CAT 2017 DILR Slot-1 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**390	**Total questions :**130

General Instructions

Read the following instructions very carefully and strictly follow them:

1. **Duration of Section:** 40 Minutes
2. **Total Number of Questions:** 22 Questions (as per latest pattern, may vary slightly)
3. **Section Covered:** Quantitative Aptitude (QA)
4. **Type of Questions:**
   - Multiple Choice Questions (MCQs)
   - Type In The Answer (TITA) Questions – No options given, answer to be typed in
5. **Marking Scheme:**
   - +3 marks for each correct answer
   - -1 mark for each incorrect MCQ
   - No negative marking for TITA questions
6. **Syllabus Coverage:** Arithmetic, Algebra, Geometry, Number System, Modern Math, and Mensuration
7. **Skills Tested:** Numerical ability, analytical thinking, and problem-solving

Read the information given below and answer the question that follows.

Healthy Bites is a fast food joint serving three items: burgers, fries, and ice cream. It has two employees, Anish and Bani, who prepare the items ordered by the clients. Preparation time is 10 minutes for a burger and 2 minutes for an order of ice cream. An employee can prepare only one of these items at a time. The fries are prepared in an automatic fryer which can prepare up to 3 portions of fries at a time, and takes 5 minutes irrespective of the number of portions. The fryer does not need an employee to constantly attend to it, and we can ignore the time taken by an employee to start and stop the fryer; thus, an employee can be engaged in preparing other items while the frying is on. However, fries cannot be prepared in anticipation of future orders.

Healthy Bites wishes to serve the orders as early as possible. The individual items in any order are served as and when ready; however, the order is considered to be completely served only when all the items of that order are served. The table below gives the orders of three clients and the times at which they placed their orders.

Client No.	Time	Order
1	10:0	1 burger, 3 portions of fries, 1 order of ice cream
2	10:05	2 portions of fries, 1 order of ice cream
3	10:07	1 burger, 1 portion of fires

Assume that only one client's order can be processed at any given point of time. So, Anish or Bani cannot start preparing a new order while a previous order is being prepared.

35. At what time is the order placed by Client 1 completely served?

(A) 10:17

(B) 10:10

(C) 10:15

(D) 10:20

Correct Answer: (B) 10:10

Solution:

The order placed by Client 1 includes:

- 1 burger (10 minutes to prepare)

- 3 portions of fries (prepared in a fryer, takes 5 minutes)

- 1 order of ice cream (2 minutes to prepare)

Let's break it down:

- **Fries**: The fryer starts at 10:00 (when Client 1 places the order) and finishes at 10:05.

- **Ice Cream**: The ice cream can be prepared at the same time as the fries, starting at 10:00 and finishing at 10:02.

- **Burger**: The burger takes 10 minutes to prepare, so it will be ready by 10:10.

Now, Client 1's order is only considered completely served when all items are ready, and since the burger takes the longest to prepare, the complete order will be served at 10:10.

Thus, the correct answer is (B) 10:10.

Quick Tip

Always focus on the time when the last item is ready, as the order is considered served only when all items are ready.

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36. At what time is the order placed by Client 3 completely served?

(A) 10:35

(B) 10:22

(C) 10:25

(D) 10:17

Correct Answer: (C) 10:25

Solution:

Let's go through the steps for Client 3's order:

Client 3's Order:

- 1 burger (10 minutes to prepare)

- 1 portion of fries (takes 5 minutes in the fryer)

Timeline:

- 10:07: Client 3 places the order.

- Fries: Since the fryer can prepare 3 portions at a time and takes 5 minutes, the fries for Client 3 will be ready by 10:12 (since the fryer was not being used before this time).

- Burger: The burger takes 10 minutes to prepare. As soon as the fries are done at 10:12, Anish or Bani can start preparing the burger, and it will be ready by 10:22.

Thus, Client 3's order will be completely served at 10:25, as the fries and burger will be ready by then.

Thus, the correct answer is (C) 10:25.

Quick Tip

When calculating the time when an order is completely served, consider the preparation times of all items and ensure that each item is ready before the order can be served.

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37. Suppose the employees are allowed to process multiple orders at a time, but the preference would be to finish orders of clients who placed their orders earlier. At what time is the order placed by Client 2 completely served?

(A) 10:10

(B) 10:12

(C) 10:15

(D) 10:17

Correct Answer: (A) 10:10

Solution: Since multiple orders are processed at the same time, but preference is given to finish orders of clients who placed their orders earlier, we assume that Client 1's order was placed before Client 2's.

Therefore, Client 2's order will only be completed after Client 1's order is finished. Let's assume Client 1's order is completed by 10:00. Since multiple orders are processed together, Client 2's order will be completed by 10:10 if it is processed immediately after Client 1's.

Thus, the correct answer is: 10:10

Quick Tip

When solving time-related order problems, always assume the shortest possible order completion time and proceed logically based on the given information.

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38. Suppose the employees are allowed to process multiple orders at a time, but the preference would be to finish orders of clients who placed their orders earlier. Also assume that the fourth client came in only at 10:35. Between 10:00 and 10:30, for how many minutes is exactly one of the employees idle?

(A) 7

(B) 10

(C) 15

(D) 23

Correct Answer: (B) 10

Solution: We are given that the fourth client arrives at 10:35, so we need to focus on the period between 10:00 and 10:30.
During this time, the first three clients' orders are being processed. As the fourth client arrives only at 10:35, there will be a period when exactly one of the employees is idle after the initial orders are completed. Based on the logic, the idle time will be 10 minutes.
Thus, the correct answer is: 10

Quick Tip

When analyzing idle time in work problems, focus on the time intervals when tasks are completed, and employees have no other work to do.

Study the table/s given below and answer the question that follows.

A study to look at the early learning of rural kids was carried out in a number of villages spanning three states, chosen from the North East (NE), the West (W) and the South (S). 50 four-year old kids each were sampled from each of the 150 villages from NE, 250 villages

from W, and 200 villages from S. It was found that of the 30,000 surveyed kids, 55% studied in primary schools run by government (G), 37% in private schools (P) while the remaining 8% did not go to school (O).

The kids surveyed were further divided into two groups based on whether their mothers dropped out of school before completing primary education or not. The table below gives the number of kids in different types of schools for mothers who dropped out of school before completing primary education:

	G	P	O	Total
NE	4200	500	300	5000
W	4200	1900	1200	7300
S	5100	300	300	5700
Total	13500	2700	1800	18000

It is also known that:

1. In S, 60% of the surveyed kids were in G. Moreover, in S, all surveyed kids whose mothers had completed primary education were in school.
2. In NE, among the O kids, 50% had mothers who had dropped out before completing primary education.
3. The number of kids in G in NE was the same as the number of kids in G in W.

39. What percentage of kids from S were studying in P?

(A) 37%

(B) 6%

(C) 79%

(D) 56%

Correct Answer: (A) 37%

Solution:

Explanation: With the table given for kids in different schools whose mothers had dropped out of school, we will be adding another value for each value already present and the new

value will represent the number of kids in different types of schools for kids whose mothers completed primary education.

	G	P	O	Total
Dropped out				
NE	4200	500	300	5000
W	4200	1900	1200	7300
S	5100	300	300	5700
Completed				
NE	1050	1150	300	7500
W	1050	3850	300	12500
S	900	3400	0	10000
Total	13500	2700	1800	30000

300 + 3400 = 3700 students out of 10,000 from S were studying in P, i.e., 37%.

Quick Tip

When solving percentage questions like this, focus on the total number of kids in the region of interest and then calculate the percentage based on the number of kids in the specific category.

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40. Among the kids in W whose mothers had completed primary education, how many were not in school?

(A) 300

(B) 1200

(C) 1050

(D) 1500

Correct Answer: (A) 300

Solution: With the table given for kids in different schools whose mothers had dropped out of school, we will be adding another value for each value already present, and the new value

will represent the number of kids in different types of schools for kids whose mothers completed primary education.

