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 the sector 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 angles is 360°, we have

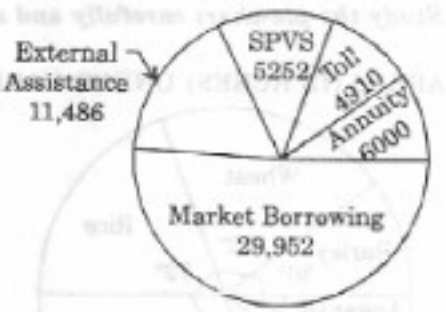
$$\text{Central angle of the component} = \left(\frac{\text{Value of the component}}{\text{Total value}} \times 360\right)^{\circ}$$

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

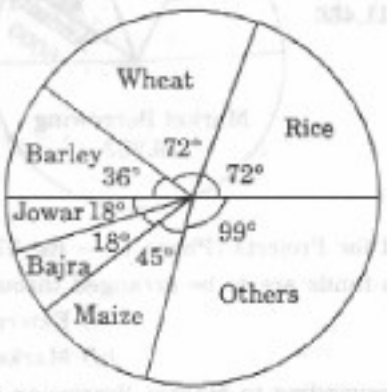
4. If NHAI could receive a total of Rs. 9695 crores as External Assistance, by what percent (approximately) should it increase the Market Borrowings to arrange for the shortage of funds ?
   (a) 4.5% (b) 7.5% (c) 6% (d) 8%
5. If the toll is to be collected through an outsourced agency by allowing a maximum 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 crores = Rs. 11486 crores.
   Rs. 11486 crores is the amount of funds to be arranged through External Assistance.
2. **(c)** : Central angle corresponding to Market Borrowing $= \left(\frac{29952}{57600} \times 360^\circ\right) = 187.2^\circ$.
3. **(b)** : Required ratio $= \frac{4910}{29952} = \frac{1}{6.1} \approx \frac{1}{6}$.
4. **(c)** : Shortage of funds arranged through External Assistance
   = Rs. (11486 – 9695) crores = Rs. 1791 crores.
   ∴ Increase required in Market Borrowings = Rs. 1791 crores.
   Percentage increase required $= \left(\frac{1791}{29952} \times 100\right)\% = 5.98\% \approx 6\%$.
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*) $33\frac{1}{3}\%$ (*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°

SOLUTION

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 central angle corresponding to that crop.

Let, the area under rice production be x million acres.

Then, $18 : 72 = 1.5 : x \Rightarrow x = \left(\frac{72 \times 1.5}{18}\right) = 6.$

Thus, the area under rice production = 6 million acres.

3. (*b*) : Let the total production of barley be T tonnes and let Z acres of land be put under barley production.

Then, the total production of wheat = (6T) tonnes.

Also, area under wheat production = (2Z) acres.

$$\left[\because \frac{\text{Area under Wheat production}}{\text{Area under Barley production}} = \frac{72°}{36°} = 2 \right.$$

$$\left. \text{and therefore, Area under wheat} = 2 \times \text{Area under barley} = (2Z) \text{ acres}\right]$$

Now, yield per acre for wheat $= \left(\frac{6T}{2Z}\right)$ tonnes/acre $= \left(\frac{3T}{Z}\right)$ tonnes/acre

and yield per acre for barley $= \left(\frac{T}{Z}\right)$ tonnes/acre.

$\therefore$ Required Ratio $= \left(\frac{3T/Z}{T/Z}\right) = 3 : 1.$

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

Then, $\frac{\text{Area under rice production}}{\text{Area under barley production}} = \frac{72°}{36°} = 2.$

$\therefore$ Area under Rice production = 2 × area under barley production = (2Z) acres.

Now, if p tonnes be the yield per acre of barley then, yield per acre of rice

$= (p + 50\% \text{ of } p)$ tonnes $= \left(\frac{3}{2}p\right)$ tonnes.

$\therefore$ Total production of rice = (yield per acre) × (area under production)

$$= \left(\frac{3}{2}p\right) \times 2Z = (3pZ) \text{ tonnes.}$$

And, Total production of barley = (pZ) tonnes.

