DASH CAT 1

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Instructions

The passage below is accompanied by a set of questions. Choose the best answer to each question.

Trillions [a book by Robin Wigglesworth] is a history of passively managed index funds, tracking the sector from its beginnings more than a century ago when a French mathematician named Louis Bachelier wrote a PhD thesis on applying probabilities to stock markets. Bachelier's book disappeared into obscurity until Leonard Jimmie Savage, a University of Chicago statistics professor, dusted it off in 1954, inspiring a generation of academics. Today, index funds have grown into a $16trn behemoth, and they are still one of the fastest-growing sectors in investment banking.

The central idea of the index fund industry is the efficient markets hypothesis, which holds that the market knows best, because "at any given time, all known, relevant information [is] already reflected in stock prices". To the investment banking industry, which has made many fortunes from the idea that some people have better information than others, there are few ideas more controversial. The academics, geeks and maverick financiers who created this new sector in the 1970s were usually laughed out of the room when they dared to suggest it.

But as the debate raged through the halls of academia and finance houses, more and more research found that when total returns including dividends are taken into account, passively tracking an index is usually the best way to make money from capital markets. In the 1990s, stock markets began trading shares in exchange-traded funds (ETFs), financial "warehouses" that package together investments in many different assets, and the idea went mainstream.

Unlike many disruptive innovations, index funds haven't concentrated money in the hands of fewer people. In fact, because they don't pay for fund managers' perceived prowess, index funds charge much lower fees than their actively managed counterparts.

The savings are enormous: the 2020 revenue of just one of the large fund managers, Fidelity, is considerably more than the cost to investors of the entire $8trn ETF sector. "The net savings [to investors]… amount to trillions of dollars, money that goes into the pockets of savers, rather than highly paid finance industry professionals," writes Wigglesworth.

But Trillions is not a love letter to passive investing. In the final quarter of the book, Wigglesworth explores the knock-on effect of the rapid expansion of index funds and ETFs, and the ways in which the industry is beginning to eat itself.

Last November, Tesla's share price leapt wildly as investors celebrated its inclusion in the S&P 500. Having posted four consecutive quarters of profits, the electric car manufacturer was deemed by the bureaucrats in charge of compiling the index to be ready for inclusion. This meant all the funds and ETFs tracking that index would be forced to buy its shares, and the sudden increase in demand caused a 70 per cent jump in its share price, pushing its already lofty market value over $650bn.

The incident is emblematic of the increasing power of those who compile indices, and those in charge of the funds that track them. "The biggest shareholders in almost every major US company are now index funds, and internationally the trend is heading the same way," writes Wigglesworth. "There are mounting signs that the index fund tail is beginning to wag the market dog."

1. Which of the following best captures the purpose of the book that the passage is primarily concerned with?

A. To emphasise the transformation that the investment banking sector underwent during the 1990s due to the introduction of ETFs.

B. To discuss the various historical works that have enabled academicians to identify index funds as the best way to make money from capital markets.

C. To track the growth of passively managed index funds and discuss their impact on capital markets.

D. To highlight the exponential growth of the passively managed index funds while extolling them for saving money for smaller investors and arming them with substantial market power.

Sol. The passage is primarily concerned with the book *Trillions* which deals with index funds. The following excerpts will help us identify the main purpose of the book:

Trillions is a history of passively managed index funds, tracking the sector from its beginnings more than a century ago.....

But Trillions is not a love letter to passive investing. In the final quarter of the book, Wigglesworth explores the knock-on effect of the rapid expansion of index funds and ETFs, and the ways in which the industry is beginning to eat itself.

It is clear that the book covers the growth of the industry from the start. It not only highlights the positive aspects but also analyses the flip side of the rapid growth of this industry. Option C comes the closest to capturing this, and hence, is the answer.

Option A: The purpose of the book is more than to highlight the changes that have taken place in the investment industry. Thus, Option A is a part of the overarching theme.

Option B: The book does more than cover the history of index funds and related works. It also critically evaluated the effect of the rapid growth of this industry has. Hence, Option B is incomplete.

Option D: Option D contains one distortion. While the author lauds the index fund for saving costs for ordinary investors, he does not applaud the knock-on effect produced by these funds as stated in the last part of the option. Instead, the author cautions against this trend by saying that the industry is beginning to eat itself.

2. "There are mounting signs that the index fund tail is beginning to wag the market dog."

Which of the following best captures the meaning of this sentence?

A. Index funds have grown to the extent that they are actively influencing markets that they were supposed to passively track.

B. The trends in the market suggest that the omnipresence of index funds in markets will significantly reduce the influence of other market elements.

C. Index funds have grown to such an extent that they are actively eating into the savings they were generating.

D. The tremendous influence of index funds on stock prices has allowed them to supplant actively managed funds.

Sol. We come across this phrase in the final paragraph: {"*The biggest shareholders in almost every major US company are now index funds, and internationally the trend is heading the same way," writes Wigglesworth.* "**There are mounting signs that the index fund tail is beginning to wag the market dog.**"} Wigglesworth emphasises the immense power that the index fund industry exercises over the capital markets. In the preceding paragraph, it is shown how rapid subscription of certain stocks dependent on the decision of index fund bureaucrats immensely affects the stock prices {*...the sudden increase in demand caused a 70 per cent jump in its share price, pushing its already lofty market value*

over $650bn...}. Given that index funds were introduced a few decades back, their phenomenal growth has elevated them from a less significant position to a more significant one.

The idiom 'tail wagging the dog' refers to a situation where an important thing is being controlled by something less so. The dog is supposed to control the tail since the tail is just another body part. The same logic applies to capital markets and index funds: index funds are just another small part of the capital markets. Although index funds are supposed to passively track the market trends, Wigglesworth emphasises the immense power that the index fund industry exercises over the capital markets today. The market trends are now contingent on the trends in the index fund industry. Here, the lines convey that the index funds, which were supposed to passively track the market, have become so humongous in terms of the influence that they now control the market. Thus, the 'tail' wags the 'dog'. Option A comes the closest to capturing this idea, and hence, is the answer.

Option B: Option B is not implied in the passage. There is no mention of the waning influence of other market elements; the passage simply discusses the increased control of index funds on the same. Hence, Option B can be eliminated.

Option C: Option C is out of scope: we cannot infer that index funds are "eating into the savings they were generating".

Option D: Option D is not discussed in the passage. The author does not delve deep into the status of actively managed funds.

Hence, Option A is the correct choice.

3. Which of the following correctly captures the change in the perception of index funds over the years?

A. Index funds were once considered to produce lower returns but now are universally accepted and consequently receive huge investments.

B. From being considered controversial and unacceptable in financial circles, they are now seen as a quality investment.

C. From being laughed at in financial circles, they have now become the dominant investment form.

D. From being trapped in obscurity for ages, index funds today are behind the success of major companies.

Sol. The following excerpt will help understand how the perception of the idea of index funds has changed over the years:

To the investment banking industry, which has made many fortunes from the idea that some people have better information than others, there are few ideas more controversial. The academics, geeks and maverick financiers who created this new sector in the 1970s were usually laughed out of the room when they dared to suggest it.

But as the debate raged through the halls of academia and finance houses, more and more research found that when total returns including dividends are taken into account, passively tracking an index is usually the best way to make money from capital markets.

The above excerpts show that while once the idea was laughed off, research proved that it is usually the best way to make money from capital markets. Thus, today, they are perceived as a good investment instrument. Option B perfectly captures this, and hence, is the answer.

The author does not discuss the earlier perception around the return potential of index funds. Option A is incorrect.

Option C exaggerates the current perception by calling index funds the dominant investment form. While they have been called a behemoth, we dont know if they dominate other forms of investment.

It cannot be inferred that index funds are behind the successes of major companies. Option D is outside the scope of the passage.

4. Which among the following best highlights the important points that summarize the history of index funds as given from the passage?

A. Genesis-Debates-Meteoric rise-Downfall

B. Origin-Controversy-Meteoric rise-Warning Signs

C. Genesis-Obscurity-Meteoric rise-Negative influence

D. Origin-Controversy-Public acceptance-Meteoric rise

Sol. The passage begins by introducing the concept of applying probabilities to stock markets, the main idea behind index funds, and how it remained controversial in finance circles for long. The debates on index funds persisted until research pronounced it as an excellent investment strategy. This led to a meteoric rise in the popularity of index funds. However, the growth of index funds had a secondary effect: their ability to influence capital markets also grew. Towards the end of the passage, the author hints at how the excess influence of index funds might not be entirely desirable. He subtly highlights the ability of index funds to drive stock prices to above-par prices and exert control over market trends. Additionally, the final line ("*There are mounting signs that the index fund tail is beginning to wag the market dog.*") appears to have a negative connotation. Thus, the author is touching upon some warning signs that might be emerging with regard to the index fund industry. {...*Wigglesworth explores the knock-on effect of the rapid expansion of index funds and ETFs, and the ways in which the industry is beginning to eat itself...*}

Hence, the author begins by tracing the Origin, highlighting the Controversy, portraying the Meteoric Rise and finally, highlighting the Warning signs in the index fund industry. Option B perfectly captures this and is the answer.

"Downfall" and "Negative influence" in Options A and C might be a bit farfetched and can be discarded. Additionally, the term "obscurity" in Option C does not fit with the overall flow of the discussion.

Option D completely misses out on the impact of index funds on the market and thus, can be rejected as a possible answer.

Hence, Option B is the correct choice.

Instructions

The passage below is accompanied by a set of questions. Choose the best answer to each question.

Since the millennium, there has been a huge increase in the visibility of philosophy, both online and off. There are, of course, books on philosophy, but also numerous popular live events, courses, podcasts, television and radio programmes, and newspaper columns. Philosophy today is as likely to be found on YouTube as it is in a bookshop or library.....This complex and heterogeneous phenomenon is generally called 'public philosophy'. It's philosophy done in public rather than behind the doors of seminar or lecture rooms, or in paywalled academic journals.

'Public philosophy' seems at first glance to be what Ludwig Wittgenstein dubbed a family resemblance term. He used the example of a game to illustrate this concept. Just because we call something a game doesn't mean that it has some essential feature that all games share. Wittgenstein maintained that, often, there are simply resemblances between the things we call by the same name, just as there are shared and overlapping physical characteristics that run through a family related by blood, but no single visible defining feature. Similarly, one may think that perhaps there's no one essential quality that all public philosophy has but, rather, there is a cluster of important features that the many examples of it have in common. In the case of games, the philosopher Bernard Suits argued _____. There was in fact something that all games shared, namely that they are voluntary activities in which players attempt to overcome unnecessary obstacles. You could simply walk and place the golf ball into the hole with your hand, but instead you have to abide by the rules of the game, which means you have to hit it there with a golf club.

Although philosophy itself is very difficult to define, it is less ambitious to look for what all public philosophy, or at least all good public philosophy, has in common. I want to argue that public philosophy can and must be identified by its purpose. We should ask the question 'Why do we engage in public philosophy?' in order to answer the question 'What is public philosophy?'

..... Like Socrates, who walked through Athens disturbing his fellow citizens with his questions and forcing them to review their opinions in order to evaluate their consistency and possible implications, public philosophy is a practice that, as it were, 'disturbs'. It forces the audience to reflect critically on what they thought they knew. The philosopher helps the process of investigation by demonstrating underlying distinctions and connections (conceptual analysis), by revealing implicit assumptions, and by letting possible implications of a given thesis emerge. The ideal outcome would be for everyone to actively participate in the process of rational investigation (thereby exercising some specific cognitive and argumentative abilities), and to achieve a more profound understanding of the examined issue.

.....Often - it is said - what distinguishes academic from public philosophy is the intended target. Public philosophy is philosophy undertaken in public venues, addressed to a nonprofessional audience. However, this definition in terms of its audience is still too general and says too little about the nature of this practice. Introductions to a philosopher or a philosophical issue are also meant for a nonprofessional audience, and yet they are not examples of public philosophy in the strict sense I'm outlining here. They differ regarding the educational purpose they want to achieve.

5. Which of the following correctly explains 'family resemblance' as defined by Wittgenstein?

A. Though family members have a shared bloodline and common heritage, they have distinct features and unique personalities.

B. Family members need not have a defining feature unique to them as long as specific other characteristics overlap among them.

C. Though there is no single defining feature common to all family members, there are shared and overlapping physical features among them.

D. A common inheritance among family members results in certain shared and overlapping features, which distinguish them from others.

Sol. *Wittgenstein maintained that, often, there are simply resemblances between the things we call by the same name, just as there are shared and overlapping physical characteristics that run through a family related by blood, but no single visible defining feature.*

What the author wants to highlight here is that just like the members of a family do not have a feature common to all, but overlapping features, the thing we call the same name often have simple resemblances.

Example: A mother has these physical characteristics: Blue eyes and Brown Hair. Her son has Black eyes and Brown hair, and her daughter has Blue eyes and Black hair. Though there is not a single feature common among the three (All three do not have the same eye or hair colour), their characteristics overlap, like a Venn diagram.

A: Option A does not talk about overlapping physical features as discussed above. It says that in spite of the shared bloodline, each family member is unique. Hence, Option A can be eliminated.

B: Option B is a distortion. The author does not talk about not having the 'need' of a defining feature as long as other overlapping features are present. It can be eliminated.

C: Option C is the correct answer as explained above.

D: The author does not talk about the common inheritance of the family members resulting in their overlapping features. Option D is out of the scope of the passage.

6. In the case of games, the philosopher Bernard Suits argued _____.

Which of the following is a suitable fill for this blank given in Paragraph 2 considering the context?

A. that the theory of Wittgenstein was far from the truth.

B. that a game needs to be defined properly first.

C. that the theory was wrong and each game did have a single defining feature.

D. that there were no overlapping features as widely held.

Sol. Paragraph 2 opens with Wittgenstein's description of the term 'family resemblance'. His example of games put forward the point that there was no common feature to all the games, but they were considered games because features overlapped among some. Hence, X was considered a game, and shared a feature with Y. Z was considered a game, and shared a different feature with Y. Though X, Y, Z does not have any feature common to all, they have overlapping features.

But after the blank in paragraph 2, the argument of Bernard Suits is given. He says that games do share a feature common to all: It is a "voluntary activity in which players attempt to overcome unnecessary obstacles." This contradicted the argument of Wittgenstein.

Hence, in the context of games, Bernard Suits argues that the argument of Wittgenstein was incorrect, and there was a shared feature. Hence, the blank should indicate the same.

A: Indicated that Wittgenstein was wrong. Hence, A is the correct answer.

B: Though a game is defined in the next lines, Bernard does not argue for the same. Option B does not fit in the blank, as the main contention of Bernard is not the definition of games but the application of the concept of 'family resemblance' to games. Hence, Option B is not the answer.

C: Bernard is not concerned with the defining feature of each game, but a shared defining feature common to all games. Hence, C is wrong.

D: Option D is in clear contradiction with what Bernard is trying to say. It can be safely eliminated.

