3

Set Theory, Venn Diagrams and Network Diagrams

Logical diagrams based situations have their own importance in the context of preparing for any aptitude examination. There are three major types of questions based on diagrams —

(i) Numerical questions on set theory based on venn diagrams

(ii) Logical questions based on set theory

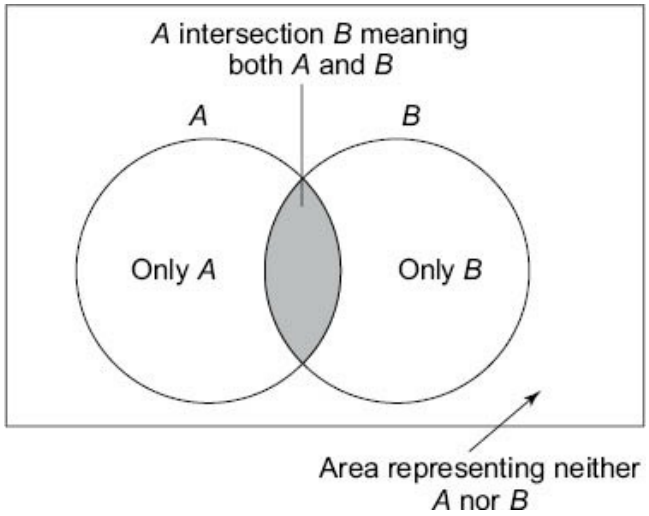
(iii) Questions based on network diagrams.

Let us first take a look at some standard theoretical inputs related to set theory.

SET THEORY

Look at the following diagrams:

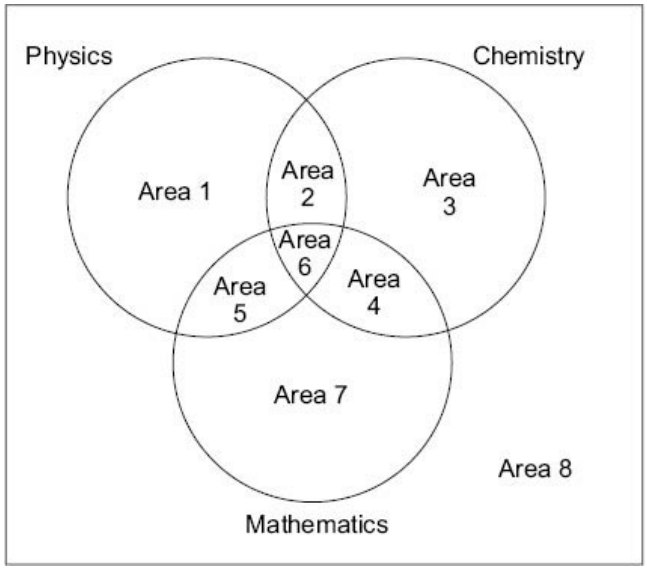
Figure 1: Refers to the situation where there are two attributes A and B. (Let's say A refers to people who passed in Physics and B refers to people who passed in Chemistry.) Then the shaded area shows the people who passed both Physics and Chemistry.



In mathematical terms, the situation is represented as:

Total number of people who passed at least 1 subject = A + B – A « B

Figure 2: Refers to the situation where there are three attributes being measured. In the figure below, we are talking about people who passed Physics, Chemistry and/or Mathematics.



In the above figure, the following explain the respective areas:

Area 1: People who passed in Physics only

Area 2: People who passed in Physics and Chemistry only (in other words—people who passed Physics and Chemistry but not Mathematics)

Area 3: People who passed Chemistry only

Area 4: People who passed Chemistry and Mathematics only (also, can be described as people who passed Chemistry and Mathematics but not Physics)

Area 5: People who passed Physics and Mathematics only (also, can be described as people who passed Physics and Mathematics but not Chemistry)

Area 6: People who passed Physics, Chemistry and Mathematics

Area 7: People who passed Mathematics only

Area 8: People who passed in no subjects

Also take note of the following language which there is normally confusion about:

People passing Physics and Chemistry—Represented by the sum of areas 2 and 6

People passing Physics and Maths—Represented by the sum of areas 5 and 6

People passing Chemistry and Maths—Represented by the sum of areas 4 and 6

People passing Physics—Represented by the sum of the areas 1, 2, 5 and 6

In mathematical terms, this means:

Total number of people who passed at least 1 subject =

P + C + M – P « C – P « M – C « M + P « C « M

Let us consider the following questions and see how these figures work in terms of real time problem solving:

ILLUSTRATION 1

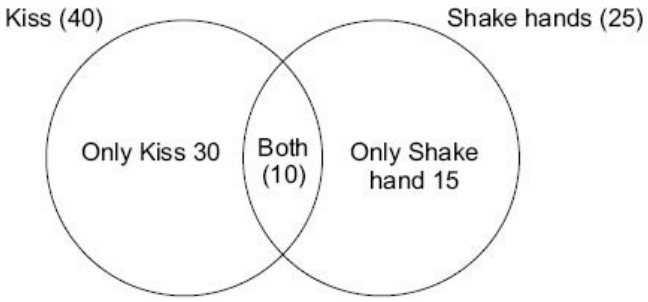
At the birthday party of Sherry, a baby boy, 40 persons chose to kiss him and 25 chose to

shake hands with him. 10 persons chose to both kiss him and shake hands with him. How many persons turned out at the party?

(a) 35 (b) 75

(c) 55 (d) 25

Sol.



From the figure, it is clear that the number of people at the party were 30 + 10 +15 = 55.

We can of course solve this mathematically as below:

Let n(A) = No. of persons who kissed Sherry = 40

n(B) = No. of persons who shake hands with Sherry = 25 and n(A« B) = No. of persons who shook hands with Sherry and kissed him both = 10

Then using the formula, n(A » B) = n(A) + n(B) – n(A « B)

n(A » B) = 40 + 25 – 10 = 55

ILLUSTRATION 2

Directions for Questions 1 to 4: Refer to the data below and answer the questions that follow:

In an examination 43% passed in Math, 52% passed in Physics and 52% passed in Chemistry. Only 8% students passed in all the three. 14% passed in Math and Physics and 21% passed in Math and Chemistry and 20% passed in Physics and Chemistry. Number of students who took the exam is 200.

Let Set P, Set C and Set M denotes the students who passed in Physics, Chemistry and Mat respectively. Then

1. How many students passed in Math only?

   (a) 16 (b) 32

   (c) 48 (d) 80

2. Find the ratio of students passing in Math only to the students passing in Chemistry only?

   (a) 16:37 (b) 29:32

   (c) 16:19 (d) 31:49

3. What is the ratio of the number of students passing in Physics only to the students passing in either Physics or Chemistry or both?

   (a) 34/46 (b) 26/84

   (c) 49/32 (d) None of these

4. A student is declared pass in the exam only if he/she clears at least two subjects. The number of students who were declared passed in this exam is?

(a) 33 (b) 66

(c) 39 (d) 78

Sol. Let P denote Physics, C denote Chemistry and M denote Maths.

