SIVA SIVANI INSTITUTE OF MANAGEMENT

DASH CAT 2

Instructions

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

There is no universally agreed-upon definition of consciousness. Awareness, including self-awareness, comes close; experience perhaps comes slightly closer. When we look at a red apple, certain neural circuits in our brains fire - but something more than that also seems to happen: we experience the redness of the apple. As philosophers often put the question: why is it like something to be a being-with-a-brain? Why is it like something to see a red apple, to hear music, to touch the bark of a tree, and so on?..... The existence of minds is the most serious affront to physicalism.

This is where the zombie - that is, the thought experiment known as the 'philosopher's zombie' - comes in. The experiment features an imagined creature exactly like you or me, but with a crucial ingredient - consciousness - missing. Though versions of the argument go back many decades, its current version was stated most explicitly by Chalmers. In his book The Conscious Mind (1996), he invites the reader to consider his zombie twin, a creature who is 'molecule for molecule identical to me' but who 'lacks conscious experience entirely'. Chalmers imagines the case where he's 'gazing out the window, experiencing some nice green sensations from seeing the trees outside, having pleasant taste experiences through munching on a chocolate bar, and feeling a dull aching sensation in my right shoulder.' Then he imagines his zombie twin in the exact same environment. The zombie will look and even act the same as the real David Chalmers,....

.....Imagining the zombie is step one in the thought experiment. In step two, Chalmers argues that if you can conceive of the zombie, then zombies are possible. And finally, step three: if zombies are possible, then physics, by itself, isn't up to the job of explaining minds. This last step is worth examining more closely. Physicalists argue that bits of matter, moving about in accordance with the laws of physics, explain everything, including the workings of the brain and, with it, the mind. Proponents of the zombie argument counter that this isn't enough: they argue that we can have all of those bits of matter in motion, and yet not have consciousness. In short, we could have a creature that looks like one of us, with a brain that's doing exactly what our brains are doing - and still, this creature would lack conscious experience. And therefore physics, by itself, isn't enough to account for minds. And so physicalism must be false.

As one begins to dissect the zombie argument, however, problems arise. To begin with, are zombies in fact logically possible? If the zombie is our exact physical duplicate, one might argue, then it will be conscious by necessity. To turn it around: it may be impossible for a being to have all the physical properties that a regular person has, and yet lack consciousness. Frankish draws a comparison with a television set. He asks if we can imagine a machine with all the electronic processes that occur in a (working) television set taking place, and yet with no picture appearing on the screen. Many of us would say no: if all of those things happen, the screen lights up as a matter of course; no extra ingredient is required.

1. *The existence of minds is the most serious affront to physicalism.*

What does the author want to convey through the above line?

A. The existence of intangible things like the mind is at odds with the materialistic nature of human beings.

B. The existence of minds shows that physicalism cannot explain every phenomenon that exists.

C. The dual nature of reality: physicalism and spiritualism contest with each other.

D. Physicalism and its proponents reject the existence of minds and conscious experience.

Sol. *As philosophers often put the question: why is it like something to be a being-with-a-brain? Why is it like something to see a red apple, to hear music, to touch the bark of a tree, and so on?..... The existence of minds is the most serious affront to physicalism.*

In the penultimate paragraph, the author writes:

And therefore physics, by itself, isn't enough to account for minds. And so physicalism must be false.

From the above excerpts, we can say that the existence of minds is at odds with physicalism. Also, as per the idea conveyed in the penultimate paragraph, physicalism believes that everything in the universe is physical, and hence, everything can be explained using physics.

A: Physicalism and materialistic nature are two different things—the latter points to a focus on material possession. Option A can be eliminated.

B: Option B comes close to capturing the point mentioned above. Hence, it is the answer.

C: Spiritualism is out of the context and scope here. Hence, Option C can be eliminated.

D: Though the existence of minds contradicts physicalism, we cannot say that physicalism rejects the existence of minds. It says that nothing exists above the physical realm. Hence, it would try to explain how the mind is a process that arises due to physical structures. Thus, Option D is not being conveyed through the line.

2. Which of the following is definitely true about the Chalmers' study mentioned in the second paragraph?

A. The zombie can only exist in the exact same environment as the conscious person it is based upon.

B. The zombie feels the same sensations as the conscious person but cannot consciously experience them.

C. An entity like a zombie exists in the physical world that lacks consciousness despite resembling a person.

D. It is possible to construct a molecule to molecule entity identical to a conscious person.

Sol. The thought experiment in Chalmers' study is of a philosophical zombie, where we imagine that a person has an entirely identical zombie twin who lacks consciousness. We will try to identify which of the assumptions is necessary by negating each option and then checking whether the study still holds:

A: The author asks the reader to imagine the zombie in the same environment as the conscious person. However, he does not say that the zombie will only exist in the same environment as the conscious person it is based on. Hence, Option C is not definitely true.

B: Option B is true as per the following excerpt:

Though versions of the argument go back many decades, its current version was stated most explicitly by Chalmers. In his book The Conscious Mind (1996), he invites the reader to consider his zombie twin, a creature who is 'molecule for molecule identical to me' but who 'lacks conscious experience entirely'.

Hence, Option B is the correct answer.

C: Since it is a thought experiment, whether a zombie exists in real life or not does matter. Hence, Option C cannot be said to be definitely true.

D: Again, since it is a thought experiment, it is not necessary to be able to construct a zombie. The zombie must only be hypothetically possible, we don't need to be able to create that zombie. Hence, Option D can be eliminated too.

3. What is the main point of contention between physicalists and the proponents of the 'philosophical zombie'?

A. Whether consciousness depends upon the structuring of the molecules or not.

B. Whether things that are completely identical physically can still behave differently.

C. Whether physical processes can account for everything in the universe or not.

D. Whether physicalism alone can explain the presence of non-physical entities such as the mind or not.

Sol. The thought experiment of the 'philosopher's zombie' has the objective of proving that in spite of all things being the same at a physical level, there can still be differences between two entities. Since physicalism espouses that the physical nature of matter should account for anything that happens in the universe, the existence of the mind and conscious experience in one and the absence of the same in the other entity negates this fact. Thus, the main point of contention is whether physics and physicalism are complete, can account for everything, or whether they lack the explanation for certain things and phenomena in the universe.

A: The main point is not whether consciousness depends upon the structuring of the molecules, as mentioned above. It is just a part of the argument. Hence, Option A can be eliminated.

B: This is one of the features of the thought experiment, but not the main point of contention. The whole experiment is undertaken to prove a certain point, which has been explained above. Option B is not that point.

C: As explained above, Option C is the correct answer.

D: The primary contention is whether physicalism sufficiently explains the presence of mind/consciousness; there is no consensus on this matter between the two groups. Option D assumes that a conclusion has been reached (physicalism to some extent explains the presence of non-physical entities such as the mind); the main issue now is establishing whether physicalism **alone** explains the presence of the mind or if there are other subjects/variables to be considered. This is evidently incorrect.

4. What is the primary purpose of the last paragraph of the passage?

A. To provide a different perspective on previous arguments by comparing them with another hypothetical situation.

B. To give an example of television sets that is equivalent to the example of the philosopher's zombie.

C. To highlight the drawbacks inherent in the thought experiment of philosopher's zombie.

D. To argue in the favour of physicalism and against the thought experiment of philosopher's zombie.

Sol. *As one begins to dissect the zombie argument, however, problems arise. To begin with, are zombies in fact logically possible?*

In the last paragraph, though the author highlights the shortcomings of the argument, he abstains from taking an extreme stance on the matter. He does not argue against it, but highlights the drawbacks present in the argument. Hence, Option C is the correct answer.

A: The author does not mention another hypothetical situation here, but gives a real-life example of television. Hence, Option A can be eliminated.

B: Though the author provides the example of television sets, the example is not similar to the thought experiment. They are two different things, and the author provides us with the perspective that instead of the philosopher's zombie, the existence of mind could be such that if we try making another entity similar to us, it would necessarily possess consciousness. Option B can be eliminated.

D: As mentioned earlier, the author does not take a stance here. He merely mentions the drawbacks of the argument without taking any sides. Hence, Option D can be eliminated.

Instructions

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

Sending humans on deep space projects is a reality, to visit other planets and colonize them. We are technologically ready to take the first steps. Popular imagination embodied in sci-fi stories—such as "The Martian," with a big station on the surface and Matt Damon stranded on Martian soil growing potatoes; or "Moon," where Sam Rockwell works for a mining company on the Moon's surface—won't be the way to start, though! Mars is our new Everest and every mountaineer knows that to conquer the summit, we need to build a base camp, not on the top, but close enough for climbers to stay and prepare. After the climbers reach the summit, they come back to the base camp to recover and return home. What would be a base camp for

astronauts near Mars? It would be a space station orbiting Mars. But, wait, did I say Mars? Before colonizing Mars, we should consider first our closest celestial neighbour. No, it is not Venus—it is the Moon.

2022 is the year the Apollo program's sister, the Artemis program, will start, aiming to take humans back to the Moon. The Orion capsule (NASA-ESA collaboration) is scheduled for its first test flight around the Moon and return to the Earth this spring. Yes, that soon! Although the Orion capsule has a crew module, the first-stage mission (Artemis I) will be uncrewed. Orion has a crew module created by NASA, a launch abort system for emergencies, and a service module created by ESA, which will provide electricity, propulsion, air conditioning, and water. Beyond the new technologies, Artemis has many differences from Apollo. It won't just go on a series of trips to touch down on the Moon and come back to Earth. Artemis is planning to settle. For that reason, Orion is part of a larger system, a system with a base camp.

After twenty years of gaining experience with the International Space Station (ISS), Gateway is the next space station lab to host humans, this time orbiting the Moon. It will have the right environment for humans to stay in for long periods: they can live, work, and store supplies there. Astronauts will depart from Gateway to the lunar surface for expeditions. When their work is done, they will return safely to Gateway, recover, and prepare to go back home. But why an orbiter base camp and not a surface station? After all, the Moon is only three days away. The Moon is a dusty, harsh environment with high levels of ionizing radiation and extreme day-to-night temperature swings; it is not suitable for long-term residents without protecting a well-conditioned—most probably—ant-like underground structure. A surface base suitable for humans should be a large structure, which, by the way, would have to be practically entirely constructed from materials from the Moon. Besides, launching large pieces from Earth and landing them on other planets is extremely difficult.

5. Which of the following can be inferred to be closest to the author's take on sci-fi stories in the context of space colonization?

A. The stories do not represent reality and can be considered entertaining rather than scientifically accurate.

B. 'Moon' is a better story than 'The Martian' as the former represents a mission on our closest celestial neighbour.

C. Popular sci-fi stories inaccurately depict that space colonization will be done by building large outposts on the surface of celestial objects.

D. Space exploration and human settlements are popular narratives in many sci-fi stories.

Sol. *Sending humans on deep space projects is a reality, to visit other planets and colonize them. We are technologically ready to take the first steps. Popular imagination embodied in sci-fi stories—such as "The Martian," with a big station on the surface and Matt Damon stranded on Martian soil growing potatoes; or "Moon," where Sam Rockwell works for a mining company on the Moon's surface—won't be the way to start, though!*

In the above excerpt, the author indicates that building massive structures or outposts on the surface of celestial objects might not be the best way forward; instead, he advocates building base camps or a connecting outpost to such places. We can safely state that the author would

find the depictions in "The Martian" or "Moon" infeasible at this point in time. Option C correctly captures the author's take on the existing sci-fi depiction of space colonization.

A: From the above excerpt, we can say that the author believes that the ideas presented in the stories are not the way to start. The author has not mentioned that these are scientifically inaccurate or that they can never achieve fruition in the future. Hence, Option A cannot be inferred.

B: Though the author talks about colonizing our Moon first, he does not mention that one story is better than the other. Hence, Option B cannot be inferred.

D: The author says that popular imagination in sci-fi stories will not be the first way to start, highlighting the popular narratives among the sci-fi stories concerned with space. However, the author does not tell us whether the narratives are popular in many sci-fi stories. These narratives may be used only when we talk about space, and a meagre percentage of sci-fi stories is concerned with space. Hence, Option D cannot be inferred.

6. What is the main point that the author wants to convey by the example of a 'base camp' in the first paragraph?

A. The base camp must be located at a point that is easily accessible to the mountaineers.

B. The space station must be located at an optimal point to ensure a proper two-way space journey.

C. The space station should be equally accessible to astronauts going on or returning from a journey.

D. The space station must be located at the middle point of the path of the journey.

Sol. *Mars is our new Everest and every mountaineer knows that to conquer the summit, we need to build a base camp, not on the top, but close enough for climbers to stay and prepare. After the climbers reach the summit, they come back to the base camp to recover and return home. What would be a base camp for astronauts near Mars? It would be a space station orbiting Mars.*

The author is not concerned with mountaineering in the passage. The author cites the example of base camps used in mountaineering to draw a parallel to space journeys. A base camp is located not at the summit, but somewhere midway, where people who are going towards the summit and the ones coming from the summit rest and recover. The author uses Everest as a metaphor for Mars and space station as the base camp.

A: As mentioned above, the main point is the space station. The example of mountaineering has just been used to further this. Option A can be eliminated.

B: As mentioned above, the author is trying to put across the point that the space station should be located at an optimal position and not on the top of Mars. Option B is the correct answer.

C: The author does not say that the station should be equally accessible to both. It is possible that the people returning from the journey would be more prioritised. The word 'equally' makes Option C incorrect.

D: The author did not specify that the space station needs to be at the exact midpoint of the journey. Thus, Option D can be eliminated too.

7. Which of the following is NOT a reason mentioned in the passage that makes a surface space station on the Moon unsuitable?

A. Sending humans from Earth and landing them on such a space station is extremely difficult.

B. There are high levels of ionizing radiation on the Moon, with considerable temperature swings.

C. The structure required to host humans would require a significant amount of materials.

D. The dusty and harsh environment of the Moon makes it challenging to host humans there.

Sol. *The Moon is a* <u>*dusty, harsh environment*</u> *with* <u>*high levels of ionizing radiation and extreme day-to-night temperature swings; it is not suitable for long-term residents without protecting a well-conditioned—most probably—ant-like underground structure. A surface base suitable for humans should be a large structure, which, by the way, would have to be practically entirely constructed from materials from the Moon. Besides, launching large pieces from Earth and landing them on other planets is extremely difficult.*</u>

A: The author mentions that sending materials from Earth to construct a large structure on the moon would be extremely difficult. The author does not say that the task of sending humans on the space station would be difficult. Option A is a distortion.

B: As mentioned in the above excerpt, Option B is one of the reasons cited in the passage.

C: The author mentions that the surface base would be a large structure, and hence, the amount of material needed would be high. Hence, Option C is one of the reasons cited.

D: In the above excerpt, the dusty and harsh environment of Moon has been cited as one of the reasons.

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

A. The Apollo mission undertook many trips but could not settle due to a lack of a base camp.

B. The Artemis program has been designed for uncrewed missions.

C. After Moon, Venus is the closest celestial body to Earth.

D. To establish a settlement, Artemis will utilize a space station in its Moon mission.

Sol. A: *Beyond the new technologies, Artemis has many differences from Apollo. It won't just go on a series of trips to touch down on the Moon and come back to Earth. Artemis is planning to settle. For that reason, Orion is part of a larger system, a system with a base camp.*

It has been mentioned that Artemis and Apollo had many differences, and one of them is that Apollo was a touchdown and return mission, while Artemis plans to settle. However, the author does not say that Apollo could not settle due to a lack of a base camp. There could have been other reasons or other technological deficiencies that prevented it from doing that. Hence, Option A is not true.

B: *Although the Orion capsule has a crew module, the first-stage mission (Artemis I) will be uncrewed.*

Artemis is a program that aims to settle humans. Hence, designing the mission without a crew in mind would not be logical. The above excerpt says that the first-stage mission will be uncrewed, maybe to do a test run. Option B is false.

