38. PIE-CHARTS

IMPORTANT FACTS AND FORMULAE

The **pie-chart** or a **pie-graph** is a method of representing a given numerical data in the form of sectors of a circle.

The sectors of the circle are constructed in such a way that the area of each sector is proportional to the corresponding value of the component of the data.

From geometry, we know that the area of a circle is proportional to the central angle.

So, the central angle of each sector must be proportional to the corresponding value of the component.

Since the sum of all the central angle is 360°, we have

$$\text{Central angle of the component} = \left(\frac{\text{Value of the component}}{\text{Total value}} * 360 \right)^{\circ}$$

SOLVED EXAMPLES

The procedure of solving problems based on pie-charts will be clear from the following solved examples.

Example 1. The following pie-chart shows the sources of funds to be collected by the National Highways Authority of India (NHAI) for its Phase II projects. Study the pie-chart and answer the questions that follow.

SOURCES OF FUNDS TO BE ARRANGED BY NHAI
FOR PHASE II PROJECTS (IN CRORES RS.)
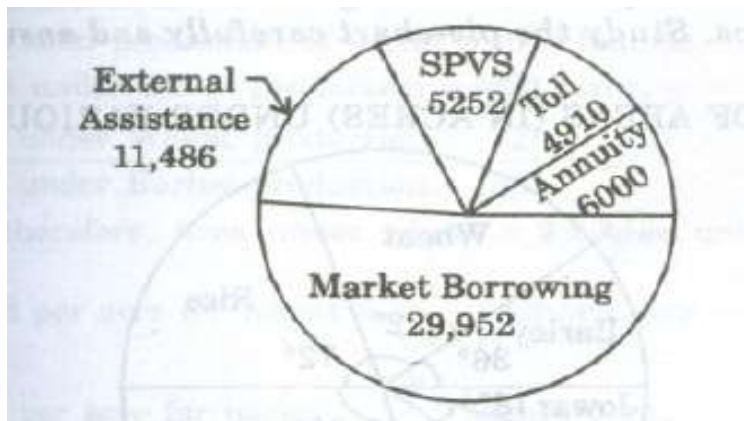
Total funds to be arranged for Projects (Phase II) =Rs.57,600 crores.
1. Near about 20% of the funds are to be arranged through:
(a) SPVS   (b) External Assistance
(c) Annuity   (d) Market Borrowing

2. The central angle corresponding to Market Borrowing is:
(a) 52°   (b) 137.8°
(c) 187.2°   (d) 192.4°

3. The approximate ratio of the funds to be arranged through Toll and that through Market Borrowing is:
(a) 2:9   (b) 1:6
(c) 3:11   (d) 2:5

4. If NHAI could receive a total of Rs. 9695 crores as External Assistance, by what percent (approximately) should it increase the Market Borrowings to arrange for the shortage of funds ?
(a) 4.5%   (b) 7.5%
(c) 6%   (d) 8%

5.If the toll is to be collected through an outsourced agency by allowing a maximum 10% commission, how much amount should be permitted to be collected by the outsourced agency, so that the project is supported with Rs. 4910 crores ?
(a) Rs.6213 crores   (b) Rs. 5827 crores
(c) Rs. 5401 crores   (d) Rs. 5216 crores

SOLUTION

1. (b): 20% of the total funds to be arranged = Rs.(20% of 57600) crores
$$= Rs.11520 \text{ crores } Rs.11486 \text{ crores.}$$

2. (c):Central angle corresponding to Market Borrowing $= \dfrac{29952}{57600} * 360°$
$$= 187.2°$$

3. (b):
Required ratio $= \dfrac{4910}{29952} = \dfrac{1}{6.1} = \dfrac{1}{6}$

4. (c):Shortage of funds arranged through External Assistance
=Rs.(11486-9695) crores =Rs. 1791 crores.
therefore, Increase required in Market Borrowings =Rs. 1791 crores.

Percentage increase required $= \left| \dfrac{1791}{29952} * 100 \right| \% = 5.98 \% = 6\%$

5. (c):Amount permitted = (Funds required from Toll for projects of Phase II) +
                                  (10 % of these funds)
                        =Rs. 4910 crores + Rs. (10% of 4910) crores
                        =Rs. (4910 + 491) crores = Rs. 5401 crores.