% of students who passed in P and C only is given by

% of students who passed in P and C – % of students who passed all three = 20% – 8% = 12%

% of students who passed in P and M only is given by

% of students who passed in P and M – % of students who passed all three = 14% – 8% = 6%

% of students who passed in M and C only is:

% of students who passed in C and M – % of students who passed all three = 21% – 8% = 13%

So, % of students who passed in P only is given by:

Total no. passing in P – No. Passing in P & C only – No. Passing P & M only – No. Passing in all threeÆ

52% – 12% – 6% – 8%- = 26%

% of students who passed in M only is:

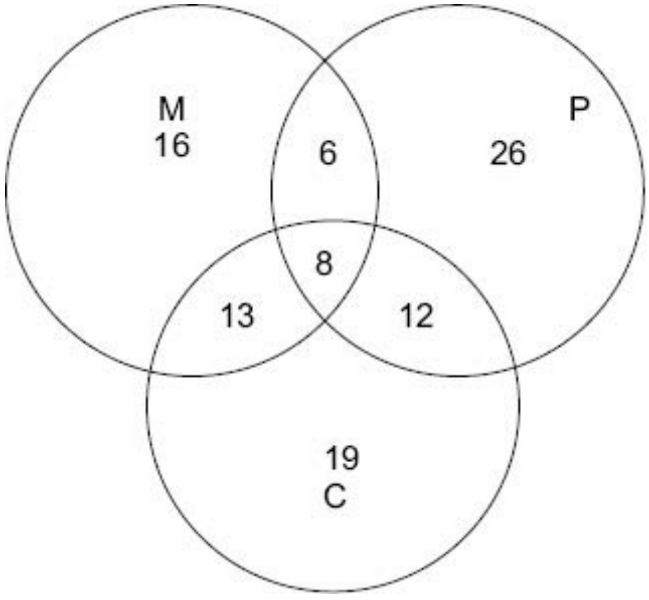
Total no. passing in M – No. Passing in M & C only – No. Passing P & M only – No. Passin in all threeÆ

43% – 13% – 6% – 8%- = 16%

% of students who passed in Chemistry only is

Total no. passing in C – No. Passing in P & C only – No. Passing C & M only – No. Passin in all three Æ

52% – 12% – 13% – 8%– = 19%



The answers are:

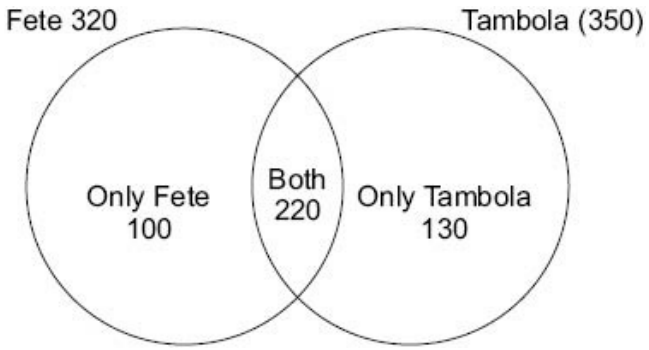
1. Only Math =16% = 32 people. Option (b) is correct.
2. Ratio of Only Math to Only Chemistry = 16:19. Option (c) is correct.
3. 26:84 is the required ratio. Option (b) is correct.
4. 39 % or 78 people. Option (d) is correct.

ILLUSTRATION 3

In the Mindworkzz club all the members participate either in the Tambola or the Fete. 320 participate in the Fete, 350 participate in the Tambola and 220 participate in both. How many members does the club have?

(a) 410 (b) 550

(c) 440 (d) None of these



The total number of people = 100 + 220 + 130 = 450

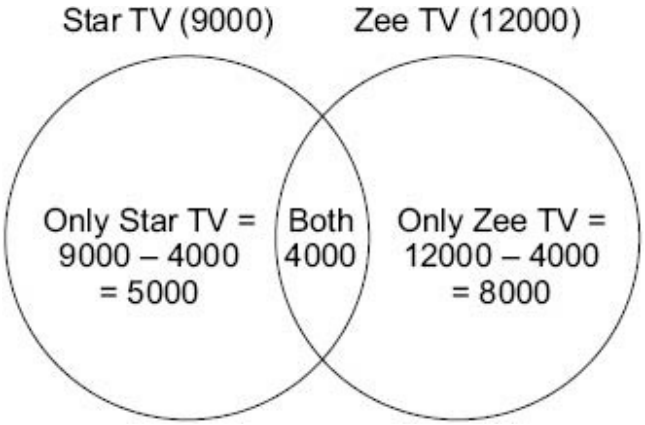
Option (d) is correct.

ILLUSTRATION 4

There are 20000 people living in Defence Colony, Gurgaon. Out of them 9000 subscribe to Star TV Network and 12000 to Zee TV Network. If 4000 subscribe to both, how many do not subscribe to any of the two?

(a) 3000 (b) 2000

(c) 1000 (d) 4000



The required answer would be 20000 – 5000 – 4000 – 8000 = 3000.

ILLUSTRATION 5

Directions for Questions 1 to 3: Refer to the data below and answer the questions that follow.

Last year, there were 3 sections in the Catalyst, a mock CAT paper. Out of them 33 students cleared the cut-off in Section 1, 34 students cleared the cut-off in Section 2 and 32 cleared the cut-off in Section 3. 10 students cleared the cut-off in Section 1 and Section 2, 9 cleared the cut-off in Section 2 and Section 3, 8 cleared the cut-off in Section 1 and Section 3. The number of people who cleared each section alone was equal and was 21 for each section.

1. How many cleared all the three sections?

   (a) 3 (b) 6

   (c) 5 (d) 7

2. How many cleared only one of the three sections?

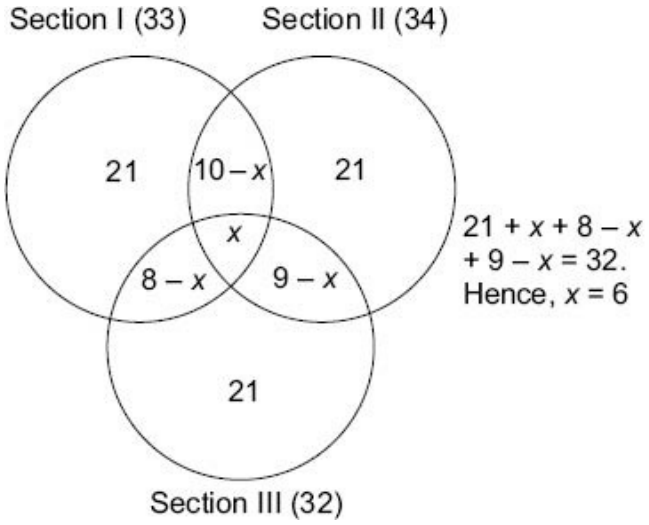
   (a) 21 (b) 63

   (c) 42 (d) 52

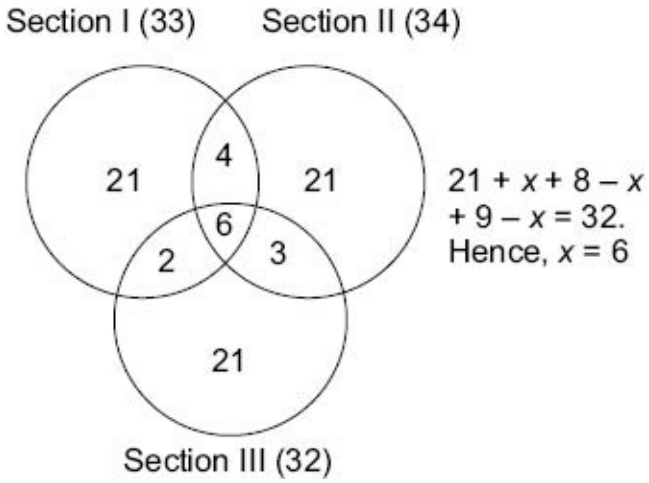
3. The ratio of the number of students clearing the cut-off in one or more of the sections to the number of students clearing the cutoff in Section 1 alone is?

