

Statistics

Selected NCERT Questions

1. A survey was conducted by a group of students as a part of their environment awareness programme, in which they collected the following data regarding the number of plants in 20 houses in a locality. Find the mean number of plants per house.

Number of plants	0-2	2-4	4-6	6-8	8-10	10-12	12-14
Number of houses	1	2	1	5	6	2	3

Which method did you use for finding the mean and why?

- Sol.** Calculation of mean number of plants per house.

Number of plants	Number of houses (f_i)	Class mark (x_i)	$f_i x_i$
0-2	1	1	1
2-4	2	3	6
4-6	1	5	5
6-8	5	7	35
8-10	6	9	54
10-12	2	11	22
12-14	3	13	39
Total	$\Sigma f_i = 20$		$\Sigma f_i x_i = 162$

$$\text{Hence, mean } (\bar{X}) = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{162}{20} = 8.1$$

Here, we used direct method to find mean because numerical values of x_i and f_i are small.

2. The following table shows the ages of the patients admitted in a hospital during a year.

Age (in years)	5 - 15	15 - 25	25 - 35	35 - 45	45 - 55	55 - 65
Number of patients	6	11	21	23	14	5

Find the mode of the data given above.

- Sol.** In the given data class interval 35 - 45 has maximum frequency.

\Rightarrow 35 - 45 is modal class.

$$\text{Now, mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Here, l = lower limit of modal class = 35

h = size of the class interval = 10

f_1 = frequency of the modal class = 23

f_0 = frequency of the class preceding the modal class = 21

f_2 = frequency of the class succeeding the modal class = 14

$$\begin{aligned} \therefore \text{Mode} &= 35 + \left(\frac{23 - 21}{2 \times 23 - 21 - 14} \right) \times 10 \\ &= 35 + \frac{2}{46 - 35} \times 10 = 35 + \frac{2}{11} \times 10 \\ &= 35 + \frac{20}{11} = 35 + 1.8 = 36.8 \end{aligned}$$

3. The table below shows the daily expenditure on food of 25 households in a locality.

Daily expenditure (in ₹)	100–150	150–200	200–250	250–300	300–350
No. of households	4	5	12	2	2

Find the mean daily expenditure on food by a suitable method.

[CBSE 2019 (30/1/3)]

Sol.

Daily expenditure	(x_i)	No. of houses (f_i)	$u_i = \frac{x_i - 225}{50}$	$f_i u_i$
100–150	125	4	-2	-8
150–200	175	5	-1	-5
200–250	225	12	0	0
250–300	275	2	1	2
300–350	325	2	2	4
Total		$\Sigma f_i = 25$		$\Sigma f_i u_i = -7$

2

$$\text{Mean} = 225 + 50 \times \left(\frac{-7}{25} \right) = 211$$

2

Mean expenditure on food is ₹211.

[CBSE Marking Scheme 2019 (30/1/3)]

4. The following data gives the information on the observed lifetimes (in hours) of 225 electrical components:

Lifetime (in hours)	0–20	20–40	40–60	60–80	80–100	100–120
Frequency	10	35	52	61	38	29

Determine the modal lifetimes of the components.

- Sol. Here, the maximum class frequency is 61 and the class corresponding to this frequency is 60–80. So, the modal class is 60–80.

Here, $l = 60$, $h = 20$, $f_1 = 61$, $f_0 = 52$, $f_2 = 38$

$$\begin{aligned}\therefore \text{Mode} &= l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h = 60 + \frac{61 - 52}{2 \times 61 - 52 - 38} \times 20 = 60 + \frac{9}{122 - 90} \times 20 \\ &= 60 + \frac{9}{32} \times 20 = 60 + \frac{45}{8} = 60 + 5.625 = 65.625\end{aligned}$$

Hence, modal lifetime of the components is 65.625 hours.

5. The median of the following data is 525. Find the values of x and y , if total frequency is 100 :

Class	Frequency
0-100	2
100-200	5
200-300	x
300-400	12
400-500	17
500-600	20
600-700	y
700-800	9
800-900	7
900-1000	4

Sol. We have

Class	Frequency	Cumulative frequency
0-100	2	2
100-200	5	7
200-300	x	$7 + x$
300-400	12	$19 + x$
400-500	17	$36 + x$
500-600	20	$56 + x$
600-700	y	$56 + x + y$
700-800	9	$65 + x + y$
800-900	7	$72 + x + y$
900-1000	4	$76 + x + y$
Total	100	

$$\therefore 76 + x + y = 100 \quad \Rightarrow \quad x + y = 24 \quad \dots(i)$$

\therefore Given median is 525.

\therefore 500-600 is the median class.

$$\therefore l = 500, \quad h = 100, \quad cf = 36 + x, \quad f = 20$$

$$\therefore \text{Median} = l + \frac{\frac{N}{2} - cf}{f} \times h$$

$$\Rightarrow 525 = 500 + \frac{50 - 36 - x}{20} \times 100$$

$$\Rightarrow 25 = (14 - x) \times 5 \quad \Rightarrow \quad 14 - x = 5 \quad \Rightarrow \quad x = 9$$

Putting $x = 9$ in equation (i), we have

$$9 + y = 24 \quad \Rightarrow \quad y = 24 - 9 = 15 \quad \Rightarrow \quad y = 15$$

6. If the median of the distribution given below is 28.5, find the values of x and y . [HOTS]

Class interval	0-10	10-20	20-30	30-40	40-50	50-60	Total
Frequency	5	x	20	15	y	5	60

Sol. Here, median = 28.5 and $n = 60$

Now, we have

Class interval	Frequency (f_i)	Cumulative frequency (cf)
0-10	5	5
10-20	x	$5 + x$
20-30	20	$25 + x$
30-40	15	$40 + x$
40-50	y	$40 + x + y$
50-60	5	$45 + x + y$
Total	$\Sigma f_i = 60$	

Since the median is given to be 28.5, thus the median class is 20 - 30.

$$\therefore \frac{n}{2} = 30, l = 20, h = 10, cf = 5 + x \text{ and } f = 20$$

$$\therefore \text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h \quad \Rightarrow \quad 28.5 = 20 + \left[\frac{30 - (5 + x)}{20} \right] \times 10$$

$$\Rightarrow 28.5 = 20 + \frac{25 - x}{20} \times 10$$

$$\Rightarrow 28.5 = 20 + \frac{25 - x}{2} \quad \Rightarrow \quad 57 = 40 + 25 - x$$

$$\Rightarrow 57 = 65 - x \quad \Rightarrow \quad x = 65 - 57 = 8$$

$$\text{Also, } n = \Sigma f_i = 60$$

$$\Rightarrow 45 + x + y = 60$$

$$\Rightarrow 45 + 8 + y = 60 \quad (\because x = 8)$$

$$\therefore y = 60 - 53 \quad \Rightarrow \quad y = 7$$

Hence, $x = 8$ and $y = 7$.

