

In a Class X Board examination, ten papers are distributed over five Groups œ PCB, Mathematics, Social Science, Vernacular and English. Each of the ten papers is evaluated out of 100. The final score of a student is calculated in the following manner. First the Group Scores are obtained by averaging marks in the papers within the Group. The final score is the simple average of the Group Scores. The data for the top ten students are presented below. (Dipan's score in English Paper II has been intentionally removed in the table).

	PCB Group			Mathe matics Group	Social Science Group		Vernacular Group		English Group		Final Score
	Ph y	Chem	Bio.		Hist.	Geo.	Pap er I	Pap er II	Pap er I	Pap er II	
Name of the student											
Ayesha (G)	98	96	97	98	95	93	94	96	96	98	96.2
Ram (B)	97	99	95	97	95	96	94	94	96	98	96.1
Dipan (B)	98	98	98	95	96	95	96	94	96	??	96.0
Sagnik (B)	97	98	99	96	96	98	94	97	92	94	95.9
Sanjiv (B)	95	96	97	98	97	96	92	93	95	96	95.7
Shreya (G)	96	89	85	100	97	98	94	95	96	95	95.5
Joseph (B)	90	94	98	100	94	97	90	92	94	95	95.0
Agni (B)	96	99	96	99	95	96	82	93	92	93	94.3
Pritam (B)	98	98	95	98	83	95	90	93	94	94	93.9
Tirna (G)	96	98	79	99	85	94	92	91	87	96	93.7

**Note:** B or G against the name of a student respectively indicates whether the student is a boy or a girl.

1. How much did Dipan get in English Paper II?
  - (1) 94
  - (2) 96.5
  - (3) 97
  - (4) 98
  - (5) 99

2. Students who obtained Group Scores of at least 95 in every group are eligible to apply for a prize. Among those who are eligible, the student obtaining the highest Group Score in Social Science Group is awarded this prize. The prize was awarded to:
- (1) Shreya
  - (2) Ram
  - (3) Ayesha
  - (4) Dipan
  - (5) no one from the top ten
3. Among the top ten students, how many boys scored at least 95 in at least one paper from each of the groups?
- (1) 1
  - (2) 2
  - (3) 3
  - (4) 4
  - (5) 5
4. Each of the ten students was allowed to improve his/her score in exactly one paper of choice with the objective of maximizing his/her final score. Everyone scored 100 in the paper in which he or she chose to improve. After that, the topper among the ten students was:
- (1) Ram
  - (2) Agni
  - (3) Pritam
  - (4) Ayesha
  - (5) Dipan
5. Had Joseph, Agni, Pritam and Tirna each obtained Group Score of 100 in the Social Science Group, then their standing in decreasing order of final score would be:
- (1) Pritam, Joseph, Tirna, Agni
  - (2) Joseph, Tirna, Agni, Pritam
  - (3) Pritam, Agni, Tirna, Joseph
  - (4) Joseph, Tirna, Pritam, Agni
  - (5) Pritam, Tirna, Agni, Joseph

51. If  $x = -0.5$ , then which of the following has the smallest value?

- (1)  $2^{\frac{1}{x}}$
- (2)  $\frac{1}{x}$
- (3)  $\frac{1}{x^2}$
- (4)  $2^x$
- (5)  $\frac{1}{\sqrt{-x}}$

52. Which among  $2^{1/2}$ ,  $3^{1/3}$ ,  $4^{1/4}$ ,  $6^{1/6}$  and  $12^{1/12}$  is the largest?

- (1)  $2^{1/2}$
- (2)  $3^{1/3}$
- (3)  $4^{1/4}$
- (4)  $6^{1/6}$
- (5)  $12^{1/12}$

53.

If  $\frac{a}{b} = \frac{1}{3}$ ,  $\frac{b}{c} = 2$ ,  $\frac{c}{d} = \frac{1}{2}$ ,  $\frac{d}{e} = 3$  and  $\frac{e}{f} = \frac{1}{4}$  then what is the value of  $\frac{abc}{def}$ ?

- (1)  $3/8$
- (2)  $27/8$
- (3)  $3/4$
- (4)  $27/4$
- (5)  $1/4$

54. The length, breadth and height of a room are in the ratio 3:2:1. If the breadth and height are halved while the length is doubled, then the total area of the four walls of the room will

- (1) remain the same
- (2) decrease by 13.64%
- (3) decrease by 15%
- (4) decrease by 18.75%
- (5) decrease by 30%

55. Consider a sequence where the  $n^{\text{th}}$  term,  $t_n = \frac{n}{n+2}$ ,  $n = 1, 2, \dots$

The value of  $t_3 \times t_4 \times t_5 \times \dots \times t_{53}$  equals:

- (1)  $2/495$
- (2)  $2/477$
- (3)  $12/55$
- (4)  $1/1485$
- (5)  $1/2970$

56. A group of 630 children is arranged in rows for a group photograph session. Each row contains three fewer children than the row in front of it. What number of rows is not possible?

- (1) 3
- (2) 4
- (3) 5
- (4) 6
- (5) 7

57. What are the values of  $x$  and  $y$  that satisfy both the equations?

$$2^{0.7x} \cdot 3^{-1.25y} = 8\sqrt{6}/27$$

$$4^{0.3x} \cdot 9^{0.2y} = 8 \cdot (81)^{1/5}$$

- (1)  $x = 2, y = 5$
- (2)  $x = 2.5, y = 6$
- (3)  $x = 3, y = 5$
- (4)  $x = 3, y = 4$
- (5)  $x = 5, y = 2$

58. The number of solutions of the equation  $2x + y = 40$  where both  $x$  and  $y$  are positive integers and  $x \leq y$  is:

- (1) 7
- (2) 13
- (3) 14
- (4) 18
- (5) 20

59. A survey was conducted of 100 people to find out whether they had read recent issues of Golmal, a monthly magazine. The summarized information regarding readership in 3 months is given below:

Only September: 18; September but not August: 23; September and July: 8; September: 28;

July: 48; July and August: 10; None of the three months: 24.

What is the number of surveyed people who have read exactly two consecutive issues (out of the three)?

- (1) 7
- (2) 9
- (3) 12
- (4) 14
- (5) 17

60. The sum of four consecutive two digit odd numbers, when divided by 10, becomes a perfect square. Which of the following can possibly be one of these four numbers?

- (1) 21
- (2) 25
- (3) 41
- (4) 67
- (5) 73

1. Dipan's Group Scores are as follows:

$$\text{PCB Group} = 98 \times \left(\frac{3}{3}\right) = 98$$

Mathematics Group = 95

$$\text{Social Science Group} = \frac{96 + 95}{2} = 95.5$$

$$\text{Vernacular Group} = \frac{96 + 94}{2} = 95$$

$$\text{English Group} = \frac{96 + x}{2} = 48 + \left(\frac{x}{2}\right)$$

Dipan's final score = 96

$\therefore$  Sum of Dipan's Group Scores =  $96 \times 5 = 480$

$$\therefore 98 + 95 + 95.5 + 95 + 48 + \frac{x}{2} = 480$$

$$\therefore \frac{x}{2} = 48.5$$

$$\therefore x = 97$$

Dipan scored 97 marks in English Paper II.

Hence, option 3.

2. From the table we can observe that only Dipan is eligible to apply for the prize.

So Dipan gets the prize.

Hence, option 4.

3. Dipan was the only boy to score at least 95 in at least one paper from each of the groups.

Hence, option 1.

4. In order to maximize scores, each student would choose to improve score in the paper in which would affect the group score the most.

Consider the options.

Ram chooses Vernacular Paper I or II.

His original group score in Vernacular group = 94

$$\text{His new score would change by } \frac{\frac{(94 + 100)}{2} - 94}{5} = 0.6$$

$$\text{His new score} = 96.1 + 0.6 = 96.7$$

Agni chooses Vernacular Paper I.

His original group score in Vernacular group = 87.5

$$\text{His new score would change by } \frac{\frac{(93 + 100)}{2} - 87.5}{5} = 1.8$$

His new score =  $94.3 + 1.8 = 96.1$

Pritam chooses History.  
His original group score in Social Science group = 89

$$\text{His new score would change by } \frac{\frac{(95 + 100)}{2} - 89}{5} = 1.7$$

His new score =  $93.9 + 1.7 = 95.6$

Ayesha chooses Geography.  
Her original group score in Social Science group = 94

$$\text{His new score would change by } \frac{\frac{(95 + 100)}{2} - 94}{5} = 0.7$$

Her new score =  $96.2 + 0.7 = 96.9$

Dipan chooses Mathematics.  
His original group score in Mathematics group = 95  
His new score would change by  $\frac{100 - 95}{5} = 1$   
His new score =  $96 + 0.6 = 97$ , which is the highest among the five options.  
Hence, option 5.

5. Group scores of Joseph, Agni, Pritam and Tirna in Social Science Group are 95.5, 95.5, 89 and 89.5 respectively. Their final scores are 95, 94.3, 93.9, 93.7 respectively. If their group scores in social science change to hundred their final scores will be affected by  $4.5/5$ ,  $4.5/5$ ,  $11/5$  and  $10.5/5$  respectively. Their new final scores would be 95.9, 95.2, 96.1 and 95.8 respectively. Their standing in decreasing order of final score would be Pritam, Joseph, Tirna, Agni.  
Hence, option 1.

51.

Out of the options, only  $\frac{1}{x}$  is negative.  
All the others are positive.

$\therefore \frac{1}{x}$  is the smallest.  
Hence, option 2.

$$52. 2^{1/2} = 2^{6/12} = (2^6)^{1/12} = 64^{1/12}$$

Similarly,  $3^{1/3} = 81^{1/12}$ ,  $4^{1/4} = 64^{1/12}$ ,  $6^{1/6} = 36^{1/12}$

Now, all the powers are equal. Thus the option with the largest base is the largest.

$3^{1/3}$  is the largest.

Hence, option 2.

53.

$$\frac{a}{d} = \frac{a}{b} \times \frac{b}{c} \times \frac{c}{d} = \frac{1}{3} \times 2 \times \frac{1}{2} = \frac{1}{3}$$

$$\frac{b}{e} = \frac{b}{c} \times \frac{c}{d} \times \frac{d}{e} = 2 \times \frac{1}{2} \times 3 = 3$$

$$\frac{c}{f} = \frac{c}{d} \times \frac{d}{e} \times \frac{e}{f} = \frac{1}{2} \times 3 \times \frac{1}{4} = \frac{3}{8}$$

$$\therefore \frac{abc}{def} = \frac{1}{3} \times 3 \times \frac{3}{8} = \frac{3}{8}$$

Hence, option 1.

54. Let the original length, breadth and height of the room be  $3x$ ,  $2x$  and  $x$  respectively.

$\therefore$  The new length, breadth and height are  $6x$ ,  $x$  and  $x/2$  respectively.

Area of four walls =  $(2 \times \text{length} \times \text{height}) + (2 \times \text{breadth} \times \text{height})$

Original area of four walls =  $6x^2 + 4x^2 = 10x^2$

New area of four walls =  $6x^2 + x^2 = 7x^2$

$\therefore$  Area of wall decreases by  $[(10x^2 - 7x^2)/10x^2] \times 100 = 30\%$

55.

$$t_n = \frac{n}{n+2}$$

$$\therefore t_3 = \frac{3}{3+2} = \frac{3}{5}$$

$$t_4 = \frac{4}{4+2} = \frac{4}{6}$$

$$t_5 = \frac{5}{5+2} = \frac{5}{7}$$

$$t_{51} = \frac{51}{53}$$

$$t_{52} = \frac{52}{54}$$

$$t_{53} = \frac{53}{55}$$

$$\therefore t_3 \times t_4 \times t_5 \times \dots \times t_{53} = \frac{3}{5} \times \frac{4}{6} \times \frac{5}{7} \times \dots \times \frac{51}{53} \times \frac{52}{54} \times \frac{53}{55}$$

$$= \frac{(3 \times 4)}{(54 \times 55)} = \frac{2}{495}$$

Hence, option 1.

56. Let there be  $n$  rows and  $a$  students in the first row.

$\therefore$  Number of students in the second row =  $a + 3$

$\therefore$  Number of students in the third row =  $a + 6$  and so on.

$\therefore$  The number of students in each row forms an arithmetic progression with common difference = 3

The total number of students = The sum of all terms in the arithmetic progression

$$= \frac{n[2a + 3(n-1)]}{2} = 630$$

Now consider options.

1.  $n = 3$

$$\frac{3[2a + 3(3 - 1)]}{2} = 630$$

$$\therefore a = 207$$

2.  $n = 4$

$$\frac{4[2a + 3(4 - 1)]}{2} = 630$$

$$\therefore a = 153$$

3.  $n = 5$

$$\frac{5[2a + 3(5 - 1)]}{2} = 630$$

$$\therefore a = 120$$

4.  $n = 6$

$$\frac{6[2a + 3(6 - 1)]}{2} = 630$$

$$\therefore a = \frac{195}{2}$$

5.  $n = 7$

$$\frac{7[2a + 3(7 - 1)]}{2} = 630$$

$$\therefore a = 81$$

As  $a$  is an integer, only  $n = 6$  is not possible.

Hence, option 4.

$$57. 2^{0.7x} \times 3^{-1.25y} = 2^{7/2} \times 3^{-5/2} = 2^{0.7 \times 5} \times 3^{-1.25 \times 2}$$

$$x = 5 \text{ and } y = 2$$

These values of  $x$  and  $y$  satisfy the second equation also.

Hence, option 5.