   (a) 78/21 (b) 3

   (c) 73/21 (d) None of these



Since, $x = 6$, the figure becomes:



The answers would be:

1. 6. Option (b) is correct.
2. 21 + 21 + 21= 63. Option (b) is correct.
3. (21 + 21 + 21 + 6 + 4 + 3 + 2)/21 = 78/21. Option (a) is correct.

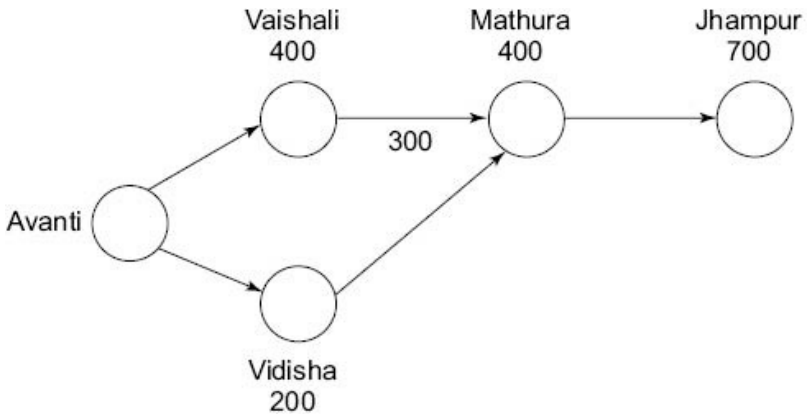
NETWORK DIAGRAMS

Having had a look at the set theory angles to diagrams based questions, let us also take a look at network diagrams:

ILLUSTRATION 6

Directions for Questions 1 to 3: Answer these questions based on the pipeline diagram below.

The following sketch shows the pipelines carrying material from one location to another. Each location has a demand for material. The demand at Vaishali is 400, at Mathura is 400, at Jhampur is 700 and at Vidisha is 200. Each arrow indicates the direction of material flow through the pipeline. The flow from Vaishali to Mathura is 300. The quantity of material flow is such that the demands at all these locations are exactly met. The capacity of each pipeline is 1000.



1. What is the free capacity available in the Avanti-Vidisha pipeline?

   (a) 300 (b) 200

   (c) 100 (d) 0

2. What is the free capacity available from Avanti to Vaishali?

   (a) 0 (b) 100

   (c) 200 (d) 300

3. The quantity moved from Avanti to Vidisha is

   (a) 200 (b) 800

   (c) 700 (d) 1000

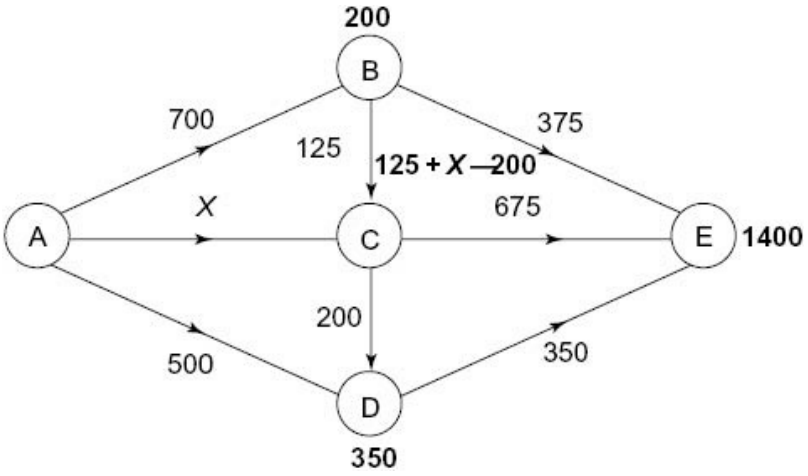
Sol. Since 700 is required at Jhampur, the requirement at Mathura must be 1100, which has to be supplied from the two pipelines coming into Mathura.

It is clear that since Vaishali to Mathura is only 300, the Vidisha-Mathura pipeline should carry 800. Hence, Avanti Vidisha should have 1000.

1. There is no free capacity in the Avanti Vidisha pipeline. Option (d) is correct.
2. Avanti-Vaishali flow should be 700 and hence the free capacity is 300. Option (d) is correct.
3. 1000. Option (d) is correct.

ILLUSTRATION 7

Directions for Questions 1 to 3: In the network diagram above, the figures represent the flow of natural gas through pipelines between major cities A, B, C, D & E (in suitable units). Assume that supply equals demand in the network (although not on individual nodes).



In the network diagram above, the figures represent the flow of natural gas through pipelines between major cities A, B, C, D & E (in suitable units). Assume that supply equals demand in the network (although not on individual nodes).

1. What is the number of units demanded at B?

   (a) 175 (b) 200

   (c) 225 (d) 250

2. If the number of units demanded in C is 225, what is the value of x?

   (a) 975 (b) 875

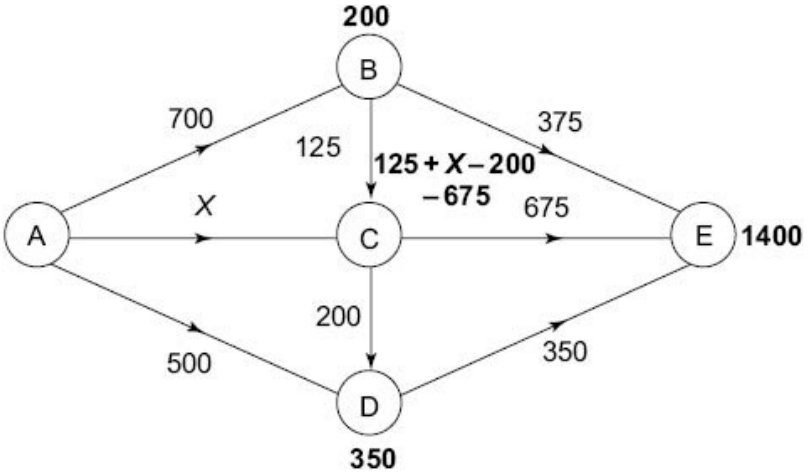
   (c) 775 (d) 950

3. What is the demand in D?

   (a) 300 (b) 350

   (c) 375 (d) 450

Sol. Refer to the following figure for the solution:



1. From the figure it would be 700 – (375 + 125) = 200. Option (b) is correct.
2. 125 + X – 200 – 675 = 225 Æ X = 975. Option (a) is correct.
3. 500 + 200 – 350 = 350. Option (b) is correct.

