times 100$

$$R_2 = \frac{13.5 \times 100}{7.5 \times 6} = 30\%$$

95. (a) From option (a),

$$\frac{2-x}{(1-x)^3} \quad (2-x)(1-x)^{-3}$$

Using Binomial here

$$(2-x)(1 \quad 3x \quad 6x^2 \quad 10x^3 \quad ...... \quad \frac{(r \quad 1)(r \quad 2)}{2!}x^r \quad .....$$

$$2 \quad 5x \quad 9x^2 \quad 14x^3 \quad .....$$

this is same series as given
Thus, option (a) is correct answer.

96. (d) The general term is of the form

$$\frac{(X + n(n+2))}{(n+2)}.$$

n(n + 2) is always divisible by (n + 2). So we can say that n(n + 2) ± 1would never be divisible by (n + 2). If we put X = –1, the numerator and denominator of all the terms would be co-prime.

97. (b) One such number is 1 which has no factor other than itself.
If the number has only one prime factor i.e. it is of the form p^a where p is a prime number and a is a natural number, then according to the question: $(a + 1)^2 = p^a$
This is possible only if a = 2 and p = 3. So the number is 9.
If the number has two prime factors then it would be of the type $p^a \times q^b$, where p and q are two distinct prime numbers. Then according to the question:
$(a + 1)^2 (b + 1)^2 = p^a \times q^b$
This is possible only if p and q are both 3. Since they are different, this is not a valid case. So there would no such case with two or more prime factors.
So there are only two such integers - 1 and 9.

98. (b) In the given equation the right hand side contains the powers of 2 and 3 only; therefore the left hand side should contain the powers of 2 and 3 only.
Since (x – 1)(x – 2)(x – 3) is a product of three consecutive numbers, it will always contain either one or two multiples of 2 and one multiple of 3. Lets make two cases:
(1) If (x – 1) and (x – 3) are multiples of 2:
Let (x – 1) be equal to 2k; then (x – 3) is equal to 2(k + 1).
Now k and (k + 1) should both contain powers of 2 or 3 only. This is possible with k = 1, 2 or 3. Also if any of k or (k + 1) is a multiple of 3, (x – 2) will not be a multiple of 3 or 2. So again it will not satisfy.
(2) If (x – 2) is a multiple of 2:
Here (x – 1) and (x – 3) will both be odd, out of which only one will be a multiple of 3. Hence the other number will be a multiple of an odd number other than 3. So the equation can be satisfied only if that other odd number is 1. Hence taking one odd number as 1 we get 1 × 2 × 3 which is equal to 6.
Hence the equation is satisfied for x = 4 only.

99. (b) Here find the number of two–digit natural numbers such that unit digit is greater than their ten's digit.
In such natural numbers, we cannot take 0 or 1 in units place.
When we take 2 at unit's place, we obtain only 1 Such number is 12.
When we take 3 at unit's place, we obtain 2 such numbes are 13 and 23.
When we take 9 at unit's place, we obtain 8 such numbers.
So, number of such numbers is (1 + 2 + 3 + ... + 8) = 36
Hence, the required number has 72 digits.

100. (d) Let first integer = (x – 1), then
Second integer = x; so..... on
According to question.
$\Rightarrow (x-1)^2 + x^2 + (x+1)^2 = (x+2)^2 + (x+3)^2$
$\Rightarrow x^2 + 1 - 2x + x^2 + x^2 + 1 + 2x = x^2 + 4 + 2.x.2 + x^2 + 9 + 2.x.3$
$\Rightarrow 3x^2 + 2 = x^2 + 4 + 4x + x^2 + 9 + 6x$
$\Rightarrow 3x^2 + 2 = 2x^2 + 10x + 13$
$\Rightarrow 3x^2 + 2 - 2x^2 - 10x - 13 = 0$
$\Rightarrow x^2 - 10x - 11 = 0$
$\Rightarrow x^2 - 11x + x - 11 = 0$
$\Rightarrow x(x - 11) + 1(x - 11) = 0$
$\Rightarrow (x + 1)(x - 11)$
$\therefore x = -1$ or 11

101. (c) Sum of $a_0 + a_1 + ... + a_{50} = 1 + 3 + ... + 101$

$$= \left(\frac{\text{last number} + 1}{2}\right)^2 = \left(\frac{101+1}{2}\right)^2 = 2601.$$

102. (c) $500! + 505! + 510! + 515!$
$= 500!\ (1 + 5k)$ (where k is a natural number)
So $(5k + 1)$ won't be a multiple of 5.
Minimum value of n for which 500 ! is divisible by $5^n = 1$.
Maximum value of n for which 500! is divisible by 5^n

$$\left[\frac{500}{5}\right]+\left[\frac{500}{5^2}\right]+\left[\frac{500}{5^3}\right]+\left[\frac{500}{5^4}\right]$$

$= 100 + 20 + 4 = 124$
Hence, there are 124 possible values of n.

103. (a) Prime factorization of 44 is $= 2 \times 2 \times 11$
To express 44 as product of five distinct integers
So, we'll have to put 1 and –1.
The only possible way comes out to be:
$44 = 2 \times (-2) \times 11 \times 1 \times (-1)$
In this case the value of n would be 11 which is also the only possible value.

104. (c) LCM of 6, 4 and 3 = 12
Multiply by 12 of each number in power

$$\Rightarrow 2^{\frac{7}{6}\times 12}, 3^{\frac{3}{4}\times 12}, 5^{\frac{2}{3}\times 12}$$

$\Rightarrow 2^{14}, 3^9, 5^8$
So, ascending order is
$5^8 > 3^9 > 2^{14}$ or $5^{2/3} > 3^{3/4} > 2^{7/6}$

105. (b) $E = 3 + 8 + 15 + 24 + ... + 195 = 1 \times 3 + 2 \times 4 + 3 \times 5 + 4 \times 6 + ... + 13 \times 15$
$\therefore\ T_n = n\,(n + 2)$ and $n = 13$

$$\therefore E = \sum_{n\ 1}^{13} T_n \quad \sum_{n\ 1}^{13} n(n\ \ 2) \quad \frac{n(n\ \ 1)(2n\ \ 1)}{6} \quad 2\times\frac{n(n\ \ 1)}{2}$$

$$= \frac{13\times 14\times 27}{6} + 2\times\frac{13\times 14}{2} = 1001$$

$= 7 \times 11 \times 13$
Hence the sum of the prime factors of E
$= 7 + 11 + 13 = 31$.

106. (b) Since 'ab' is a two - digit prime number and one of its digit is 3, it can assume any of the values among 13, 23, 31, 37,43, 53, 73 and 83.
As the absolute difference between the digits of the number is not a factor of 2, the number among the obtained numbers that satisfy the aforementioned condition are 37, 73 and 83. Hence, the number of values that 'ab' can assume is 3.

107. (d) Let the number be N.
In order to maximize the number of factors of N^3, N^2 must be expressed as a product of as many prime factors as possible.
No. of factors of $N^2 = 105 = 3 \times 5 \times 7$
where a = 2 b = 4 c = 6
then power original number
$= (2 + 1)\,(4 + 1)\,(6 + 1)$
$\therefore\ N^2 = (a)^2\,(b)^4\,(c)^6$, where a, b and c are prime numbers.
$\therefore\ N^3 = (a)^3\,(b)^6\,(c)^9$
Where $N = a^p\,b^q\,c^r$ no $= (p + 1)\,(q + 1)\,(r + 1)$
Hence, the number of factors of N^3
$= (3 + 1) \times (6 + 1) \times (9 \times 1) = 4 \times 7 \times 10 = 280$.

108. (a) $1080 = 2^3 \times 3^3 \times 5^1$
(where $N = a^p b^q c^r$
$\therefore$ No. of factors $(p + 1)\,(q + 1)\,(r + 1)$
$\therefore$ No. of factors of 1080 $(3 + 1)\,(3 + 1)\,(1 + 1)$
$= 4 \times 4 \times 2 = 32$
$1800 = 2^3 \times 3^2 \times 5^2$
(where $N = a^p b^q c^r$
$\therefore$ No. of factor $(p + 1)\,(q + 1)\,(r + 1)$
$\therefore$ Number of factor of $1800 = (3 + 1)(2 + 1)(2 + 1)$
$= 4 \times 3 \times 3 = 36$
$\therefore$ HCF of 1080 and $1800 = 2^3 \times 3^2 \times 5$
where $N = a^p, b^q, c^r$
No. of factors HCl $= (p + 1)(q + 1)(r + 1)$
$\therefore$ No. of factors HCF of two numbers $= (3 + 1)\,(2 + 1)\,(1 + 1)$
$= 4 \times 3 \times 2 = 24$
So, the required number of divisors
$= (32 + 36) - 2 \times 24 = 20$

109. (c) $\because\ f(2n) = 1^4 + 2^4 + 3^4 + 4^4 + 5^4 + ... + (2n)^4$
$\Rightarrow f(2n) = (1^4 + 3^4 + 5^4 + ... + (2n - 1)^4) + (2^4 + 4^4 + 6^4 + ... + (2n)^4)$
$\therefore\ 1^4 + 3^4 + 5^4 + ... + (2n - 1)^4$
$= f(2n) - (2^4 + 4^4 + 6^4 + ... + (2n)^4)$
$= f(2n) - 2^4 \times (1^4 + 2^4 + 3^4 + ... + n^4)$
$= f(2n) - 16 \times f(n)$

110. (d) For d = 1, Total = 46
(1, 2, 3, 4, 5), (2, 3, 4, 5, 6) ....(46, 47, 48, 49, 50)
For d = 2, total = 42
(1, 3, 5, 7, 9), (2, 4,6, 8, 10)......... (42, 44, 46, 48, 50)
For d = 3, total = 38
(1, 4, 7, 10, 13) (2, 5, 8, 11, 14) .... (38, 41, 44, 47, 50)
For d = 12, total = 2
(1, 13, 25, 37, 49) (2, 14, 26, 38, 50)
So total = 46 + 42 + 38 2

Possible APs $= \frac{12}{2}\,(2 + 46) = 288$.

111. (c) Let the two numbers be x and y
according to question,

$x + y = 600$ and $\frac{x}{y} = \frac{7}{8}$

$\because\ x + y = 600$ ...(i)

$\frac{x}{y} = \frac{7}{8} \Rightarrow 8x - 7y = 0$ ...(ii)

From equation (i) and (ii)
$x = 280$ and $y = 320$
$\therefore$ LCM of 280 and 320 = 2240

112. (a) Put n = 5, in the given relation then, $P_5 = 267$
Again,
$P_6 = P_5 - P_4 + P_3 - P_2$
$\Rightarrow P_6 = -P_1$
$P_7 = -P_2$,
Similarly, $P_8 = -P_3$
$P_9 = -P_4$
$P_{10} = -P_5$
The sequence repeats its terms after every 10 terms.
Here, we observe following pattern
$P_{531} = P_{(530 + 1)} = P_1 = 211$
$P_{753} = P_{(750 + 3)} = P_3 = 420$
$P_{975} = P_{(970 + 5)} = P_5 = 267$
So, $P_{531} + P_{753} + P_{975} = 211 + 420 + 267 = 898$.

113. (a) Let the batsman scored a 2's, b 4's and c 6's.
$\Rightarrow 2a + 4b + 6c = 100$
$\Rightarrow a + 2b + 3c = 50.$ ...(i)
When c = 1, (i) becomes a + 2b = 47
$\Rightarrow a = 47 - 2b$ ....(ii)
Since $a \geq 1$ and $b \geq 1$, the number of solutions of (ii) is 23.
When c = 2, (i) becomes a + 2b = 44
$\Rightarrow a = 44 - 2b$ ...(iii)
Since $a \geq 1$ and $b \geq 1$, the number of solutions of (iii) is 21.
When c = 3, (i) becomes a + 2b = 41
$\Rightarrow a = 41 - 2b$ ...(iv)
Since $a \geq 1$ and $b \geq 1$, the number of solutions of (iv) is 20.
When c = 4, (i) becomes a + 2b = 38
$\Rightarrow a = 38 - 2b$ ...(v)
Since $a \geq 1$ and $b \geq 1$, the number of solutions of (v) is 18.
Thus, we see a pattern emerging.
$\therefore$ The total number of ways
$= 23 + 21 + 20 + 18 + ... + 3 + 2 = 184.$

114. (d) Here, we take the 1st option, a delete all perfect squares and perfect cubes, then a total of 22 perfect square will be deleted (1^2, 2^2 .... 22^2) and a total of 7 perfect cubes will be deleted (1^3 2^3,.... 7^3) and Two numbers are common in between them viz. 1^6 and 2^6 which are perfect squares as well as perfect cubes
Thus, 500 is the (500 – 22 – 7 + 2) = 473 rd term.
So, 476th term = 500 + 3 = 503.

115. (c) Here, $343^b = 676$
$\Rightarrow \quad 7^{3b} = 26^2$
Now, $\quad 7^a = 26$
$\Rightarrow \quad 7^{3b} = (7^a)^2$
$\Rightarrow \quad 2a = 3b$

116. (c) In order to maximize the power of 2 in the product, one of the ten numbers has to be 64 as this is the highest two–digit number of the form 2^k, where k is a natural number.
There has to be maximum number of multiples of 8 among the ten numbers. In a set of ten consecutive natural numbers, there can be a maximum of two numbers that will be a multiple of 8.
The possible sets of ten consecutive natural numbers that satisfy the aforementioned conditions are 55 to 64, 56 to 65, 63 to 72 and 64 to 73. The highest power of 2 in the product of any of these sets of ten numbers will be 13.

117. (245) Let x be the initial quantity of wine in the vessel. y litres of content is removed twice. The part of wine left is $x\left(1-\frac{y}{x}\right)^2$
Now in 98 L of sample 18 L is wine which is same as $\frac{18}{98}$ part of the solution

$$\left(1-\frac{y}{x}\right)^2 = \frac{(x-y)^2}{x^2} = \frac{18}{98} = \frac{9}{49}$$

$$\Rightarrow \frac{(x-140)^2}{x^2} = \frac{9}{49} \Rightarrow x = 245.$$

118. (d) x = L.C.M. of (7, 8, 9) – 3 = 504 – 3 = 501
$x^3 + 2x^2 + x - 3 = (x-1)(x+1)(x+2) - 1$
$= 500 \times 502 \times 503 - 1$
Remainder when $500 \times 502 \times 503 - 1$ is divided by:
11 = 4
3 = 0
4 = 3
Required remainder = least possible number which when divided by 11, 3 and 4 leavs remainder 4, 0 and 3 respectively.
Such least no. is 15.

119. (12) For the amount to get tripled, the increase is 200% of the principal. If it happens in 24 years then it will take 12 years for the increase to be 100% of the principal.

120. (b) $P = 15^{100}(1 \times 2 \times 3 \times .... \times 100)$
$= 15^{100} \times 100!$
Highest power of 2 in P = 97 (2 will be deciding factor for number of zeroes because number of lives will be greater than number of zeroes in this number)
$Q = 25^{20\times 50}(1 \times 2 \times 3x .... \times 50) = 5^{2000} \times 50!$
Highest power of 2 in $\theta = 47$
So Highest power of 2 in

$$\frac{P^2}{Q} \times 10^{1767} = 2 \times 97 + 1767 - 47 = 1914$$

Hence, number of zeroes = 1914.

121. (b) Solve by option.
Option (a): If the product of the digits is 6. then the factors of 6 are 1,2, 3 and 6. This combination of digits is not suitable. So it is not the answer.
Option (b): If the product of the digits is 8, then the factors of 8 are 1, 2, 4 and 8. So only possible combination is 1, 1, 2, 4.
Hence, the number is 4112. It is suitable for answer.
Similarly, we can check options (c) and (d).