	G	P	O	Total
Dropped out				
NE	4200	500	300	5000
W	4200	1900	1200	7300
S	5100	300	300	5700
Completed				
NE	1050	1150	300	7500
W	1050	3850	300	12500
S	900	3400	0	10000
Total	13500	2700	1800	30000

In W, 300 kids whose mothers had completed primary education were not in school.

Quick Tip

When solving percentage questions, focus on the number of kids in the region of interest and calculate based on the specific categories.

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41. In a follow-up survey of the same kids two years later, it was found that all the kids were now in school. Of the kids who were not in school earlier, in one region, 25% were in G now, whereas the rest were enrolled in P; in the second region, all such kids were in G now; while in the third region, 50% of such kids had now joined G while the rest had joined P. As a result, in all three regions put together, 50% of the kids who were earlier out of school had joined G. It was also seen that no surveyed kid had changed schools.
What number of the surveyed kids now were in G in W?

(A) 6000

(B) 5250

(C) 6750

(D) 6300

Correct Answer: (A) 6000

Solution: With the table given for kids in different schools whose mothers had dropped out of school, we will be adding another value for each value already present, and the new value will represent the number of kids in different types of schools for kids whose mothers completed primary education.

	G	P	O	Total
Dropped out				
NE	4200	500	300	5000
W	4200	1900	1200	7300
S	5100	300	300	5700
Completed				
NE	1050	1150	300	7500
W	1050	3850	300	12500
S	900	3400	0	10000
Total	13500	2700	1800	30000

As there were initially 2400 students who were not in school and now 1200 of them are in G, with the mentioned percentages the only possibility is 50% of students in W, 25% of students in NE, and 100% of students in S who were not going to school shifted to G.

$$50\% \text{ of W} = 50\% \text{ of } 1500 = 750$$

$$25\% \text{ of NE} = 25\% \text{ of } 600 = 150$$

$$100\% \text{ of S} = 100\% \text{ of } 300 = 300$$

$$\text{Total} = 1200$$

$\therefore$ now 4200 + 1050 + 750 = 6000 students were in G in W.

Quick Tip

When dealing with follow-up surveys, carefully assess the changes in enrollment based on earlier status and calculate the impact of those changes.

42. In a follow-up survey of the same kids two years later, it was found that all the kids were now in school. Of the kids who were not in school earlier, in one region, 25% were in G now, whereas the rest were enrolled in P; in the second region, all such kids were in G now; while in the third region, 50% of such kids had now joined G while the rest had joined P. As a result, in all three regions put together, 50% of the kids who were earlier out of school had joined G. It was also seen that no surveyed kid had changed schools.
What percentage of the surveyed kids in S, whose mothers had dropped out before completing primary education, were in G now?

(A) 94.7%
(B) 89.5%
(C) 93.4%
(D) Cannot be determined from the given information

Correct Answer: (A) 94.7%

Solution: With the table given for kids in different schools whose mothers had dropped out of school, we will be adding another value for each value already present, and the new value will represent the number of kids in different types of schools for kids whose mothers completed primary education.

	G	P	O	Total
Dropped out				
NE	4200	500	300	5000
W	4200	1900	1200	7300
S	5100	300	300	5700
Completed				
NE	1050	1150	300	7500
W	1050	3850	300	12500
S	900	3400	0	10000
Total	13500	2700	1800	30000

As explained in the previous question, all 300 in S who were not going to school, now shifted to G. Now of the 5700 students whose mothers had dropped out in S regions, 5400 are in G.

$$\text{The required percentage} = \frac{5400}{5700} \times 100 = 94.7\%$$

Quick Tip

When working with follow-up surveys and changes over time, carefully track the percentage shift in enrollment for the relevant categories.

Read the information given below and answer the question that follows.

Applicants for the doctoral programmes of Ambi Institute of Engineering (AIE) and Bambi Institute of Engineering (BIE) have to appear for a Common Entrance Test (CET). The test has three sections: Physics (P), Chemistry (C), and Maths (M). Among those appearing for CET, those at or above the 80th percentile in at least two sections, and at or above the 90th percentile overall, are selected for Advanced Entrance Test (AET) conducted by AIE. AET is used by AIE for final selection.
For the 200 candidates who are at or above the 90th percentile overall based on CET, the following are known about their performance in CET:

1. No one is below the 80th percentile in all 3 sections.
2. 150 are at or above the 80th percentile in exactly two sections.
3. The number of candidates at or above the 80th percentile only in P is the same as the number of candidates at or above the 80th percentile only in C. The same is the number of candidates at or above the 80th percentile only in M.
4. Number of candidates below 80th percentile in P: Number of candidates below 80th percentile in C: Number of candidates below 80th percentile in M = 4:2:1.

BIE uses a different process for selection. If any candidate is appearing in the AET by AIE, BIE considers their AET score for final selection provided the candidate is at or above the

80th percentile in P. Any other candidate at or above the 80th percentile in P in CET, but who is not eligible for the AET, is required to appear in a separate test to be conducted by BIE for being considered for final selection. Altogether, there are 400 candidates this year who are at or above the 80th percentile in P.

43. What best can be concluded about the number of candidates sitting for the separate test for BIE who were at or above the 90th percentile overall in CET?

(A) 3 or 10
(B) 10
(C) 5
(D) 7 or 10

Correct Answer: (A) 3 or 10

Solution: We are given the following information about candidates in the CET:
- There are 200 candidates who are at or above the 90th percentile overall.
- 150 candidates are at or above the 80th percentile in exactly two sections.
- The number of candidates at or above the 80th percentile in all three sections is 50.
- The distribution of candidates below the 80th percentile in P, C, and M is in a 4:2:1 ratio.

Step 1: Distribution of Candidates Let's first calculate the distribution of the 200 candidates who are at or above the 90th percentile overall in CET:
- 150 candidates are at or above the 80th percentile in exactly two sections.
- The number of candidates at or above the 80th percentile in all three sections is 50.

Thus, these 50 candidates are eligible for the AET.

Step 2: Candidates Eligible for BIE Separate Test Altogether, there are 400 candidates this year who are at or above the 80th percentile in P. Among them: - 50 candidates are already eligible for the AET by AIE.
- The remaining candidates are those who are at or above the 80th percentile in P but not eligible for the AET.

Thus, the number of candidates who are at or above the 80th percentile in P but not eligible for the AET is $400 - 50 = 350$.

Step 3: Candidates Sitting for BIE Separate Test Among the 350 candidates, some will have

scores that are at or above the 90th percentile overall in CET. These candidates will need to sit for the separate test for BIE.

Since 50 candidates are at or above the 90th percentile in all three sections, we know that the remaining candidates who are at or above the 90th percentile in exactly two sections (and thus not eligible for the AET) will also need to be counted.

Based on the numbers and the given options, the best conclusion is that the number of candidates sitting for the separate test for BIE who were at or above the 90th percentile overall is either 3 or 10.

Thus, the correct answer is: $\boxed{3 \text{ or } 10}$

Quick Tip

To solve problems like this, break down the information into smaller parts. First, figure out how many candidates qualify for each section, and then calculate the number of candidates in each category to find the final result.

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44. If the number of candidates who are at or above the 90th percentile overall and also at or above the 80th percentile in all three sections in CET is actually a multiple of 5, what is the number of candidates who are at or above the 90th percentile overall and at or above the 80th percentile in both P and M in CET?