$\therefore$ Percentage production of barley to that of rice = $\left(\frac{pZ}{3pZ} \times 100\right)\% = 33\frac{1}{3}\%$.

5. (b) : Initially, let t acres be the total area under consideration.

Then, area under wheat production initially was = $\left(\frac{72}{360} \times t\right)$ acres = $\left(\frac{t}{5}\right)$ acres.

Now, if the total area under consideration be increased by 5%, then the new value of the total area = $\left(\frac{105}{100}t\right)$ acres.

Also, if the area under wheat production be increased by 12%, then the new value of the area under wheat = $\left[\frac{t}{5} + \left(12\% \text{ of } \frac{t}{5}\right)\right]$ acres = $\left(\frac{112t}{500}\right)$ acres.

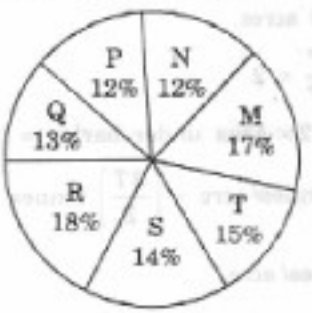
$\therefore$ Central angle corresponding to wheat in the new pie-chart

$$= \left[\frac{\text{Area under wheat (new)}}{\text{Total area (new)}} \times 360\right]^\circ = \left[\frac{\left(\frac{112t}{500}\right)}{\left(\frac{105t}{100}\right)} \times 360\right]^\circ = 76.8^\circ.$$

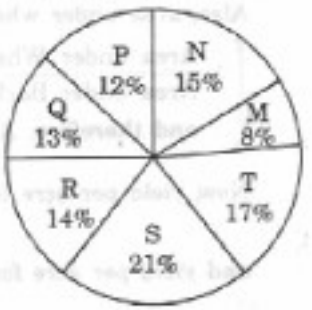
Example 3. ***The following pie-charts show the distribution of students of graduate and post-graduate levels in seven different institutes — M, N, P, Q, R, S and T in a town.*** **(Bank P.O. 2003)**

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 = 27300



Total Number of Students of Post-Graduate Level = 24700



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 at post-graduate level from institute S and the number of students studying at graduate level from institute Q ?

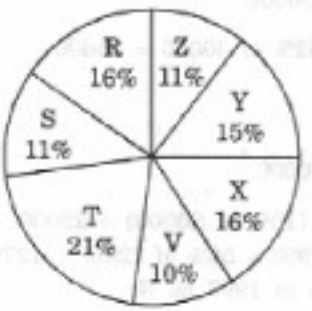
(*a*) 13 : 19 (*b*) 21 : 13 (*c*) 13 : 8 (*d*) 19 : 13

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 of 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 = $\frac{(21\% \text{ of } 24700)}{(14\% \text{ of } 27300)} = \frac{21 \times 24700}{14 \times 27300} = \frac{19}{14}$.
5. (*d*) : Required ratio = $\frac{(21\% \text{ of } 24700)}{(13\% \text{ of } 27300)} = \frac{21 \times 24700}{13 \times 27300} = \frac{19}{13}$.

Example 4. ***Study the following pie-chart and the table and answer the questions based on them.*** (S.B.I.P.O. 1999)

PROPORTION OF POPULATION OF SEVEN VILLAGES IN 1997



Village	% Population Below Poverty Line
X	38
Y	52
Z	42
R	51
S	49
T	46
V	58

1. Find the population of village 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 population of 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 increase 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 1999, the population of village R increases by 10% while that of village Z reduces by 5% compared to that in 1997 and the percentage of population below poverty line remains unchanged for all the villages, then find the approximate ratio of population of village R below poverty line to the ratio of population of village Z 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 $x = 12160 \Rightarrow x = \dfrac{12160 \times 100}{38} = 32000$.

Now, if s be the population of village S, then

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

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)

$\therefore$ Required ratio $= \dfrac{46\% \text{ of } (21\% \text{ of N})}{42\% \text{ of } (11\% \text{ of N})} = \dfrac{46 \times 21}{42 \times 11} = \dfrac{23}{11}$.

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

Let the population of village Y be y.

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

$\therefore$ Population of village Y below poverty line = 52% of 30000 = 15600.