Example 2. The pie-chart provided below gives the distribution of land (in a village) under various food crops. Study the pie-chart carefully and answer the questions that follow.

DISTRIBUTION OF AREAS (IN ACRES) UNDER VARIOUS FOOD CROPS
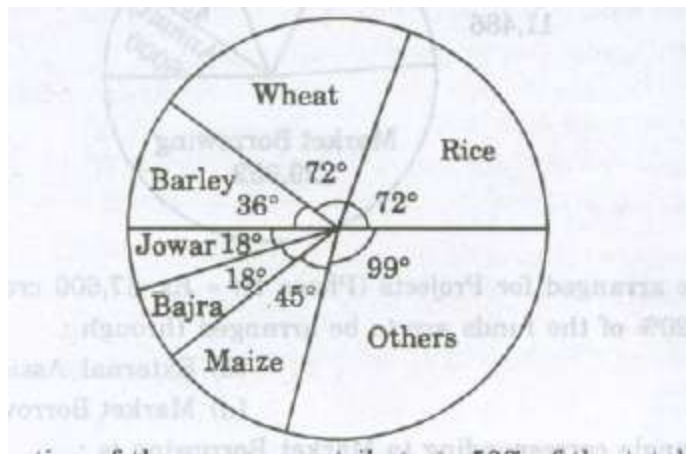
1.Which combination of three crops contribute to 50% of the total area under the food crops ?
(a) Wheat, Barley and Jowar   (b)Rice, Wheat and Jowar
(c) Rice, Wheat and Barley   (d)Bajra, Maize and Rice

2.If the total area under jowar was 1.5 million acres, then what was the area (in million acres) under rice?
(a)6   (b)7.5   (c)9   (d)4.5

3.If the production of wheat is 6 times that of barley, then what is the ratio between the yield per acre of wheat and barley ?
(a) 3:2   (b) 3:1   (c) 12:1   (d) 2:3

4.If the yield per acre of rice was 50% more than that of barley, then the production of barley is what percent of that of rice ?
(a)30%   (b)33 %   (c)35%   (d)36%

5.If the total area goes up by 5%, and the area under wheat production goes up by 12%   , then what will be the angle for wheat in the new pie-chart ?
(a) 62.4°   (b) 76.8°   (c) 80.6°   (d) 84.2°

SOLUTIONS
1.(c):The total of the central angles corresponding to the three crops which cover 50% of the total area ,should be 180°.Now, the total of the central angles for the given combinations are:

(i) Wheat,Barley and jowar = (72°+36°+18°)=126°
(ii) Rice,Wheat and Jowar = (72°+72°+18°)=162°
(iii) Rice,Wheat and Barley = (72°+72°+36°)=180°
(iv)Bajra,Maize and Rice = (18°+45°+72°) = 135°
Clearly:(iii) is the required combination.

2.(a): The area under any of the food crops is proportional to the angle corresponding to that crop.
Let the area under the rice production be x million acres.
Then, $18:72 = 1.5:x \Rightarrow x=(72*15/18)=6$
Thus, the area under rice production be = 6 million acres.

3.(b): Let the total production of barley be T tones and let Z acres of land be put under barley production.
Then, the total production of wheat =(6T) tones.
Also,area under wheat production = (2Z) acres.

$$\therefore \frac{\text{Area Under Wheat Production}}{\text{Area Under Barley Production}} = \frac{72°}{36°} = 2$$

And therefore,Area under wheat = 2*Area under Barley = (2Z)acres

Now, yield per acre for wheat = (6T/2Z) tones/acre = (3T/Z) tones/acre
And yield per acre for barley = (T/Z) tones/acre.

$$\therefore \text{Required ratio} = \frac{3T/Z}{T/Z} = 3:1.$$

4. (b):Let Z acres of land be put under barley production.

$$\text{Then,} \quad \frac{\text{Area Under Rice Production}}{\text{Area Under Barley Production}} = \frac{72°}{36°} = 2.$$

$\therefore$ Area under rice production = 2 * area under barley production = (2Z) acres.
Now,if p tones be the yield per acre of barley then ,yield per acre of rice
=(p+50% of p) tones =(3/2 p) tones.
$\therefore$ Total production of rice = (yield per acre) * (area under production)
= (3/2 p)*2Z=(3pZ) tones.
And,Total production of barley = (pz) tones.
$\therefore$ Percentage production of barley to that rice = (pZ/3pZ *100)%= 33 1/3% .