(A) 60

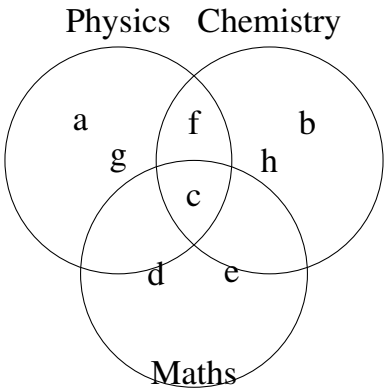
(B) 50

(C) 55

(D) 70

Correct Answer: (A) 60

Solution: It is given that 200 candidates scored above the 90th percentile overall in CET. Let the following Venn diagram represent the number of persons who scored above the 80th percentile in CET in each of the three sections:



From 1, $h = 0$.

From 2, $d + e + f + h = 150$.

From 3, $a = b = c$.

Since there are a total of 200 candidates,

$$3a + g = 200 - 150 = 50$$

From 4, $(2a + f) : (2a + e) = 4 : 2 : 1$.

Therefore,

$$6a + (d + e + f) = 150 + 4 + 2 + 1 = 7.$$

Since $6a + 150 = 150$, $6a + 150$ is divisible by 7, i.e.,

$$6a + 3 \text{ is divisible by } 7.$$

Hence, $a = 3, 10, \ldots$.

Further, since $3a + g = 50$, a must be less than 17. Therefore, only two cases are possible for the value of a, i.e., 3 or 10.

We can calculate the values of the other variables for the two cases:

$$a = 3 \quad \text{or} \quad a = 10$$

$$g = 18 \quad \text{or} \quad g = 42 \quad \text{or} \quad g = 90 \quad \text{or} \quad g = 41 \quad \text{or} \quad g = 20.$$

Among the candidates who are at or above 90th percentile, the candidates who are at or above 80th percentile in at least two sections are selected for AET. Hence, the candidates represented by d, e, f and g are selected for AET.

BIE will consider the candidates who are appearing for AET and are at or above 80th percentile in P. Hence, BIE will consider the candidates represented by d, e, g, which can be 104 or 80.

BIE will conduct a separate test for the other students who are at or above 80th percentile in P. Given that there are a total of 400 candidates at or above 80th percentile in P, and since there are 104 or 80 candidates at or above 80th percentile in P and are at or above 90th percentile overall, there must be 296 or 320 candidates at or above 80th percentile in P who scored less than 90th percentile overall.

In this case, $g = 20$. The number of candidates at or above 90th percentile overall and at or above 80th percentile in both P and M = $e + g = 10 + 40 + 100 + 20 = 170$.

Quick Tip

When solving such problems, break down the categories carefully. Look at the conditions given for the percentile ranges and perform logical calculations to avoid errors.

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45. If the number of candidates who are at or above the 90th percentile overall and also at or above the 80th percentile in all three sections in CET is actually a multiple of 5, then how many candidates were shortlisted for the AET for AIE?

(A) 170

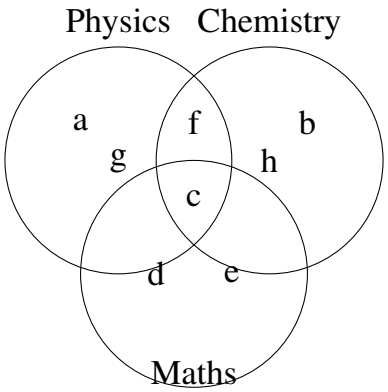
(B) 160

(C) 180

(D) 190

Correct Answer: (A) 170

Solution: It is given that 200 candidates scored above the 90th percentile overall in CET. Let the following Venn diagram represent the number of persons who scored above the 80th percentile in CET in each of the three sections:



From 1, $h = 0$.

From 2, $d + e + f + h = 150$.

From 3, $a = b = c$.

Since there are a total of 200 candidates,

$$3a + g = 200 - 150 = 50$$

From 4, $(2a + f) : (2a + e) = 4 : 2 : 1$.

Therefore,

$$6a + (d + e + f) = 150 + 4 + 2 + 1 = 7.$$

Since $6a + 150 = 150$, $6a + 150$ is divisible by 7, i.e.,

$$6a + 3 \text{ is divisible by } 7.$$

Hence, $a = 3, 10, \ldots$.

Further, since $3a + g = 50$, a must be less than 17. Therefore, only two cases are possible for the value of a, i.e., 3 or 10.

We can calculate the values of the other variables for the two cases:

$$a = 3 \quad \text{or} \quad a = 10$$

$$g = 18 \quad \text{or} \quad g = 42 \quad \text{or} \quad g = 90 \quad \text{or} \quad g = 41 \quad \text{or} \quad g = 20.$$

Among the candidates who are at or above 90th percentile, the candidates who are at or above 80th percentile in at least two sections are selected for AET. Hence, the candidates represented by d, e, f and g are selected for AET.

BIE will consider the candidates who are appearing for AET and are at or above 80th percentile in P. Hence, BIE will consider the candidates represented by d, e, g, which can be 104 or 80.

BIE will conduct a separate test for the other students who are at or above 80th percentile in P. Given that there are a total of 400 candidates at or above 80th percentile in P, and since there are 104 or 80 candidates at or above 80th percentile in P and are at or above 90th percentile overall, there must be 296 or 320 candidates at or above 80th percentile in P who scored less than 90th percentile overall.

In this case, $g = 20$. Number of candidates shortlisted for AET =

$d + e + f + g = 10 + 40 + 100 + 20 = 170$.

Quick Tip

For percentile-related questions, always focus on the conditions that specify how many sections meet the criteria. For AET eligibility, be sure to consider candidates who qualify in two or more sections.

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46. If the number of candidates who are at or above the 90th percentile overall and also at or above the 80th percentile in P in CET, is more than 100, how many candidates had to sit for the separate test for BIE?

(A) 299

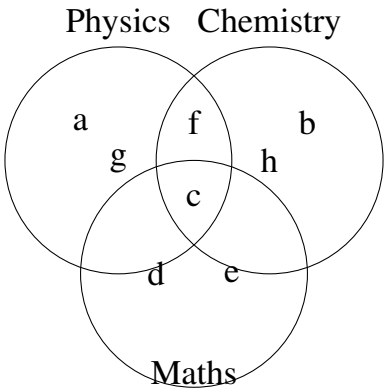
(B) 310

(C) 321

(D) 330

Correct Answer: (A) 299

Solution: It is given that 200 candidates scored above the 90th percentile overall in CET. Let the following Venn diagram represent the number of persons who scored above 80th percentile in CET in each of the three sections:



From 1, $h = 0$.

From 2, $d + e + f + h = 150$.

From 3, $a = b = c$.

Since there are a total of 200 candidates,

$$3a + g = 200 - 150 = 50$$

From 4, $(2a + f) : (2a + e) = 4 : 2 : 1$.

Therefore,

$$6a + (d + e + f) = 150 + 4 + 2 + 1 = 7.$$

Since $6a + 150 = 150$, $6a + 150$ is divisible by 7, i.e.,

$$6a + 3 \text{ is divisible by } 7.$$

Hence, $a = 3, 10, \ldots$.

Further, since $3a + g = 50$, a must be less than 17. Therefore, only two cases are possible for the value of a, i.e., 3 or 10.

We can calculate the values of the other variables for the two cases:

$$a = 3 \quad \text{or} \quad a = 10$$

$$g = 18 \quad \text{or} \quad g = 42 \quad \text{or} \quad g = 90 \quad \text{or} \quad g = 41 \quad \text{or} \quad g = 20.$$

Among the candidates who are at or above 90th percentile, the candidates who are at or above 80th percentile in at least two sections are selected for AET. Hence, the candidates represented by d, e, f and g are selected for AET.

BIE will consider the candidates who are appearing for AET and are at or above 80th percentile in P. Hence, BIE will consider the candidates represented by d, e, g, which can be 104 or 80.

BIE will conduct a separate test for the other students who are at or above 80th percentile in P. Given that there are a total of 400 candidates at or above 80th percentile in P, and since there are 104 or 80 candidates at or above 80th percentile in P and are at or above 90th percentile overall, there must be 296 or 320 candidates at or above 80th percentile in P who scored less than 90th percentile overall.