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

Let the population of village V in 1997 be v.

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

Now, population of village V in 1998 = 20000 + (10% of 20000) = 22000.

$\therefore$ 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 $N = \dfrac{16}{100} N$

and population of village Z in 1997 = 11% of $N = \dfrac{11}{100} N$.

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

and population of village Z in 1999 $= \left\{\dfrac{11}{100} N - \left(5\% \text{ of } \dfrac{11}{100} N\right)\right\} = \dfrac{1045}{10000} N$

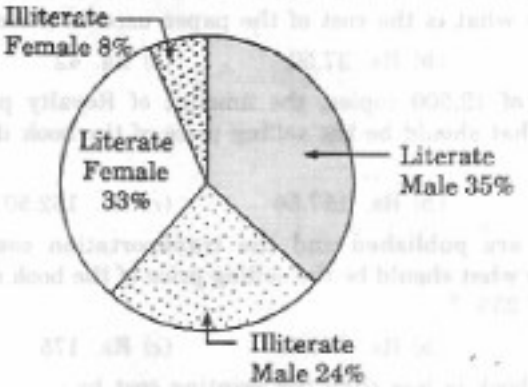
Now, population of village R below poverty line for 1999 = 51% of $\left(\dfrac{1760}{10000} N\right)$

and population of village Z below poverty line for 1999 = 42% of $\left(\dfrac{1045}{10000} N\right)$.

$\therefore$ Required ratio $= \dfrac{51\% \text{ of } \left(\dfrac{1760}{10000} N\right)}{42\% \text{ of } \left(\dfrac{1045}{10000} N\right)} = \dfrac{51 \times 1760}{42 \times 1045} = \dfrac{2}{1}$.

EXERCISE 38

1. The following pie-chart shows the percentage of Literate and Illiterate — Males and Females in a city. **(Bank P.O. 2003)**



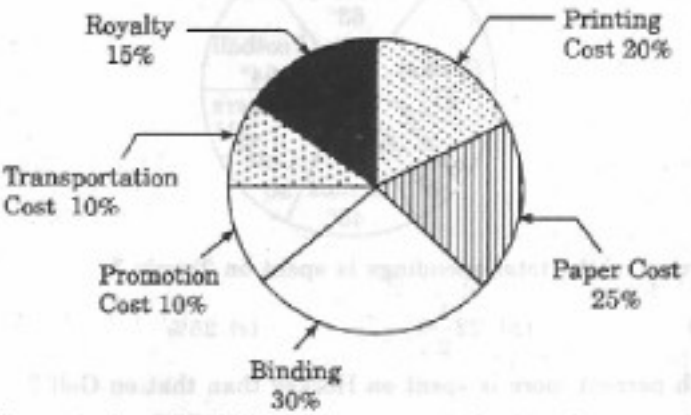
Total number = 2,50,000.

What is the difference between the number of Literate Males and Literate Females ?

(*a*) 75,000 (*b*) 1,500 (*c*) 5,000 (*d*) 500

Directions (Questions 2 to 10) : ***The following pie-chart shows the percentage distribution of the expenditure incurred in publishing a book. Study the pie-chart and answer the questions based on it.*** **(Bank P.O. 2002)**

VARIOUS EXPENDITURES (IN PERCENTAGE) INCURRED IN PUBLISHING A BOOK



2. What is the central angle of the sector corresponding to the expenditure incurred on Royalty ?

(*a*) 15° (*b*) 24° (*c*) 54° (*d*) 48°

3. Which two expenditures together have a central angle of 108° ?

(*a*) Binding Cost and Transportation Cost (*b*) Printing Cost and Paper Cost
(*c*) Royalty and Promotion Cost (*d*) Binding Cost and Paper Cost

4. If the difference between the two expenditures are represented by 18° in the pie-chart, then these expenditures possibly are :

(*a*) Binding Cost and Promotion Cost (*b*) Paper Cost and Royalty
(*c*) Binding Cost and Printing Post (*d*) Paper Cost and Printing Cost

5. If for an edition of the book, the cost of paper is Rs. 56250, then find the promotion cost for this edition.

(*a*) Rs. 20,000 (*b*) Rs. 22,500 (*c*) Rs. 25,500 (*d*) Rs. 28,125

6. If for a certain quantity of books, the publisher has to pay Rs. 30,600 as printing cost, then what will be the amount of royalty to be paid for these books ?