7. The lengths of 40 leaves of a plant are measured correctly to the nearest millimetre, and the data obtained is represented in the following table:

Length (in mm)	118-126	127-135	136-144	145-153	154-162	163-171	172-180
Number of leaves	3	5	9	12	5	4	2

Find the median length of the leaves.

Sol. Here, the classes are not in inclusive form. So, we first convert them in inclusive form by subtracting $\frac{h}{2}$ from the lower limit and adding $\frac{h}{2}$ to the upper limit of each class, where h is the difference between the lower limit of a class and the upper limit of preceding class.

Now, we have

Class interval	Number of leaves	Cumulative frequency
117.5–126.5	3	3
126.5–135.5	5	8
135.5–144.5	9	17
144.5–153.5	12	29
153.5–162.5	5	34
162.5–171.5	4	38
171.5–180.5	2	40
Total	$\Sigma f_i = 40$	

We have, $n = 40 \Rightarrow \frac{n}{2} = 20$

And, the cumulative frequency just greater than $\frac{n}{2}$ is 29 and corresponding class is 144.5 – 153.5.

So median class is 144.5 – 153.5.

Here, we have $\frac{n}{2} = 20, l = 144.5, h = 9, f = 12, cf = 17$

$$\begin{aligned}
 \therefore \text{Median} &= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h = 144.5 + \left(\frac{20 - 17}{12} \right) \times 9 \\
 &= 144.5 + \frac{3}{12} \times 9 = 144.5 + \frac{9}{4} \\
 &= 144.5 + 2.25 = 146.75 \text{ mm.}
 \end{aligned}$$

Hence, the median length of the leaves is 146.75 mm.

8. The distribution below gives the weights of 30 students of a class. Find the median weight of the students.

Weight (in kg)	40–45	45–50	50–55	55–60	60–65	65–70	70–75
Number of students	2	3	8	6	6	3	2

Sol. Calculation of median

Weight (in kg)	Number of students (f)	Cumulative frequency (cf)
40–45	2	2
45–50	3	5
50–55	8	13
55–60	6	19
60–65	6	25
65–70	3	28
70–75	2	30
Total	$\Sigma f_i = 30$	

We have, $\Sigma f_i = n = 30 \Rightarrow \frac{n}{2} = 15$

The cumulative frequency just greater than $\frac{n}{2} = 15$ is 19, and the corresponding class is 55 – 60.

\therefore 55 – 60 is the median class.

Now, we have $\frac{n}{2} = 15, l = 55, cf = 13, f = 6, h = 5$

$$\therefore \text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

$$= 55 + \left(\frac{15 - 13}{6} \right) \times 5 = 55 + \frac{2}{6} \times 5 = 55 + 1.67 = 56.67$$

Hence, median weight is 56.67 kg.

Multiple Choice Questions

Choose and write the correct option in the following questions.

1. The table below shows the time taken by a group of students to complete 100 m race.

Time taken (in sec)	18-20	20-22	22-24	24-26	26-28	28-30
No. of students	3	18	26	19	9	5

Which of these is the mean time taken, in sec, by the group of students to complete the 100 m race when calculated using direct method?

- (a) 18.16 (b) 18.96 (c) 23.7 (d) 33.7
2. Vatsal grows cucumbers in his farm. He collects some of them and measures their lengths and represents his data as shown below.

Height (in cm)	110-120	120-130	130-140	140-150	150-160	160-170	170-180
No. of cucumbers	10	18	12	n	26	11	19

When calculated using assumed mean method, Vatsal gets the mean length of the cucumber as 147.25 cm. Which of the following statement is true? [Competency Based Question]

- (a) There are a smaller number of cucumbers of length (140 – 150) mm than of length (120 – 130) mm.
- (b) There are a greater number of cucumbers of length (140 – 150) mm than of length (130 – 140) mm.
- (c) There are a greater number of cucumbers of length (140 – 150) mm than of length (150 – 160) mm.
- (d) There are a smaller number of cucumbers of length (140 – 150) mm than of length (170 – 180) mm.
3. For the following distribution : [NCERT Exemplar]

Marks	Number of students
Below 10	3
Below 20	12
Below 30	27
Below 40	57
Below 50	75
Below 60	80

The modal class is

- (a) 10-20 (b) 20-30 (c) 30-40 (d) 50-60

4. A grouped data is shown below:

Class Interval	Frequency	Cumulative frequency
0–10	4	4
10–20	a	$4 + a$
20–30	4	$8 + a$
30–40	b	$8 + a + b$
40–50	5	$13 + a + b$
Total	$13 + a + b$	

If the median of the grouped data is 22.50 and the total frequency is 20, then what is the value of a ?

- (a) 3 (b) 4 (c) 5 (d) 6
5. Consider the following frequency distribution of the height of 60 students of a class:

Height (in cm)	150–155	155–160	160–165	165–170	170–175	175–180
No. of students	15	13	10	8	9	5

The sum of the lower limit of the modal class and upper limit of the median class is

[NCERT Exemplar]

- (a) 310 (b) 315 (c) 320 (d) 330
6. Consider the following frequency distribution:

Class	0–5	6–11	12–17	18–23	24–29
Frequency	13	10	15	8	11

The upper limit of the median class is

[NCERT Exemplar]

- (a) 17 (b) 17.5 (c) 18 (d) 18.5
7. The table below shows the time spent by 100 students on exercising every day.