EXERCISE

Directions for Questions 1 and 2: Refer to the data below and answer the questions that follow:

In the Indian athletic squad sent to the Olympics, 21 athletes were in the triathlon team; 26 were in the pentathlon team; and 29 were in the marathon team. 14 athletes can take part in triathlon and pentathlon; 12 can take part in marathon and triathlon; 15 can take part in pentathlon and marathon; and 8 can take part in all the three games.

1. How many players are there in all?

   (a) 35 (b) 43

   (c) 49 (d) none of these

2. How many were in the marathon team only?

   (a) 10 (b) 14

   (c) 18 (d) 15

Directions for Questions 3 and 4: Refer to the data below and answer the questions that follow.

In a test in which 120 students appeared, 90 passed in History, 65 passed in Sociology and 75 passed in Political Science. 30 students passed in only one subject and 55 students in only two. 5 students passed no subjects.

3. How many students passed in all the three subjects?

   (a) 25 (b) 30

   (c) 35 (d) Data insufficient

4. Find the number of students who passed in at least two subjects.

   (a) 85 (b) 95

   (c) 90 (d) Data insufficient

Directions for Questions 5 to 8: Refer to the data below and answer the questions that follow.

5% of the passengers who boarded Guwahati- New Delhi Rajdhani Express on 20th February, 2002 do not like coffee, tea and ice cream and 10% like all the three. 20% like coffee and tea, 25% like ice cream and coffee and 25% like ice cream and tea. 55% like coffee, 50% like tea and 50 % like ice cream.

5. The number of passengers who like only coffee is greater than the passengers who like only ice cream by

   (a) 50% (b) 100%

   (c) 25% (d) 0

6. The percentage of passengers who like both tea and ice cream but not coffee is

   (a) 15 (b) 5

   (c) 10 (d) 25

7. The percentage of passengers who like at least 2 of the 3 products is

   (a) 40 (b) 45

   (c) 50 (d) 60

8. If the number of passengers is 180, then the number of passengers who like ice cream only is

   (a) 10 (b) 18

   (c) 27 (d) 36

Directions for Questions 9 to 15: Refer to the data below and answer the questions that follow.

In a survey among students at all the IIMs, it was found that 48% preferred coffee, 54% liked tea and 64% smoked. Of the total, 28% liked coffee and tea, 32% smoked and drank tea and 30% smoked and drank coffee. Only 6% did none of these. If the total number of students is 2000 then find

9. The ratio of the number of students who like only coffee to the number who like only tea is

   (a) 5:3 (b) 8:9

   (c) 2:3 (d) 3:2

10. Number of students who like coffee and smoking but not tea is

    (a) 600 (b) 240

    (c) 280 (d) 360

11. The percentage of those who like coffee or tea but not smoking among those who like at least one of these is

    (a) more than 30 (b) less than 30

    (c) less than 25 (d) none of these

12. The percentage of those who like at least one of these is

    (a) 100 (b) 90

(c) Nil (d) 94

13. The two items having the ratio 1:2 are

(a) Tea only and tea and smoking only.

(b) Coffee and smoking only and tea only.

(c) Coffee and tea but not smoking and smoking but not coffee and tea.

(d) None of these

14. The number of persons who like coffee and smoking only and the number who like tea only bear a ratio

(a) 1:2 (b) 1:1

(c) 5:1 (d) 2:1

15. Percentage of those who like tea and smoking but not coffee is

(a) 14 (b) 14.9

(c) less than 14 (d) more than 15

16. 30 monkeys went to a picnic. 25 monkeys chose to irritate cows while 20 chose to irritate buffaloes. How many chose to irritate both buffaloes and cows?

(a) 10 (b) 15

(c) 5 (d) 20

Directions for Questions 17 to 20: Refer to the data below and answer the questions that follow.

In the CBSE Board Exams last year, 53% passed in Biology, 61% passed in English, 60% in Socia Studies, 24% in Biology & English, 35% in English & Social Studies, 27% in Biology and Socia Studies and 5% in none.

17. Percentage of passes in all subjects is

(a) Nil (b) 12

(c) 7 (d) 10

18. If the number of students in the class is 200, how many passed in only one subject?

(a) 48 (b) 46

(c) more than 50 (d) less than 40

19. If the number of students in the class is 300, what will be the % change in the number of passes in only two subjects, if the original number of students is 200?

(a) More than 50% (b) Less than 50%

(c) 50% (d) None of these

20. What is the ratio of percentage of passes in Biology and Social Studies but not English in relation to the percentage of passes in Social Studies and English but not Biology?

(a) 5:7 (b) 7:5

(c) 4:5 (d) None of these

Directions for Questions 21 to 25: Refer to the data below and answer the questions that follow.

In the McGraw Hill Mindworkzz Quiz held last year, participants were free to choose their respective areas from which they were asked questions. Out of 880 participants, 224 chose Mythology, 240 chose Science and 336 chose Sports, 64 chose both Sports and Science, 80 chose Mythology and Sports, 40 chose Mythology and Science and 24 chose all the three areas.

21. The percentage of participants who did not choose any area is
    (a) 23.59% (b) 30.25%
    (c) 37.46% (d) 27.27%
22. Of those participating, the percentage who choose only one area is
    (a) 60% (b) more than 60%
    (c) less than 60% (d) more than 75%
23. Number of participants who chose at least two areas is
    (a) 112 (b) 24
    (c) 136 (d) None of these
24. Which of the following areas shows a ratio of 1:8?
    (a) Mythology & Science but not Sports: Mythology only
    (b) Mythology & Sports but not Science: Science only
    (c) Science: Sports
    (d) None of these
25. The ratio of students choosing Sports & Science but not Mythology to Science but no Mythology & Sports is
    (a) 2:5 (b) 1:4
    (c) 1:5 (d) 1:2

Directions for Questions 26 to 30: Refer to the data below and answer the questions that follow.

The table here gives the distribution of students according to professional courses.

Courses	**STUDENTS**			
	English		**Math**	
	MALES	**FEMALES**	**MALES**	**FEMALES**
Part-time MBA	30	10	50	10
Full-time MBA only	150	8	16	6
CA only	90	10	37	3
Full time MBA & CA	70	2	7	1

26. What is the percentage of Math students over English students?

(a) 50.4 (b) 61.4

(c) 49.4 (d) None of these

27. The average number of females in all the courses is (count people doing full-time MBA and CA as a separate course)

(a) less than 12 (b) greater than 12

(c) 12 (d) None of these

28. The ratio of the number of girls to the number of boys is

(a) 5:36 (b) 1:9

(c) 1:7.2 (d) None of these

29. The percentage increase in students of full-time MBA only over CA only is

(a) less than 20 (b) less than 25

(c) less than 30 (d) more than 30

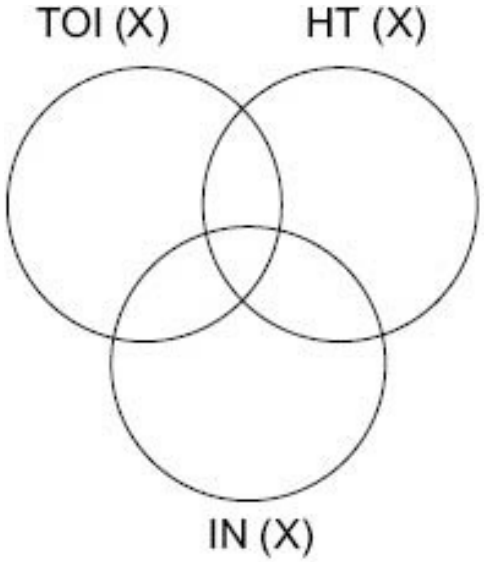
30. The number of students doing full-time MBA or CA is

(a) 320 (b) 80

(c) 160 (d) None of these.