7. Which of the following cannot be inferred to be a feature of 'public philosophy'?

A. Philosophers and the general public can practice public philosophy at zero cost.

B. One of its aims is to make the general public use their seat of critical reasoning.

C. Its audience is the whole public instead of a select few.

D. It aims to have a wide, profound and deep discussion of the matter at hand.

Sol. A: *It's philosophy done in public rather than behind the doors of seminar or lecture rooms, or in paywalled academic journals.*

Since it is practised in the public instead of 'paywalled academic journals', we can infer that its cost to the public is minimal or zero. But we cannot say the same for the philosopher who is propagating the philosophy, as he must be investing his time and effort to include the widespread public. Hence, Option A cannot be inferred as a feature, and hence, is the answer.

B: *....public philosophy is a practice that, as it were, 'disturbs'. It forces the audience to reflect critically on what they thought they knew.*

From the above excerpt, we can infer that one of the major features of public philosophy is to make the general public use their seat of critical reasoning. Hence, B can be inferred.

C: *It's philosophy done in public rather than behind the doors of seminar or lecture rooms, or in paywalled academic journals.*

As mentioned in the excerpt above, public philosophy aims at the general public, instead of a select few who have access to seminars and lectures or who are able to pay for academic journals. Hence, C can be inferred.

D: *The ideal outcome would be for everyone to actively participate in the process of rational investigation (thereby exercising some specific cognitive and argumentative abilities), and to achieve a more profound understanding of the examined issue.*

From the above excerpt, we can infer that public philosophy aims to have a profound discussion about an examined issue in which a wide public participates. Hence, D can be inferred.

8. Which of the following correctly summarizes the author's take on the distinction between academic and public philosophy?

A. While academic philosophy targets a professional audience, public philosophy targets the general, non-professional audience.

B. Academic philosophy is restricted to seminars or journals, while public philosophy is undertaken in public venues.

C. Both academic and public philosophy share a defining feature and differ only in the name assigned to them.

D. The educational purpose of public philosophy differs from that of academic philosophy.

Sol. .....*Often - it is said - what distinguishes academic from public philosophy is the intended target. Public philosophy is philosophy undertaken in public venues, addressed to a nonprofessional audience. However, this definition in terms of its audience is still too general and says too little about the nature of this practice. Introductions to a philosopher or a philosophical issue are also meant for a nonprofessional audience, and yet they are not examples of public philosophy in the strict sense I'm outlining here. They differ regarding the educational purpose they want to achieve.*

The author believes that academic and public philosophies are not distinguished because of their intended targets, as this definition would be too general and would not say much about the nature of the practice. The author says at the end that a difference would be the educational purpose public philosophy

and introductions to a philosopher serve. Here, introductions to a philosopher is given as an example of academic philosophy to further his point. Hence, Option D is the correct answer.

A: Option A is the point that the author is trying to repudiate. Hence, Option A is not the answer.

B: Option B is also the part of the argument that the author repudiates. Option B can be eliminated.

C: Option C is a distortion. A 'defining feature' is mentioned in the previous paragraphs to present the inherent problems in defining public philosophy with its other counterparts. It has not been mentioned in the context of the discussion of academic and public philosophy. Hence, Option C can be eliminated too.

Instructions

The passage below is accompanied by a set of questions. Choose the best answer to each question.

Small animals don't usually grow very old. Since they're always at risk of becoming another critter's quick snack, the best way to ensure that their genes will make it into the next generation is having a bunch of young as soon as possible. This is certainly true for insects, which, with some famous exceptions like cicadas, often have a life expectancy best expressed in days, weeks or months. In contrast, animals like elephants and humans raise only a few offspring and have bodies that survive for decades: If your size or lifestyle offers protection, you can afford to take your time. This contrasting pattern is so common it suggests that because reproduction and maintenance are both costly, animals simply can't maximize both. So the more energy and nutrients an individual invests in producing offspring, the faster it will probably age, and the shorter its life will be. Yet in social insects such as termites, ants, bees and wasps, the queens appear to have found a way to have their cake and eat it. In many colonies, queens that lay hundreds of eggs every day can stay alive for years or even decades, while workers that never lay a single egg in their life will die after a few months. To try to learn more about what enables the long life of queens in social insects, a team of researchers...decided to compare the activity levels of various genes in termites, ants and bees

...the team found that genes that are known to play crucial roles in reproduction showed different activity patterns in queens than they did in sterile workers. Some of these genes, which carry instructions for making proteins called vitellogenins, were active in queens of all species. The main role of vitellogenins is to support the production of yolk for the eggs. But some scientists suspect that vitellogenins may be doing more than that: In honeybees, at least, research has found that vitellogenins also function as antioxidants. If vitellogenins do the same thing in other social insects, they might contribute to the resistance of queens to oxidation. The team also found differences in the activity of genes involved in the prevention of oxidative damage or the repair of such damage, between queens and egg-laying workers compared with sterile workers. But the precise genes involved differed strongly from one species to another. Apparently, each species has evolved its own way of keeping its queens alive longer, says Korb, who led the study.

The scientists also checked the nutrient-sensing gene network that can increase lifespan when manipulated in fruit flies and didn't find obvious patterns across ages and castes. But they did find something else: differences in the activity of genes involved in the production and effects of a substance called juvenile hormone, a molecule involved in reorganizing the bodies of most maturing insects. Perhaps the same hormone that allows insects to become full-grown adults can also help them to delay ageing, the scientists speculate. But again, precisely how these juvenile hormone-related genes were tuned up or down varied from species to species. To Korb, this somewhat bewildering variety across species reveals an important lesson about the nature of ageing: There isn't one button or switch that allows a species to invest more, or less, in maintenance or reproduction, but a whole dashboard of them that is set up slightly differently in each species.

"The tradeoff between lifespan and reproduction is clearly not hardwired — it is much more flexible than people thought," she says. "Species have evolved different solutions," depending on their own social and natural environments.

9. Which of the following could be an evolutionary change to ensure gene propagation for a species with low life expectations?

A. The species trades off a significant amount of their reproductive potential to increase their lifespan.

B. The species start producing offspring at a much younger age than before.

C. The species allow only the young among them to reproduce to reduce the age of reproduction.

D. The species evolve to become even smaller, reducing the energy needed for survival.

Sol. *...the best way to ensure that their genes will make it into the next generation is having a bunch of young as soon as possible.*

As mentioned in the above excerpt, the best way to ensure gene propagation is by producing offspring from an early age. Hence, Option B is the correct answer.

A: If an organism is giving up the chance to have many offspring to live a few years longer, it would be detrimental to the species as a whole. We cannot say that individual survival is more important for an organism than the survival of the species from an evolutionary standpoint. Hence, A is not the answer.

C: This is a distortion of what is given. Moreover, the objective is to start reproducing as early as possible and not limit reproduction to a few.

D: The objective is to ensure gene propagation which is not improved by the change in option D.

Thus, the answer is Option B.

10. The passage mentions: ".... the queens appear to have found a way to have their cake and eat it." Here, the author is trying to point out that:

A. a contrasting pattern exists between the life spans of bigger animals and certain insects.

B. non-reproducing organisms generally die early in spite of allocating high energy to maintenance.

C. the queens in certain species live longer because of an increased reproduction potential.

D. the queens of certain species have found a way to maximise both reproduction and maintenance.

Sol. *This contrasting pattern is so common it suggests that because reproduction and maintenance are both costly, animals simply can't maximize both. So the more energy and nutrients an individual invests in producing offspring, the faster it will probably age, and the shorter its life will be. Yet in social insects such as termites, ants, bees and wasps, the queens appear to have found a way to have their cake and eat it. In many colonies, queens that lay hundreds of eggs every day can stay alive for years or even decades, while workers that never lay a single egg in their life will die after a few months.*

To understand the point the author is trying to make here, we need to understand the context in which the remark has been made. The author says that reproduction and lifespan are at odds due to the considerable energy each requires. Then he says that the queens of some social insect species have found a way to maximise both. The phrase 'have your cake and eat it too' refers to someone having the best of both worlds. Hence, the author is trying to point out that some species have found out a way to maximise both of these. Option D is the answer.

A: The author does not make this remark to show the contrasting pattern, but the exceptions to the pattern. Option A is not the answer.

B: Option B is a distortion. The author wants to point out having the best of both worlds, and not how not reproducing is fatal to some.

C: Option C is distorted too. Though there is a correlation in some species that an increasing amount of reproduction corresponds to an increased lifespan, the author does not want to point our attention to a relation here, but to the unification of two characteristics that seem to be at odds. Thus, C can be eliminated too.

11. Which of the following is true as per the passage?

A. Juvenile hormones are speculated to play a part in reorganizing the bodies of matured insects as well as their ageing process.

B. The composition of juvenile hormones in different organisms cannot be measured precisely.

C. The aspect of optimizing reproduction at the cost of maintenance is hardwired naturally but varies greatly among different species.

D. The surrounding environment determines the way in which a species deals with the dilemma of lifespan and reproduction.

Sol. A: ....*juvenile hormone, a molecule involved in reorganizing the bodies of most maturing insects.*

It has been given in the passage that the hormone plays a role in reorganizing the bodies of 'maturing' insects and not already 'matured' insects. Hence, A is not true.

B: *But again, precisely how these juvenile hormone-related genes were tuned up or down varied from species to species.*

The author does not say whether the measurement of these hormones is imprecise. The author only talks about the fact that the precise difference in the tuning of the genes which cause the release of these hormones varies across species. Hence, we cannot comment on Option B.

C: *The tradeoff between lifespan and reproduction is clearly not hardwired — it is much more flexible than people thought.*

Option C is just the opposite of what has been mentioned in the passage. It is not true.

D: *"Species have evolved different solutions," depending on their own social and natural environments.*

It has been mentioned that species come up with different solutions to the problem of lifespan vs reproduction, and these solutions depend on the social and natural environment these species live in. Hence, Option D is the answer.

12. What is the purpose of including the second paragraph in the passage?

A. To differentiate between the genes and activity patterns present in queens and workers in certain species.

B. To identify the reasons behind a positive correlation between reproduction and maintenance in the queens of some species.

C. To justify the nature of evolution among different species that leads to an increase in lifespan.

D. To explain the causes that could lead to an increased lifespan of certain members of a species.

Sol. The passage is concerned with two distinct features that seem to be at odds with each other: Reproduction and Maintenance(since maintenance leads to increased lifespan, the two terms can be used interchangeably here).

The third paragraph has been introduced to investigate the reasons which could lead to a positive correlation between the two features. The author identifies the activity of certain genes which lead to an increase in both. Option B correctly captures this, and hence, is the answer.

A: The main purpose of the author in this paragraph is not to differentiate the genes or activity patterns between queens and workers. Rather, the author wants to delve into why the queens exhibit each of the two features without compromising on the other.

C: The main contention of the author in this paragraph is not to justify an increased lifespan, but to justify an increased lifespan in spite of an increase in reproduction. Thus, Option C is incomplete.

D: Option D fails to mention the role of reproduction in the discussion too. The author wants to explain the causes of increased lifespan even when there is an increase in reproduction. Option D is incomplete too.

Instructions

The passage below is accompanied by a set of questions. Choose the best answer to each question.

Wheelchairs for different sports vary widely, although they share some similarities. Many are built from high-tech materials, such as carbon fiber, that make them both strong and lightweight. They often include rubber-coated wheel-turning grips that athletes grab with gloved hands to maximize friction. But beyond that, the designs diverge. In wheelchair fencing, for example, the wheels are locked into place while athletes strike and dodge from set positions. So fencing chairs are equipped with leg straps and sturdy handles that help the athlete stay solidly seated. And many have a lower than usual back to enable more upper-body movement.

The basic shape of a fencing chair still looks a lot like that of an everyday wheelchair. But this is not at all the case with racing chairs...A third wheel in the front of such a device enables a low, elongated shape, which works optimally with the athlete's position: kneeling and leaning forward. Spoked wheels are usually swapped out for smooth disks that generate less air turbulence, reducing the effort required to move at high speeds.

For sports that require more manoeuvrability, yet another design element is required. "Your tires or your wheels are actually slanted," says retired American wheelchair basketball player Becca Murray, who has participated in three Paralympic Games and won gold at two of them. "And the dynamic of that is that it helps you be faster, and you're able to turn quicker on the dime, whereas your everyday chair—it doesn't let you turn as sharp." Additional wheels on the back of the chair also help with these speedy turns and add stability. But such chairs do sometimes tip over, so designs must be sturdy. This is also why athletes wear straps or belts across their hips and legs. "If you were to fall over, you want to be able to just get right back up," Murray says. "So you want your wheelchair to stay attached to you, almost like you're one with the wheelchair."

In addition to suiting a specific sport, a device must serve each athlete's unique needs. "Most of the equipment is custom-made: it's designed to get the most out of that individual athlete's physical body," says Ian Brittain....For instance, prosthetic legs for track and field may or may not include mechanical knee joints. "Some runners, depending on the length of their limb, will have a knee joint added" if they

have an above-the-knee amputation, Dyer says. “But there are some unique athletes, and a good example of that is the British athlete Richard Whitehead.” Whitehead has two above-the-knee amputations and has developed his own running style—one that does not require knee joints at all.

....Among athletes who compete in wheelchairs, similar customization is necessary. For instance, increasing the height of the chair’s back and the slope of its seat, also called the “dump,” can help compensate for abdominal weakness. “I actually have a little dump in my chair because I don’t have all my core muscles to help me with that balance,” Murray explains. “It just means that my knees are higher than where I’m sitting, so it’s on an incline.” Players with injuries high on their spine may have less abdominal strength than Murray and require a dump even in their everyday chair. Others with amputations or knee injuries may have more abdominal strength and not need a dump at all.

13. Which of the following best describes the idea organization in the passage?

A. Wheelchairs for sports-Requirements-Modifications-Customizations

B. Paralympic Wheelchairs-Racing and Modifications-Other devices-Custom designs

C. Devices for disabled-Wheelchair Racing-Other devices-Customizations

D. Wheelchairs for sports-Racing and modifications-Other devices-Custom designs

Sol. The following is the flow of the ideas in the passage:

The author introduces the use of wheelchairs in sports, and how they vary from sport to sport, highlighting different features of the same. The author then delves into the reason for this: the different requirements of different sports. While some require the athlete to achieve high speeds, others require him to be fixed at a position and manoeuvre. The author then talks about the different modifications that are made to the wheelchairs to suit these requirements. The author then talks at length about how not only wheelchairs but all the devices designed for this purpose must be customized to suit the individual, depending upon the nature of the injury and disability.

Option A comes the closest in capturing this idea flow, and hence, is the answer.

B: The Paralympics has not been mentioned in the passage in the beginning, the scope of the first paragraph extends to all sports which have participation from the specially abled.

C: The major contention of the author here is wheelchair. Other devices are introduced in the penultimate paragraph to further his point about customization. Since Option C mentions devices in the beginning of the idea flow, it can be eliminated.

D: Option D comes close to the answer. However, it has two faults. The first is that Racing has been mentioned to introduce the different requirements of different sports. Hence, we are missing out on fencing, if we write only Racing instead of requirements. The second is that 'Other devices' are mentioned to make a wider point: Customization. Hence, Option A is a better choice.