122. (c) Let n be xyz and since n is odd z can take only odd values i.e. 1, 3, 5 and 9 Now, $x \leq y$ and $x \geq z$

Possible values			
x	y	z	n
1	1, 2, 3, 4, ….9	1	9
2	2, 3, 4, ….9	1	8
3	3, 4, …..9	1, 3	14
4	4, 5, 6, ….9	1, 3	12
5	5, 6, ….9	1,3,5	15
6	6, 7, ….9	1, 3, 5	12
7	7, 8, 9	1, 3, 5, 7	12
8	8, 9	1, 3, 5, 7	8
9	9	1, 3, 5, 7, 9	5

$\therefore$ Total number of elemenls in P = 95.

123. (a) $x = 106^{90} - 49^{90}$
$\because$ $(x^n - a^n)$ is divisible by both (x – a) and (x + a) whenever n is even
$\Rightarrow (106^{90} - 49^{90})$ is divisible by both 57 and 155
$57 = 19 \times 3$
$155 = 31 \times 5$
Therefore, $(106^{90} - 49^{90})$ will be divisible by $(19 \times 31) =$ 589 as well.
Also, note that $(106^{90} - 49^{90})$ will be odd and options (b) and (c) are even. Hence, they can be rejected.

124. (b) $1000 = 2^3 \times 5^3$ and $2000 = 2^4 \times 5^3$
Since LCM (c, a) and LCM (b, c) is $2^4 \times 5^3$ and LCM (a, b) = $2^3 \times 5^3$, so the factor 2^4 must be present in c.
Hence c = $2^4 \times 5^x$, where x ranges from 0 to 3
Therefore, there are four possible values of C.
Since, HCF of (a, b) = K × 5^3, it means
a = $2^y \times 5^3$
b = $2^z \times 5^3$
x = 0 to 3, y = 0, then z = 3 → 4 cases.
x = 0 to 3, y = 1, then z = 3 → 4 cases.
x = 0 to 3, y = 2, then z = 3 → 4 cases.
x = 0 to 3, y = 3, then z = 3 → 4 cases.
x = 0 to 3, y = 3, then z = 2 → 4 cases.
x = 0 to 3, y = 3, then z = 1 → 4 cases.
x = 0 to 3, y = 3, then z = 0 → 4 cases.
Hence, total cases = 28.

125. (31) Let the four numbers are XA, XB, XC and XD respectively
where X is the common factor of each pair of numbers and A, B, C, D are prime to each other.
Then,
$310 = 2 \times 5 \times 31$
$651 = 31 \times 21 = 3 \times 7 \times 31$
∴ GCF (310, 651) = 31
∴ highest common factor of all = 31

126. (a) Here, $7^4 = 2401$
∴ $7^{700} = (7^4)^{175} = (2401)^{175}$
Any power of 2401 will end with 1 as the units digit and 0 as the tens digit.
∴ When it is divided by 100, the remainder is 1.

127. (d) Let the 4-digit sequence be abcd.
In base 6, this represents 216a + 36b + 6c + d and each of a, b, c, d is less than 6.
In base 10, it represents 1000a + 100b + 10c + d.
Given 4(216a + 36b + 6c + d)
= 1000a + 100b + 10c + d
⇒136a = 44b + 14c + 3d ...(A)
By trial a = 1, b = 2, c = 3, d = 2
If a = 2, the LHS = 272
[If we consider b = 5, we need 272 – 220 or 52 from 14c + 3d (c, d)=(2, 8) but 8 is not a proper digit in base 6.
If a= 3, the LHS = 408, while 44b + 14c + 3d can at the most be (44 + 14 + 3) 5 or 305.
∴ There are no other possible values that satisfy (A)]
∴ abcd = 1232 and a + b + c + d = 8

128. (b) Remainder [N/625]

$$= \text{Remainder}\left[\frac{\text{the number formed by the last four digits}}{625}\right]$$

$$= \text{Remainder}\left[\frac{8888}{625}\right]$$

$$= \text{Remainder}\left[\frac{14 \times 625 \quad 138}{625}\right] \quad 138$$

129. (b) Here, $120 \le n \le 240$.
$120 = 2^3\,(3)(5)$ and $240 = 2^4\,(3)(5)$
So, the prime factors involved in 120 and 240 are the same.
So, number of co-primes of 240 lying between 120 and 240 = $\phi(240) - \phi(120)$.

$$= 240\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{5}\right) - 120\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{5}\right)$$

$$= (240-120)\left(\frac{1}{2}\right)\left(\frac{2}{3}\right)\left(\frac{4}{5}\right) \quad 32$$

130. (d) Let the number of girls be 2x and number of boys be x.
Girls getting admission = 0.6 x
Boys getting admission = 0.45 x
Number of students not getting admission = 3x – 0.6x – 0.45x = 1.95x

$$\% = \frac{1.95x}{3x} \times 100 = 65\%$$

Alternatively,
Let the no. of boys appearing for the admission test be *b* % of candidates who get admission.

$$\frac{\frac{30}{100} \times 2b + \frac{45}{100} b}{2b + b} \times 100 = 35\%$$

2 CHAPTER

SET THEORY

Directions for questions 1 to 3 **: Read the information given below and answer the questions that follow :**

Ghoshbabu is staying at Ghosh Housing Society, Aghosh Colony, Dighoshpur, Calcutta. In Ghosh Housing Society 6 persons read daily Ganashakti and 4 read Anand Bazar Patrika; In his colony there is no person who reads both. Total number of persons who read these two newspapers in Aghosh Colony and Dighoshpur is 52 and 200 respectively. Number of persons who read Ganashakti in Aghosh Colony and Dighoshpur is 33 and 121 respectively; while the persons who read Anand Bazar Patrika in Aghosh Colony and Dighoshpur are 32 and 117 respectively.

1. Number of persons in Dighoshpur who read only Ganashakti is ***(1994)***
(a) 121 (b) 83 (c) 79 (d) 127
2. Number of persons in Aghosh Colony who read both of these newspapers is ***(1994)***
(a) 13 (b) 20 (c) 19 (d) 14
3. Number of persons in Aghosh Colony who read only one newspaper ***(1994)***
(a) 29 (b) 19 (c) 39 (d) 20

Directions for questions 4 & 5 **: Read the information given below and answer the questions that follow :**

There are three different cable channels namely Ahead, Luck and Bang. In a survey it was found that 85% of viewers respond to Bang, 20 % to Luck, and 30% to Ahead. 20% of viewers respond to exactly two channels and 5% to none.

4. What percentage of the viewers responded to all three ? ***(1995)***
(a) 10 (b) 12 (c) 14 (d) None of these
5. Assuming 20% respond to Ahead and Bang and 16% respond to Bang and Luck, what is the percentage of viewers who watch only Luck ? ***(1995)***
(a) 20 (b) 10 (c) 16 (d) None of these
6. In a locality, two-thirds of the people have cable-TV, one-fifth have VCR, and one-tenth have both, what is the fraction of people having either cable -TV or VCR ? ***(1996)***
(a) 19/30 (b) 3/5 (c) 17/30 (d) 23/30

Directions for questions 7 to 9 **: Read the information given below and answer the questions that follow :**

A survey of 200 people in a community who watched at least one of the three channels — BBC, CNN and DD — showed that 80% of the people watched DD, 22% watched BBC, and 15% watched CNN.

7. What is the maximum percentage of people who can watch all the three channels? ***(1997)***
(a) 12.5 (b) 8.5 (c) 17 (d) Insufficient data
8. If 5% of the people watched DD and CNN, 10% watched DD and BBC, then what per cent of the people watched BBC and CNN only? ***(1997)***
(a) 2% (b) 5% (c) 8.5% (d) Can't be determined
9. Referring to the previous question, how many per cent of the people watched all the three channels? ***(1997)***
(a) 3.5% (b) 0% (c) 8.5% (d) Can't be determined
10. In a political survey, 78% of the politicians favour at least one proposal. 50% of them are in favour of proposal A, 30% are in favour of proposal B and 20% are in favour of proposal C. 5% are in favour of all three proposals. What is the percentage of people favouring more than one proposal? ***(1999)***
(a) 16 (b) 17 (c) 18 (d) 19

11. There are two disjoint sets S_1 and S_2 where **(2000)**

$S_1 = \{f(1), f(2), f(3)............\}$

$S_2 = \{g(1), g(2), g(3)............\}$ such that $S_1 \cup S_2$ forms the set of natural number.

Also $f(1) < f(2) < f(3)$............ & $g(1) < g(2) < g(3)$ and $f(n) = g((g(n)) + 1$ then what is $g(1)$?

(a) 0 (b) 1 (c) 2 (d) can't be determined

12. Let 'f' be a function from set A to set B for a set, XCB define $f^{-1}(X) = \{x \in A : f(x) \in X\}$ Then which of the following is necessarily true for a subset U of X? **(2000)**

(a) $f((f^{-1})U) = U$ (b) $f(f^{-1}(U)) \subset U$ (c) $f\{f^{-1}(U)) \supset U$ (d) $f(f^{-1}(U)) \neq U$

Directions for questions 13 to 16 **: Read the information given below and answer the questions that follow :**

A and B are two sets (e.g. A = mothers, B = women). The elements that could belong to both the sets (e.g. women who are mothers) is given by the set C = A.B. The elements which could belong to either A or B, or both, is indicated by the set $D = A \cup B$. A set that does not contain any elements is known as null set, represented by ϕ (for example, if none of the women in the set B is a mother, then C = A.B. is a null set , or $C = \phi$).

Let 'V' signify the set of all vertebrates; 'M' the set all mammals; 'D' dogs, 'F' fish; 'A' alsatian and 'P', a dog named Pluto.

13. Given that X = M.D is such that X = D, which of the following is true? **(2001)**

(a) All dogs are mammals (b) Some dogs are mammals
(c) $X = \phi$ (d) All mammals are dogs

14. If Y = F.(D.V), is not a null set, it implies that : **(2001)**

(a) All fishes are vertebrates (b) All dogs are vertebrates
(c) Some fishes are dogs (d) None of these

15. If $Z = (P.D) \cup M$, then **(2002)**

(a) The elements of Z consist of Pluto the dog or any other mammal
(b) Z implies any dog or mammal
(c) Z implies Pluto or any dog that is a mammal
(d) Z is a null set

16. If $P.A = \phi$ and $P \cup A = D$, then which of the following is true? **(2002)**

(a) Pluto and alsatians are dogs (b) Pluto is an alsatian
(c) Pluto is not an alsatian (d) D is a null set

17. Let T be the set of integers { 3, 11, 19, 27 .....451, 459, 467} and S be a subset of T such that the sum of no two elements of S is 470. The maximum possible number of elements in S is **(2003)**

(a) 32 (b) 28 (c) 29 (d) 30

18. Consider the sets $T_n = \{n, n+1, n+2, n+3, n+4\}$, where n = 1, 2, 3, ..., 96. How many of these sets contains 6 or any integral multiple thereof (i.e. any one of the numbers 6, 12, 18,...........)? **(2004)**

(a) 80 (b) 81 (c) 82 (d) 83

Directions for Questions 19 to 21 **: Answer the questions on the basis of the tables given below.**

Two binary operations $\oplus$ and * are defined over the set {a , e, f, g, h} as per the following tables :

$\oplus$	a	e	f	g	h
a	a	e	f	g	h
e	e	f	g	h	a
f	f	g	h	a	e
g	g	h	a	e	f
h	h	a	e	f	g

*	a	e	f	g	h
a	a	a	a	a	a
e	a	e	f	g	h
f	a	f	h	e	g
g	a	g	e	h	f
h	a	h	g	f	e

Thus, according to the first table $f \oplus g = a$, while according to the second table $g * h = f$, and so on.
Also, let $f^2 = f * f$, $g^3 = g * g * g$, and so on.

19. What is the smallest positive integer n such that $g^n = e$? ***(2003)***
(a) 4 (b) 5 (c) 2 (d) 3

20. Upon simplification, $f \oplus [f * \{f \oplus (f * f)\}]$ equals ***(2003)***
(a) e (b) f (c) g (d) h

21. Upon simplification, $\{a^{10} * (f^{10} \oplus g^9)\} \oplus e^8$ equals ***(2003)***
(a) e (b) f (c) g (d) h

22. A survey on a sample of 25 new cars being sold at a local auto dealer was conducted to see which of the three popular options — air-conditioning, radio and power windows - were already installed. The survey found ***(2003)***
15 had air conditioning
2 had air conditioning and power windows but no radios
12 had radio
6 had air-conditioning and radio but no power windows
11 had power windows
4 had radio and power windows
3 had all three options.
What is the number of cars that had none of the options?
(a) 4 (b) 3 (c) 1 (d) 2

23. 70 per cent of the employees in a multinational corporation have VCD players, 75 per cent have microwave ovens, 80 per cent have ACs and 85 per cent have washing machines. At least what percentage of employees has all four gadgets? ***(2003)***
(a) 15 (b) 5 (c) 10 (d) Cannot be determined

24. A survey was conducted of 100 people to find out whether they had read recent issues of Golmal, a monthly magazine. The summarized information regarding readership in 3 months is given below: ***(2006)***
Only September : 18; September but not August: 23; September and July : 8; September : 28;
July : 48; July and August : 10; None of the three months : 24.
What is the number of surveyed people who have read exactly two consecutive issues (out of the three)?
(a) 7 (b) 9 (c) 12 (d) 14 (e) 17

25. S1 = {2, 4, 6, 8, ... 800} ***(2009)***
S2 = {3, 6, 9, 12, ... 900}
If S3 = S1 ∪ S2, then what will be the 105th element of S3 if all its elements are arranged in increasing order?
(a) 120 (b) 630 (c) 158 (d) 198

26. In a factory making radioactive substances, it was considered that the three cubes of uranium together are hazardous. So the company authorities decided to have the stack of uranium interspersed with lead cubes. But there is a new worker in a company who does not know the rule. So he arranges the uranium stack the way he wanted. What is the number of hazardous combinations of uranium in a stack of 5? ***(2010)***
(a) 3 (b) 7 (c) 8 (d) 10

27. For constructing the working class consumer price index number of a particular town, the following weights corresponding to different group of items were assigned : Food-55, Fuel-15, Clothing -10, Rent -8 and Miscellaneous-12.
It is known that the rise in food prices is double that of fuel and the rise in miscellaneous group prices is double that of rent. In October 2006, the increased D.A. by a factory of that town by 182% fully compensated for the rise in prices of food and rent but did not compensate for anything else. Another factory of the same locality increased D.A. by 46.5%, which compensated for the rise in fuel and miscellaneous groups.
Which is the correct combination of the rise in prices of food, fuel, rent and miscellaneous groups? ***(2011)***
(a) 320. 14, 159.57, 95.64, 166.82 (b) 317.14 , 158.57, 94 .64, 189.28
(c) 311.14, 159.57, 90 .64, 198.28 (d) 321.14, 162.57, 84.46, 175.38

28. Let S = {1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12}. The number of subsets of S comprising composite number(s) only and that of those comprising prime number(s) only are N_1 and N_2 respectively. What is the absolute difference between N_1 and N_2? ***(2013)***
(a) 0 (b) 32 (c) 48 (d) 24

29. Find the range of 'x' if $\frac{1}{|x|-2} < 0.5$ ***(2014)***
(a) $x < -4$ (b) $(x > 4) \cup (x < -4)$
(c) $(x < -4) \cup (-2 < x < 2) \cup (x > 4)$ (d) $-2 < x < 2$

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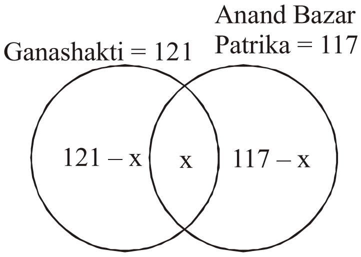
ANSWERS WITH SOLUTIONS

1. (b) Suppose G and A are represented by Ganashakti and Anand Bazar Patrika respectively



Given that

$n(G \cup A) = 200$

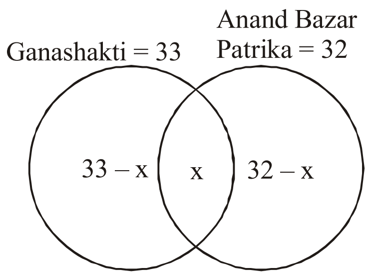
$\Rightarrow \quad (121 - x) + x + (117 - x) = 200$

$\Rightarrow \quad x = 238 - 200 = 38$

No. of persons in Dighospur who read only Ganashakti

$= 121 - x = 121 - 38 = 83$.

