

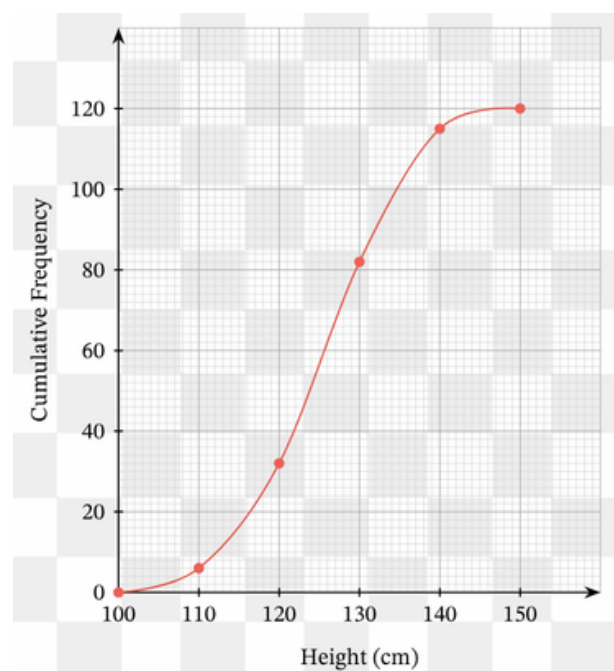
Cumulative Frequency - GCSE Maths

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1. Introduction

- **Cumulative Frequency** is a running total of values(frequencies) through the classes in a frequency distribution.
- It helps us to generate cumulative graphs.
- It is useful in finding Median, Quartiles and Percentiles.



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2. How to Draw a Cumulative Frequency Diagram

Example:

Following is a table showing the marks of students from a school, in a test, draw the cumulative frequency diagram.

Solution:

STEP#1: Work out the Cumulative Frequency of each class-

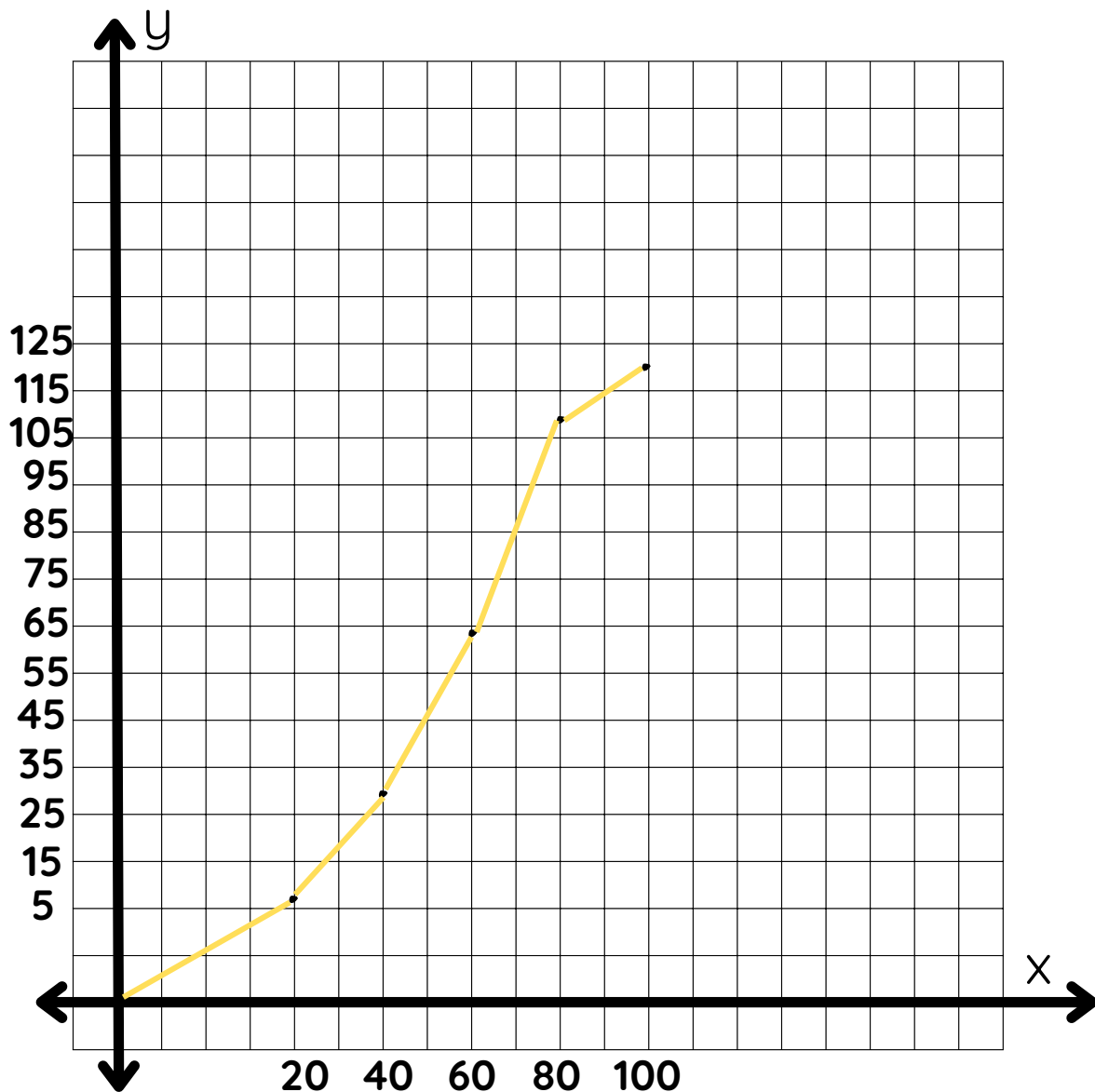
Test Mark	Frequency	CF
$0 \leq M \leq 20$	6	6
$20 \leq M \leq 40$	22	$6 + 22 = 28$
$40 \leq M \leq 60$	36	$28 + 36 = 64$
$60 \leq M \leq 80$	45	$64 + 45 = 109$
$80 \leq M \leq 100$	11	$109 + 11 = 120$