58.  $2x + y = 40$

$\therefore y = 40 - 2x$

x and y are positive integers and  $x \leq y$

If  $x = 1, y = 38$

$x = 2, y = 36$

$x = 3, y = 34$

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$x = 12, y = 16$

$x = 13, y = 14$

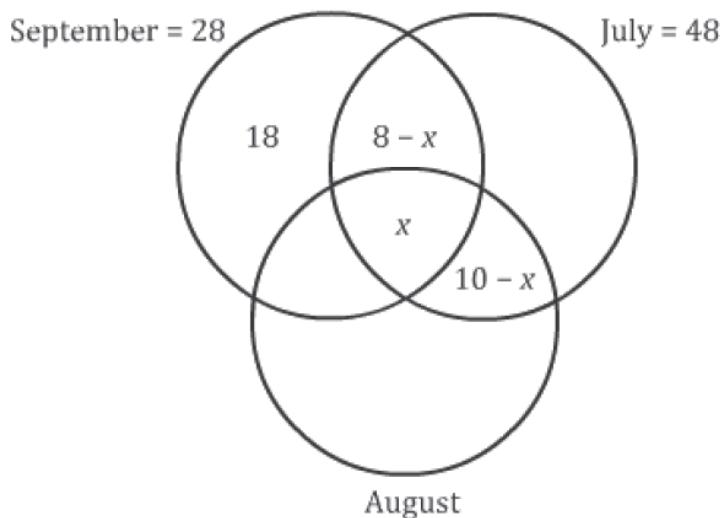
$x = 14, y = 12$

$\therefore$  For  $x > 13, y \leq x$

$\therefore$  There are 13 solutions to the given equation.

Hence, option 2.

59.



$100 - 24 = 76$  had read at least one issue.

If  $x$  people read all the three issues, then  $(8 - x)$  people read only the September and July issues.

23 people read the September issue but not the August issue.

$\therefore 18 + 8 - x = 23$

$\therefore x = 3$

As 28 people read the September issue,  $[28 - (8 - 3) - 3 - 18] = 2$  people read only the August and September issues.

As 10 people read the July and August issues,  $10 - 3 = 7$  people read only the July and August issues.

$\therefore$  The number of people who have read exactly two consecutive issues =  $7 + 2 = 9$

Hence, option 2.

**60.** The four consecutive two-digit odd numbers will have (1, 3, 5, 7) or (3, 5, 7, 9) or (5, 7, 9, 1) or (7, 9, 1, 3) as units digits.

As the sum divided by 10 yields a perfect square, the sum is a multiple of 10.

∴ The units digits have to be (7, 9, 1, 3).

Thus the four numbers will be  $(10x + 7)$ ,  $(10x + 9)$ ,  $(10x + 11)$  and  $(10x + 13)$ , where  $0 < x < 9$  (as each of these numbers is a two digit number)

Sum of these numbers =  $40x + 40 = 40(x + 1)$

Now,  $40(x + 1)/10 = 4(x + 1)$  is a perfect square

As 4 is a perfect square  $(x + 1)$  is some perfect square  $< 10$

$x + 1 = 4$ ,  $x = 3$ , and the four numbers are 37, 39, 41 and 43

$x + 1 = 9$ ,  $x = 8$ , and the four numbers are 87, 89, 91 and 93

Hence, option 3.

**Directions for Questions 21 to 26:** Each question is followed by two statements, A and B. Answer each question using the following instructions:

- Choose1 if the question can be answered by using one of the statements alone but not by using the other statement alone.
- Choose 2 if the question can be answered by using either of the statements alone.
- Choose 3 if the question can be answered by using both statements together but not by either statement alone.
- Choose4 if the question cannot be answered on the basis of the two statements.

21. Four candidates for an award obtain distinct scores in a test. Each of the four casts a vote to choose the winner of the award. The candidate who gets the largest number of votes wins the award. In case of a tie in the voting process, the candidate with the highest score wins the award. Who wins the award?
- A: the candidate with top three scores each vote for the top scorer amongst the other three.
  - B: The candidate with the lowest score votes for the player with the second highest score.
22. Zakib spends 30 % of his income on his children's education, 20% on recreation and 10% on healthcare. The corresponding percentages for Supriyo are 40%,25% and 13%. Who spends more on children's education?
- A: Zakib spends more on recreation than Supriyo.
  - B: Supriyo spends more on healthcare than Zakib.
23. Tarak is standing 2 steps to the left of a red mark and 3 steps to the right of a blue mark. He tosses a coin. If it comes up heads, he moves one step to the right; otherwise he moves one step to the left. He keeps doing this until he reaches one of the two marks, and then he stops. At which mark does he stop?
- A: He stops after 21 coin tosses.
  - B: He obtains three more tails than heads.
24. In a class of 30 students, Rashmi secured the third rank among the girl while her brother Kumar studying in the same class secured the sixth rank in the whole class. Between the two who had a better overall rank?
- A: Kumar was among the top 25 % of the boys merit list in the class In which 60% were boys
  - B: There were three boys among the top five rank holder and three girls among the top ten rank holders.
25. Nandini paid for an article using currency notes of denominations Rs.1, Rs.2, Rs.5 and Rs.10 using at least one note of each denomination . The total number of five and ten rupee notes used was one more than the total number of one and two rupee notes used. What was the price of the article?
- A: Nandini used a total of 13 currency notes.
  - B: The price of the article was a multiple of Rs. 10.
26. Ravi spent less than Rs.75 to buy one kilogram each of potato, onion, and gourd. Which one of the three vegetables bought was the costliest?
- A: 2 kg potato and 1 kg gourd cost less than 1 kg potato and 2 kg gourd.
  - B: 1 kg potato and 2 kg onion together cost the same as 1 kg onion and.2 kg gourd.

20. Suppose you have a currency, named Miso, in three denominations: 1 Miso, 10 Misos and 50 Misos. In how many ways can you pay a bill of 107 Misos?

- (1) 17
- (2) 16
- (3) 18
- (4) 15
- (5) 19

21. How many pairs of positive integers  $m, n$  satisfy  $1/m + 4/n = 1/12$  where  $n$  is an odd integer less than 60?

- (1) 6
- (2) 4
- (3) 7
- (4) 5
- (5) 3

22. A confused bank teller transposed the rupees and paise when he cashed a cheque for Shailaja, giving her rupees instead of paise and paise instead of rupees. After buying a toffee for 50 paise, Shailaja noticed that she was left with exactly three times as much as the amount on the cheque. Which of the following is a valid statement about the cheque amount?

- (1) Over Rupees 13 but less than Rupees 14
- (2) Over Rupees 7 but less than Rupees 8
- (3) Over Rupees 22 but less than Rupees 23
- (4) Over Rupees 18 but less than Rupees 19
- (5) Over Rupees 4 but less than Rupees 5

23. Consider the set  $S = \{2, 3, 4, \dots, 2n + 1\}$ , where  $n$  is a positive integer larger than 2007. Define  $X$  as the average of the odd integers in  $S$  and  $Y$  as the average of the even integers in  $S$ . What is the value of  $X - Y$ ?

- (1) 0
- (2) 1
- (3)  $n/2$
- (4)  $n+1/2n$
- (5) 2008

24. Ten years ago, the ages of the members of a joint family of eight people added up to 231 years. Three years later, one member died at the age of 60 years and a child was born during the same year. After another three years, one more member died, again at 60, and a child was born during the same year. The current average age of this eight member joint family is nearest to:

- (1) 23 years
- (2) 22 years
- (3) 21 years
- (4) 25 years
- (5) 24 years

25. A function  $f(x)$  satisfies  $f(1) = 3600$ , and  $f(1) + f(2) + \dots + f(n) = n^2 f(n)$ , for all positive integers  $n > 1$ . What is the value of  $f(9)$ ?
- (1) 80
  - (2) 240
  - (3) 200
  - (4) 100
  - (5) 120

**Questions 21 to 26:**

21. By statement A alone you can find out who wins the award.  
But statement B alone is not sufficient.  
So answer is (1).
22. By statement A you cannot find the answer.  
By statement B alone you can find who spends more on children's education.  
So answer is (1).
23. By using statement A alone you cannot get the answer.  
By statement B alone is sufficient to get the answer.  
So answer is (1).
24. By statement A you can get the answer.  
By statement B you can get the answer.  
both the statement alone are sufficient, so answer is (2).
25. Statement A alone is not sufficient.  
Statement B alone is not sufficient.  
Combining both the statement you cannot get a unique answer.  
So answer is (4).
26. Statement A alone is not sufficient.  
Statement B alone is not sufficient.  
Combining both the statement you can get the answer.  
So answer is (3).

**20.** The bill can be paid in 18 ways as shown in the given table. Hence, option 3.

50 Misos	10 Misos	1 Miso	Total
0	0	107	107
0	1	97	107
0	2	87	107
0	3	77	107
0	4	67	107
0	5	57	107
0	6	47	107
0	7	37	107
0	8	27	107
0	9	17	107
0	10	7	107
1	0	57	107
1	1	47	107
1	2	37	107
1	3	27	107
1	4	17	107
1	5	7	107
2	0	7	107

$$21. \frac{1}{m} + \frac{4}{n} = \frac{1}{12}$$

$$\therefore \frac{1}{m} = \frac{1}{12} - \frac{4}{n}$$

$$\therefore m = \frac{12n}{(n - 48)}$$

As,  $m$  is a positive integer,  $n$  should be greater than 48 and moreover since  $n$  is a positive odd integer lesser than 60,  $n$  can take values 49, 51, 53, 55, 57 and 59.

If  $n = 49, 51, 57$  then  $m$  is a positive integer.

If  $n = 53, 55, 59$  then  $m$  is not an integer.

$\therefore$  3 pairs of values of  $m$  and  $n$  satisfy the given equation.

Hence, option 5.

**22.** Let the amount on Shailaja's cheque be Rs.  $x$  and paise  $y = (100x + y)$  paise ( $x$  and  $y$  are positive integers)

The teller gives her  $(100y + x)$  paise.

$$\text{Now, } 100y + x - 50 = 3(100x + y)$$

$$\therefore 97y - 299x = 50$$

$$\therefore y = (50 + 299x)/97 = (50 + 8x)/97 + 3$$

Now as  $y$  is an integer,  $(50 + 8x)$  has to be a multiple of 97 with  $x, y \leq 99$

$$50 + 8x = 97k \text{ (} k \text{ is an integer)}$$

$$\therefore x = 12k - 6 + (k - 2)/8$$

$$\therefore k = 2, 10, 18\dots$$

$$\therefore x = 18, 115, 212\dots$$

$\therefore x = 18$  is the only possible value.

This implies that  $y = 5$

$\therefore$  The amount on Shailaja's cheque is over Rs. 18 but less than Rs. 19.

Hence, option 4.

**23.**  $Y = (2 + 4 + 6 + 8 + \dots + 2n)/n$

$$X = (3 + 5 + 7 + 9 + \dots + (2n + 1))/n$$

$$= ((2 + 1) + (3 + 1) + (4 + 1) + (5 + 1) + \dots + (2n + 1))/n$$

$$= (2 + 4 + 6 + 8 + \dots + 2n)/n + (1 + 1 + 1 + 1 + \dots n \text{ times})/n$$

$$= Y + 1$$

$$\therefore X - Y = 1$$

Hence, option 2.

Note: The information that ' $n$  is a positive integer larger than 2007' does not affect the answer in any way.

**24.** The sum of the ages of the members of the family ten years ago = 231

$\therefore$  The sum of the ages of the members of the family seven years ago =  $231 + (3 \times 8) - 60 = 195$

$\therefore$  The sum of the ages of the members of the family four years ago =  $195 + (3 \times 8) - 60 = 159$

$\therefore$  The sum of the ages of the members of the family now =  $159 + (4 \times 8) = 191$

$\therefore$  Required average =  $191/8 = 23.875 \approx 24$

Hence, option 5.

$$25. f(1) + f(2) + f(3) + \dots + f(n-1) + f(n) = n^2 f(n) \dots (I)$$

$$\text{Similarly, } f(1) + f(2) + f(3) + \dots + f(n-1) = (n-1)^2 f(n-1) \dots (II)$$

$$\therefore f(n) = n^2 f(n) - (n-1)^2 f(n-1) \dots (I) - (II)$$

$$\therefore (n^2 - 1)f(n) = (n-1)^2 f(n-1)$$

$$\therefore f(n) = (n-1)^2 / (n^2 - 1) f(n-1)$$

$$\therefore f(n) = (n-1) / (n+1) f(n-1)$$

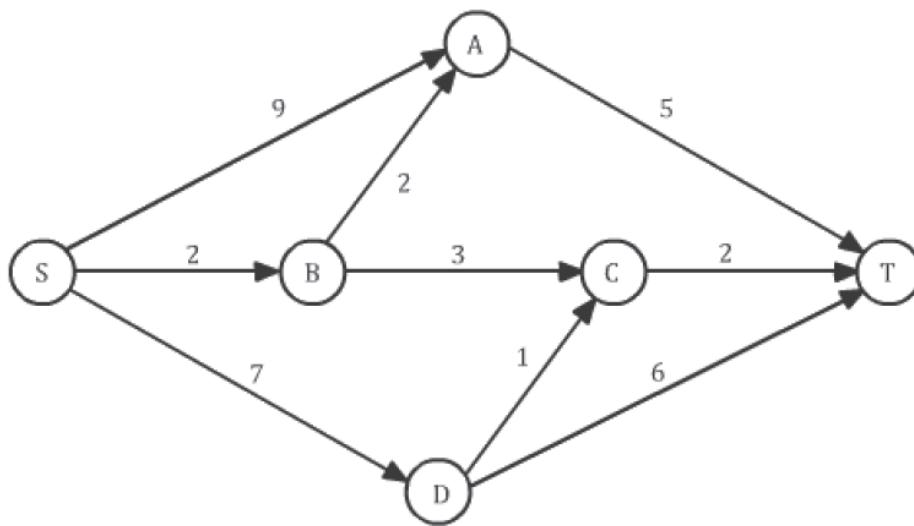
$$\therefore f(9) = 8/10 \times 7/9 \times 6/8 \times 5/7 \times 4/6 \times 3/5 \times 2/4 \times 1/3 \times 3600$$

$$= (2 \times 3600) / (10 \times 9) = 80$$

Hence, option 1.

