# CHAPTER – 7
ROUTES, NETWORKS, 3D

Worked our Examples:

These questions are based on the following data.

The triangular chart given below represents the percentage of vehicle owners who own a Car, a Bike and a Scooter for six cities - Delhi, Mumbai, Kolkatta, Chennai, Hyderabad and Bangalore. (Assume that no vehicle has more than one owner and that there are no other types of vehicles).
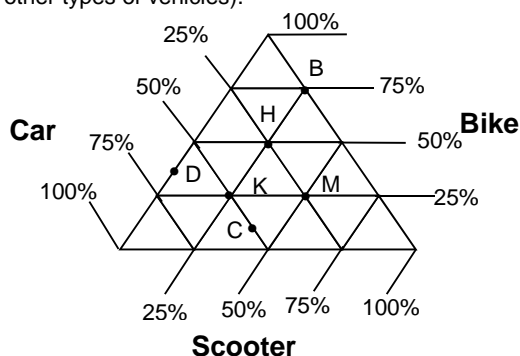
The number of vehicle owners (only these three) in various cities are as follows (in thousands):

D (Delhi) – 900 ; M (Mumbai) – 800
K (Kolkata) – 700 ; C (Chennai) – 600
H (Hyderabad) – 500 ; B (Bangalore) – 400

Solutions for questions 7.01 to 7.05:

The following table can be obtained from the given information. However, students should only calculate those values that are required to solve specific questions.

Vehicle / City	Total	Cars	Bikes	Scooters
Delhi	9,00,000	62.5% = 5,62,500	37.5% = 3,37,500	0%
Mumbai	8,00,000	25% = 2,00,000	25% = 2,00,000	50% = 4,00,000
Kolkata	7,00,000	50% = 3,50,000	25% = 1,75,000	25% = 1,75,000
Chennai	6,00,000	50% = 3,00,000	12.5% = 75,000	37.5% = 2,25,000
Hyderabad	5,00,000	25% = 1,25,000	50% = 2,50,000	25% = 1,25,000
Bangalore	4,00,000	0%	75% = 3,00,000	25% = 1,00,000
Total	39,00,000	15,37,500	13,37,500	10,25,000

7.01: What is the total number of vehicle owners who own a Bike in the city which has the highest number of bikes and the city which has the lowest number of bikes, put together? (Assume that no person has more than one vehicle of the same kind).
(A) 3,37,500   (B) 75,000
(C) 4,12,500   (D) 5,12,500

Sol: Highest number of bikes = 3,37,500
Lowest number of bikes = 75,000

4,12,500

Choice (C)

7.02: The number of car-owners in Chennai exceeds the number of scooter-owners in Hyderabad by
(A) 1,75,000   (B) 1,25,000
(C) 50,000   (D) None of these

Sol: Number of car owners in Chennai = 3,00,000
Number of scooter Owners in Hyd = 1,25,000

1,75,000

Choice (A)

7.03: The total number of bike-owners, in all the six cities put together is
(A) 15,37,500
(B) 10,25,000
(C) 13,37,500
(D) None of these

Sol: The total number of bike-owners for all the six cities put together is 13,37,500, as can be observed in the table.   Choice (C)

7.04: The number of bike-owners in Chennai forms what percentage of the number of scooter-owners in Hyderabad and Bangalore put together?
(A) $66^2/_3$%
(B) 75%
(C) $33^1/_3$%
(D) 25%

Sol: Required percentage =

$$\frac{75,000}{1,00,000 + 1,25,000} \times 100 = 33.33\%$$

Choice (C)

**7.05:** For the six cities, the total number of car owners is what percent more than the total number of scooter-owners?

(A) 15% (B) 33$^1/_3$%
(B) 50% (D) None of these

Sol: Total number of car-owners = 15,37,580
Total number of scooter-owners = 10,25,000
Required percentage =

$$\frac{15,37,500 - 10,25,000}{10,25,000} \times 100 = 50\%$$

Choice (C)

Exercise – 7(a)

Directions for questions 1 to 5: These questions are based on the following data.