Time (in minutes)	Number of students
0–10	x
10–20	24
20–30	32
30–40	21
40–50	y
50–60	5

If the median time spent by the students on exercising is 26.25 minutes which statement correctly compares the frequencies of the class intervals 0 – 10 and 40 – 50?

- (a) There are twice as many students who exercise 40 – 50 minutes each day as the number of students who exercise 0 – 10 minutes each day.
- (b) There are thrice as many students who exercise 40 – 50 minutes each day as the number of students who exercise 0 – 10 minutes each day.
- (c) There are twice as many students who exercise 0 – 10 minutes each day as the number of students who exercise 40 – 50 minutes each day.
- (d) There are thrice as many students who exercise 0 – 10 minutes each day as the number of students who exercise 40 – 50 minutes each day.

8. The table below shows the age of people attending a musical concert.

Age (in years)	0–10	10–20	20–30	30–40	40–50
Number of people	2	19	32	23	19

If five more people of age 21 yrs., 32 yrs., 35 yrs., 44 yrs., and 11 yrs. attend the concert, which statement describes the central tendency of the new data? [Competency Based Question]

- (a) The central tendency of the data increases by 0.1 as the mean increases by 0.1.
(b) The central tendency of the data increases by 0.2 as the median increases by 0.2.
(c) The central tendency of the data increases by 0.1 as the median increases by 0.1.
(d) The central tendency of the data increases by 0.2 as the mean increases by 0.2.

9. Consider the data:

[NCERT Exemplar]

Class	65–85	85–105	105–125	125–145	145–165	165–185	185–205
Frequency	4	5	13	20	14	7	4

The difference of the upper limit of the median class and the lower limit of the modal class is

- (a) 0 (b) 19 (c) 20 (d) 38

10. For the following distribution

[NCERT Exemplar]

Class	0–5	5–10	10–15	15–20	20–25
Frequency	10	15	12	20	9

The sum of lower limits of the median class and modal class is [Competency Based Question]

- (a) 15 (b) 25 (c) 30 (d) 35

Answers

1. (c) 2. (b) 3. (c) 4. (c) 5. (b) 6. (b) 7. (a)
8. (b) 9. (c) 10. (b)

Very Short Answer Questions

Each of the following questions are of 1 mark.

1. Find the class-marks of the classes 10–25 and 35–55.

[CBSE 2020 (30/2/1)]

Sol. We have,

$$\begin{aligned}\text{Class mark of the class } 10-25 &= \frac{25 + 10}{2} \\ &= \frac{35}{2} = 17.5\end{aligned}$$

$$\text{and, class mark of the class } 35-55 = \frac{55 + 35}{2} = \frac{90}{2} = 45$$

2. If the mean of the first n natural numbers is 15, then find n .

[CBSE 2020 (30/1/1)]

Sol. We have, mean of first n natural numbers = $\frac{n(n+1)}{2n}$

$$\Rightarrow 15 = \frac{n+1}{2} \quad \Rightarrow n+1 = 30$$

$$\Rightarrow n = 30 - 1 = 29$$

$$\therefore n = 29$$

3. Using the empirical formula, find the mode of a distribution whose mean is 8.32 and the median is 8.05. [CBSE 2020 (30/3/1)]

Sol. Given, Mean = 8.32 and Median = 8.05

$$\begin{aligned}\therefore \text{Mode} &= 3 \text{ Median} - 2 \text{ Mean} \\ &= 3 \times 8.05 - 2 \times 8.32 \\ &= 24.15 - 16.64 = 7.51\end{aligned}$$

4. A data has 13 observations arranged in descending order. Which observation represents the median of data?

Sol. Total no. of observations = 13, which is odd.

$$\therefore \text{The median will be } \left(\frac{n+1}{2}\right)^{\text{th}} \text{ term} = \left(\frac{13+1}{2}\right)^{\text{th}} = \left(\frac{14}{2}\right)^{\text{th}} = 7^{\text{th}}$$

i.e., 7th term will be the median.

5. In an arranged series of an even number of $2n$ terms which term is median?

Sol. No. of terms = $2n$ which are even.

$$\begin{aligned}\therefore \text{The median term will be } &\frac{\left[\left(\frac{n}{2}\right)^{\text{th}} + \left(\frac{n}{2} + 1\right)^{\text{th}}\right]}{2} \\ &= \frac{\left[\left(\frac{2n}{2}\right)^{\text{th}} + \left(\frac{2n}{2} + 1\right)^{\text{th}}\right]}{2} = \left[\frac{n^{\text{th}} + (n+1)^{\text{th}}}{2}\right] \quad [\text{Put } n = 2n]\end{aligned}$$

i.e., the mean of n^{th} and $(n+1)^{\text{th}}$ term will be the median.

6. Write the modal class for the following frequency distribution:

Class Interval	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	33	38	65	52	19	48

Sol. Maximum frequency, i.e., 65 corresponds to the class 30-40.

\therefore Modal class is 30 - 40.

Short Answer Questions-I

Each of the following questions are of 2 marks.

1. Find the mean of the following distribution:

[CBSE 2020(30/1/1)]

Class	3-5	5-7	7-9	9-11	11-13
Frequency	5	10	10	7	8

Sol. We have

Class	Frequency (f_i)	Mid-value(x_i)	$f_i \cdot x_i$
3 - 5	5	4	20
5 - 7	10	6	60
7 - 9	10	8	80
9 - 11	7	10	70
11 - 13	8	12	96
Total	$\Sigma f_i = 40$		$\Sigma f_i x_i = 326$

We have, $\Sigma f_i = 40$, $\Sigma f_i x_i = 326$

$$\therefore \text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{326}{40} = 8.15$$

2. Find the mode of the following distribution:

[CBSE 2020(30/5/1)]

Marks:	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Number of Students:	4	6	7	12	5	6

Sol. We have,

Marks	No. of Students
0 – 10	4
10 – 20	6
20 – 30	7
30 – 40	12
40 – 50	5
50 – 60	6