[Always remember that the last row of CF shows the total of objects in the respective dataset]

STEP#2: Now, we need to draw the graph. So, add scales on the graph and show the Cumulative frequency on the vertical axis.

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STEP#2:



STEP#3: Plot value on graph at the end point of each interval.

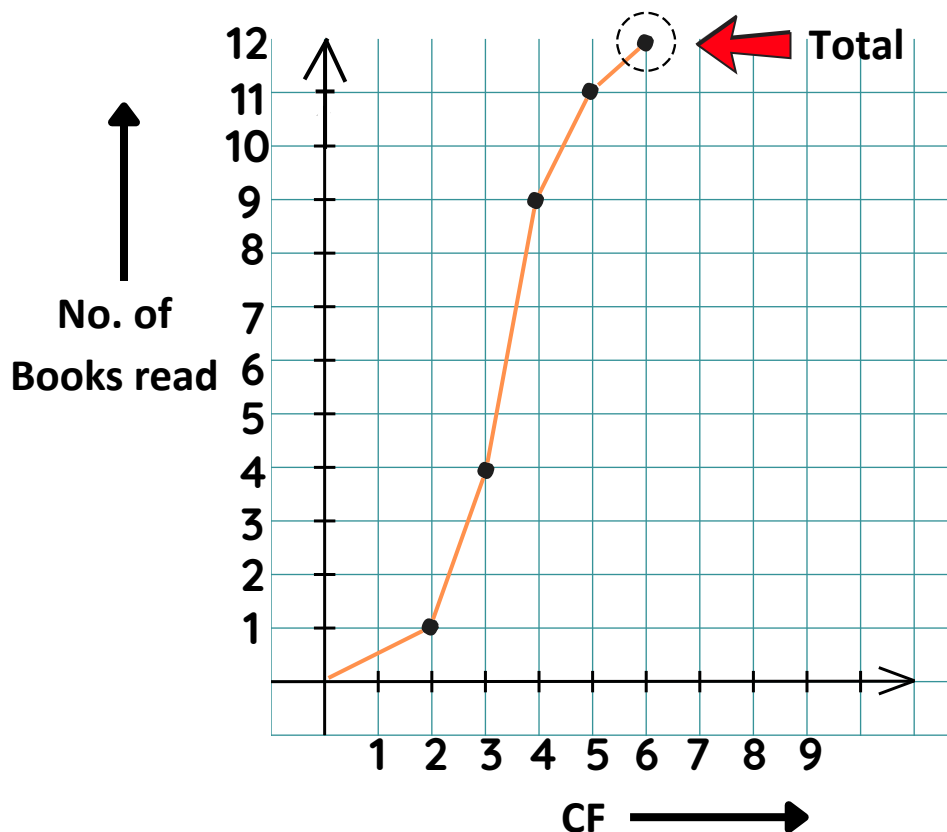
STEP#4: Join the points with straight line or smooth curve.