Directions for Questions 31 to 34: Refer to the data below and answer the questions that follow:

A newspaper agent sells The TOI, The HT and The IN in equal numbers to 302 persons. Seven ge HT & IN, twelve get The TOI & IN, nine get The TOI &HT and three get all the three newspapers. The details are given in the Venn diagram:



31. How many get only one paper?

(a) 280 (b) 327

(c) 109 (d) None of these

32. What percent get The TOI and The HT but not The IN

(a) more than 65% (b) less than 60%

(c) @ 64% (d) None of these.

33. The number of persons buying The TOI and The HT only, The TOI and The IN only and Th HT and The IN only are in the ratio of

(a) 6:4:9 (b) 6:9:4

(c) 4:9:6 (d) None of these

34. The difference between the number reading The HT and The IN only and The HT only is

(a) 77 (b) 78

(c) 83 (d) None of these.

35. A group of 78 people watch Zee TV, Star Plus or Sony. Of these, 36 watch Zee TV, 48 watch Star Plus and 32 watch Sony. If 14 people watch both Zee TV and Star Plus, 20 people watch both Star Plus and Sony, and 12 people watch both Sony and Zee TV find the ratio of the number of people who watch only Zee TV to the number of people who watch only Sony.

(a) 9:4 (b) 3:2

(c) 5:3 (d) 7:4

Directions for Questions 36 to 37: Answer the questions based on the following information.

The following data was observed from a study of car complaints received from 180 respondents at Colonel Verma's car care workshop, viz., engine problem, transmission problem or mileage problem. Of those surveyed, there was no one who faced exactly two of these problems. There were 90 respondents who faced engine problems, 120 who faced transmission problems and 150 who faced mileage problems.

36. How many of them faced all the three problems?

(a) 45 (b) 60

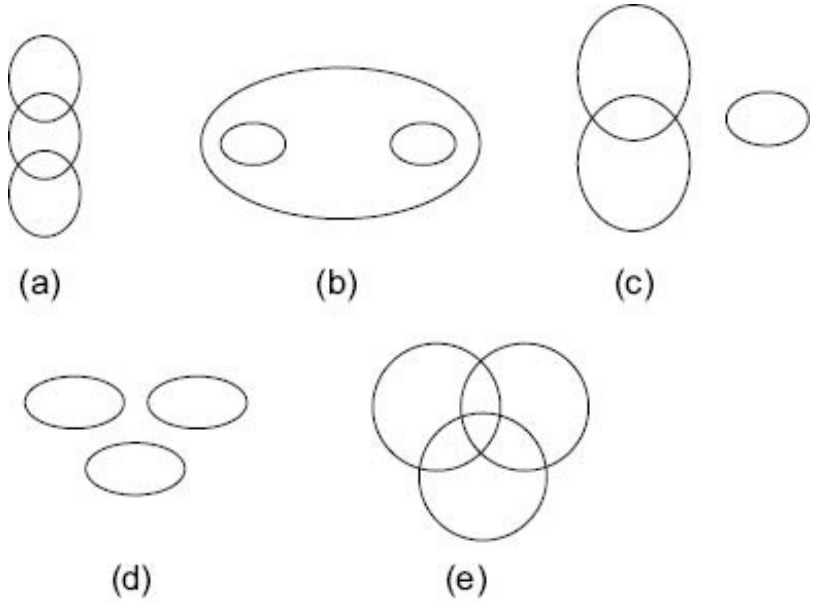
(c) 90 (d) 20

37. How many of them faced either transmission problems or engine problems?

(a) 30 (b) 60

(c) 90 (d) 40

Direction for Questions 38 to 42: given below are five diagrams one of which describes the relationship among the three classes given in each of the five questions that follow. You have to decide which of the diagrams is the most suitable for a particular set of classes. The number of the diagram is your answer.

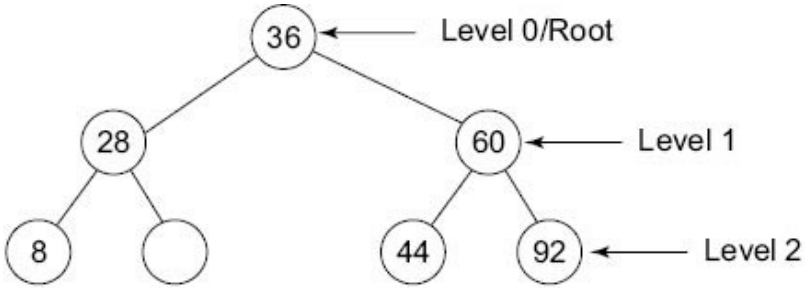


38. Elephants, tigers, animals
39. Administrators, Doctors, Authors
40. Platinum, Copper, Gold
41. Gold, Platinum, Ornaments
42. Television, Radio, Mediums of Entertainment

Direction for Questions 43 to 45: In the ancient game of "placing the numbers on a tree branch" a sequence of numbers is provided to an individual participant and he is then asked to place the numbers in the branches of a hanging tree with the first number forming the top most node of the tree (and this node is called the root of the tree) and the subsequent numbers are placed in the left sub tree if the number is smaller than the number at the root or in the right sub tree, if the number is greater than the number in the root. A node is denoted by an oval and has to include a number in it. Each node at a level can be viewed as a tree itself and the same rule applies to it as well. For every node, if a number is greater than the number at the node, then it must be in the nodes to its right and if the number be smaller than the number at the node, then it must be in the nodes to its left. New numbers must obey the rule of all nodes above itself.

Numbers shall not repeat themselves in the nodes and in case a number appears which has already appeared earlier in the tree it has to be placed on the right most of its possible positions.

E.g, 36, 28, 60, 92, 8, 44



Given is a sequence of numbers and an empty tree. Fill the numbers in the appropriate nodes. The sequence is given in order and starts from 56

56, 60, 16, 36, 28, 72, 12, 20, 64, 16, 80, 68, 36, 56, 20

43. What are the numbers at level 2?

(a) 12, 20, 28 (b) 12, 36, 72

(c) 12,36,56,72 (d) 16, 36,64, 80

44. What is the sum of the numbers at the level 3?

(a) 172 (b) 128

(c) 76 (d) 208

45. How many nodes are at the 4th level?

(a) 7 (b) 3

(c) 9 (d) 2

46. Seventy percent of the employees in a multinational corporation have VCD players, 75 percent have microwave ovens, 80 percent have ACs and 85 percent have washing machines. At least what percentage of employees has all four gadgets?