14. Which of the following can be inferred from the passage?

A. In the sport of wheelchair fencing, more emphasis is placed on sturdiness than agility.

B. Rubber gloves are the most appropriate for handling rubber-coated wheel-turning grips.

C. The third wheel added to racing wheelchairs performs a completely different function as compared to the third wheel added to basketball wheelchairs.

D. A wheelchair with spokes would be slower than one with discs, other factors remaining constant.

Sol. Option A: *In wheelchair fencing, for example, the wheels are locked into place while athletes strike and dodge from set positions. So fencing chairs are equipped with leg straps and sturdy handles that help the athlete stay solidly seated.*

The passage indicates that the wheelchairs need to be solid and sturdy. The option misconstrues this fact and says that in the game, sturdiness is an overall preferred ability over agility. This cannot be inferred, as the athlete could require a great deal of agility. Option A cannot be inferred.

Option B: {*They often include rubber-coated wheel-turning grips that athletes grab with gloved hands to maximize friction.* }

The passage does not mention that the gloves worn are rubber gloves. Hence, Option B cannot be inferred.

Option C: The statement here can be inferred. With regard to racing, the author states the following: { *But this is not at all the case with racing chairs...A third wheel in the front of such a device enables a low, elongated shape, which works optimally with the athlete's position: kneeling and leaning forward.* }

At the same time, the author presents the following remark concerning wheelchairs in basketball: { *Additional wheels on the back of the chair also help with these speedy turns and add stability. But such chairs do sometimes tip over, so designs must be sturdy.* } It is evident that the purpose of adding extra wheels is different in each case. Hence, Option B is correct.

Option D: Though it has been mentioned that smooth disks generate less air turbulence, reducing the effort to move at high speeds, we cannot say that it actually increases the speed of the wheelchair. Its function could be limited to facilitating movement at high speeds and not affecting the ability to accelerate. Option D cannot be inferred.

15. Which of the following is the author most likely to agree with?

A. Improvements in wheelchair performance in sports results in better features for average wheelchair users with time.

B. An added knee joint is not a perfect indicator of whether the leg of the athlete is amputated below or above the knee.

C. The straps that hold the athlete to the wheelchair can also result in a mishap if the wheelchair turns over.

D. Speed is not as important as comfort when it comes to the everyday use of wheelchairs and other similar devices.

Sol. A: In various examples throughout the passage, the author has provided how the features important in sports are not used in normal wheelchairs. He has not mentioned anywhere that the research and development that goes into improving performance results in better features for the average users too. Hence, Option A can be eliminated.

B: *"Some runners, depending on the length of their limb, will have a knee joint added" if they have an above-the-knee amputation, Dyer says. "But there are some unique athletes, and a good example of that is the British athlete Richard Whitehead." Whitehead has two above-the-knee amputations and has developed his own running style—one that does not require knee joints at all.*

If athletes have an above the knee amputation, then they have a knee joint added. However, it is not an indicator of the same, as some athletes have above the knee amputations and still do not use knee joints. Hence, Option B is correct.

C: The author does not mention the flip side to the use of straps, only the advantages. Hence, Option C can be eliminated.

D: Though the importance of speed is more important in sports than in everyday life, as evidenced from the examples given in the passage, it had not been mentioned anywhere that comfort is given a priority over speed in everyday use. Hence, Option D is out of the scope, and can be eliminated.

16. Which of the following best explains 'dump' as mentioned in the passage?

A. It is an incline given to the wheelchair so that the athlete can have the required height and back support.

B. It is a modification made in wheelchairs and other similar devices to strengthen the abdominal and core muscles.

C. It is customization in wheelchairs to compensate for weak or no core muscles and provide better balance.

D. It is a rehabilitative technique used by athletes to gain balance and heal injuries to the core muscles.

Sol. *For instance, increasing the height of the chair's back and the slope of its seat, also called the "dump," can help compensate for abdominal weakness. "I actually have a little dump in my chair because I don't have all my core muscles to help me with that balance," Murray explains.*

Hence, 'dump' is a customization/modification whose main use is to help individuals with balance in case of abdominal/core weakness. Option C captures this properly and is the answer.

A: Height is not a factor that makes 'dump' useful. Hence, A can be eliminated.

B: The modification is done to compensate for abdominal/core muscles. It has not been mentioned that 'dump' actually strengthens the core muscles with use. Option B can be eliminated.

D: Again, the rehabilitative aspect of 'dump' has not been mentioned. It is possible that it merely provides support and does not do anything to heal the injury in the long term. Hence, Option D can be eliminated too.

17. **The passage given below is followed by four alternate summaries. Choose the option that best captures the essence of the passage.**

Rasputin cemented his relationship with the Russian czar and czarina when he supposedly helped alleviate their only son Alexei's haemophilia. Rasputin's alleged healing powers continue to be debated today. The Czar's sister, Grand Duchess Olga, wrote that she observed Rasputin healing Alexei by kneeling at the foot of his bed and praying; the calming atmosphere that he created in the palace may have assisted with the recovery. Alexandra's lady-in-waiting, Baroness Sophie Buxhoeveden, thought that Rasputin employed peasant folk medicine used in Siberian villages to treat internal bleeding in horses. Historians continue to debate Rasputin's impact on Alexei's health.

A. Rasputin's impact on Alexei's health, which helped him get closer to the Russian rulers, continues to be debated to this date.

B. Rasputin's methods of healing Alexei varied from prayers and consolation to using peasant folk medicines.

C. Rasputin's healing powers, which helped him cure Alexei, might have been a result of the calming atmosphere he created.

D. Rasputin's ability to heal Alexei gained him the favour of the czar and czarina, despite debates around the healing methods used.

Sol. The main points of the passage are:

1. Rasputin became close to the Russian rulers after he helped cure their son.

2. His effect on Alexei's health is debated to this date, with many theories to explain the phenomenon.

A: Option A captures the above two points appropriately, and hence, is the answer.

B: Option B mentions the theories which have been put forward. These are mere theories, and one cannot say if Rasputin employed any of these methods, let alone all of them. Hence, Option B is a distortion.

C: Though one of the points made in the passage, Option C fails to cover any of the above two points appropriately. Hence, Option C can be eliminated.

D: Although option D correctly captures Point 1, it misinterprets Point 2. The favour was not won **despite** the debates; the debates have been mentioned separately. Hence, D can be eliminated.

18. Choose the most logical order of sentences from among the given choices to construct a coherent paragraph.

1. Turlock Irrigation District, in California's San Joaquin Valley, will build the first solar canal prototype.

2. This will help operators, developers and regulators refine designs, assess co-benefits and evaluate how these systems perform.

3. California's ageing power infrastructure has contributed to catastrophic wildfires and multiday outages.

4. Building smart solar developments on canals and other disturbed lands can make power and water infrastructure more resilient.

Sol. A brief reading of the sentences suggests that the passage is about the use of solar technology to counter certain problems. 34 is a mandatory pair, which introduces the problems in Califonia and suggests how solar developments could be a solution. 2 mentions 'this', which is not in agreement with 'solar developments' in 4, hence, 2 cannot follow 4. Thus, we have another pair, 12, which talks about a certain prototype and its benefits.

Out of 34 and 12, 34 is a better introductory pair, as it introduces the problem. Mentioning the prototype first and then the problem would not be appropriate. Hence, the correct sequence is 3412.

19. Choose the most logical order of sentences from among the given choices to construct a coherent paragraph.

1. Recognizing some early modern writings on emotions for what they are is no easy task due to diverging and rapidly changing vocabularies for talking about emotions.

2. 'Passion,' in particular, is connected with a kind of receptivity, but how the passions are receptive and what they are receptive to tend to cross over various comfortable divisions taken to mark early modern philosophy.

3. Seventeenth-century philosophers favoured talk of 'passion', 'affect,' and 'affection,' while their eighteenth-century counterparts made increasing use of 'sentiment.'

4. Another difficulty arises from the seemingly ambivalent nature early modern philosophers granted to the emotions.

Sol. A brief reading of the sentences suggests that the paragraph must be about the theories of emotions in philosophy, and the problems inherent in them.

1 talks about the difficulties that arise in the identification of works on emotions because of the diverse and changing vocabulary used. The author then exemplifies it in 3 by differentiating the vocabulary use of seventeenth and eighteenth-century philosophers. 4 then delves into another difficulty that arises due to the ambivalent nature given to the emotions. This difficulty is then explained in 2, showing how passion was expressed differently. Hence, the correct sequence is 1342.

20. **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.**

1. Chemicals, though difficult to remove from the ecosystem, are an important part of our daily usage.

2. Substances like pesticides wipe out many non-target insects, which are fundamental to all ecosystems and, therefore, to the provision of clean air, water and food.

3. There has been a fiftyfold increase in the production of chemicals since 1950 and this is projected to triple again by 2050.

4. Chemical pollution threatens Earth's systems by damaging the biological and physical processes that underpin all life.

5. Thus, shifting to a circular economy is really important. That means changing materials and products so they can be reused, not wasted.

Sol. A brief reading of the sentences suggests that the paragraph is about the pervasive effects of chemical products in our ecosystem. The author has taken a negative and cautionary stance towards them. Statements 2, 3, 4, and 5, present a similar tone, where the author is presenting a grim picture.

4 introduces the concept of chemical pollution. 2 then presents one of the major effects chemical substances have. 3 then adds to the author's argument by presenting figures about chemicals produced over years. 5 then presents a solution to the problem of this overproduction.

Statement 1, however, is alluding to the importance of chemicals in daily usage, warranting a discussion about the uses of chemicals in our daily life. Thus, there is no place for this sentence in the paragraph, and hence, it is out of context here.

21. **Choose the most logical order of sentences from among the given choices to construct a coherent paragraph.**

1. The big problem is that there is no coherent ideology in Russia. There is no shared way of interpreting the world.

2. When my wife, who is Ukrainian, and I woke up last Thursday in our Dubai hotel room, our whole world had turned upside down. We turned on Putin's televised address about the military operation.

3. There's a huge divide of opinions between the "New Russians" - my generation, people born in the 1990s, who never lived in Soviet times - and the older generation.

4. We were disgusted by the theatrical performance of a president we had never chosen. We were even more disgusted by the thought that most people in Russia would believe him.

Sol. A brief reading of the sentences suggests that the paragraph is about the Russian invasion of Ukraine. The author and his wife are dumbfounded by the declaration of the military operation and are more dejected because this action would not be universally condemned in Russia. The author also points out what the problem is, and then expounds on that problem.

24 forms a mandatory pair, that introduces the topic at hand by recording the author and his wife's reactions, and what disgusted them. The author then delves into the problem in 1, by saying that a shared perspective of the world is absent. The author then becomes more specific in 3, mentioning the ideological divide between the young and the old. Hence, the correct order is 2413.

22. **The passage given below is followed by four alternate summaries. Choose the option that best captures the essence of the passage.**

The conventional moral thinking on animal ethics: we can use and kill animals for our purposes, as long as we treat them 'humanely' and do not inflict 'unnecessary' suffering on them. But because animals are chattel property, the concepts of 'humane' treatment and 'necessary' suffering are largely meaningless as moral concepts. They are primarily economic concepts that, in reality, translate into very little protection for animals. Moreover, the idea that killing animals is not a serious issue as long as animals are not made to suffer rests explicitly on the widely accepted idea that animals do not have a morally significant interest in continuing to live. And that is nothing more than an anthropocentric stipulation.

A. The conventional moral thinking on the ethics of animal slaughter should be viewed as an economic concept.

B. The claim of minimizing the suffering of animals reared for use and slaughter fails as a moral justification and merely serves to defend human interests.

C. The humane treatment of animals is not only morally justified but economically pragmatic.

D. Animals have an interest in living, and this should be considered in the ethics of animal slaughter.

Sol. The paragraph has the following main points:

1. The conventional moral thinking on animals fails as a moral concept, and is more of an economic concept.

2. These offer little protection to animals, and are largely based on assumptions made by humans.

A: The author is not advocating that the 'humane treatment' should be viewed as an economic concept. He directly states it, and moves on to make his major points. Hence, Option A is not the answer.

B: Option B comes the closest in capturing the main points mentioned above, hence, is the correct answer.

C: Option C has not been mentioned in the paragraph. It is a distortion, and hence, can be eliminated.

D: The author does not say that the animals have an interest in living. He says that it is an assumption that animals do not have a morally significant interest in living, without proper verification. Hence, Option D can be eliminated too.

23. **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.**

1. This over-engineering adds to the costs of building and launching the satellites — a modern communications satellite can cost about $500 million.

2. A car like that would need twice the number of parts as a usual car - one main and one backup - along with a gigantic fuel tank.

3. To keep satellites working as long as possible, engineers build in redundant systems and pack in as much fuel as they can fit.

4. Imagine you're going to go buy a car tomorrow but you're never going to be able to put more gas in it; can never change the oil; can never maintain or fix anything.

5. How expensive and how complicated do you think that car is going to be? That's exactly what we have been doing with satellites.

Sol. A brief reading of the sentences suggests that the main contention of the author is servicing of satellites, and how a lack of the same is responsible for increased costs.

The author opens the paragraph with 4, which is a thought experiment. He asks us to imagine if we were unable to service or refuel our cars again. 2 and 5 mention the repercussions of this limitation. 31 and together explain how this thought experiment can help us understand the overengineering necessary in satellites. Now both 2 and 5 are not needed as both point to the same drawbacks. Between 2 and 5, 5 acts as a better bridge to 31 and hence 2 is the odd one out.

24. **The passage given below is followed by four alternate summaries. Choose the option that best captures the essence of the passage.**

On TikTok and Instagram Reels, we watch everyday people - adults as well as children - play. For all the polished, perfect videos made by professional influencers, there are hundreds of thousands of others. Such roleplay is liberating because it can quickly transform the most familiar circumstances into fantasies. It is challenging for the same reason. The mise en scène of the Victorian parlour used curtains and candlelight to signal a space designed for play. TikTok and Instagram Reels accomplish this transformation with stunning immediacy and few physical props. Look down at the screen and you're in the world. Look up and you're out - on a busy street or at the dinner table in the middle of a conversation.

A. Roleplay on the internet is both liberating and challenging as it enables a quick transformation of our circumstances.

B. TikTok and Instagram Reels allow people to transform their circumstances into fantasies effortlessly; this form of online roleplay is both liberating as well as challenging.

C. Internet roleplay is challenging because of its immersive and addictive nature of making people realise their fantasies.

D. Roleplay, disguised as a liberating force on the internet, is quite challenging because a demarcation of reality is absent.

Sol. The main points of the paragraph are as follows:

1. The roleplay over the internet is quite liberating as they transform the daily circumstances into fantasies.

2. However, this quick transform can make this platform challenging, as the transformation is stunningly immediate.

A: Option A appropriately captures both these points, and hence, is the correct answer.