2. (a)



For Aghosh Colony

Given that , $n(G \cup A) = 52$

$(33 - x) + x + (32 - x) = 52$

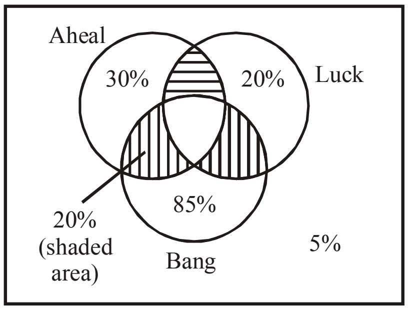
$x = 65 - 52 = 13$

3. (c) No. of persons in Aghosh Colony who read only one newspaper

$= (33 - x) + (32 - x) = (33 - 13) + (32 - 13)$

$= 20 + 19 = 39$

4. (a)



Here, $n(A \cup L \cup B) = 100 - 5 = 95$

$n(A \cap L) + n(L \cap B) + n(B \cap A) - 3n(A \cap L \cap B) = 20$

$n(A \cup L \cup B)$
$= n(A) + n(L) + n(B) - n(A \cap L) - n(L \cap B) - n(B \cap A) + n(A \cap L \cap B)$

$95 = 85 + 30 + 20 - [n(A \cap L) + n(L \cap B) + n(B \cap A) - 3n(A \cap L \cap B)] - 3n(A \cap L \cap B) + n(A \cap L \cap B)$

$\Rightarrow 95 = 135 - 20 - 2n(A \cap L \cap B)$

or $\quad n(A \cap L \cap B) = \frac{20}{2} = 10$

5. (d) Percentage of viewers who watch only Luck

$n(\text{only } L) = n(L) - n(L \cap B) - n(L \cap A) + n(L \cap B \cap A)$

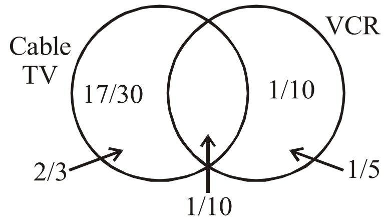
$= 20 - (16) - [20 - \{16 - 10\} - \{20 - 10\} + 10] + 10$

$= 20 - 16 - [20 - 6 - 10 + 10] + 10 = 20 - 16 - 14 + 10 = 0$

6. (d) Fraction of people who watch Cable-TV only

$= \left(\frac{2}{3} - \frac{1}{10}\right) = \frac{17}{30}$

Fraction of people who have VCR only $= \frac{1}{5} - \frac{1}{10} = \frac{1}{10}$



Fraction of people having either cable TV or VCR

$= \frac{17}{30} + \frac{1}{10} + \frac{1}{10} = \frac{23}{30}$

Alternatively:

$n(A) \quad \frac{2}{3}, n(B) \quad \frac{1}{5}, n(A \cap B) \quad \frac{1}{10}$

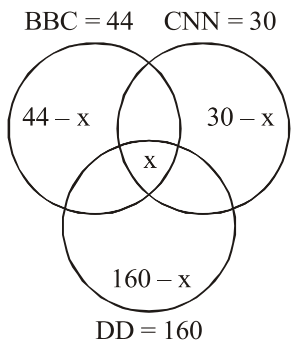
$n(A \text{ or } B) = n(A \cup B) \quad n(A) \quad n(B) - n(A \cap B)$

$\frac{2}{3} \quad \frac{1}{5} - \frac{1}{10}$

$\frac{23}{30}$

7. (b) We solve such question from venn diagram. For max. percentage of people who watch all three channels, we consider that there are no such people who watch only two channels.

Let x personals of viewers responded all the three channels.



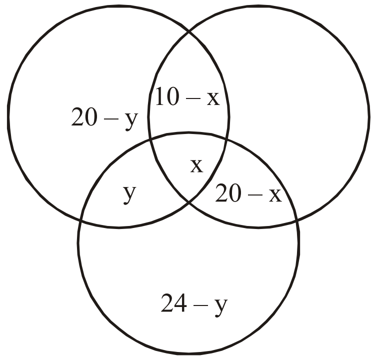
According to the given conditions,

$160 - x + 44 - x + 30 - x + x = 200$

$\Rightarrow 160 + 44 + 30 - 2x = 200 \ \Rightarrow x = 17$

Hence, 8.5% of people watched all the three channels.

8. (a) CNN = 30 DD = 160



BBC = 44

Let x viewers watch all the three channels.
Let y viewers watch CNN and BBC only.
From venn diagram :

$160 + (24 - y) + y + (20 - y) = 200$

$\Rightarrow y = -200 + 204 \Rightarrow y = 4$

$\therefore$ 2% of viewers watch BBC and CNN only.

9. (d) From the previous question data, we can't determine how many people watched all the three channels. The data are insufficient.

10. (b) $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B)$

$- n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$

or $78 = 50 + 30 + 20 - \Sigma n(A \cap B) + 5$

or $\Sigma n(A \cap B) = 27$

This includes $n(A \cap B \cap C)$ three times.

$\therefore$ Percentage of people favouring more than one proposal $= 27 - 5 \times 2 = 17$

11. (b) It is given that $f(n) = g(g(n)) + 1$

Therefore, $f(n) > g(g(n))$

Also, g(1) g(2) g(3) shows that the function g(x) is an increasing function. So for a natural number n,

$g(n) \geq n$

$\Rightarrow g(g(n)) \geq g(n)$

Thus, $f(n) > g(n)$ for every n

or $f(1) > g(1) \Rightarrow g(1)$ is the least number in $S_1 \cup S_2$.

Now, $S_1 \cup S_2$ = set of natural numbers.

Therefore, 1 in $S_1 \cup S_2$ is the smallest number.

Thus, $g(1) = 1$.

12. (c) We have $f^{-1}\{x \in A : f(x) \in X\}$

i.e., if there is an *x* such that f(x) is in X then x belongs to this set $f^{-1}(X)$.

Now, if $u \in U$ and $f(u) = v$ for some $v \in f\ (U)$.

i.e., $u \in f^{-1}((U)))$.

Thus every element in U is in $f^{-1}(f(U))$.

The option (a) is possible but it is not true in every case as shown in the following example.

Let $f(x) = x^2$, defined on the set of integers and let U = {–3, ,2, –1, 1, 2, 3} which is not same as U.

13. (a) $X = M.D. \Rightarrow X = D$

It clearly shows that all dogs are mammals.

14. (c) $Y = F \cap (D \cap V)$ is not a null set means some F's are D's and some D's are V's. That means some fishes are dogs.

15. (a) P.D. = A dog which name is Pluto

$(P.D.) \cup M = P \cup M$

This contains Pluto the dog or any other mammal.

16. (c) $P.A. = \phi \Rightarrow$ Pluto is not an alsatian.

$P \cup A = D \Rightarrow$ Pluto and alsatians constitutes the dogs.

17. (d) T = {3, 11, 19, 27 ....467} is an AP with a=3 and d = 8.

To find number of terms, we use the formula for nth term :

$a + (n - 1)\,d = 3 + (n - 1)\,8 = 467.$

Hence, n = 59. S = subset in which not sum of two elements = 470 .

So, S can be a set in which either the first half or the second half of the terms are present. So number of maximum possible elements in $S = \frac{59}{2} = 29.5 \approx 30.$

18. (a) Sets starting from 1, 7, 13..... does not contain multiple of 6.

Now 1, 7, 13, 19..... forms an A.P.

$\Rightarrow T_n = 1 + (n-1)6 \leq 96 \Rightarrow 6n \leq 101 \Rightarrow n = 16$

$\therefore$ No. of sets which doesn't contain the multiple of 6 $= 96 - 16 = 80$.

19. (a) $g * g = h$

$\Rightarrow (g * g) * g = h * g = f \ \ \Rightarrow g * (g * g * g) = g * f = e$

$\therefore n = 4$

20. (d) $f \oplus [f * \{f \oplus (f * f)\}] = f \oplus [f * \{f \oplus h)\}]$

$= f \oplus [f * e] = f \oplus [f] = h$

21. (a) Clearly, $a^{10} = a$

$f^{10} = h * f * f^7 = g * f^7 = e * f^6 = f * f^5 = f * f = h$

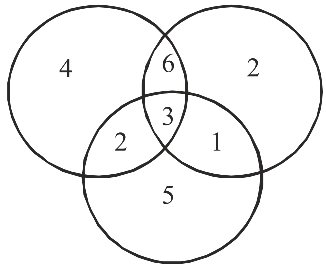
$g^9 = g^4 * g * g^4 = (e * g) * g^4 = g * e = g$

$e^8 = e$

Now, $\left\{a^{10} * (f^{10} \oplus g^9)\right\} \oplus e^8$

$= \{a * (h \oplus g)\} \oplus e = (a * f) \oplus e = a \oplus e = e.$

22. (d) AC = 15 Radio = 12



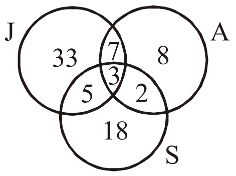
Power windows = 11

Total cars having any one of AC, radio or power windows = 4 + 6 + 3 + 2 + 1 + 2 + 5 = 23

Cars with no options = 25 – 23 = 2.

23. (c) Employees who doesn't have VCD = 100 – 70 = 30%
Employees who doesn't have MWO = 100 – 75 = 25%
Employees who doesn't have AC = 100 – 80 = 20%
Employees who doesn't have WM = 100 – 85 = 15%
$\therefore$ Total employees who doesn't have atleast one of the four equipments = 30 + 25 + 20 + 15 = 90%
$\therefore$ Percentage of employees having all four gadgets
= 100 – 90 = 10%.

24. (b) Putting the given information in the form of a venn diagram, we get



$n(J \cup A \cup S) = 100 - 24 = 76$

$n(S \cap J) = 8$; $n(\text{only } S) = 18$

$$n(S \text{ but not } A) = 23 = \overbrace{n(\text{only}S)}^{18} + \underbrace{n(S) - n(S \cap A)}_{5}$$

$n(S \cap A \cap J) = n(S \cap J) - 5 = 8 - 5 = 3$

To find the people who have read exactly 2 consecutive issues (out of 3) we shall find the people reading J & A and A & S.
Hence required no. = 7 + 2 = 9.

25. (c) Starting from 1, in every set of 6 consecutive natural numbers there will be 4 elements that belong to S3 (e.g. 2, 3, 4, 6). So we can say that the 104th element of S3 will be $\frac{(4 \times 104)}{6} = 156$. The next element i.e. the 105th element will be 158.

26. (c) For a stack of 5 cubes to be hazardous atleast 3 cubes of uranium have to be together. So there are 3 cases:
Case I: 3 uranium and 2 lead cubes are present.
They can be arranged in 3 ways (with the uranium cubes at positions (1, 2, 3 or 2, 3, 4 or 3, 4, 5) when uranium is together.
Case II: 4 uranium & 1 lead cube:
If the 4 uranium cubes are together then they can be arranged in 2 ways (UUUUL and LUUUU). If 3 uranium cubes are together then they can be arranged in 2 ways (UULU, and ULUUU).
CaseIII: 5 uranium cubes which can be arranged in 1 way. So in all 3 +4 + 1 = 8 ways.

27. (b) The rise in food prices is double that of fuel prices and the rise in miscellaneous groups prices is double that of rent. Only option 'b' satisfies the above criteria.

28. (c) Here set S has 6 composite and 4 prime numbers.
The number of subsets of S comprising composite numbers only = $2^6 - 1$
The number of subset of S comprising prime numbers only $2^4 - 1$
Hence, the required difference = $(2^6 - 1) - (2^4 - 1)$
= (63 – 15) = 48.

29. (c) There would be two cases.
They are as follows :
Case I : $x \geq 0$ ...(i)
The inequality becomes,

$$\frac{1}{x-2} < 0.5$$

$\Rightarrow (x - 2) < 0.5\,(x - 2)^2$
$\Rightarrow (x - 2)^2 - 2\,(x - 2) > 0$
$\Rightarrow (x - 2)\,(x - 4) > 0$
$\Rightarrow x > 4$ or $x < 2$
Using (i), the range becomes
$x > 4$ or $0 \leq x < 2$ ...(ii)
Case II : $x < 0$ ...(iii)
The inequality becomes,

$$\frac{1}{-x-2} < 0.5$$

$$\Rightarrow \frac{1}{x+2} > -0.5$$

$\Rightarrow 2\,(x + 2) + (x + 2)^2 > 0$
$\Rightarrow (x + 2)\,(x + 4) > 0$
$\Rightarrow x > -2$ or $x < -4$
Using (iii), the range becomes
$-2 < x < 0$ or $x < -4$ ...(iv)
Combining (ii) and (iv),
The range is $(x < -4) \cup (-2 < x < 2) \cup (x > 4)$.

3 CHAPTER FUNCTIONS

Directions for questions 1 & 2 **: Read the information given below and answer the questions that follow :**

If md (x) = | x |,
mn (x, y) = minimum of x and y and
Ma (a, b, c, ...) = maximum of a, b, c, ...

1. Value of Ma [md (a), mn (md(b), a), mn (ab, md(ac))] where a = –2, b = –3, c = 4 is *(1994)*
(a) 2 (b) 6 (c) 8 (d) –2

2. Given that a > b then the relation Ma [md (a), mn (a, b)] = mn [a, md (Ma (a, b))] does not hold if *(1994)*
(a) a < 0, b < 0 (b) a > 0, b > 0 (c) a > 0, b < 0, | a | < | b | (d) a > 0, b < 0, |a | > | b |

Directions for questions 3 to 6 **: Read the information given below and answer the questions that follow :**

If $f(x) = 2x + 3$ and $g(x) = \dfrac{x-3}{2}$, then

3. fog (x) = *(1994)*
(a) 1 (b) gof(x) (c) $\dfrac{15x+9}{16x-5}$ (d) $\dfrac{1}{x}$

4. For what value of x; f (x) = g (x – 3) ? *(1994)*
(a) –3 (b) 1/4 (c) –4 (d) None of these

5. What is value of (gofofogogof) (x) (fogofog) (x) ? *(1994)*
(a) x (b) x^2 (c) $\dfrac{5x+3}{4x-1}$ (d) $\dfrac{(x+3)(5x+3)}{(4x-5)(4x-1)}$

6. What is the value of fo(fog) o (gof) (x)? *(1994)*
(a) x (b) x^2 (c) 2x+3 (d) $\dfrac{x+3}{4x-5}$

Directions for questions 7 to 10 **: Read the information given below and answer the questions that follow :**

le (x, y) = least of (x, y)
mo (x) = |x|
me (x, y) = maximum of (x, y)

7. Find the value of me (a + mo(le (a, b)), mo (a + me (mo (a) mo (b)))), at a = –2 and b = –3. *(1995)*
(a) 1 (b) 0 (c) 5 (d) 3

8. Which of the following must always be correct for a, b > 0 *(1995)*
(a) mo (le (a, b)) ≥ me (mo (a), mo (b)) (b) mo (le (a, b)) > me (mo (a), mo (b))
(c) mo (le (a, b)) < (le (mo (a), mo (b)) (d) mo (le (a, b)) = le (mo (a), mo (b))

9. For what values of a is me $(a^2 - 3a, a - 3) < 0$? *(1995)*
(a) 0 a 3 (b) a 0 (c) a 3 (d) a = 3

10. For what values of a le $(a^2 - 3a, a - 3) < 0$? *(1995)*

(a) $1 < a < 3$ (b) $a < 0$ and $a < 3$ (c) $a < 0$ and $a \leq 3$ (d) $a < 0$ or $a > 3$

11. Largest value of min $(2 + x^2, 6 - 3x)$, when $x > 0$ is *(1995)*

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

Directions for questions 12 & 13 **: Read the information given below and answer the questions that follow :**

A,S, M and D are functions of x and y, and they are defined as follows :

A (x, y) = x + y
S (x, y) = x – y
M (x, y) = xy
D (x, y) = x / y where $y \neq 0$.