C: The passage does not mention this fact. Option C can be eliminated.

D: *Artemis is planning to settle. For that reason, Orion is part of a larger system, a system with a base camp.*

The author mentions that since Artemis is planning to settle, Orion will be part of a system that includes a base camp, referring to a space station. Thus, Artemis plans to utilize this to establish a settlement on the moon. Option D is the correct answer.

Instructions

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

One key element of human language is semantics, the connection of words with meanings. Scientists had long thought that unlike our words, animal vocalizations were involuntary, reflecting the emotional state of the animal without conveying any other information. But over the last four decades, numerous studies have shown that various animals have distinct calls with specific meanings.

Many bird species use different alarm calls for different predators. Japanese tits, which nest in tree cavities, have one call that causes their chicks to crouch down to avoid being pulled out of the nest by crows, and another call for tree snakes that sends the chicks jumping out of the nest entirely. Siberian jays vary their calls depending on whether a predatory hawk is seen perching, looking for prey or actively attacking — and each call elicits a different response from other nearby jays. And black-capped chickadees change the number of "dees" in their characteristic call to indicate the relative size and threat of predators.

Two recent studies suggest that the order of some birds' vocalizations may impact their meaning. Though the idea is still controversial, this could represent a rudimentary form of the rules governing the order and combination of words and elements in human language known as syntax, as illustrated by the classic "dog bites man" vs. "man bites dog" example.

In addition to alert calls, many bird species use recruitment calls that summon other members of their species. Both Japanese tits and southern pied babblers appear to combine alert calls with recruitment calls to create a sort of call to arms, gathering their compatriots into a mob to harass and chase off a predator. When the birds hear this call, they approach the caller while scanning for danger.

Scientists led by ethologist Toshitaka Suzuki of Kyoto University discovered that the order of the combined calls matters to the Japanese tits. When Suzuki's team played a recorded "alert+recruitment" combo to wild tits, it elicited a much stronger mobbing response than an artificially reversed "recruitment+alert" call. This could simply be explained by the birds responding to the combined alert+recruitment call as its own signal without recognizing the parts of the combination, but the scientists came up with a clever way to test this question.

Willow tits have their own distinct recruitment calls, which Japanese tits also understand and respond to in the wild. When Suzuki's team combined the willow tit recruitment call with the Japanese tit alert call, the Japanese tits responded with the same combined scanning and approaching behaviour — but only if the calls were in the correct alert+recruitment order.

"These results demonstrate a new parallel between animal communication systems and human language," Suzuki and colleagues wrote in Current Biology in 2017.

But it's a matter of interpretation whether the call combinations of the tits and babblers is really relevant to discussions of human language, which involves more complex sequences, says behavioural neuroscientist Adam Fishbein of the University of California, San Diego.

"If they were doing something more like language, you would get a whole bunch of different combinations of things," Fishbein says. "It's such a restricted system within the birds."

9. Which of the following correctly captures the features of 'involuntary vocalization'?

A. Vocalization that cannot be controlled by the animal, and represents its emotions.

B. Vocalization that changes rapidly with the emotional state of the animal.

C. Vocalization that has distinct meaning depending upon the emotional state of the animal.

D. Vocalization that has no information other than reflecting the emotional state of the animal.

Sol. *Scientists had long thought that unlike our words, animal vocalizations were involuntary, reflecting the emotional state of the animal without conveying any other information. But over the last four decades, numerous studies have shown that various animals have distinct calls with specific meanings.*

From the above excerpt, we can infer that involuntary vocalizations have the following properties:

1. They reflect the emotional state of the animal.

2. They do not convey any other information than the emotional state.

3. Scientists have proven otherwise by using the fact that various animals have distinct calls with specific meanings.

A: It has not been mentioned that the animal cannot control an 'involuntary vocalization'. It is possible that the organism is able to alter the loudness of the call. Hence, Option A can be eliminated.

B: The rate at which the vocalization changes with a change in emotional state has not been mentioned here, Hence, Option B can be eliminated too.

C: Option C is contrary to what has been mentioned in the passage(point 3 above). The passage states that distinct calls have 'specific' meanings and does not indicate that a single call can be interpreted differently. Hence, Option C can be eliminated.

D: Option D comes the closest to capturing the points mentioned above. Hence, Option D is the correct answer.

10. The example given in the third paragraph has been mentioned to suggest that:

A. The vocalizations of birds can change according to the threat they are facing.

B. The order of vocalizations can affect the meaning the birds want to convey.

C. The syntax rules in human language could be applicable to bird vocalizations.

D. The syntax used by birds is likely to be a simpler version of human syntax.

Sol. *Two recent studies suggest that the order of some birds' vocalizations may impact their meaning. Though the idea is still controversial, this could represent a rudimentary form of the rules governing the order and combination of words and elements in human language known as syntax, as illustrated by the classic "dog bites man" vs. "man bites dog" example.*

The author opens the third paragraph by suggesting that the order of vocalizations could impact the meaning birds want to convey. He then gives an example of how syntax affects the meaning of sentences in human language. Thus, the author mentions the example to further the point he made at the beginning of the paragraph. Hence, Option B is the correct answer.

The example has not been made to relate the vocalizations with the threats birds are facing, but to exemplify the effect of the order on the meaning of the message. Option A can be eliminated.

The author does not want to say that human syntax rules are applicable to bird vocalizations. He is merely saying that the ordering could cause changes in meaning in bird language, as they do in human language. He does not aim to generalize this to say that all our syntax rules are applicable to birds. Hence, Option C can be eliminated.

Option D cannot be inferred from the passage and hence can be eliminated.

11. Which of the following is true about the two experiments on birds' alert calls mentioned in the passage?

A. One is complete and gives only concrete conclusions, while the other has certain shortcomings.

B. They have similar aims but have completely different procedures.

C. One of them is an improved version of the other.

D. None of them can establish a conclusion satisfactorily.

Sol. *This could simply be explained by the birds responding to the combined alert+recruitment call as its own signal without recognizing the parts of the combination, but the scientists came up with a clever way to test this question.*

The scientists realized that the results of the study could be explained by other reasons than what they suspected, making the conclusions weak. Hence, they included another step that would eliminate other possibilities. Hence, we can say that the second experiment was an improved version of the first. Hence, Option C is the correct answer.

A: We cannot say that the second experiment gives concrete conclusions only. Though it helps eliminate certain shortcomings of the first experiment, it cannot be said that the experiment has no loopholes. Hence, Option A is out of the scope.

B: Most of the steps in the two are common. The only difference is the additional steps introduced in the second experiment. Hence, Option B can be eliminated.

D: The second experiment does establish the conclusion that the order of vocalization in birds matters while conveying a message. Option D can be eliminated too.

12. Which of the following is true according to the passage?

A. The vocal system of birds restricts them from producing distinct vocalizations.

B. The primary purpose of vocalizations in birds is to alert other members about predators.

C. Birds respond to calls from other birds even if they are not from their own species.

D. Birds show a weak response to sounds that are played artificially.

Sol. A: The author mentions that birds have a restricted system, pointing to the fact that the vocalizations of the birds are not as complex as human language, and not that the vocal system of the birds has some limitations. Option A is not true.

B: The passage mentions the' alert' and 'recruitment' purposes of vocalizations. However, it has not been mentioned what is the primary purpose for which vocalizations are produced. Option B is not true either.

C: *Willow tits have their own distinct recruitment calls, which Japanese tits also understand and respond to in the wild.*

From the above line, we can infer that there is at least one instance where cross-species communication takes place in birds. Hence, Option C is the correct answer.

D: In the passage, the author mentions that there was a weak response to the artificially reversed recording. The weak response was due to the altered nature of the vocalizations, and not because they were being played artificially. Hence, Option D can be eliminated.

Instructions

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

Historical chauvinism seems to be a general feature of our collective memories. But why does this bias occur? There are at least two classes of psychological factors likely to contribute. The first set concerns motivation. Belonging to successful, influential groups is good for our self-esteem. Mentally inflating our group's role in history can help fulfil this ego-protection role. Indeed, people who more strongly endorse group-oriented moral values such as loyalty and respect for authority tend to show more collective overclaiming. These are precisely the people for whom we might expect that chauvinistic renderings of their group's history would be more emotionally satisfying.

Cognitive biases likely also play an important role. Quantifying a group's historical influence is a difficult (perhaps impossible) task. When faced with a difficult cognitive task, people often unconsciously swap it out for an easier task. In this case, they might substitute the difficult historical judgment with the simpler task of evaluating how easily important events come to mind. For instance, Americans might know, if pressed, that the Soviets launched the first artificial satellite and the first life form (1957), as well as the first person into space (1961). However, when asked about important developments in space exploration, US accomplishments such as Neil Armstrong's 'giant leap for mankind' (1969) probably come to mind more quickly. That subjective feeling of cognitive ease and familiarity then informs the influence judgment. Such a substitution would be a prime example of a well-studied cognitive shortcut called the availability heuristic.

We were curious to see whether people overclaim because they apply the availability heuristic to a biased collective memory. In another experiment, we had our American participants list, as quickly as they could, the most important events involving their home state as well as those involving two other states (our participants came from California, Massachusetts or Virginia). A simple event count for each state would indicate how easily people could think of home-state versus other-state events. In addition to this retrieval fluency task, participants rated how much of US history could be attributed to people from each of the three states....

.....What do these experiments suggest about how we might deflate collective chauvinism? One route to de-biasing collective memory could be to promote historical curricula in schools that adopt a transnational perspective on events, with the nation de-centred from its traditional role as hero of the story. Similarly, STEM training could place various developments in historical perspective. For instance, where did the decimal notation system come from, and why was it an important tool in advancing mathematical thought? How did the adoption of Arabic numerals rather than the cumbersome Roman numerals help advance mathematics? Rather than presenting scientific knowledge as an atemporal final product, educators could discuss the many contributions from various sources across the world.

It is worth keeping in mind the functional role of collective memory. As social beings belonging to communities that vastly transcend our face-to-face networks, we do need a shared vision of the past (and future) that is relevant to contemporary concerns and that can bind communities together in common purpose. On balance, we propose, exclusively nationalistic, chauvinistic renderings of the past are bad for humanity. However, might a re-visioned memory of 'our common glories' be helpful, if the 'our' in that formulation were more inclusive? This is a question for further consideration.

13. According to the passage, who among the following is likely to be the most affected by 'Historical Chauvinism'?

A. A historian who has extensively researched the history of his own country and its contributions to the world.

B. A blue-collar worker who is proud of being a citizen of the richest country in the world.

C. A freedom fighter who spent all his life fighting for the freedom of his country.

D. A policeman who believes that any and all insubordination should be dealt with with an iron fist.

Sol. The passage presents two main factors contributing to historical chauvinism: (1) motivation and (2) availability heuristics. Under the banner of motivation, the author discusses how certain attributes make individuals more prone/susceptible to 'collectively overclaim'; characteristics such as loyalty to a group and respect for authority (to a somewhat extreme extent) are two such traits. Let us examine the given choices based on the above:

Option A: The passage does not mention that researching extensively about one's history would mean that one becomes biased; it is difficult to identify how the statement here can be attached to either loyalty or respect for authority. Moreover, the availability heuristic is discussed in the context of it being a cognitive shortcut. If someone has extensively researched their country's contribution to the world, they would not need to take a cognitive shortcut to evaluate it. Thus, Option A can be eliminated.

Option B: Again, feeling pride in one's country's achievement need not be extreme. Hence, Option B can be eliminated too.

Option C: Though the freedom fighter has devoted all of his life to his country, it is not necessary that he is affected by the bias of overclaiming. He might be well aware of the shortcomings of his nation/community. Option C can be eliminated.

Option D: In this case, we can perceive one of the stated traits - respect for authority. Given that 'all insubordination' is reciprocated harshly, it is perhaps safe to state that the authoritarian attitude is on the extreme side. Hence, Option D is the correct choice.

14. The primary reason why the example of space exploration in the second paragraph has been mentioned is to show:

A. that the accomplishments of one's own community come to mind more easily than others.

B. how historical chauvinism fades when a person is pressed about the facts.

C. how availability heuristic plays a role in historical chauvinism.

D. that people tend to take the cognitively easier path, thereby causing availability heuristic.

Sol. *Cognitive biases likely also play an important role. Quantifying a group's historical influence is a difficult (perhaps impossible) task. When faced with a difficult cognitive task, people often unconsciously swap it out for an easier task. In this case, they might substitute the difficult historical judgment with the simpler task of evaluating how easily important events come to mind. For instance, Americans might know, if pressed, that the Soviets launched the first artificial satellite and the first life form (1957), as well as the first person into space (1961). However, when asked about important developments in space exploration, US accomplishments such as Neil Armstrong's 'giant leap for mankind' (1969) probably come to mind more quickly. That subjective feeling of cognitive ease and familiarity then informs the influence judgment. Such a substitution would be a prime example of a well-studied cognitive shortcut called the availability heuristic.*

In the second paragraph, the author is trying to outline how cognitive biases could result in historical chauvinism. The one bias that the author wants to mention is the availability heuristic, where a person becomes biased due to the examples that he can recall easily. To explain this effect, the author gives the example of space exploration. A person is more likely to remember the achievements of his own country, which results in him believing that his country is superior

to others. Since the main intention of the author is to expound on availability heuristic, Option C is the correct answer.

Though true, the author wants to highlight the problem associated with the ease of availability of this information, and not the phenomenon itself. Hence, Option A can be eliminated.

Similarly, both B and D are true. But since the paragraph is concerned with how cognitive biases affect historical chauvinism, the two options can be eliminated too.

15. Which of the following has been mentioned as a way to counter historical chauvinism?

A. Teaching the evolution of science with time in the context of one's country.

B. Allowing a student to discover the perspective of other countries on his own.

C. Highlighting the contributions other countries have made in global development.

D. Provide extensive STEM training to eliminate the bias of historical chauvinism.

Sol. A: *One route to de-biasing collective memory could be to promote historical curricula in schools that adopt a transnational perspective on events, with the nation de-centred from its traditional role as hero of the story.*

The author advocated providing a transnational perspective. Teaching the evolution of science in the context of one's own country is unlikely to yield any benefits in eliminating the bias. Hence, Option A can be eliminated.

B: Allowing a student to discover on his own has not been mentioned as a measure. The author advocates the inclusion of transnational perspectives in the curricula. Hence, Option B can be eliminated.

C: *For instance, where did the decimal notation system come from, and why was it an important tool in advancing mathematical thought? How did the adoption of Arabic numerals rather than the cumbersome Roman numerals help advance mathematics? Rather than presenting scientific knowledge as an atemporal final product, educators could discuss the many contributions from various sources across the world.*

Thus, the author is advocating that the contributions of other countries must be highlighted too. Hence, Option C is the correct answer.

D: *Similarly, STEM training could place various developments in historical perspective.*

In the above line, the author is trying to convey that STEM training should place developments in historical perspective, meaning that our technical sciences should be more cognizant of history. He does not advocate extensive STEM training, but some changes in the existing methods. Option D can be eliminated too.

16. Which of the following would provide an answer to the question asked in the last paragraph?

A. Grammatical changes, such as using different pronouns, have the ability to eliminate cognitive biases.

B. Extreme nationalism has been behind the biggest threats mankind has faced throughout history.

C. Thinking of ourselves as global citizens would enable us to have a more balanced historical perspective.

D. Forgetting the undesirable parts of history makes a person more accepting of other nations.

Sol. *However, might a re-visioned memory of 'our common glories' be helpful, if the 'our' in that formulation were more inclusive?*

The author speculates whether making the word 'our' more inclusive could counter historical chauvinism. The author means that our collective identity should not be limited to our social group/nation, but to the global order. This means that instead of talking about the glories our country has achieved, we talk about the achievements we as humanity have achieved. Hence, Option C is the correct answer.

A: The author wants 'our' to become more inclusive. He is not proposing changing grammar but what we denote using 'our'. Hence, Option A is a distortion.

B: This does not help answer the question, and runs tangent to it.