(a) Rs. 19,450 (b) Rs. 21,200 (c) Rs. 22,950 (d) Rs. 26,150

7. The price of the book is marked 20% above the C.P. If the marked price of the book is Rs. 180, then what is the cost of the paper used in a single copy of the book ?

(a) Rs. 36 (b) Rs. 37.50 (c) Rs. 42 (d) Rs. 44.25

8. For an edition of 12,500 copies, the amount of Royalty paid by the publisher is Rs. 2,81,250. What should be the selling price of the book if the publisher desires a profit of 5% ?

(a) Rs. 152.50 (b) Rs. 157.50 (c) Rs. 162.50 (d) Rs. 167.50

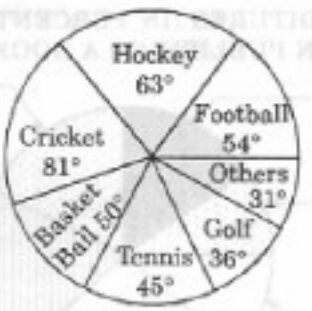
9. If 5500 copies are published and the transportation cost on them amounts to Rs. 82,500, then what should be the selling price of the book so that the publisher can earn a profit of 25% ?

(a) Rs. 187.50 (b) Rs. 191.50 (c) Rs. 175 (d) Rs. 180

10. Royalty on the book is less than the printing cost by :

(a) 5% (b) $33\frac{1}{3}\%$ (c) 20% (d) 25%

Directions (Questions 11 to 15) : ***The circle-graph given here shows the spendings of a country on various sports during a particular year. Study the graph carefully and answer the questions given below it.***



11. What percent of the total spendings is spent on Tennis ?

(a) $12\frac{1}{2}\%$ (b) $22\frac{1}{2}\%$ (c) 25% (d) 45%

12. How much percent more is spent on Hockey than that on Golf ?

(a) 27% (b) 35% (c) 37.5% (d) 75%

13. How much percent less is spent on Football than that on Cricket ?

(a) $22\frac{2}{9}\%$ (b) 27% (c) $33\frac{1}{3}\%$ (d) $37\frac{1}{2}\%$

14. If the total amount spent on sports during the year was Rs. 2 crores, the amount spent on Cricket and Hockey together was :

(a) Rs. 8,00,000 (b) Rs. 80,00,000 (c) Rs. 1,20,00,000 (d) Rs. 1,60,00,000

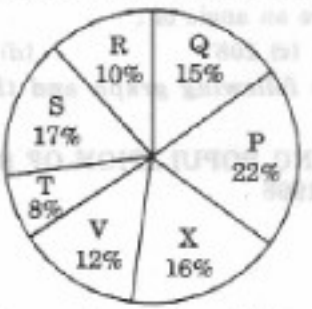
15. If the total amount spent on sports during the year be Rs. 1,80,00,000, the amount spent on Basketball exceeds that on Tennis by :

(a) Rs. 2,50,000 (b) Rs. 3,60,000 (c) Rs. 3,75,000 (d) Rs. 4,10,000

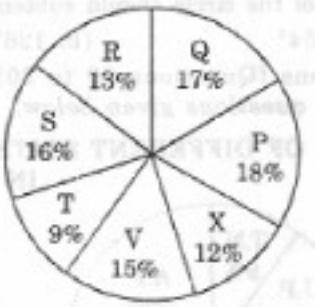
Directions (Questions 16 to 20) : ***Study the following graph carefully and answer the questions given below :*** (Bank P.O. 2002)

DISTRIBUTION OF CANDIDATES WHO WERE ENROLLED FOR MBA ENTRANCE EXAM AND THE CANDIDATES (OUT OF THOSE ENROLLED) WHO PASSED THE EXAM IN DIFFERENT INSTITUTES

Candidates Enrolled = 8550



Candidates who Passed the Exam = 5700



16. What percentage of candidates passed the Exam from institute T out of the total number of candidates enrolled from the same institute ?
(*a*) 50% (*b*) 62.5% (*c*) 75% (*d*) 80%