2015
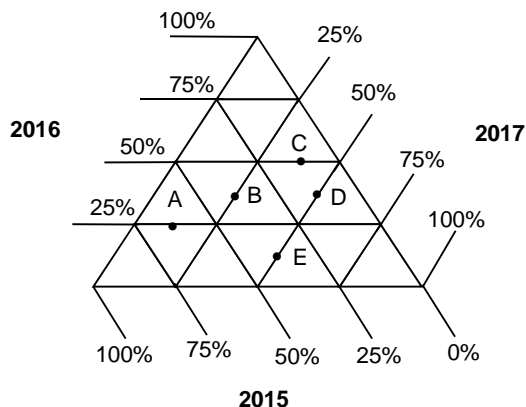
The above triangular chart represents the profit percentages earned by five companies A, B, C, D and E across three years.

Note: (1) Profit percentage is calculated on sales revenue.
(2) Profit = Sales Revenue – Expenditure.

Sales revenue of the five companies across three years
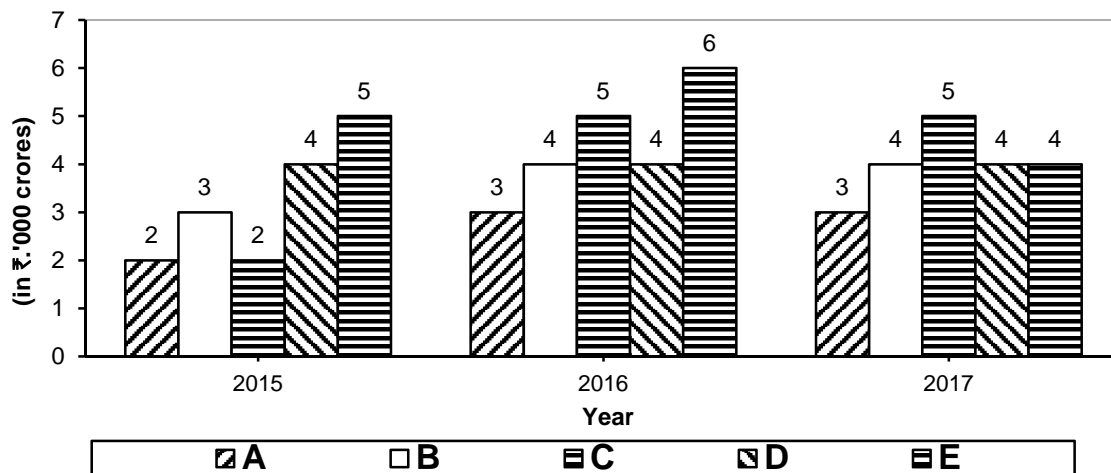
1. Which of the following companies earned the maximum profit during the year 2017?
(A) C (B) A (C) B (D) D

2. What is the ratio of the expenditure of C to that of D during the year 2015?
(A) 1:3 (B) 1:2 (C) 3:5 (D) 2:3

Directions for questions 3 to 5: Type in your answer in the input box provided below the question.

3. What is the highest profit earned (in crores) by any of the companies in any year?

4. What is the total profit earned (in crores) by company A during the given years?

5. During the year 2018, if the sales revenue of B increases by 25% and the expenditure decreases by 20%, then the profit percentage of B in 2018 is more (in percentage points) than that of 2017 by

The following diagram gives the percentage of work done by three people Rajesh, Ramesh and Rakesh in completing five different tasks A, B, C, D and E.
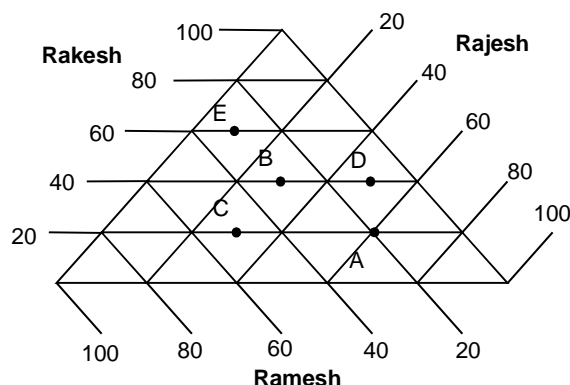
### The amount to be paid for completing the five tasks are as follows.