D: The author is not asking to forget history, but be inclusive of other countries too. Hence, Option D can be eliminated.

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

Anthropologists sometimes find love stories in the cultures that they study, but these stories are generally quite different from those that Western cultures tell - but (as happens today) Western narratives have infiltrated them. Western culture's influence is no doubt due to its political, military and economic hegemony. But it is also due to the fact that it invests an extraordinary amount of thought, energy and emotion into love, amore, amour, amor, Liebe - obviously, the English term is only a stand-in for the rest. Love is emoted with hearts, posted on billboards ('You'll love our cereal'), promoted on dating sites, printed on Christmas cards, and celebrated on Valentine's Day.

A. One of the prominent reasons for Western hegemony in the world is their considerable investment in popular narratives like love.

B. In spite of supposed western supremacy, there exist considerable differences in other cultures on certain topics, such as love.

C. The infiltration of the Western narratives in the love stories of other cultures is not due to their political, military and economic hegemony, but rather due to the significant importance the West gives to the idea of love.

D. Western narratives of love have permeated love stories of other cultures in part due to the importance given to love in Western Culture.

Sol. The main points of the passage are:

1. Inspite of the cultural differences, the Western narratives of love have infiltrated other cultures.

2. Though western hegemony plays a part, it is primarily due to the significant investment made by the West in these narratives.

Option D comes the closest in capturing both the points and hence, is the correct answer.

A: The author does not say that the investment in popular narratives leads to western hegemony, but that both of these help in the infiltration of Western narratives of love in other cultures. Option A is a distortion and can be eliminated.

B: Option B does not cover any of the two main points satisfactorily. Hence, it can be eliminated.

C: Option C is a distortion. Pay heed to the following lines: {*Western culture's influence is **no doubt** due to its political, military and economic hegemony. But **it is also** due to ...*} Hence, the West's political, military and economic hegemony does play a role in the infiltration of the Western narratives in the love stories of other cultures. Therefore, Option C is incorrect.

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

1. Interestingly, individuals' employment status did not matter as much as the overall unemployment rate

2. Psychological factors such as trauma, anxiety, and stress can create sensations of pain as real as those caused by physical injury or illness.

3. In economically challenging times, people reported more pain regardless of whether they were employed or unemployed themselves.

4. I worked with my co-author, Andrew Oswald, to explore how the state of the economy can influence pain levels on a national scale.

Sol. A brief reading of the sentences suggests that the paragraph is about how unemployment can make people experience physical pain.

2 is an apt introductory sentence, as it introduces the phenomenon of psychological factors that can make a person experience sensations of pain. 4 then connects it with the rest of the paragraph, but mentioning that the author undertook a study to find a correlation between unemployment and these sensations. 13 forms a mandatory pair, where the author presents the eccentric finding that these sensations of pain depend more on collective unemployment than individual unemployment. Hence, the correct sequence is 2413.

19. **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. According to a Gallup poll in 2015, a third of Americans thought that animals should have the same rights as humans, compared with a quarter in 2008.

2. The think tank on animal welfare in America asked people to protect animals by caring for them instead of taking drastic first steps.

3. Earlier, this progression was marked by the end of slavery and by the adoption of women's suffrage and gay marriage.

4. But protecting animals in this way would have far-reaching consequences—among them, abandoning a centuries-old paradigm of animal-welfare laws.

5. Although the immediate question before Justice Tuitt was the future of a solitary elephant, the case raised the broader question of whether animals represent the latest frontier in the expansion of rights in America

Sol. A brief reading of the sentences tells us that the paragraph must be about saving animals and how this would affect the concept of rights in America.

53 is an apt introductory pair, where the author introduces the effect of a single case on the expansion of rights in America. This expansion was initially marked by certain events, as mentioned in 3. 1 and 2 cannot be connected together to get a paragraph. Hence, one of them must be coupled with 4 to get the paragraph.

4 talks about a drastic step that must have been suggested in the previous line. 2 suggests that no drastic step should be taken, and can be eliminated. 1 talks about one such step, where people advocated that animals be given rights equivalent to those given to humans. Hence, 2 is out of context here.

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

Do we really need assertiveness training these days, when everywhere you look women are loudly professing how empowered and confident they are? If we are smashing glass ceilings, are we really likely to cave in to pressure from our family to not order the jalfrezi for fear it will be too spicy, as one scenario in A Woman in Your Own Right plays out? It turns out that awareness and action are not the same thing. "It is easier to recognise inequality, to be aware of it, than it is to know how to change our behaviour". "We simply don't know how to alter our speech or approach, so again the skills in this book are essential for personal change."

A. Assertiveness training has become obsolete due to the widespread awareness and acceptance of women's empowerment and gender equality.

B. One must not confuse awareness and action when it comes to gender issues like empowerment and equality.

C. Even though there is more awareness about gender inequality, assertiveness training is as necessary today as it was before.

D. Even though there is awareness about gender inequality, this awareness doesn't necessarily translate into assertive behaviour among women.

Sol. The author opens the paragraph by asking whether we need assertiveness training since women are becoming more and more aware of the gaps in empowerment. The author then

answers the question, saying that action and awareness need not be the same thing. He then cites the possible reasons for the same.

A: Option A is contrary to what the author is saying. Hence, Option A can be eliminated.

B: The author is not making a generalization that awareness and action should not be confused in sensitive matters. Instead, the main contention of the author is assertiveness, and we cannot make the generalization. Hence, Option B can be eliminated.

C: Option C is close to the right summary. It does give the answer mentioned for the need for assertiveness training but it fails to mention why the training is still necessary. Moreover, it contains a distortion about the training being as necessary today as earlier which is not mentioned in the passage.

D: Option D comes the closest to capturing the main point mentioned above. Hence, D is the correct answer.

21. **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. Every episode takes the same blueprint and spins it into individual strands of gold.

2. But it only takes a few moments to adjust to the fact that these are five new people looking at an iPad in a big car on their way to a new town.

3. It looks the same and the structure is just as it was, but the furniture is all different and there's a photograph of a new family on the wall.

4. Looking at the German hosts is like visiting a seaside waxwork museum, and the Jonathan Van Ness statue is sort of wonky.

5. At first, watching the show Queer Eye Germany - which launches today - is like visiting an old house long after you have moved out.

Sol. A brief reading of the sentences suggests that the paragraph is about the German adaptation of a popular show. The author is trying to explain how it feels to watch a German rendering of the same.

5 is an apt opening sentence, that sets the context by introducing how the new show feels using a comparison of visiting an old house. 3 then explains this comparison. 42 is a mandatory pair, that describes the initial experience and how the audience gradually starts to become accepting of the show.

Here 1 is the odd one out, as it tries to establish a connection between the blueprints of the original and German adapted episodes, and does not fit with the other four.

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

1. Signs in public parks remind kids to wash their hands, and public health advice suggests avoiding homegrown food and rainwater that might be contaminated.

2. The young, the poor and the Indigenous community have a heightened exposure to risk, mostly caused by improperly maintained rental buildings near contaminated sites.

3. A thin veneer of dust settles on everything - play equipment, windowsills, growing vegetables - and washes into water tanks.

4. The contemporary industrial conditions are much improved, but the ongoing health effects are still hideous and unevenly distributed among the city's population.

Sol. A brief reading of the sentences suggests that the paragraph deals with the environmental situation of a region: the situation has improved but still a lot of challenges ahead.

42 is a mandatory pair, as 4 mentions that there is an uneven distribution of risk, and 2 provides the specific details about this. 31 is another important pair, where 3 mentions the layer of dust entering the water tanks too, and 1 mentions the precautions taken against this water contamination.

Out of 42 and 31, 42 seems a good introductory pair, as 4 is an apt introduction to the challenges that have been mentioned in the remaining sentences. Hence, the correct sequence is 4231.

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

Leucippus is named by most sources as the originator of the atomist theory that the universe consists of two different elements, which he called 'the full' or 'solid,' and 'the empty' or 'void'. Both the void and the solid atoms within it are thought to be infinite, and between them to constitute the elements of everything. Because little is known of Leucippus' views and his specific contributions to atomist theory, a fuller discussion of the developed atomist doctrine is found in the entry for Democritus.

A. The contributions of Leucippus, the supposed creator of the atomist theory of the universe as being constituted by two kinds of elements, are little known.

B. According to the atomist theory of Leucippus, the universe is made up of the solid and the void, and the universe exists between them.

C. According to Leucippus, the solid and the void are infinite, and their unique combinations give rise to everything that exists in the universe.

D. The atomist theory of the solid and the void was originated by Leucippus and then expanded by Democritus.

Sol The main points of the paragraph are:

1. Leucippus is considered to be the originator of the atomist theory, but little is known about his contributions.

2. The atomist theory imagines the universe to be made up of two elements: the solid and the void. Everything in the universe lies between these two.

Option A comes the closest in capturing these two points, and hence, is the correct answer.

Options B and C completely miss out on point 1. Hence, they can be eliminated.

Option D does not capture either of the two main points satisfactorily. Hence, it can be eliminated too.

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

1. When we purchased the property four decades back, it was badly degraded pasture; the native longleafs were long gone, fires long excluded; hard farming followed by overgrazing had left little for cows to eat and depleted the land of the former savanna's biological richness.

2. The picture of degradation was completed by errant coils of rusted barbed wire, bottle dumps and a dead refrigerator.

3. With a pocket-full of blazing stars and assorted other wildflower seeds, I'm ready to spend another hour restoring the several acres of longleaf pine savanna that surrounds my home in north Florida.

4. Instead of flowers under widely spaced pine trees, there were patches of bare sand, clumps of dog fennel and head-high stands of ragweed and other ruderals overtopping scraggly pasture grasses.

Sol. A brief reading of the sentences suggests that the author is describing a savanna she is trying to restore and the state it was in before.

3 is an apt opening statement that sets the context. It introduces the savanna and how the author is working to restore it. The rest of the sentences describe the state it was in before. 1 is an apt follow-up to 3, and begins to describe how the savanna looked in an earlier time period. 2 is an apt concluding sentence, as it tries to complete the picture the author is trying to paint, and hence, 4 must precede it. Hence, the correct sequence is 3142.

Instructions

There are 19 football players in the Indian team. The head coach of the team, Stimac needs to select the Playing 11 (the 11 players that start a game) from these 19 players. Also, the 19 players are represented as follows:

Forwards: A, B, C, D, E

Midfielders: F, G, H, I, J

Defenders: K, L, M, N, O, P

Goalkeepers: Q, R, S

The coach can select the team in two formations:

A. The 4-3-3 Formation - This formation has 1 goalkeeper, 4 defenders, 3 midfielders and 3 forwards

B. The Diamond Formation - This formation has 1 goalkeeper, 4 defenders, 4 midfielders and 2 forwards

Also, the following constraints need to be considered while selecting the players.

1. Exactly one of A and B is a part of the Playing 11.

2. Exactly one of B or G is a part of the Playing 11.

3. Q is selected if and only if D is selected.

4. If both N and K are a part of Playing 11, R is not a part of the Playing 11.

25. If Stimac has to select the Playing 11 in the diamond formation, in how many ways can he select the players?

Sol. Let us divide this into cases.

Since in diamond formation, we need to select 4/5 midfielders, we need to leave out one of them.

Case 1: G does not play.

Midfielders: F H I J [Number of cases = 1]

Forwards: One of B and G plays. So, B has to be present. If B is present, A can't be present.

Hence, among the forwards, along with B, one of C, D or E plays.

Now, Q plays if and only if D plays. Hence we can get these cases:

MIDFIELDERS	FORWARDS	GOALKEEPER
F H I J	B C	R
		S
	B D	Q
	B E	R
		S

Selecting the defenders:

When R is not there in the team, we can select 4/6 defenders in 6C4 = 6C2 ways.

If R is there, we need to subtract the cases where both N and K are there in the team, that is there are 2 more defenders from the remaining 4.

So, we subtract 4C2.

MIDFIELDERS	FORWARDS	GOALKEEPER	DEFENDERS
F H I J	B C	R	6C2 - 4C2 = 9
		S	6C2 = 15
	B D	Q	6C2 = 15
	B E	R	6C2 - 4C2 = 9
		S	6C2 = 15

Total = 63 ways.

Case 2: G plays.

B cannot play and hence A has to play, and we again choose between C, D and E and repeat the same.

The only difference here is that we also have to multiply the final answer with 4(because we need to choose 3 out of F / H / I / J).

MIDFIELDERS	FORWARDS	GOALKEEPER	DEFENDERS
G and three of F H I J	A C	R	6C2 - 4C2 = 9
		S	6C2 = 15
	A D	Q	6C2 = 15
	A E	R	6C2 - 4C2 = 9
		S	6C2 = 15

Hence, we get 63 x 4.

Total number of ways = 63 + 63 x 4 = 63 x 5 = 315.

26. In the previous question, what is the ratio of the number of teams in which A played to the number of teams in which B played?

A. 4:1

B. 4:3

C. 3:1

D. 5:3

Sol. Let us divide this into cases.

Since in diamond formation, we need to select 4/5 midfielders, we need to leave out one of them.

Case 1: G does not play.

Midfielders: F H I J [Number of cases = 1]

Forwards: One of B and G plays. So, B has to be present. If B is present, A can't be present.

Hence, among the forwards, along with B, one of C, D or E plays.

Now, Q plays if and only if D plays. Hence we can get these cases:

MIDFIELDERS	FORWARDS	GOALKEEPER
F H I J	B C	R
		S
	B D	Q
	B E	R
		S

Selecting the defenders:

When R is not there in the team, we can select 4/6 defenders in 6C4 = 6C2 ways.

If R is there, we need to subtract the cases where both N and K are there in the team, that is there are 2 more defenders from the remaining 4.

So, we subtract 4C2.

MIDFIELDERS	FORWARDS	GOALKEEPER	DEFENDERS
F H I J	B C	R	6C2 - 4C2 = 9
		S	6C2 = 15
	B D	Q	6C2 = 15
	B E	R	6C2 - 4C2 = 9
		S	6C2 = 15

Total = 63 ways.

Case 2: G plays.

B cannot play and hence A has to play, and we again choose between C, D and E and repeat the same.

The only difference here is that we also have to multiply the final answer with 4(because we need to choose 3 out of F / H / I / J).

MIDFIELDERS	FORWARDS	GOALKEEPER	DEFENDERS
G and three of F H I J	A C	R	6C2 - 4C2 = 9
		S	6C2 = 15
	A D	Q	6C2 = 15
	A E	R	6C2 - 4C2 = 9
		S	6C2 = 15

Hence, we get 63 x 4.

Total number of ways = 63 + 63 x 4 = 63 x 5 = 315.

Hence, the second part has A in the team and the first part has B in the team. Hence, 4:1.

27. C is the captain of the team and has to be selected in the Playing-11. If Stimac has to select the Playing 11 in the 4-3-3 formation, in how many ways can he select the players?

Sol. Let us start with the forwards. We cannot select both A and B or none of them. Hence, we have C and A/B.

Now, we need one more forward. D or E has to be chosen. Hence, we have one of A/B and one of D/E.

If B is chosen, G is not chosen. So, we can note down the possible squad of midfielders.

Depending on whether D plays, either R/S is the keeper or Q is the keeper. The defenders can be calculated in a similar fashion as follows:

When R is not there in the team, we can select 4/6 defenders in 6C4 = 6C2 ways.

If R is there, we need to subtract the cases where both N and K are there in the team, that is there are 2 more defenders from the remaining 4.

So, we subtract 4C2.

FORWARDS	MIDFIELDERS	GOALKEEPER	DEFENDERS	TOTAL
C A E	2 from F H I J	R	6C2 - 4C2 = 9	4C2 x 9 = 54
		S	6C2 = 15	4C2 x 15 = 90
C A D	2 from F H I J	Q	6C2 = 15	4C2 x 15 = 90
C B D	3 from F H I J	Q	6C2 = 15	4C3 x 15 = 60
C B E	3 from F H I J	R	6C2 - 4C2 = 9	4C3 x 9 = 36
		S	6C2 = 15	4C3 x 15 = 60

We get a total of 54 + 90 + 90 + 60 + 36 + 60 = 390 cases.