12. What is the value of M(M(A(M(x, y), S (y, x)), x), A (y,x)) for x =2 , y = 3 ? *(1996)*

(a) 50 (b) 140 (c) 25 (d) 70

13. What is the value of S[M(D(A(a, b),2), D(A(a, b),2)),M(D(S(a,b),2), D(S(a, b), 2))] ? *(1996)*

(a) $a^2 + b^2$ (b) ab (c) $a^2 - b^2$ (d) a/b

Directions for questions 14 to 16 **: Read the information given below and answer the questions that follow :**

The following functions have been defined :

la (x, y, z) = min (x + y, y + z)
le (x, y, z) = max (x – y, y – z)
ma (x, y, z) = (½) [le (x, y, z) + la (x, y, z)]

14. Given that $x > y > z > 0$, which of the following is necessarily true? *(1997)*

(a) la (x, y, z) < le (x, y, z) (b) ma (x, y, z) < la (x, y, z)
(c) ma (x, y, z) < le (x, y, z) (d) cannot be determined

15. What is the value of ma (10, 4, le (la (10, 5, 3), 5, 3)) ? *(1997)*

(a) 7.0 (b) 6.5 (c) 8.0 (d) 7.5

16. For x = 15, y = 10 and z = 9, find the value of : le (x, min (y, x – z), le (9, 8, ma (x, y, z))) *(1997)*

(a) 5 (b) 12 (c) 9 (d) 4

Directions for questions 17 to 19 **: Read the information given below and answer the questions that follow :**

The following operations are defined for real numbers a # b = a + b if a and b both are positive else a # b = 1. a ∇ b = $(ab)^{a+b}$ if ab is positive else a ∇ b = 1.

17. (2 # 1) / (1 ∇ 2) = *(1998)*

(a) 1/8 (b) 1 (c) 3/8 (d) 3

18. {((1 # 1) # 2) – ($10^{1.3}$ ∇ $\log_{10} 0.1$)}/(1 ∇ 2) = *(1998)*

(a) 3/8 (b) $4 \log_{10} 0.1/8$ (c) $(4 + 10^{1.3})/8$ (d) cannot be determined

19. ((X # – Y)/(– X ∇ Y)) = 3/8, then which of the following must be true? *(1998)*

(a) X = 2, Y = 1 (b) X > 0, Y < 0
(c) X and Y both are positive (d) X and Y both are negative

Directions for questions 20 to 22 **: Read the information given below and answer the questions that follow :**

If x & y are real numbers, the functions are defined as $f(x, y) = |x + y|$, $F(x, y) = -f(x, y)$ and $G(x, y) = -F(x, y)$. Now with the help of this information answer the following questions.

20. Which of the following will be necessarily true? *(1999)*

(a) G (f(x, y), F (x, y)) > F (f(x, y), G (x, y)) (b) F (F (x, y), F (x, y)) = F (G(x, y), G(x, y))
(c) F (G(x, y), (x + y)) ≠ G(F (x, y), (x + y)) (d) F (f (x, y), f (x, y)) = G (F(x, y), f(x, y))

21. If $y = x$, which of the following will give x^2 as the final value ? *(1999)*

(a) f(x, y) G(x, y)4 (b) G(f(x, y) f(x, y), F(x, y)/8

(c) –F(x, y) G(x, y)/$\log_2 16$ (d) –f(x, y) G(x, y) F(x, y)/F(3x, 3y)

22. What will be the final value given by the function $G(f(G(F(f(2,-3),0)-2),0),-1)$? *(1999)*

(a) 2 (b) –2 (c) 1 (d) –1

Directions for questions 23 to 26 **: Read the information given below and answer the questions that follow :**

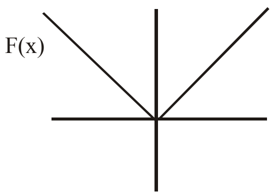
Any function has been defined for a variable x, where range of $x \in (-2, 2)$.

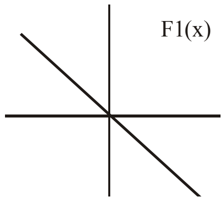
Mark (a) if $F1(x) = -F(x)$

Mark (b) if $F1(x) = F(-x)$

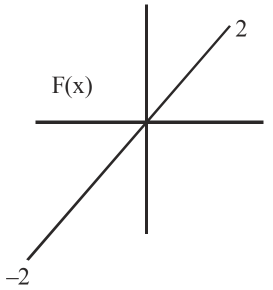
Mark (c) if $F1(x) = -F(-x)$

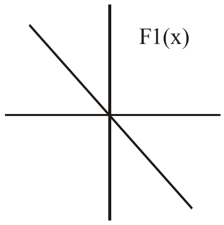
Otherwise mark (d).

23. 

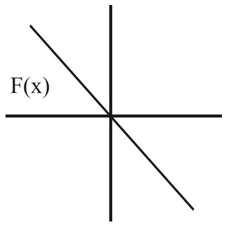


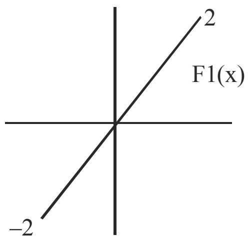
(1999)

24. 

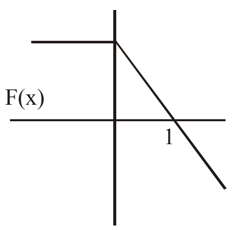


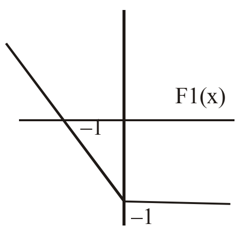
(1999)

25. 



(1999)

26. 



(1999)

27. There is a set of 'n' natural numbers. The function 'H' is such that it finds the highest common factor between any two numbers. What is the minimum number of times that the function has to be invoked to find the H.C.F. of the given set of numbers? ***(1999)***
(a) 1/2 n (b) n – 1 (c) n (d) None of these

Directions for questions 28 & 29 **: Read the information given below and answer the questions that follow :**

Certain relation is defined among variable A & B.
Using the relation answer the questions given below :
@ (A, B) = average of A and B
\ (A, B) = product of A and B
x (A, B) = the result when A is divided by B

28. The sum of A and B is given by ***(2000)***
(a) \(@ (A, B), 2) (b) @ (\ (A, B),2) (c) @ (X (A, B), 2) (d) None of these

29. The average of A, B and C is given by ***(2000)***
(a) @ (× (\ (@ (A, B), 2), C), 3) (b) \ (x(\ (@(A, B))C, 2)
(c) X(@(\ (@(A, B), 2)C, 3) (d) X(\ (@(\ (@(A, B), 2), C), 2), 3)

Directions for questions 30 to 32 **: Read the information given below and answer the questions that follow :**

x and y are non-zero real numbers

$f(x, y) = +(x+y)^{0.5}$, if $(x+y)^{0.5}$ is real otherwise $= (x+y)^2$

$g(x, y) = (x+y)^2$ if $(x+y)^{0.5}$ is real, otherwise $= -(x+y)$

30. For which of the following is f (x ,y) necessarily greater than g (x, y)? ***(2000)***
(a) x and y are positive (b) x and y are negative (c) x and y are greater than –1 (d) None of these

31. Which of the following is necessarily false ? ***(2000)***
(a) $f(x, y) \ge g(x, y)$ for $0 \le x, y < 0.5$ (b) $f(x, y) > g(x, y)$ when $x, y < -1$
(c) $f(x, y) > g(x, y)$ for $x, y > 1$ (d) None of these

32. If f (x, y) = g (x, y) then ***(2000)***
(a) x = y (b) x + y = 1 (c) x + y = –2 (d) Both b and c

33. Which of the following equations will best fit for the given data ? ***(2000)***

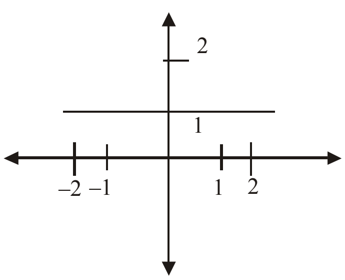
x	1	2	3	4	5	6
y	4	8	14	22	32	44

(a) y = ax + b (b) $y = a + bx + cx^2$ (c) $y = e^{ax + b}$ (d) None of these

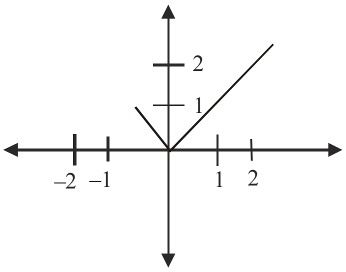
34. If $f(0, y) = y + 1$, and $f(x+1, y) = f(x, f(x, y))$ then, what is the value of $f(1, 2)$? ***(2000)***
(a) 1 (b) 2 (c) 3 (d) 4

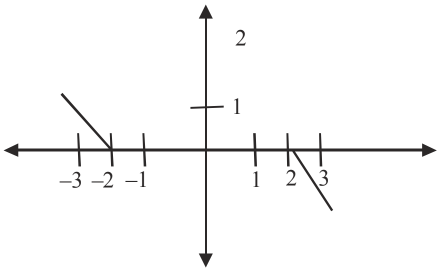
Directions for questions 35 to 37 **: Read the information given below and answer the questions that follow :**

Graphs of some functions are given. Mark the correct options from the following:
(a) f(x) = 3f(–x) (b) f(x) = f(–x) (c) f(x) = –f(–x) (d) 6f(x) = 3f(–x) for x > 0

35. 

(2000)

36.  *(2000)*

37.  *(2000)*

Directions for questions 38 to 40 **: Read the information given below and answer the questions that follow :**

Functions m and M are defined as follows:

m(a, b, c) = min (a + b, c, a)

M(a, b, c) = max (a + b, c, a)

38. If a = – 2, b = – 3 and c = 2 what is the maximum between $[m(a,b,c)+M(a,b,c)]/2$ and $[m(a,b,c)-M(a,b,c)]/2$? *(2000)*

(a) 3/2 (b) 7/2 (c) –3/2 (d) –7/2

39. If a and b, c are negative, then what gives the minimum of a and b? *(2000)*

(a) m (a, b, c) (b) –M (–a, a, –b) (c) m (a+ b, b, c) (d) none of these

40. What is m (M(a–b, b,c), m (a + b,c,b) , –M (a,b,c)) for a = 2, b= 4, c = 3? *(2000)*

(a) –4 (b) 0 (c) –6 (d) 3

Directions for questions 41 & 42 **: Read the information given below and answer the questions that follow :**

f(x) = 1/(1 + x) if x is positive

= 1 + x if x is negative or zero

$f^n(x) = f(f^{n-1}(x))$

41. If $x = 1$ find $f^1(x)f^2(x)f^3(x)f^4(x)$ *(2000)*

(a) 1/5 (b) 1/6 (c) 1/7 (d) 1/8

42. If x = –1 what will $f^5(x)$ be *(2000)*

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

43. If $f(x) = \log\left\{\frac{1+x}{1-x}\right\}$, then f(x) + f(y) is *(2002)*

(a) $f(x+y)$ (b) $f\left\{\frac{x+y}{1+xy}\right\}$ (c) $(x+y)f\left\{\frac{1}{1+xy}\right\}$ (d) $\frac{f(x)+f(y)}{1+xy}$

44. Suppose, for any real number x, [x] denotes the greatest integer less than or equal to x. Let L (x, y) = [x] + [y] + [x + y] and R(x,y)= [2x] + [2y]. Then it's impossible to find any two positive real numbers x and y for which ***(2002)***

(a) $L(x, y) = R(x, y)$ (b) $L(x, y) \neq R(x, y)$ (c) $L(x, y) < R(x, y)$ (d) $L(x, y) > R(x, y)$

45. Let $g(x) = \max(5-x, x+2)$. The smallest possible value of g (x) is ***(2003C)***

(a) 4.0 (b) 4.5 (c) 1.5 (d) None of these

46. Let $f(x) = |x-2| + |2.5-x| + |3.6-x|$, where x is a real number, attains a minimum at? ***(2003C)***

(a) $x = 2.3$ (b) $x = 2.5$ (c) $x = 2.7$ (d) None of these

47. When the curves $y = \log_{10} x$ and $y = x^{-1}$ are drawn in the x-y plane, how many times do they intersect for values $x \geq 1$? ***(2003C)***

(a) Never (b) Once (c) Twice (d) More than twice.

48. Consider the following two curves in the xy- plane; $y = x^3 + x^2 + 5$; $y = x^2 + x + 5$. ***(2003C)***

Which of the following statements is true for $-2 \leq x \leq 2$?

(a) The two carves intersect once (b) The two curves intersect twice

(c) The two curves do not intersect (d) The two curves intersect thrice

49. On January 1, 2004 two new societies, S_1 and S_2, are formed, each with *n* members. On the first day of each subsequent month, S_1 adds *b* members while S_2 multiplies its current number of members by a constant factor *r*. Both the societies have the same number of members on July 2, 2004. If $b = 10.5n$, what is the value of *r*? ***(2004)***

(a) 2.0 (b) 1.9 (c) 1.8 (d) 1.7

50. If $f(x) = x^3 - 4x + p$, and f (0) and f (1) are of opposite signs, then which of the following is necessarily true? ***(2004)***

(a) $-1 < p < 2$ (b) $0 < p < 3$ (c) $-2 < p < 1$ (d) $-3 < p < 0$

51. Let $f(x) = ax^2 - b|x|$, where a and b are constants. Then at x = 0, f (x) is ***(2004)***

(a) maximized whenever $a > 0, b > 0$ (b) maximized whenever $a > 0, b < 0$

(c) minimized whenever $a > 0, b > 0$ (d) minimized whenever $a > 0, b < 0$

Directions for Questions 52 and 53 : **Answer the questions on the basis of the information given below :**

$$
\begin{aligned}
f_1(x) &= x && 0 \leq x \leq 1 \\
&= 1 && x \geq 1 \\
&= 0 && \text{otherwise} \\
f_2(x) &= f_1(-x) && \text{for all } x \\
f_3(x) &= -f_2(x) && \text{for all } x \\
f_4(x) &= f_3(-x) && \text{for all } x
\end{aligned}
$$

52. How many of the following products are necessarily zero for every x ? ***(2004 - 2 marks)***

$f_1(x)\, f_2(x)$, $f_2(x)\, f_3(x)$, $f_2(x)\, f_4(x)$

(a) 0 (b) 1 (c) 2 (d) 3

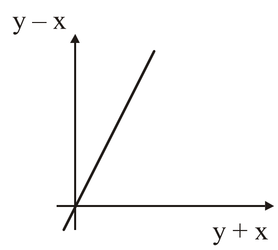
53. Which of the following is necessarily true? ***(2004 - 2 marks)***

(a) $f_4(x) = f_1(x)$ for all x (b) $f_1(x) = -f_3(-x)$ for all x (c) $f_2(-x) = f_4(x)$ for all x (d) $f_1(x) + f_3(x) = 0$ for all x

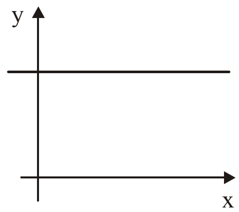
54. Let g(x) be a function such that $g(x + 1) + g(x - 1) = g(x)$ for every real x. Then for what value of p is the relation $g(x + p) = g(x)$ necessarily true for every real x? ***(2005 - 2 marks)***

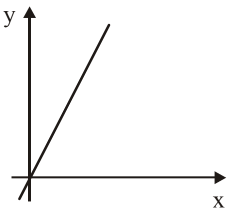
(a) 5 (b) 3 (c) 2 (d) 6

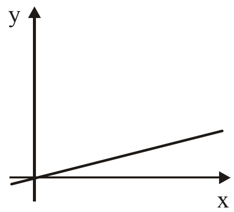
55. The graph of $y - x$ against $y + x$ is as shown below. (All graphs in this question are drawn to scale and the same scale is used on each axis).