Task	Amount (in ₹)
A	12,000
B	15,000
C	20,000
D	10,000
E	18,000

The amount for each task must be paid to the persons in the same ratio in which they completed the respective tasks.

6. Assuming that work required for each of the five tasks was in proportion of the amount paid for them, then approximately what percent of the total work was done by Ramesh?
(A) 28%   (B) 31%
(C) 34%   (D) 36%

7. Rajesh got the maximum amount for doing his part in which of the following tasks?
(A) A   (B) B   (C) C   (D) D

8. The total amount (in ₹) paid to Rakesh was
(A) 20,400   (B) 24,400
(C) 27,200   (D) 29,600

Directions for questions 9 to 12: These questions are based on the following data.

The network shows the water pipelines connecting the 6 cities (A, B, C, D, E, F).
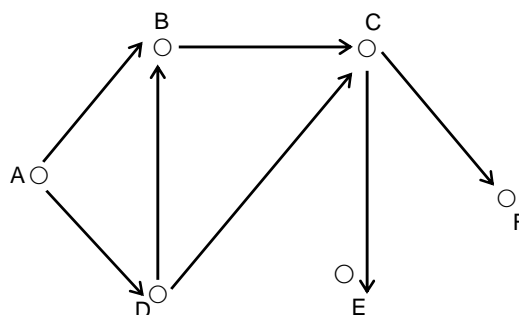

Through a pipeline, water can flow only in one direction as indicated by the arrow in the diagram.
– The maximum carrying capacity of any of the pipelines is 1000 m^3 per day.
– The daily requirement at C is 400 m^3.
– The slack in the pipeline is the difference between its maximum carrying capacity and the actual load carried by the pipeline.
– The slack in pipeline CE is 100 m^3 less than the slack in pipeline CF. The slack in pipeline AD is 300 m^3.
– The daily requirement at D = 100 m^3.
– The amount of water that flows through pipeline BC is twice the daily requirement at C.
– Slack in pipeline AB = 200 m^3.
– The ratio of the requirement at B to the slack in pipeline CE is 1 : 2.
– The ratio of the slacks in pipelines CE and CF is 6 : 7. The quantity of water flowing through the pipeline DB is the same as that flowing through pipeline DC.

9. Find the daily requirement (in m³) at E, if it is known that its requirement is exactly met by the water flowing through the pipelines shown.
   (A) 300   (B) 400
   (C) 600   (D) 700

10. Find the daily requirement (in m³) at F, if it is known that its requirement is exactly met by the water flowing through the pipelines shown.
    (A) 300   (B) 400
    (C) 800   (D) 900

11. If there exists a larger external pipeline of capacity 5000 m³ that supplies water to city a such that the requirements of all the 6 cities are met by the water supplied by it, then what is the slack in the external pipeline? It is given that the daily requirement at A = 500 m³.
    (A) 2500 m³   (B) 3000 m³
    (C) 3500 m³   (D) 2000 m³

12. If on a particular day, the pipeline joining cities D and B is damaged and the amount of water that is intended to flow through pipeline DB gets wasted in the process, then find how much water is wasted on that day?
    (A) 200 m³   (B) 100 m³
   (C) 300 m³   (D) 340 m³

Directions for questions 13 to 15: Answer the questions on the basis of the information given below.
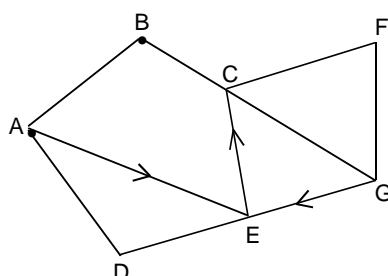
The above network shows 7 cities - A, B, C, D, E, F and G connected via two-way roads and one- way roads. For the one-way roads, the direction of travel is as indicated by the arrows in the diagram. Roads which do not contain any arrows are two-way roads.