Here, modal class is 30 – 40

$$\therefore l = 30, h = 10, f_0 = 12, f_1 = 7, f_2 = 5, h = 10$$

$$\begin{aligned}\therefore \text{Mode} &= l + \frac{f_0 - f_1}{2f_0 - f_1 - f_2} \times h \\ &= 30 + \frac{12 - 7}{2 \times 12 - 7 - 5} \times 10 \\ &= 30 + \frac{50}{12}\end{aligned}$$

$$\text{Mode} = 30 + 4.16 = 34.16$$

3. Find the median class of the following distribution:

Class	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	4	4	8	10	12	8	4

Sol. First we find the cumulative frequency

Classes	Frequency	Cumulative frequency
0–10	4	4
10–20	4	8
20–30	8	16
30–40	10	26
40–50	12	38
50–60	8	46
60–70	4	50
Total	50	

$$\text{Here, } \frac{n}{2} = \frac{50}{2} = 25$$

$$\therefore \text{Median class} = 30 - 40.$$

4. Median of a data is 52.5 and its Mean is 54, use empirical relationship between three measures of central tendency to find its mode.

Sol. We have,

$$\text{Median} = 52.5$$

$$\text{and, Mean} = 54$$

We know that $3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$

$$\Rightarrow 3 \times 52.5 = \text{Mode} + 2 \times 54$$

$$\Rightarrow \text{Mode} = 157.5 - 108$$

$$= 49.5$$

5. Consider the following frequency distribution.

Class	0-5	6-11	12-17	18-23	24-29
Frequency	13	10	15	8	11

Find the upper limit of median class.

Sol. Classes are not continuous, hence make them continuous by adding 0.5 to the upper limits and subtracting 0.5 from the lower limits.

Class Interval	Frequency	Cumulative frequency
0-5.5	13	13
5.5-11.5	10	23
11.5-17.5	15	38
17.5-23.5	08	46
23.5-29.5	11	57
Total	$\Sigma f = 57$	

Note: Class interval can't be negative hence the first CI is starting from 0.

Now to find median class we calculate $\frac{\Sigma f}{2} = \frac{57}{2} = 28.5$

\therefore Median class = 11.5 - 17.5.

So, the upper limit is 17.5.

6. The data regarding the heights of 50 girls of class X of a school is given below:

Heights (in cm)	120-130	130-140	140-150	150-160	160-170	Total
No. of girls	2	8	12	20	8	50

Change the above distribution to 'More than type' distribution.

Sol. We have,

Heights (in cm)	No. of girls
More than 120	50
More than 130	48
More than 140	40
More than 150	28
More than 160	8

Short Answer Questions-II

Each of the following questions are of 3 marks.

1. A class teacher has the following absentee record of 40 students of a class for the whole term.

Find the mean number of days a student was absent.

[CBSE 2019 (30/3/1)]

Number of days:	0-6	6-12	12-18	18-24	24-30	30-36	36-42
Number of students	10	11	7	4	4	3	1

Sol.

Calculating mean using step deviation method.						
15.	No. of days (class interval)	No. of students (f_i)	x_i ($\frac{\text{Upper} + \text{Lower limit}}{2}$)	$u_i = \frac{x_i - A}{h}$	$f_i \times u_i$	
	0-6	10	3	$\frac{3-21}{6} = -3$	$10 \times -3 = -30$	
	6-12	11	9	$\frac{9-21}{6} = -2$	$11 \times -2 = -22$	
	12-18	7	15	$\frac{15-21}{6} = -1$	$7 \times -1 = -7$	
	18-24	4	21	$\frac{21-21}{6} = 0$	$4 \times 0 = 0$	
	24-30	4	27	$\frac{27-21}{6} = 1$	$4 \times 1 = 4$	
	30-36	3	33	$\frac{33-21}{6} = 2$	$3 \times 2 = 6$	
	36-42	1	39	$\frac{39-21}{6} = 3$	$1 \times 3 = 3$	
	Total :	$\Sigma f_i = 40$			$\Sigma f_i u_i = -46$	
Class size (h) = $6-0 = 6$						
Assumed mean (A) = 21						
Mean = $A + \frac{\Sigma f_i u_i \times h}{\Sigma f_i}$						
$\Rightarrow \text{Mean} = 21 + \left(\frac{-46}{40} \right) \times 6$						
$= 21 - \frac{23 \times 6}{10}$						
$= 21 - 6.9$						
$= 14.1 \text{ days}$						
Mean of no. of days student remains absent = 14 days						

2. If the mean of the following distribution is 6, find the value of p .

x	2	4	6	10	$p+5$
f	3	2	3	1	2

Sol. Calculation of mean

x_i	f_i	$f_i x_i$
2	3	6
4	2	8
6	3	18
10	1	10
$p + 5$	2	$2p + 10$
Total	$\Sigma f_i = 11$	$\Sigma f_i x_i = 2p + 52$

We have, $\Sigma f_i = 11$, $\Sigma f_i x_i = 2p + 52$, $\bar{X} = 6$

$$\therefore \text{Mean } (\bar{X}) = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow 6 = \frac{2p + 52}{11} \Rightarrow 66 = 2p + 52$$

$$\Rightarrow 2p = 14 \Rightarrow p = 7$$

3. Compute the mode for the following frequency distribution [CBSE 2019(30/2/1)]

Size of items (in cm)	0-4	4-8	8-12	12-16	16-20	20-24	24-28
Frequency	5	7	9	17	12	10	6

Sol.

Size of items (in cm)	Frequency
0 - 4	5
4 - 8	7
8 - 12	9
12 - 16	17
16 - 20	12
20 - 24	10
24 - 28	6

Here, maximum frequency is 17.

\therefore 12 - 16 is the modal class.