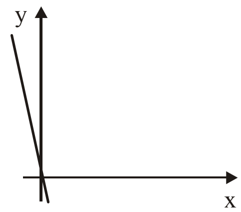


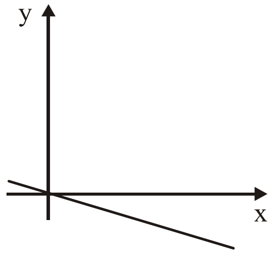
Which of the following shows the graph of y against x? ***(2006)***

(a) 

(b) 

(c) 

(d) 

(e) 

56. Let f(x) = max (2x + 1, 3 – 4x), where x is any real number. Then the minimum possible value of f(x) is ***(2006)***
(a) 1/3 (b) 1/2 (c) 2/3 (d) 4/3 (e) 5/3

57. A quadratic function $f(x)$ attains a maximum of 3 at $x = 1$. The value of the function at $x = 0$ is 1. What is the value of $f(x)$ at $x = 10$? ***(2007)***
(a) –105 (b) –119 (c) –159 (d) –110 (e) –180

Directions for questions 58 and 59 : Mr. David manufactures and sells a single product at a fixed price in a niche market. The selling price of each unit is Rs. 30. On the other hand, the cost, in rupees, of producing x units is $240 + bx + cx^2$, where b and c are some constants. Mr. David noticed that doubling the daily production from 20 to 40 units increases the daily production cost by $66\frac{2}{3}\%$. However, an increase in daily production from 40 to 60 units results in an increase of only 50% in the daily production cost. Assume that demand is unlimited and that Mr. David can sell as much as he can produce. His objective is to maximize the profit

58. How many units should Mr. David produce daily? ***(2007)***
(a) 150 (b) 130 (c) 100
(d) 70 (e) Cannot be determined

59. What is the maximum daily profit, in rupees, that Mr. David can realize from his business? ***(2007)***
(a) 760 (b) 620 (c) 920 (d) 840
(e) Cannot be determined

60. Suppose, the seed of any positive integer *n* is defined as follows :
seed (*n*) = n, if n < 10 = seed (s (n)), otherwise,
where s (n) indicates the sum of digits of n. For example, seed (7) = 7, seed (248) = seed (2 + 4 + 8) = seed (14) = seed (1 + 4) = seed (5) = 5 etc. How many positive integers *n*, such that *n* < 500, will have seed (*n*) = 9? ***(2008)***
(a) 39 (b) 72 (c) 81 (d) 108 (e) 55

61. Let f (x) be a function satisfying f (x) f (y) = f (xy) for all real x, y. If f (2) = 4, then what is the value of $f\left(\frac{1}{2}\right)$? ***(2008)***
(a) 0 (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) 1
(e) cannot be determined

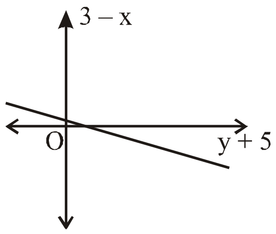
62. [x] = Greatest integer less than or equal to x {x} = x – [x]. How many real values of x satisfy the equation $5[x] + 3\{x\} = 6 + x$? ***(2009)***
(a) 0 (b) 1 (c) 2 (d) More than 2

63. A function f(x) is defined for all real values of x as $2f(x) + f(1 - x) = x^2$. What is the value of f(5)? ***(2009)***
(a) 10 (b) 17 (c) $\frac{34}{3}$ (d) Cannot be determined

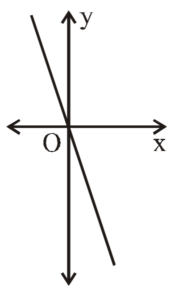
64. In the X-Y plane two distinct lines are drawn parallel to the line $3y - 4x = 15$, each at a distance of 3 units from the given straight line. What are the lengths of the line segments of these two lines lying inside the circle $x^2 + y^2 = 25$? ***(2010)***
(a) 6 and 8 (b) 0 and 8 (c) 0 and 10 (d) 8 and 10

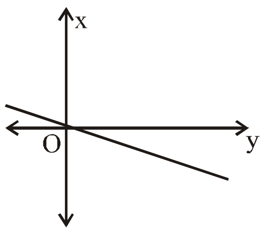
65. A function f(x) is defined for all real values of x as $f(x) = ax^2 + bx + 1$. It is also known that $f(5) = f(k) = 0$, where k is not equal to 5. If $a < 0$, then which of the following is definitely correct? ***(2010)***
(a) $b < 0$ (b) $b > 0$ (c) $k < 0$ (d) $k > 0$

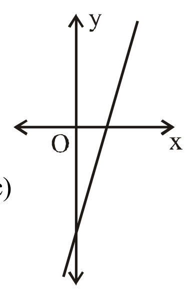
66. The graph of '3 – x' against 'y + 5' is as shown below. (All the graphs in this question are drawn to scale and the same scale has been used on each axis.) ***(2010)***

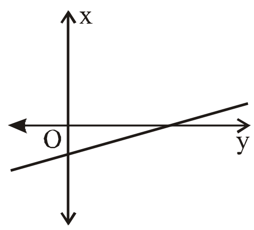


Which of the following shows the graph of y against x?

(a)


(b)


(c)


(d)


67. Consider the expression $\dfrac{(a^2 + a + 1)(b^2 + b + 1)(c^2 + c + 1)(d^2 + d + 1)(e^2 + e + 1)}{abcde}$

Where *a*, *b*, *c*, *d* and e are positive numbers. The minimum value of the expression is ***(2010)***
(a) 3 (b) 1 (c) 10 (d) 243

68. If $mx^m - nx^n = 0$, then what is the value of $\dfrac{1}{x^m + x^n} + \dfrac{1}{x^m - x^n}$ in terms of x^n? ***(2010)***
(a) $\dfrac{2mn}{x^n(n^2 - m^2)}$ (b) $\dfrac{2mn}{x^n(n^2 + m^2)}$ (c) $\dfrac{2mn}{x^n(m^2 - n^2)}$ (d) $\dfrac{2mn}{x^n(m^2 + n^2)}$

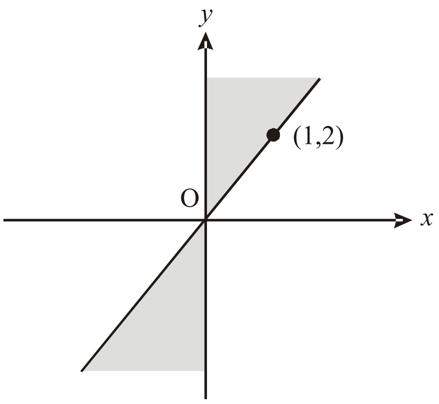
69. If $f\left(x + \dfrac{y}{8}, x - \dfrac{y}{8}\right) = xy$, then $f(m, n) + f(n, m) = 0$ ***(2010)***
(a) only when $m = n$ (b) only when $m \neq n$ (c) only when $m = -n$ (d) for all m and n

70. There are three coplanar parallel lines. If any p points are taken on each of the lines, then find the maximum number of triangles with the vertices of these points. ***(2010)***
(a) $p^2(4p - 3)$ (b) $p^3(4p - 3)$ (c) $p(4p - 3)$ (d) p^3

71. If three positive real numbers *a*, *b* and *c* $(c > a)$ are in Harmonic Progression, then $\log(a + c) + \log(a - 2b + c)$ is equal to: ***(2010)***
(a) $2 \log(c - b)$ (b) $2 \log(a - c)$ (c) $2 \log(c - a)$ (d) $\log a + \log b + \log c$

72. When '2' is added to each of the three roots of $x^3 - Ax^2 + Bx - C = 0$, we get the roots of $x^3 + Px^2 + Qx - 18 = 0$. A, B, C, P and Q are all non-zero real numbers. What is the value of $(4A + 2B + C)$? ***(2011)***
(a) 10 (b) –10 (c) 11 (d) Cannot be determined

73. The shaded portion of figure shows the graph of which of the following ? *(2011)*



(a) $x(y-2x) \geq 0$ (b) $x(y-2x) \leq 0$ (c) $x\left(y+\frac{1}{2}x\right) \geq 0$ (d) $x\left(y-\frac{1}{2}x\right) \leq 0$

74. Let f be an injective map with domain $\{x, y, z\}$ and range $\{1, 2, 3\}$ such that exactly one of the following statements is correct and the remaining are false. $f(x) = 1, f(y) \neq 1, f(z) \neq 2$. The value of $f^{-1}(1)$ is *(2011)*
(a) x (b) y (c) z (d) None of the above

75. A function f(x) is defined for real values of x as: $f(x) = \dfrac{1}{\log_{5-|x|}\sqrt{x^3 - 7x^2 + 14x - 8}}$ What is the domain of f(x)? *(2012)*
(a) $x \in (0, \infty)$ (b) $x \in (-5, -4) \cup (-4, 4) \cup (4, 5)$
(c) $x \in (1, 2) \cup (4, 5)$ (d) $x \in (1, 2) \cup (4, \infty)$

76. A function F(n) is defined as $F(n-1) = \dfrac{1}{(2 - F(n))}$ for all natural numbers 'n'. If F(1) = 2, then what is the value of [F(1)] + [F(2)] +...........+ [F(50)]? (Here, [x] is equal to the greatest integer less than or equal to 'x') *(2012)*
(a) 51 (b) 55 (c) 54 (d) None of these

77. At how many points do the graphs of $y = \frac{1}{x}$ and $y = x^2 - 4$ intersect each other? *(2013)*
(a) 0 (b) 1 (c) 2 (d) 3

78. If f(x) = (secx + cosecx)(tanx – cotx) and $\frac{\pi}{4} < x < \frac{\pi}{2}$, then f(x) lies in the range of *(2013)*
(a) $[-\infty, 0)$ (b) $(0, \infty)$ (c) $(-\infty, 0]$ (d) None of these

79. Let $f(x) = ax^2 + bx + c$, where a, b and c are real numbers and $a \neq 0$. If f(x) attains its maximum value at x = 2, then what is the sum of the roots of f(x) = 0? *(2013)*
(a) 4 (b) –2 (c) 8 (d) –4

80. 'f' is a real function such that f(x + y) = f(xy) for all real values of x and y. If f(–7) = 7, then the value of f(–49) + f(49) is *(2014)*
(a) 7 (b) 14 (c) 0 (d) 49

81. The coordinates of two diagonally opposite vertices of a rectangle are (4, 3) and (-4,-3). Find the number of such rectangle(s), if the other two vertices also have integral coordinates. *(2015)*
(a) 1 (b) 4 (c) 5 (d) 10

82. If log 2x = 2 log (x + 1), find the number of real values of x?. *(2015)*

83. If $[\log_{10} 1] + [\log_{10} 2] + [\log_{10} 4] + ... + [\log_{10} n] = n$ where [x] denotes the greatest integer less than or equal to x, then *(2016)*
(a) $96 \leq n < 104$ (b) $104 < - n < 107$ (c) $107 \leq n < 111$ (d) $111 \leq n < 116$

84. Consider two figures A and D that are defined in the co-ordinate plane. Each figure represents the graph of a certain function, as defined below:

$A: |x| - |y| = a$

$D: |y| = d$

If the are enclosed by A and D is O. Which of the following is a possible value of (a, d) : *(2016)*
(a) (2,1) (b) (–2, 1) (c) (–2, 3) (d) (2 ,3)

85. The area of the closed region bounded by the equation |x| + |y| = 2 in the two-dimensional plane is *(2017)*
(a) 4π (b) 4 (c) 8 (d) 2π

ANSWERS WITH SOLUTIONS

1. (b) $\text{Ma}\,[\text{md}(a), \text{mn}(\text{md}(b), a), \text{mn}(ab, \text{md}(ac))]$

$\text{Ma}\,[|-2|, \text{mn}(|-3|, -2), \text{mn}(6, |-8|)]$

$\text{Ma}\,[2, \text{mn}(3, -2), \text{mn}(6, 8)]$

$\text{Ma}\,[2, -2, 6] = 6.$

2. (a) $\text{Ma}[\text{md}(a), \text{mn}(a, b)] = \text{mn}[a, \text{md}(\text{Ma}(a, b))]$

$\text{Ma}[2, -3] = \text{mn}[-2, \text{md}(-2)]$

$2 = \text{mn}(-2, 2)$ or $2 = -2$

relation does not hold for $a = -2$ and $b = -3$
or $a < 0, b < 0$

3. (b) $fog(x) = f\{g(x)\} = f\left(\frac{x-3}{2}\right) = 2\left(\frac{x-3}{2}\right) + 3 = x$

And $gof(x) = g\{f(x)\} = g(2x+3) = \frac{2x+3-3}{2} = x$

Clearly $fog(x) = gof(x)$.

4. (c) $f(x) = g(x-3)$

$2x + 3 = \frac{x-3-3}{2} \Rightarrow 2x + 3 = \frac{x-6}{2}$

$4x + 6 = x - 6$ or $3x = -12$ or $x = -4$.

5. (b) $\{go\,fo\,fo\,go\,go\,f(x)\}\ \{fo\,go\,g(x)\}$

From Q. 3 we have $fog(x) \quad gof(x) \quad x$

Therefore above expression becomes $(x).(x) = x^2$.

6. (c) $fo\,(fo\,g)o\,(go\,f)(x)$

we have, $fo\,g(x) = go\,f(x) = x$

So given expression reduces to $f(x)$ that is $2x + 3$.

7. (a) Find $\text{me}(a + \text{mo}(le(a, b)), \text{mo}(a + \text{me}(\text{mo}(a), \text{mo}(b))))$

Given $a = -2, b = -3$

Now, $a \quad \text{mo}(\ell e(a, b)) \quad -2 + \text{mo}(\ell e(-2, -3))$

$= -2 + \text{mo}(-3) = -2 + 3 = 1$

And $\text{mo}(a + \text{me}(\text{mo}(a), \text{mo}(b)))$

$= \text{mo}(-2 + \text{me}(\text{mo}(-2), \text{mo}(-3)))$

$= \text{mo}(-2 + \text{me}(2, 3)) = \text{mo}(-2 + 3) = \text{mo}(1) \quad 1$

Hence, $\text{me}(1, 1) = 1$.

8. (d) (a) $\text{mo}(\ell e(a, b)) \geq \text{me}(\text{mo}(a), \text{mo}(b))$

$\Rightarrow \ell e(a, b) \geq \text{me}(a, b)$ as $a, b > 0$ which is false.

(b) $\text{mo}(\ell e(a, b)) > \text{me}(\text{mo}(a), \text{mo}(b))$

$\Rightarrow \ell e(a, b) > \text{me}(a, b)$ which is again false.

(c) $\text{mo}(\ell e(a, b)) < \ell e(\text{mo}(a), \text{mo}(b))$

or $\ell e(a, b) < \ell e(a, b)$ which is false

(d) $\text{mo}(\ell e(a, b)) = \ell e(\text{mo}(a), \text{mo}(b))$

or $\ell e(a, b) = \ell e(a, b)$ TRUE

9. (a) To solve this, take arbitrary values of a in the range specified
In option (a), $0 < a < 3$, take $a = 1$.
Then $\text{me}(a^2 - 3a, a - 3) < 0$
$\Rightarrow \text{me}(-2, -2) < 0 \Rightarrow -2 < 0$, which is true
In option (b), $a < 0$, take $a = -2$.
Then $\text{me}(a^2 - 3a, a - 3) < 0$
$\Rightarrow \text{me}(10, -5) < 0 \Rightarrow 10 < 0$, which is false
In option (c), $a > 3$, take $a = 4$.
Then $\text{me}\,(a^2 - 3a, a - 3) < 0$
$\Rightarrow \text{me}\,(4, 1) < 0 \Rightarrow 4 < 0$, which is false
In option (d), $a = 3$ then $\text{me}(a^2 - 3a, a - 3) < 0$
$\Rightarrow \text{me}\,(0, 0) < 0 \Rightarrow 0 < 0$, which is false
$\therefore$ Option (a) is right one.