B: Option B contains a distortion of calling the transformation effortless - while it may be quick and immediate, we cannot say that it is effortless. Moreover, it does not establish the cause-effect between the immediacy of transformation and the liberating and challenging nature.

C: Option C fails to mention 1, and hence, can be eliminated.

D: The author does not say that roleplay is disguised as a liberating force. It hints at a sinister nature of the subject, which is not the contention of the author. Hence, Option D can be eliminated too.

Instructions

There was an intense debate at the international chess federation about the origin of chess. Some people deemed Persia to be the place it originated, while most believed it was India. To settle the matter once and for all, the federation president decided to check the chess understanding of a grandmaster from Persia and India each, represented by Alireza and Anand respectively.

Details of the game:

	a	b	c	d	e	f	g	h	
8	a8	b8	c8	d8	e8	f8	g8	h8	8
7	a7	b7	c7	d7	e7	f7	g7	h7	7
6	a6	b6	c6	d6	e6	f6	g6	h6	6
5	a5	b5	c5	d5	e5	f5	g5	h5	5
4	a4	b4	c4	d4	e4	f4	g4	h4	4
3	a3	b3	c3	d3	e3	f3	g3	h3	3
2	a2	b2	c2	d2	e2	f2	g2	h2	2
1	a1	b1	c1	d1	e1	f1	g1	h1	1
	a	b	c	d	e	f	g	h	

The chessboard is an 8x8 table, with 64 squares with black and white colours arranged as above. The rows are called ranks, and the columns are called files. Ranks are denoted by numbers 1 to 8 and files are denoted by the letters a to h. Hence, the square in the third row and second column would be denoted as b3. Only 1 piece can be placed on a single square.

Each piece has defined movement criteria. A piece X is said to be checking piece Y if Y is on a square that is within the reach of X on the next move.

The following pieces will be used to determine grandmasters' understanding of chess:

Movement of a Queen: A queen can move anywhere on the file, rank and the set of diagonals it is on. E.g. if the queen is on d4, on the next move, it can reach anywhere on the d file, 4th rank on the next move. It can also reach the diagonals connecting a1 to h8 and g1 to a7. Thus, if a piece was placed on any of these squares, a queen would check this piece.

Movement of a Rook: A rook has the same movement as a queen, except that it cannot move on the diagonals. Thus, it can reach anywhere on the rank or file it is placed upon.

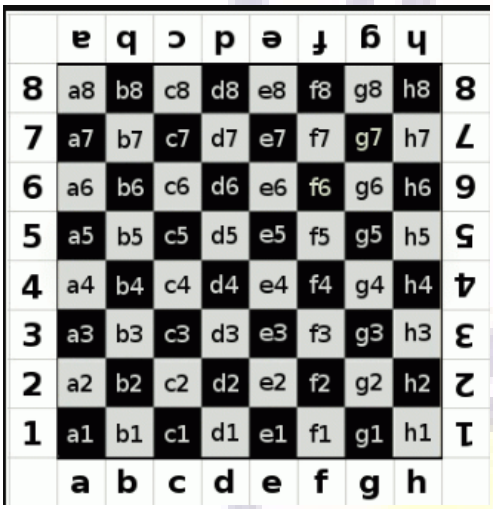
Movement of a King: A king can move to any of the squares in the vicinity of the square it is currently in. This means that if a king is placed on c6, it can reach 8 squares: b5, b6, b7, c5, c7, d5, d6, d7.

The activity of a piece refers to the number of squares that it can reach in the next turn. E.g. If a king is placed on a2, its activity is 5, as it can reach 5 squares: a1, a3, b1, b2, b3.

The grandmasters were asked the following questions. Choose the correct answer for each using the information given above.

25. A king and N queens were placed on the board such that the king is not being checked by any of the N queens. What is the maximum possible value of N?

Sol. Since a queen can check a piece on the same rank, file, and set of diagonals as the queen, we need to place the king on a square that interferes with the minimum squares in this manner to get the maximum value of N. The number of squares in the same file or rank remains the same for each square. The number of squares in the same set of diagonals changes.



E.g. If the king was placed on c7, we cannot place a queen on a5, b6, c7, d8, b8, d6, e5, f4, g3, h2: A total of 9 square in the set of diagonals.

However, if the king is placed on an outermost square, say a1, then the number of squares in the same set of diagonals is minimized: a1, b2, c3, d4, e5, f6, g7, h8: A total of 8 squares.

Thus, we will keep the king on an outermost square(Rank 1/8, File a/h). We cannot keep a queen on the 8 squares mentioned.

On a-file, we have 7 other squares (a2 to a8) on which we cannot place a queen: 7 squares.

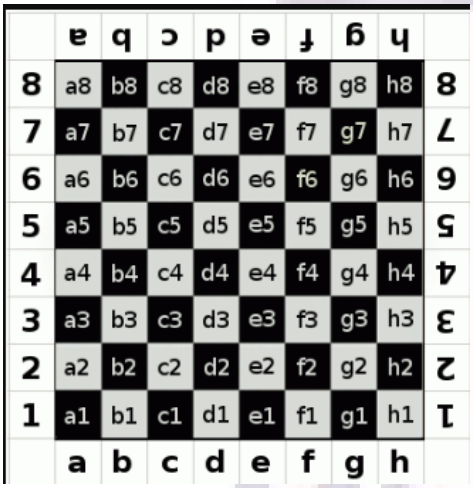
On 1st rank, we have 7 other squares (b1 to h1) on which we cannot place a queen: 7 squares.

Thus, there are a total of 8+7+7=22 squares on which a queen cannot be placed. Thus out of 64 squares, 64-22=42 squares are available for a queen to be placed. Thus, the maximum value of N is 42.

26. A king and N rooks were placed on the board such that the king is not being checked by any of the N rooks. What is the maximum possible value of N?

Sol. A king can only be checked by a rook if it is in the same rank or file as the king. The number of squares in the same rank or file remain the same for each piece.

A rank and a file have 8 squares each. Thus if a king were placed on a square, say a1, the squares a1, a2 to a8 in the a-file, and the squares b1 to h1 in the 1st rank would be unavailable for a rook. Thus, a total of 15 squares.

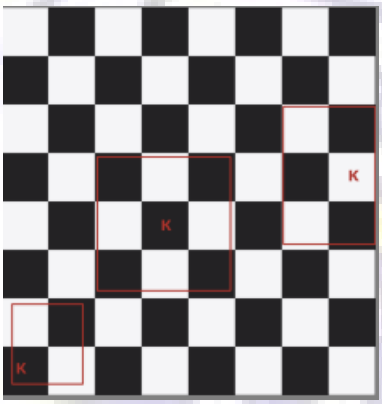


Thus, the maximum value of N will be 64-15 = 49 in this case.

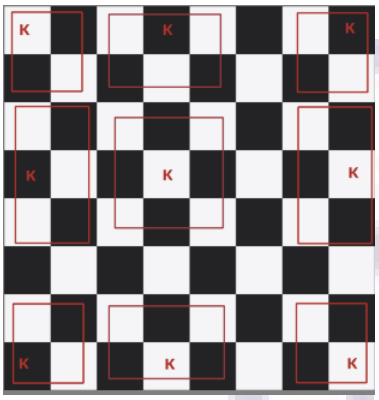
27. What is the maximum number of kings that can be placed on the chessboard such that none of the kings can check another king even after moving once?

Sol. To make sure that a king cannot reach another king even after moving once, we need to make sure that the reach of no two kings intersects. Since a king can check only the square in its vicinity, we will make sure that there is at least two squares horizontally, vertically or diagonally between any two kings.

A king checks all the squares that are in its vicinity. Thus, if a king is placed in the middle, it would check 8 squares and would be placed on 1, thus making 9 squares unavailable. However, when a king is placed on one of the side squares, that is, squares in the 1st/8th rank or a/h file, then it has only 5 squares in its vicinity, and makes only 6 squares unavailable. Similarly, when a king is placed on a corner square, it would make only 4 squares unavailable.



Thus, we will first put the kings on the 4 corners and side squares. The distribution looks like follows:

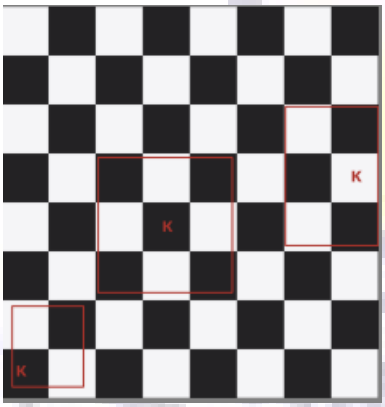


Thus, we can place 9 kings who cannot check each other even after moving once.

The representation in this explanation is only one of the multiple possible cases. Though there are other possible cases, all will lead to an answer that is equal to or lesser than 9.

28. How many kings can be placed on the board such that no two kings check each other?

Sol. A king checks all the squares that are in its vicinity. Thus, if a king is placed in the middle, it would check 8 squares and would be placed on 1, thus making 9 squares unavailable. However, when a king is placed on one of the side squares, that is, squares in the 1st/8th rank or a/h file, then it has only 5 squares in its vicinity, and makes only 6 squares unavailable. Similarly, when a king is placed on a corner square, it would make only 4 squares unavailable.

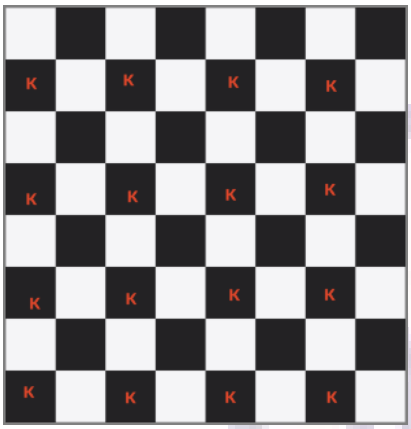


Thus, we can see here that if we have a 2x2 matrix, we can definitely place at most 1 king in it. Any more, and the kings are definitely in check.

Thus, in the maximum condition, we can place only 1 king in 4 squares. Thus, for 64 squares, we can place only \frac{64}{4}464=16 kings at most.

We will try to place 16 kings on the board. If the condition is violated, we will try with 15, then 14, and so on.

16 kings: Starting with one of the corners, we can place the 16 kings in the following manner:

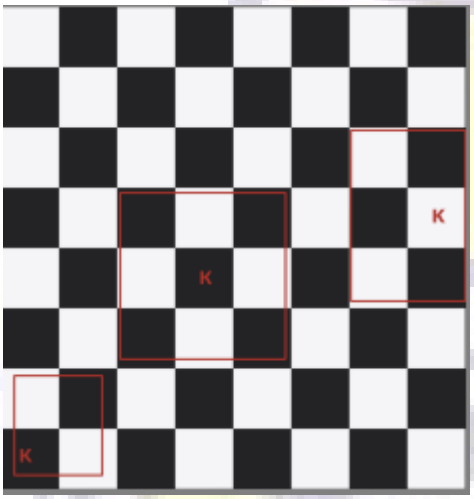


Since no condition is violated, we can see that the maximum number of kings that can be placed without checking each other is 16.

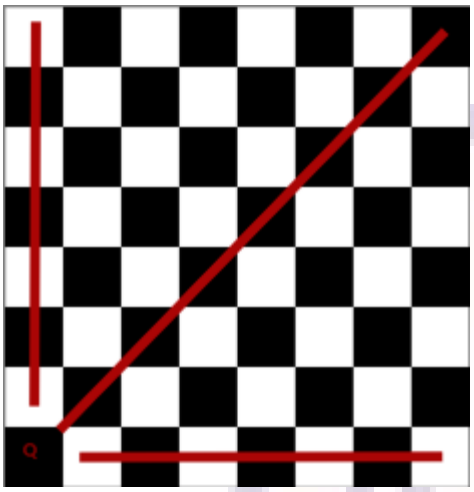
The representation in this explanation is only one of the multiple possible cases. Though there are other possible cases, all will lead to an answer that is equal to or lesser than 16.

29. A king is placed on the board such that it has as low activity as possible for a king. A queen is also placed on the board, such that its activity is as low as possible without checking the king. If the pieces do not check each other, in how many ways can this placement be done?

Sol. It has been given that the activity of the king should be as low as possible. This is possible only when it is placed on one of the corners.

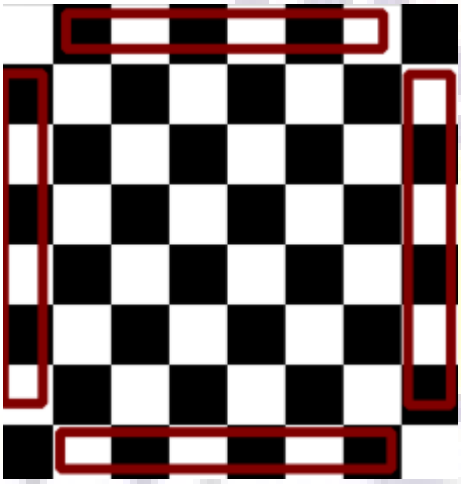


When in the corner, the King reaches 3 squares. When on a side, it reaches 5 squares. Otherwise, it reaches 8 squares. Thus, a king is placed in a corner.



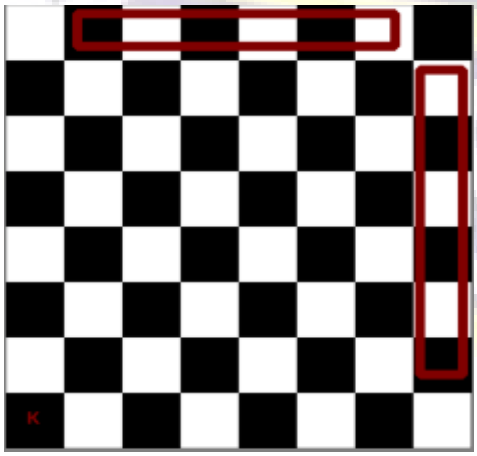
The squares a queen covers on its rank and file remain constant. The number of squares, however, changes with position. They are minimized when a queen is placed on the outermost squares, touching the edges of the board.

However, we can see that when a queen is kept on one of the corners, it reaches the other three corners too. Hence, it would necessarily check the king. Hence, the queen can be on the following squares:



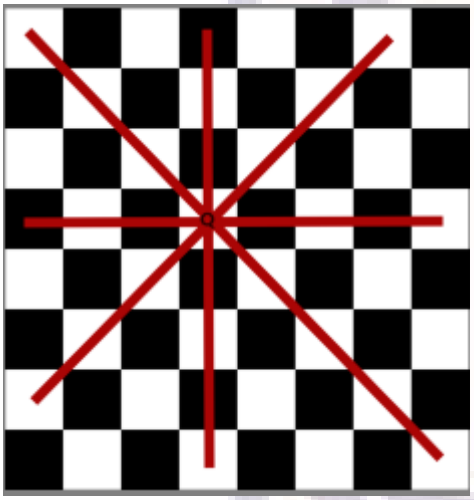
There are 24 possible squares. However, the king will be on one of the 4 corners, eliminating 12 squares that are in the same file or rank. Thus, we are left with 12 squares for the queen.