Now, we have

$$l = 12, h = 4, f_1 = 17 \text{ and } f_0 = 9, f_2 = 12$$

$$\therefore \text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

$$= 12 + \frac{17 - 9}{2 \times 17 - 9 - 12} \times 4$$

$$\Rightarrow \text{Mode} = 12 + \frac{32}{13} = 12 + 2.46 = 14.46$$

$$\therefore \text{Mode} = 14.46$$

4. Find the value of p , if the mean of the following distribution is 7.5.

[CBSE 2020 (30/3/1)]

Classes	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14
Frequency (f_i)	6	8	15	p	8	4

Sol. We have,

Class	Frequency (f)	x	fx
2 - 4	6	3	18
4 - 6	8	5	40
6 - 8	15	7	105
8 - 10	p	9	$9p$
10 - 12	8	11	88
12 - 14	4	13	52
	$41 + p$		$303 + 9p$

$$\text{Mean} = 7.5 = \frac{303 + 9p}{p + 41} \quad \Rightarrow \quad p = 3$$

5. The table below shows the salaries of 280 persons:

Salary (In thousand ₹)	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
No. of Persons	49	133	63	15	6	7	4	2	1

Calculate the median salary of the data.

[CBSE 2018 (30/1/1)]

Sol.

22) Distribution of frequencies:

Salary in thousand ₹	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
No. of persons	49	133	63	15	6	7	4	2	1

To find: median.

No. of people = 280.

$\Rightarrow \frac{n}{2} = 140$, the 140th term lies in class interval 10-15.

\Rightarrow median class = 10-15.

$l = 10$, $h = 5$, $f = 133$, $\frac{n}{2} = 140$, $cf = 49$.

We know, median = $l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$.

\Rightarrow median = $10 + \frac{140 - 49}{133} \times 5$.

$\approx 10 + \frac{91}{133} \times 5$.

$= 10 + \frac{65}{19}$.

$= 10 + 3.421$.

$= 13.421$.

The median salary is 13.421 thousand rupees.

[Topper's Answer 2018]

Long Answer Questions

Each of the following questions are of 5 marks.

1. The mean of the following distribution is 18. Find the frequency f of the class 19 – 21.

Class	11-13	13-15	15-17	17-19	19-21	21-23	23-25
Frequency	3	6	9	13	f	5	4

[CBSE 2018 (30/1/1)]

Sol.

Frequency distribution:				
choice i)	Class	Frequency	x_i	$f_i x_i$
	11-13	3	12	$3 \times 12 = 36$
	13-15	6	14	$6 \times 14 = 84$
	15-17	9	16	$9 \times 16 = 144$
	17-19	13	18	$13 \times 18 = 234$
	19-21	f	20	$f \times 20 = 20f$
	21-23	5	22	$5 \times 22 = 110$
	23-25	4	24	$4 \times 24 = 96$
	Total: \rightarrow	$40 + f$		$704 + 20f$
Given, mean = 18. To find: value of f .				
We know,				
$\text{mean } (\bar{x}) = \frac{\sum f_i x_i}{\sum f_i}$				
$\rightarrow 18 = \frac{704 + 20f}{40 + f}$				
$720 - 704 = 20f - 18f$				
$16 = 2f$				
$\Rightarrow f = 8$				
[Topper's Answer 2018]				
The value of f is 8				

2. The mean of the following frequency table is 50. But the frequencies f_1 and f_2 in class 20-40 and 60-80 respectively are missing. Find the missing frequencies. [Competency Based Question]

Classes	0-20	20-40	40-60	60-80	80-100	Total
Frequency	17	f_1	32	f_2	19	120

Sol. Let the assumed mean $A = 50$ and $h = 20$.

Calculation of mean

Class interval	Mid-values (x_i)	Frequency (f_i)	$u_i = \frac{x_i - 50}{20}$	$f_i u_i$
0-20	10	17	-2	-34
20-40	30	f_1	-1	$-f_1$
40-60	50	32	0	0
60-80	70	f_2	1	f_2
80-100	90	19	2	38
Total		$\Sigma f_i = 68 + f_1 + f_2$		$\Sigma f_i u_i = 4 - f_1 + f_2$

We have, $\Sigma f_i = 120$ (Given)

$$\Rightarrow 68 + f_1 + f_2 = 120$$

$$\Rightarrow f_1 + f_2 = 52 \quad \dots(i)$$

Now, mean = 50

$$\Rightarrow \bar{X} = A + h \left(\frac{\Sigma f_i u_i}{\Sigma f_i} \right)$$

$$\Rightarrow 50 = 50 + 20 \times \left\{ \frac{4 - f_1 + f_2}{120} \right\}$$

$$\Rightarrow 50 = 50 + \frac{4 - f_1 + f_2}{6} \Rightarrow 0 = \frac{4 - f_1 + f_2}{6} \quad \dots(ii)$$

$$f_1 - f_2 = 4$$

From equations (i) and (ii), we get

$$f_1 + f_2 = 52$$

$$\frac{f_1 - f_2}{2f_1} = \frac{4}{56}$$

$$\Rightarrow f_1 = 28$$

Putting the value of f_1 in equation (i), we get

$$28 + f_2 = 52 \Rightarrow f_2 = 24$$

Hence, the missing frequencies f_1 is 28 and f_2 is 24.

3. The distribution given below shows the number of wickets taken by bowlers in one-day cricket matches. Find the mean and the median of the number of wickets taken.

Number of wickets	20 – 60	60 – 100	100 – 140	140 – 180	180 – 220	220 – 260
Number of bowlers	7	5	16	12	2	3

Sol. We have,

For Mean

No. of wickets	(f_i) No. of bowlers	(x_i) Mid values	$u_i = \frac{x_i - A}{h}$	$f_i \cdot u_i$
20 – 60	7	40	-3	-21
60 – 100	5	80	-2	-10
100 – 140	16	120	-1	-16
140 – 180	12	160 = A	0	0
180 – 220	2	200	1	2
220 – 260	3	240	2	6
Total	45			-39

We have,

$$A = 160, h = 40, \Sigma f_i = 45, \Sigma f_i u_i = -39$$

$$\text{Mean} = A + \frac{\Sigma f_i \cdot u_i}{\Sigma f_i} \times h$$

$$= 160 + \frac{-39 \times 40}{45} = 160 - 34.67 = 125.33$$

For Median

Number of wickets	Number of bowlers	Cumulative Frequency
20 – 60	7	7
60 – 100	5	12
100 – 140	16	28
140 – 180	12	40
180 – 220	2	42
220 – 260	3	45
Total	45	

We have,

$$n = 45 \Rightarrow \frac{n}{2} = 22.5$$

\therefore 100 – 140 is the median class.