17. What is the ratio of candidates passed to the candidates enrolled from institute P ?
(*a*) 9 : 11 (*b*) 14 : 17 (*c*) 6 : 11 (*d*) 9 : 17

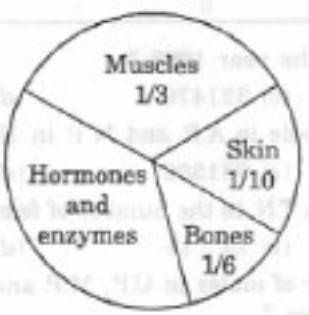
18. What is the percentage of candidates passed to the candidates enrolled for institutes Q and R together ?
(*a*) 68% (*b*) 80% (*c*) 74% (*d*) 65%

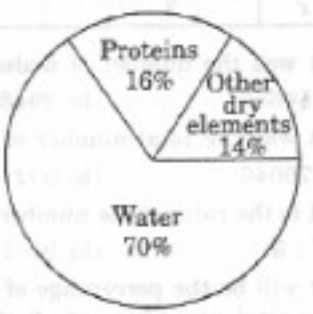
19. Which institute has the highest percentage of candidates passed to the candidates enrolled ?
(*a*) Q (*b*) R (*c*) V (*d*) T

20. The number of candidates passed from institutes S and P together exceeds the number of candidates enrolled from institutes T and R together by :
(*a*) 228 (*b*) 279 (*c*) 399 (*d*) 407

Directions (Questions 21 to 25) : ***Study the following pie-diagrams carefully and answer the questions given below it.***

PERCENTAGE COMPOSITION OF HUMAN BODY





21. In the human body, what part is made of neither bones nor skin ?
(*a*) $\frac{1}{40}$ (*b*) $\frac{3}{80}$ (*c*) $\frac{2}{5}$ (*d*) None of these

22. What is the ratio of the distribution of proteins in the muscles to that of the distribution of proteins in the bones ?
(*a*) 1 : 18 (*b*) 1 : 2 (*c*) 2 : 1 (*d*) 18 : 1

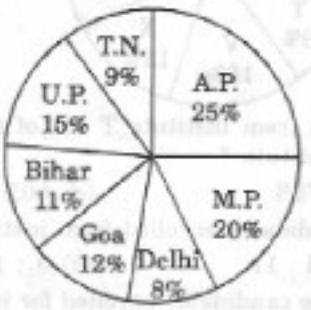
23. What will be the quantity of water in the body of a person weighing 50 kg ?
(a) 20 kg (b) 35 kg (c) 41 kg (d) 42.5 kg

24. What percent of the total weight of human body is equivalent to the weight of the proteins in skin in human body ?
(a) 0.016 (b) 1.6 (c) 0.16 (d) Data inadequate

25. To show the distribution of proteins and other dry elements in the human body, the arc of the circle should subtend at the centre an angle of :
(a) 54° (b) 126° (c) 108° (d) 252°

Directions (Questions 26 to 30) : ***Study the following graph and the table and answer the questions given below.***

DATA OF DIFFERENT STATES REGARDING POPULATION OF STATES IN THE YEAR 1998



Total Population of the given States = 3276000

States	Sex and Literacy wise Population Ratio					
	Sex			Literacy		
	M	—	F	Literate	—	Illiterate
A.P.	5	:	3	2	:	7
M.P.	3	:	1	1	:	4
Delhi	2	:	3	2	:	1
Goa	3	:	5	3	:	2
Bihar	3	:	4	5	:	1
U.P.	3	:	2	7	:	2
T.N.	3	:	4	9	:	4

26. What was the number of males in U.P. in the year 1998 ?
(a) 254650 (b) 294840 (c) 321470 (d) 341200

27. What was the total number of illiterate people in A.P. and M.P. in 1998 ?
(a) 876040 (b) 932170 (c) 981550 (d) 1161160

28. What is the ratio of the number of females in T.N. to the number of females in Delhi ?
(a) 7 : 5 (b) 9 : 7 (c) 13 : 11 (d) 15 : 14