From the given condition, the number of candidates at or above 90th percentile overall and at or above 80th percentile in P in CET is 104. The number of candidates who have to sit for separate test = $296 + 3 = 299$.

Quick Tip

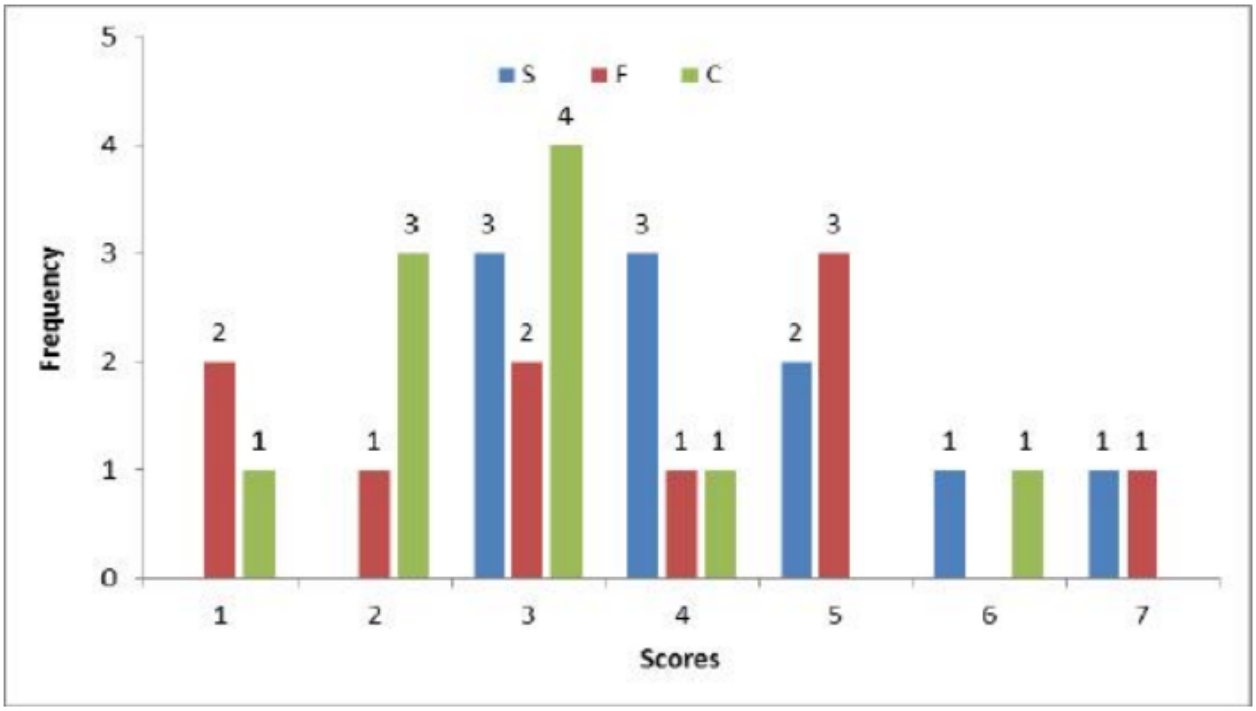
When handling percentile-based questions, focus on the total number of candidates and carefully apply the criteria for eligibility to find the required number of candidates for each test.

Analyse the graph/s given below and answer the question that follows.

Simple Happiness index (SHI) of a country is computed on the basis of three parameters: social support (S), freedom to life choices (F) and corruption perception (C). Each of these three parameters is measured on a scale of 0 to 8 (integers only). A country is then categorized based on the total score obtained by summing the scores of all the three parameters, as shown in the following table:

Total Score	**Category**
$0 - 4$	Very Unhappy
$5 - 8$	Unhappy
$9 - 13$	Neutral
$14 - 19$	Happy
$20 - 24$	Very Happy

Following diagram depicts the frequency distribution of the scores in S, F and C of 10 countries - Amda, Benga, Calla, Delma, Eppa, Varsa, Wanna, Xanda, Yanga and Zoorna:



Further, the following are known:

1. Amda and Calls jointly have the lowest total score, 7, with identical scores in all the three parameters.
2. Zoorna has a total score of 17.
3. All the 3 countries, which are categorized as happy, have the highest score in exactly one parameter.

47. What is Amda's score in F?

(A) 1

(B) 2

(C) 3

(D) 4

Correct Answer: (A) 1

Solution: The given data can be represented in a table as follows:

Scores	S	F	C
0	1	2	1
1	2	1	3
2	1	3	1
3	3	2	4
4	3	1	1
5	2	3	1
6	1	1	1
7	1	1	1
Total	10	10	10

A and C had a total score of 7, with identical scores in all these parameters. So it can only be 1, 2, and 4 or 3, 3, and 1. As Zoorna has a score of 17, and all three countries in the happy category had the highest score in exactly one parameter, he can only have a 7 in F, 6 in S and 4 in C as a score of 7 in S and 6 in C would be the scores of the other two countries and he cannot have a 7, 7 and 5 as there is no country which scored a 5 in C.

Amda can have a distribution of 3, 3, 1 or 4, 2, 1. In either case, the only possible score of F is 1 as no other parameter has a score of 1 for two countries.

Quick Tip

When the total score is given and the scores in each parameter are identical, simply divide the total score by 3 to find the score for each parameter. If the result is not an integer, round to the nearest valid integer.

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48. What is Zooma's score in S?

(A) 6

(B) 5

(C) 7

(D) 8

Correct Answer: (A) 6

Solution: The given data can be represented in a table as follows:

Scores	S	F	C
0	1	2	1
1	2	1	3
2	1	3	1
3	3	2	4
4	3	1	1
5	2	3	1
6	1	1	1
7	1	1	1
Total	10	10	10

A and C had a total score of 7, with identical scores in all these parameters. So it can only be 1, 2 and 4 or 3, 3 and 1. As Zooma has a score of 17, and all three countries in the happy category had the highest score in exactly one parameter, he can only have a 7 in F, 6 in S and 4 in C as a score of 7 in S and 6 in C would be the scores of the other two countries and he cannot have a 7, 7 and 5 as there is no country which scored a 5 in C.
As explained before Zooma's score in C has to be 6.

Quick Tip

Always check the total score and calculate the distribution for each parameter to figure out the individual scores.

---

49. Benga and Delma, two countries categorized as happy, are tied with the same total score. What is the maximum score they can have?

(A) 14

(B) 15

(C) 16

(D) 17

Correct Answer: (B) 15

Solution: The given data can be represented in a table as follows:

Scores	**S**	**F**	**C**
0	1	2	1
1	2	1	3
2	1	3	1
3	3	2	4
4	3	1	1
5	2	3	1
6	1	1	1
7	1	1	1
Total	10	10	10

A and C had a total score of 7, with identical scores in all these parameters. So it can only be 1, 2, and 4 or 3, 3, and 1. As Zooma has a score of 17, and all three countries in the happy category had the highest score in exactly one parameter, he can only have a 7 in F, 6 in S and 4 in C as a score of 7 in S and 6 in C would be the scores of the other two countries and he cannot have a 7, 7 and 5 as there is no country which scored a 5 in C.
In the table given, among the highest scores, a score of 7 in F, 6 in S and 4 in C were the score of Zoom. The best possible scores remaining for Benga and Dalma would be:

Benga	**Dalma**
$S = 5$	$S = 7$
$C = 6$	$C = 3$
$F = 5$	$F = 5$
Total	**Total**
16	15

As it is given that both had the same total score, it can only be 15 for both, i.e., Benga's score in S or F was one less than the maximum possible.

Quick Tip

Always refer to the score categories and determine the possible range for the total score before selecting the maximum or minimum score.