5.(b): Initially,let t be the total area under considerations.
The area under wheat production initially was =(72/360 * t)acres = (t/5)acres.
Now,if the total area under consideration be increased by 5%,
then the new value of the total area= (105/100 t) acres.
Also,if the area under wheat production be increased by 12%,

then the new value of area under wheat = $\left| \frac{t}{5} +(12\% \text{ of } \frac{t}{5}) \right|$ acres = (112t/500)acres.

∴Central angle corresponding to wheat in the pie-chart

$$= \left[\frac{\text{Area Under Wheat (new)}}{\text{Total area (new)}} * \mathbf{360}\right]^{\circ} = \left|\frac{(112t/500)}{(105t/100)} * 360\right|^{\circ} = 76.8°$$

Example 3.The following pie-charts show the distribution of students of graduate and post graduate levels in seven different institute-M,N,P,Q,R,S and T in a town.

DISTRIBUTION OF STUDENTS AT GRADUATE AND POST-GRADUATE LEVELS IN SEVEN INSTITUTES-M,N,P,Q,R,S AND T.

Total   Number of students of graduate level   **Total   Number of students of post graduate level**
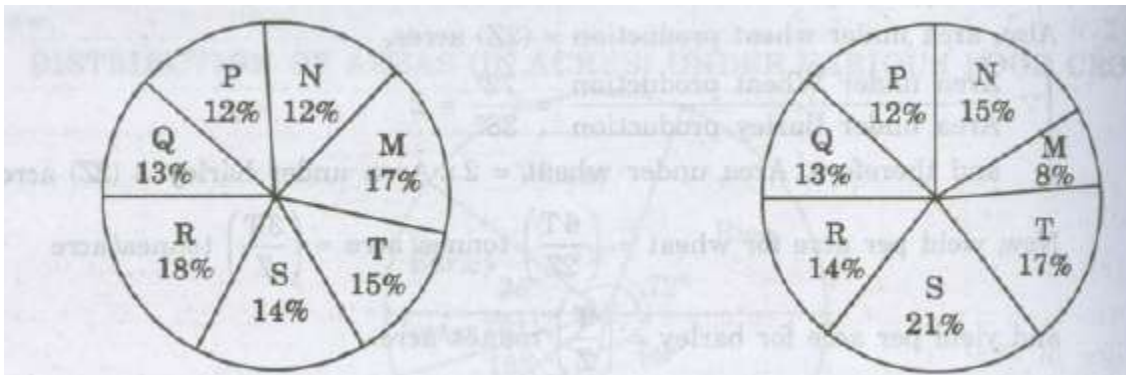

1.How many students of institutes M and S are studying at graduate level?
   (a) 7516   (b) 8463   (c) 9127   (d) 9404

2.Total number of students studying at post -graduate level from institutes N and P is:
   (a) 5601   (b) 5944   (c) 6669   (d) 7004

3.What is the total number of graduate and post-graduate level students in institute R?
   (a) 8320   (b) 7916   (c) 9116   (d) 8372

4 .What is the ratio between the number of students studying at post graduate and graduate levels respectively from institute S?
     (a) 14:19   (b) 19:21   (c) 17:21   (d) 19:14

5.What is the ratio between the number of students studying post graduate level from institute S and the number of students studying at graduate level from institute Q?
     (a) 13:19   (b) 21:13   (c) 13:8   (d)19:13

SOLUTION

1.(b):Students of institute M at graduate level = 17% of 27300 = 4641.
   Students of institute S at graduate level = 14% of 27300 = 3822
   ∴Total number students at graduate level in institutes M and S = 4641+3822=8463

2.(c):Required number = (15% of 24700) + (12% of 24700) = 3705 + 2964 = 6669.

3.(d):Required number = (18% of 27300) + (14% of 24700) = 4914 + 3458 = 8372.

4.(d):Required ratio = $\dfrac{(21\% \text{ of } 24700)}{(14\% \text{ of } 27300)} = \dfrac{21 * 24700}{14 * 27300} = \dfrac{19}{14}$

5.(d):Required ratio = $\dfrac{(21\% \text{ of } 24700)}{(13\% \text{ of } 27300)} = \dfrac{21 * 24700}{13 * 27300} = \dfrac{19}{13}$

Example 4.Study the following pie-chart and the table and the answer the questions based on them.