$\therefore l = 100, cf = 12, f = 16, h = 40$

$$\therefore \text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$$

$$= 100 + \frac{22.5 - 12}{16} \times 40 = 100 + \frac{10.5 \times 40}{16} = 100 + 26.25 = 126.25$$

\therefore Median = 126.25

4. If the median of the following frequency distribution is 32.5. Find the values of f_1 and f_2 .

Class	0–10	10–20	20–30	30–40	40–50	50–60	60–70	Total
Frequency	f_1	5	9	12	f_2	3	2	40

[CBSE 2019 (30/1/1)]

Sol.

Class	Frequency	Cumulative Frequency
0–10	f_1	f_1
10–20	5	$5 + f_1$
20–30	9	$14 + f_1$
30–40	12	$26 + f_1$
50–60	f_2	$26 + f_1 + f_2$
50–60	3	$29 + f_1 + f_2$
60–70	2	$31 + f_1 + f_2$
	$\Sigma f = 40$	

Median = 32.5 \Rightarrow Median class is 30–40.

$$\text{Now } 32.5 = 30 + \frac{10}{12}(20 - 14 - f_1)$$

$$\Rightarrow f_1 = 3$$

$$\text{Also } 31 + f_1 + f_2 = 40$$

$$\Rightarrow f_2 = 6$$

[CBSE Marking Scheme 2019 (30/1/1)]

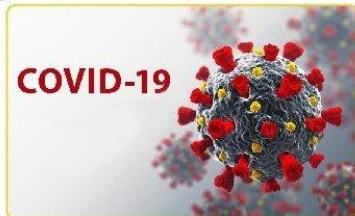
Case Study-based Questions

Each of the following questions are of 4 marks.

1. Read the following and answer any four questions from (i) to (v).

COVID-19 Pandemic

The COVID-19 pandemic, also known as coronavirus pandemic, is an ongoing pandemic of coronavirus disease caused by the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) among humans.



The following table shows the age distribution of case admitted during a day in two different hospitals

Table 1:

Age (in years)	5 – 15	15 – 25	25 – 35	35 – 45	45 – 55	55 – 65
No. of cases	6	11	21	23	14	5

Table 2:

Age (in years)	5 – 15	15 – 25	25 – 35	35 – 45	45 – 55	55 – 65
No. of cases	8	16	10	42	24	12

[CBSE Question Bank]

Refer to table 1

- (i) The average age for which maximum cases occurred is
(a) 32.24 (b) 34.36 (c) 36.82 (d) 42.24
- (ii) The upper limit of modal class is
(a) 15 (b) 25 (c) 35 (d) 45
- (iii) The mean of the given data is
(a) 26.2 (b) 32.4 (c) 33.5 (d) 35.4

Refer to table 2

- (iv) The mode of the given data is
(a) 41.4 (b) 48.2 (c) 55.3 (d) 64.6
- (v) The median of the given data is
(a) 32.7 (b) 40.2 (c) 42.3 (d) 48.6

Sol. (i) We have for table 1

Age (in years)	No. of Cases
5–15	6
15–25	11
25–35	21
35–45	23
45–55	14
55–65	5

Since 23 is the maximum frequency, therefore 35 – 45 is the modal class.

$$\begin{aligned}\therefore \text{Mode} &= l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h \\ &= 35 + \frac{23 - 21}{2 \times 23 - 21 - 14} \times 10 = 35 + \frac{20}{11} \\ &= 35 + 1.82 = 36.82\end{aligned}$$

\therefore Option (c) is correct.

(ii) Modal class is 35 – 45.

\therefore Upper limit is 45.

\therefore Option (d) is correct.

(iii) We have,

Age (in years)	No. of cases (f_i)	Mid value (x_i)	$f_i x_i$
5 – 15	6	10	60
15 – 25	11	20	220
25 – 35	21	30	630
35 – 45	23	40	920
45 – 55	14	50	700
55 – 65	5	60	300
Total	80		2830

$$\begin{aligned}\therefore \text{Average age} &= \frac{\sum f_i x_i}{\sum f_i} = \frac{2830}{80} \\ &= 35.38 \approx 35.4\end{aligned}$$

\therefore Option (d) is correct.

(iv) We have for table 2

Age (in years)	No. of cases	cf
5 – 15	8	8
15 – 25	16	24
25 – 35	10	34
35 – 45	42	76
45 – 55	24	100
55 – 65	12	112
Total	112	

We have, 42 is the maximum frequency, therefore 35 – 45 is the modal class.

$$\begin{aligned}\therefore \text{Mode} &= l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h \\ &= 35 + \frac{42 - 10}{2 \times 42 - 10 - 24} \times 10 \\ &= 35 + \frac{320}{50} \\ &= 35 + 6.4 = 41.4\end{aligned}$$

\therefore Option (a) is correct.

(v) We have, $N = 112 \Rightarrow \frac{N}{2} = 56$

Since 76 is just greater than 56 in cumulative frequency.

$\therefore 35 - 45$ is the median class.

$$\begin{aligned}\therefore \text{Median} &= l + \frac{\frac{N}{2} - cf}{f} \times h \\ &= 35 + \frac{56 - 34}{42} \times 10 \\ &= 35 + \frac{220}{42} = 40.23 \approx 40.2\end{aligned}$$

\therefore Option (b) is correct.

2. Electricity Energy Consumption

Electricity energy consumption is the form of energy consumption that uses electric energy. Global electricity consumption continues to increase faster than world population, leading to an increase in the average amount of electricity consumed per person (per capita electricity consumption).

Tariff	: LT - Residential	Bill Number	:384756
Type of Supply	: Single Phase	Connected Load	:3 KW
Meter Reading Date	: 31-11-13	Meter Reading	:65789
Previous Reading Date	: 31-10-13	Previous Meter Reading	:65500
Units Consumed			:289

A survey is conducted for 56 families of a colony. The following table gives the weekly consumption of electricity of these families.

Weekly consumption (in units)	0-10	10-20	20-30	30-40	40-50	50-60
No. of families	16	12	18	6	4	0

Based on the above information, answer the following questions:

Refer to data received from colony

- What is the median weekly consumption?
- What is the mean weekly consumption?