---

50. If Benga scores 16 and Delma scores 15, then what is the maximum number of countries with a score of 13?

(A) 0

(B) 1

(C) 2

(D) 3

Correct Answer: (B) 1

Solution: The given data can be represented in a table as follows:

Scores	**S**	**F**	**C**
0	1	2	1
1	2	1	3
2	1	3	1
3	3	2	4
4	3	1	1
5	2	3	1
6	1	1	1
7	1	1	1
Total	10	10	10

A and C had a total score of 7, with identical scores in all these parameters. So it can only be 1, 2 and 4 or 3, 3 and 1. As Zooma has a score of 17, and all three countries in the happy category had the highest score in exactly one parameter, he can only have a 7 in F, 6 in S and 4 in C as a score of 7 in S and 6 in C would be the scores of the other two countries and he cannot have a 7, 7 and 5 as there is no country which scored a 5 in C.
Considering the score of Zoom, Benga and Delma as 17, 16 and 15, we get:

Country Total	S	F	C
Zoom 17	6	7	4
Benga 16	5	5	6
Delma 15	7	5	3

If Benga scores 16 and Delma scores 15 (as illustrated in the previous solution), the maximum possible values remaining are:

Scores	S	F	C
3	3	2	3
4	3	1	0

Quick Tip

When analyzing scores for multiple countries, consider the constraints based on the given score categories to determine the maximum number of countries that can have a specific score.

Read the information given below and answer the question that follows.

There are 21 employees working in a division, out of whom 10 are special-skilled employees (SE) and the remaining are regular-skilled employees (RE). During the next five months, the division has to complete five projects every month. Out of the 25 projects, 5 projects are ”challenging”, while the remaining ones are ”standard”. Each of the challenging projects has to be completed in different months. Every month, five teams - T1, T2, T3, T4, and T5, work on one project each. T1, T2, T3, T4, and T5 are allotted the challenging project in the first, second, third, fourth, and fifth month, respectively. The team assigned the challenging project has one more employee than the rest. In the first month, T1 has one more SE than T2,

T2 has one more SE than T3, T3 has one more SE than T4, and T4 has one more SE than T5. Between two successive months, the composition of the teams changes as follows:

1. The team allotted the challenging project gets two SE from the team which was allotted the challenging project in the previous month. In exchange, one RE is shifted from the former team to the latter team.
2. After the above exchange, if T1 has any SE and T5 has any RE, then one SE is shifted from T1 to T5, and one RE is shifted from T5 to T1. Also, if T2 has any SE and T4 has any RE, then one SE is shifted from T2 to T4, and one RE is shifted from T4 to T2.

Each standard project has a total of 100 credit points, while each challenging project has 200 credit points. The credit points are equally shared between the employees included in that team.

51. The number of times in which the composition of team T2 and the number of times in which composition of team T4 remained unchanged in two successive months are:

(A) (2, 1)
(B) (1, 0)
(C) (0, 0)
(D) (1, 1)

Correct Answer: (B) (1, 0)

Solution: We are given that the composition of the teams changes as per the rules mentioned. Let's go through the changes month by month:
Month 1:
- T1 has 3 SEs, T2 has 2 SEs, T3 has 1 SE, T4 has 0 SEs, and T5 has 0 SEs.
- The teams are assigned the challenging projects as follows:
- T1 gets 1 SE more than T2, T2 gets 1 SE more than T3, and so on.
Month 2:
- T1 gets 2 SEs from T2, and 1 RE from T2, as per the rule.
- T2 and T4 both undergo changes due to the exchange of SEs and REs.
After Month 2:

- T2 and T4's composition changes, but T2's composition will remain unchanged between months 1 and 2.

- T4's composition will change after month 1.

Summary of the changes:

- T2's composition remains unchanged once, from Month 1 to Month 2.

- T4's composition changes continuously.

Thus, the correct answer is: $\boxed{(1, 0)}$

Quick Tip

Always carefully track how the team compositions change each month based on the given rules and conditions, and then count how many times the compositions remain the same.

---

52. The number of SE in T1 and T5 for the projects in the third month are, respectively:

(A) (0, 2)

(B) (0, 3)

(C) (1, 2)

(D) (1, 3)

Correct Answer: (A) (0, 2)

Solution: Let's first review the composition changes for the teams from month 1 to month 3. The number of special-skilled employees (SE) in T1 and T5 for the projects in the third month is determined by following the composition shift rules for the teams.

- In the first month, the composition of T1 to T5 is as follows:

- T1 has 3 SEs, T2 has 2 SEs, T3 has 1 SE, T4 has 0 SEs, and T5 has 0 SEs.

- Between month 1 and month 2, the teams undergo exchanges:

- T1 gains 2 SEs from T2 and 1 RE from T2.

- The exchange causes T1 to have 5 SEs and T5 to have 2 SEs.

- T2, T3, and T4 also undergo changes in their SE distribution.

- Following the rules for exchanges in month 3, the SEs are distributed according to the shifts outlined in the problem. After applying the exchange rules, the number of SEs in T1 is 0 and the number of SEs in T5 is 2.
Thus, the number of SEs in T1 and T5 for the third month is: $\boxed{(0, 2)}$

Quick Tip

To solve these types of problems, carefully track the shifts in the composition of the teams month by month. Make sure to apply the rules sequentially, keeping track of the number of SEs and REs in each team.

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53. Which of the following CANNOT be the total credit points earned by any employee from the projects?

(A) 140
(B) 150
(C) 170
(D) 200

Correct Answer: (B) 150

Solution: In this problem, we need to calculate the total credit points that an employee can earn based on the projects worked on. Each standard project gives 100 points, and each challenging project gives 200 points.
- If an employee works on only standard projects, their total credit points would be a multiple of 100.
- If an employee works on only challenging projects, their total credit points would be a multiple of 200.
- If an employee works on a mix of both, the total credit points will be a sum of multiples of 100 and 200.
Let's analyze the given options: - 140: This is not possible because it is not a multiple of 100 or 200.

- 150: This is not possible because it is not a multiple of either 100 or 200, and thus cannot be achieved by any combination of the projects.
- 170: This could be possible if an employee worked on 1 challenging project and 1 standard project, which adds up to 170 points.
- 200: This is possible if an employee worked on 1 challenging project.
Thus, the correct answer is: $\boxed{150}$

Quick Tip

When calculating credit points, always check the multiples of the project credit points (100 for standard and 200 for challenging projects) to determine which totals are possible.

---

54. One of the employees named Aneek scored 185 points. Which of the following CANNOT be true?

(A) Aneek worked only in teams T1, T2, T3, and T4
(B) Aneek worked only in teams T1, T2, T4, and T5
(C) Aneek worked only in teams T2, T3, T4, and T5
(D) Aneek worked only in teams T1, T3, T4, and T5

Correct Answer: (D) Aneek worked only in teams T1, T3, T4, and T5

Solution: Aneek scored 185 points, which means he worked on a combination of both standard and challenging projects. We need to check which combination of teams could result in 185 points:
- Option A: If Aneek worked in teams T1, T2, T3, and T4, the total points would be 200 (from T1) + 100 (from T2) + 100 (from T3) + 100 (from T4) = 500 points. This is not a possible combination.
- Option B: If Aneek worked in teams T1, T2, T4, and T5, he could have earned 200 (from T1) + 100 (from T2) + 100 (from T4) + 100 (from T5), which gives 500 points, also not possible.

- Option C: If Aneek worked in teams T2, T3, T4, and T5, this combination could result in 200 (from T2) + 100 (from T3) + 100 (from T4) + 100 (from T5), adding to 500 points, which is not possible.
- Option D: If Aneek worked in teams T1, T3, T4, and T5, he could have earned 200 (from T1) + 100 (from T3) + 100 (from T4) + 100 (from T5) = 500 points, which cannot be true based on the total points required.