(a) 15 (b) 5

(c) 10 (d) Cannot be determined

Answer Key

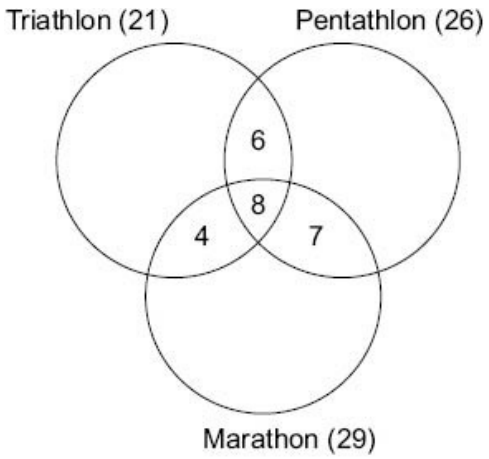
1. (b)	2. (a)	3. (b)	4. (a)
5. (b)	6. (a)	7. (c)	8. (b)
9. (c)	10. (b)	11. (a)	12. (d)
13. (c)	14. (b)	15. (a)	16. (b)
17. (c)	18. (c)	19. (c)	20. (a)
21. (d)	22. (c)	23. (c)	24. (a)
25. (b)	26. (d)	27. (b)	28. (b)
29. (c)	30. (a)	31. (a)	32. (c)
33. (b)	34. (d)	35. (a)	36. (c)
37. (b)	38. (b)	39. (b)	40. (d)
41. (a)	42. (b)	43. (c)	44. (d)
45. (d)	46. (c)		

Solutions

Solutions for Questions 1 and 2: Since there are 14 who are in triathlon and pentathlon, and there are 8 who take part in all three games, there will be 6 who take part in only triathlon and pentathlon.

Similarly,

Only triathlon and marathon = 12 – 8 = 4 & Only Pentathlon and Marathon = 15 – 8 = 7.

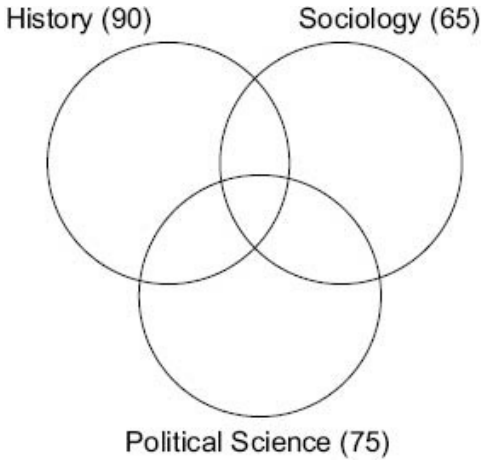


The figure above can be completed with values for each sport (only) plugged in:

The answers would be:

1. 3 + 6 + 8 + 4 + 5 + 7 + 10 = 43. Option (b) is correct.
2. Option (a) is correct.

Solutions for Questions 3 and 4:



The given situation can be read as follows:

115 students are being counted 75 + 65 + 90 = 230 times.

This means that there is an extra count of 115. This extra count of 115 can be created in 2 ways.

A. By putting people in the 'passed exactly two subjects' category. In such a case each person would get counted 2 times (double counted), i.e., an extra count of 1.

B. By putting people in the 'all three' category, each person put there would be triple counted. 1 person counted 3 times – meaning an extra count of 2 per person.

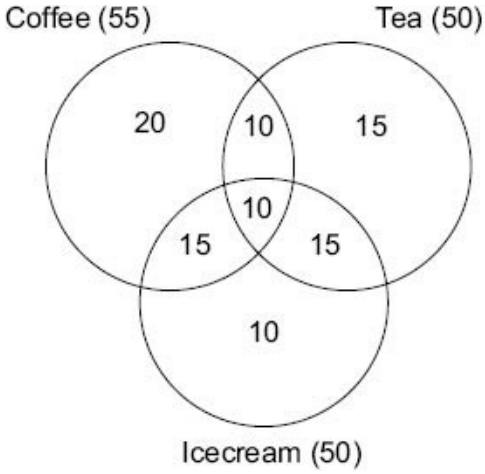
The problem tells us that there are 55 students who passed exactly two subjects. This means an extra count of 55 would be accounted for. This would leave an extra count of 115–55 = 60 more to be accounted for by 'passed all three' category. This can be done by using 30 people in the 'all 3' category.

Hence, the answers are:

3. Option (b)

4. Option (a)

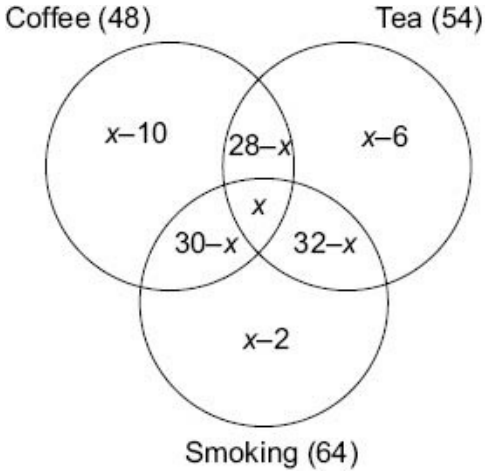
Solutions for Questions 5 to 8: Based on the information provided we would get the following figure:



The answers could be read off the figure as:

5. [(20 – 10)/10] * 100 = 100%. Option (b) is correct.
6. 15% (from the figure). Option (a) is correct.
7. 10+10+15+15=50%. Option (c) is correct.
8. Only ice cream is 10% of the total. Hence, 10% of 180 =18. Option (b) is correct.

Solutions for Questions 9 to 15: If you try to draw a figure for this question, the figure would be something like:



We can then solve this as:

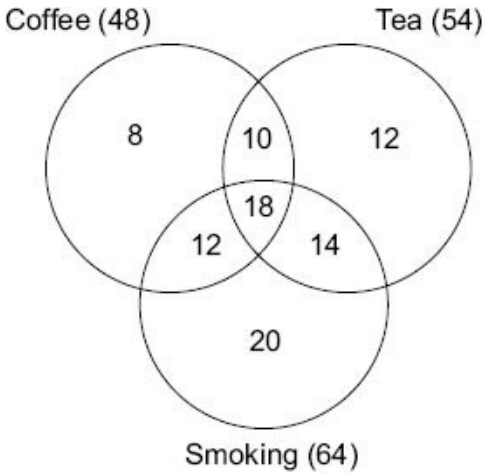
$x - 10 + 28 - x + x + 30 - x + x + 2 + 32 - x + x - 6 = 94$ Æ $x + 76 = 94$ Æ $x = 18$.

Note: In this question, since all the values for the use of the set theory formula are given, we can find the missing value of students who liked all three as follows:

94 = 48 + 54 + 64 – 28 – 32 – 30 + All three Æ All three = 18

As you can see this is a much more convenient way of solving this question, and the learning you take away for the 3 circle situation is that whenever you have all the values known and the only unknown value is the center value – it is wiser and more efficient to solve for the unknown using the formula rather than trying to solve through a venn diagram.