10. (a,b) In option (a), take $a = 2$

$\ell e(a^2 - 3a,\ a - 3) = \ell e(-2, -1) = -2 < 0$

In option (b), take $a = -1$

$\ell e(a^2 - 3a,\ a - 3) = \ell e(4, -4) = -4 < 0$

Again take $a = 2$

$\ell e(a^2 - 3a,\ a - 3) = \ell e(-2, -1) = -2 < 0$ which true

In option (c), take $a = 3$

$\therefore\ \ell e(a^2 - 3a,\ a - 3) = \ell e(6, 0) = 0 < 0$ which is false

In option (d), take $a = 4$

$\therefore\ \ell e(a^2 - 3a,\ a - 3) = \ell e(4, 1) = 1 < 0$ which is false.

Hence options (a) and (b) are correct.

11. (c) Equating $2 + x^2 = 6 - 3x$

$\Rightarrow x^2 + 3x - 4 = 0 \Rightarrow x^2 + 4x - x - 4 = 0$

or $(x + 4)(x - 1) = 0 \Rightarrow x = -4$ or 1

But $x > 0$. So, $x = 1$
Thus, $2 + x^2 = 3$ and $6 - 3x = 3$
It means the largest value of function $\min(2 + x^2, 6 - 3x)$ is 3.

12. (d) $M(M(A(M(x, y), S(y, x)), x), A(y, x))$

$\Rightarrow M(M(A(6, 1), 2), A(3, 2))$

$\Rightarrow M(M(7, 2), A(3, 2))$

$\Rightarrow M(14, 5) = 70.$

13. (b) $S[M(D(A(a, b), 2), D(A(a, b), 2)),$
$M(D(S(a, b), 2), D(S(a, b), 2))]$

$\Rightarrow S[M(D(a+b, 2), D(a+b, 2)),$
$M(D(a-b, 2), D(a-b, 2))]$

$$\Rightarrow S\left[M\left(\frac{a+b}{2}, \frac{a+b}{2}\right), M\left(\frac{a-b}{2}, \frac{a-b}{2}\right)\right]$$

$$\Rightarrow S\left[\left(\frac{a+b}{2}\right)^2, \left(\frac{a-b}{2}\right)^2\right] = \frac{(a+b)^2 - (a-b)^2}{4} = ab.$$

14. (d) Since $x > y > z > 0$
$\therefore \text{la}(x, y, z) \quad \min(x \quad y, y \quad z)$
and $\text{le} = \max\,(x - y, y - z)$
we cannot find the value of la and le. Therefore we can't say whether la > le or le > la
Hence, we can't comment, as data is insufficient.

15. (b) la (10, 5, 3) = 8; le (8, 5, 3) = 3

$$\text{ma}(10,4,3)=\frac{1}{2}[6+7]=\frac{13}{2}=6.5.$$

16. (c) $\text{ma}(15,10,9)=\frac{1}{2}[5+19]=12$

min (10, 6) = 6 ; le (9, 8, 12) = 1; le (15, 6, 1) = 9.

17. (c) $\frac{(2\#1)}{1\nabla 2}=\frac{2+1}{2^{2+1}}=\frac{3}{8}.$

18. (d) Here, (1 # 1) # 2 = (1 + 1) # 2 = 2 + 2 = 4

And $10^{1.3}\nabla\log_{10}0.1=10^{1.3}\nabla(-1)$

But $10^{1.3}\times(-1)=-10^{1.3}$ which is –ve,

so the operation $(ab)^{a+b}$ fails.

19. (b) Equating with a # b = a + b :

Option (a) : b = –Y = –1

Operation fails for –ve value of b.

Option (b) : b = –Y > 0 at Y < 0

a = X > 0

$\therefore\ (X\#-Y)/(-X\nabla Y)=(a\#b)\ (-a)\nabla(-b)$

$=(a+b)\ (ab)^{-(a+b)}$

Operation succeeds.

Option (c) :

b = – Y < 0 as Y > 0

Operation fails.

Option (d) :

a = X < 0 as X < 0

Operation fails.

Hence option (b) is correct.

20. (b) f(x, y) = |x + y|

F(x, y) = – f(x, y) = – |x + y|

G(x, y) = – F(x, y) = |x + y|

We will check all the options one by one.

Option (a) :

G(f(x, y), F(x, y)) > F(f(x, y), G(x, y))

G |x+y|,– (x+y) F |x y|, |x y|

0 > – 2 |x + y|

which is invalid when x + y = 0

Option (b) :

$$F\big(F(x,y),F(x,y)\big)=F\big(G(x,y),G(x,y)\big)$$

$$F\big(-|x+y|,-|x+y|\big)=F\big(|x+y|,(x+y)\big)$$

$$-\big|-|x+y|-|x\ \ y|\big|\quad -2|x\ \ y|$$

$$-2|x+y|=-2|x+y|$$

which is true.

Option (c) :

$$F\big(G(x,y),(x+y)\big)\neq G\big(F(x,y),(x+y)\big)$$

$$F\big(|x+y|,(x+y)\neq G(-|x+y|,(x+y)\big)$$

$$-\big||x+y|+x+y\big|\neq\big|-|x+y|+x+y\big|$$

which is not valid when x = 0, y = 0.

Option (d) :

f f(x, y), f(x, y) G F(x, y), f(x, y)

$$F\big(|x+y|,|x+y|\big)=G\big(-|x+y|,|x+y|\big)$$

$$-\big||x+y|+|x+y|\big|=\big|-|x+y|+|x+y|\big|$$

$$-2|x+y|=0\Rightarrow|x+y|=0$$

which is not valid when x = 1, y = 0 etc.

Hence option (b) is correct.

21. (c) Consider option (a) :

F(x, y)G(x, y)4 |x y|.|x y|4 $(x\ \ y)^2$4

$=16x^2\neq x^2$ as x = y

Consider option (b) :

$$G\big(f(x,y)f(x,y),\ F(x,y)\big)/8=G\big(|x+y|^2,-|x+y|\big)/8$$

$$=\big(|x+y|^2-|x+y|\big)/8$$

$$=\frac{x^2-|x|}{4}\neq x^2\ \text{ as } x=y$$

Consider option (c) :

as – F (x, y) . G(x, y) = – [–|x + y| . |x + y|] = $4x^2$ for x = y.

And $\log_2 16=\log_2 2^4=4$, which gives value of (c) as x^2.

Consider option (d) :

$$\frac{-f(x,y)G(x,y)F(x,y)}{F(3x,3y)}=\frac{-|x+y|\,|x+y|\,(-|x+y|)}{-|3x+3y|}$$

$$=\frac{|x+y|^3}{-3|x+y|}$$

$$=-\frac{4}{3}x^2\neq x^2\ \text{ as } x=y$$

22. (a) Solving the given function from innermost bracket, we obtain

$G(f(G(F(f(2,-3),0),-2),0),-1)$

$=G(f(G(F|2-3|,0),-2),0),-1)$

$=G(f(G(-|1+0|,-2),0),-1)\qquad(\because|2-3|=1)$

$=G(f(|-1-2|,0),-1)$

$=G(|3+0|,-1)\qquad(\because|-1-2|=3)$

$=|3-1|=2$

23. (d) From the graph F1(x) = F(x) for $x\in(-2,0)$

but, F1(x) = –F(x) for $x\in(0,2)$.

No option of (a, b, c) satisfy this condition.

24. (d) From the graphs, F1(x) = –F(x) and also F1(x) = F(–x). So, both (a) and (b) are satisifed which is not given in any of the option.

25. (d) By observation F1(x) = – F(x) and also F1(x) = F(–x). So, both (a) and (b) are satisfied. Since no option is given, mark (d) as the answer.

26. (c) By observation F1(x) = –F(–x). This can be checked by taking any value of x say 1, 2. So, answer is (c).

27. (b) Out of n numbers, HCF of 1st and 2nd numbers can be calculated by invoking the function once.

Then HCF of this HCF and 3rd number can be calculated by invoking the function 2nd time and so on.

Each time the function is invoked, instead of two numbers we are left with one, i.e., one number is eliminated. Getting the final HCF means eliminating (n – 1) numbers and thus function has to be invoked (n – 1) times.

28. (a) From the given conditions, we obtain

$$@(A,B)=\frac{A+B}{2}$$
$$\backslash(A,B)=B\times A$$
$$\text{And }\; X(A,B)=\frac{A}{B}$$
$$@(A,B)=\frac{A+B}{2}$$
$$\therefore \backslash(@(A,B),2)=\left(\frac{A\quad B}{2}\right)\times 2\quad A\quad B$$

29. (d)
$$\frac{A+B+C}{3}=\frac{2\left(\frac{A+B}{2}\right)+C}{3}=\frac{2\left(\frac{2\left(\frac{A+B}{2}\right)+C}{2}\right)}{3}$$
$$=\frac{2\left(\frac{2@(A,B)+C}{2}\right)}{3}$$
$$=\frac{2}{3}\left(@(\backslash(@(A,B),2),C)\right)$$
$$=\frac{1}{3}\left(\backslash(@(\backslash@(A,B),2),C),2\right)$$
$$=X(\backslash(@(\backslash@(A,B),2),C),2),3)$$

30. (d) We know that
$$\begin{cases} x^2<x, & 0<x<1 \\ x^2\ge x & 1\le x,\ x\le 0\end{cases}$$
Taking option (a) :
$$\left.\begin{aligned} f(x,y)&=\ (x+y)^{0.5} \\ g(x,y)&=\ (x+y)^2\end{aligned}\right\}\text{ when x and y are positive}$$
Thus for $x+y>1$, $(x+y)^{0.5}<(x+y)^2$

Therefore, $f(x,y)<g(x,y)$

Taking option (b) :
$$\left.\begin{aligned} f(x,y)&=(x+y)^2 \\ g(x,y)&=-(x+y)\end{aligned}\right\}\text{ x and y are negative}$$
Take $x=-\frac{1}{4},\ y=-\frac{1}{8}$
$$f(x,y)=\left(-\frac{1}{4}-\frac{1}{8}\right)^2=\frac{9}{64}$$
$$g(x,y)=-\left(-\frac{1}{4}-\frac{1}{8}\right)=\frac{24}{64}$$
Clearly, $f(x,y)<g(x,y)$

Taking option (c) :

Using option (a) or (b), we get

$f(x,y)<g(x,y)$

Hence option (d) is correct.

31. (c) When $0\le x,y<0.5, x+y$ may be <1 or ≥ 0 so given statement (a) is true.
When $x, y<-1$, again statement (b) is true.
When $x, y>1, x+y>1$, hence $f(x,y)<g(x,y)$.
Thus statement (c) given is necessarily false.

32. (b) When $x+y=1$ we have $(x+y)^2=(x+y)^{0.5}$
i.e., $f(x,y)=g(x,y)$
Thus correct answer is (b).

33. (b) At $x=1, y=4;$ and $x=2, y=8$
$4=a+b$ and $8=2a+b$
$\Rightarrow\ a=4, b=0$
So, $y=ax+b \Rightarrow y=4x$
The other values do not satisfy this last equation. so option (a) is not fit.
Similarly, we may find that option (c) is also not fit. But option (b) is absolutely fit.

34. (d) $f(x+1,y)=f[x,f(x,y)]$
Put $x=0$,
$f(1,y)=f[0,f(0,y)]=f[0,y+1]=y+1+1=y+2$
Put $y=2$, $f(1,2)=4$.

35. (b) As graph is symmetrical about y axis, we can say function is even, so $f(x)=f(-x)$

36. (d) We see from the graph. Value of $f(x)$ in the left region is twice the value of $f(x)$ in the right region.
So, $2f(x)=f(-x)$ or $6f(x)=3f(-x)$

37. (c) $f(-x)$ is replication of $f(x)$ about y axis, $-f(x)$ is replication of $f(x)$ about x-axis and $-f(-x)$ is replication of $f(x)$ about y axis followed by replication about x-axis . Thus given graph is $f(x)=-f(-x)$.

For Qs. 38-41.

Putting the actual values in the functions, we get the required answers.

38. (c) $m(a, b, c)=-5$, $M(a, b, c)=2$
$$\therefore \frac{m(a,b,c)\quad M(a,b,c)}{2}\quad \frac{-5\quad 2}{2}\quad -\frac{3}{2}$$
$$\text{And }\frac{m(a,b,c)-M(a,b,c)}{2}\quad\frac{-5-2}{2}\quad -\frac{7}{2}$$
So $\frac{m(a,b,c)\quad M(a,b,c)}{2}$ is maximum and maximum value is $-3/2$.

39. (c) Suppose $a=-1, b=-2, c=-4$
Then
$m(a, b, c)=\min(a+b, c, a)$
$=\min(-3,-4,-1)=-4;\ -M(-a, a, -b)$
$=-\max(0,-b,-a)=-\max(0,2,1)=-2;\ m(a+b, b, c)$
$=\min(a+2b, c, a+b)=\min(-5,-4,-3)$
$=-5$
Clearly option (c) is correct.

40. (c)
$$\begin{aligned} \text{Here, } M(a-b, b, c) &= \max(a, c, a-b)\\ &= \max(2,3,-2)=3\\ m(a+b, c, b) &= \min(a+b+c, b, a+b)\\ &= \min(9,4,6)=4\\ \text{And}\quad -M(a, b, c) &= -\max(a+b, c, a)\\ &= -\max(6,3,2)=-6\end{aligned}$$
$$\begin{aligned}\therefore\ m(M(a-b, b, c), m(a+b, c, b), -M(a, b, c))\\ = m(3, 4, -6)\\ = \min(3+4, -6, 3)=-6.\end{aligned}$$

41. (d) $f(1) = \frac{1}{1+1} = \frac{1}{2}$ as x is positive

$$f^2(1) = f(f(1)) = f\left(\frac{1}{2}\right) = \frac{1}{1+1/2} = \frac{2}{3};$$

$$f^3(1) = f(f^2(1)) = f[2/3] = \frac{3}{5};$$

$$f^4(1) = \frac{5}{8}. \text{ Thus } f^1(1)f^2(1)f^3(1)f^4(1) = \frac{1}{8}.$$

42. (c) When x is negative, $f(x) = 1 + x$

$$f(-1) = 1 - 1 = 0;$$

$$f^2(-1) = f(f(-1)) = f(0) = 1;$$

$$f^3(-1) = f(f^2(-1)) = f(1) = \frac{1}{1+1} = \frac{1}{2};$$

$$f^4(-1) = f(1/2) = 2/3 \text{ and } f^5(-1) = f\left(\frac{2}{3}\right) = \frac{3}{5}.$$

43. (b) $f(x) = \log\left(\frac{1+x}{1-x}\right)$ and $f(y) = \log\left(\frac{1+y}{1-y}\right)$

$$\therefore\ f(x) + f(y) = \log\left(\frac{1+x}{1-x}\right) + \log\left(\frac{1+y}{1-y}\right)$$

$$= \log\left\{\left(\frac{1+x}{1-x}\right)\left(\frac{1+y}{1-y}\right)\right\} = \log\left(\frac{1+x+y+xy}{1-x-y+xy}\right)$$

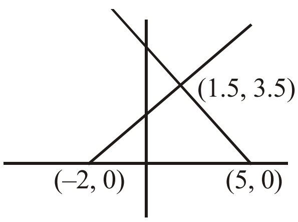
$$= \log\frac{(1+xy)\left(1+\frac{x+y}{1+xy}\right)}{(1+xy)\left(1-\frac{x+y}{1+xy}\right)}$$

[Divide and multiply the numerator & denominator by $(1+xy)$]

$$= \log\frac{1+\frac{x+y}{1+xy}}{1-\frac{x+y}{1+xy}} = f\left(\frac{x+y}{1+xy}\right)$$

44. (d) [x] means if $x = 5.5$, then $[x] = 5$
$L[x, y] = [x] + [y] + [x + y]$, $R(x, y) = [2x] + [2y]$
Relationship between L (x, y) and R (x, y) can be found by putting various values of x and y.
Put $x = 1.6$ and $y = 1.8$.
$L(x, y) = 1 + 1 + 3 = 5$ and $R(x, y) = 3 + 3 = 6$
So, (b) and (c) are wrong.
If $x = 1.2$ and $y = 2.3$.
$L(x, y) = 1 + 2 + 3 = 6$ and $R(x, y) = 2 + 4 = 6$
Or $R(x, y) = L(x, y)$, so (a) is not true
We see that (d) will never be possible

45. (d) $g(x) = \max(5 - x, x + 2)$. Drawing the graph,



The bold lines representing the function g (x) intersect one another at a unique point. It clearly shows that the smallest value of $g(x) = 3.5$.