29. What will be the percentage of total number of males in U.P., M.P. and Goa together to the total population of all the given states ?
(a) 25% (b) 27.5% (c) 28.5% (d) 31.5%

30. If in the year 1998, there was an increase of 10% in the population of U.P. and 12% in the population of M.P. compared to the previous year, then what was the ratio of populations of U.P. and M.P. in 1997 ?
(a) 42 : 55 (b) 48 : 55 (c) 7 : 11 (d) 4 : 5

ANSWERS

1. (c)	2. (c)	3. (a)	4. (d)	5. (b)	6. (c)	7. (b)	8. (b)	9. (a)
10. (d)	11. (a)	12. (d)	13. (c)	14. (b)	15. (a)	16. (c)	17. (c)	18. (b)
19. (b)	20. (c)	21. (d)	22. (c)	23. (b)	24. (b)	25. (c)	26. (b)	27. (d)
28. (d)	29. (c)	30. (a)						

SOLUTIONS

1. Difference = (35% of 2,50,000) – (33% of 2,50,000)
= (35% – 33%) of 2,50,000 = 2% of 2,50,000 = 5000.

2. Central angle corresponding to Royalty = (15% of 360)° = 54°.

3. Central angle of 108° = $\left(\frac{108}{360}\times 100\right)\%$ of the total expenditure
= 30% of the total expenditure.
From the pie-chart it is clear that :
Binding Cost + Transportation Cost = (20% + 10%) of the total expenditure
= 30% of the total expenditure.
∴ Binding Cost and Transportation Cost together have a central angle of 108°.

4. Central angle of 18° = $\left(\frac{18}{360}\times 100\right)\%$ of the total expenditure
= 5% of the total expenditure.
From the pie-chart it is clear that :
Out of the given combinations, only in combination (*d*) the difference is 5% *i.e.*
Paper Cost – Printing Cost = (25% – 20%) of total expenditure
= 5% of total expenditure.

5. Let the Promotion Cost for this edition be Rs. *p*.
Then, 25 : 10 = 56250 : *p* ⇒ *p* = Rs. $\left(\frac{56250\times 10}{25}\right)$ = Rs. 22500.

6. Let the amount of Royalty to be paid for these books be Rs. *r*.
Then, 20 : 15 = 30600 : *r* ⇒ *r* = Rs. $\left(\frac{30600\times 15}{20}\right)$ = Rs. 22950.

7. Clearly, marked price of the book = 120% of C.P.
Also, cost of paper = 25% of C.P.
Let the cost of paper for a single book be Rs. *n*.
Then, 120 : 25 = 180 : *n* ⇒ *n* = Rs. $\left(\frac{25\times 180}{120}\right)$ = Rs. 37.50.

8. Clearly, S.P. of the book = 105% of C.P.
Let the selling price of this edition (of 12500 books) be Rs. *x*.
Then, 15 : 105 = 281250 : *x* ⇒ *x* = Rs. $\left(\frac{105\times 281250}{15}\right)$ = Rs. 1968750.
∴ S.P. of one book = Rs. $\left(\frac{1968750}{12500}\right)$ = Rs. 157.50.

9. For the publisher to earn a profit of 25%, S.P. = 125% of C.P.
Also Transportation Cost = 10% of C.P.
Let the S.P. of 5500 books be Rs. x.
Then, $10 : 125 = 82500 : x \Rightarrow x$ = Rs. $\left(\frac{125 \times 82500}{10}\right)$ = Rs. 1031250.
$\therefore$ S.P. of one book = Rs. $\left(\frac{1031250}{5500}\right)$ = Rs. 187.50.

10. Printing Cost of book = 20% of C.P.
Royalty on book = 15% of C.P.
Difference = (20% of C.P.) – (15% of C.P.) = 5% of C.P.
$\therefore$ Percentage difference = $\left(\frac{\text{Difference}}{\text{Printing Cost}} \times 100\right)\%$
$= \left(\frac{5\% \text{ of C.P.}}{20\% \text{ of C.P.}} \times 100\right)\% = 25\%$.
Thus, Royalty on the book is 25% less than the Printing Cost.