Based on this value of x we get the diagram completed as:



The answers then are:

9. 8:12 = 2:3 Æ Option (c) is correct.
10. 12 % of 2000 = 240. Option (b) is correct.
11. 30/94 Æ more than 30%. Option (a) is correct.
12. 94%. Option (d) is correct.
13. Option (c) is correct as the ratio turns out to be 10:20 in that case.
14. 12:12 = 1:1 Æ Option (b) is correct.
15. 14%. Option (a) is correct.
16. $30 = 25 + 20 - x$ Æ $x = 15$. Option (b) is correct.

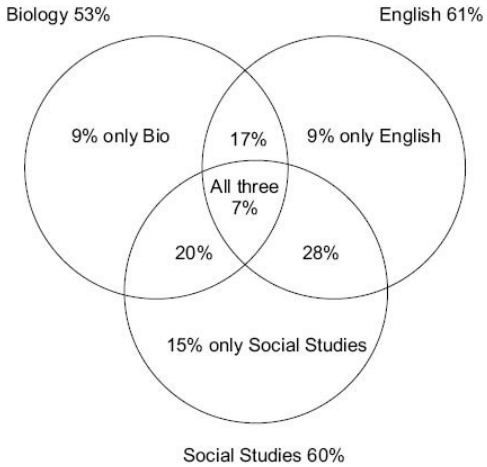
Solutions for Questions 17 to 20:

Let people who passed all three be x. Then:

$53 + 61 + 60 - 24 - 35 - 27 + x = 95$

Æ $x = 7$.

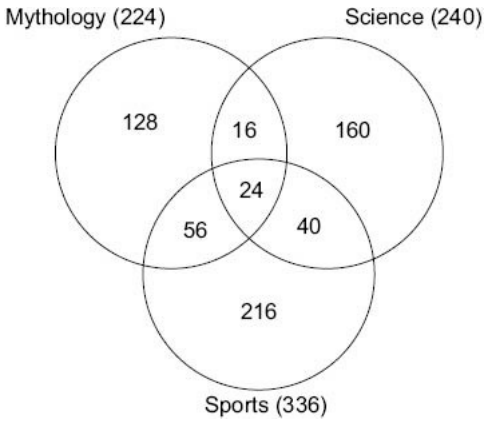
The venn diagram in this case would become:



17. Option (c) is correct.
18. 33% of 200 = more than 50. Option (c) is correct.
19. If the number of students is increased by 50%, the number of students in each category would also be increased by 50%. Option (c) is correct.

20. 20:28 = 5:7. Option (a) is correct.

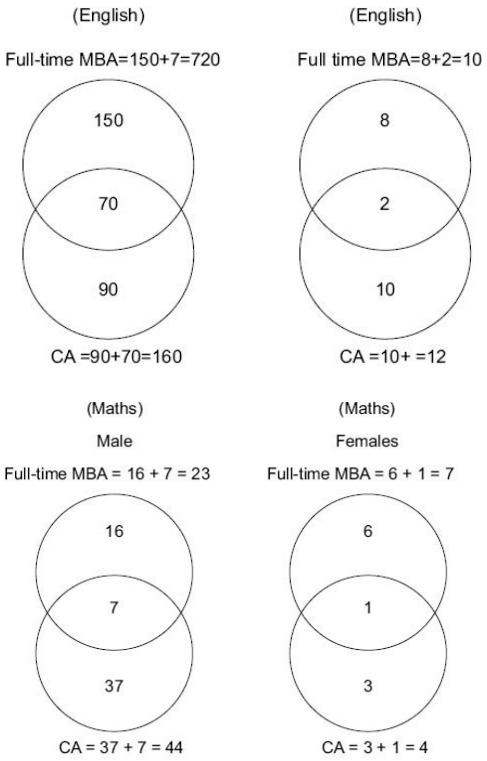
Solutions for Questions 21 to 25: The following figure would emerge on using all the information in the question:



The answers would then be:

21. 240/880 = 27.27%. Option (d) is correct.
22. 504/880 = 57.27%. Hence, less than 60. Option (c) is correct.
23. 40 + 16 + 56 + 24 = 136. Option (c) is correct.
24. Option a gives us 16:128 = 1:8. Option (a) is hence correct.
25. 40:160 Æ 1:4. Option (b) is correct.

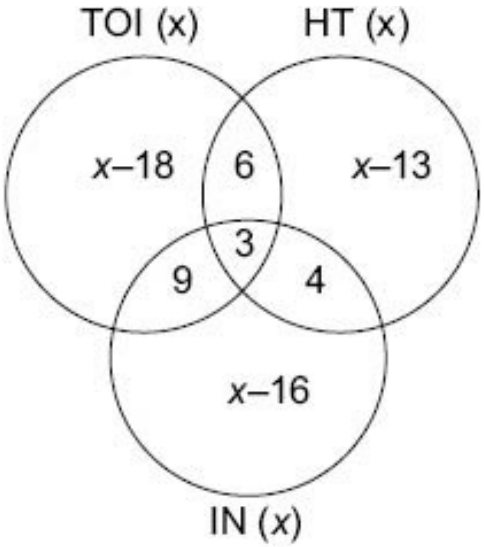
Solutions for Questions 26 to 30: The following Venn diagrams would emerge:



26. Math Students = 130. English Students =370
    130/370 = 35.13%. Option (d) is correct.
27. Number of Female Students = 10 + 8 + 10 + 2 + 10 + 6 + 3 + 1 = 50. Average number of females per course = 50/4 = 12.5. Option (b) is correct.
28. 50:450 = 1:9. Option (b) is correct.

29. 40/140 Æ 28.57%. Option (c) is correct.
30. From the figures, this value would be 150 + 8 + 90 + 10 + 16 + 6 + 37 + 3 = 320. Option (a) is correct.

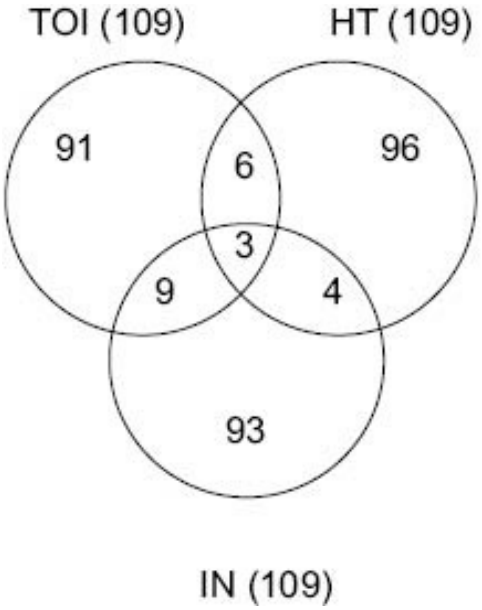
Solutions for Questions 31 to 34: The following figure would emerge-



Based on this figure we have:

$x + x - 13 + 4 + x - 16 = 302$ Æ $3x - 25 = 302$ Æ $x = 327$. Hence, x =109.