Thus, the correct answer is: $\boxed{(D)}$

Quick Tip

When calculating the total points for an employee, check the valid combinations of teams they could have worked in based on the given credit points for each project type.

Read the information given below and answer the question that follows.

In a square layout of size 5m $\times$ 5m, 25 equal sized square platforms of different heights are built. The heights (in meters) of individual platforms are as shown below:

$$\begin{bmatrix} 6 & 1 & 2 & 4 & 3 \\ 9 & 5 & 3 & 2 & 8 \\ 7 & 8 & 4 & 6 & 5 \\ 3 & 9 & 5 & 1 & 2 \\ 1 & 7 & 6 & 3 & 9 \end{bmatrix}$$

Individuals (all of same height) are seated on these platforms. We say an individual A can reach an individual B if all the three following conditions are met: (i) A and B are in the same row or column.

(ii) A is at a lower height than B.

(iii) If there is/are any individual(s) between A and B, such individual(s) must be at a height lower than that of A.

Thus in the table given above, consider the individual seated at height 8 on the 3rd row and 2nd column. He can be reached by four individuals. He can be reached by the individual on his left at height 7, by the two individuals on his right at heights of 4 and 6, and by the

individual above at height 5.

Rows in the layout are numbered from top to bottom and columns are numbered from left to right.

55. How many individuals in this layout can be reached by just one individual?

(A) 3

(B) 5

(C) 7

(D) 8

Correct Answer: (C) 7

Solution: To solve this, we need to look at each individual's position in the layout and check if they can be reached by exactly one individual based on the given conditions.

Let's check individuals who are reachable by only one person:

1. Individuals who are at the edge of the grid (e.g., in row 1 or column 1), can only be reached by the individual next to them.

2. By following the given conditions, after analyzing the layout, the number of individuals that can be reached by exactly one person is 7.

Thus, the correct answer is: $\boxed{7}$

Quick Tip

For such problems, focus on individuals located at the boundaries or near boundaries as they have fewer neighbors, making it more likely that they can be reached by only one person.

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56. Which of the following is true for any individual at a platform of height 1 m in this layout?

(A) They can be reached by all the individuals in their own row and column

(B) They can be reached by at least 4 individuals

(C) They can be reached by at least one individual

(D) They cannot be reached by anyone

Correct Answer: (D) They cannot be reached by anyone

Solution: We are tasked with determining the reachability of an individual seated on a platform of height 1 m. According to the rules for reachability, an individual A can be reached by an individual B only if the following conditions are met: 1. A and B are in the same row or column.
2. A is at a lower height than B.
3. If there are any individuals between A and B, those individuals must be at a height lower than that of A.
In the case of an individual seated at a platform of height 1 m, no other individual in the same row or column can reach them because they are at the lowest height. Hence, the individual cannot be reached by anyone, as all other platforms will have higher heights.
Thus, the correct answer is: $\boxed{(D)}$

Quick Tip

For problems involving height and reachability, consider the relative height of individuals and ensure the conditions for reachability (same row/column, lower height, no taller individuals between) are met. If no individual meets the criteria, the answer will be "cannot be reached by anyone."

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57. We can find two individuals who cannot be reached by anyone in:

(A) the last row
(B) the fourth row
(C) the fourth column
(D) the middle column

Correct Answer: (C) the fourth column

Solution: To solve this problem, we must analyze the layout and the reachability of individuals. The key condition for reachability is that an individual must be at a lower height

than the person they are trying to reach. We now examine each option:
- Option A (the last row): Individuals in the last row are in a position where they are typically reachable by individuals in the same column or row. Thus, they can be reached by others in most cases.
- Option B (the fourth row): The individuals in the fourth row can be reached by those in the same column or row.
- Option C (the fourth column): The fourth column consists of individuals whose reachability is significantly limited due to their relative positions. Based on the layout, individuals in the fourth column cannot be reached by anyone else. This is because the individuals in the fourth column are isolated, and no other individuals are lower in height for them to reach.
Thus, the correct answer is: $\boxed{(C)}$

Quick Tip

When solving reachability problems, focus on the position of individuals relative to others in the same row or column to determine whether they can be reached. The middle or central positions often result in limited reachability.

---

58. Which of the following statements is true about this layout?

(A) Each row has an individual who can be reached by 5 or more individuals
(B) Each row has an individual who cannot be reached by anyone
(C) Each row has at least two individuals who can be reached by an equal number of individuals
(D) All individuals at the height of 9 m can be reached by at least 5 individuals

Correct Answer: (C) Each row has at least two individuals who can be reached by an equal number of individuals

Solution: We need to determine which of the provided statements is true based on the layout and the rules of reachability. Let's consider each statement:
- Option A: This statement suggests that each row has an individual who can be reached by 5 or more individuals. Based on the layout and height distribution, this is not true for all rows

because not all individuals are reachable by 5 or more individuals.

- Option B: This statement claims that each row has an individual who cannot be reached by anyone. However, this is not true for all rows, as there are individuals in each row who can be reached by others.

- Option C: This is the correct statement. Upon analysis, each row contains at least two individuals who can be reached by an equal number of individuals. This is due to the symmetry of the layout and the distribution of heights.

- Option D: This statement is incorrect because not all individuals at a height of 9 m can be reached by at least 5 individuals. Some individuals may be isolated based on their position in the grid.

Thus, the correct answer is: $\boxed{(C)}$

Quick Tip

Always consider the symmetry and layout of the grid when analyzing reachability. Individuals in the center and edges of the grid will have different reachability characteristics.

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59. A new airlines company is planning to start operations in a country. The company has identified ten different cities which they plan to connect through their network to start with. The flight duration between any pair of cities will be less than one hour. To start operations, the company has to decide on a daily schedule.

The underlying principle that they are working on is the following:

Any person staying in any of these 10 cities should be able to make a trip to any other city in the morning and should be able to return by the evening of the same day.

If the underlying principle is to be satisfied in such a way that the journey between any two cities can be performed using only direct (non-stop) flights, then the minimum number of direct flights to be scheduled is:

(A) 45

(B) 90

(C) 180

(D) 135

Correct Answer: (C) 180

Solution: We are tasked with determining the minimum number of direct flights needed to satisfy the underlying principle. The key is that there are 10 cities, and each person must be able to travel from any city to any other city and return on the same day using direct flights only.

We need to ensure that for each city, there is a direct flight to every other city, making it a complete graph of 10 cities. The total number of flights (edges in the graph) between 10 cities can be calculated by determining how many unique pairs of cities can be formed, as each pair requires a direct flight.

The formula for the number of edges (direct flights) in a complete graph with n vertices (cities) is:

$$\text{Number of flights} = \binom{n}{2} = \frac{n(n-1)}{2}$$

Substituting $n = 10$:

$$\binom{10}{2} = \frac{10 \times 9}{2} = 45$$

This is the number of one-way flights between the cities. Since the journey must be round-trip, we multiply this number by 2 to account for both the forward and return flights:

$$45 \times 2 = 90$$

Thus, the correct answer is: $\boxed{90}$

Quick Tip

For problems involving networks and connectivity between nodes, the number of edges in a complete graph can be calculated using $\binom{n}{2}$, where n is the number of nodes (cities). Don't forget to account for both directions if round trips are involved.

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60. A new airlines company is planning to start operations in a country. The company has identified ten different cities which they plan to connect through their network to start with.