28. In the previous question, how many teams have R in them?

Sol. Let us start with the forwards. We cannot select both A and B or none of them. Hence, we have C and A/B.

Now, we need one more forward. D or E has to be chosen. Hence, we have one of A/B and one of D/E.

If B is chosen, G is not chosen. So, we can note down the possible squad of midfielders.

Depending on whether D plays, either R/S is the keeper or Q is the keeper. The defenders can be calculated in a similar fashion as follows:

When R is not there in the team, we can select 4/6 defenders in 6C4 = 6C2 ways.

If R is there, we need to subtract the cases where both N and K are there in the team, that is there are 2 more defenders from the remaining 4.

So, we subtract 4C2.

FORWARDS	MIDFIELDERS	GOALKEEPER	DEFENDERS	TOTAL
C A E	2 from F H I J	R	6C2 - 4C2 = 9	4C2 x 9 = 54
		S	6C2 = 15	4C2 x 15 = 90
C A D	2 from F H I J	Q	6C2 = 15	4C2 x 15 = 90
C B D	3 from F H I J	Q	6C2 = 15	4C3 x 15 = 60
C B E	3 from F H I J	R	6C2 - 4C2 = 9	4C3 x 9 = 36
		S	6C2 = 15	4C3 x 15 = 60

R is present in 54 + 36 = 90 of them.

29. If P and S are not available for selection, find out the total number of ways in which Stimac can select the players.

Note: There is no restriction on the formation.

A. 145

B. 90

C. 155

D. 165

Sol. We are given that P and S are not available. This means that either Q or R is the goalkeeper. Now, for Q to be the goalkeeper, D must be a part of the team. And vice versa. Let us divide this into 2 cases.

Case 1: Q is in the team - D is in the team

We can select any four of the five defenders(one of them not available) in 5C4 that is 5 ways.

Case 2: R is in the team - D is not in the team

We can select one of N or K, and all of L, M, and O in 2 ways.

Now, let us further classify them into Diamond and 4-3-3 formation.

Diamond	D	A or B
	D̶	A or B & C or E
4-3-3	D	A or B & C or E
	D̶	A or B & C & E

In the above table, if D is there in a diamond formation, there is space for one more forward, which is either A or B.

If D is not there in a diamond formation, there is space for two more forwards. One of them is A or B and the other is C or E.

If D is there in a 4-3-3 formation, one of A or B and one of C or E is also present.

If D is not there in a 4-3-3 formation, one of A or B and C and E are present.

				Combination of forward + midfielder	Combination of defender + Goalkeeper	Product
Diamond	D	DA	G + 3 of (F, H, I, J)	4	5	20
	D	DB	FHIJ	1	5	5
	~~D~~	AC	G + 3 of (F, H, I, J)	4	2	8
	~~D~~	AE	G + 3 of (F, H, I, J)	4	2	8
	~~D~~	BC	FHIJ	1	2	2
	~~D~~	BE	FHIJ	1	2	2
4-3-3	D	ACD	G + 2 of (F, H, I, J)	6	5	30
	D	AED	G + 2 of (F, H, I, J)	6	5	30
	D	BCD	3 of (F, H, I, J)	4	5	20
	D	BED	3 of (F, H, I, J)	4	5	20
	~~D~~	ACE	G + 2 of (F, H, I, J)	6	2	12
	~~D~~	BCE	3 of (F, H, I, J)	4	2	8

Hence, we get a total of $20 + 5 + 8 + 8 + 2 + 2 + 30 + 30 + 20 + 20 + 12 + 8 = 165$.

30. In the previous question, what is the difference between the number of 4-3-3 teams formed and the number of diamond-formation teams formed?

A. 0

B. 75

C. 45

D. 25

Sol. We are given that P and S are not available. This means that either Q or R is the goalkeeper. Now, for Q to be the goalkeeper, D must be a part of the team. And vice versa. Let us divide this into 2 cases.

Case 1: Q is in the team - D is in the team

We can select any four of the five defenders(one of them not available) in 5C4 that is 5 ways.

Case 2: R is in the team - D is not in the team

We can select one of N or K, and all of L, M, and O in 2 ways.

Now, let us further classify them into Diamond and 4-3-3 formation.

Diamond	D	A or B
	~~D~~	A or B & C or E
4-3-3	D	A or B & C or E
	~~D~~	A or B & C & E

In the above table, if D is there in a diamond formation, there is space for one more forward, which is either A or B.

If D is not there in a diamond formation, there is space for two more forwards. One of them is A or B and the other is C or E.

If D is there in a 4-3-3 formation, one of A or B and one of C or E is also present.

If D is not there in a 4-3-3 formation, one of A or B and C and E are present.

				Combination of forward + midfielder	Combination of defender + Goalkeeper	Product
Diamond	D	DA	G + 3 of (F, H, I, J)	4	5	20
	D	DB	FHIJ	1	5	5
	~~D~~	AC	G + 3 of (F, H, I, J)	4	2	8
	~~D~~	AE	G + 3 of (F, H, I, J)	4	2	8
	~~D~~	BC	FHIJ	1	2	2
	~~D~~	BE	FHIJ	1	2	2
4-3-3	D	ACD	G + 2 of (F, H, I, J)	6	5	30
	D	AED	G + 2 of (F, H, I, J)	6	5	30
	D	BCD	3 of (F, H, I, J)	4	5	20
	D	BED	3 of (F, H, I, J)	4	5	20
	~~D~~	ACE	G + 2 of (F, H, I, J)	6	2	12
	~~D~~	BCE	3 of (F, H, I, J)	4	2	8

Hence, we get a total of 20 + 5 + 8 + 8 + 2 + 2 = 45 diamond and 30 + 30 + 20 + 20 + 12 + 8 = 120 4-3-3 formations.

Hence, difference = 75.

Instructions

Eight players A, B, C, D, E, F, G, H from a particular squad are sitting around a round table, all facing away from the table. They wear jerseys from 1 to 8. The following information is known about their sitting arrangements.

1. E and F wear odd-numbered jerseys.

2. The player wearing jersey number 1 sits between two players, one wearing a prime-numbered jersey and the other wearing a composite-numbered jersey.

3. There is one player between the players wearing 3 and 4.

4. There are exactly two players between B and the one wearing 4.

5. There are exactly three players between A and the one wearing 6.

6. D is wearing number 2 and is sitting between two players wearing jerseys that have prime numbers on them.

7. A is sitting to the immediate left of B.

It is also known that five among them are from the playing 11 and three among them are from among the substitutes. The three substitutes are all wearing jerseys that have odd numbers and are seated adjacent to each other. Based on the information provided, answer the questions that follow.

31. For how many player(s) can we uniquely identify the jersey number(s)?

A. 2

B. 3

C. 5

D. 8

Sol. From (5) and (7), we can arrange them as follows:
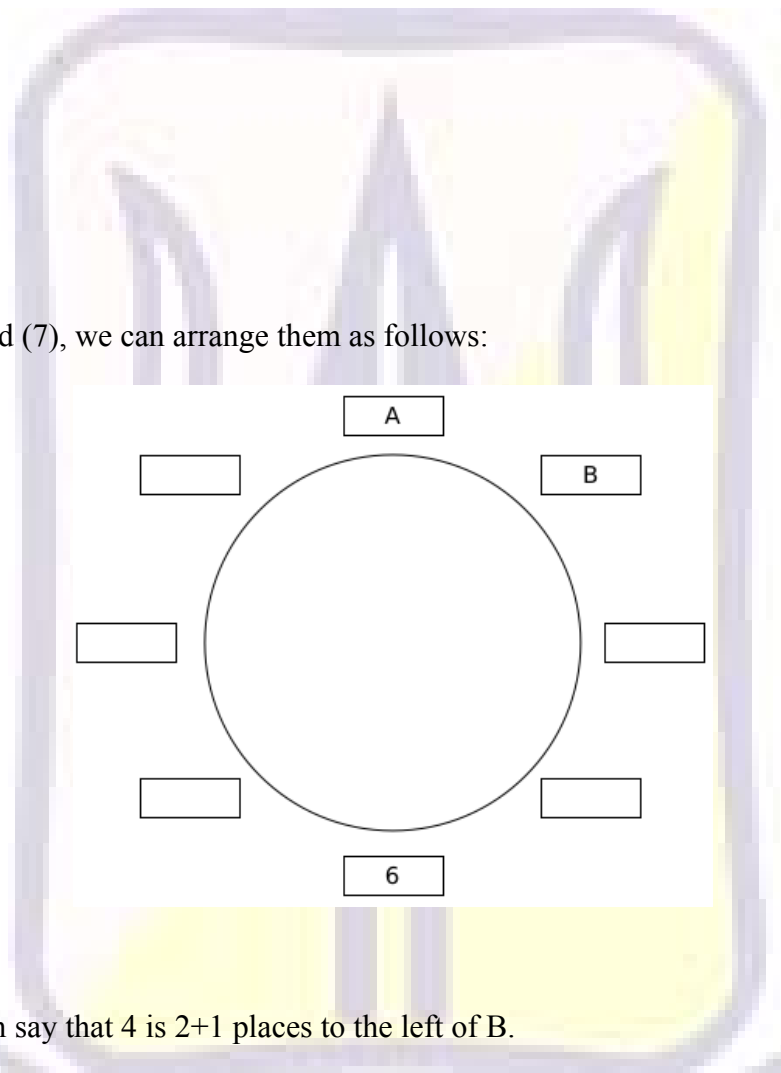
From (4), we can say that 4 is 2+1 places to the left of B.

From (3), we can say that there is only one person between 3 and 4.

```
        A | 3
  [   ]        B
  4                [   ]

  [   ]        [   ]
        6
```

From (6), D is wearing number 2 and is sitting between two prime numbers. So, we can come up with the following 2 arrangements.

```
        A | 3                          A | 3
  [   ]       B | 5            [   ]          B | 7
  4                 D | 2      4                    D | 2

  [   ]       7                [   ]          5
        6                            6
```

From (2), the player wearing 1 sits between 4 and 3, and 8 occupies the only vacant place.

```
        A | 3                          A | 3
   1         B | 5               1           B | 7
  4                D | 2         4                 D | 2

   8         7                   8           5
        6                            6
```

From (1), we can get the following:
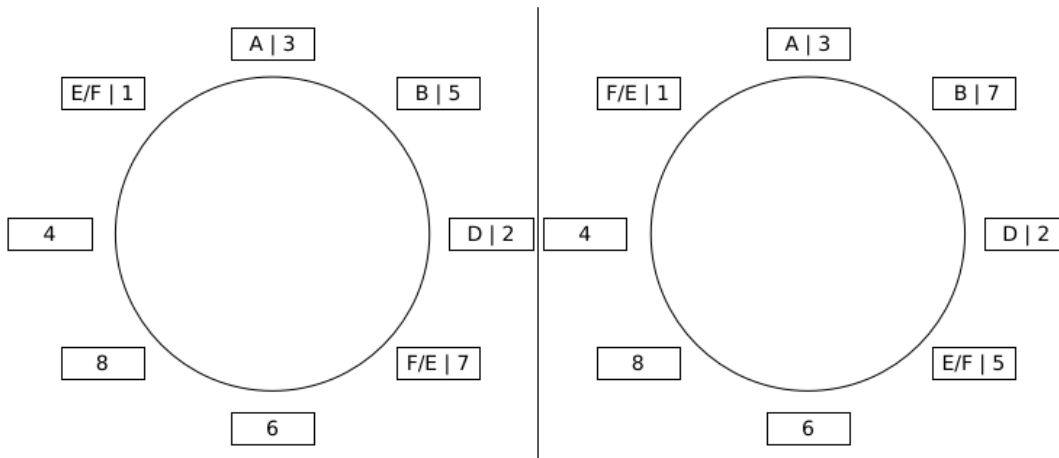
Also, 1, 3, and 7 are the substitutes and the rest are from the playing - 11.
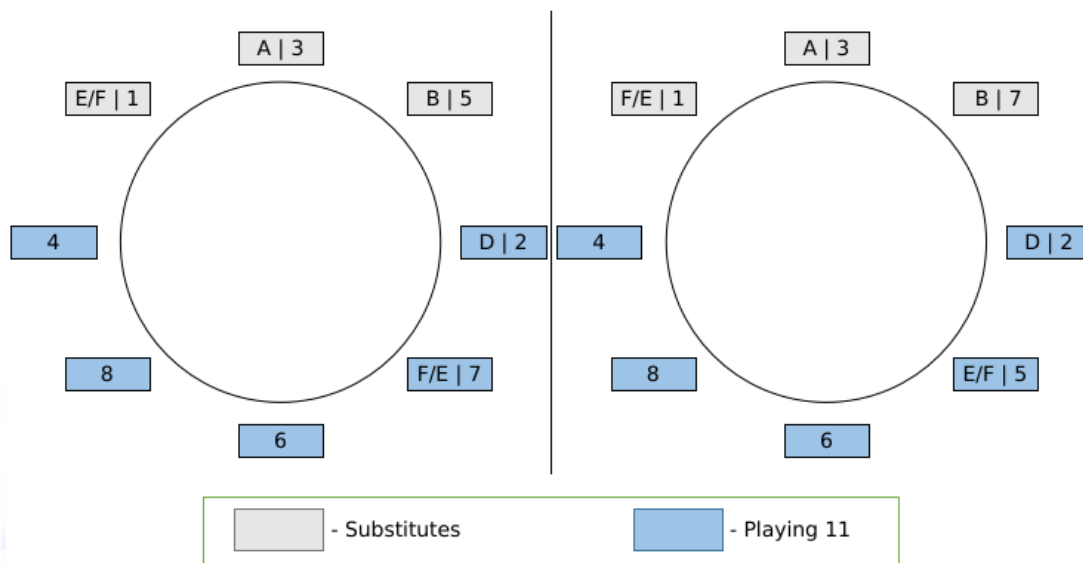
We can identify that A wears 3 and D wears 2.

Hence, only two players exist whose jersey numbers can be uniquely identified.