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3. How to Find Median and Quartiles from a Cumulative Frequency Diagram?

Example:

The following is a Cumulative frequency diagram. Find the median and the Upper and lower quartiles.



We know median is the value at half of the total, thus we find the half and plot the value on graph to find the median.

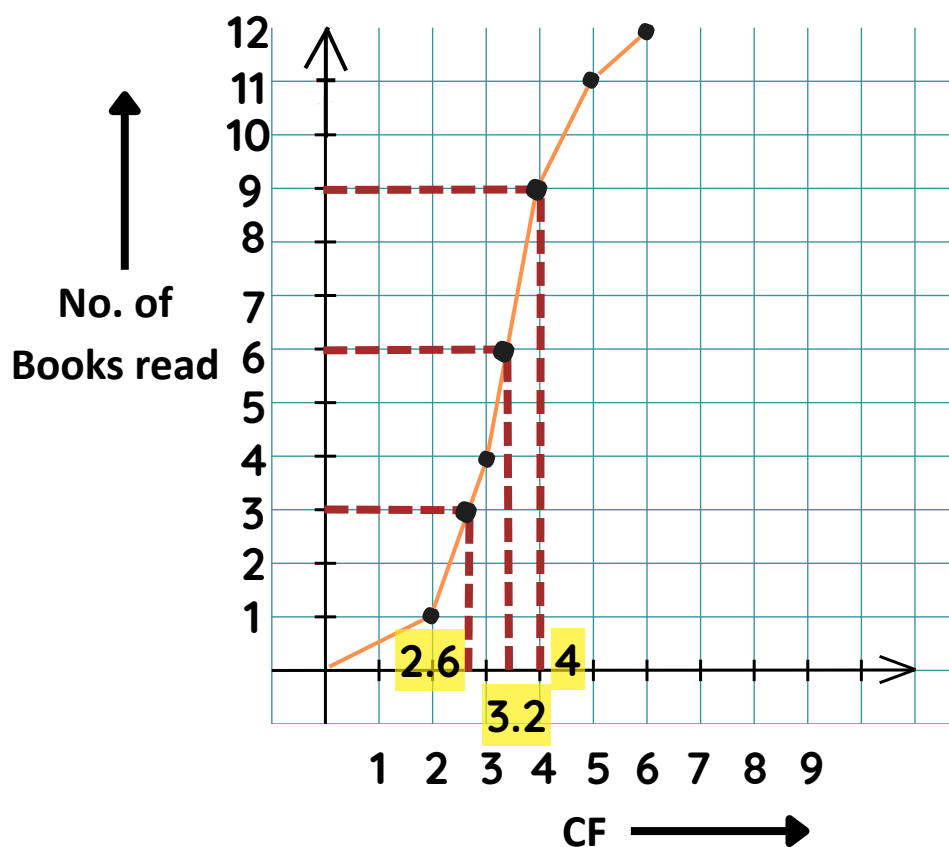
In a similar way we do find the Upper Quartile and Lower Quartile's values.