**Answer questions 16 to 20 on the basis of the information given below.**

A significant amount of traffic flows from point S to point T in the one-way street network shown below. Points A, B, C, and D are junctions in the network, and the arrows mark the direction of traffic flow. The fuel cost in rupees for travelling along a street is indicated by the number adjacent to the arrow representing the street.



Motorists travelling from point S to point T would obviously take the route for which the total cost of travelling is the minimum. If two or more routes have the same least travel cost, then motorists are indifferent between them. Hence, the traffic gets evenly distributed among all the least cost routes.

The government can control the flow of traffic only by levying appropriate toll at each junction. For example, if a motorist takes the route S-A-T (using junction A alone), then the total cost of travel would be Rs 14 (i.e. Rs 9 + Rs 5) plus the toll charged at junction A.

16. If the government wants to ensure that all motorists travelling from S to T pay the same amount (fuel costs and toll combined) regardless of the route they choose and the street from B to C is under repairs (and hence unusable), then a feasible set of toll charged (in rupees) at junctions A, B, C, and D respectively to achieve this goal is:
- (1) 2, 5, 3, 2
  - (2) 0, 5, 3, 1
  - (3) 1, 5, 3, 2
  - (4) 2, 3, 5, 1
  - (5) 1, 3, 5, 1

17. If the government wants to ensure that no traffic flows on the street from D to T, while equal amount of traffic flows through junctions A and C, then a feasible set of toll charged (in rupees) at junctions A, B, C, and D respectively to achieve this goal is:

- (1) 1, 5, 3, 3
- (2) 1, 4, 4, 3
- (3) 1, 5, 4, 2
- (4) 0, 5, 2, 3
- (5) 0, 5, 2, 2

18. If the government wants to ensure that all routes from S to T get the same amount of traffic, then a feasible set of toll charged (in rupees) at junctions A, B, C, and D respectively to achieve this goal is:

- (1) 0, 5, 2, 2
- (2) 0, 5, 4, 1
- (3) 1, 5, 3, 3
- (4) 1, 5, 3, 2
- (5) 1, 5, 4, 2

19. If the government wants to ensure that the traffic at S gets evenly distributed along streets from S to A, from S to B, and from S to D, then a feasible set of toll charged (in rupees) at junctions A, B, C, and D respectively to achieve this goal is:

- (1) 0, 5, 4, 1
- (2) 0, 5, 2, 2
- (3) 1, 5, 3, 3
- (4) 1, 5, 3, 2
- (5) 0, 4, 3, 2

20. The government wants to devise a toll policy such that the total cost to the commuters per trip is minimized. The policy should also ensure that not more than 70 per cent of the total traffic passes through junction B. The cost incurred by the commuter travelling from point S to point T under this policy will be:

- (1) Rs 7
- (2) Rs 9
- (3) Rs 10
- (4) Rs 13
- (5) Rs 14

An airline has a certain free luggage allowance and charges for excess luggage at a fixed rate per kg. Two passengers, Raja and have 60 kg of luggage between them, and are charged Rs. 1200 and Rs. 2400 respectively for excess luggage. Hand the entire luggage to one of them, the excess luggage charge would have been Rs. 5400.

67. What is the weight of Praja's luggage?

- (1) 20 kg
- (2) 25 kg
- (3) 30 kg
- (4) 35 kg
- (5) 40 kg

68. What is the free luggage allowance?

- (1) 10 kg
- (2) 15 kg
- (3) 20 kg
- (4) 25 kg
- (5) 30 kg

69. Arun, Barun and Kiranmala start from the same place and travel in the same direction at speeds of 30, 40 and 60 km per hour respectively. Barun starts two hours after Arun. If Barun and Kiranmala overtake Arun at the same instant, how many hours after Arun did Kiranmala start?

- (1) 3
- (2) 3.5
- (3) 4
- (4) 4.5
- (5) 5

70. When you reverse the digits of the number 13, the number increases by 18. How many other two digit numbers increase by 18 when their digits are reversed?

- (1) 5
- (2) 6
- (3) 7
- (4) 8
- (5) 10

71. A semi-circle is drawn with AB as its diameter. From C, a point on AB, a line perpendicular to AB is drawn meeting the circumference of the semi-circle at D. Given that AC = 2 cm and CD = 6 cm, the area of the semi-circle (in sq. cm.) will be:

- (1)  $32\pi$
- (2)  $50\pi$
- (3)  $40.5\pi$
- (4)  $81\pi$
- (5) undeterminable

72. There are 6 tasks and 6 persons. Task 1 cannot be assigned either to person 1 or to person 2; task 2 must be assigned to either person 3 or person 4. Every person is to be assigned one task. In how many ways can the assignment be done?

- (1) 144
- (2) 180
- (3) 192
- (4) 360
- (5) 716

73. The number of employees in Obelix Menhir Co. is a prime number and is less than 300. The ratio of the number of employees who are graduates and above, to that of employees who are not, can possibly be:

- (1) 101:88
- (2) 87:100
- (3) 110:111
- (4) 85:98
- (5) 97:84

74. If  $\log_y x = a$ ,  $\log_z y = b$ ,  $\log_x z = ab$ ,

then which of the following pairs of values for  $(a, b)$  is not possible?

- (1) -2, 1/2
- (2) 1, 1
- (3) 0.4, 2.5
- (4)  $\pi$ ,  $1/\pi$
- (5) 2, 2

75. An equilateral triangle BP is drawn inside a square ABCD. What is the value of the angle APD in degrees?

- (1) 75
- (2) 90
- (3) 120
- (4) 135
- (5) 150

16. Let the toll charged at junctions A, B, C and D be a, b, c and d respectively.  
 Since the cost of travel including toll on routes S-A-T, S-D-T, S-B-A-T and S-D-C-T is the same.  
 $\therefore 14 + a = 13 + d = 9 + a + b = 10 + c + d$   
 Thus,  $b = 5$ ,  $d - a = 1$ ,  $c = 3$   
 If  $a = 0$ ,  $d = 1$ , If  $a = 1$ ,  $d = 2$  and if  $a = 2$ ,  $d = 3$   
 Hence, both options 2 and 3 satisfy the given criteria.
- Note: The question makers took care of this inconsistency while calculating scores.
17. Since the cost of travel including toll on routes S-A-T, S-B-C-T, S-B-A-T and S-D-C-T is the same.  
 $\therefore 14 + a = 7 + b + c = 9 + a + b = 10 + c + d$   
 $\therefore b = 5$ ,  $d = 2$ ,  $c - a = 2$   
 Only option 5 satisfies these criteria.  
 Hence, option 5.
18. Since the cost of travel including toll on all routes is the same.  
 $\therefore 14 + a = 7 + b + c = 13 + d = 9 + a + b = 10 + c + d$   
 $\therefore b = 5$ ,  $d = 2$ ,  $c = 3$  and  $a = 1$   
 Hence, option 4.
19. But we want traffic along S-A, S-B and S-D to be the same.  
 As routes lead to C from both B and D, we can increase the toll at C so that the cost of travelling along S-B-C-T and S-D-C-T is more than that along the other three routes.  
 Now,  $14 + a = 9 + b = 13 + d$   
 $\therefore a = 0$ ,  $b = 5$  and  $d = 1$   
 Also,  $7 + b + c > 14$  and  $10 + d + c > 14$   
 $\therefore c > 3$   
 Hence, option 1.
20. If toll charges at all junctions are made 0, 100% traffic will pass through S-B-C-T.  
 This is not possible.  
 If toll charges at A and B are made 0, then 100% traffic will pass through S-B-A-T.  
 This is also not possible.  
 If toll charges at C and D are made 0, that at B are made Rs.3, then the traffic will get equally divided between S-D-C-T and S-B-C-T.  
 Thus, the cost incurred will be Rs 10.  
 Hence, option 3.

**67.** Let  $f$  kg be the free luggage allowance and let Raja and Praja have  $r$  kg and  $p$  kg excess luggage respectively.

Let  $x$  be the fixed rate per kg for excess luggage.

$$\therefore 2f + r + p = 60 \quad \dots \text{(i)}$$

$$rx = 1200 \quad \dots \text{(ii)}$$

$$px = 2400 \quad \dots \text{(iii)}$$

$$(60 - f)x = 5400 \quad \dots \text{(iv)}$$

From (ii) and (iii),

$$p = 2r \quad \dots \text{(v)}$$

Substituting in (i),

$$2f + 3r = 60$$

$$\therefore f = 30 - 3r/2 \quad \dots \text{(vi)}$$

Substituting in (iv),

$$(60 - 30 + 3r/2)x = 5400$$

$$\therefore 30x + 3rx/2 = 5400$$

From (ii),

$$rx = 1200$$

$$\therefore 30x = 3600$$

$$\therefore x = 120$$

$$\therefore r = 10, p = 20 \text{ and } f = 15$$

Hence, option 4.

**68.**  $f = 15$  kg

Hence, option 2.

**69.** Arun has travelled 60 km when Barun starts.

Barun overtakes Arun in  $60/(40 - 30) = 6$  hrs

In this time, Barun travels  $6 \times 40 = 240$  km from the starting point.

Kiranmala overtakes Arun at the same point.

Kiranmala takes  $240/60 = 4$  hrs to reach there.

Arun takes  $240/30 = 8$  hrs to reach there.

$\therefore$  Kiranmala starts  $8 - 4 = 4$  hrs after Arun.

Hence, option 3.

**70.** Let  $10x + y$  be a two digit number, where  $x$  and  $y$  are positive single digit integers and  $x > 0$ .

Its reverse =  $10y + x$

Now,  $10y + x - 10x - y = 18$

$$\therefore 9(y - x) = 18$$

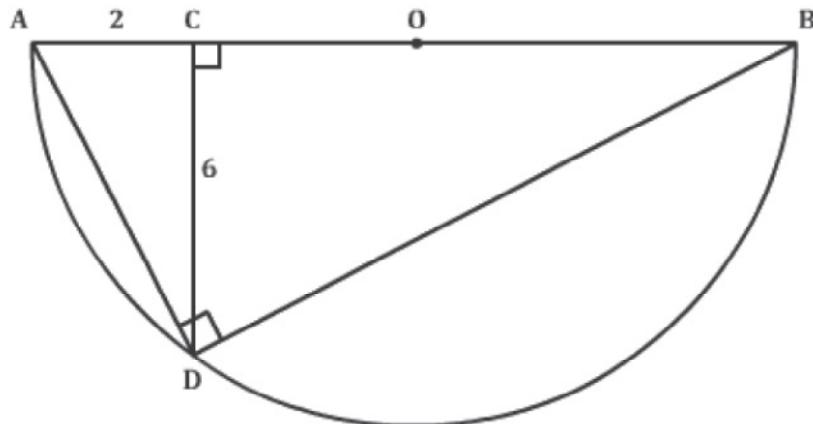
$$\therefore y - x = 2$$

Thus  $y$  and  $x$  can be (1, 3), (2, 4), (3, 5), (4, 6), (5, 7), (6, 8) and (7, 9)

$\therefore$  Other than 13, there are 6 such numbers.

Hence, option 2.

71.



Let  $CD = x$  cm

$\triangle ACD$  and  $\triangle ADB$  are similar triangles.

$$\therefore AD/AB = AC/AD$$

$$\therefore AD^2 = AC \times AB$$

$$\therefore (AC^2 + CD^2) = 2 \times (2 + x)$$

$$\therefore 40 = 2 \times (2 + x)$$

$$\therefore x = 18$$

$$\therefore \text{Diameter } AB = 20 \text{ cm}$$

$$\therefore \text{Radius} = 10 \text{ cm}$$

$$\therefore \text{Area} = 50\pi \text{ sq. cm.}$$

Hence option 2.

72. Task 2 can be assigned in 2 ways (either to person 3 or person 4).

Task 1 can then be assigned in 3 ways (persons 3 or 4, 5 and 6)

The remaining 4 tasks can be assigned to the remaining 4 persons in  $4! = 24$  ways

$\therefore$  The assignment can be done in  $24 \times 2 \times 3 = 144$  ways

Hence, option 1.

73. Consider options. As the number of employees is prime we can add the numerator and denominator of ratios directly to find the number of employees.

1. Number of employees =  $101 + 88 = 189$

Number of employees = 189, which is not a prime number.

$\therefore$  Option 1 is eliminated.

2. Number of employees =  $87 + 100 = 187$

Number of employees = 187, which is not a prime number.

- $\therefore$  Option 2 is eliminated.
3. Number of employees =  $110 + 111 = 221$   
 Number of employees = 221, which is not a prime number.  
 $\therefore$  Option 3 is eliminated.
4. Number of employees =  $85 + 98 = 183$   
 Number of employees = 183, which is not a prime number.  
 $\therefore$  Option 4 is eliminated.
5. Number of employees =  $97 + 84 = 181$   
 Number of employees = 181, which is a prime number.
- $\therefore$  The ratio of employees = 97:84  
 Hence, option 5.