32. Who represents the only player in the Playing 11, among the eight players wearing an odd-numbered jersey?

A. A

B. E

C. F

D. Cannot be determined
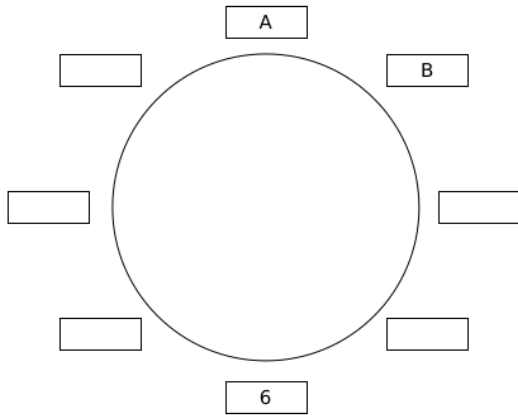
Sol. From (5) and (7), we can arrange them as follows:

From (4), we can say that 4 is 2+1 places to the left of B.
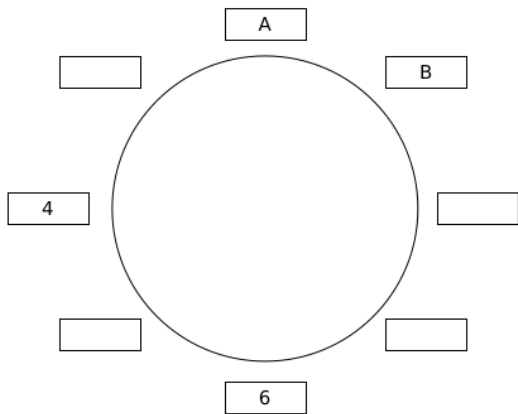
From (3), we can say that there is only one person between 3 and 4.
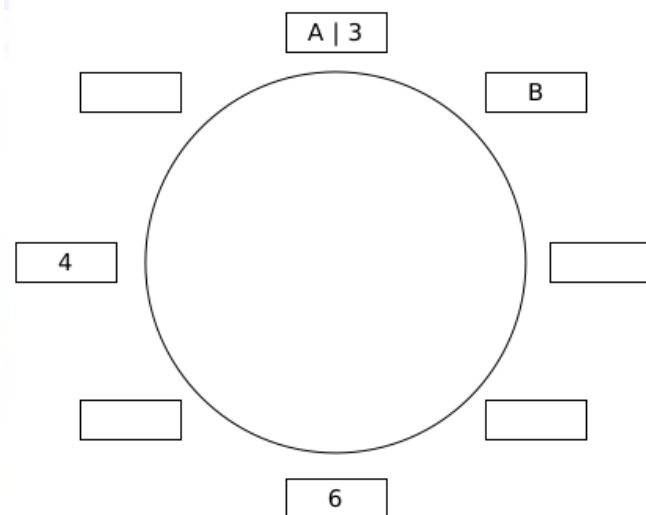
From (6), D is wearing number 2 and is sitting between two prime numbers. So, we can come up with the following 2 arrangements.
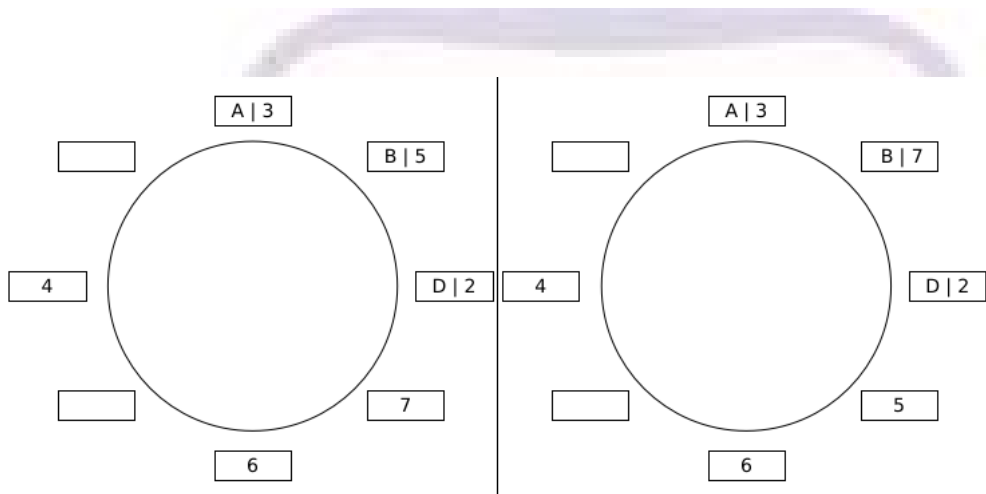
From (2), the player wearing 1 sits between 4 and 3, and 8 occupies the only vacant place.

From (1), we can get the following:
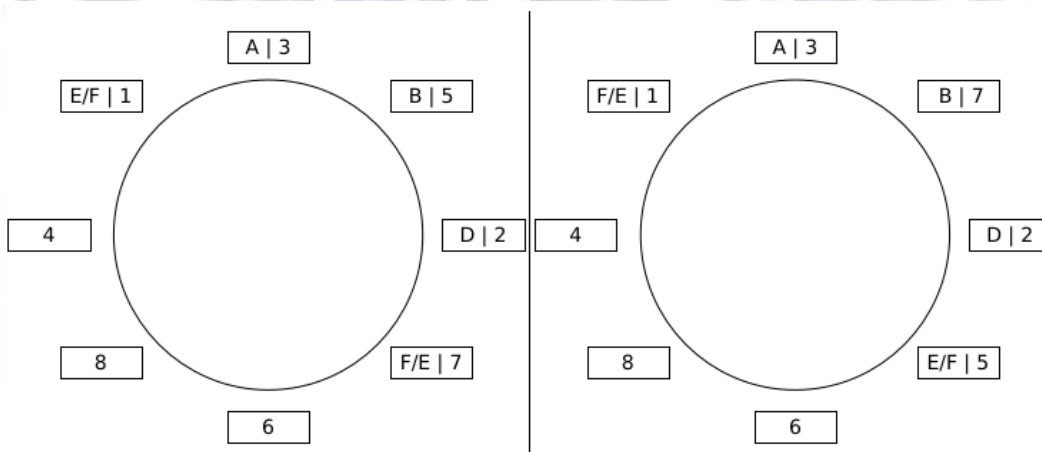
Also, 1, 3, and 7 are the substitutes and the rest are from the playing - 11.
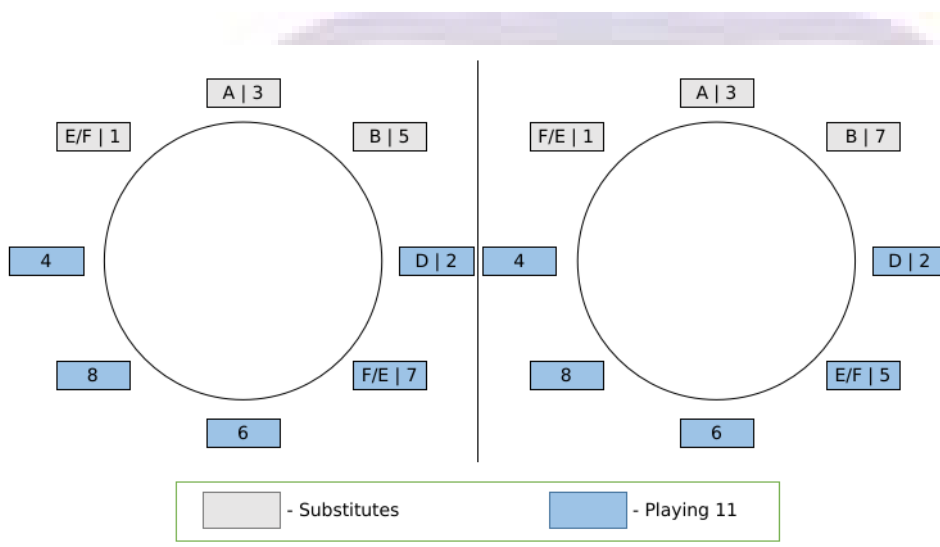
EIther E / F is the player among the playing-11 wearing an odd-numbered jersey.

Hence, it cannot be determined.

33. If G and H have at least one person in between them, what is the jersey number of the player who is sitting two places to the right of C? Enter -1 if it cannot be determined.

Sol. From (5) and (7), we can arrange them as follows:

From (4), we can say that 4 is 2+1 places to the left of B.

From (3), we can say that there is only one person between 3 and 4.

From (6), D is wearing number 2 and is sitting between two prime numbers. So, we can come up with the following 2 arrangements.

From (2), the player wearing 1 sits between 4 and 3, and 8 occupies the only vacant place.

Left diagram:
A | 3 (top)
1 (upper left), B | 5 (upper right)
4 (left), D | 2 (right)
8 (lower left), 7 (lower right)
6 (bottom)

Right diagram:
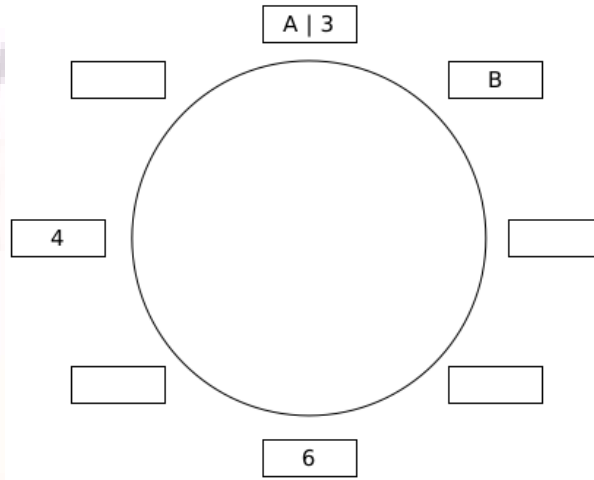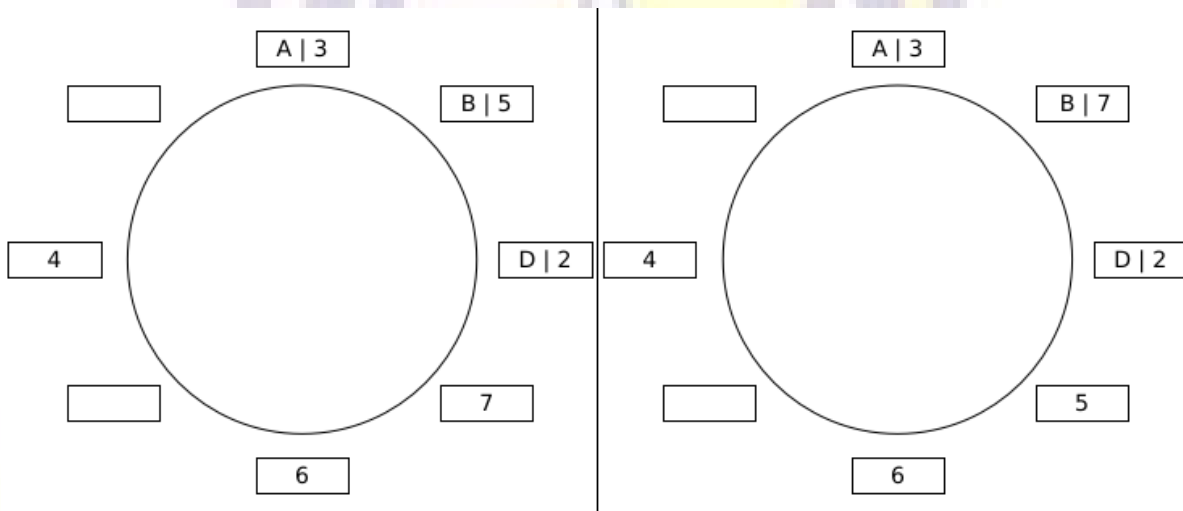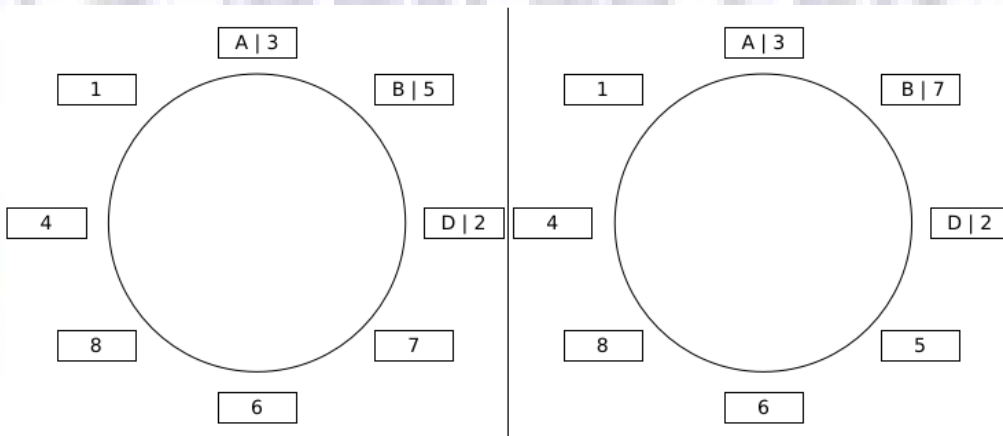A | 3 (top)
1 (upper left), B | 7 (upper right)
4 (left), D | 2 (right)
8 (lower left), 5 (lower right)
6 (bottom)

From (1), we can get the following:

Left diagram:
A | 3 (top)
E/F | 1 (upper left), B | 5 (upper right)
4 (left), D | 2 (right)
8 (lower left), F/E | 7 (lower right)
6 (bottom)

Right diagram:
A | 3 (top)
F/E | 1 (upper left), B | 7 (upper right)
4 (left), D | 2 (right)
8 (lower left), E/F | 5 (lower right)
6 (bottom)

Also, 1, 3, and 7 are the substitutes and the rest are from the playing - 11.

Left diagram:
A | 3 (top, Substitute)
E/F | 1 (upper left, Substitute), B | 5 (upper right, Playing 11)
4 (left, Playing 11), D | 2 (right, Playing 11)
8 (lower left, Playing 11), F/E | 7 (lower right, Substitute)
6 (bottom, Playing 11)

Right diagram:
A | 3 (top, Substitute)
F/E | 1 (upper left, Substitute), B | 7 (upper right, Playing 11)
4 (left, Playing 11), D | 2 (right, Playing 11)
8 (lower left, Playing 11), E/F | 5 (lower right, Playing 11)
6 (bottom, Playing 11)

- Substitutes
- Playing 11

According to this question, 4 and 6 represent G and H in any order. 8 represents C.

We do not know who among E or F is 2 places to the right of C. But we know that he definitely wears jersey number 1.

34. If G and H have at least one person in between them, who is opposite to B?

A. E

B. F

C. C

D. Cannot be determined
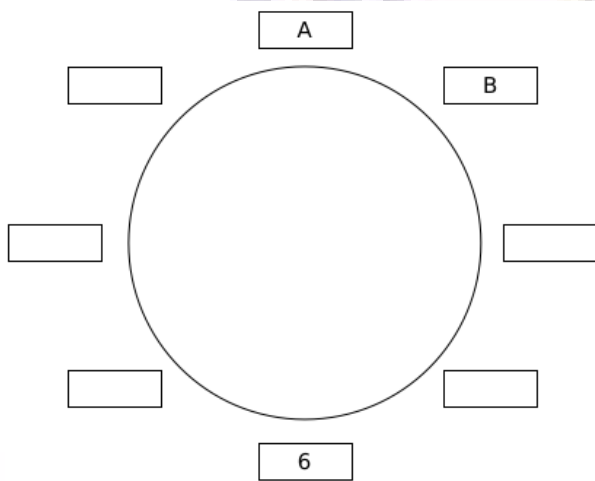
Sol. From (5) and (7), we can arrange them as follows:

From (4), we can say that 4 is 2+1 places to the left of B.