Sol. (i) From Table

Weekly consumption (in units)	No. of families (f_i)	cf
0-10	16	16
10-20	12	28
20-30	18	46
30-40	6	52
40-50	4	56
50-60	0	56

We have, $N = 56 \Rightarrow \frac{N}{2} = 28$

∴ 20 – 30 is the median class.

$$\begin{aligned}\therefore \text{Median} &= l + \frac{\frac{N}{2} - cf}{f} \times h \\ &= 20 + \frac{28 - 28}{18} \times 10 = 20\end{aligned}$$

(ii)

Class	Frequency (f_i)	Mid value (x_i)	$f_i x_i$
0 – 10	16	5	80
10 – 20	12	15	180
20 – 30	18	25	450
30 – 40	6	35	210
40 – 50	4	45	180
50 – 60	0	55	0
Total	56		1100

$$\therefore \text{Mean} = \frac{\sum f_i x_i}{\sum f_i} = \frac{1100}{56} = 19.64$$

PROFICIENCY EXERCISE

■ Objective Type Questions:

[1 mark each]

1. Choose and write the correct option in each of the following questions.

(i) When calculated using direct method, the mean of the data set shown in the table below is 31.

Class Interval	Frequency
0–10	22
10–20	24
20–30	35
30–40	30
40–50	27
50–60	m
60–70	6
70–80	4

What is the frequency for the class interval 50–60?

(a) 8

(b) 10

(c) 12

(d) 20

(ii) The table below summarizes the data about the heights of students in a class.

Height (in cm)	130–140	140–150	150–160	160–170	170–180
Number of students	6	14	20	12	8

When calculated using assumed mean method what is the mean height of students in the class?

(a) 154.33 cm

(b) 155.33 cm

(c) 156.33 cm

(d) 157.33 cm

(iii) If the mean of data is 27 and mode is 45 then median is

(a) 30

(b) 27

(c) 32

(d) 33

- (iv) The runs scored by a batsman in 35 different matches are given below:

Runs Scored	0-15	15-30	30-45	45-60	60-75	75-90
Frequency	5	7	4	8	8	3

Number of matches in which the batsman scored less than 60 runs are

- (a) 16 (b) 24 (c) 8 (d) 19
- (v) $\sum f_i = 18$, $\sum f_i x_i = 2p + 24$ and mean of any distribution is 2, then p is equal to
- (a) 3 (b) 4 (c) 8 (d) 6

Very Short Answer Questions:

[1 mark each]

2. Consider the following frequency distribution.

Class	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	3	9	15	30	18	5

Determine the modal class.

3. In the formula $\bar{X} = A + h \left(\frac{\sum f_i u_i}{\sum f_i} \right)$ for finding the mean of grouped frequency distribution, what is the value of u_i ? [NCERT Exemplar]
4. The time, in seconds, taken by 150 athletes to run a 110 m hurdle race are tabulated below:

Class	13.8-14	14-14.2	14.2-14.4	14.4-14.6	14.6-14.8	14.8-15
Frequency	2	4	5	71	48	20

Find the number of athletes who completed the race in less than 14.6 seconds. [NCERT Exemplar]

5. In the following distribution:

Monthly income range (in ₹)	More than ₹10000	More than ₹13000	More than ₹16000	More than ₹19000	More than ₹22000	More than ₹25000
Number of families	100	85	69	50	33	15

Find the number of families having income range ₹16000 – ₹19000.

6. Consider the following distribution:

Marks Obtained	Less than 10	Less than 20	Less than 30	Less than 40	Less than 50
Numbers of students	02	10	15	30	40

Find the number of students having marks in range 30-40.

7. What is the empirical relation between mean, median and mode?

Short Answer Questions-I:

[2 marks each]

8. Find the mode of the following frequency distribution:

Class Interval	25-30	30-35	35-40	40-45	45-50	50-55
Frequency	25	34	50	42	38	14

9. Write the median class of the following distribution:

[CBSE 2019 (30/2/1)]

Classes	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	14	6	8	20	15	12	9

10. The mean, median and mode of grouped data are always different. State True or False and justify your answer.

11. Find the class marks of classes 15–35 and 20–40.
 12. If the mean of the following distribution is 2.6, then find the value of k .

x_i	1	2	3	4	5
f_i	k	5	8	1	2

■ Short Answer Questions-II:

[3 marks each]

13. Obtain the median for the following frequency distribution.

x_i	10	20	30	40	50
f_i	5	3	6	8	8

Calculate the median salary of the data.

[CBSE 2018(30/1)]

14. Find the mode of the following frequency distribution.

Class	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	8	10	10	16	12	6	7

[CBSE 2019(30/1/1)]

15. The weights of tea in 70 packets is given in the following table:

Weight (In gms.)	200–201	201–202	202–203	203–204	204–205	205–206
Number of Packets	12	26	20	9	2	1

Find the modal weight.

[CBSE 2019 (C) (30/1/1)]

16. Find the value of p , if the mean of the following distribution is 20.

x	15	17	19	$20+p$	23
f	2	3	4	5	6

17. For the following distribution, calculate mean:

Classes	25–29	30–34	35–39	40–44	45–49	50–54	55–59
Frequency	14	22	16	6	5	3	4

18. Find the mean age of 100 residents of a town from the following data:

Age equal and above (in years)	0	10	20	30	40	50	60	70
No. of Persons	100	90	75	50	25	15	5	0

19. The mileage (km per litre) of 50 cars of the same model was tested by a manufacturer and details are tabulated as given below:

Mileage (km/L)	10–12	12–14	14–16	16–18
Number of cars	7	12	18	13

Find the mean mileage. The manufacturer claimed that the mileage of the model was 16 km/L.

■ Long Answer Questions:

[5 marks each]

20. Thirty women were examined in a hospital by a doctor and the number of heart beat per minutes were recorded and summarised as follows. Find the mean heart beats per minute for the women, choosing a suitable method.