74.

$$\text{If } \log_y x = a, \log_z y = b, \log_x z = ab$$

$$\therefore a \cdot \log_z y = ab$$

$$\therefore b = \log_z y$$

$$\therefore b \cdot \log_x z = ab$$

$$\therefore a = \log_x z$$

$$\therefore \log_y x = ab = \log_z y \times \log_x z$$

$$\therefore \frac{\log x}{\log y} = \frac{\log y}{\log x} \times \frac{\log z}{\log x}$$

$$\therefore \frac{\log x}{\log y} = \frac{\log y}{\log x}$$

$$\therefore (\log x)^2 = (\log y)^2$$

$$\therefore \log x = \pm \log y$$

$$\therefore \log x = \log y \text{ or } \log x = -\log y$$

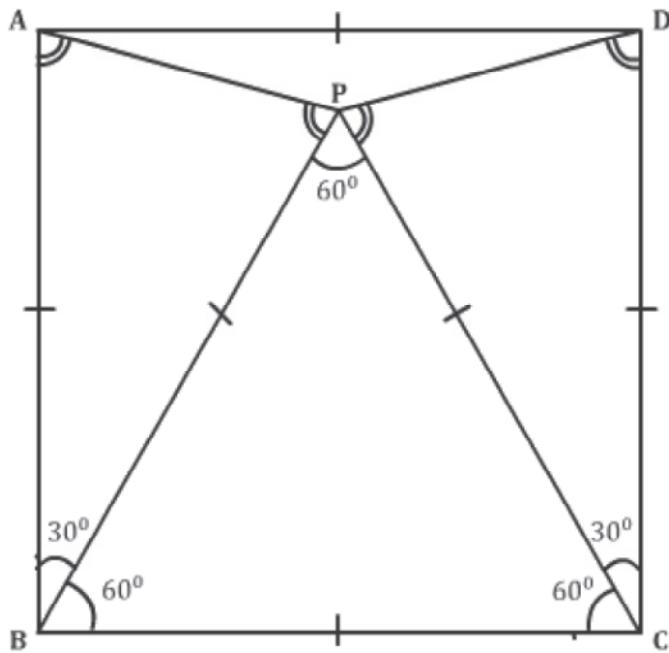
$$\therefore x = y \text{ or } x = \frac{1}{y}$$

$$\therefore ab = \log_y x = 1 \text{ or } -1$$

Only option 5 does not satisfy this.

Hence, option 5.

75.



$$AP = PC = BC$$

$$m\angle BPC = m\angle PCB = m\angle PBC = 60^\circ$$

$$\text{Also, } PC = CD = BP = AB$$

$\triangle ABP$  and  $\triangle PCD$  are isosceles triangles.

$$m\angle ABP = m\angle PCD = 90 - 60 = 30^\circ$$

$$\therefore m\angle APB = m\angle DPC = (180 - 30)/2 = 75^\circ$$

$$\therefore m\angle APD = 360 - (m\angle APB + m\angle DPC + m\angle BPC) = 360 - (75 + 75 + 60) = 150^\circ$$

Hence, option 5.

**Directions for Questions 17 to 20:** Answer the questions on the basis of the information given below. A study was conducted to ascertain the relative importance that employees in five different countries assigned to five different traits in their Chief Executive Officers. The traits were compassion (C), decisiveness (D), negotiation skills (N), public visibility (P), and vision (V). The level of dissimilarity between two countries is the maximum difference in the ranks allotted by the two countries to any of the five traits. The following table indicates the rank order of the five traits for each country.

Rank	Country				
	India	China	Japan	Malaysia	Thailand
1	C	N	D	V	V
2	P	C	N	D	C
3	N	P	C	P	N
4	V	D	V	C	P
5	D	V	P	N	D

17. Which of the following countries is least dissimilar to India?  
1. China                    2. Japan                    3. Malaysia                    4. Thailand
  
18. Which amongst the following countries is most dissimilar to India?  
1. China                    2. Japan                    3. Malaysia                    4. Thailand
  
19. Which of the following pairs of countries are most dissimilar?  
1. China & Japan                    2. India & China  
3. Malaysia & Japan                    4. Thailand & Japan
  
20. Three of the following four pairs of countries have identical levels of dissimilarity. Which pair is the odd one out?  
1. Malaysia & China                    2. China & Thailand  
3. Thailand & Japan                    4. Japan & Malaysia

**Directions for Questions 68 and 69:** Answer the questions on the basis of the information given below.

$$\begin{array}{lll} f_1(x) = & x & 0 \leq x \leq 1 \\ = & 1 & x \geq 1 \\ = & 0 & \text{Otherwise} \end{array}$$

$$\begin{array}{lll} f_2'(x) = & f_1(-x) & \text{for all } x \\ f_3'(x) = & -f_2(x) & \text{for all } x \\ f_4'(x) = & f_3(-x) & \text{for all } x \end{array}$$

68. How many of the following products are necessarily zero for every  $x$ :  
 $f_1(X)f_2(x), f_2(X)f_3(x), f_2(x)f_4(x)$ .

1. 0      2. 1      3. 2      4. 3

69. Which of the following is necessarily true?

1.  $f_4(x) = f_1(x)$  for all  $x$       2.  $f_1(X) = -f_3(-x)$  for all  $x$   
 3.  $f_2(-x) = f_4(x)$  for all  $x$       4.  $f_1(X) + f_3(x) = 0$  for all  $x$

**Directions for Questions 70 and 71:** Answer the questions independently of each other.

70. Consider the sequence of numbers  $a_1, a_2, a_3, \dots$  to infinity where  $a_1 = 81.33$  and  $a_2 = -19$  and  $a_j = a_{j-1} - a_{j-2}$  for  $j \geq 3$ .  
 What is the sum of the first 6002 terms of this sequence?

1. -100.33      2. -30.00      3. 62.33      4. 119.33

71. Let  $u = (\log_2 x)^2 - 6\log_2 x + 12$  where  $x$  is a real number. Then the equation  $x^u = 256$ , has
1. No solution for  $x$
  2. exactly one solution for  $x$ .
  3. Exactly two distinct solutions for  $x$
  4. Exactly three distinct solutions for  $x$

**Directions for Questions 72 and 73:** Answer the questions on the basis of the information given below.

In an examination, there are 100 questions divided into three groups A, B and C such that each group contains at least one question. Each question in group A carries 1 mark, each question in group B carries 2 marks and each question in group C carries 3 marks. It is known that the questions in group A together carry at least 60% of the total marks.

72. If group B contains 23 questions, then how many questions are there in group C?  
 1. 1      2. 2      3. 3      4. Cannot be determined
73. If group C contains 8 questions and group B carries at least 20% of the total marks, which of the following best describes the number of questions in group B?  
 1. 11 or 12      2. 12 or 13      3. 13 or 14      4. 14 or 15

**Caselet : 17 – 20**

17. For India-China, dissimilarity = 2  
For India-Japan, dissimilarity = 4  
For India-Malaysia, dissimilarity = 3  
For India-Thailand, dissimilarity = 3  
Hence answer is (1) CHINA.
18. From above question, answer option is (2) JAPAN.
19. For China-Japan dissimilarity = 3  
For India-China dissimilarity = 2  
For Malaysia-Japan dissimilarity = 3  
For Thailand-Japan dissimilarity = 4  
So answer is (4).
20. For Malaysia-China dissimilarity = 4  
For China-Thailand dissimilarity = 4  
For Thailand-Japan dissimilarity = 4  
For Japan-Malaysia dissimilarity = 3  
So answer is (4).
68. For all the finite values of  $f_1(x)$  the values of  $f_2(x)$  is zero thus  $f_1(x)$   $f_2(x)$  is always zero  $f_3(x)$   $f_4(x)$  is also equal to zero for the same reason
69. By substituting the values we get  $f_1(x) = -f_3(-x)$ . Hence answer option is (2).
70. Given that  $a_1=81.33, a_2=-19$   
 $a_3=a_2-a_1$   
 $a_4=a_3-a_2=-a_1$   
 $a_5=a_4-a_3=-a_2$   
 $a_6=a_5-a_4=a_1-a_2$   
 $a_7=a_1$   
 $a_1+a_2+a_3+a_4+a_5+a_6=0$   
So for every 6 terms sum will be 0  
So  $a_1+a_2+\dots+a_{6000}=0$   
 $a_1+a_2+\dots+a_{6002}=a_{6001}+a_{6002}=a_1+a_2$   
 $=81.33-19=62.33$ . Hence answer option is (3).
71.  $x^u = 256$   
take log on base 2,  $u \log_2 x = 8$   
let  $\log_2 x = p$   
then  $8/p = p^2 - 6p + 12$   
 $p^3 - 6p^2 + 12p - 8 = 0$   
 $p^2(p-2) - 4p(p-2) + 4(p-2)$   
 $(p^2 - 4p + 4)(p-2) = 0$   
 $(p-2)^3 = 0$   
 $p = 2$   
Hence exactly one solution. Answer option is (2).
72. Group A carries 1 mark  
Group B carries 2 mark  
Group C carries 3 marks  
Now group A carries atleast 60% that means group B and C carry at the most 40% but since we don't know the actual breakup of B and C we cannot predict the no. of questions in C.
73. Group C contains 8 questions that is 24 marks , now group B carries atleast 20% that means group C carries atleast 20% marks , but 20% correspond to 24 marks which then is the least no of marks in group B but in B each question carries 2 marks so the least no of questions is equal to  $24/2 = 12$  hence option (2) .

The following table gives some financial details of twelve Indian companies.

Company	Sales (Rs.crore)	Expenditure (Rs.crore)	Other Income (Rs.crore)	Liquidity Ratio	Net Profit (Rs.crore)
A	5800	2790	380	1.40	350
B	5490	4790	920	1.75	450
C	6400	2680	1240	1.62	180
D	3800	2190	1350	1.48	950
E	7820	6230	740	1.80	1020
F	2100	1980	980	1.73	800
G	4500	4230	650	1.36	720
H	3420	2140	1020	1.44	850
I	6500	5460	1460	1.33	650
J	6200	5840	1100	1.40	480
K	3680	2200	940	1.75	525
L	4500	3680	1130	1.45	550

Each of the above twelve companies belongs to exactly one of the four sectors – Pharmaceuticals, Automobiles, Mobiles and Construction. It is also known that, there are at least two of the above twelve companies in each of the four sectors.

Further, it is also known that,

- (i) for any two mobile companies X and Y, if sales of X are more than Y, the expenditure of X will be more than that of Y and the other income of X will be less than that of Y.
  - (ii) for any two automobile companies X and Y, if the expenditure of X is less than that of Y, the liquidity ratio of X will be more than that of Y.
  - (iii) for any two pharmaceutical companies X and Y, if the other income of X is more than that of Y, the net profit of X is more than that of Y.

32. Which among the following cannot be a pharmaceutical company?

- (1) A                    (2) E                    (3) B  
 (4) J                    (5) None of these

33. If there are four companies in sector S, then S can be

- (1) Only Pharmaceuticals
- (2) Only Automobiles
- (3) Only Pharmaceuticals or Mobiles
- (4) Only Construction
- (5) Only Pharmaceuticals, Mobiles and Construction

34. If all the four sectors have the same number of companies, then which of the following is true?

- B is a pharmaceutical company.
- F is a mobile company.
- I is a construction company.
- B is a construction company.
- None of these

**DIRECTIONS** for questions 35 and 36: Answer the questions on the basis of the information given below.

Each of the eight students Akash, Balu, Chakri, Diren, Ehsaan, Fatima, Giri and Hari, is of a different height. All of them are standing in a row in the increasing order of their heights such that the shortest person is at the extreme left. Three of them are from 1<sup>st</sup> standard, three from 2<sup>nd</sup> standard and two from 3<sup>rd</sup> standard.

- (iv) for any two construction companies X and Y, if the liquidity ratio of X is less than that of Y, the net profit of X is more than that of Y.

Further,

partner,  
for every pharmacist  
than Rs.5000 crore.

for every  
than 1.6

for every construction co  
more than Rs.1000 crore.

for every automobile company, the net profit is more than Rs.700 crore

31. Which among the following must be a construction company?

- (1) I                    (2) D                    (3) J  
(4) C                    (5) None of these

- (i) Akash, the second tallest, is not from 1<sup>st</sup> standard and Balu, who is the fourth tallest is from 2<sup>nd</sup> standard.
  - (ii) Ehsaan is from 2<sup>nd</sup> standard but Chakri is not from 3<sup>rd</sup> standard.
  - (iii) Hari is taller than Giri but shorter than Balu, while Diren is shorter than Akash.
  - (iv) Chakri is shorter than Giri but taller than Fatima.
  - (v) Neither the shortest nor the second shortest is from 1<sup>st</sup> standard.

35. Which two students from the same standard are adjacent to each other?

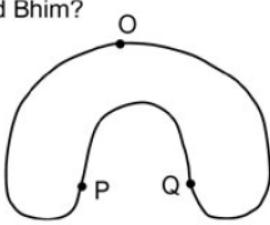
- (1) Hari and Balu      (2) Balu and Giri  
 (3) Giri and Hari      (4) Chakri and Balu  
 (5) None of these

36. Which of the following statements is definitely true?

- Which of the following statements is definitely true?