From (3), we can say that there is only one person between 3 and 4.

```
            A | 3
  ┌──┐              ┌───┐
  └──┘              │ B │
        (  circle  )└───┘
  ┌──┐              ┌──┐
  │4 │              └──┘
  └──┘
  ┌──┐              ┌──┐
  └──┘    ┌───┐     └──┘
          │ 6 │
          └───┘
```

From (6), D is wearing number 2 and is sitting between two prime numbers. So, we can come up with the following 2 arrangements.

```
          A | 3                          A | 3
 ┌──┐            ┌─────┐        ┌──┐            ┌─────┐
 └──┘            │ B|5 │        └──┘            │ B|7 │
      ( circle )  └─────┘             ( circle ) └─────┘
 ┌──┐            ┌─────┐        ┌──┐            ┌─────┐
 │4 │            │ D|2 │        │4 │            │ D|2 │
 └──┘            └─────┘        └──┘            └─────┘
 ┌──┐            ┌──┐           ┌──┐            ┌──┐
 └──┘            │7 │           └──┘            │5 │
      ┌──┐       └──┘                ┌──┐       └──┘
      │6 │                           │6 │
      └──┘                           └──┘
```

From (2), the player wearing 1 sits between 4 and 3, and 8 occupies the only vacant place.

```
          A | 3                          A | 3
 ┌──┐            ┌─────┐        ┌──┐            ┌─────┐
 │1 │            │ B|5 │        │1 │            │ B|7 │
 └──┘ ( circle )  └─────┘       └──┘ ( circle ) └─────┘
 ┌──┐            ┌─────┐        ┌──┐            ┌─────┐
 │4 │            │ D|2 │        │4 │            │ D|2 │
 └──┘            └─────┘        └──┘            └─────┘
 ┌──┐            ┌──┐           ┌──┐            ┌──┐
 │8 │            │7 │           │8 │            │5 │
 └──┘  ┌──┐      └──┘           └──┘  ┌──┐      └──┘
       │6 │                           │6 │
       └──┘                           └──┘
```
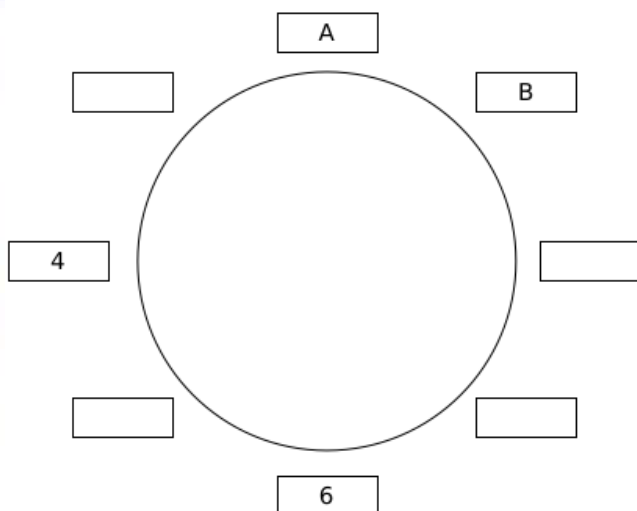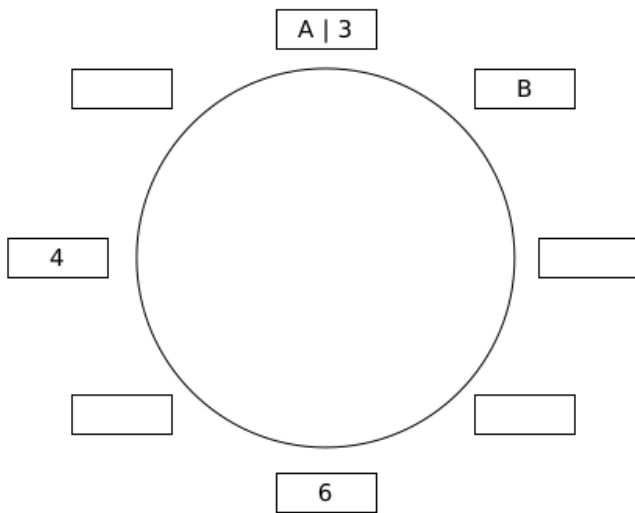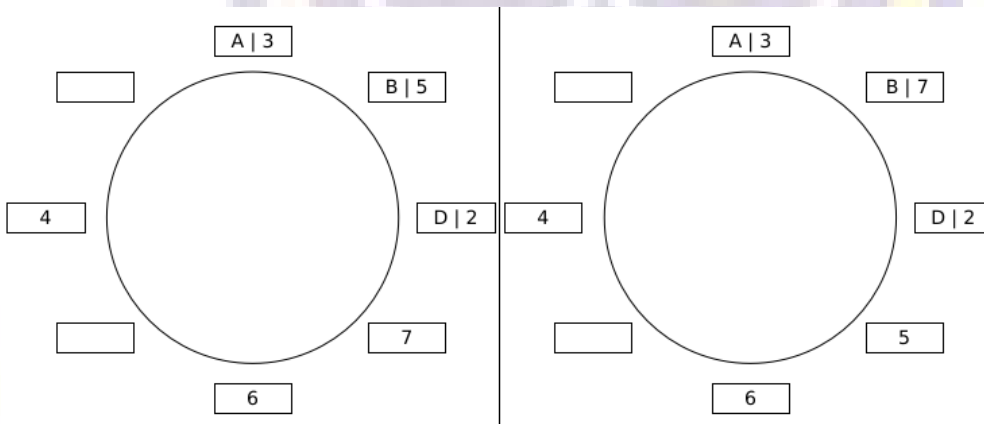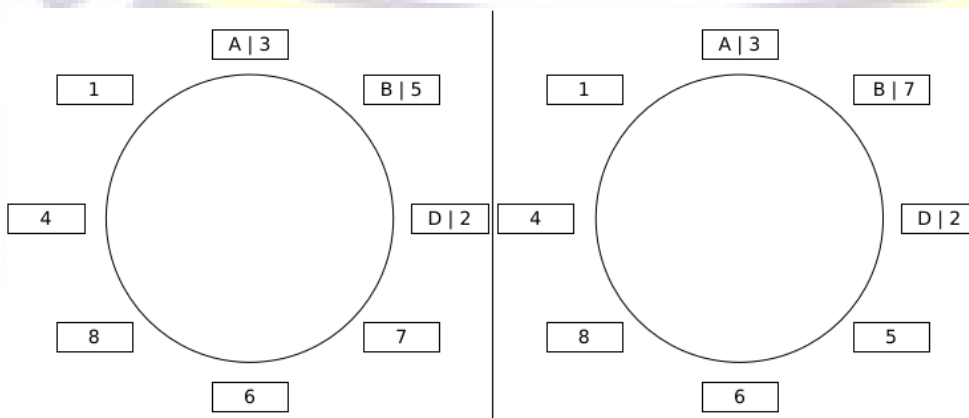
From (1), we can get the following:
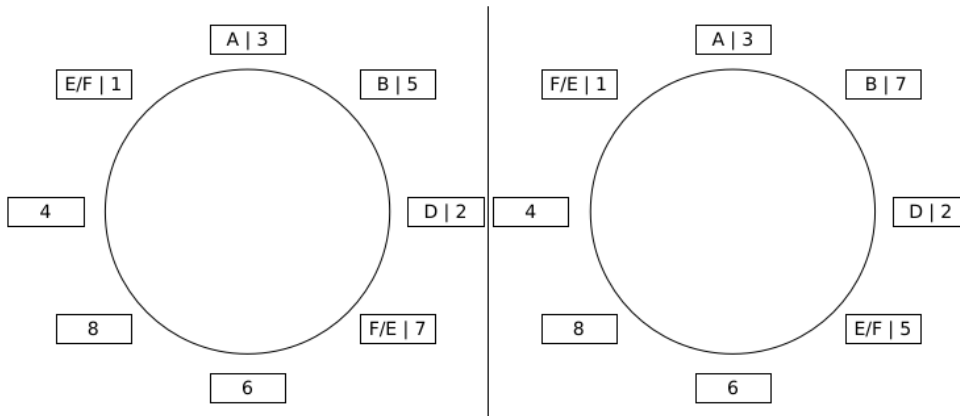
Also, 1, 3, and 7 are the substitutes and the rest are from the playing - 11.
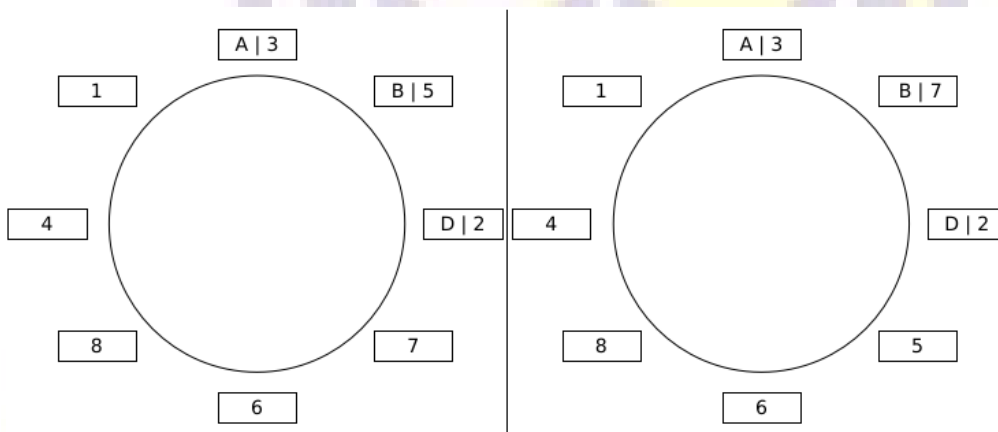

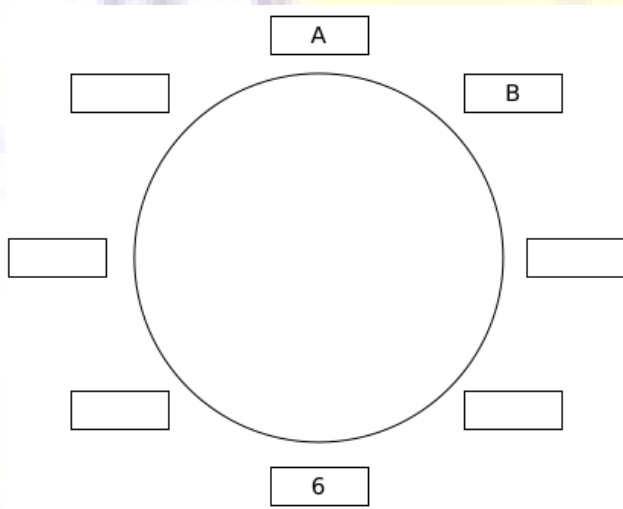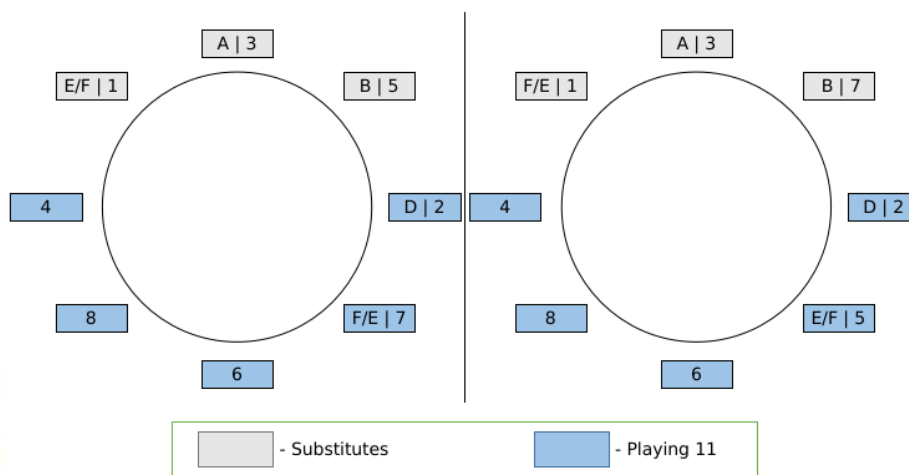According to this question, 4 and 6 represent G and H in any order. 8 represents C.

C, wearing number 8, is opposite to B.

Instructions

In a tournament, 64 teams are participating for the title of the international champion. These 64 teams are seeded 1 to 64, where 1 is the highest seed and 64 is the lowest seed. The tournament is played in rounds, such that in each round, half the teams are eliminated and the other half qualify to the next round. Each team also has a dynamic seed, which keeps changing with each round. Dynamic seed is only calculated for teams that are still alive in a particular round and is only calculated at the beginning of a new round. In Round 1, the dynamic seed of each team is the same as their seed at the beginning of the tournament. From Round 2, it is calculated as follows:

Dynamic seed of team A = Dynamic seed of Team A in the last round or the dynamic seed of the team that Team A defeated in the last round, whichever is a higher seed.

Thus, suppose if the team seeded 2 defeats the team seeded 1 in Round 1, then at the start of the second round, the dynamic seed of the team originally seeded 2 becomes 1[since seed 1 is a higher seed than seed 2].

Round 1:

1. In Round 1, there are a total of 32 games played. In each game, there are two teams participating, and all 64 teams play one game each.

2. The sum of the dynamic seeds of the two teams in any game is either 97 or 33.

3. In a game, only one team wins. There are no ties.

4. If in a game, a higher dynamic seeded team wins, it qualifies to the next round, and the other team is eliminated.

5. If in a game, a lower dynamic seeded team wins, the game is replayed, and the winner of the replayed game qualifies to the next round and the original game is no longer considered valid.

Round 2:

1. At the start of Round 2, the dynamic seeds of the remaining teams are recalculated.

2. The 32 teams are then arranged in ascending order of their dynamic seeds.

3. The highest dynamic seeded team plays the lowest dynamic seeded team. The second-highest dynamic seeded team plays the second-lowest dynamic seeded team and so on.

4. Round 2 is played in the exact same way as points 3, 4, and 5 mentioned for Round 1.

5. 16 teams qualify for Round 3.

This system followed in Round 2 continues in the subsequent rounds till there are 2 finalists left. The round preceding the finals is called the semi-finals and the round preceding that is called the quarter finals.

In the final, only one game is played, and the winner of the game is declared the champion.

Based on the information answer the questions that follow.

35. What are the dynamic seeds of the four teams at the start of the semi-finals?

A. 1, 3, 5, 7

B. 1, 2, 3, 4

C. 1, 17, 33, 49

D. 1, 2, 15, 16

Sol. Let us figure out how the tournament proceeds. We will follow a bottom-up approach:

First, we know that the seeds add up to either 33 or 97. This means that teams seeded 1 2, 3, ... 16 played teams seeded 32, 31, 30, ..., 17 respectively, and teams seeded 33, 34,....., 48 played teams seeded 64, 63, ... 49 respectively.

Now, suppose that in the match between 1 and 32, if 1 wins, then 1's dynamic seed at the start of round 2 is 1[because 1 is the highest seed], but if 32 wins, both in the original game and the replayed game, then 32 qualifies to the second round and gets a dynamic seed of 1 [Seed 1 > Seed 32]. So, we can conclude that whoever wins at any game, will enter the second round with the higher seed among teams playing the game. Thus, in the game between 16 and 17, whoever wins, goes to round 2 with a dynamic seed of 16. We can also say that in Round 2, the team with a dynamic seed of 16 is either the team whose original seed is 16 or the team whose original seed is 17.

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

At the start of round 2, we get the dynamic seeds as 1, 2, 3, 4, 5, ..., 16, 33, 34, 35, 36, ..., 47, 48.

Doing the same for Round 2:

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Continuing for Rounds 3, 4, 5, we get:

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 6
1	4	1
2	3	2

As we can see, the dynamic seed of the semi-finalists are 1, 2, 3, 4.

36. If the team originally seeded 2 played in the finals, which of the following could be the original seed of the team that was the other finalist?

A. 7

B. 22

C. 47

D. 17

Sol. Let us figure out how the tournament proceeds. We will follow a bottom-up approach:

First, we know that the seeds add up to either 33 or 97. This means that teams seeded 1 2, 3, ... 16 played teams seeded 32, 31, 30, ..., 17 respectively, and teams seeded 33, 34,....., 48 played teams seeded 64, 63, ... 49 respectively.

Now, suppose that in the match between 1 and 32, if 1 wins, then 1's dynamic seed at the start of round 2 is 1[because 1 is the highest seed], but if 32 wins, both in the original game and the replayed game, then 32 qualifies to the second round and gets a dynamic seed of 1 [Seed 1 > Seed 32]. So, we can conclude that whoever wins at any game, will enter the second round with the higher seed among teams playing the game. Thus, in the game between 16 and 17, whoever wins, goes to round 2 with a dynamic seed of 16. We can also say that in Round 2, the team with a dynamic seed of 16 is either the team whose original seed is 16 or the team whose original seed is 17.

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

At the start of round 2, we get the dynamic seeds as 1, 2, 3, 4, 5, ..., 16, 33, 34, 35, 36, ..., 47, 48.

Doing the same for Round 2:

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Continuing for Rounds 3, 4, 5, we get:

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 6
1	4	1
2	3	2

Since 2 is one of the finalists, we can be sure that it represents the team with a dynamic seed of 2 in the finals.

Hence, any other team who could have ended up with a dynamic seed of 2 in the finals, is already eliminated. Hence, we need to find out one of the remaining teams. This also implies that the team will definitely end up with a dynamic seed of 1 in the finals. So, it is either 1, or a team who defeated 1, or a team who defeated a team, who defeated one, and so on. We can simply use the table to track it.