11. Percentage of money spent on Tennis = $\left(\frac{45}{360} \times 100\right)\% = 12\frac{1}{2}\%$.

12. Let the total spendings on sports be Rs. x. Then,
Amount spent on Golf = Rs. $\left(\frac{36}{360} \times x\right)$ = Rs. $\frac{x}{10}$.
Amount spent on Hockey = Rs. $\left(\frac{63}{360} \times x\right)$ = Rs. $\frac{7}{40}x$.
Difference = Rs. $\left(\frac{7}{40}x - \frac{x}{10}\right)$ = Rs. $\frac{3x}{40}$.
$\therefore$ Required Percentage = $\left[\left(\frac{3x/40}{x/10}\right) \times 100\right]\% = 75\%$.

13. Let the total spendings on sports be Rs. x. Then,
Amount spent on Cricket = Rs. $\left(\frac{81}{360} \times x\right)$ = Rs. $\left(\frac{9}{40}x\right)$.
Amount spent on Football = Rs. $\left(\frac{54}{360} \times x\right)$ = Rs. $\left(\frac{3}{20}x\right)$.
Difference = Rs. $\left(\frac{9}{40}x - \frac{3}{20}x\right)$ = Rs. $\frac{3}{40}x$.
$\therefore$ Required Percentage = $\left[\left(\frac{3x/40}{9x/40}\right) \times 100\right]\% = 33\frac{1}{3}\%$.

14. Amount spent on Cricket and Hockey together
= Rs. $\left[\frac{(81+63)}{360} \times 2\right]$ crores = Rs. 0.8 crores = Rs. 8000000.

15. Amount spent on Basketball exceeds that on Tennis by :
Rs. $\left[\frac{(50-45)}{360} \times 18000000\right]$ = Rs. 250000.

16. Required percentage = $\left(\frac{9\% \text{ of } 5700}{8\% \text{ of } 8550} \times 100\right)\% = \left(\frac{9 \times 5700}{8 \times 8550} \times 100\right)\% = 75\%$.

17. Required ratio $= \left(\frac{18\% \text{ of } 5700}{22\% \text{ of } 8550}\right) = \left(\frac{18 \times 5700}{22 \times 8550}\right) = \frac{6}{11}$.

18. Candidates passed from institutes Q and R together
$= [(13\% + 17\%) \text{ of } 5700] = 30\% \text{ of } 5700.$

Candidates enrolled from institutes Q and R together
$= [(15\% + 10\%) \text{ of } 8550] = 25\% \text{ of } 8550.$

$\therefore$ Required Percentage $= \left(\frac{30\% \text{ of } 5700}{25\% \text{ of } 8550} \times 100\right)\% = \left(\frac{30 \times 5700}{25 \times 8550} \times 100\right)\% = 80\%.$

19. The percentage of candidates passed to candidates enrolled can be determined for each institute as under :

(*i*) $P = \left[\left(\frac{18\% \text{ of } 5700}{22\% \text{ of } 8550}\right) \times 100\right]\% = \left[\frac{18 \times 5700}{22 \times 8550} \times 100\right]\% = \left[\frac{18 \times 2}{22 \times 3} \times 100\right]\% = 54.55\%.$

(*ii*) $Q = \left[\left(\frac{17\% \text{ of } 5700}{15\% \text{ of } 8550}\right) \times 100\right]\% = 75.56\%.$

(*iii*) $R = \left[\left(\frac{13\% \text{ of } 5700}{10\% \text{ of } 8550}\right) \times 100\right]\% = 86.67\%.$

(*iv*) $S = \left[\left(\frac{16\% \text{ of } 5700}{17\% \text{ of } 8550}\right) \times 100\right]\% = 62.75\%.$

(*v*) $T = \left[\left(\frac{9\% \text{ of } 5700}{8\% \text{ of } 8550}\right) \times 100\right]\% = 75\%.$

(*vi*) $V = \left[\left(\frac{15\% \text{ of } 5700}{12\% \text{ of } 8550}\right) \times 100\right]\% = 83.33\%.$

(*vii*) $X = \left[\left(\frac{12\% \text{ of } 5700}{16\% \text{ of } 8550}\right) \times 100\right]\% = 50\%.$

Highest of these is 86.67% corresponding to institute R.