  - (1) Each 2<sup>nd</sup> standard student is next to at least one 3<sup>rd</sup> standard student.
  - (2) Each 3<sup>rd</sup> standard student is next to at least one 2<sup>nd</sup> standard student.
  - (3) No two students of the same standard are adjacent to each other.
  - (4) All the above
  - (5) None of the above

**DIRECTIONS** for questions 1 to 13: Answer the questions independently of each other.

1. Ramu and Somu are competing in a 100 m race. Initially, Ramu runs at twice Somu's speed for the first fifty metres. After the 50 m mark, Ramu runs at  $\frac{1}{4}$ th his initial speed while Somu continues to run at his original speed. If Somu catches up with Ramu at a distance of 'x' metres from the finish line, then find x.  
 (1) 37.5      (2) 25  
 (3) 75      (4) 42.5  
 (5) Somu will never catch up with Ramu
  2. When the curves  $y = 10^x$  and  $xy = 1$  are drawn in the X-Y plane, how many times do they intersect for values of  $y \geq 2$ ?  
 (1) Never      (2) Once      (3) Twice  
 (4) Thrice      (5) More than thrice
  3. Anoop found the product, P, of two two-digit natural numbers, M and N. He then reversed the digits of each of M and N and found the product of the resultant numbers. Interestingly, he found both products to be the same. If the product of the tens digit of M and the tens digit of N is prime, find the sum of all the possible values of P that Anoop could have obtained.  
 (1) 2604      (2) 2712      (3) 2627  
 (4) 4684      (5) 4664
  4. Three circles of equal radii have been drawn inside an equilateral triangle, of side  $a$ , such that each circle touches the other two circles as well as two sides of the triangle. Then, the radius of each circle is  
 (1)  $\frac{a}{2(\sqrt{3}+1)}$       (2)  $\frac{a}{2(\sqrt{3}-1)}$       (3)  $\frac{a}{\sqrt{3}+1}$   
 (4)  $\frac{a}{\sqrt{3}-1}$       (5)  $\frac{a}{4(\sqrt{3}-1)}$
  5. Thirty-six equally spaced points –  $P_1$  through  $P_{36}$  – are plotted on a circle, and some of these points are joined successively to form a regular polygon. How many distinct such regular polygons are possible?  
 (1) 7      (2) 23      (3) 37  
 (4) 27      (5) None of these
  6. If  $l + m + n \neq 0$ , which of the following conditions must  $l$ ,  $m$  and  $n$  satisfy so that the system of simultaneous linear equations  $x + 3y - 4z = l$ ,  $2x - y - z = m$ ,  $x + y - 2z = n$  has at least one solution?  
 (1)  $3l - 2m + 7n = 0$       (2)  $3l - 2m - 7n = 0$   
 (3)  $3l + 2m - 7n = 0$       (4)  $2l + 3m + 7n = 0$   
 (5)  $2l + 3m - 7n = 0$
  7. There are  $n$  terms in an arithmetic progression. The  $n$  terms of the arithmetic progression are now distributed into eight sub-series –  $S_1$ ,  $S_2$  .....and  $S_8$  – as follows. The 1<sup>st</sup>, 9<sup>th</sup>, 17<sup>th</sup> terms and so on go into  $S_1$ ; the 2<sup>nd</sup>, 10<sup>th</sup>, 18<sup>th</sup> terms and so on go into  $S_2$ ; the 3<sup>rd</sup>, 11<sup>th</sup>, 19<sup>th</sup> terms and so on go into  $S_3$ , and so on for  $S_4$  till  $S_8$ . If for exactly three of the eight sub-series, the average of the sub-series is a term of the same sub-series, which of the following could be a possible value of  $n$ ?  
 (1) 37      (2) 53      (3) 49  
 (4) 50      (5) 51
  8. What is the minimum value of the expression  $2x^2 + 3y^2 - 4x - 12y + 18$ ?  
 (1) 18      (2) 10      (3) 4  
 (4) 0      (5) -10
  9. One day the king summoned all the soldiers in his army and made them stand in a queue. To the first soldier, he gave three gold coins and to every subsequent soldier, he gave four gold coins more than what he gave to the previous soldier. Then the king ordered each soldier to distribute all the coins that he received among the peasants, if and only if it is possible to distribute the coins such that each peasant to whom the soldier distributes gets as many coins as the number of peasants to whom the soldier distributes the coins. If no two soldiers were allowed to distribute coins to the same peasant and there were a total of 4000 soldiers in the king's army, how many peasants received at least one gold coin?  
 (1) 386      (2) 284      (3) 576  
 (4) 4000      (5) None of these
  10. Two cyclists, Arjun and Bhim, started towards O from P and Q respectively, along the path shown below, in opposite directions. They met for the first time at 9:00 a.m. at O. At this moment they reversed their directions but maintained their respective initial speeds and met for the second time at 10:30 a.m., following which Arjun reached O for the second time 75 minutes after Bhim reached O for the second time. What is the ratio of the speeds of Arjun and Bhim?
- 
- (1) 1 : 2      (2) 2 : 3      (3) 3 : 4  
 (4) 1 : 3      (5) Cannot be determined

## SECTION – I

### Solutions for questions 1 to 13:

1. Let them meet at 'x' m from the start, after, say time 't'.  
 Let their speeds be  $r$  and  $s$

$r = 2s$  (initially)

Later  $r = s/2$

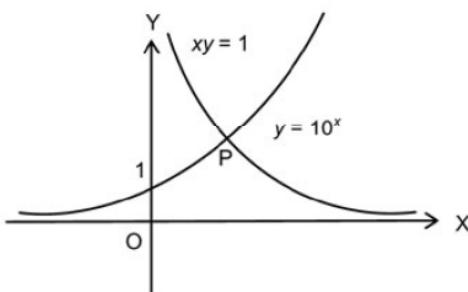
$$\frac{x-50}{s/2} + \frac{50}{2s} = \frac{x}{s} \Rightarrow x = 75 \text{ m}$$

∴ If it is a 100 m race, then Somu will catch Ramu at  $100 - 75 = 25$  m from the finishing line. Choice (2)

2. The graphs of  $y = 10^x$  and  $xy = 1$  are shown below and  $y = 10^x$  intersects  $y$ -axis at  $y = 1$ . Also if  $P(x, y)$  is the point of intersection of the curves then  $y = 10^{1/y}$  (substituting value of  $x$  from  $xy = 1$ ).

$$\Rightarrow y^y = 10$$

Given that  $y \geq 2$ , we need to see if the solution for  $y^y = 10$  gives us a root for  $y$  which is greater than or equal to 2.  
 Now by simple observation since  $2^2 < 10 < 3^3$ ,  $2 < y < 3$



Hence, we see that the curves intersect at only one point where  $y \geq 2$ .  
 Choice (2)

**Note :** Though the graph of  $xy = 1$  lies in both the first and the third quadrants, only the first quadrant is relevant, since  $y \geq 2$ .

3. Let the two digit numbers be  $10a + b$  and  $10c + d$

$$\therefore p = (10a + b)(10c + d) = (10b + a)(10d + c)$$

$$100ac + 10ad + 10bc + bd = 100bd + 10bc + 10ad + 10ac$$

$$99ac = 99bd$$

$$ac = bd$$

It is known that  $ac$  is prime. Whenever the product of two whole numbers is prime, one of them must be 1 and the other must be the prime number.

As product of  $a$  and  $c$  is prime, one of them must be one. The other digit must be prime.

∴ The other digit could be 2 or 3 or 5 or 7.

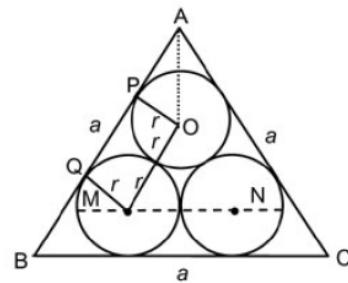
∴  $ac = bd = 2$  or 3 or 5 or 7.

$bd$  must also have one digit as prime and the other digit as 2 or 3 or 5 or 7.

The possible products of  $(ab)$  and  $(cd)$  are (11) (22), (12) (21), (11) (33), (13) (31), (11) (55), (15) (51), (11) (77) and (17) (71) i.e., 242, 252, 363, 403, 605, 765, 847 and 1207. Therefore the sum of all possible products = 4684.

Choice (4)

4.



Consider  $MN = 4r < BC \Rightarrow r < \frac{a}{4}$ . Hence, we need to look

for the choice where the denominator is greater than 4. Only choice (1) is possible.

#### Alternative solution:

Let the radius of the circle be  $r$ .

In the figure given above,  $PQ = 2r$

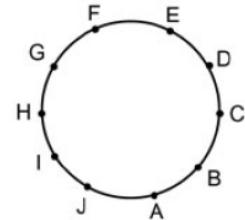
$$\text{In } \triangle APO, \tan \angle PAO = \tan 30^\circ = \frac{r}{AP} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow AP = \sqrt{3}r$$

$$\text{Similarly, } BQ = \sqrt{3}r$$

$$\therefore a = \sqrt{3}r + 2r + \sqrt{3}r \Rightarrow r = \frac{a}{2(\sqrt{3} + 1)} \quad \text{Choice (1)}$$

5. For the sake of understanding, first consider only 10 points. Let A, B, C, D, E, F, G, H, I and J be the given points.



The regular polygons that can be formed by using the given points are:

The decagon ABCDEFGHIJ and the two pentagons ACEGI, BDFHG.

i.e., 3 regular polygons can be drawn.

i.e., polygon of 10 sides = 1 polygon. ( $= 10 \div 10$ )

Polygon of 5 sides = 2 polygons. ( $= 10 \div 5$ )

Now for 36 points, the number of polygons of various number of sides will be

No. of sides	No. of distinct regular polygons
3	12 = $(36 \div 3)$
4	9
6	6
9	4
12	3
18	2
36	1

Hence a total of  $12 + 9 + 6 + 4 + 3 + 2 + 1 = 37$ .

Choice (3)

6. Observing the pattern of choices, we first consider and evaluate  $3l$ ,  $2m$  and  $7n$ .

$$3l = 3a + 9b - 12c \rightarrow (1)$$

$$2m = 4a - 2b - 2c \rightarrow (2)$$

$$7n = 7a + 7b - 14c \rightarrow (3)$$

From (1), (2) and (3), by observing the coefficient of  $a$ , we can say that

$$(1) + (2) - (3) = 0$$

$$\therefore 3l + 2m - 7n = 0$$

Choice (3)

7. The  $n$  terms are distributed into 8 sub-series. If a sub-series has an odd number of terms, the average of the sub-series would be a term of the same sub-series. If it has an even number of terms, the average would not be a term of the sub-series. As the average lies in the same sub-series for 3 of the 8 sub-series the number of terms, i.e.,  $n$  has to be of the form 'An even multiple of  $8 \pm 3$ ' i.e.,  $16k \pm 3$  where  $k$  is a natural number.

Among the given choices, only 51 is a possible value.

Choice (5)

8. Let  $2x^2 + 3y^2 - 4x - 12y + 18$  be denoted by E.

$$E = 2(x^2 - 2x) + 3(y^2 - 4y) + 18$$

$$= 2(x-1)^2 + 3(y-2)^2 + (18 - 2 - 12) = 2(x-1)^2 + 3(y-2)^2 + 4$$

Since the minimum value of  $(x-1)^2$  and  $(y-2)^2$  is independently 0 each, the minimum value of E is  $0 + 0 + 4 = 4$ .

Choice (3)

9. If a soldier has to distribute a certain number of coins among say ' $n$ ' peasants such that each peasant gets  $n$  coins, the number of coins with him or her has to be a perfect square. Perfect squares leave a remainder of 0 or 1 when divided by 4. However, all the numbers in given sequence (i.e., of the form  $3 + 4k$ ) leave a remainder of 3. Thus, there were no soldiers who could distribute their coins. Hence zero peasants received at least one gold coin.

Choice (5)

10. Though we do not know the distance PQ along the track, we can observe that the time interval that is relevant is from 9:00 a.m. to 10:30 a.m., within which Arjun and Bhim covered the entire track-length once, travelling in opposite directions. Also, later, Arjun took 75 minutes more than Bhim to complete one full track-length (and return to O).

Let the length of the track be L meters and the speeds of Arjun and Bhim be  $p$  and  $q$  m/s respectively.

Together, the two cover the entire track in 90 minutes

$$\text{i.e. } L = 90(p+q) \text{ ----- (1)}$$

Arjun takes 75 minutes more than Bhim to cover the entire track

$$\text{i.e. } \frac{L}{p} = \frac{L}{q} + 75 \text{ ----- (2)}$$

Since  $L = 90(p+q)$

$$\frac{90(p+q)}{p} = \frac{90(p+q)}{q} + 75$$

$$\Rightarrow \frac{q}{p} - \frac{p}{q} = \frac{5}{6} \text{ ----- (3)}$$

Checking for  $p : q$  from choices,  $p : q = 2 : 3$  satisfies.

Choice (2)

### Solutions for questions 31 to 34:

It is given that

For each Pharmaceutical company, sales is more than Rs.5000 crore.

$\therefore$  The possible pharmaceutical companies are [A, B, C, E, I, J]

Similarly by taking the condition given for other sectors

The possible Mobile companies are [B, C, E, F, K]

The possible Automobile companies are [D, E, F, G, H]

The possible constructions companies are [C, D, H, I, J, L]

From the above details,

A cannot belong to any other sector  $\Rightarrow$  A is a pharmaceutical company

Similarly,

K  $\rightarrow$  Mobile company

G  $\rightarrow$  Automobile company

L  $\rightarrow$  Construction company

Now by taking the condition given for the pharmaceutical sector, and comparing with A except C all others satisfied.

Pharma: [A, B, E, I, J]

Similarly, by observing the condition for mobiles, and comparing with K, except C all other companies satisfied

Mobiles: [B, E, F, K]

By observing the condition for Automobiles, and comparing with G, except for E all others satisfied.

Automobiles: [D, F, G, H]

By observing the condition for construction, and comparing with company L, except D and J all others satisfied.

Construction: [C, H, I, L]

Now from the above results, C must be a construction Company, D must be an automobile company, J must be a pharmaceutical company.

Now by comparing D and H, H cannot be an automobile company, which means H must be a construction company. Similarly, by comparing J and E, E cannot be a pharma company.

Hence, E must be a mobile company. Also, comparing H and I, I cannot be a construction company. Therefore I is a pharma company. Hence the final distribution is:

Mobiles	:	<span style="border: 1px solid black; padding: 2px;">K, E</span>
Construction	:	<span style="border: 1px solid black; padding: 2px;">C, L, H</span>
Automobile	:	<span style="border: 1px solid black; padding: 2px;">G, D</span>
Pharma	:	<span style="border: 1px solid black; padding: 2px;">A, I, J</span>

and B is either Mobiles or Pharma. F is either Mobiles or Automobile.

31. C must be a construction company. Choice (4)
32. E cannot be a pharmaceutical company. Choice (2)
33. Only Mobiles or Pharma could possibly have four companies. Choice (3)
34. The companies and the sectors are  
 A, J, I – Pharma  
 K, B, E – Mobiles  
 L, C, H – Construction  
 G, D, F – Automobiles  
 None of the statements is true. Choice (5)

#### Solutions for questions 35 and 36:

Let the order of the persons based on their heights is as follows.

1 2 3      4 5 6 7 8

Here, 1 represents the shortest and 8 represents the tallest.