Thus, the total number of arrangements will be 4\times\ 12=484× 12=48.



30. A queen and a rook are to be placed on the board such that the queen should have as high activity as possible. If the queen and the rook do not check each other, what is the number of ways this can be achieved?

Sol. The activity of a rook remains the same irrespective of where it is placed. The activity of a queen, however, changes. If it is placed in one of the corners, it is minimum. When placed in any of the four squares in the centre, its activity is the maximum, as the number of squares covered in the diagonals increases.



Here, it covers 7 squares in its file and rank. It covers 7 squares in one diagonal and 6 in the other. Thus, the total number of square unavailable to a rook are 7+7+7+6+1=28.

Thus, a rook can be placed in any of the remaining 64-28=36 squares.

Thus, the total number of ways would be 4\times\ 36=1444× 36=144.

Instructions

Akash is a leading Psychiatrist in Hyderabad. He has exactly five patients Gojo, Muzan, Erwin, Joe, Peter who attend his clinic exactly four times a week Monday through Friday. Every day he exactly schedules all his appointments in five slots among :

Slot 1 : (10:00 - 10:45), Slot 2 : (10:45 - 11:30), Slot 3 : (11:30 - 12:15), Slot 4 : (12:15 - 1:00), Slot 5 : (1:00 - 1:45).

	10:00-10:45	10:45-11:30	11:30-12:15	12:15-1:00	1:00-1:45
Mon					
Tue					
Wed					
Thu					
Fri					

Additionally, it has been informed that :

1) Peter got the last slot among the four people on multiple days and he had a Wednesday appointment in the time slot (12:15 - 1:00)

2) For every patient, Akash makes sure there is a time difference of at least 24 hours between the end of the patient's prior appointment and the beginning of his next appointment. .

3)Every day he accepts exactly four appointments.

4)Gojo does not have an appointment scheduled on Friday.

5) Joe, Erwin, Muzan have their appointments scheduled one after the other in three consecutively timed slots in the given order on Thursday.

6) Peter had his four appointments booked in four distinct time slots.

31. Which of the following statement is necessarily true?

A. Akash has appointments booked on all five days Monday to Friday in slot 1.

B. Akash has appointments booked on all five days Monday to Friday in slot 2.

C. Akash has appointments booked on all five days Monday to Friday in slot 3.

D. Akash has appointments booked on all five days Monday to Friday in slot 4.

Sol. Using statement 4 Gojo did not have an appointment on Friday and hence he must have had appointments on Monday, Tuesday, Wednesday, Thursday.

He can have the four appointments in slot 1, slot 2, slot 3, slot 4 and slot 5. The different possible slots for Gojo on the four days are : (1, 2, 3, 4), (1, 2, 3, 5), (2, 3, 4, 5), (1, 2, 4, 5), (1, 3, 4, 5).

But since the appointment on Wednesday has been booked for slot 4 by Peter, Gojo we can have two possibilities :

(Monday - Slot 1), (Tuesday - slot 2), (Wednesday - slot 3), (Thursday-slot 4).

(Monday- slot 1), (Tuesday- slot 2), (Wednesday - slot 3), (Thursday-slot 5).

Case 1 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday					Gojo
Friday					

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday				Gojo	
Friday					

In Case 1:

In this case, Peter cannot have a slot on Thursday considering the condition that there must be at least a time difference of 24 hours between the slots. Hence the only possibility for Peter must be :

In statement 1 it has been mentioned that Peter had the last slot among the four people on multiple days and in statement 6 it has been mentioned that Peter's slots were distinct.

Hence in the four slots, Peter must have slot 4 on one day and slot 5 on another day.

It has also been mentioned that Joe, Erwin and Muzan were given consecutively timed slots on Thursday and hence there can be two possibilities. Hence Peter must have a slot on Friday because all the appointments on Thursday have been confirmed.

The two cases can be represented as :

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan		Gojo
Friday					Peter

Case 1b :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday		Joe	Erwin	Muzan	Gojo
Friday					Peter

1b fails because Muzan does not have a slot on Friday and this fails the condition that there are fours appointments every day.

For Case 2 :

Since it has been given that Peter had his four slots in different time frames and among the four people he was allotted the last slot on multiple days.Hence he must have one appointment in slot 4 and one more in slot 5. Since all the slots on Thursday have been booked. He must have a slot on Monday, Tuesday, Wednesday and Friday. The only possible schedule is :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan	Gojo	
Friday					Peter

Using the conditions provided since slot 1, slot 2, slot 3 are booked for Thursday. In the same given order Joe, Erwin and Muzan must be allotted the slots on Friday as slot 5 has already been booked.

Since Joe has an appointment during the first slot on Thursday he cannot have a slot booked on Wednesday. Hence on Wednesday, the first two slots must be for Erwin and Muzan.

Since Erwin has an appointment during the first slot on Wednesday. He cannot have an appointment on Tuesday. Hence Muzan must have his appointment scheduled in the first slot on Tuesday.

Since no exact information has been provided on the appointments of Erwin, Joe on Monday and Joe on Tuesday. They can have multiple possibilities in accordance with the conditions.

The inferred information can be represented as :

(X indicates that slot is empty).

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	X	Gojo
Friday	X	Joe	Erwin	Muzan	Peter

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	Gojo	X
Friday	X	Joe	Erwin	Muzan	Peter

Hence only in slot 2, we can confirm Akash has appointments booked from Monday to Friday.

32. Who has an appointment scheduled in the third slot on Tuesday?

A. Peter

B. Erwin

C. Joe

D. Gojo

Sol. Using statement 4 Gojo did not have an appointment on Friday and hence he must have had appointments on Monday, Tuesday, Wednesday, Thursday.

He can have the four appointments in slot 1, slot 2, slot 3, slot 4 and slot 5. The different possible slots for Gojo on the four days are : (1, 2, 3, 4), (1, 2, 3, 5), (2, 3, 4, 5), (1, 2, 4, 5), (1, 3, 4, 5).

But since the appointment on Wednesday has been booked for slot 4 by Peter, Gojo we can have two possibilities :

(Monday - Slot 1), (Tuesday - slot 2), (Wednesday - slot 3), (Thursday-slot 4).

(Monday- slot 1), (Tuesday- slot 2), (Wednesday - slot 3), (Thursday-slot 5).

Case 1 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday					Gojo
Friday					

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday				Gojo	
Friday					

In Case 1:

In this case, Peter cannot have a slot on Thursday considering the condition that there must be at least a time difference of 24 hours between the slots. Hence the only possibility for Peter must be :

In statement 1 it has been mentioned that Peter had the last slot among the four people on multiple days and in statement 6 it has been mentioned that Peter's slots were distinct.

Hence in the four slots, Peter must have slot 4 on one day and slot 5 on another day.

It has also been mentioned that Joe, Erwin and Muzan were given consecutively timed slots on Thursday and hence there can be two possibilities. Hence Peter must have a slot on Friday because all the appointments on Thursday have been confirmed.

The two cases can be represented as :

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan		Gojo
Friday					Peter

Case 1b :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday		Joe	Erwin	Muzan	Gojo
Friday					Peter

1b fails because Muzan does not have a slot on Friday and this fails the condition that there are fours appointments every day.

For Case 2 :

Since it has been given that Peter had his four slots in different time frames and among the four people he was allotted the last slot on multiple days.Hence he must have one appointment in slot 4 and one more in slot 5. Since all the slots on Thursday have been booked. He must have a slot on Monday, Tuesday, Wednesday and Friday. The only possible schedule is :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan	Gojo	
Friday					Peter

Using the conditions provided since slot 1, slot 2, slot 3 are booked for Thursday. In the same given order Joe, Erwin and Muzan must be allotted the slots on Friday as slot 5 has already been booked.

Since Joe has an appointment during the first slot on Thursday he cannot have a slot booked on Wednesday. Hence on Wednesday, the first two slots must be for Erwin and Muzan.

Since Erwin has an appointment during the first slot on Wednesday. He cannot have an appointment on Tuesday. Hence Muzan must have his appointment scheduled in the first slot on Tuesday.

Since no exact information has been provided on the appointments of Erwin, Joe on Monday and Joe on Tuesday. They can have multiple possibilities in accordance with the conditions.

The inferred information can be represented as :

(X indicates that slot is empty).

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	X	Gojo
Friday	X	Joe	Erwin	Muzan	Peter

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	Gojo	X
Friday	X	Joe	Erwin	Muzan	Peter

Hence only in slot 2, we can confirm Akash has appointments booked from Monday to Friday.

Peter has an appointment scheduled in the third slot on Tuesday.

33. If Joe has an appointment scheduled in the fourth slot on Monday, the appointment in the fifth slot on Tuesday is scheduled for ?

A. Muzan

B. Gojo

C. Joe

D. Peter

Sol. Using statement 4 Gojo did not have an appointment on Friday and hence he must have had appointments on Monday, Tuesday, Wednesday, Thursday.

He can have the four appointments in slot 1, slot 2, slot 3, slot 4 and slot 5. The different possible slots for Gojo on the four days are : (1, 2, 3, 4), (1, 2, 3, 5), (2, 3, 4, 5), (1, 2, 4, 5), (1, 3, 4, 5).

But since the appointment on Wednesday has been booked for slot 4 by Peter, Gojo we can have two possibilities :

(Monday - Slot 1), (Tuesday - slot 2), (Wednesday - slot 3), (Thursday-slot 4).

(Monday- slot 1), (Tuesday- slot 2), (Wednesday - slot 3), (Thursday-slot 5).

Case 1 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday					Gojo
Friday					

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday				Gojo	
Friday					

In Case 1:

In this case, Peter cannot have a slot on Thursday considering the condition that there must be at least a time difference of 24 hours between the slots. Hence the only possibility for Peter must be :

In statement 1 it has been mentioned that Peter had the last slot among the four people on multiple days and in statement 6 it has been mentioned that Peter's slots were distinct.

Hence in the four slots, Peter must have slot 4 on one day and slot 5 on another day.

It has also been mentioned that Joe, Erwin and Muzan were given consecutively timed slots on Thursday and hence there can be two possibilities. Hence Peter must have a slot on Friday because all the appointments on Thursday have been confirmed.

The two cases can be represented as :

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan		Gojo
Friday					Peter

Case 1b :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday		Joe	Erwin	Muzan	Gojo
Friday					Peter

1b fails because Muzan does not have a slot on Friday and this fails the condition that there are fours appointments every day.

For Case 2 :

Since it has been given that Peter had his four slots in different time frames and among the four people he was allotted the last slot on multiple days.Hence he must have one appointment in slot 4 and one more in slot 5. Since all the slots on Thursday have been booked. He must have a slot on Monday, Tuesday, Wednesday and Friday. The only possible schedule is :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan	Gojo	
Friday					Peter

Using the conditions provided since slot 1, slot 2, slot 3 are booked for Thursday. In the same given order Joe, Erwin and Muzan must be allotted the slots on Friday as slot 5 has already been booked.

Since Joe has an appointment during the first slot on Thursday he cannot have a slot booked on Wednesday. Hence on Wednesday, the first two slots must be for Erwin and Muzan.

Since Erwin has an appointment during the first slot on Wednesday. He cannot have an appointment on Tuesday. Hence Muzan must have his appointment scheduled in the first slot on Tuesday.

Since no exact information has been provided on the appointments of Erwin, Joe on Monday and Joe on Tuesday. They can have multiple possibilities in accordance with the conditions.

The inferred information can be represented as :

(X indicates that slot is empty).

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	X	Gojo
Friday	X	Joe	Erwin	Muzan	Peter

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	Gojo	X
Friday	X	Joe	Erwin	Muzan	Peter

Since Joe must have an appointment on both Monday and Tuesday if slot 4 on Monday is assigned to Joe then the only possible appointment for Joe on Tuesday will be in slot 5.

34. Who among the following has an appointment scheduled in the first slot on Wednesday?

A. Joe

B. Erwin

C. Muzan

D. Gojo

Sol. Using statement 4 Gojo did not have an appointment on Friday and hence he must have had appointments on Monday, Tuesday, Wednesday, Thursday.

He can have the four appointments in slot 1, slot 2, slot 3, slot 4 and slot 5. The different possible slots for Gojo on the four days are : (1, 2, 3, 4), (1, 2, 3, 5), (2, 3, 4, 5), (1, 2, 4, 5), (1, 3, 4, 5).

But since the appointment on Wednesday has been booked for slot 4 by Peter, Gojo we can have two possibilities :

(Monday - Slot 1), (Tuesday - slot 2), (Wednesday - slot 3), (Thursday-slot 4).

(Monday- slot 1), (Tuesday- slot 2), (Wednesday - slot 3), (Thursday-slot 5).

Case 1 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday					Gojo
Friday					

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo				
Tuesday		Gojo			
Wednesday			Gojo	Peter	
Thursday				Gojo	
Friday					

In Case 1:

In this case, Peter cannot have a slot on Thursday considering the condition that there must be at least a time difference of 24 hours between the slots. Hence the only possibility for Peter must be :

In statement 1 it has been mentioned that Peter had the last slot among the four people on multiple days and in statement 6 it has been mentioned that Peter's slots were distinct.

Hence in the four slots, Peter must have slot 4 on one day and slot 5 on another day.

It has also been mentioned that Joe, Erwin and Muzan were given consecutively timed slots on Thursday and hence there can be two possibilities. Hence Peter must have a slot on Friday because all the appointments on Thursday have been confirmed.

The two cases can be represented as :

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan		Gojo
Friday					Peter

Case 1b :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday		Joe	Erwin	Muzan	Gojo
Friday					Peter

1b fails because Muzan does not have a slot on Friday and this fails the condition that there are four appointments every day.

For Case 2 :

Since it has been given that Peter had his four slots in different time frames and among the four people he was allotted the last slot on multiple days. Hence he must have one appointment in slot 4 and one more in slot 5. Since all the slots on Thursday have been booked. He must have a slot on Monday, Tuesday, Wednesday and Friday. The only possible schedule is :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday		Gojo	Peter		
Wednesday			Gojo	Peter	
Thursday	Joe	Erwin	Muzan	Gojo	
Friday					Peter

Using the conditions provided since slot 1, slot 2, slot 3 are booked for Thursday. In the same given order Joe, Erwin and Muzan must be allotted the slots on Friday as slot 5 has already been booked.

Since Joe has an appointment during the first slot on Thursday he cannot have a slot booked on Wednesday. Hence on Wednesday, the first two slots must be for Erwin and Muzan.

Since Erwin has an appointment during the first slot on Wednesday. He cannot have an appointment on Tuesday. Hence Muzan must have his appointment scheduled in the first slot on Tuesday.

Since no exact information has been provided on the appointments of Erwin, Joe on Monday and Joe on Tuesday. They can have multiple possibilities in accordance with the conditions.

The inferred information can be represented as :

(X indicates that slot is empty).