Number of heart beat per minute	65–68	68–71	71–74	74–77	77–80	80–83	83–86
Number of women	2	4	3	8	7	4	2

21. Find the mean and mode for the following data:

Classes	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	4	8	10	12	10	4	2

[CBSE 2018 (C) (30/1)]

22. Calculate the mean of the following frequency distribution:

Class	10-30	30-50	50-70	70-90	90-110	110-130
Frequency	5	8	12	20	3	2

[CBSE 2019(30/4/2)]

23. If the mean of the following frequency distribution is 62.8, then find the missing frequency x :

Class	0-20	20-40	40-60	60-80	80-100	100-120
Frequency	5	8	x	12	7	8

[CBSE 2019 (C) (30/1/1)]

24. The annual rainfall record of a city of 66 days is given in the following table:

Rainfall (in cm)	0-10	10-20	20-30	30-40	40-50	50-60
Number of days	22	10	8	15	5	6

Calculate the median rainfall.

25. Find the median of the following.

Classes	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Frequency	10	8	12	24	6	25	15

26. The following is the frequency distribution of duration for 100 calls made on a mobile phone:

Duration (in seconds)	95-125	125-155	155-185	185-215	215-245
Number of calls	14	22	28	21	15

Calculate the average duration (in sec.) of a call. Find the median.

27. The mean of the following frequency distribution is 62.8 and the sum of all the frequencies is 50. Compute the missing frequency f_1 and f_2 .

Classes	0-20	20-40	40-60	60-80	80-100	100-120
Frequency	5	f_1	10	f_2	7	8

[Competency Based Question]

Answers

- (i) (c) (ii) (b) (iii) (d) (iv) (b) (v) (d)
- 30-40 3. $\frac{x_i - a}{h}$ 4. 82 5. 19 6. 15
- 3 Median = Mode + 2 Mean 8. 38.33 9. 30-40
- False, it depends on the data 11. 25, 30 12. $k = 4$ 13. 40
- Mode = 36 15. Mode = 201.7 16. $p = 1$ 17. 36.36
- 31 years 19. 14.48 km/L 20. 75.9 21. Mean = 42.2, Mode = 45
- 65.6 23. $x = 10$ 24. 21.25 cm 25. 58.33
- Average = 170.3 sec, Median = 170 sec 27. $f_1 = 8, f_2 = 12$

Self-Assessment

Time allowed: 1 hour

Max. marks: 40

SECTION A

1. Choose and write the correct option in the following questions.

(3 × 1 = 3)

- (i) A data set is shown.

Class Interval	4–6	6–8	8–10	10–12	12–14	14–16	16–18
Frequency	2	6	20	28	12	10	2

What is the mean and mode of the data shown?

- (a) Mean: 11; Mode: 10.33 (b) Mean: 11; Mode: 10.67
(c) Mean: 10; Mode: 10.33 (d) Mean: 10; Mode: 10.67
- (ii) A grouped data is shown below:

Class Interval	0–15	15–30	30–45	45–60	60–75	75–90
Frequency	2	26	32	42	28	30

Which of the following is the most effective measure of central tendency?

- (a) Mean because the data has extreme data points.
(b) Mean because the data has no extreme data points.
(c) Median because the data has extreme data points.
(d) Median because the data has no extreme data points.
- (iii) In the formula $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$ for finding the mean of a grouped data, d_i 's are deviations from a of
- (a) lower limits of the classes (b) upper limits of the classes
(c) mid-points of the classes (d) frequencies of the class marks

2. Solve the following questions.

(2 × 1 = 2)

- (i) The mean of 11 observations is 50. If the mean of first 6 observations is 49 and that of the last six observations is 52, what is the value of 6th observation?
(ii) Find the median of first 10 prime numbers.

SECTION B

- Solve the following questions.

(4 × 2 = 8)

3. Find the mean of the following distribution:

x	4	6	9	10	15
f	5	10	10	7	8

4. If x_i 's are the mid-points of the class intervals of a grouped data. f_i 's are the corresponding frequencies and \bar{x} is the mean, then find $\sum f_i(x_i - \bar{x})$.

5. If the mean of the following distribution is 27, find the value of p .

Classes	0–10	10–20	20–30	30–40	40–50
Frequency	8	p	12	13	10

6. Following table shows the weight of 12 students:

Weight (in kgs)	67	70	72	73	75
Number of students	4	3	2	2	1

Find the mean weight of the students.

■ Solve the following questions.

$$(4 \times 3 = 12)$$

7. Calculate the median from the following data:

Rent (in ₹)	Number of tenants
1500–2500	8
2500–3500	10
3500–4500	15
4500–5500	25
5500–6500	40
6500–7500	20
7500–8500	15
8500–9500	7

8. Calculate the missing frequency from the following distribution, it being given that the median of the distribution is 24.

Age (in years)	0–10	10–20	20–30	30–40	40–50
Number of persons	5	25	f	18	7

9. Find the median for the following distribution.

Classes	20–30	30–40	40–50	50–60	60–70	70–80	80–90
Frequency	10	8	12	24	6	25	15

10. 50 students enter for a school javelin throw competition. The distance (in metres) thrown are recorded below:

Distance (in m)	0–20	20–40	40–60	60–80	80–100
No. of students	6	11	17	12	4

Calculate the median distance by using the formula for median.

■ Solve the following questions.

$$(3 \times 5 = 15)$$

11. The following distribution gives the daily income of 50 workers of a factory:

Daily income (in ₹)	100–120	120–140	140–160	160–180	180–200
Number of workers	12	14	8	6	10

Find the median.

12. An aircraft has 120 passenger seats. The number of seats occupied during 100 flights is given in the following table:

Number of seats	100–104	104–108	108–112	112–116	116–120
Frequency	15	20	32	18	15

Determine the mean number of seats occupied over the flights.

13. The marks obtained by 100 students of a class in an examination are given below.

Marks	No. of students
0–5	2
5–10	5
10–15	6
15–20	8
20–25	10
25–30	25
30–35	20
35–40	18
40–45	4
45–50	2

Find median.

Answers

1. (i) (b) (ii) (c) (iii) (c) 2. (i) 56 (ii) 12
3. 9 4. 0 5. $p = 7$ 6. 70.25 kg 7. ₹5,800 8. $f = 25$
9. 58.33 (approx) 10. 49.41 m 11. ₹138 12. 110 seats 13. 29.5