From (i), we get

1 2 3      4 <sup>B</sup> 5 6 <sup>A</sup> 7 8

From (iii), H is taller than G but shorter than B. Also from (iv), C is shorter than G but taller than F. Hence, we get

E    C    G      H    B    D    A    E  
1    2    3      4    5    6    7    8

Also, D is shorter than A. Hence, E must be the tallest.

The final order must be as follows.

⇒ E    C    G      H    B    D    A    E  
1    2    3      4    5    6    7    8

Given, B and E are from 2<sup>nd</sup> standard. Also C is not from 3<sup>rd</sup> standard and neither the shortest nor the 2<sup>nd</sup> shortest (i.e., F and C) is from 1<sup>st</sup> standard.

⇒ C is also from 2<sup>nd</sup> standard. As three are from 1<sup>st</sup> standard and two are from 3<sup>rd</sup> standard F and A are from 3<sup>rd</sup> standard (as they are not from 1<sup>st</sup> standard) and D, G and H are from 1<sup>st</sup> standard.

35. Only G and H are adjacent as well as from the same standard i.e. 1<sup>st</sup> standard. Choice (3)
36. B, a 2<sup>nd</sup> standard student is not adjacent to a 3<sup>rd</sup> standard student.  
 ∴ (1) is false.  
 Both A and F (i.e., 3<sup>rd</sup> standard students) are adjacent to 2<sup>nd</sup> standard students.  
 ∴ (2) is true  
 G and H are from the same standard and are adjacent to each other.  
 ∴ (3) is false. Choice (2)

Directions for Questions 13 to 16: Answer the questions on the basis of the information given below.

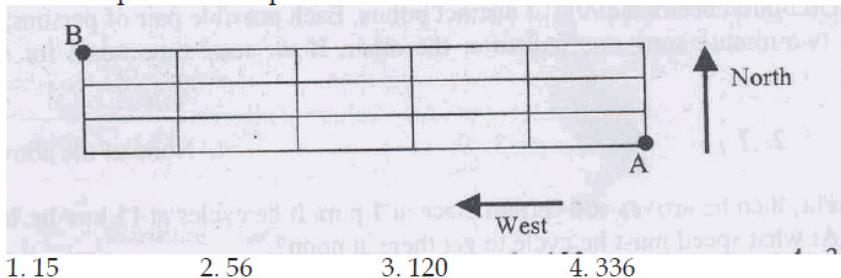
Prof. Singh has been tracking the number of visitors to his homepage. His service provider has provided him with the following data on the country of origin of the visitors and the university they belong to:

Number of visitors			
DAY			
COUNTRY	1	2	3
Canada	2	0	
Netherlands	1	1	
India	1	2	
UK	2	0	
USA	1	0	

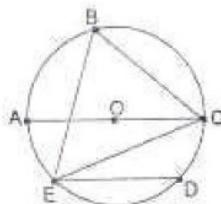
Number of visitors			
DAY			
UNIVERSITY	1	2	3
University 1	1	0	0
University 1	2	0	0
University 1	0	1	0
University 1	0	0	2
University 1	1	0	0
University 1	1	0	1
University 1	2	0	0
University 1	0	2	0

13. To which country Does University 5 belong?
  1. India or Netherlands but not USA
  2. India or USA but not Netherlands
  3. Netherlands or USA but not India
  4. India or USA but not UK
  
14. University 1 can belong to
  - 1.UK
  2. Canada
  3. Netherlands
  4. USA
  
15. Visitors from how many universities from UK visited Prof. Singh's homepage in the three days?
  - 1.1
  - 2.2
  - 3.3
  - 4.4
  
16. Which among the listed countries can possibly host three of the eight listed universities?
  - 1.None
  2. Only UK
  3. Only India
  4. Both India and UK

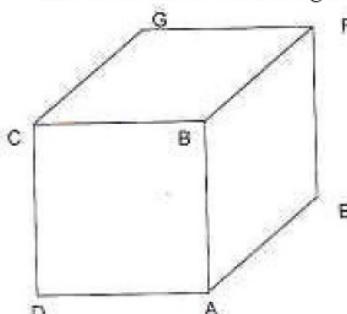
59. In the adjoining figure, the lines represent one-way roads allowing travel only northwards or only westwards. Along how many distinct routes can a car reach point B from point A?



60. In the adjoining figure, chord ED is parallel to the diameter AC of the circle. If  $\angle CBE = 65^\circ$ , then what is the value of  $\angle DEC$ ?



61. If the lengths of diagonals DF, AG and CE of the cube shown in the adjoining figure are equal to the three sides of a triangle, then the radius of the circle circumscribing that triangle will be



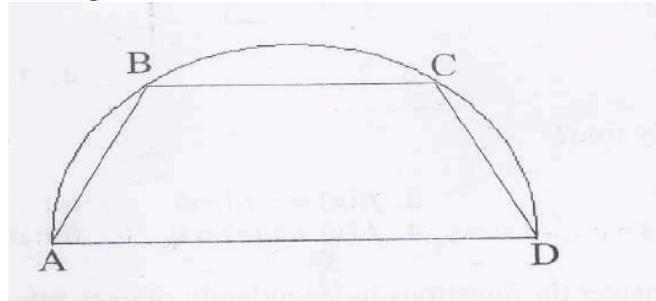
1. equal to the side of the cube
  2.  $\sqrt{3}$  times the side of the cube
  3.  $\frac{1}{\sqrt{3}}$  times the side of the cube
  4. impossible to find from the given information
62. A sprinter starts running on a circular path of radius  $r$  metres. Her average speed (in metres/minute) is  $\frac{r}{2}$  during the first 30 seconds,  $\frac{r}{4}$  during next one minute,  $\frac{r}{8}$  during next 2 minutes,  $\frac{r}{16}$  during next 4 minutes, and so on. What is the ratio of the time taken for the  $n$ th round to that for the previous round?

1. 4                  2. 8                  3. 16                  4. 32

63. Let  $C$  be a circle with centre  $P_0$  and  $AB$  be a diameter of  $C$ . Suppose  $P_1$  is the mid point of the line segment  $P_0B$ ,  $P_2$  is the mid point of the line segment  $P_1B$  and so on. Let  $C_1, C_2, C_3, \dots$  be circles with diameters  $P_0P_1, P_1P_2, P_2P_3, \dots$  respectively. Suppose the circles  $C_1, C_2, C_3$ , are all shaded. The ratio of the area of the unshaded portion of  $C$  to that of the original circle  $C$  is

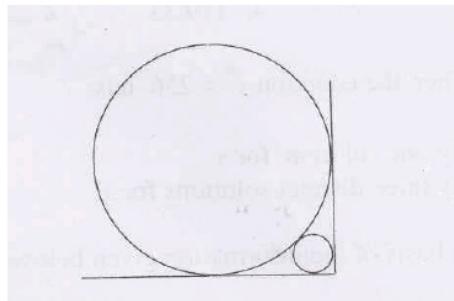
1. 8:9                  2. 9:10                  3. 10:11                  4. 11:12

64. On a semicircle with diameter AD, chord BC is parallel to the diameter. Further, each of the chords AB and CD has length 2, while AD has length 8. What is the length of BC?



1. 7.5      2. 7      3. 7.75      4. None of the above

65. A circle with radius 2 is placed against a right angle. Another smaller circle is also placed as shown in the adjoining figure. What is the radius of the smaller circle?



1.  $3-2\sqrt{2}$       2.  $4-2\sqrt{2}$       3.  $7-4\sqrt{2}$       4.  $6-4\sqrt{2}$

66. The remainder, when  $(15^{23} + 23^{23})$  is divided by 19, is  
1. 4      2. 15      3. 0      4. 18

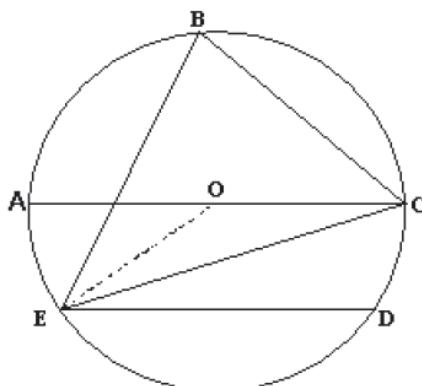
67. A new flag is to be designed with six vertical stripes using some or all of the colours yellow, green, blue and red. Then, the number of ways this can be done such that no two adjacent stripes have the same colour is  
1.  $12 \times 81$       2.  $16 \times 192$       3.  $20 \times 125$       4.  $24 \times 216$

**Questions 13 to 16:**

From the observation of the given table we come to know that  
University Country

University	Country
4	UK
6	USA
8	India
7	CA/UK
5	NL/India
3	NL
2	UK/CA
1	NL

13. Answer option (1)  
 14. Answer option (3)  
 15. Answer option (2)  
 16. Answer option (1)  
 59. Total no of ways is equal to  $(m+n-2)!/(m-1)!(n-1)!$  Where  $m=4$  &  $n=6$  thus number of ways = 56. Hence answer option is (2).  
 60.

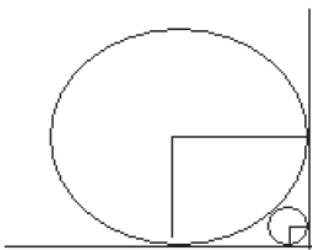


Angle EBD is  $65^\circ$  so the angle EOC will be  $130^\circ$  now angle OCE and OEC will be same (angle opposite the equal sides) so  $OCE+OEC+130^\circ=180^\circ$  hence OCE will be  $25^\circ$  since AC and ED are parallel hence angle CED will be equal to angle OCE hence angle DEC will be equal to  $25^\circ$ . hence answer option is (4).

61. If the side of a triangle is  $a$  then length of the triangle will be  $a\sqrt{3}$ . So sides of that triangle will be  $a\sqrt{3}$ . So circum radius of the this triangle will be  $a\sqrt{3}\sqrt{3}/(4\sqrt{3}/4)a^2$ . When you solve this equal to  $a$ . hence answer option is (1).  
 62. Radius is  $r$  meters so he will cover one circumference in  $30+60+120+240=450$  seconds in first round and in second round he will take  $480+960+1920+3840=7200$  seconds. So the required ratio is  $7200/450=16$ . Hence answer option is (3).  
 63. Let the diameter AB is  $2r$ , so  $P_0B$  will be  $r$ ,  $P_1B$  will be  $r/2$  and  $P_2B$  will be  $r/4$  and so on. Diameter of  $C_1$  will be  $r/2$  diameter of  $C_2$  will be  $r/4$  and so on. So total shaded region will be  $? \cdot (r/4)^2 + ? \cdot (r/8)^2 + \dots$  (this will be a infinite series). Hence total Shaded area =  $? \cdot (r/4)^2 / (1 - 1/4) = 4(? \cdot (r/4)^2) / 3 = ? \cdot r^2 / 12$ . Area of Original circle will be  $? \cdot r^2$ . Hence area of unshaded portion will be  $11? \cdot r^2 / 12$ . So the required ratio is  $11:12$ . Hence answer is (4).

64. Join B&C to the centre of circle O . AO = BO = CO = DO = 4 Area of the triangle ABO =  $\sqrt{5}(5-4)(5-4)(5-1) = \sqrt{15} = (1/2) * 4 * x$  thus  $x = \sqrt{15}/2$ .  $x$ = height of ? ABO= BL. Thus AL =  $\sqrt{[4 - (15/4)]} = \sqrt{1/4} = \frac{1}{2}$  and BC =  $8 - 2(AL) = 8 - 1 = 7$

65.



Let the radius of small circle is  $r$ . So the diagonal of small circle is  $\sqrt{2} r$ . Radius of the larger circle is 2(given). Hence the diagonal of the larger square is  $2\sqrt{2}$ . Hence  $2\sqrt{2} = 2 + r + \sqrt{2}r$ .

We get  $r = 6 - 4\sqrt{2}$ . Hence answer option is (4).

66. We can rewrite the numerator as  $(4)23 + 423$ . Hence we get remainder = 0. Hence answer option is (3).

67. The first strip can be coloured in 4 ways 2nd in 3, 3rd in 3and so on thus total no of ways =  $4 * 3 * 3 * 3 * 3 * 3 = 12 * 81$

**Directions for Questions 38 to 41:** Answer the following questions based on the information given below.

The Table below shows the comparative costs, in US Dollars, of major surgeries in USA and a select few Asian countries.

Procedure	Comparative Costs in USA and some Asian Countries (in US Dollars)				
	USA	India	Thailand	Singapore	Malaysia
Heart Bypass	130000	10000	11000	18500	9000
Heart Valve Replacement	160000	9000	10000	12500	9000
Angioplasty	57000	11000	13000	13000	11000
Hip Replacement	43000	9000	12000	12000	10000
Hysterectomy	20000	3000	4500	6000	3000
Knee Replacement	40000	8500	10000	13000	8000
Spinal Fusion	62000	5500	7000	9000	6000

The equivalent of one US Dollar in the local currencies is given below.

	1 US Dollar Equivalent	
India	40.928	Rupees
Malaysia	3.51	Ringits
Thailand	32.89	Bahts
Singapore	1.53	\$ Dollars

A consulting firm found that the quality of the health services were not the same in all the countries above. A poor quality of a surgery may have significant repercussions in future, resulting in more cost in correcting mistakes. The cost of poor quality of surgery is given in the table below.

Procedure	Comparative Costs in USA and some Asian Countries (in US Dollars)				
	USA	India	Thailand	Singapore	Malaysia
Heart Bypass	0	3	3	2	4
Heart Valve Replacement	0	5	4	5	5
Angioplasty	0	5	5	4	6
Hip Replacement	0	7	5	5	8
Hysterectomy	0	5	6	5	4
Knee Replacement	0	9	6	4	4
Spinal Fusion	0	5	6	5	6

38. The rupee value increases to Rs.35 for a US Dollar, and all other things including quality, remain the same. What is the approximate difference in cost, in US Dollars, between Singapore and India for a Spinal Fusion, taking this change into account?
- 700
  - 2500
  - 4500
  - 8000
  - No difference

39. Approximately, what difference in amount in Bahts will it make to a Thai citizen if she were to get a hysterectomy done in India instead of in her native country, taking into account the cost of poor quality? It costs 7500 Bahts for one-way travel between Thailand and India.
- 23500
  - 40500
  - 57500
  - 67500
  - 75000

40. A US citizen is hurt in an accident and requires an angioplasty, hip replacement and a knee replacement. Cost of foreign travel and stay is not a consideration since the government will take care of it. Which country will result in the cheapest package, taking cost of poor quality into account?