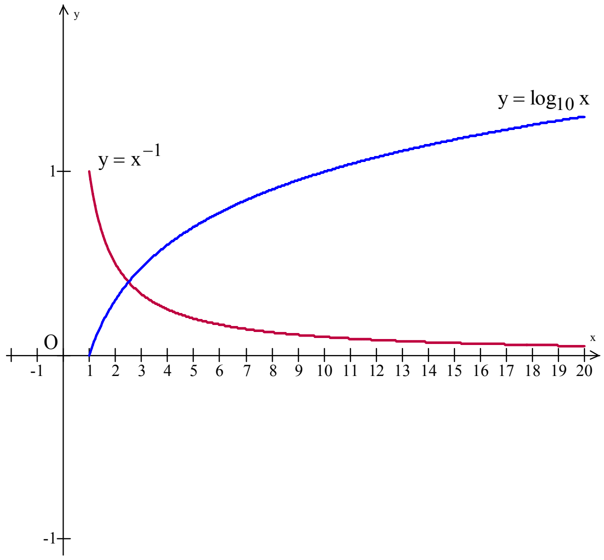
46. (b) $f(x) = |x-2| + |2.5-x| + |3.6-x|$ can attain minimum value when either of the three terms = 0.

Case I : When $|x-2| = 0 \Rightarrow x = 2$,
Value of f (x) $= 0.5 + 1.6 = 2.1$.

Case II : When $|2.5-x| = 0 \Rightarrow x = 2.5$
Value of $f(x) = 0.5 + 0 + 1.1 = 1.6$.

Case III : When $|3.6 - x| = 0 \Rightarrow x = 3.6$
Value of $f(x) = 1.6 + 1.1 + 0 = 2.7$.
Hence the minimum value of f (x) is 1.6 at x=2.5.

47. (b) The curves can be plotted as follows :



We see that they meet once.

48. (d) Solving the given two curves, we get
$x^3 + x^2 + 5 = x^2 + x + 5 \Rightarrow x^3 - x = 0$
$\Rightarrow x = 0, 1, -1$
All these three points lie in $-2 \le x \le 2$.
At $x = 0$, $y = 0 + 0 + 5 = 5$; $y = 0 + 0 + 5 = 5$
$\Rightarrow$ Point = (0, 5)
At $x = 1$, $y = 1^3 + 1^2 + 5 = 7$; $y = 1^2 + 1 + 5 = 7$
$\Rightarrow$ Point = (1, 7)
At $x = -1$, $y = (-1)^3 + (-1)^2 + 5 = 5$; $y = (-1)^2 - 1 + 5 = 5$
$\Rightarrow$ Point = (–1, 5)
Hence, the two curves intersect at three points.

49. (a) Using the given conditions, we find the following number of members on the indicated date:

Date	No. of members of S_1	No. of members of S_2
Jan 1	n	n
Feb 1	n + b	nr
Mar 1	n + 2b	nr^2
Apr 1	n + 3b	nr^3
May 1	n + 4b	nr^4
Jun 1	n + 5b	nr^5
Jul 1	n + 6b	nr^6
Jul 2	n + 6b	nr^6

Since, on July 2, 2004, number of members of each society are same.

$\therefore \quad n + 6b = nr^6$ ......(i)

But Putting b = 10.5 n in (i), we obtain

$n + 6 \times 10.5\, n = nr^6$ or $64\, n = nr^6$ or $r = 2$.

50. (b) $f(x) = x^3 - 4x + p$

$f(0) = p$ (positive)

Let $p > 0$ ....(ii)

$f(1) = p - 3$ (which will be negative)

$\Rightarrow p - 3 < 0$ or $p < 3$ ....(ii)

From (i) and (ii)

$0 < p < 3$.

Again let $p < 0$ (iii) then $p - 3 > 0$ (iv)

From (iii) and (iv) :

$3 < p < 0$

which is not possible

51. (d) $f(x) = ax^2 - bx$. In this function, x^2 and x are always positive.

The value thus depends on a and b. $f(0) = a - b$. Using different options, we find that $a - b$ will be positive if $a > 0$ and $b < 0$.

The minimum value of a positive function is 0. Hence (d) is correct option.

52. (c) $f_1(x)f_2(x) = f_1(x)f_1(-x) = 0$ for any value of x because if $x > 0$, then $f_1(-x) = 0$ and if $x < 0$ then $f_1(x) = 0$

$f_2(x)f_3(x) = f_1(-x)[-f_2(x)] = f_1(-x)[-f_1(-x)] = 0$ if $x \geq 0$ and < 0 if $x < 0$

$f_2(x)f_4(x) = f_1(-x)\, f_3(-x) = f_1(-x)\, [-f_2(-x)]$

$= -f_1(-x)\, f_1(x) = 0$ (As above)

So all of them are zero.

53. (b) $f_4(x) = f_3(-x) = -f_2(-x) = -f_1(x)$

So, (a) and (c) are not true.

$-f_3(-x) = f_2(-x) = f_1(x)$, i.e., option (b) is true.

54. (d) $g(x+1) + g(x-1) = g(x)$

$\Rightarrow g(x+1) = g(x) - g(x-1)$

Using $x = x + 5$

$\Rightarrow g(x+6) = g(x+5) - g(x+4)$

$= g(x+4) - g(x+3) - g(x+4) = -g(x+3)$

$= -[g(x+2) - g(x+1)]$

$= -g(x+2) + g(x+1)$

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

Hence p = 6.

55. (d) All graphs in this question are drawn to scale and same scale is used on each axis.

By inspection of the graph of (y – x) against (y + x), you can find that angle of inclination of the graph (line) is more than 45°.

$\therefore$ Slope of the line = tan (45° + θ),

where $0° < \theta < 45°$

$$\Rightarrow \frac{y-x}{y+x} = \frac{1+\tan\theta}{1-\tan\theta}$$

$$\Rightarrow \frac{y}{x} = -\frac{1}{\tan\theta} \quad \text{[By componendo and dividendo]}$$

Hence slope of the graph (line) of y against x $= -\dfrac{1}{\tan\theta}$

Now, $0° < \theta < 45°$.

$\Rightarrow 0 < \tan\theta < 1$

$$\Rightarrow -\frac{1}{\tan\theta} < -1$$

By inspection of the graph (line) of y against x, you can find that the slope of the graph of y against x is less than –1 only in option (d).

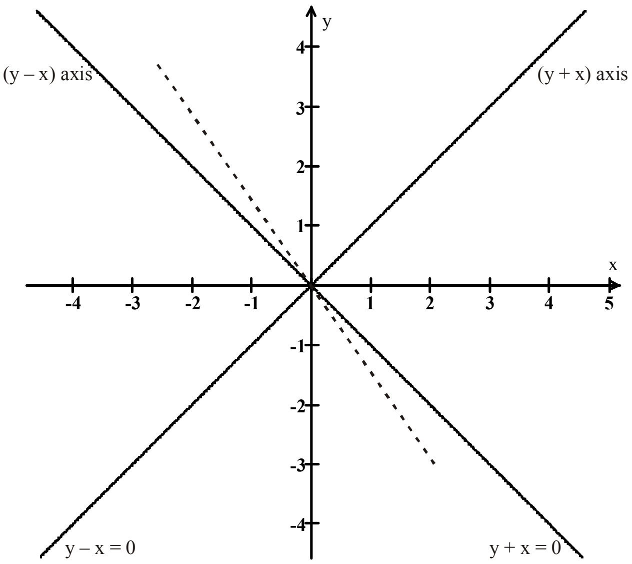
Alternative Method :

In the normal xy-plane, the graph of y – x = 0 is a line passing through the origin and bisects quadrant I and III of the x–y plane.

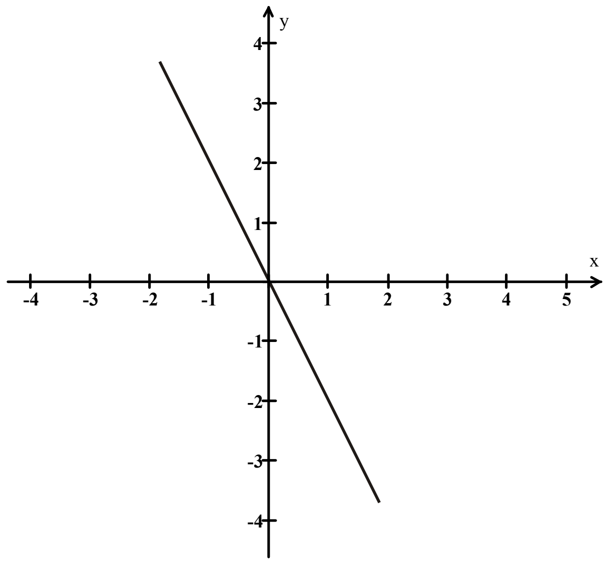
The graph of y + x = 0 is a line passing through the origin and bisects the II and IV quadrants of x – y plane.

So line y – x = 0 and y + x = 0 are perpendicular to each other like the lines x = 0 and y = 0.

Also x = 0 and y = 0 repersent y-axis and x-axis. In the same way y – x = 0 and y + x = 0 reprersent (y + x) axis and (y – x) axis respectively as shown in the graph.



Here dotted line is the graph drawn in the question. If we observe this dotted line with respect to x- and y-axis, it looks like



So the option (d) is correct.

56. (e) $f(x) = \max(2x + 1, 3 - 4x)$
The minimum possible value in this case will be when $2x + 1 = 3 - 4x$.
The reason for this is that the 'max' function will only take the higher value out of $2x + 1$ and $3 - 4x$. So for minimum value of f(x)

$$2x + 1 = 3 - 4x \quad \text{or} \quad x = \frac{1}{3}$$

$$\text{At } x = \frac{1}{3},\ f(x) = 2 \times \frac{1}{3} + 1 = \frac{5}{3}$$

57. (c) Let the quadratic function be $ax^2 + bx + c$
At $x = 0$, $ax^2 + bx + c = 1 \Rightarrow c = 1$
At $x = 1$, $ax^2 + bx + c = a + b + c = 3$ or $a + b = 2$ ...(i)
As the function attains maxima at $x = 1$, so

$$\left.\frac{dy}{dx}\right|_{x=1} = 0 \text{ or } \left.2ax + b\right|_{x=1} = 2a + b = 0 \qquad \text{...(ii)}$$

Using (i) and (ii), we get $a = -2$ and $b = 4$
At $x = 10$, $ax^2 + bx + c = -2(10^2) + 4 \times 10 + 1$
$= -200 + 41 = -159.$

58. (c) Cost function, $C(x) = 240 + bx + cx^2$
When production changes from 20 to 40 units, then

$$C(40) - C(20) = \frac{2}{3}C(20)$$

$\Rightarrow 3.C(40) - 5.C(20) = 0$
$\Rightarrow 3[240 + 40b + 1600c] - 5[240 + 20b + 400c] = 0$
$\Rightarrow 140c + b = 24$ ...(i)
When production changes from 40 to 60 units, then

$$C(60) - C(40) = \frac{1}{2}C(40)$$

$\Rightarrow 2.C(60) - 3.C(40) = 0$
$\Rightarrow 2[240 + 60b + 3600c] - 3[240 + 40b + 1600c] = 0$
$\Rightarrow 480 + 120b + 7200c - 720 - 120b - 4800c = 0$
$\Rightarrow 2400c - 240 = 0$

$$\Rightarrow c = \frac{1}{10}$$

$$\therefore \quad b = 10 \qquad \left[\text{Putting } c = \frac{1}{10} \text{ in (i)}\right]$$

$$\therefore \quad \text{Cost function, } C(x) \quad \frac{1}{10}x^2 \quad 10x \quad 240$$

Profit function, $P(x) = R(x) - C(x)$

$$\Rightarrow P(x) = 30x - \left(\frac{x^2}{10} + 10x + 240\right)$$

$$\Rightarrow P(x) = -\frac{x^2}{10} + 20x - 240$$

On differentiating we get,

$$P'(x) = -\frac{x}{5} + 20 \qquad \text{...(ii)}$$

Put $P'(x) = 0$, for maxima or minima
$\therefore \quad x = 100$
Again differentiating equation (ii), we get

$$P''(x) = -\frac{1}{5} \Rightarrow P''(100) = -\frac{1}{5} < 0$$

Hence, profit is maximum when production = 100 units

59. (a) Maximum daily profit = $P(100)$

$$= -\frac{(100)^2}{10} + 20 \times 100 - 240 = -1000 + 2000 - 240 = \text{Rs}$$

760

60. (e) The given function can be described as seed (n) = Sum of the digits of n. Here, we have to find the number of positive integers n such that $n < 500$ and sum of the digits of $n = 9$. So, the number n will be 9, 18, 27, ... and so on but less than 500. Actually these are the numbers divisible by 9 but less than 500.

$$\text{Now, } \frac{500}{9} = 55.55\ .....$$

Hence, required number of n = 55.

61. (b) $f(x).\ f(y) = f(x.y)$
$\Rightarrow \quad p(0)\ .\ p(1) = p(0)$
$\therefore \quad p(1) = 1$

$$\text{Now, } p(2)\ .\ p\left(\frac{1}{2}\right) = p(1)$$

$$\Rightarrow \quad 4 \times p\left(\frac{1}{2}\right) = 1$$

$$\therefore \quad p\left(\frac{1}{2}\right) = \frac{1}{4}.$$

62. (a) $\{x\} = x - [x] \qquad \text{or} \qquad \{x\} + [x] = x$
The given equation
$5[x] + 3\{x\} = 6 + x \Rightarrow 2[x] + 3([x] + \{x\}) = 6 + x$
reduces to
$2[x] + 3x = 6 + x$
or $2[x] + 2x = 6$
or $[x] + x = 3$ ...(i)
Since 3 and [x] are both integers, in the above equation x must also be an integer.
$\Rightarrow [x] = x$

$$\text{Hence, } 2x = 3 \text{ or } x = \frac{3}{2}$$

No satisfactory solution in equation ...(i)

63. (c) $2f(x) + f(1 - x) = x^2$
Replacing x by $(1 - x)$ in the above equation, we get:
$2f(1 - x) + f(x) = (1 - x)^2$
Solving the above pair of equations, we get:

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

$$\text{Thus, } f(5) = \frac{34}{3}.$$

64. (c) Distance of origin (0, 0) from the line $3y - 4x - 15 = 0$:

$$\left|\frac{3(0) - 4(0) - 15}{\sqrt{3^2 + 4^2}}\right| = \frac{15}{5} = 3 \text{ units}$$

Let the new lines drawn parallel to $3y - 4x - 15 = 0$ be L_1 and L_2.
Distance of L_1 from origin = 3 + 3 = 6 units
Distance of L_2 from origin = 3 – 3 = 0 units
The circle $x_2 + y_2 = 25$ has a radius of 5 units.
Hence line segment of L_1 lying outside the circle will be of zero length (L_1 does not cut the circle).
Chord cut by L_2 will be diameter = 10 units

65. (c) It can be concluded that 5 and k are the two distinct roots of the equation $ax^2 + bx + 1 = 0$.