Case 1a :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	X	Gojo
Friday	X	Joe	Erwin	Muzan	Peter

Case 2 :

	10 - 10: 45	10:45-11:30	11:30-12:15	12:15-1:00	1: 00 - 1:45
Monday	Gojo	Peter			
Tuesday	Muzan	Gojo	Peter		
Wednesday	Erwin	Muzan	Gojo	Peter	X
Thursday	Joe	Erwin	Muzan	Gojo	X
Friday	X	Joe	Erwin	Muzan	Peter

Erwin has an appointment scheduled in the first slot on Wednesday.

Instructions

In a game involving a dice numbered 1-6, there are two players involved. There are two categories of numbers such that all of 1-6 can be categorised into one of the two categories. There are two different versions of the game, the P-NP version and the OE version. In the P-NP version, the two categories of numbers are - prime: 2, 3, 5, and non-prime: 1, 4, 6. In the OE version, the two categories of numbers are odd: 1, 3, 5 and even: 2, 4, 6. A game between A and B, where A rolls the dice first, proceeds as follows:

1. A rolls a number from one category, say Category-1. B rolls next and keeps rolling till he either rolls a number from a different category(in this case Category-2) or rolls a numerically greater number in the same category(in this case Category-1).

2. If B rolls a numerically greater number in the same category(Category-1), B wins and the same comes to an end.

3. If B rolls a number from a different category(Category-2), A gets back the turn and he keeps rolling till he either rolls a number from a different category(now Category-1) or a numerically greater number in the same category(Category-2) and this goes on till a player wins the game.

For example, in the P-NP version of the game, if A starts the game, and rolls a 6(NP), then B has to keep rolling till he gets a prime because he cannot get a numerically greater non-prime. Once he throws a prime, A gets his chance back and can win by either rolling a higher prime. or transfer the dice back to B by rolling a non-prime, and it goes on accordingly till A/B wins.

Based on the information given, answer the questions that follow.

35. If a game has 7 rolls in total such that the winner was decided in the 7th roll, what can be the maximum value of the sum of the numbers that were rolled in these seven rolls? The OE Version of the game was played.

A. 40

B. 39

C. 38

D. 36

Sol. Let us assume that the rolls are as follows:

_ _ _ _ _ _ _ _

To maximise, we need to put the maximum possible values in each of the rolls, that is 6. But that is not possible.

Because, if the seventh roll is a 6, the sixth roll has to be an even number less than 6. Now, to maximise, we will assume it to be 4.

Now, we can start the game with a 6. [Say A starts a game]

Now, B can keep rolling 6's as long as he can, because he needs to roll an even number greater than 6(not possible) or an odd number to pass over the roll to A. Since our motive is to maximise, we will make sure that B keeps rolling 6 as long as possible.

Now, if we continue with this pattern, B rolls his last 6, and then he follows it up with an odd number(5 - highest), and passes over the dice to A. A rolls a 4, and B rolls a 6 to win.

Hence, we get

6 6 6 6 5 4 6

Hence, the sum of the numbers = 6 + 6 + 6 + 6 + 5 + 4 + 6 = 39.

36. In an OE version of the game, the first roll was a 1, and the fifth and last roll was a 6. It is also known that all numbers that come up in these five rolls are unique and are in ascending order from the first roll to the fifth roll. In how many of these games could the player who starts the game win the game as well?

Sol. 1 _ _ _ 6.

We know that the number that comes before 6 has to be even, for the last 6 to win, and that number is mandatorily 4.

Hence, we can only find out one arrangement.

1 2 3 4 6.

Let us confirm if this is a valid arrangement.

Let us say that P starts the game.

P rolls 1.

Q rolls 2.

Turn is with P. P rolls 3.

Turn is with Q. Q rolls 4.

Turn's with P. P rolls 6, and wins.

This satisfies the case. Additionally, we see that P starts and wins this game. Hence, there is only one case.

37. If a P-NP version of the game ended with the 5th roll of the dice, and 4 and 5 came up on the second and third rolls respectively, in how many different ways could the game have proceeded? It is given that A started the game.

A. 30

B. 27

C. 12

D. 15

Sol. Let us denote the numbers as

_ **4** **5** _ _

A started the game.

Hence, 4 was necessarily rolled by B, 5 could be rolled by A or B.

Case 1: 5 was rolled by B

In this case, when B rolled 4, he rolled a number in the same category as A. SInce this is a P-NP game, A must have rolled an NP. Hence, A rolled a 1, 4, or 6. However, we know that if A would have rolled a 1 and B rolled a 4, the game would be over. Hence, we have to remove the case where A rolls a 1. Hence there are a total of 2 cases.

The fourth roll is by A because, in the third roll, B got a prime. Now the fifth roll cannot be by A, it has to be by B because the fifth roll decides the winner. The winner throws the final throw. A cannot win since he has to get a prime greater than 5, which is not possible. Hence, the final throw is by B. This also means that A throws a non-prime in throw 4. B's (5th) throw is also a non-prime greater than A's (fourth) throw. Hence, we can get (1, 4), (1, 6), and (4, 6). There are thus a total of 3 cases.

We get 2 x 3 = 6 cases.

Case 2: 5 was rolled by A

In this case, when B rolled a 4, he rolled a number in a different category as A. SInce this is a P-NP game, A must have rolled a P. Hence, A rolled a 2, 3, 5.

Hence, there are a total of 3 cases.

The fourth roll is by B because, in the third roll, A got a prime. Now the fifth roll cannot be by B, it has to be by A because the fifth roll decides the winner. The winner throws the final throw. B cannot win since he has to get a prime greater than 5, which is not possible. Hence, the final throw is by A. This also means that B throws a non-prime in throw 4. A's (5th) throw is also a non-prime greater than B's (fourth) throw. Hence, we can get (1, 4), (1, 6), and (4, 6). There are thus a total of 3 cases.

We get 3 x 3 = 9 cases.

We get a total of 6 + 9 = 15 cases.

38. In the previous question, in how many of the different ways did the person who started the game(A) win the game?

Sol. Let us denote the numbers as

_ 4 5 _ _

A started the game.

Hence, 4 was necessarily rolled by B, 5 could be rolled by A or B.

Case 1: 5 was rolled by B

In this case, when B rolled 4, he rolled a number in the same category as A. SInce this is a P-NP game, A must have rolled an NP. Hence, A rolled a 1, 4, or 6. However, we know that if A would have rolled a 1 and B rolled a 4, the game would be over. Hence, we have to remove the case where A rolls a 1. Hence there are a total of 2 cases.

The fourth roll is by A because, in the third roll, B got a prime. Now the fifth roll cannot be by A, it has to be by B because the fifth roll decides the winner. The winner throws the final throw. A cannot win since he has to get a prime greater than 5, which is not possible. Hence, the final throw is by B. This also means that A throws a non-prime in throw 4. B's (5th) throw is also a non-prime greater than A's (fourth) throw. Hence, we can get (1, 4), (1, 6), and (4, 6). There are thus a total of 3 cases.

We get 2 x 3 = 6 cases.

Case 2: 5 was rolled by A

In this case, when B rolled a 4, he rolled a number in a different category as A. SInce this is a P-NP game, A must have rolled a P. Hence, A rolled a 2, 3, 5.

Hence, there are a total of 3 cases.

The fourth roll is by B because, in the third roll, A got a prime. Now the fifth roll cannot be by B, it has to be by A because the fifth roll decides the winner. The winner throws the final throw. B cannot win since he has to get a prime greater than 5, which is not possible. Hence, the final throw is by A. This also means that B throws a non-prime in throw 4. A's (5th) throw is also a non-prime greater than B's (fourth) throw. Hence, we can get (1, 4), (1, 6), and (4, 6). There are thus a total of 3 cases.

We get 3 x 3 = 9 cases.

We get a total of 6 + 9 = 15 cases.

However, only in the last nine cases, did A start the game and win it as well. Hence, the answer to this question is 9.

39. It has been provided additionally that A can roll only prime numbers and B can roll only non-prime numbers. In an OE version of the game, what is the minimum possible sum of all throws if the game was completed in 10 throws exactly?

A. 20

B. 19

C. 18

D. 16

Sol. We have to count the rolling of dice backwards.

Let us assume that A wins.

A can only roll 2, 3, 5. A player can not win with a 2, because in OE, no other even number is lesser than 2.

Hence, he could have rolled a 3 or a 5.

To win, this 5 or 3 should be preceded by another odd number by B. B can roll only 1 among odd numbers. So, B rolls a 1 in the second last throw. We can easily eliminate any throws between B's 1 and A's 3/5 because if A rolls an odd number in between, it will again be 3/5 and that will be the last roll.

So we are sure that the pattern is in the following lines

..... 1B 3/5A

Now, let us figure out the third last number.

It has to be an even number by A. Because ->

a. It cannot be an odd number by A, where the last throw will be by B[not possible]

b. It cannot be an even number by B, because then it has to be preceded by a larger even number of A, which is not possible.

So, we get the series as

..... 2A 1B 3/5A

Now, let us find out the fourth last number.

It has to be an odd number by B. Because ->

a. It cannot be an even number by B, the turn does not alternate between the third and second last throws.

b. It cannot be an odd number by A, because it has to be preceded by a larger odd number of B, that is not possible.

Hence, we get the following pattern:

..... 1-B 2-A 1-B 2-A 1-B 2-A 1-B 3/5-A

Let us assume that B wins.

B can only roll 1, 4, 6. A player can not win with a 1, because in OE, no other odd number is lesser than 1.

Hence, he could have rolled a 4 or a 6.

To win, this 4 or 6 should be preceded by another even number by A. A can roll only 2 among even numbers. So, A rolls a 2 in the second last throw. We can easily eliminate any throws between A's 2 and B's 4/6 because if B rolls an even number in between, it will again be 4/6 and that will be the last roll.

So we are sure that the pattern is in the following lines

..... 2A 4/6B

Now, let us figure out the third last number.

It has to be an odd number by B. Because ->

a. It cannot be an even number by B, where the last throw will be by A[not possible]

b. It cannot be an odd number by A, because then it has to be preceded by a larger odd number of B, which is not possible.

So, we get the series as

..... 1B 2A 4/6B

Now, let us find out the fourth last number.

It has to be an even number by A. Because ->

a. It cannot be an odd number by A, the turn does not alternate between the third and second last throws.

b. It cannot be an even number by A, because it has to be preceded by a larger even number of B, that is not possible.

Hence, we get the following pattern:

.....1-B 2-A 1-B 2-A 1-B 2-A 4/6-B

Hence, we get the following cases

In all four cases, the first 8 throws will add to 2+1 * 4 = 12.

Case 1 gives the minimum value of the last two throws, 9th and 10th throws.

Hence, the minimum possible sum = 12 + 1 + 3 = 16.

40. It has been provided additionally that A can roll only prime numbers and B can roll only non-prime numbers. In an OE version of the game, what is the minimum possible sum of all throws if the game was completed in 11 throws exactly?

Sol. We have to count the rolling of dice backwards.

Let us assume that A wins.

A can only roll 2, 3, 5. A player can not win with a 2, because in OE, no other even number is lesser than 2.

Hence, he could have rolled a 3 or a 5.

To win, this 5 or 3 should be preceded by another odd number by B. B can roll only 1 among odd numbers. So, B rolls a 1 in the second last throw. We can easily eliminate any throws between B's 1 and A's 3/5 because if A rolls an odd number in between, it will again be 3/5 and that will be the last roll.

So we are sure that the pattern is in the following lines

..... 1B 3/5A

Now, let us figure out the third last number.

It has to be an even number by A. Because ->

a. It cannot be an odd number by A, where the last throw will be by B[not possible]

b. It cannot be an even number by B, because then it has to be preceded by a larger even number of A, which is not possible.

So, we get the series as

..... 2A 1B 3/5A

Now, let us find out the fourth last number.

It has to be an odd number by B. Because ->

a. It cannot be an even number by B, the turn does not alternate between the third and second last throws.

b. It cannot be an odd number by A, because it has to be preceded by a larger odd number of B, that is not possible.

Hence, we get the following pattern:

..... 1-B 2-A 1-B 2-A 1-B 2-A 1-B 3/5-A

Let us assume that B wins.

B can only roll 1, 4, 6. A player can not win with a 1, because in OE, no other odd number is lesser than 1.

Hence, he could have rolled a 4 or a 6.

To win, this 4 or 6 should be preceded by another even number by A. A can roll only 2 among even numbers. So, A rolls a 2 in the second last throw. We can easily eliminate any throws between A's 2 and B's 4/6 because if B rolls an even number in between, it will again be 4/6 and that will be the last roll.

So we are sure that the pattern is in the following lines

..... 2A 4/6B

Now, let us figure out the third last number.

It has to be an odd number by B. Because ->

a. It cannot be an even number by B, where the last throw will be by A[not possible]

b. It cannot be an odd number by A, because then it has to be preceded by a larger odd number of B, which is not possible.

So, we get the series as

..... 1B 2A 4/6B

Now, let us find out the fourth last number.

It has to be an even number by A. Because ->

a. It cannot be an odd number by A, the turn does not alternate between the third and second last throws.

b. It cannot be an even number by A, because it has to be preceded by a larger even number of B, that is not possible.

Hence, we get the following pattern:

.....1-B 2-A 1-B 2-A 1-B 2-A 4/6-B

Hence, we get the following cases

Cases/Player	....	B	A	B	A	B	A
Case 1	....	1	2	1	2	1	3
Case 2	....	1	2	1	2	1	5
	....	A	B	A	B	A	B
Case 3	....	2	1	2	1	2	4
Case 4	....	2	1	2	1	2	6

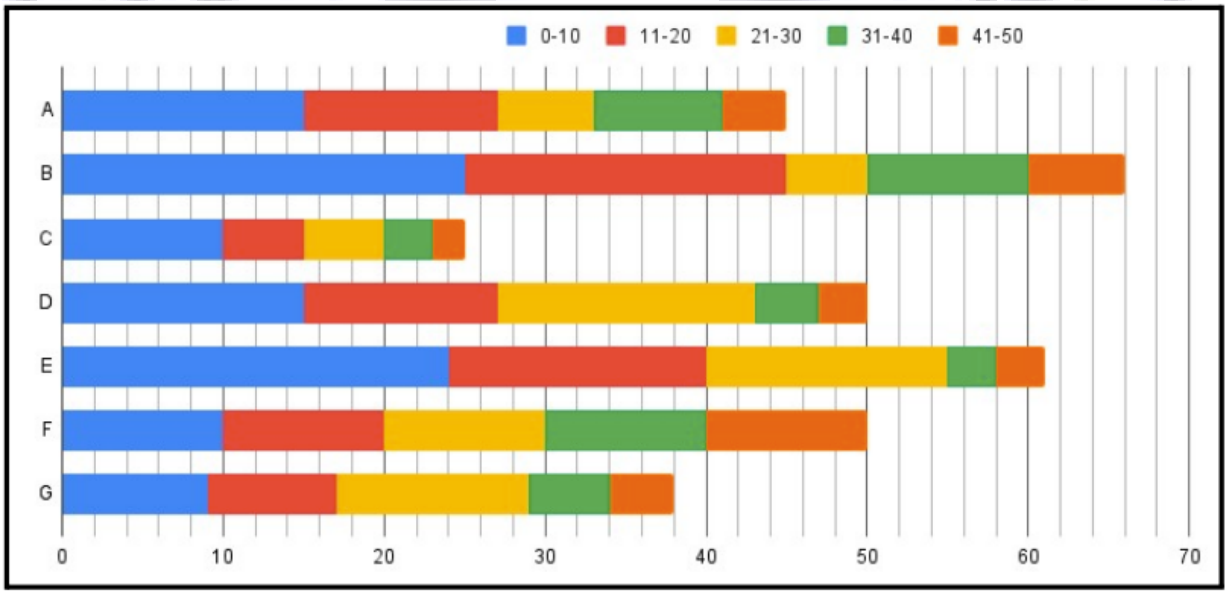
In all four cases, the first 8 throws will add to 2+1 * 4 = 12.