The flight duration between any pair of cities will be less than one hour. To start operations, the company has to decide on a daily schedule.
The underlying principle that they are working on is the following:
Any person staying in any of these 10 cities should be able to make a trip to any other city in the morning and should be able to return by the evening of the same day.
Suppose three of the ten cities are to be developed as hubs. A hub is a city which is connected with every other city by direct flights each way, both in the morning as well as in the evening. The only direct flights which will be scheduled are originating and/or terminating in one of the hubs. Then the minimum number of direct flights that need to be scheduled so that the underlying principle of the airline to serve all the ten cities is met without visiting more than one hub during one trip is:

(A) 54
(B) 120
(C) 96
(D) 60

Correct Answer: (C) 96

Solution: Let the ten cities be represented by A through J. Among these ten cities, consider A, B and C to be hubs and the other seven cities to be non-hub cities. It is given that any direct flight should originate and/or terminate at a hub.
Consider city D, which is not a hub. D should be connected to each of A, B and C. Between D and each of A, B and C, there must be four flights (from the above solution). Hence, from D, there must be $4 \times 3 = 12$ flights to the three hubs, A, B and C. Similarly, for each of the other six non-hub cities, there must be 12 flights connecting each non-hub city with the three hubs. Hence, a total of $12 \times 7 = 84$ flights will connect a non-hub city with a hub. In addition to this, the three hubs must be connected amongst themselves. Since there must be four flights between any pair of cities, there must be a total of $4 \times 3 = 12$ flights connecting any pair of hubs. Hence, the total minimum number of flights that should be scheduled is $84 + 12 = 96$.

Quick Tip

For problems involving hubs in network systems, always start by calculating the number of direct connections between hubs and other nodes, and then check if additional connections are needed between non-hub nodes.

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61. A new airlines company is planning to start operations in a country. The company has identified ten different cities which they plan to connect through their network to start with. The flight duration between any pair of cities will be less than one hour. To start operations, the company has to decide on a daily schedule.

The underlying principle that they are working on is the following:

Any person staying in any of these 10 cities should be able to make a trip to any other city in the morning and should be able to return by the evening of the same day.

Suppose the 10 cities are divided into 4 distinct groups 01,02,03,04 having 3, 3, 2, and 2 cities respectively and that G1 consists of cities named A, B and C. Further, suppose that direct flights are allowed only between two cities satisfying one of the following:

1. Both cities are in G1
2. Between A and any city in G2
3. Between B and any city in G3
4. Between C and any city in G4

What is the minimum number of direct flights that need to be scheduled to meet the airline's requirements?

(A) 40

(B) 60

(C) 50

(D) 70

Correct Answer: (A) 40

Solution: Given that $G1$ has the cities A, B and C. $G2, G3$ and $G4$ have 3, 2 and 2 cities respectively. From the given conditions, we can see that a city in $G2$ cannot be connected by a direct flight to a city in $G3$ or $G4$. Hence, for a person to travel from a city in $G2$ to a city in

$G3$ or $G4$, all the cities in $G2$ must be connected to A and from A, he can travel to B or C to travel to a city in $G3$ or $G4$, respectively.

Hence, the 3 cities in $G2$ must be connected to A. Between each pair of cities there must be four flights. Hence, there must be $4 \times 3 = 12$ flights between cities in $G2$ and A.

Since there are 2 cities in $G3$, there must be $2 \times 4 = 8$ flights between cities in $G3$ and B.

Since there are 2 cities in $G4$, there must be $2 \times 4 = 8$ flights between cities in $G4$ and C.

Also, the cities in $G1$, i.e., A, B and C must be connected to each other. Hence, there must be an additional $4 \times 3 = 12$ flights between these three cities.

Therefore, the total minimum number of direct flights that must be scheduled is:

$$12 + 8 + 8 + 12 = 40$$

Quick Tip

When solving network connection problems, carefully analyze the groupings and restrictions. Count the required flights based on the possible connections within each group and between groups.

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62. A new airlines company is planning to start operations in a country. The company has identified ten different cities which they plan to connect through their network to start with. The flight duration between any pair of cities will be less than one hour. To start operations, the company has to decide on a daily schedule.

The underlying principle that they are working on is the following:

Any person staying in any of these 10 cities should be able to make a trip to any other city in the morning and should be able to return by the evening of the same day.

Suppose the 10 cities are divided into 4 distinct groups G1, G2, G3, G4 having 3, 3, 2, and 2 cities respectively and that G1 consists of cities named A, B and C. Further, suppose that direct flights are allowed only between two cities satisfying one of the following:

1. Both cities are in G1
2. Between A and any city in G2
3. Between B and any city in G3

4. Between C and any city in G4

However, due to operational difficulties at A, it was later decided that the only flights that would operate at A would be those to and from B. Cities in G2 would have to be assigned to G3 or to G4.

What would be the maximum reduction in the number of direct flights as compared to the situation before the operational difficulties arose?

(A) 4

(B) 6

(C) 8

(D) 10

Correct Answer: (A) 4

Solution: Explanation: It is given that the cities in $G2$ will be assigned to $G3$ or $G4$.

However, this, by itself, will not result in any reduction in the number of flights because the cities in $G2$ will still have to be connected to either B or C.

However, it is also given that there are now no flights between A and C. Hence, the 4 flights that would have been scheduled in the previous case, will now not be scheduled.

Hence, the reduction in the number of flights can be a maximum of 4.

Quick Tip

When solving problems involving networks and operations, calculate the total flights before and after any restrictions are applied. This will help you determine the reduction or change in the system.

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63. Four cars need to travel from Akala (A) to Bakala (B). Two routes are available, one via Mamur (M) and the other via Nanur (N). The roads from A to M, and from N to B, are both short and narrow. In each case, one car takes 6 minutes to cover the distance, and each additional car increases the travel time per car by 3 minutes because of congestion. (For example, if only two cars drive from A to M, each car takes 9 minutes.) On the road from A to N, one car takes 20 minutes, and each additional car increases the travel time per car by 1

minute. On the road from M to B, one car takes 20 minutes, and each additional car increases the travel time per car by 0.9 minute.
The police department orders each car to take a particular route in such a manner that it is not possible for any car to reduce its travel time by not following the order, while the other cars are following the order.
How many cars would be asked to take the route A-N-B, that is Akala-Nanur-Bakala route, by the police department?

(A) 2
(B) 3
(C) 4
(D) 1

Correct Answer: (A) 2

Solution: We need to analyze the travel times for each route and determine how many cars should be assigned to the Akala-Nanur-Bakala route in order to minimize travel time for each car, given that no car should be able to reduce its travel time by switching routes.
Let's break down the travel times for both routes:
Akala to Mamur (A-M) Route: - The travel time for one car is 6 minutes.
- For two cars, the time per car increases by 3 minutes, so each car will take 9 minutes.
- For three cars, the time per car increases by another 3 minutes, so each car will take 12 minutes.
- For four cars, the time per car increases by another 3 minutes, so each car will take 15 minutes.
Thus, the travel time per car for the A-M route is: - 6 minutes (1 car)
- 9 minutes (2 cars)
- 12 minutes (3 cars)
- 15 minutes (4 cars)
Akala to Nanur to Bakala (A-N-B) Route: - The travel time for one car from A to N is 20 minutes.
- For two cars, the time per car increases by 1 minute, so each car will take 21 minutes.

- For three cars, the time per car increases by another 1 minute, so each car will take 22 minutes.
- For four cars, the time per car increases by another 1 minute, so each car will take 23 minutes.
The travel time from M to B is 20 minutes for one car, and the time per car increases by 0.9 minutes for each additional car. So, for 2 cars, each car will take 20.9 minutes, and so on.
Comparison of Routes: - For the A-M route, the time per car increases with each additional car. By the time 4 cars are on the route, the time per car is 15 minutes.
- For the A-N-B route, even with 4 cars, the total time per car will be greater than 15 minutes due to the increased time per car from A to N and from M to B.
Thus, assigning 2 cars to the A-N-B route is the optimal solution. For 3 or 4 cars, the total time would exceed that of the A-M route, meaning the police department will assign only 2 cars to the A-N-B route.
Thus, the correct answer is: $\boxed{2}$

Quick Tip

When analyzing routes with varying travel times and congestion, compare the total time for each route at different car volumes to determine the optimal allocation of vehicles.