20. Required difference $= [(16\% + 18\%) \text{ of } 5700] - [(8\% + 10\%) \text{ of } 8550]$
$= [(34\% \text{ of } 5700) - (18\% \text{ of } 8550)] = (1938 - 1539) = 399.$

21. Part of the body made of neither bones nor skin $= 1 - \left(\frac{1}{6} + \frac{1}{10}\right) = \frac{11}{15}$.

22. Required ratio $= \frac{16\% \text{ of } \frac{1}{3}}{16\% \text{ of } \frac{1}{6}} = \frac{6}{3} = \frac{2}{1}$.

23. Quantity of water in the body of a person weighing 50 kg = (70% of 50) kg = 35 kg.

24. Let the body weight be x kg.

Then, weight of skin protein in the body $= \left[16\% \text{ of } \left(\frac{1}{10} \text{ of } x\right)\right] \text{ kg} = \left(\frac{16}{1000}x\right) \text{ kg}$

$\therefore$ Required percentage $= \left[\frac{\left(\frac{16}{1000}x\right)}{x} \times 100\right]\% = 1.6\%.$

25. Percentage of proteins and other dry elements in the body = (16% + 14%) = 30%

$\therefore$ Central angle corresponding to proteins and other dry elements together
$= 30\% \text{ of } 360^\circ = 108^\circ.$

26. Number of males in U.P. $= \left[\frac{3}{5} \text{ of } (15\% \text{ of } 3276000)\right] = \frac{3}{5} \times \frac{15}{100} \times 3276000 = 294840.$

27. No. of illiterate people in A.P. $= \left[\frac{7}{9} \text{ of } (25\% \text{ of } 3276000)\right] = 637000.$

No. of illiterate people in M.P. $= \left[\frac{4}{5} \text{ of } (20\% \text{ of } 3276000)\right] = 524160.$

Total number = (637000 + 524160) = 1161160.

28. Required ratio $= \frac{\frac{4}{7} \text{ of } (9\% \text{ of } 3276000)}{\frac{3}{5} \text{ of } (8\% \text{ of } 3276000)} = \frac{\left(\frac{4}{7} \times 9\right)}{\left(\frac{3}{5} \times 8\right)} = \left(\frac{4}{7} \times 9 \times \frac{5}{3} \times \frac{1}{8}\right) = \frac{15}{14}.$

29. Number of males in U.P. $= \left[\frac{3}{5} \text{ of } (15\% \text{ of } N)\right] = \frac{3}{5} \times \frac{15}{100} \times N = 9 \times \frac{N}{100}$

where N = 3276000.

Number of males in M.P. $= \left[\frac{3}{4} \text{ of } (20\% \text{ of } N)\right] = \frac{3}{4} \times \frac{20}{100} \times N = 15 \times \frac{N}{100}.$

Number of males in Goa $= \left[\frac{3}{8} \text{ of } (12\% \text{ of } N)\right] = \frac{3}{8} \times \frac{12}{100} \times N = 4.5 \times \frac{N}{100}.$

$\therefore$ Total number of males in these three states $= (9 + 15 + 4.5) \times \frac{N}{100} = \left(28.5 \times \frac{N}{100}\right)$

$\therefore$ Required Percentage $= \left[\frac{\left(28.5 \times \frac{N}{100}\right)}{N} \times 100\right]\% = 28.5\%.$

30. Let x be the population of U.P. in 1997. Then,

Population of U.P. in 1998 = 110% of $x = \frac{110}{100} \times x.$

Also, let y be the population of M.P. in 1997. Then,

Population of M.P. in 1998 = 112% of $y = \frac{112}{100} \times y.$

Ratio of populations of U.P. and M.P. in 1998 $= \frac{\left(\frac{110}{100} \times x\right)}{\left(\frac{112}{100} \times y\right)} = \frac{110x}{112y}.$

From the pie-chart, this ratio is $\frac{15}{20}$.

$\therefore \quad \frac{110x}{112y} = \frac{15}{20} \Rightarrow \frac{x}{y} = \frac{15}{20} \times \frac{112}{110} = \frac{42}{55}.$

Thus, ratio of populations of U.P. and M.P. in 1997 = $x : y = 42 : 55$.