PROPORTION OF POPULATION OF SEVEN VILLAGES IN 1997
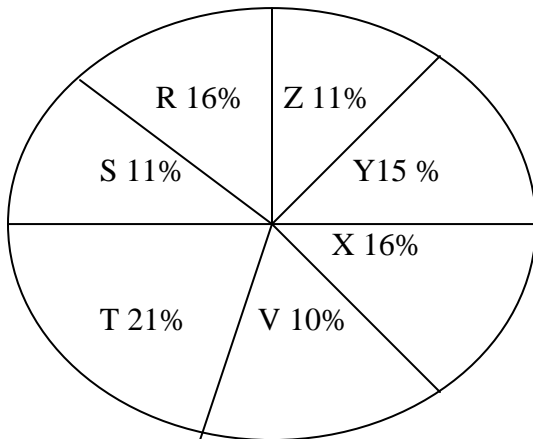
village	% population below poverty
X	38
Y	52
Z	42
R	51
S	49
T	46
V	58

1.Find the population of villages S if the population of village X below poverty line in 1997 is 12160.
   (a). 18500   (b) 20500   (c) 22000   (d) 26000

2.The ratio of the population of the village T below poverty line to that of village Z below poverty line in 1997 is:
   (a) 11:23   (b) 13:11   (c) 23:11   (d) 11:13

3.If the population of village R in 1997 is 32000,then what will be the population of village Y below poverty line in that year?
   (a) 14100   (b)15600   (c) 16500   (d) 17000

4.If in 1998, the population of villages Y and V increases by 10% each and the percentage of population below poverty line remains unchanged for all the villages, then find the population of village V below poverty line in 1998,given that the population of village Y in 1997 was 30000.
   (a) 11250   (b) 12760   (c) 13140   (d) 13780

5.If in 1998,the population of village R increases by 10% while that of village Z reduces by 5% compared that in 1997 and the percentage of population below poverty line remains unchanged for all the village,then find the approximate ratio of population of village R below poverty line for the year 1999.
   (a) 2:1   (b) 3:2   (c) 4:3   (d) 5:4

SOLUTION

1.(c):Let the population of village X be x

Then,38% of x=12160 $\Rightarrow$ x $= \dfrac{12160 * 100}{38}$ =3200

Now ,if s be the population village S,then

16:11 = 32000 : s $\Rightarrow$ s$= \dfrac{11 * 32000}{16}$ = 22000.

2.(c): Let N be the total population of all the seven villages.

Then ,population of village T below poverty line = 46% of (21% of N) and population of village Z below poverty line = 42% of (11% of N)

$$\therefore \text{Required ratio} = \frac{46\% \text{ of } (21\% \text{ of } N)}{42\% \text{ of } (11\% \text{ of } N)} = \frac{46 * 21}{42 * 11} = \frac{23}{11}$$

3.(b): Population of village R = 32000(given)

Let the population of village Y be y.

Then, 16:15 = 32000 : y $\Rightarrow$ y $= \dfrac{15 * 32000}{16}$ =30000

4.(b): Population of village Y in 1997 = 30000(given) .

Let the population village V in 1997 be v.

Then, 15:10 = 30000:v $\Rightarrow$ v $= \dfrac{30000 * 10}{15}$ = 20000.

Now population of village V in 1998 = 20000 + (10% 0f 20000) = 20000.

$\therefore$ Population of village V below poverty line in 1998 = 58% of 22000 = 12760.

5.(a) : Let the total population of all the seven villages in 1997 be N.

Then,population of village R in 1997 = 16% of N = 16/ 100 N

And population of village Z in 1997 = 11% of N =11/100 N

$\therefore$ Population of village R in 1999 = {16/100N+(10% of 16/100 N)}=1760/10000 N

and population of village Z in 1999 = {11/100 N-(5% of 11/100 N)} = 1045/10000 N.
Now,population of village R below poverty line for 1999 = 51% of(1760/10000 N)
And population of village Z below poverty line 1999 = 42% of (1045/10000 n)

$$\text{Required ratio} = \frac{51\% \text{ of } (1760/10000 \text{ N})}{42\% \text{ of } (1045/10000 \text{ N})} = \frac{51 * 1760}{42 * 1045} = \frac{2}{1.}$$