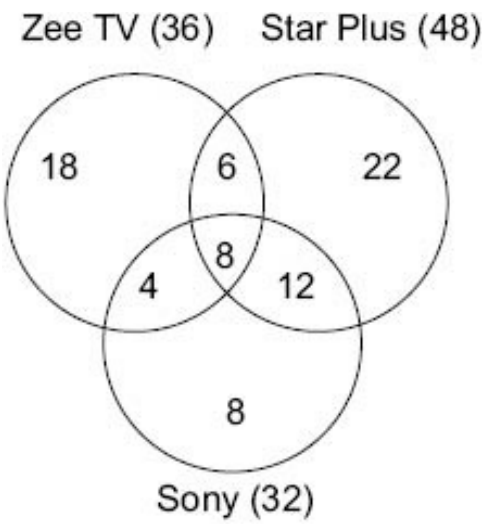
Consequently the figure becomes:



The answers are:

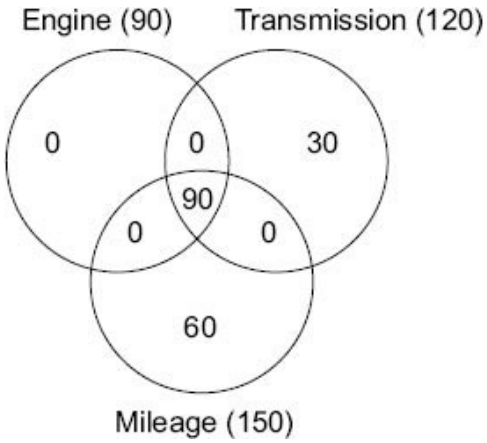
31. 91 + 93 + 96 = 280. Option (a) is correct.
32. 193/302 @ 64%. Option (c) is correct.
33. 6:9:4 is the required ratio. Option (b) is correct.
34. 96 – 4 = 92. Options (d) is correct.
35. 78 = 36 + 48 + 32 – 14 – 20 – 12 + x Æ x = 8.

The figure for this question would become:

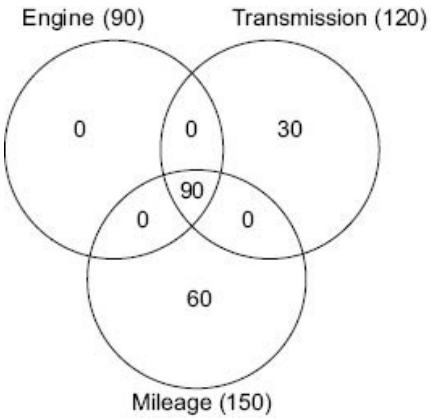


Required ratio is 18:8 Æ 9:4. Option (a) is correct.

36. Option (c) is correct.

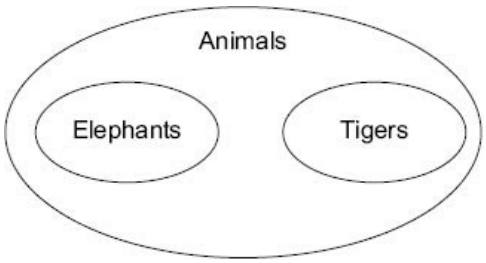


37. There are 30 such people. Option (b) is correct.

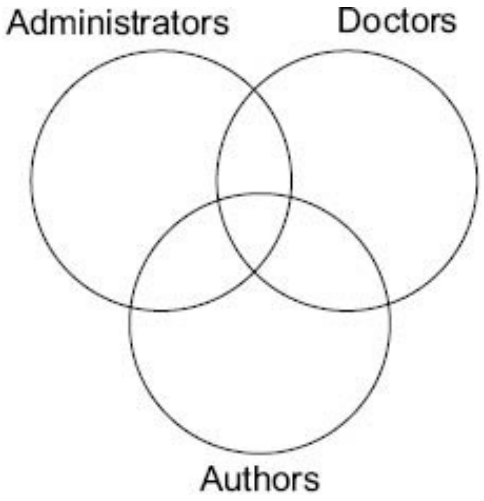


Solutions for Questions 38 to 42:

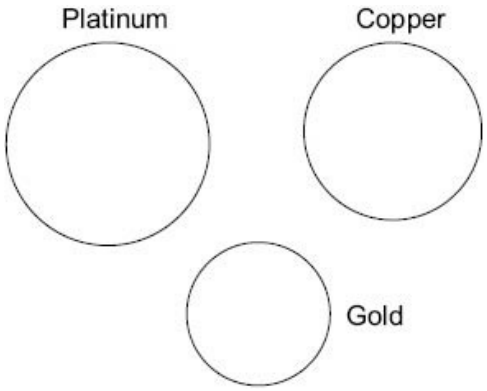
38. Option (b) is correct



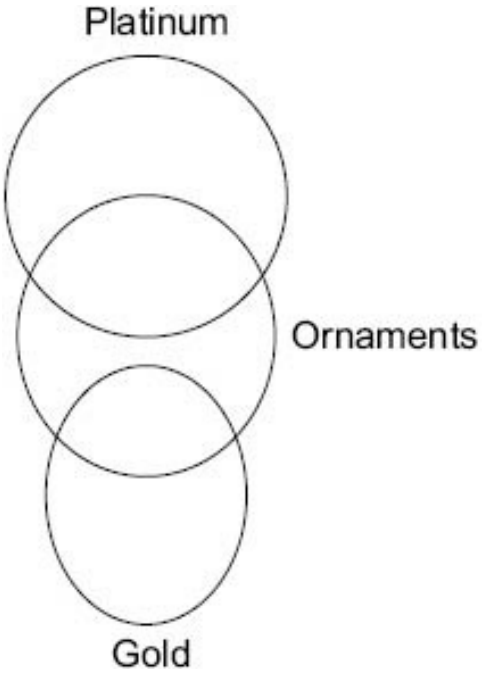
39. Option (b) is correct.



40. Option (d) is correct.

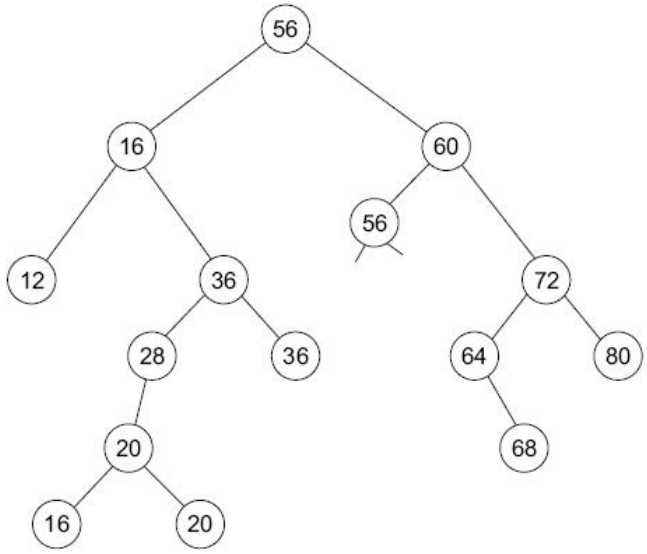


41. Option (a) is correct.



42. Option (b) is correct

Solutions for Questions 43 to 45:



The answers can be read off the above grid.

43. Option (c) is correct.
44. The sum is 208 = 80 + 64 + 36 + 28. Option (d) is correct.
45. There are 2 nodes at the 4^{th} level. Option (d) is correct.
46. The least percentage of people with all 4 gadgets would happen if all the employees who are not having any one of the four objects is mutually exclusive.

    Thus, 100 – 30 – 25 – 20 – 15 = 10

    Option (c) is correct.