Team 1	Team 2	Dynamic Seed of winner at the start of round 6
1	4	1
2	3	2

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

Hence, any of the teams with a grey coloured cell could have been the finalist.

17 is the answer.

37. Which of the following can represent the original seeds of the four teams who played the semifinals?

A. {5, 9, 28, 39}

B. {10, 15, 16, 34}

C. {2, 8, 11, 12}

D. {4, 9, 55, 42}

Sol. Let us figure out how the tournament proceeds. We will follow a bottom-up approach:

First, we know that the seeds add up to either 33 or 91. This means that teams seeded 1 2, 3, ... 16 played teams seeded 32, 31, 30, ..., 17 respectively, and teams seeded 33, 34,....., 48 played teams seeded 64, 63, ... 49 respectively.

Now, suppose that in the match between 1 and 32, if 1 wins, then 1's dynamic seed at the start of round 2 is 1[because 1 is the highest seed], but if 32 wins, both in the original game and the replayed game, then 32 qualifies to the second round and gets a dynamic seed of 1 [Seed 1 > Seed 32]. So, we can conclude that whoever wins at any game, will enter the second round with the higher seed among teams playing the game. Thus, in the game between 16 and 17, whoever wins, goes to round 2 with a dynamic seed of 16. We can also say that in Round 2, the team with a dynamic seed of 16 is either the team whose original seed is 16 or the team whose original seed is 17.

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

At the start of round 2, we get the dynamic seeds as 1, 2, 3, 4, 5, ..., 16, 33, 34, 35, 36, ..., 47, 48.

Doing the same for Round 2:

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Continuing for Rounds 3, 4, 5, we get:

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 6
1	4	1
2	3	2

In the semi-finals, the teams with dynamic seeds of 1, 2, 3, 4 represent 4 different groups of 16 teams. Any four from four different groups might represent the teams in the semi-finals.

Let us track back from the semifinals.

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

Hence, any combination that has a team from all four divisions is valid.

{2, 8, 11, 12} is valid.

38. If the team originally seeded 61 plays the team originally seeded 64 in one of the semi-finals, which two teams could have played the other semi-final?

A. 16 and 48

B. 8 and 41

C. 14 and 45

D. 7 and 43

Sol. Let us figure out how the tournament proceeds. We will follow a bottom-up approach:

First, we know that the seeds add up to either 33 or 91. This means that teams seeded 1 2, 3, ... 16 played teams seeded 32, 31, 30, ..., 17 respectively, and teams seeded 33, 34,....., 48 played teams seeded 64, 63, ... 49 respectively.

Now, suppose that in the match between 1 and 32, if 1 wins, then 1's dynamic seed at the start of round 2 is 1[because 1 is the highest seed], but if 32 wins, both in the original game and the replayed game, then 32 qualifies to the second round and gets a dynamic seed of 1 [Seed 1 > Seed 32]. So, we can conclude that whoever wins at any game, will enter the second round with the higher seed among teams playing the game. Thus, in the game between 16 and 17, whoever wins, goes to round 2 with a dynamic seed of 16. We can also say that in Round 2, the team with a dynamic seed of 16 is either the team whose original seed is 16 or the team whose original seed is 17.

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

At the start of round 2, we get the dynamic seeds as 1, 2, 3, 4, 5, ..., 16, 33, 34, 35, 36, ..., 47, 48.

Doing the same for Round 2:

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Continuing for Rounds 3, 4, 5, we get:

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 6
1	4	1
2	3	2

In the semi-finals, the teams with dynamic seeds of 1, 2, 3, 4 represent 4 different groups of 16 teams. Any four from four different groups might represent the teams in the semi-finals.

Let us track back from the semifinals.

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

64 and 61 end up with dynamic seeds of 1 and 4 respectively.

Hence the other two semifinalists end up with the dynamic seeds of 2 and 3.

7 and 43 represent one such combination.

39. If the Team originally seeded 61 played the Team originally seeded 64 in the semis, what can be the minimum number of matches that were replayed?

A. 6

B. 8

C. 12

D. 14

Sol. Let us figure out how the tournament proceeds. We will follow a bottom-up approach:

First, we know that the seeds add up to either 33 or 91. This means that teams seeded 1 2, 3, ... 16 played teams seeded 32, 31, 30, ..., 17 respectively, and teams seeded 33, 34,....., 48 played teams seeded 64, 63, ... 49 respectively.

Now, suppose that in the match between 1 and 32, if 1 wins, then 1's dynamic seed at the start of round 2 is 1[because 1 is the highest seed], but if 32 wins, both in the original game and the replayed game, then 32 qualifies to the second round and gets a dynamic seed of 1 [Seed 1 > Seed 32]. So, we can conclude that whoever wins at any game, will enter the second round with the higher seed among teams playing the game. Thus, in the game between 16 and 17, whoever wins, goes to round 2 with a dynamic seed of 16. We can also say that in Round 2, the team with a dynamic seed of 16 is either the team whose original seed is 16 or the team whose original seed is 17.

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

At the start of round 2, we get the dynamic seeds as 1, 2, 3, 4, 5, ..., 16, 33, 34, 35, 36, ..., 47, 48.

Doing the same for Round 2:

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Continuing for Rounds 3, 4, 5, we get:

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 6
1	4	1
2	3	2

In the semi-finals, the teams with dynamic seeds of 1, 2, 3, 4 represent 4 different groups of 16 teams. Any four from four different groups might represent the teams in the semi-finals.

Let us track back from the semifinals.

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

We will assume that in only games that 61 and 64 played in, the higher seeded player (if not 61/64) got eliminated. In rest of the matches, the higher seeded player won. The following represents the dynamic ranks.

Round 1: 61 v 36, 64 v 33

Round 2: 13 v 36, 16 v 33

Round 3: 1 v 16, 4 v 13

Round 4: In round 4, their dynamic ranks are 1 and 4, so no more upsets are there.

So, a total of 6.

40. If the team originally seeded 33, won the tournament, find out the minimum number of replayed matches, and the teams that played the other semis in this case[the one where 33 did not play]?

A. Three, 2-3

B. Two, 2-3

C. Two, 1-4

D. Three, 1-4

Sol. Let us figure out how the tournament proceeds. We will follow a bottom-up approach:

First, we know that the seeds add up to either 33 or 91. This means that teams seeded 1 2, 3, ... 16 played teams seeded 32, 31, 30, ..., 17 respectively, and teams seeded 33, 34,....., 48 played teams seeded 64, 63, ... 49 respectively.

Now, suppose that in the match between 1 and 32, if 1 wins, then 1's dynamic seed at the start of round 2 is 1[because 1 is the highest seed], but if 32 wins, both in the original game and the replayed game, then 32 qualifies to the second round and gets a dynamic seed of 1 [Seed 1 > Seed 32]. So, we can conclude that whoever wins at any game, will enter the second round with the higher seed among teams playing the game. Thus, in the game between 16 and 17, whoever wins, goes to round 2 with a dynamic seed of 16. We can also say that in Round 2, the team with a dynamic seed of 16 is either the team whose original seed is 16 or the team whose original seed is 17.

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

At the start of round 2, we get the dynamic seeds as 1, 2, 3, 4, 5, ..., 16, 33, 34, 35, 36, ..., 47, 48.

Doing the same for Round 2:

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Continuing for Rounds 3, 4, 5, we get:

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 6
1	4	1
2	3	2

In the semi-finals, the teams with dynamic seeds of 1, 2, 3, 4 represent 4 different groups of 16 teams. Any four from four different groups might represent the teams in the semi-finals.

Let us track back from the semifinals.

Team 1	Team 2	Dynamic Seed of winner at the start of round 5
1	8	1
2	7	2
3	6	3
4	5	4

Team 1	Team 2	Dynamic Seed of winner at the start of round 4
1	16	1
2	15	2
3	14	3
4	13	4
5	12	5
6	11	6
7	10	7
8	9	8

Team 1	Team 2	Dynamic Seed of winner at the start of round 3
1	48	1
2	47	2
3	46	3
4	45	4
5	44	5
6	43	6
7	42	7
8	41	8
9	40	9
10	39	10
11	38	11
12	37	12
13	36	13
14	35	14
15	34	15
16	33	16

Team 1	Team 2	Dynamic Seed of winner at the start of round 2	Team 1	Team 2	Dynamic Seed of winner at the start of round 2
1	32	1	33	64	33
2	31	2	34	63	34
3	30	3	35	62	35
4	29	4	36	61	36
5	28	5	37	60	37
6	27	6	38	59	38
7	26	7	39	58	39
8	25	8	40	57	40
9	24	9	41	56	41
10	23	10	42	55	42
11	22	11	43	54	43
12	21	12	44	53	44
13	20	13	45	52	45
14	19	14	46	51	46
15	18	15	47	50	47
16	17	16	48	49	48

33's dynamic seed in the final is 1. So, in the semi-finals, the matches were between

a. 1(33), and 4(4 - to minimise the number of upsets)

b. 2(2 - to minimise the number of upsets), and 3(3 - minimise the number of upsets)

Now to calculate the number of matches that had to be replayed, we consider:

1. Round 1 - nil

2. Round 2 - 16 v 33

3. Round 3 - 1 v 16

Only 2 matches were replayed.

Instructions

The CPI(Cumulative Performance Index) of six different students A, B, C, D, E, and F have been recorded across six semesters I to VI. The CPI in any semester is the average of the SPI(Semester Performance Index) till that semester. E.g. The CPI of Student B in the 5th semester is 8.9, which is the average of SPIs that B achieved in semesters 1 to 5.

	I	II	III	IV	V	VI
A	9.6	9.4	9.5	9.3	9.3	9
B	8.7	8.8	8.9	8.8	8.9	9
C	7.6	8.4	8.5	8.6	8.8	8.8
D	7.5	7.5	7.5	7.9	8.2	8.3
E	9	8.5	8.6	8.9	9.1	9.2
F	9.6	9.5	9.4	9.2	9.3	9

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

41. Who had an equal value of SPI and CPI in a semester for the most number of times?

A. A

B. B

C. C

D. D

Sol. If we look at the values of the CPI, it is the average of all SPI till that point. In the first semester, since only one SPI is available, the SPI will be equal to CPI.

In all the other semesters, if the SPI for any one semester is equal to the CPI, this means that the SPI for that semester is equal to the average of the SPI's till the last semester.

For example, if for a student, the SPI for the 5th semester is 9.6 and the CPI for the 5th semester is also 9.6, we can say that

$$\frac{SPI_I + SPI_{II} + SPI_{III} + SPI_{IV} + SPI_V}{5} = 9.6$$

Now, if the SPI of the V the semester is 9.6, we can also say that the average of the SPI's till the 4th semester is 9.6.

Hence, the CPI of the 4th semester is 9.6.

So, we can say that if the CPI of two consecutive semesters is the same, the SPI of the later semester is equal to the CPI of the later semester.

Among all students, D has this occurring three times.

Hence, option D.

42. Who had the highest SPI in the fifth semester?

A. B

B. D

C. E

D. F

Sol. The SPI of the fifth semester can be calculated by the following formula

$$4 \times CPI4 + SPI5 = 5 \times CPI5$$

$$SPI5 = 5 \times CPI5 - 4 \times CPI4$$

	Vth sem
A	9.3
B	9.3
C	9.6
D	9.4
E	9.9
F	9.7

Hence E had the highest SPI in the Vth semester.

43. Who had the lowest SPI in the 4th semester?

A. A

B. B

C. C

D. D

Sol. The SPI of the fourth semester can be calculated by the following formula

$3 \times CPI3 + SPI4 = 4 \times CPI4$

$SPI4 \quad = 4 \times CPI4 - 3 \times CPI3$

	IVth semester
A	8.7
B	8.5
C	8.9
D	9.1
E	9.8
F	8.6

Hence B had the lowest SPI in the IVth semester.

44. If we consider only the first three semesters, who had the overall highest SPI in any semester and in which semester?

A. A, Sem III

B. F, Sem I

C. F, Sem III

D. A, Sem I

Sol. We can either calculate the SPI's for all three semesters or go by the options.

$SPI1 \quad = CPI1$

$SPI2 \quad = 2CPI2 - CPI1$

$SPI3 \quad = 3CPI3 - 2CPI2$

	I	II	III
A	9.6	9.2	9.7
B	8.7	8.9	9.1
C	7.6	9.2	8.7
D	7.5	7.5	7.5
E	9	8	8.8
F	9.6	9.4	9.2

A has the value of 9.7 in the IIIrd semester, which is the highest.

45. A shopkeeper buys a table for some price and then spends an additional 20% of that price on repairs. He then marks the price of the table at Rs 15000 and sells it at a discount of 15%. He has a profit percentage of 25% on the transaction. What was the cost that he paid for the table(without the additional price for repairing)?

A. Rs 9,500

B. Rs 8,600

C. Rs 8,500

D. Rs 11,500

Sol. The selling price $= \left(1 - \frac{15}{100}\right) \times 15000 = 12750$

Let the cost of the table be x. The additional repairs cost him 0.2x.

Total cost = 1.2x

Hence, Selling Price $= \left(1 - \frac{25}{100}\right) \times 1.2x = 12750$

$\frac{5}{4} \times 1.2x = 12750$

$1.5x = 12750$

$x = \frac{12750}{1.5} = 8500$

Therefore, cost price of the table is Rs 8,500.

46. A five-digit number(left-most digit is necessarily non-zero) in base 5 is formed only using digits '1' and '0'. How many of these numbers can be formed such that they are even and are divisible by 5, in the decimal notation?

A. 5

B. 4

C. 3

D. 6

Sol. Let the 5 digit number in base 5 be
1 _ _ _ _
Now, the rightmost digit has to be zero, for this to be divisible by 5.
1 _ _ _ 0
We now have to fill in 0/1 in the spaces.
To ensure that it is even as well, we need a total of even number of 1's. Hence, we can have 4/2 1's.
Hence
11110
11000
10100
10010
The correct answer is 4.

47. If the probability of getting exactly one head and one tail when we toss two identical biased coins is 32%, what is the probability that we get a 'head' while tossing one of the coins? The probability of getting a head is more than the probability of getting a tail.

A. 0.6

B. 0.75

C. 0.8

D. 0.675

Sol. Let the probability of getting a head be x [0<x<1 - If we see it as a percentage, it is 100x %]

Hence, P(T) = 1-x

Now, the given condition says exactly one head and one tail.

P(HT+TH) = x(1-x) + (1-x)x = 2x(1-x)

2x(1-x) = 0.32

x(1-x) = 0.16

0.2 x 0.8 = 0.16

0.2 + 0.8 = 1

Hence, x can be either 0.2 or 0.8.

However, the probability of getting a head is more than the probability of getting a tail.

Hence, x = 0.8

48. Find out the number of solutions of 2{x} + 3[x] = 5. Enter -1 if there are infinite solutions.

{x} = Fractional part of x, $0 \le \{x\} < 1$

[x] is the integer part of x

[x] + {x} = x

Sol. 2{x} +3[x] = 5

3[x] is an integer, 5 is an integer, so 2{x} should also be an integer.

Hence, {x} is either 0 or 0.5

If {x} = 0, 3[x] = 5, which is not possible.

If {x} = 0.5, 3[x] = 4, which is again not possible.

Hence, we do not get any value for x.

49. How many isosceles triangles with integer sides are possible if the perimeter of the triangle is 35 units?

A. 10

B. 8

C. 9

D. 7

Sol. Let the equal sides be a.
Hence,
$a + a + b = 35$
$b = 35 - 2a$
Sum of lengths of any two sides of a triangle should be greater than the third side.
In this question, side of the triangle are a, a, 35-2a
(i) a+a > 35-2a
a > 8.75
(ii) 35-2a+a > a
2a < 35
a < 17.5
a can take values, 9, 10, 11, ..., 16, 17
Therefore, a can take 9 values.

Answer is option C.

50. A certain sum of money invested at a certain rate of simple interest triples itself in 30 years. In how many years does this sum become six times?