Case 1 gives the minimum value of the last three throws, 9th, 10th and 11th throws.

Hence, the minimum possible sum = 12 + 2 + 1 + 3 = 18.

Instructions

In an ODI match between India and New Zealand, four players from India (A, B, C and D) and three players from New Zealand(E, F, G) had scored more than 50 runs each. Also, each of the players had definitely scored exactly 10, 20, 30, 40, 50 runs at some point in their innings. The following graph represents the number of balls(deliveries) taken by each of them to score 0-10, 11-20, 21-30, 31-40, and 41-50 runs. The same information for runs scored beyond 50 is not available for this match.



For example, G scored the first 10 runs in 9 balls, the next ten runs in 8 balls,....., and the last ten runs till 50 (41-50) in 4 balls. G scored 50 runs in 38 balls. Also, note that if G had not scored any run in the 10th ball that he faced, that ball is counted in the 11-20 range, and not in the 0-10 range.

Strike rate SR = $\frac{\text{Total number of runs scored}}{\text{Total number of balls faced}} \times 100$

SR can be calculated for different ranges as well. The following notation should be followed for the following questions:

The Strike Rate for F for runs scored from 11 to 20 is denoted by

$SR_{F(11\text{-}20)} = \frac{\text{Total runs}}{\text{Total balls}} \times 100 = \frac{10}{10} \times 100 = 100$

Based on the information provided, answer the following questions.

41. If P represents a player among A to G, such that

$SR_{P(0\text{-}30)} < 100$ and $SR_{P(31\text{-}50)} > 100$, how many players can P represent?

Sol. The Strike Rate is > 100 if the number of runs is more than the number of balls, and similarly, if the number of runs is less than the number of balls, the SR is less than 100.

	0-30	31-50
A	33	12
B	50	16
C	20	5
D	43	7
E	55	6
F	30	20
G	29	9

A, B, D and E satisfy the conditions. Hence, four players fall in the category.

42. Which player has the lowest SR value for the runs scored from 21 to 40?

A. D

B. F

C. E

D. More than one

Sol. The lowest strike value means that the number of balls faced is more.

A - 6 + 8 = 14

B - 5 + 10 = 15

C - 5 + 3 = 8

D - 16 + 4 = 20

E - 15 + 3 = 18

F - 10 + 10 = 20

G - 12 +5 = 17

Both D and F have the lowest strike rate.

43. Which player from India reached 25+ runs in the most number of balls possible?

A. A

B. B

C. D

D. Cannot be determined

Sol. We need to check the range for 21-30 because 25 falls in this range.

B starts it at the very end. Hence, B takes the most number of balls to reach 25+ runs.

Hence, B is the answer.

44. If SR_1 represents the highest strike rate of an Indian player while scoring runs from 21-50, and SR_2 represents the highest strike rate of a New Zealand player while scoring from 21-50, which of the following is right?

A. $\frac{SR_1}{SR_2} = \frac{1}{2}$

B. $\frac{SR_1}{SR_2} = \frac{21}{10}$

C. SR_2 IS 110% more than SR_1

D. SR_1 IS 200% more than SR_2

Sol. From the Indian players, C scored the runs in the lowest possible number of balls.

Hence, $SR_1 = 30/10 = 3$

From the New Zealand players, E and G scored them in 21 balls each.

Hence, $SR_1 = 30/21 = 10/7$

$\frac{SR_1}{SR_2} = \frac{21}{10}$

45. If N is a four-digit number that has 7 even factors, what is the smallest possible value of N?

[Enter -1 is no such value of N exists.]

Sol. N has 7 even factors.

Now, we know that N definitely has a power of 2 in its prime factorisation.

So, $N = 2^a p^b ....$

In this case, the total number of even factors is given by:

(a)(b+1).... = 7

7 can be expressed as

7 = 1 x 7

Case 1:

a = 1

b + 1 = 7, in that case.

b = 6

So, $N=2p^6$

<p is a prime number>

Case 2: It is also possible that

a = 7 and b + 1 = 1 => b = 0.

This means that N only has 2 as its prime factor.

N = $N=2^7$

However, N has 4 digits. Hence, we can completely eliminate case 2. Since $2^7=128$ has three digits.

Case 1: $N=2p^6$

p has to be the smallest number possible, hence p = 3.

So, $N = 2*3^6 = 1458$.

46. If the ratio of an internal angle of a regular polygon of n sides to that of a regular polygon of m sides is 3:4, find out the sum of m and n. Enter -1 if it cannot be determined.

Sol. According to the given conditions,

$$\frac{(n-2)180}{n} : \frac{(m-2)180}{m} = 3:4$$

$$1-\frac{2}{n} : 1-\frac{2}{m} = 3:4$$

$$\frac{1-\frac{2}{n}}{1-\frac{2}{m}} = 3:4 \dashrightarrow 4-\frac{8}{n} = 3-\frac{6}{m} \dashrightarrow \frac{8}{n}-\frac{6}{m} = 1$$

$$8m - 6n = mn \dashrightarrow mn - 8m + 6n - 48 = -48$$

$$m(n-8) + 6(n-8) = -48$$

$$(n-8)(m+6) = -48$$

$$(8-n)(m+6) = 48$$

Now, n can take values from 3 to 7.

If n = 3, we get 8 - 3 as 5, that is not divisible by 48.

If n = 4, 8 - 4 = 4, hence m = 6

n = 5, m = 10

n = 6, m = 18

n = 7, m = 42

Hence, for different values, we get different values of m+n. Hence, the answer cannot be determined.

47. The general terms of two series a, b are represented by :

$a_{n+1} = 1 - \frac{1}{a_n}$ for $n \geq 3$, $a_3 = 2$.

$b_{n+1} = 1 - \frac{1}{b_n}$ for $n \geq 4$, $b_4 = 3$.

Find $a_{2012} + b_{2012}$

A. $-\frac{1}{3}$

B. $-\frac{1}{2}$

C. $\frac{1}{6}$

D. $-\frac{3}{2}$

Sol. For the first series since $a_3 = 2$

Substituting n = 3 in the function. $a_4 = 1 - \frac{1}{2} = \frac{1}{2}$

Substituting n = 4 in the function. $a_5 = 1 - 2 = -1$

Substituting n = 5 in the function. $a_6 = 2$

Hence the sequence repeats itself every third term.

For the series in b_n. We have $b_4 = 3$

Substituting n = 4 in the function $b_5 = 1 - \frac{1}{3} = \frac{2}{3}$

Substituting n = 5 in the function $b_6 = 1 - \frac{1}{\left(\frac{2}{3}\right)} = -\frac{1}{2}$

Substituting n = 6 in the function $b_7 = 1 - \frac{1}{\left(-\frac{1}{2}\right)} = 3$.

The function repeats after every third term.

Since the function repeats itself after every third term.

We have : $a_k = a_{k+3} = a_{k+6} =$.....

$b_k = b_{k+3} = b_{k+6} =$.....

$a_{2012} = a_{3n+2} = a_5$. Hence $a_{2012} = -1$

Similarly $b_{2012} = b_5 = \frac{2}{3}$

$a_{2012} + b_{2012} = -1 + \frac{2}{3} = -\frac{1}{3}$

48. For the functions $F(x) = x^2+ax+c$, $G(x) = x^2+ax+d$ the minima are P and Q respectively such that P - Q = 5. If the roots of the quadratic equation $x^2-15x+c^2-d^2 = 0$ are X, Y and $\frac{XY}{X+Y} = 7$. Determine the values of c, d ?

A. c = 21, d = 16

B. c = 19, d = 14

C. c = 17, d = 12

D. c = 13, d =8

Sol. For the two given functions :

$F(x) = x^2+ax+c$, $G(x) = x^2+ax+d$.

The function G(x) can be rewritten as : F(x)+d-c. Only the constant part is varying for both the functions.

Hence if the minima of G(x) is equal to minima of F(x)+d-c.

The minima of F(x) - minima of G(x) = c-d.

Hence the value of c-d = P-Q = 5.

In the additional information provided we were given the value of

$\frac{(\text{Product of roots})}{(\text{Sum of roots})}$

Hence : $\frac{(c^2 - d^2)}{(15)} = 7$.

$c^2-d^2 = 105$

Since c-d = 5, c+d =21.

Solving from this we get c = 13, d = 8.

49. If two positive numbers M and N (in order) are in the ratio of r:1, and M is also r^3 % of N, find out the value of 100r.

Sol. $\frac{M}{N} = \frac{r}{1}$

M = Nr

Also,

$M = \frac{r^3}{100} \times N$

$r = \frac{r^3}{100}$

$r^2 = 100$

r = 10

100r = 1000.

50. If a factor of N is chosen randomly, what is the probability that it is divisible by 6?

$N = 2^6 3^8 4^4 5^4$

A. 116/135

B. 118/135

C. 112/135

D. 106/135

Sol. $N = 2^6 3^8 4^4 5^4 = 2^{14} 3^8 5^4$

Now, the total number of factors = (14+1)(8+1)(4+1) = 15 x 9 x 5

Total number of factors that are in the form of 6x are 14 x 8 x (4+1) = 14 x 8 x 5

[We exclude the 0 powers of 2 and 3]

Hence the probability = (14 x 8 x 5) / (15 x 9 x 5) = 112/135

51. A shopkeeper bought two products X and Y. When the two products were combinedly sold at a price of Rs 1236 the profit percentage was P%. When both of them were sold at a price of Rs 1172 the profit percentage was Q% and P-Q =16. The marked price of X when the product is marked up by $\frac{200}{3}$ % is equal to the cost price of Y. Determine the individual cost price of X and Y.

A. Rs 300, Rs 500

B. Rs 600, Rs 1000

C. Rs 150, Rs 250

D. Rs 75, Rs 125

Sol. Considering the cost price of X = Rs A.

The cost price of Y = Rs B.

Given that the profit percentage, when sold at Rs 1236, is 16% higher in comparison to when sold at Rs 1172.

This can be represented as :

$\frac{(1236-(A+B)).100}{(A+B)} - \frac{(1172-(A+B))100}{A+B} = 16$

We get : $\frac{6400}{A+B} = 16$

A+B = Rs 400.

The sum of the cost price of the two products is Rs 400.

Since given that : A(1+200/300) = B and A+B = 400.

Solving this we get A = Rs 150, B = Rs 250.

52. Arjun invested an equal amount in two compound and simple interest schemes simultaneously for a period of 3 years each. The two schemes have an equal rate of interest. If the interest earned from the compound interest scheme is A and the interest earned from the simple interest scheme is B and the ratio of A: B is 61: 48. Determine the rate of interest.

A. 15%

B. 20%

C. 25%

D. 30%

Sol. Considering the amount invested in each scheme is equal to Rs X.

The rate of interest for each scheme = r%.

The interest generated from the compound interest scheme = $X . \left(1 + \frac{r}{100}\right)^3 - X$

The interest generated from the simple interest scheme = $X . \left(1 + \frac{3r}{100}\right) - X$ Considering $\frac{r}{100} = k$

Interest from the simple interest scheme = 3 X k

Interest from the compound interest scheme = $X(k^3+3k^2+3k) = Xk (k^2+3k+3)$

Substituting the ratio we have : $\frac{k2+3k+3}{3} = \frac{61}{48}$

$(k^2 + 3k + 3) = \frac{61}{16}$

$k^2 + 3k + \frac{13}{16} = 0$

The value of k solving for the roots of the quadratic equation is:

$k = \frac{1}{4}$, $k = -\frac{13}{4}$

Hence the value of $\frac{r}{100} = \frac{1}{4}$

r = 25%

53. If two sides of a triangle are of length n and 2n[n is a natural number], how many integer values can the third side take? Note - The length of the sides are not necessarily distinct.

A. n - 1

B. 2n - 2

C. 2n - 1

D. n – 2

Sol. Let us assume that the third side is m.
If m is the smallest side, then,
2n - n < m
m > n.
Hence, m cannot be the smallest side.
If m is between n and 2n, then
n + m > 2n
m > n
If m is the largest side, then,
n + 2n > m
m < 3n
Hence, m can take values from n + 1 to 3n - 1
The total number of values = 3n - 1 - n - 1 + 1 = 2n - 1.

54. If the diameter of a cylinder is increased by 10%, what should be the approximate percentage decrease in the height of the cylinder to keep its volume constant?

A. 17.35%

B. 11.11%

C. 9.09%

D. 19.38%

Sol. Let the initial height and radius of the cylinder be 'h' and 'r' respectively.

The volume remains the same.

Hence, $V=V_1$

Since the diameter is increased by 10%, the radius also increases by the same amount by percentage.

Hence, $r_1=1.1r$

Now,

$\pi r^2 h = \pi (1.1r)^2 h_1$

$r^2 h=1.21r^2 h_1$

$h=1.21h_1$

$h = 1.21h1$

$h_1 = \frac{h}{1.21}$

Percentage decrease $= \frac{h-h1}{h} = \frac{h-\frac{h}{1.21}}{h} = 1 - \frac{1}{1.21} = \frac{0.21}{1.21} \times 100 = 17.35\ \%$

55. The current ages of three friends, Arjun, Vikas and Charan, are X, Y and Z in the given order. The ratio of the ages of Vikas and Arjun nine years from now is 12: 7. The ages of Charan and Vikas, six years from now, are in the ratio 9: 11. Determine the value of 231(Z) - 324(X)?

A. 851

B. 963

C. 563

D. 742

Sol. Using the given information, the current age of Arjun = X, the current age of Vikas = Y and the current age of Charan = Z.

In the first statement, it has been provided that : $\frac{(Y+9)}{(X+9)} = \frac{12}{7}$

Expanding this we get : 7Y + 63 = 12X + 108.

7Y- 12X = 45. (1)

In the second condition : $\frac{(Z+6)}{(Y+6)} = \frac{9}{11}$

Expanding this, we have 11Z+66 = 9Y+54.

9Y - 11Z = 12. (2)

They are given to determine the value of a linear equation in X and Z.

Cancelling out the variable in Y we have :

Multiplying (1) with 9 and multiplying (2) with 7 and subtracting them we have :

9*(7Y-12X) - 7*(9Y-11Z) = 45*9 - 12*7

(63Y - 108X) - (63Y - 77Z) = 405 - 84.