13. The number of distinct paths from city A to city G without going through any city more than once is
    (A) 3   (B) 4   (C) 5   (D) 6

14. If the road connecting cities C and G is damaged and traffic cannot go along that road, then the number of distinct ways in which city G can be reached from city E without going through any city more than once is
    (A) 3   (B) 1   (C) 4   (D) 2

15. In the previous question, if it is assumed that all the roads other than the damaged road allow two-way traffic, then the number of distinct ways of reaching city G from city E without going through any city more than once is
    (A) 3   (B) 2   (C) 4   (D) 5

Directions for questions 16 to 20: These questions are based on the following data.
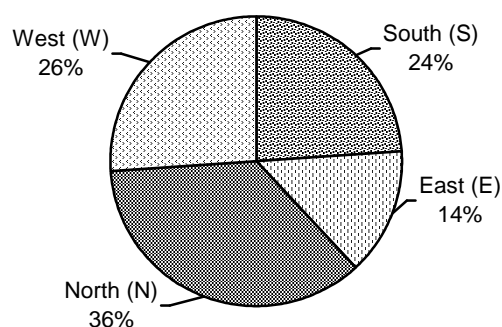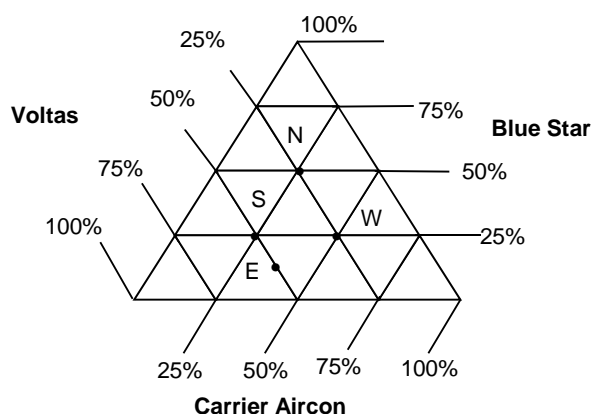
The above triangular chart depicts split up of, by company, the sales of ACs - namely Voltas, Bluestar and Carrier Aircon, in the four regions of India – North (N), South (S), East (E) and West (W). Total number of ACs sold is 10 lakhs and the pie chart indicates the split up of sale of ACs by different regions.

16. In which region did Voltas sell the maximum number of ACs?
    (A) North   (B) South   (C) East   (D) West

17. What is the total number of ACs sold by Carrier Aircon in the given four regions?
(A) 3,22,500
(B) 3,32,500
(C) 3,45,000
(D) None of these

18. How many ACs did Blue Star sell in East and North regions, put together?
(A) 77,500
(B) 82,500
(C) 1,97,500
(D) 2,45,000

19. By what percent is the number of ACs sold by Voltas in the South region more than that Blue Star?
(A) 50%
(B) 100%
(C) 200%
(D) None of these

20. What is the ratio of the number of ACs sold by Voltas in East region to the total number of ACs sold in the North region by the three companies put together approximately?
(A) 1 : 2   (B) 1 : 6   (C) 2 : 7   (D) 1 : 5

Exercise – 7(b)

Directions for questions 1 to 3: Answer the questions on the basis of the information given below.

The Gunrock Marathon is an event in which contestants run in different directions starting from the Gunrock Circle (GC). Each contestant is free to run in any direction and all of them start at the same time. However, if a contestant decides to run in a certain direction, he has to continue running in the same direction throughout the race. The figure shows the locations of each of the 8 contestants numbered 1 to 8 at the end of day 1. (Consider GC to be at the origin whose coordinates are (0, 0) and all positions are specified with respect to GC).
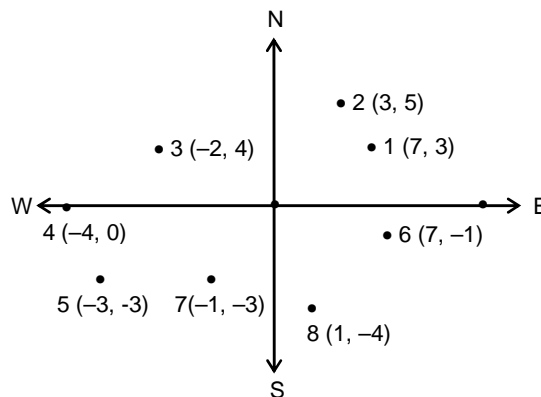
1. Only contestants numbered 5 to 8 start running southward of GC. If the contestants ran non-stop, then who among them has the least average speed?
(A) 5   (B) 7   (C) 8   (D) 6

2. Initially due to a fault in map making, the location of GC was taken as (0, 0) instead of (1, 1). If all the contestant locations remain the same, who has run the maximum distance?
(A) 1
(B) 6
(C) 2
(D) Both 1 and 6

3. Two of the contestants who are the farthest apart at the end of day 1 are _____.
(A) 2 & 8
(B) 1 & 5
(C) 1 & 4
(D) 2 & 5

Directions for questions 4 to 8: Answer the following questions based on the information given below.