Also, product of the roots $= \frac{1}{a} < 0$ (as $a < 0$).

Hence, $5k < 0 \Rightarrow k < 0$.

66. (c) The given graph must be of an equation of type

$$\frac{3-x}{y+5} = -\frac{1}{k} \text{ where } k > 1.$$

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

$y + 5 = kx - 3k$

$y = kx - (3k + 5)$

This is the equation of a line in the x-y plane, whose slope (k) is greater than zero and it has a negative intercept (of length $3k + 5$) on the y-axis.

Only one graph satisfies the condition.

67. (d) $\frac{a^2+a+1}{3} \geq (a^2 \times a \times 1)^{1/3}$ ....By AM – GM relation

Hence, $\frac{a^2+a+1}{3} \geq a$ or $\frac{a^2+a+1}{a} \geq 3$

Similarly, a similar relation for b, c, d and e and then multiplying, we get

$$\frac{(a^2+a+1)(b^2+b+1)(c^2+c+1)(d^2+d+1)(e^2+e+1)}{abcde} \geq 3^5 = 243$$

68. (a) $mx^m = nx^n$

$\therefore x^m = \frac{nx^n}{m}$

$\therefore$ Given $\left(\frac{1}{\frac{nx^n}{m}+x^n} + \frac{1}{\frac{nx^n}{m}-x^n}\right)$

$= \left(\frac{m}{x^n(n+m)} + \frac{m}{x^n(n-m)}\right)$

$= \frac{m}{x^n}\left(\frac{1}{n+m} + \frac{1}{n-m}\right) = \frac{2mn}{x^n(n^2-m^2)}$.

69. (d) $f\left(x+\frac{y}{8}, x-\frac{y}{8}\right) = xy$

put $\frac{y}{8} = k$, $f(x+k, x-k) = 8xk$

put $x + k = A$, $x - k = B$ or $x = \frac{A+B}{2}$ and $k = \frac{A-B}{2}$

Now, $f(A, B) = 8\left(\frac{A+B}{2}\right)\left(\frac{A-B}{2}\right)$

$f(A, B) = 2(A^2 - B^2)$; $f(B, A) = 2(B^2 - A^2)$

then $f(m, n) + f(n, m) = 0$ for all m, n

70. (a) The number of triangles with vertices on different lines

$= {}^pC_1 \times {}^pC_1 \times {}^pC_1 = p^3$

The number of triangles with 2 vertices on one line and the third vertex on any one of the other two lines

$= {}^3C_1\,({}^pC_2 \times {}^{2p}C_1) = 6p.\ \frac{p(p-1)}{2} = 3p^2(p-1)$

$\therefore$ the required number of triangles $= p^3 + 3p^2(p-1)$
$= 4p^3 - 3p^2 = p^2(4p-3)$

(The work "maximum" shows that no selection of points from each of the three lines are collinear).

71. (c) Since a, b, c are in H.P.

$\therefore\quad b \ \ \frac{2ac}{a \ \ c}, \Rightarrow b(a+c) = 2ac$

Now $\log(a+c) + \log(a-2b+c)$

$= \log[(a+c)\{(a+c)-2b\}]$

$= \log[(a+c)^2 - 2b(a+c)]$

$= \log[(a+c)^2 - 2 \times 2ac]$

$= \log(a-c)^2$ or $\log(c-a)^2$

$= 2\log(a-c)$ or $2\log(c-a)$

$\therefore\quad \log(a+c) + \log(a-2b+c) = 2\log(c-a)$

72. (a) Let the roots of the equation $x^3 - Ax^2 + Bx - C = 0$ be α, β, γ respectively.

So the roots of $x^3 + Px^2 + Qx - 18 = 0$ will be $\alpha + 2, \beta + 2, \gamma + 2$.

$(\alpha+2)(\beta+2)(\gamma+2) = 18$

$\Rightarrow 4(\alpha+\beta+\gamma) + 2(\alpha\beta+\beta\gamma+\gamma\alpha) + \alpha\beta\gamma + 8 = 18$

$\Rightarrow 4A + 2B + C = 10$

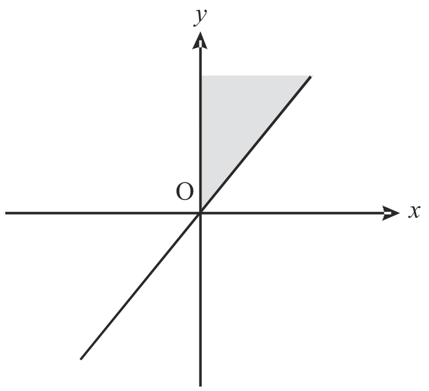
73. (a) Each of the answer choices in the form of the product of two factors on the left and a "≥ 0" or "≤ 0" on the right.

The product will be negative when the two factors have opposite signs, and it will be positive when the factors have the same sign. Choice (a), for example, has a "≥ 0", so you'll be looking for other factors to have the same sign.

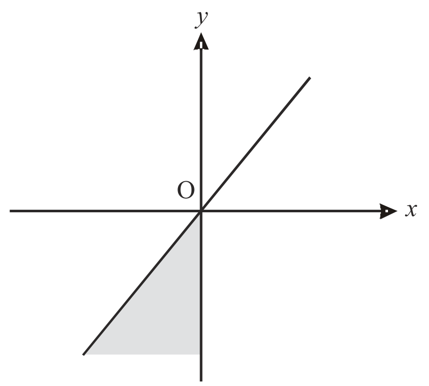
Either : $x \geq 0$ and $y - 2x \geq 0 \Rightarrow x \geq 0$ and $y \geq 2x$

or $x \leq 0$ and $y - 2x \leq 0 \Rightarrow x \leq 0$ and $y \leq 2x$

The graph of $x \geq 0$ and $y \geq 2x$ looks like this :



The graph of $x \leq 0$ and $y \leq 2x$ looks like this.



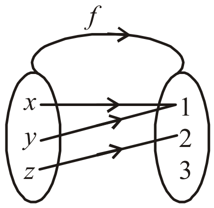
Together, they make the graph in the figure.

74. (b) There are following three cases arise :

Case (I) :

When $f\ \ x\ \ \ 1$, is correct

then $f\ \ y\ \ \ 1$ and $f\ \ z\ \ \ 2$



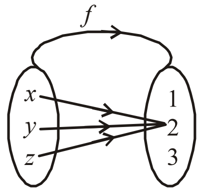
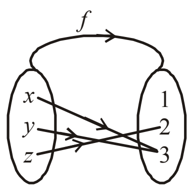
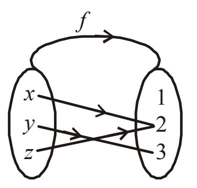
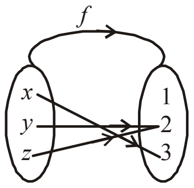
clearly the mapping f is not injective (i.e., not one-one) Hence this case is not possible.

Case (II) :

When $f\ \ y\ \neq 1$, is correct

then $f\ \ x\ \neq 1$ and $f\ \ z\ \ \ 2$

Hence z mapped to 2 but x and y or mapped to 2 or 3 or one of them mapped to 2 and the other mapped to 3.

1. 
2. 
3. 
4. 

Clearly in all the above 4 sub-cases, we see that the mapping f is not injective (i.e. not one-one). Hence, this case is not possible.

Case (III) :

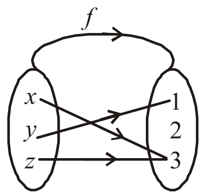
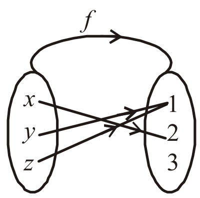
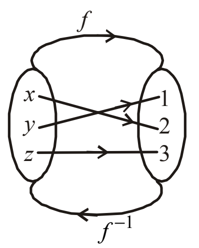
If $f\ \ z\ \neq 2$, is correct

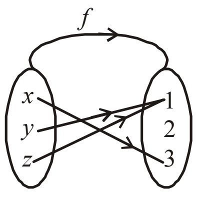
then $f\ \ x\ \neq 1$ and $f\ \ y\ \ \ 1$

Hence y mapped 1 but x mapped 2 or 3

Whereas y mapped 1 or 3.

The possible four mapping are as follows :

1. 
2. 
3. 

4. 

Clearly in sub case (c), the mapping is injective (i.e., one-one). Hence this case is possible and

$f^{-1}\ 1\ \ \ y$

75. (c) $f(x) = \dfrac{1}{\log_{5-|x|}\sqrt{x^3 - 7x^2 + 14x - 8}}$

$= \dfrac{1}{\log_{5-|x|}\sqrt{(x-1)(x-2)(x-4)}}$

Base of the logarithmic function $5 - |x| > 0$ and $5 - |x| \neq 1$

So, $x \in (-5, -4) \cup (-4, 4) \cup (4, 5)$ ...(i)

Also, $(x-1)(x-2)(x-4)$ must be greater than zero as well

So, $x \in (1, 2) \cup (4, \infty)$ ...(ii)

Combining (i) and (ii) : $x \in (1, 2) \cup (4, 5)$

76. (a) Given that $F(n-1) = \dfrac{1}{(2 - F(n))}$ and $F(1) = 2$.

For $n = 2 : F(1) = \dfrac{1}{(2 - F(2))}$

$\Rightarrow F(2) = \dfrac{3}{2}$,

Similarly, we can find the values of F(3), F (4), F (5) as

$\dfrac{4}{3}, \dfrac{5}{4}$ and $\dfrac{6}{5}$ respectively.

$\Rightarrow F(n) = \dfrac{n+1}{n}$

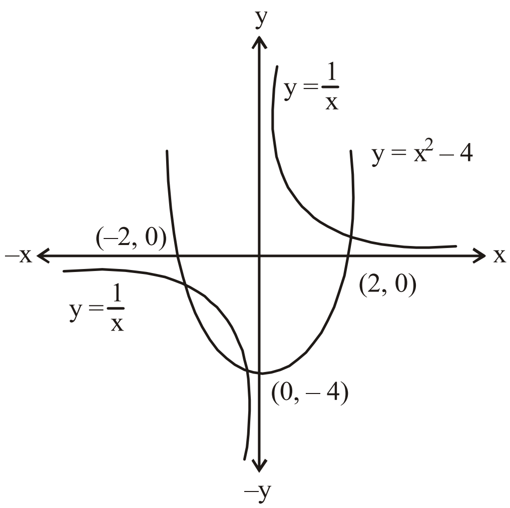
From this we can say that every term except [F(1)], of the series [F(1)] + [F (2)] + ... + [F (50)] is equal to 1 as for 'n' > 0, F (n) lies between 1 and 2.

Therefore, [F (1)] + [F (2)] + ... + [F (50)] = 51.

Hence, option (a) is the correct choice.

77. (d) The graphs of the two functions are shown below:

If a > 0 in any parabolic function then parabola open up side



From the above figure, it is obvious that the graphs of the two functions intersect at three points.

78. (b) Convert into sine form this is a increasing function

At $x = \dfrac{\pi}{4}$, $f(x) = 0$

At $x = \dfrac{\pi}{2}$, $f(x) = \infty$

Hence, f(x) lies in the range of $(0, \infty)$

79. (a) The sum of the roots of $ax^2 + bx + c = 0$ is $\frac{-b}{a}$.

By differentiating we get $2ax + b = 0$

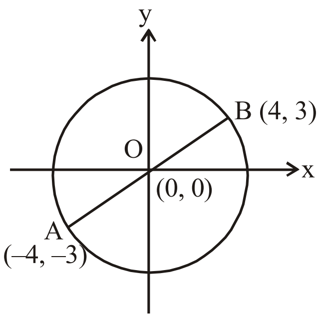
$ax^2 + bx + c$ attains its maximum value at $x = \frac{-b}{2a}$.

$\therefore \frac{-b}{2a} = 2 \Rightarrow \frac{-b}{a} = 4$

Hence, the sum of the roots = 4.

80. (b) Let us assume $f(0) = K$, where 'K' is a constant.
Then, $f(0 + y) = f(0.y) = f(0) = K$
and $f(x + 0) = f(x.0) = f(0) = K$.
This proves that the function is a constant function.
Thus, the value of
$f(-49) = f(49) = 7$
Hence, $f(-49) + f(49) = 14$.

81. (c)

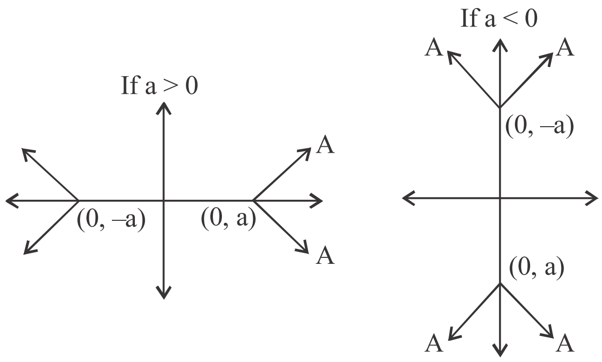


Other two vertices will make two right angled triangles with AB as the common hypotenuse. So they must lie on the circle with AB as the diameter and O as the centre. Radius of that circle will be 5 units.
There will be 5 such pairs in which both the coordinates are integers.
[(5, 0), (–5, 0), [(4, 3), (4, –3)],
[(–3, 4), (3, –4)] [(–3, –4), (3, 4)] and [(0 5), (0, –5)]

82. (0) Clearly, $x > 0$
So, $2x = x^2 + 2x + 1$
$\Rightarrow 0 = x^2 + 1$
Here, no any real roots.
Hence, there are no solutions.

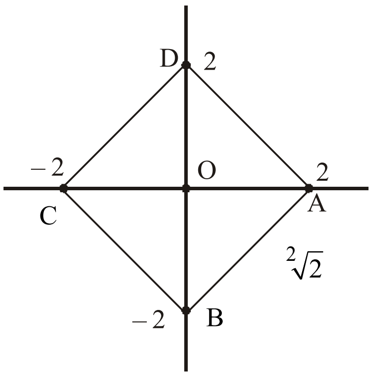
83. (c) $[\log_{10} x] = 0$, for any value of $x \in \{1, 2, ...9\}$, ...(1)
Similarly $[\log_{10}x] = 1$, for $x \in \{10, 11, 12 ... 99\}$...(2)
and $[\log_{10}x] = 2$, for
$x \in \{100, 101, 102, ... 999\}$ ...(3)
Now consider, $1 \le n \le 9$, then
$[\log_{10}1] + [\log_{10}2] + [\log_{10}3] ... [\log_{10} n] = 0$ (i.e., $\neq n$)
Hence the expression given in the question cannot be satisfied.
Now consider, $10 \le n \le 99$, then $[\log_{10}1] + [\log_{10}2] ... [\log_{10}n]$
From (1) and (2), the above expression becomes (0 + 0 ... 9 times) + (1 + 1 + ... (n – 9) times) = n – 9
Using the same approach, for
$100 \le n \le 999$, $[\log_{10}1] + [\log_{10}2] ... [\log_{10}n]$
$= 90 + 2(n - 99)$
If can be seen that, only for the third case i.e., $100 \le n \le 999$, can the expression given in the question be satisfied.
Hence $90 + 2(n - 99) = n$
$\Rightarrow n = 198 - 90 = 108$
$\therefore 107 \le n < 111$.

84. (b) The lines represented by A where $a > 0$ and when $a < 0$ are given in the following figures



The area enclosed by A and D would be zero if $d < |a|$. In choice (b), $d = 1$ and $a = -2$ i.e., $d < |a|$.
If $a > 0$, then the only case when the area enclosed by A and D will be zero, is when $d = 0$.

85. (c)



Area = $2\sqrt{2} \times 2\sqrt{2}$
= 8

$$\left[\begin{array}{ll} \therefore & AB = \sqrt{(2)^2 + (2)^2} \\ AB & = 2\sqrt{2} \end{array}\right]$$