- (1) India
- (2) Thailand
- (3) Malaysia
- (4) Singapore
- (5) USA

41. Taking the cost of poor quality into account, which country/countries will be the most expensive for knee replacement?

- (1) India
- (2) Thailand
- (3) Malaysia
- (4) Singapore
- (5) India and Singapore

1. The price of Darjeeling tea (in rupees per kilogram) is  $100 + 0.10n$ , on the  $n^{\text{th}}$  day of 2007 ( $n = 1, 2, \dots, 100$ ), and then remains constant. On the other hand, the price of Ooty tea (in rupees per kilogram) is  $89 + 0.15n$ , on the  $n^{\text{th}}$  day of 2007 ( $n = 1, 2, \dots, 365$ ). On which date in 2007 will the prices of these two varieties of tea be equal?

- (1) May 21
- (2) April 11
- (3) May 20
- (4) April 10
- (5) June 30

2. A quadratic function  $f(x)$  attains a maximum of 3 at  $x = 1$ . The value of the function at  $x = 0$  is 1. What is the value of  $f(x)$  at  $x = 10$ ?

- (1) -119
- (2) -159
- (3) -110
- (4) -180
- (5) -105

3. Two circles with centres P and Q cut each other at two distinct points A and B. The circles have the same radii and neither P nor Q falls within the intersection of the circles. What is the smallest range that includes all possible values of the angle AQP in degrees?

- (1) Between 0 and 90
- (2) Between 0 and 30
- (3) Between 0 and 60
- (4) Between 0 and 75
- (5) Between 0 and 45

**Directions for Questions 4 and 5:**

Let  $S$  be the set of all pairs  $(i, j)$  where  $1 \leq i \leq j < n$  and  $n \geq 4$ . Any two distinct members of  $S$  are called “friends” if they have one constituent of the pairs in common and “enemies” otherwise. For example, if  $n = 4$ , then  $S = \{(1, 2), (1, 3), (1, 4), (2, 3), (2, 4), (3, 4)\}$ . Here,  $(1, 2)$  and  $(1, 3)$  are friends,  $(1, 2)$  and  $(2, 3)$  are also friends, but  $(1, 4)$  and  $(2, 3)$  are enemies.

4. For general  $n$ , how many enemies will each member of  $S$  have?

- (1)  $n - 3$
- (2)  $\frac{1}{2}(n^2 - 3n - 2)$
- (3)  $2n - 7$
- (4)  $\frac{1}{2}(n^2 - 5n + 6)$
- (5)  $\frac{1}{2}(n^2 - 7n + 14)$

5. For general  $n$ , consider any two members of  $S$  that are friends. How many other members of  $S$  will be common friends of both these members?

- (1)  $\frac{1}{2}(n^2 - 5n + 8)$
- (2)  $2n - 6$
- (3)  $\frac{1}{2}n(n - 3)$
- (4)  $n - 2$
- (5)  $\frac{1}{2}(n^2 - 7n + 16)$

**Directions for Questions 6 and 7:**

Shabnam is considering three alternatives to invest her surplus cash for a week. She wishes to guarantee maximum returns on her investment. She has three options, each of which can be utilized fully or partially in conjunction with others.

Option A: Invest in a public sector bank. It promises a return of +0.10%

Option B: Invest in mutual funds of ABC Ltd. A rise in the stock market will result in a return of +5%, while a fall will entail a return of -3%

Option C: Invest in mutual funds of CBA Ltd. A rise in the stock market will result in a return of -2.5%, while a fall will entail a return of +2%

6. The maximum guaranteed return to Shabnam is

- (1) 0.25%
- (2) 0.10%
- (3) 0.20%
- (4) 0.15%
- (5) 0.30%

7. What strategy will maximize the guaranteed return to Shabnam?

- (1) 100% in option A
- (2) 36% in option B and 64% in option C
- (3) 64% in option B and 36% in option C
- (4) 1/3 in each of the three options
- (5) 30% in option A, 32% in option B and 38% in option C

**38.** Cost of spinal fusion in India = Rs.  $5500 \times 40.928$

$$\text{Cost with the increased value of Rupee} = 5500 \times 40.928 / 35 = 6431 \text{ USD}$$

Cost of Spinal Fusion in Singapore = 9000 USD

$$\text{Required difference} = 9000 - 6431 = 2569 \text{ USD}$$

Hence, option 2.

**39.** Cost of Hysterectomy in Thailand =  $4500 + 6000 = 10500$  USD

$$\text{Cost of Hysterectomy in India} = 3000 + 5000 = 8000 \text{ USD}$$

$$\text{Travelling cost} = 15000 \text{ Bahts} = 15000 / 32.89 \text{ USD} = 456 \text{ USD}$$

$$\text{Required difference} = 10500 - 8456 = 2044 \text{ USD} = 2044 \times 32.89 = 67227 \text{ Bahts}$$

Hence, option 4.

**40.** As shown in the table, Malaysia will have the cheapest package.

Hence, option 3.

	India	Thailand	Singapore	Malaysia	USA
Angioplasty	16000	18000	17000	18000	57000
Hip Replacement	16000	17000	17000	18000	43000
Knee Replacement	17500	16000	17000	12000	40000
Total	49500	51000	51000	48000	140000

**41.** Referring to the table formulated in the first question, India will be the most expensive for knee replacement.

Hence, option 1.

1. Note that the price of Darjeeling tea remains constant after the 100<sup>th</sup> day ( $n=100$ ).

If the prices of the two varieties of tea become equal before  $n = 100$ , then

$$100 + 0.1n = 89 + 0.15n$$

$\therefore n = 220$ , which is not possible. (Since  $n$  has been assumed to be less than 100)

$\therefore$  The prices of the two varieties will be equal after  $n = 100$ ,

i.e., when the price of Darjeeling tea =  $100 + 0.1 \times 100 = 110$

$$\therefore 89 + 0.15n = 110$$

$$\therefore n = 140$$

2007 is not a leap year. Number of days till 30<sup>th</sup> April =  $31 + 28 + 31 + 30 = 120$

The prices of the two varieties will be equal on 20<sup>th</sup> May.

Hence, option 3.

2. Let  $f(x) = px^2 + qx + k$ , where  $p, q$  and  $k$  are integers,  $p, 0$

$$\therefore f(0) = k = 1$$

$$\therefore f(x) = px^2 + qx + 1$$

$$f(x) = px^2 + qx + k$$

$$f'(x) = 2px + q$$

When  $f'(x) = 0$ ,  $x = -q/2p = 1$

$f(x)$  attains maximum at  $x = 1$

$$\therefore q = -2p$$

$$f(1) = p + q + 1 = 3$$

$$\therefore 1 - p = 3$$

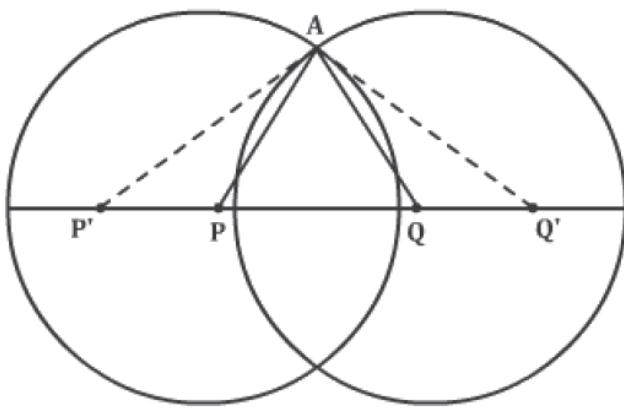
$$\therefore p = -2$$

$$\therefore q = 4$$

$$\therefore f(x) = -2x^2 + 4x + 1$$

$$\therefore f(10) = -200 + 40 + 1 = -159$$

Hence, option 2.



P and Q do not lie within the intersection of the two circles.

So they lie on the circumferences or outside the circumferences. If they lie on the circumferences,

$$\angle AQP = 60^\circ$$

From the diagram, if they lie outside the circumferences,  $\angle AQ'P' < 60^\circ$

Also,  $\angle AQP$  would be  $0^\circ$  if A, Q and P were collinear.

But as P and Q cut each other in two distinct points, A, Q and P cannot be collinear.

$$\therefore \angle AQP > 0^\circ$$

$$\therefore \angle AQP \text{ lies between } 0^\circ \text{ and } 60^\circ.$$

Hence, option 3.

4. Enemies of every pair are the pairs formed with all numbers other than the two in the member itself.  
 $\therefore$  If there are  $n$  elements then each member has

$${(n-2)C_2} = \frac{n^2 - 5n + 6}{2} \text{ enemies}$$

Hence, option 4.

5. Two members are friends if they have one element in common.

$\therefore$  All the members having one constituent as the common element are common friends.

There are  $(n - 3)$  such friends.

Also, one pair formed by the uncommon constituents of the two friends is a common friend.

$\therefore$  There are  $n - 3 + 1 = n - 2$  common friends.

Hence, option 4.

6. Let Shabnam have Rs. 100 to invest. Let Rs.  $x$ , Rs.  $y$  and Rs.  $z$  be invested in option A, B and C respectively.

$$\therefore x + y + z = 100 \dots (I)$$

If there is a rise in the stock market, returns =  $0.001x + 0.05y - 0.025z$

If there is a fall in the stock market, returns =  $0.001x - 0.03y + 0.02z$

Now,  $x$ ,  $y$  and  $z$  are such that regardless of whether the market rises or falls, they give the same return, which is the maximum guaranteed return.

$$\therefore 0.001x + 0.05y - 0.025z = 0.001x - 0.03y + 0.02z$$

$$\therefore y/z = 9/16$$

Now, consider different possible values of  $x$ ,  $y$  and  $z$ . The returns are as follows:

<b><math>x</math></b>	<b><math>y</math></b>	<b><math>z</math></b>	<b>Returns = <math>0.001x + 0.05y - 0.025z</math></b>
75	9	16	0.125
50	18	32	0.15
25	27	48	0.175
0	36	64	0.2

We see that as the values of  $y$  and  $z$  increase, the returns increase.

$\therefore$  The returns are maximum when  $x = 0\%$ ,  $y = 36\%$  and  $z = 64\%$   
The maximum returns are 0.2%.

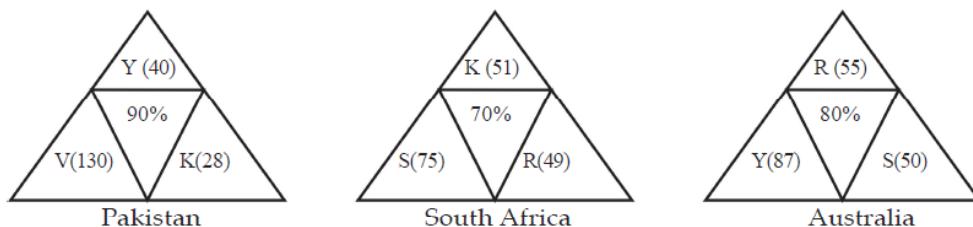
Hence, option 3.

7. As shown by the table formulated in the first question, maximum returns are guaranteed by investing 36% in option B and 64% in option C.

Hence, option 2.

**Directions for Questions 27 to 30:** Answer the questions on the basis of the information given below.

Coach John sat with the score cards of Indian players from the 3 games in a one-day cricket tournament where the same set of players played for India and all the major batsmen got out. John summarized the batting performance through three diagrams, one for each game. In each diagram, the three outer triangles communicate the number of runs scored by the three top scorers from India, where K, R, S, V, and Y represent Kaif, Rahul, Saurav, Virender, and Yuvraj respectively. The middle triangle in each diagram denotes the percentage of total score that was scored by the top three Indian scorers in that game. No two players score the same number of runs in the same game. John also calculated two batting indices for each player based on his scores in the tournament; the R-index of a batsman is the difference between his highest and lowest scores in the 3 games while the M-index is the middle number, if his scores are arranged in a non-increasing order.