The diagram shows the interconnections between a refinery A and eight depots. Oil from the refinery is to be transported to these depots using tankers. The capacity of the depots (in '000 litres) are given. The distance from the refinery to the depots and between two neighbouring depots are also given. Oil can be transported only in the direction in which the arrows point. So also at each depot, only if it is filled to full capacity, the remaining quantity can be passed on to any of the next depots. Irrespective of the quantity transported, the cost of transportation is ₹150/km. Oil can be transmitted only in quantities which are integral multiples of 50,000 litres. All depots currently hold 50% of their capacities.
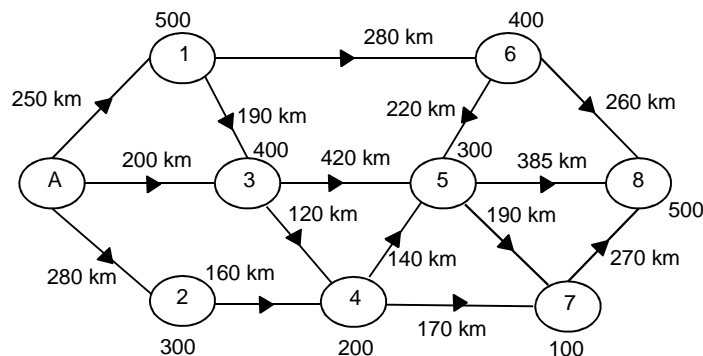
4. What can be the minimum quantity (in litres) that is sent from A, for part of it to reach depot 8?

5. What is the maximum quantity (in '000 litres) that can be sent from A, with a possibility that no part of it still reaches depot 8?

6. What is the minimum cost of transporting the required oil from A to depot 8?

7. If the pipelines between depots 1 and 3 and depots 4 and 7 are closed for repairs, what will be the minimum cost of transporting oil from the refinery to depot 8?

8. What should be the minimum quantity of oil at refinery A, such that all the depots can be filled from their existing level to their capacities?
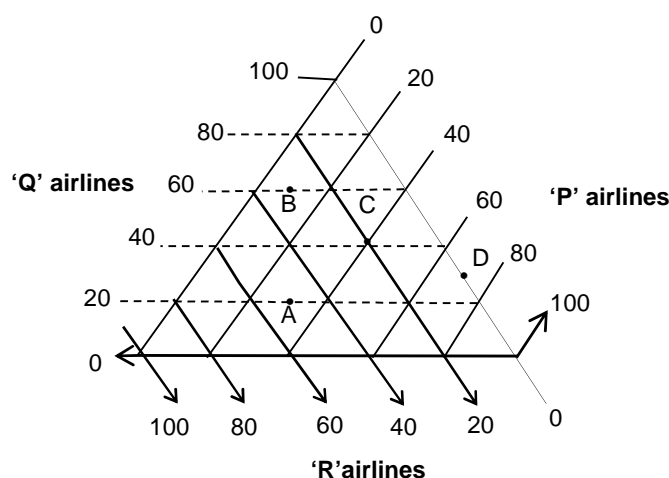
	A	B	C	D
Roadways	250	400	350	200
Railways	400	200	250	300
Airways	350	400	100	400

The table and 3D chart along side give the details of the total number of passengers travelling using different means in four different countries A, B, C and D and the distribution of passengers, among those using airways, using the three different airlines, namely P, Q and R airlines in those countries. There are only 3 airlines operating in these countries.