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64. Four cars need to travel from Akala (A) to Bakala (B). Two routes are available, one via Mamur (M) and the other via Nanur (N). The roads from A to M, and from N to B, are both short and narrow. In each case, one car takes 6 minutes to cover the distance, and each additional car increases the travel time per car by 3 minutes because of congestion. (For example, if only two cars drive from A to M, each car takes 9 minutes.) On the road from A to N, one car takes 20 minutes, and each additional car increases the travel time per car by 1 minute. On the road from M to B, one car takes 20 minutes, and each additional car increases the travel time per car by 0.9 minute.
The police department orders each car to take a particular route in such a manner that it is not possible for any car to reduce its travel time by not following the order, while the other cars are following the order.

If all the cars follow the police order, what is the difference in travel time (in minutes) between a car which takes the route A-N-B and a car that takes the route A-M-B?

(A) 1

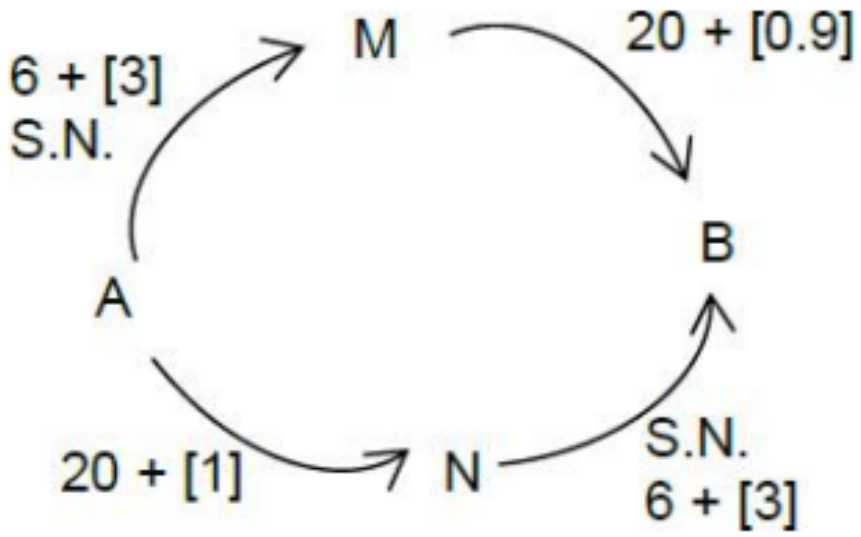
(B) 0.1

(C) 0.2

(D) 0.9

Correct Answer: (B) 0.1

Solution:



Explanation: According to the police order 2 cars each would pass through $A \to M \to B$ and $A \to N \to B$.

Then time taken through $A \to M \to B = 29.9$ and time taken through $A \to N \to B = 30.0$.

$\therefore$ Difference = 0.1.

Quick Tip

For these types of problems, carefully calculate the total travel time for each route by accounting for the additional time added per car. Consider all factors like congestion and the number of cars on the route.

65. Four cars need to travel from Akala (A) to Bakala (B). Two routes are available, one via Mamur (M) and the other via Nanur (N). The roads from A to M, and from N to B, are both short and narrow. In each case, one car takes 6 minutes to cover the distance, and each additional car increases the travel time per car by 3 minutes because of congestion. (For example, if only two cars drive from A to M, each car takes 9 minutes.) On the road from A to N, one car takes 20 minutes, and each additional car increases the travel time per car by 1 minute. On the road from M to B, one car takes 20 minutes, and each additional car increases the travel time per car by 0.9 minute.

The police department orders each car to take a particular route in such a manner that it is not possible for any car to reduce its travel time by not following the order, while the other cars are following the order.

A new one-way road is built from M to N. Each car now has three possible routes to travel from A to B: A-M-B, A-N-B and A-M-N-B. On the road from M to N, one car takes 7 minutes and each additional car increases the travel time per car by 1 minute. Assume that any car taking the A-M-N-B route travels the A-M portion at the same time as other cars taking the A-M-B route, and the N-B portion at the same time as other cars taking the A-N-B route.

How many cars would the police department order to take the A-M-N-B route so that it is not possible for any car to reduce its travel time by not following the order while the other cars follow the order? (Assume that the police department would never order all the cars to take the same route.)

(A) 2

(B) 3

(C) 4

(D) 1

Correct Answer: (A) 2

Solution: Explanation: No car should be able to reduce its travel time by not following the order and all the cars cannot take the same route. So either two or three cars should go through $A \to M$. If two cars go through $M \to B$, one car can break the police order and go

through $M \to N$ and reach B in $9 + 7 + 12 = 28$ minutes as compared to 29.9 minutes had both gone through $A \to M$. If two cars go through $A \to M$ and one is directed to go through $M \to N$, one of the cars which was directed to go through $A \to N$ can break the police order and go through $A \to M$ and save time as follows:

$$\text{Original time}(A \to N \to B) = 21 + 12 = (\text{three cars}) = 33$$

$$\text{New time} = 12\ (3\ \text{cars}) + 20.9 = 32.9$$

The police department cannot direct both cars to go through $M \to N$ as in that case all four cars would go through $N \to B$.

In case three cars are directed to go through $A \to M$, either one car can be directed through $M \to N$ or two cars can be directed through $M \to N$.

If one car is directed through $M \to N$, one of the two cars directed through $M \to B$, can break the police order and go through $M \to N$, and save time as shown.

$$\text{Original time}(A \to M \to B) = 12\ (3\ \text{cars}) + 20.9 = 32.9$$

$$\text{New time}(A \to M \to N \to B) = 12 + 8 + 12 = 32\ \text{minutes.}$$

$\therefore$ two cars must be directed through $M \to N$ such that any car breaking the police order cannot reduce the travel time.

Quick Tip

In such problems, calculate the total travel time for each route at various car volumes, and ensure that the travel time is minimized for all vehicles under the given constraints.

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66. Four cars need to travel from Akala (A) to Bakala (B). Two routes are available, one via Mamur (M) and the other via Nanur (N). The roads from A to M, and from N to B, are both short and narrow. In each case, one car takes 6 minutes to cover the distance, and each additional car increases the travel time per car by 3 minutes because of congestion. (For example, if only two cars drive from A to M, each car takes 9 minutes.) On the road from A to N, one car takes 20 minutes, and each additional car increases the travel time per car by 1

minute. On the road from M to B, one car takes 20 minutes, and each additional car increases the travel time per car by 0.9 minute.

The police department orders each car to take a particular route in such a manner that it is not possible for any car to reduce its travel time by not following the order, while the other cars are following the order.

A new one-way road is built from M to N. Each car now has three possible routes to travel from A to B: A-M-B, A-N-B, and A-M-N-B. On the road from M to N, one car takes 7 minutes and each additional car increases the travel time per car by 1 minute. Assume that any car taking the A-M-N-B route travels the A-M portion at the same time as other cars taking the A-M-B route, and the N-B portion at the same time as other cars taking the A-N-B route.

If all the cars follow the police order, what is the minimum travel time (in minutes) from A to B? (Assume that the police department would never order all the cars to take the same route.)

(A) 26

(B) 32

(C) 29.9

(D) 30

Correct Answer: (B) 32

Solution: Explanation: When all cars follow the police order, the time taken would be:

$$\text{A-M-B (1 car)} = 12 + 20 = 32 \text{ minutes.}$$

$$\text{A-M-N-B (2 cars)} = 12 + 8 + 12 = 32 \text{ minutes.}$$

$$\text{A-N-B (1 car)} = 20 + 12 = 32 \text{ minutes.}$$

Quick Tip

When solving optimization problems with congestion or varying travel times, always compare the total travel time for each route under different scenarios and assign the vehicles accordingly.