A. 60 years

B. 75 years

C. 90 years

D. 120 years

Sol. Let the amount of money be P.
Since it triples itself, the simple interest = 3P - P = 2P.
Now, 2P = P(30)r
r = 2/30

If sum becomes 6 times, them simple interest = 6P - P = 5P

Now, 5P = P(t)(2/30)
t = 75 years.

51. If a boat travels a certain distance upstream in 3 hours and the same distance downstream in 2 hours, and t_1 is defined as the time the boat would take the cover the same distance in still water, and t_2 is defined as the time the boat would take the cover the same distance downstream if it only moves by the flow of water and has zero velocity of its own, find out the value of $\frac{t_2}{t_1}$.

A. 2

B. 5

C. 13/6

D. 1/5

Sol. Let the speed of the boat be x and that of the stream be y.

Now, $\frac{d}{x+y} = 2, \frac{d}{x-y} = 3$

Hence,

$\frac{x+y}{d} = 1/2$ .... (1)

$\frac{x-y}{d} = 1/3$ ....(2)

Solving (1) and (2), we get
$\frac{x}{d} = \frac{5}{12}, \frac{y}{d} = \frac{1}{12}$

$t_1 = \frac{d}{x} = 12/5$
$t_2 = \frac{d}{y} = 12$
Hence, $\frac{t_2}{t_1} = 12/(12/5) = 5$

52. A:B = k:1, B:C = k:1, C:D = k:1, and (A-D):(B-C) = 7:2. If A:C = q:1, find q. It is known that k is not equal to 1.
Enter -1 if it cannot be determined.

Sol. A:B = k:1

B:C = k:1

C:D = k:1

A:B:C = k^2:k:1

A:B:C:D = k^3:k^2:k:1

Now,

A - D : B - C = $\frac{k^3-1}{k^2-k} = \frac{(k-1)(k^2+k+1)}{k(k-1)} = \frac{k^2+k+1}{k} = k+1+\frac{1}{k}$

k + 1 + 1/k = 7/2

k + 1/k = 5/2

k = 2 or k = 1/2

A:C is equal to k^2

Hence, it cannot be uniquely determined.

53. A quadratic equation $x^2 + bx + c = 0$ has roots p and q (both the roots are not equal to zero). Find out the quadratic equation whose roots are (-1/p) and (-1/q).

A. $cx^2 + bx - 1 = 0$

B. $cx^2 + bx + 1 = 0$

C. $x^2 - bx + c = 0$

D. $cx^2 - bx + 1 = 0$

Sol. The quadratic equation that has been given to us is as follows:

$x^2 + bx + c = 0$

Since roots of the equation are p, and q.

p + q = -b and pq = c

Now, we need to find out the equation whose roots are -1/p and -1/q.

The sum of roots of the equation $= -\frac{1}{p} - \frac{1}{q} = \frac{(p+q)}{pq} = -\frac{(-b)}{c} = \frac{b}{c}$

The product of the roots $= \frac{1}{pq} = \frac{1}{c}$

Hence the revised equation is

$$x^2 - \left(\frac{b}{c}\right)x + \frac{1}{c} = 0$$

$$cx^2 - bx + 1 = 0$$

54. 1 inlet and 1 outlet pipe take 5 hours to fill a tank. 1 inlet and 2 outlet pipes take 6 hours to fill the tank. Find in how much time will 4 inlet and 10 outlet tanks fill the tank? All inlet pipes and all outlet pipes are identical.

A. 1 hour 20 mins

B. 1 hour 40 mins

C. 1 hour 30 mins

D. 1 hour 45 mins

Sol. Let the capacity of the tank be LCM(5,6) = 30 units.
Let the inlet pipe fill x units and the outlet pipe empty y units in one hr,
5x - 5y = 30
x - y = 6   .... (1)
6x - 12y = 30
x - 2y = 5...... (2)
Solving (1) and (2),
we get x =7, y = 1
4x - 10y = 28 - 10 = 18 units. 4 inlet and 10 outlet pipes fill 18 units in one hour.

Hence, they take 30/18 = 5/3 = $1\frac{2}{3}$ hours to fill the tank.

$\frac{2}{3}$ hrs = 40 min

Hence, 1 hour 40 mins.

55. A sphere has a cone of the largest volume inside it, such that the height of the cone is equal to the radius of the cone. What is the percentage of the volume inside the sphere that is not occupied by the cone?

A. 66.67%

B. 75%

C. 80%

D. 62.75%

Sol. The cross-sectional view looks like this:
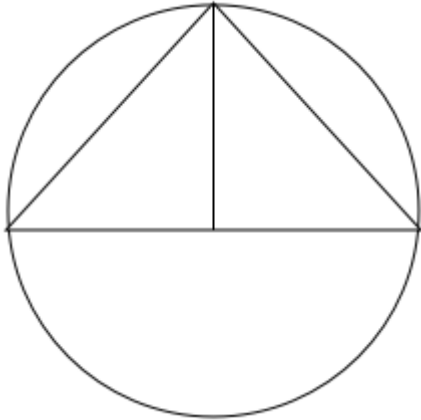
Since the height and the radius are the same, the volume of the cone $= \frac{1}{3\pi} r^2 h = \frac{1}{3} \pi r^3$

The volume of the sphere $= \frac{4}{3} \pi r^3$

$\frac{1}{4}$ th of sphere volume is occupied by cone.

Hence, the sphere still has 75% volume left in it.

56. If 5 pens, 8 pencils, and 20 erasers cost Rs 107, and 2 pens, 10 pencils, and 12 erasers cost Rs 78, what is the cost of 57 pens, 166 pencils and 272 erasers?

A. 1709

B. 1500

C. 1607

D. 1239

Sol. Let a pen cost a, a pencil cost b, and an eraser cost c.

5a + 8b + 20c = 107

2a + 10b + 12c = 78

We need 57a + 166b +272c

Multiplying the first equation by p and the second equation by q, we get

5p + 2q = 57 .... (1)

8p + 10q = 166 .... (2)

5(1) - (2)

17p = 285 - 166

17p = 119

p = 7

q=11

Let us see if the third variable is also satisfying the conditions

20 x 7 + 12 x 11 = 272

Hence, we can find out the value as 7 x 107 + 11 x 78 = 749 + 858 = 1607

57. In a 2000 metre race, A, B and C are three of the participants. A defeats B by 400 metres and B defeats C by 320 metres. By how much distance does A defeat C?

A. 626 metres

B. 465 metres

C. 660 metres

D. 656 metres

Sol. The ratio of the speeds of A and B = 2000: 1600 =5:4
The ratio of the speeds of B and C = 2000:1680 = 25:21
The ratio of speeds of A:B: C = 5 x 25 : 100 : 21 x 4 = 125: 100: 84
Hence, when A covers 2000 metres, C covers $\frac{2000}{125} \times 84 = 1344$ metres.
Hence, A wins by 2000 - 1344 = 656 metres.

58. If the area of a regular hexagon is $6\sqrt{3}$ sq units, find out the area of a regular octagon that shares a side with the regular hexagon.

A. $8+8\sqrt{2}$

B. $12+8\sqrt{3}$

C. $8+12\sqrt{2}$

D. $12\sqrt{3}-4$

Sol. The area of a regular hexagon = 6 x Area of an equilateral triangle having the same side

$6\sqrt{3} = 6\frac{\sqrt{3}}{4} a^2$

$a = 2$

Now, if we have an octagon of side 2, the area of the octagon = $2 (1+ \sqrt{2}) a^2 = 8 (1 + \sqrt{2})$
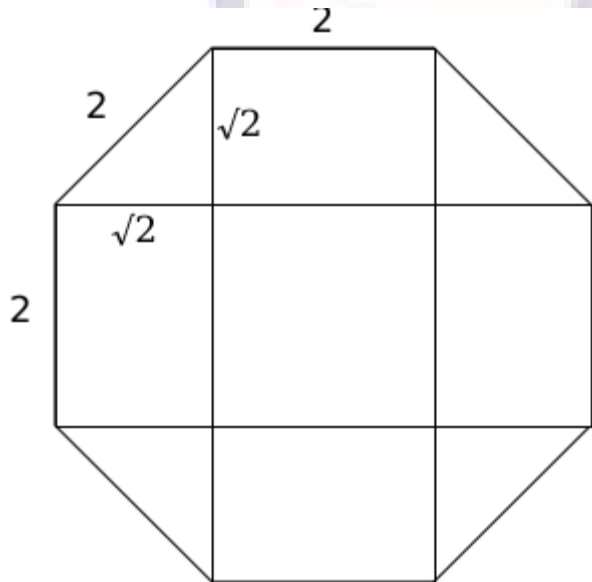
The area can also be calculated without the formula.

Area of 4 rectangles + Area of square + Area of 4 triangles

$(4 \times 2 \times \sqrt{2}) + (2 \times 2) + (4 \times \sqrt{2} \times \sqrt{2}) = 8 + 8 \sqrt{2}$

59. A school has girls and boys in the ratio of 3:5. If some new students join the school and the number of girls increase by 30% and the total strength improves by 50%, find out the percentage increase in the number of boys.

A. 60

B. 80

C. 75

D. 62

Sol. Let the number of girls and boys be 3x and 5x.
New number of girls = 1.3 × 3x = 3.9x
New total number of students = 8x (1.5) = 12x
Number of boys = 12x - 3.9x = 8.1x
Difference in the number of boys = 8.1x - 5x = 3.1x
Percentage = $\frac{3.1x}{5x} \times 100 = 62\%$

60. A runs twice as fast as B. A gives B a headstart of 1600 m and also starts the race 50 seconds late. As a result, they reach the finish at the same time. What is the speed of A? The race is for a length of 4800 metres.

A. 32 m/s

B. 8 m/s

C. 40 m/s

D. 120 m/s

Sol. Let the speed of B be a and that of A be 2a.
Hence, A takes a total of 4800/2a to finish the race.

Time taken by B = Time taken by A + 50 seconds to finish 3200 m (As it is already 1600 m ahead)
(2400/a + 50)a = 3200
800/a = 50
a = 16
A's speed = 2a = 32 m/s

Answer is option A.

61. The profit earned by selling 24 items is equal to the cost price of 5 items. The selling price of 48 items is numerically equal to the cost price of how many items?

A. 54

B. 53

C. 58

D. 48

Sol. 24 × Profit = 5C.P
24(S.P - C.P) = 5C.P
24S.P - 24C.P = 5C.P
24S.P = 29C.P
48S.P = 58C.P
Hence, SP of 48 items is equal to the CP of 58 items.

62. Alcohol solutions A, and B have 23% and 35% alcohol in them respectively. When A and B are mixed in the ratio of 7:5, we get solution C. What is the amount of water in solution D, which has 620 mL of pure alcohol, such that solution D is obtained by mixing B and C in ratio 3:4?

A. 1380mL

B. 1785mL

C. 2000mL

D. 1760mL

Sol. A - 23%

B - 35%

A and B are mixed in the ratio 7:5,

C alcohol % = $\frac{23(7)+35(5)}{7+5}$ = 28%

D alcohol % = $\frac{35(3)+28(4)}{3+4}$ = 31%

If 31% of D is alcohol = 620 mL, then

water = 69% = (620/31) × 69 = 1380 mL.

Answer is option A.

63. If log 36 = log 45 - log c + log d, find out the value of $2^{\frac{5d}{c}}$

A. 16

B. 32

C. 64

D. 128

Sol. If log 36 = log 45 - log c + log d

log 36 = log 45d/c

36 = 45d/c

c:d = 5:4

Hence, $2^{\frac{5d}{c}}$ = 16.

64. Find out the smallest number which when individually divided by 16, 17, and 20 leave remainders 13, 14 and 17 respectively.

A. 1357

B. 1460

C. 1268

D. 1456

Sol. 16 - 13 = 3
17 - 14 = 3
20 - 17 = 3
Hence, we find out the LCM(16, 17, 20) = 16 X 17 X 5 = 1360.
Now, we subtract 3 from this LCM.
1360 - 3 = 1357.
Hence, 1357 is smallest possible number.

65. If both the triangles are equilateral, the bigger triangle has a circumcircle C, and the smaller triangle has one of its vertices on the midpoint of the base of the larger triangle and the other two vertices on the circle's circumference, find out the length of the side of the smaller triangle. The area of the circle is pi unit squared.
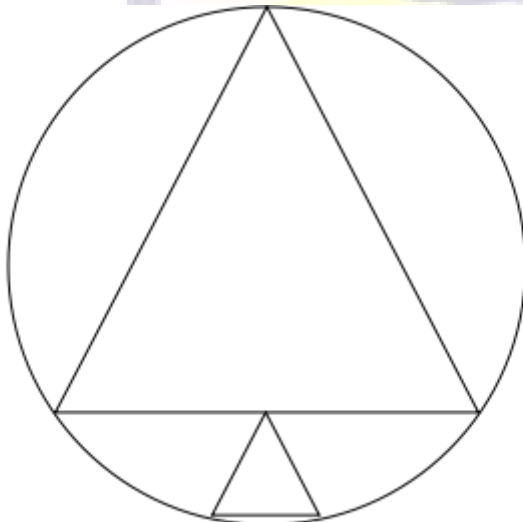
A. $\frac{\sqrt{3}}{2}(-1+\sqrt{5})$

B. $\frac{\sqrt{3}}{4}(-1+\sqrt{5})$

C. $\frac{\sqrt{3}}{2}(1+\sqrt{5})$

D. $\frac{\sqrt{3}}{4}(1+\sqrt{5})$

Sol.
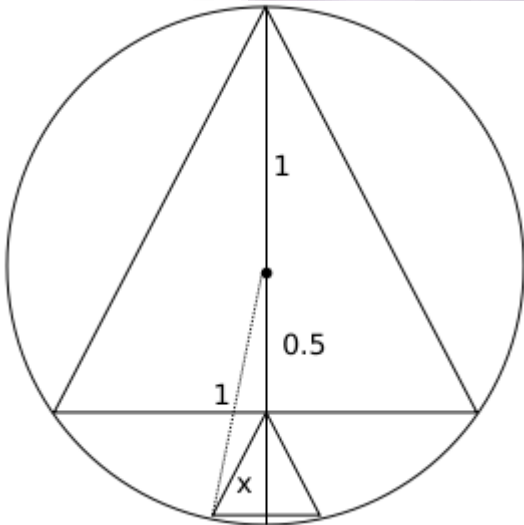
Since the circumcenter divided the altitude in ratio 2:1, the distance from the centre to the mid of the base is 0.5.

Let us apply the cosine rule,

$1^2 = 0.5^2 + x^2 - 2 \times 0.5 \times x \cos 150$

$1 = 0.25 + x^2 + \frac{\sqrt{3}}{2} x$

$0.75 = x^2 + \frac{\sqrt{3}}{2} x$

$3 = 4x^2 + 2\sqrt{3} x$

Solving, we get $x = \frac{\sqrt{15}-\sqrt{3}}{4}$

66. Find out the number of integral values of x ($|x| < 50$) satisfying the following inequality.
$(x^2-1)^3 (x^4-1)^3(x^8-1)^3(x^{16}-1)^3(x^{32}-1)^3 > 0$

Sol. $(x^2-1)^3(x^4-1)^3(x^8-1)^3(x^{16}-1)^3(x^{32}-1)^3 > 0$

$x^{32}-1 = (x^{16}+1)(x^{16}-1)$

$x^{16}+1$ is always greater than zero.

So, we can consider the rest of the inequation.

$(x^2-1)^3(x^4-1)^3(x^8-1)^3(x^{16}-1)^6 > 0$

Similarly,

$(x^2-1)^3(x^4-1)^3(x^8-1)^9 > 0$

$(x^2-1)^3(x^4-1)^{12} > 0$

$(x^2-1)^{15} > 0$

This is positive when x^2-1 is positive.

$|x| > 1$

Hence, the values that satisfy them are $\{-49, -48, -47,....., -2, 2,...., 47, 48, 49\}$

Hence a total of 96 values.