9. The difference between the number of passengers using Q airlines in country D and those using P airlines in country B is
(A) 300   (B) 80   (C) 50   (D) 20

10. The number of passengers using R airlines in country A is what percentage of those using the roadways in the same country?
(A) 70
(B) 20
(C) 17.5
(D) None of these

11. If all the passengers of country C travelling by rail start travelling in Q and P airlines equally, then in country C, the number of passengers using R airlines is approximately what percentage of the

number of passengers using Q airlines? (Given that all other factors remain constant)

(A) 25%   (B) $33\frac{1}{3}$

(C) 12%   (D) 50%

12. The passengers using R airlines is what percentage of the total passengers in all the countries.
(A) 10%   (B) 16.60%

(C) 8.75%   (D) $33\frac{1}{3}$ %

13. If P and Q airlines of countries B and D are merged together, then what percentage of the total passengers travelling in those countries will they carry?
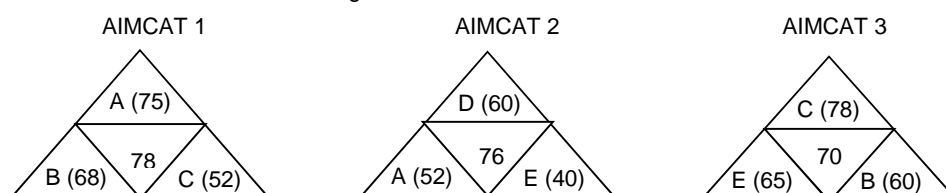(A) 25%   (B) 50%   (C) 75%   (D) 35.7%

A complicated process is broken down into twelve sub processes. Some of the sub processes can be executed simultaneously as long as the conditions are met. The following table gives the time required for each sub process and the conditions to be satisfied before executing them.

Sub process	Time taken (in minutes)	Other sub processes to be completed before starting this
A	12	I, H
B	15	H, G
C	24	J
D	7	H
E	11	F, K
F	5	B, D
G	25	None
H	17	None
I	13	G
J	10	A
K	9	D, L
L	8	None

14. E can be executed only after executing
(A) A (B) J (C) H (D) I

15. If the work is started at 10:00 a.m., then what is the earliest time by which E can be finished?
(A) 10:44 a.m. (B) 10:50 a.m.

(C) 11:02 a.m. (D) None of these

16. What is the minimum time taken to finish the entire process?
(A) 84 minutes (B) 80 minutes
(C) 78 minutes (D) 25 minutes

Directions for questions 17 to 20: Answer these questions on the basus of the information given below.

Five students – A, B, C, D and E were comparing the marks they got in three Aimcats. In the diagrams below, for each Aimcat, the three outer triangles give the marks scored by the three students who scored the highest marks in that Aimcat. The triangle at the centre gives the marks scored by these three students as a percentage of the total marks scored by all the five students in that Aimcat. Assume that no two students scored the same marks in an aimcat and the scores of all the students in each Aimcat is an integer and that each student scored at least 20 marks in each Aimcat.

AIMCAT 1   AIMCAT 2   AIMCAT 3

A (75)   D (60)   C (78)
      78   76   70
B (68)   C (52)   A (52)   E (40)   E (65)   B (60)

In order to check the consistency in their scores they devised two indices, the consistency index (C) which is the difference between the highest and the lowest score in the three Aimcats and a reliability index (R) which is the middle value when the scores of each student are arranged in an increasing order.

17. Which of the following could be the score of D in Aimcat 3?
(A) 20 (B) 25
(C) 36 (D) 62

18. What can be the highest value of the C index for any student?
(A) 58 (B) 52
(C) 47 (D) 60

19. Who among the following students can have the lowest value of the R-index?
(A) Only A and C (B) Only A, C and D
(C) Only A, D, and E (D) Only D and E

20. Who among the following students can have the highest value of the R index?
(A) Only A (B) Only D
(C) Only B (D) Only A or B

Key

Exercise – 7(a)

1. D	5. 27	9. B	13. D	17. B
2. B	6. B	10. A	14. D	18. C
3. 2500	7. A	11. B	15. C	19. B
4. 2375	8. C	12. C	16. B	20. D

Exercise – 7(b)

1. B	5. 1100	9. B	13. D	17. C
2. D	6. 1,14,000	10. A	14. C	18. A
3. B	7. 1,18,500	11. C	15. D	19. D
4. 3,50,000	8. 13,50,000	12. C	16. A	20. C