= 77Z - 108X = 321.

Multiplying this with 3 we get : 231Z - 324X = 963

56. A tank is in the form of a uniform cylinder with height h and volume V litres. Two inlet pipes A and B are placed at a height of $\frac{h}{2}$ units and h units. When an outlet pipe is fixed at a height $\frac{h}{2}$, it takes exactly 17 hours to fill the tank. When an outlet pipe is fixed at a height of $\frac{3h}{5}$ the time taken to fill the tank is $\frac{82}{5}$ hours. How long does it take to fill the tank if only the two inlet pipes exist? Each inlet pipe has the same capacity and each outlet pipe has the same capacity.

Sol. Given the total volume of the tank is V litres and the height of the tank is h units.

The position of an inlet pipe does not affect the time taken to fill the tank but the same is not true for an outlet tank. The time requirement varies with the

When the outlet is placed at a height of $\frac{h}{2}$ the outlet will be draining off the volume filled in the upper half of the tank.

Considering the rate of filling A and B to be equal = a lit/hr, b lit/hr.

Considering the rate for the outlet to be = c lit/hr.

Applying the conditions for the information provided :

$$\frac{V}{2(a+b)} + \frac{V}{2(a+b-c)} = 17$$

$$\frac{3V}{5(a+b)} + \frac{2V}{5(a+b-c)} = \frac{82}{5}$$

Considering $\frac{V}{a+b} = P \frac{V}{a+b-c} = Q$

$\frac{P}{2} + \frac{Q}{2} = 17$ (1)

3P+2Q = 82 (2)

Solving for P and Q we get P = 14 and Q = 20.

Hence if only the inlet pipes exist the time taken is :

$\frac{V}{a+b}$ = 14 hours

57. In a class of 108 students, when a high jump competition was held, everyone took part. The total height of all the students who could jump above the 150 cm mark is 6200 cm. The total height of all the students who could clear the 145 cm mark is 11,132 cm. The number of students who failed to clear the 145 cm mark, the number of students who cleared the 145 cm but failed to clear the 150 cm and the number of students who cleared the 150 cm mark are in an arithmetic progression in the given order. Determine the average height of the students in the class who cleared the 145 cm mark but failed to clear the 150 cm mark.

A. 128 cm

B. 137 cm

C. 152 cm

D. 143 cm

Sol. All the 108 students took part in the competition. The students could be divided into three categories.

Students who did not clear the 145 cm mark = a.

Students who cleared the 145 cm mark but failed to clear the 150 cm mark = b.

Students who cleared the 150 cm mark = c.

Hence a+b+c = 108.

Given that a, b, c are in an arithmetic progression in the given order. Hence b = $\frac{(a+b+c)}{3}$. Using the arithmetic mean formula = $\frac{(a+b+c)}{3} = \frac{108}{3} = 36$

The total height of students who cleared the 145 cm mark = Total height of students who cleared 145 cm mark and failed to clear 150 cm mark + Total height of students who cleared the 150 cm mark.

11,132 = 6200 + K.

= 11132 - 6200 = 4932.

The average height of the students who cleared the 145 cm but failed to clear the 150 cm = $\frac{4932}{36}$ = 137 cm.

58. In how many ways can the letters of the word "CRYPTOCURRENCY" be arranged such that the relative order of the vowels stays the same as in the original word?

A. $\frac{14!}{(2!)^2(3!)^3}$

B. $\frac{14!}{2!(3!)^3}$

C. $\frac{14!}{2!(3!)^2}$

D. $\frac{14!}{(3!)^4}$

Sol. CRYPTOCURRENCY has the following distribution of letters.

C - 3

R - 3

Y - 2

P - 1

T - 1

O - 1

U - 1

E - 1

N - 1

The number of permutations = $\frac{14!}{3!3!2!}$

However, the relative order of the vowels has to remain the same.

This means that O should come before U and U should come before E.

In these total permutations, the three vowels will arrange them in 3! ways.

So, we need to divide the total number of permutations by 3!.

Hence, we get the required number of arrangements = $\frac{14!}{3!3!2!} \times \frac{1}{3!} = \frac{14!}{2!(3!)^3}$

59. If the cost price, selling price and the marked price are in an increasing arithmetic progression in this order, what is the ratio of the markup percentage and the discount percentage?

Enter -1 if it cannot be determined.

Sol. Let us assume the cost price is 100. Let the MP be 150 and the SP be 125.

Now, markup percentage = 50%

Discount % = $\frac{25}{150} \times 100 = \frac{50}{3}\%$

Ratio = 3:1

Let us take one more example.

Let us assume the cost price is 100. Let the MP be 200 and the SP be 150.

Now, markup percentage = 100%

Discount % = $\frac{50}{200} \times 100 = 25\%$

Ratio = 4:1

Hence, for different values, we get different ratios of the Markup % and Discount %.

[-1] is the right answer since it cannot be determined.

Alternate explanation:

Let the cost price be C, the selling price be C + d, and the marked price be C + 2d.

Markup percentage $= \frac{MP-CP}{CP}.100 = \frac{C+2d-C}{C}.100 = \frac{200d}{C}$

Discount percentage $= \frac{MP-SP}{MP}.100 = \frac{C+2d-C-d}{C+2d}.100 = \frac{100d}{C+2d}$

Ratio $= \frac{\frac{200d}{C}}{\frac{100d}{C+2d}} = \frac{200d}{C}.\frac{C+2d}{100d} = \frac{2(C+2d)}{2} = 2\left(1+\frac{2d}{C}\right)$

Hence, we cannot determine the value of the ratio of the markup percentage and the discount percentage.

60. On a circular track of circumference 120 meters, three people, A, B, and C run at constant integral speeds (in m/sec). The speed of A is 5 m/sec and is greater than that of B, and when A and B start running on the track simultaneously in opposite directions, they can meet at a total of 8 distinct points on the track. When B and C start running on the track simultaneously in opposite directions, they meet at 9 distinct points. If A, B, and C start running simultaneously from the same point at a time after how many seconds do all three of them meet at the starting point?

A. 120 seconds

B. 96 seconds

C. 192 seconds

D. 108 seconds

Sol. Given the speed of A = 5 m/sec. Considering the speed to B = b m/sec and the speed of C to be c m/sec.

When two people with speeds a, b run on a track of length L in the opposite directions, the number of distinct points they can meet is: a+b

It has been given that the circumference is equal to 120 meters.

The number of distinct meeting points is 8. a+b = 8

Solving this we get multiple possibilities:

a = 5m/sec, b = 3m/sec or a = 5 m/sec, b = $\frac{25}{3}$ m/sec, a = 5m/sec, b = 35 m/sec.

But since it has been mentioned in the question that the speeds are integral and the speed of a is greater than that of b,

The possible value for b = 3m/sec.

Using the value of b and applying the same for B and C.

Since the number of distinct points is 9.

The possible ratios can be 1: 8, 2: 7, 4: 5, 5: 4, 7: 2, 8: 1.

There can be a single possible case to form the value of their reduced speeds to be equal to 9.

The case is b = 3m/sec and c = 24m/sec. This is when the ratio is 1: 8.

The time after which all three of them meet at the starting point is :

LCM of $\left(\frac{120}{5}, \frac{120}{3}, \frac{120}{24}\right)$

= (24, 40, 5)

We get the LCM as 120 seconds

61. A, B, and C together do a piece of work in 24 days. A is twice as efficient as B and half as efficient as C. If X represents the number of days that A takes to finish this work, and Y represents the number of days C takes to finish this work, find out |X-Y|.

Sol. Let the number of units of work that B does in a day be b.

Hence, A does 2b and C does 4b units in one day.

Hence, total work is equivalent to 24 x (b + 2b + 4b) = 24 x 7b = 168b.

Now, A can do the work in 168b/2b = 84 days = X

C can do the same piece of work in 168b/4b = 42 days = Y

Hence, X - Y = 42

62. If $\log_7 72 = x$, $\log_7 192 = y$. Which of the following is an appropriate representation of $\log_3 24$?

A. $\frac{(x+2y)}{(x+3y)}$

B. $\frac{(x+y)}{(2y-x)}$

C. $\frac{(x+y)}{(2x-y)}$

D. $\frac{(x-y)}{(2x+y)}$

Sol. Given that : If $\log_7 72 = x$.

This can be represented as : $3 . (\log_7 2) + 2 . (\log_7 3) = x$

Similarly : $\log_7 192 = y$

$= 6 . (\log_7 2) + 1 . (\log_7 3) = y$

Considering $\log_7 3 = p$, $\log_7 2 = q$

We have : $2p+3q = x$, (1)

p +6q = y. (2)

Solving for the two variables by multiplying the equation (1) with 2 and subtracting the equation (2) from this we get :

$\log_7 3 = \frac{2x-y}{3}, \log_7 2 = \frac{2y-x}{9}$

The value of $\log_3 24 = \log_3 3 + 3 . (\log_3 2) = 1 + 3 . \frac{(\log_7 2)}{\log_7 3} = 1+3 . \left(\frac{q}{p}\right)$.

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

63. A boat takes 18 minutes to travel from P to Q upstream and then back to P downstream in a river. What is the time that it would take to travel from P to R such that PR = 2 PQ and R and Q are on opposite sides of P? The speed of the boat in still water is 5 km/h and the speed of the river is 3 km/h.

A. 5.7 minutes

B. 9 minutes

C. 3.6 minutes

D. 7.2 minutes

Sol. Downstream speed = a = 3 + 5 = 8

Upstream speed = b = 5 - 3 = 2

Now, let PQ = d, Hence, RP = 2d

$\frac{d}{2} + \frac{d}{8} = \frac{18}{60} = \frac{3}{10}$

d = 12/25

Now, time to travel PR = $\frac{2\times\frac{12}{25}}{8} \times 60 \text{ min } \frac{36}{5} = 7.2$

64. A school had 100 students. Among them, there were 'A' boys and the rest were girls. When a workshop was held in the school, x boys from the school did not attend, all girls from the school attended and additionally, y girls from other schools joined. The ratio of boys to girls attending the workshop was 24: 29. Had y boys not participated in the workshop and additionally, x girls from other schools joined the workshop, the ratio of boys to girls attending the workshop would have been 21: 26. Determine y - x.

Sol. In the school the total number of students = 100.

The number of boys in the school = A.

The girls in the school = 100-A.

If x boys were absent for the workshop and additional y girls attended the same. The number of boys attending the workshop is A-x, the number of girls attending the workshop is 100-A+y.

Given that : $\frac{(A-x)}{(100-(A-y))} = \frac{24}{29}$

Using the other condition we have :

$\frac{(A-y)}{(100-(A-x))} = \frac{21}{26}$

Considering A-x =P, A-y = Q.

$\frac{P}{100-Q} = \frac{24}{29}$, $\frac{Q}{100-P} = \frac{21}{26}$

Expanding the two equations we get :

29P+24Q = 2400.

26Q+21P = 2100.

Solving we get P = 48, Q = 42.

A-x = 48, A-y = 42.

Subtracting the two we get y-x = 48-42 = 6

65. Determine the number of integral values of x, for which the inequality : $\frac{(x-5)}{(x+3)(x-9)(x-13)} < 0$

A. 7

B. 8

C. 9

D. 10

Sol. For the given inequality :

In order to make sure the inequality : $\frac{(x-5)}{(x+3)(x-9)(x-13)} < 0$ holds true.

We must have: One among the numerator and denominator to be positive and the other to be negative.

Considering the different ranges :

(-∞, -3),(-3, 5), (5, 9), (9, 13), (13,∞) :

The sign of inequality varies in these different ranges :

Case 1: (-∞, -3)

Considering a value : (-4) from this range :

The result of the function would be given by :

$\frac{(-9)}{(-1)(-13)(-17)}$

The value of the function is positive.

Case 2 : (-3, 5)

The sign of the inequality for numbers in the ranges can be determined by :

Considering a value in this range: -2.

The result of the function : $\frac{-7}{(1)(-11)(-15)}$

The net result is negative.

Case 3 :In the range of (5, 9) :

Considering 6

$\frac{(1)}{(4)(-3)(-7)}$. The product is positive.

Case 4: In the range of (9, 13) :

Considering 10 in this range :

The value of the function is :

$\frac{(5)}{(8)(1)(-3)}$. The function is negative.

Case 5 in the range of (13,∞).

Considering 14 in this range :

$\frac{(9)}{(17)(5)(1)}$. The function is positive.

Hence the possible integral values are : (-2, -1, 0, 1, 2, 3, 4). and (10, 11, 12).

A total of 10 possible values.

Alternatively :

The sign of the function varies alternatively when consecutive ranges are considered.

Hence once the sign for the first range is found to be negative.

For the second range, this becomes positive.

Considering the value in the range :

$(-\infty, -3)$. The value of the function is positive.

For values in the range :

$(-3, 5)$. The value of the function is negative.

For the next range of values :

(5, 9). The value of the function is positive.

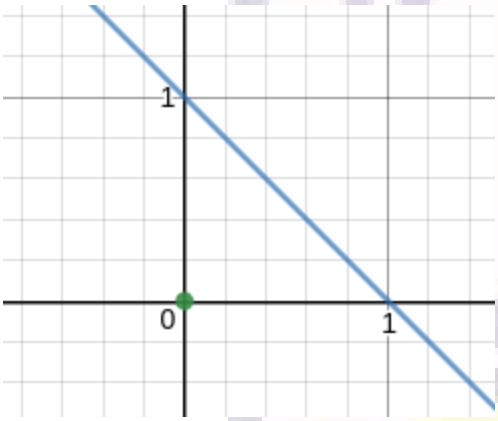
In a similar fashion, this changes alternatively.

Hence the values : (- 2, -1, 0, 1, 2, 3, 4, 10, 11, 12) satisfies the condition that the inequality is negative.

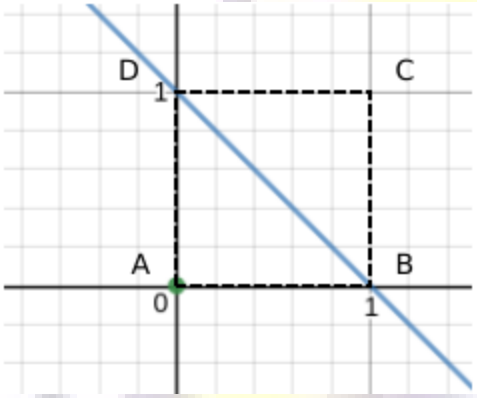
66. If the reflection of (0,0) on the line x + y = 1 is (A,B), what is the value of A+B?

Sol. To find out the reflection of a point P on a line K, we draw a perpendicular from P on K, and then extend it to the other side to a distance that is the same as the distance of P from K.

So, if we plot the point P and line K, we get



Now, if we plot a square having points (0,0), (0,1), (1,0) and (1,1), we get



Now, C is (1,1). If we draw a line from A to C, this is perpendicular to x + y = 1[diagonal of a square].

Hence, the distance from A to the centre is the same as that of C.

C(1,1) is the reflection.