27. How many players among those listed definitely scored less than Yuvraj in the tournament?  
1.0      2.1      3.2      4. More than 2
28. Which of the players had the best M-index from the tournament?  
1.Rahul      2.Saurav      3.Virender      4. Yuvraj
29. For how many Indian players is it possible to calculate the exact M-index?  
1.0      2.1      3. 2      4. More than 2
30. Among the players mentioned, who can have the lowest R-index from the tournament?  
1. Only Kaif, Rahul or Yuvraj  
2. Only Kaif or Rahul  
3. Only Kaif or Yuvraj  
4. Only Kaif

52. A milkman mixes 20 litres of water with 80 litres of milk. After selling one-fourth of this mixture, he adds water to replenish the quantity that he has sold. What is the current proportion of water to milk?  
 1. 2:3      2. 1:2      3. 1:3      4. 3:4
53. Let  $f(x) = ax^2 - b|x|$ , where  $a$  and  $b$  are constants. Then at  $x = 0$ ,  $f(x)$  is  
 1. maximized whenever  $a > 0, b > 0$       2. Maximized whenever  $a > 0, b < 0$   
 3. minimized whenever  $a > 0, b > 0$       4. minimized whenever  $a > 0, b < 0$
54. If  $f(x) = x^3 - 4x + p$ , and  $f(0)$  and  $f(1)$  are of opposite signs, then which of the following is necessarily true?  
 1.  $-1 < p < 2$       2.  $0 < p < 3$       3.  $-2 < p < 1$       4.  $-3 < p < 0$
55.  $N$  persons stand on the circumference of a circle at distinct points. Each possible pair of persons, not standing next to each other, sings a two-minute song one pair after the other. If the total time taken for singing is 28 minutes, what is  $N$ ?  
 1. 5      2. 7      3. 9      4. None of the above
56. If a man cycles at 10 km/hr, then he arrives at a certain place at 1 p.m. If he cycles at 15 km/hr, he will arrive at the same place at 11 a.m. At what speed must he cycle to get there at noon?  
 1. 11 km/hr      2. 12 km/hr      3. 13 Km/hr      4. 14 Km/hr
- 57.
- Let  $y = \frac{1}{2 + \frac{1}{3 + \frac{1}{2 + \frac{1}{3 + \dots}}}}$
- What is the value of  $y$ ?  
 1.  $\frac{\sqrt{13}+3}{2}$       2.  $\frac{\sqrt{13}-3}{2}$       3.  $\frac{\sqrt{15}+3}{2}$       4.  $\frac{\sqrt{15}-3}{2}$
58. A rectangular sheet of paper, when halved by folding it at the mid point of its longer side, results in a rectangle, whose longer and shorter sides are in the same proportion as the longer and shorter sides of the original rectangle. If the shorter side of the original rectangle is 2, what is the area of the smaller rectangle?  
 1.  $4\sqrt{2}$       2.  $2\sqrt{2}$       3.  $\sqrt{2}$       4. None of the above

Against Pakistan total was 220 so rest made only 22  
Against South Africa total was 250 so rest made only 75  
Against Australia total was 240 so rest made only 48  
Now based on this information

27. Number of players those have definitely scored less than Yuvraj are 2 i.e Saurav and Rahul. Hence Answer option is(3).
28. Clearly from the above information best M index is of Saurav. Answer option is(2).
29. It is possible to calculate the exact M index for Rahul and Saurav. Answer option is (3).
30. Lowest R index can be of Kaif or Rahul who have R index of 23 or more. Answer option is (2).
52. Out of total 100 liters of mixture there is 20 liters of water and 80 liters of milk. When he sells  $\frac{1}{4}$  part of mixture that is 25 liters now water will be 15 liter and 60 liters of milk in total 75 liters of mixture. When he adds 25 liters water in it now total water will be  $25+15=40$  liters and milk is 60 liters. So the required ratio is 40:60=2:3. Hence answer is 1.
53.  $f(x) = ax^2 - b|x|$ . Value of  $x^2$  and  $|x|$  is always greater than or equal to zero. the value of function depends only on a and b. The given function will be minimized when you put  $a>0$  and  $b<0$ . Hence answer option is (4).
54.  $f(x)=x^3-4x+p$  so  $f(0)=p$  and  $f(1)=p-3$  if  $f(0)$  and  $f(1)$  are of opposite sign then the range of p will be  $0 < p < 3$  and the other way round is not possible. Hence answer option is (2).
55. Total songs are 14. Two people can be selected in  $nC2$  ways but there will be n pairs which are adjacent .So answer will be  $=>nC2 - n =14$ , on solving we will get  $n=7$ . Hence answer option is 2.
56. In both the cases distance covered is constant hence speed will be inversely proportional to time. So the ratio of times taken in both the cases will be 3:2. On ratio scale difference is 1 while actual difference is 2. So C.F.M. is 2 so time taken in first case is 6 hours and in second case it is 4 hours hence total distance covered is  $10*6=60$  KM. he is taking 6 hours in first case and reaching there at 1 p.m. so must had started at 7 a.m. To reach there at noon time taken is 5 hours and distance is 60 km. so speed should be 12 kmph. Hence answer option is (2).
57. We can write the given expression as  $Y=1/(2+1/(3+Y))$   
when we solve this quadratic equation we get  $Y=(\sqrt{15}+3)/2$ . Hence answer option is (4).
58. Let the longer side of bigger rectangle is  $2x$  so the ratio of longer side and smaller side is  $2x:2$  and one side of smaller rectangle will be 2 while other side will be  $x$ , so for this rectangle ratio is  $2:x$ . according to problem  $2x/2=2/x$  this gives  $x=\sqrt{2}$ . So the area of smaller rectangle will be  $2\sqrt{2}$ . Hence answer is (2).

**Directions for Questions 5 to 8:** Answer the questions on the basis of the information given below.

The Dean's office recently scanned student results into the central computer system. When their character reading software cannot read something, it leaves that space blank. The scanner output reads as follows:

Name	Finance	Marketing	Statistics	Strategy	Operations	GPA
Aparna		B	F			1.4
Bikas	D	D	F	F		
Chandra		D	A	F	F	2.4
Deepak	A	B		D	D	3.2
Fazal	D	F	B		D	2.4
Gowri	C	C	A		B	3.8
Hari		B	A		D	2.8
Ismet			B		A	
Jagdeep	A	A	B		C	3.8
Kunal	F		A	F	F	1.8
Leena	B	A		B	F	3.2
Manab			A	B	B	
Nisha	A	D	B	A	F	3.6
Osman	C		B	B	A	4.6
Preeti	F	D		D		3.2
Rahul	A	C	A		F	4.2
Sameer		C	F	B		
Tara	B					2.4
Utkarsh			F	C	A	3.0
Vipul	A		C	C	F	2.4

In the grading system, A, B, C, D, and F grades fetch 6, 4, 3, 2, and 0 grade points respectively. The Grade Point Average (GPA) is the arithmetic mean of the grade points obtained in the five subjects. For example Nisha's GPA is  $(6 + 2 + 4 + 6 + 0) / 5 = 3.6$ .

Some additional facts are also known about the students' grades. These are

- a. Vipul obtained the same grade in Marketing as Aparna obtained in Finance and Strategy.
  - b. Fazal obtained the same grade in Strategy as Utkarsh did in Marketing.
  - c. Tara received the same grade in exactly three courses.
5. What grade did Preeti obtain in Statistics?  
 1.A            2.B            3.C            4.D
6. In Operations, Tara could have received the same grade as  
 1. Ismet            2. Hari            3. Jagdeep            4. Manab
7. What grade did Utkarsh obtain in Finance?  
 1.B            2. C            3. D            4.F
8. In Strategy, Gowri's grade point was higher than that obtained by  
 1.Fazal            2. Hari            3.Nisha            4.Rahul

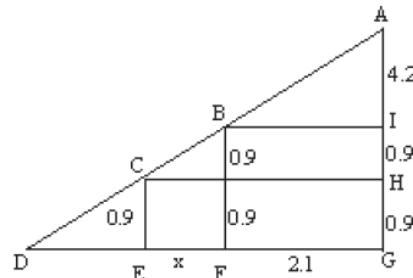
39. The total number of integer pairs  $(x, y)$  satisfying the equation  $x + y = xy$  is  
 1.0                  2.1                  3.2                  4. None of the above
40. Two boats, traveling at 5 and 10 kms per hour, head directly towards each other. They begin at a distance of 20 kms from each other. How far apart are they (in kms) one minute before they collide?  
 1.1/12              2.1/6              3.1/4              4.1/3
41. Each family in a locality has at most two adults, and no family has fewer than 3 children. Considering all the families together, there are more adults than boys, more boys than girls, and more girls than families. Then the minimum possible number of families in the locality is  
 1.4                  2.5                  3.2                  4.3
42. Suppose  $n$  is an integer such that the sum of the digits of  $n$  is 2, and  $10^{10} < n < 10^{11}$ . The number of different values for  $n$  is  
 1.11                  2. 10                  3.9                  4. 8
43. In NutsAndBolts factory, one machine produces only nuts at the rate of 100 nuts per minute and needs to be cleaned for 5 minutes after production of every 1000 nuts. Another machine produces only bolts at the rate of 75 bolts per minute and needs to be cleaned for 10 minutes after production of every 1500 bolts. If both the machines start production at the same time, what is the minimum duration required for producing 9000 pairs of nuts and bolts?  
 1. 130 minutes              2. 135 minutes  
 3.170 minutes              4. 180 minutes
44. On January 1, 2004 two new societies, S1 and S2, are formed, each with  $n$  members. On the first day of each subsequent month, S1 adds  $b$  members while S2 multiplies its current number of members by a constant factor  $r$ . Both the societies have the same number of members on July 2, 2004. If  $b = 10.5n$ , what is the value of  $r$ ?  
 1.2.0                  2.9                  3.1.8                  4.1.7
45. Karan and Arjun run a 100-metre race, where Karan beats Arjun by 10 metres. To do a favour to Arjun, Karan starts 10 metres behind the starting line in a second 100-metre race. They both run at their earlier speeds. Which of the following is true in connection with the second race?  
 1. Karan and Arjun reach the finishing line simultaneously.  
 2. Arjun beats Karan by 1 metre.  
 3. Arjun beats Karan by 11metres.  
 4. Karan beats Arjun by 1 metre.
46. A father and his son are waiting at a bus stop in the evening. There is a lamp post behind them. The lamp post, the father and his son stand on the same straight line. The father observes that the shadows of his head and his son's head are incident at the same point on the ground. If the heights of the lamp post, the father and his son are 6 metres, 1.8 metres and 0.9 metres respectively, and the father is standing 2.1 metres away from the post, then how far (in metres) is the son standing from his father?  
 1.0.9                  2.0.75                  3. 0.6                  4.0.45
47. If the sum of the first 11 terms of an arithmetic progression equals that of the first 19 terms, then what is the sum of the first 30 terms?  
 1.0                  2. -1                  3. 1                  4.Not Unique

48. if  $\frac{a}{b+c} = \frac{b}{b+c} = \frac{c}{b+c} = r$  then  $r$  cannot take any value except  
 1. 1/2                  2. -1                  3.1/2 or -1              4.-1/2 or -1

**Que 5-8**

5. Grade points of Preeti are  $0 + 2*2 + x + y = 3.2 * 5 = 16$   
So  $x = y = 6$ . Answer option is(1).
6. For Tara grade points are  $4 + 3x + y = 2.4 * 5$  (Using c statement)  
 $3x + y = 12 - 4$   
 $3x + y = 8$ .  
Possible values of  $x$  &  $y$  are  $x = 0, 1, 2$  and corresponding values of  $y = 8, 5, 2$   
Out of these only possible value is  $x = 2$  and  $y = 2$ . Answer option is(2).
7. In marketing Utkarsh grade is B (Using statement b & previous calculation)  
Now,  
For Utkarsh  $x + 4 + 0 + 3 + 6 = 3*5$   
 $x + 13 = 15$ , or  $x = 2 = D$ . Answer option is(3)
8. For Gowri  
 $3 + 3 + 6 + x + 4 = 3.8 * 5$   
 $x + 16 = 19$   
 $x = 3 = C = \text{Grade in strategy}$   
For Fazal  
 $2 + 0 + 4 + x + 2 = 2.4 * 5 = 12$   
 $x = 4 = B$   
For Hari we don't know  
For Nisha grade for strategy is  $A = 6$   
For Rahul  
 $6 + 3 + 6 + x + 0 = 4.2 * 5$   
 $x = 6 = A$   
So the only answer option left is Hari. Answer option is(2).
39. Given equation is  $x+y=xy$ , so only two pairs satisfies this and those are  $(0,0)$  and  $(2,2)$ . Hence answer option is (3).
40. Their relative speed is 15 km/h they are 20 km apart hence in 80 min they will collide. Now in 79 min distance covered by first boat is  $79/12$  km and distance traveled by second boat is  $79/6$  km so they are  $\frac{1}{4}$  km apart. Hence answer option is (3).
41. adult>boys>girls>families
- |   |   |   |  |
|---|---|---|--|
| A | B | G | F                                      |
| 4 | 3 | 2 | 1 - 4 Adults per family-not applicable |
| 5 | 4 | 3 | 2 - adult\family>2                     |
| 6 | 5 | 4 | 3 - possible condition                 |
- So the answer option is (4).
42. Here  $n$  is going to be an eleven digit number.  
(i) if first digit is 1 then another 1 can be fixed at 10 places. So there are 10 ways.  
(ii) if first digit is 2, there is only one number, so 1 way.  
Total number of ways=11. Hence answer is 1.
43. 1st m/c produces 1000 nuts in 15m or say 2000 nuts in 30 m.  
2nd m/c produces 1500 bolts in 30m.  
Total 1500 pairs in 30 m so 9000 pairs in  $180-10=170$ m (we have to subtract last 10m of rest. Hence answer option is 3.
44. It is given that  $b=10.5n$  so total members s1 on July 2, 2004 =  $n+63n$  (for 6 months) =  $64n$ . Similarly S2 will be  $n^r r^6$ . So  $64n = n^r r^6$ . Hence  $r = 2$ . So answer option is (1).

45. Time in which Karan travels 100 m Arjun travels only 90 m. Hence the ratio of their speeds is 10:9.  
 Time in which Karan covers 110m, Arjun will cover 99m. Hence Arjun is beaten by 1 meter. Hence answer is 4.
46. The shadow of head of father and son coincide so diagram will be like this:



If their heads coincide at point D then angle ACH and angle ABI will be the same.

In triangle ABI and triangle TCH

$$4.2/2.1 = 5.1/(2.1+x)$$

When we solve this equation we get  $x=0.9$ . hence answer option is 1.

47. Sum of the first 11 terms of an A.P. for which first term is  $a$  and common difference is  $d$  will be  $11/2(2a+10d)$  and for 19 terms it will be  $19/2(2a+18d)$ . According to problem  $11/2(2a+10d)=19/2(2a+18d)$   
 $22a+110d=38a+342d$   
 $16a=-232d \Rightarrow 2a=-29d$   
 Now we have to find out sum of first 30 terms that will be  
 $15(2a+29d)=30a+435d \Rightarrow 15*(-29)d+435d \Rightarrow 0$ . Hence answer option is 1.
48. The given condition will be satisfied only when all of  $a, b$ , and  $c$  are equal and then put any value you will get  $r=1/2$ . when  $a+b+c=0$ , we get the value of  $r = -1$ . Hence answer is option (3).