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$$\text{Median} = \frac{12}{2} = 6\text{th value}$$

$$\text{Lower Quartile} = \frac{12}{4} = 3\text{th value}$$

$$\text{Upper Quartile} = 3\left(\frac{12}{4}\right) = 9\text{th value}$$



$$\text{Median} = 3.2$$

$$\text{Lower Quartile} = 2.6$$

$$\text{Upper Quartile} = 4$$

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4. Solved Examples

Example:

The Frequency table shows the masses of 50 cats copy and complete the frequency table -

Mass(kg)	Frequency
$3 < m \leq 4$	4
$4 < m \leq 5$	12
$5 < m \leq 6$	17
$6 < m \leq 7$	10
$7 < m \leq 8$	7

Answer:

Mass(kg)	CF
$3 < m \leq 4$	4
$4 < m \leq 5$	$4 + 12 = 16$
$5 < m \leq 6$	$16 + 17 = 33$
$6 < m \leq 7$	$33 + 10 = 43$
$7 < m \leq 8$	$43 + 7 = 50$

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Example:

The frequency table shows the amount of pocket money for 40 teenagers:

Pocket Money x (£)	CF
$0 < x \leq 1$	2
$0 < x \leq 2$	8
$0 < x \leq 3$	19
$0 < x \leq 4$	32
$0 < x \leq 5$	39
$0 < x \leq 6$	40



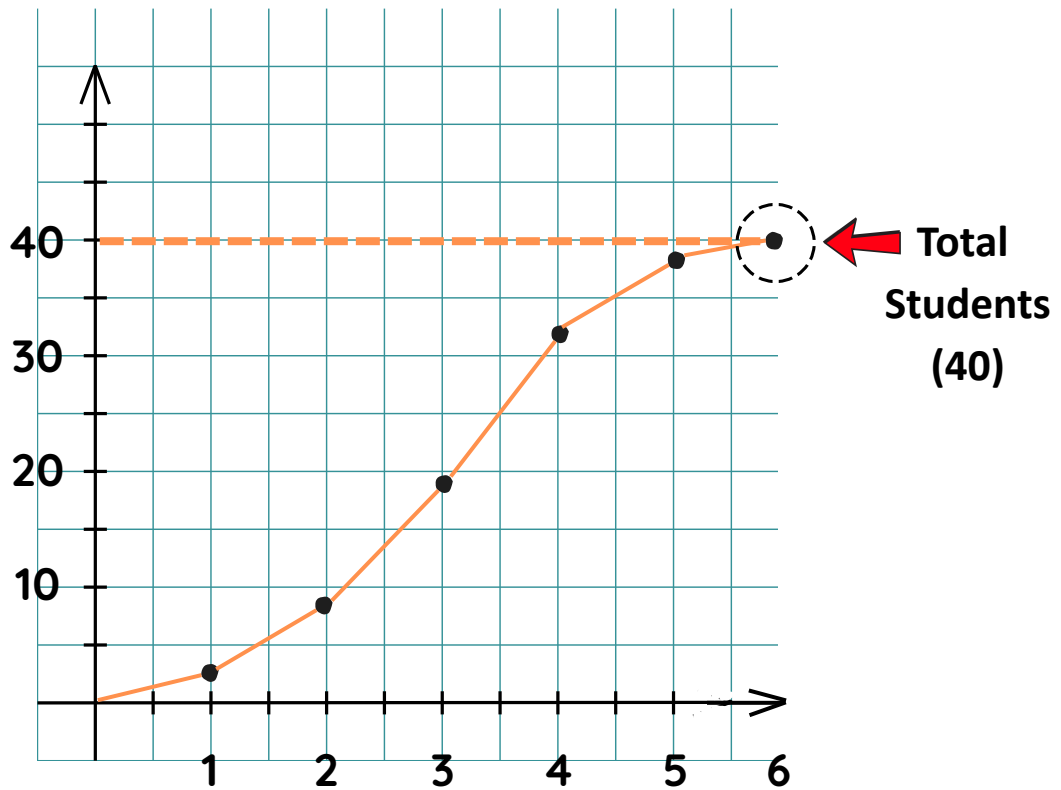
(a) Draw a Cumulative Frequency diagram for the table.

Answer:

To draw a Cumulative frequency diagram for the table, we select a scale and plot the CF on the Horizontal axis.

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(a)



(b) Use the Cumulative frequency diagram to estimate the median pocket money -

$$\text{Total Students} = 40$$

$$\text{Half of total} = \frac{40}{2}$$

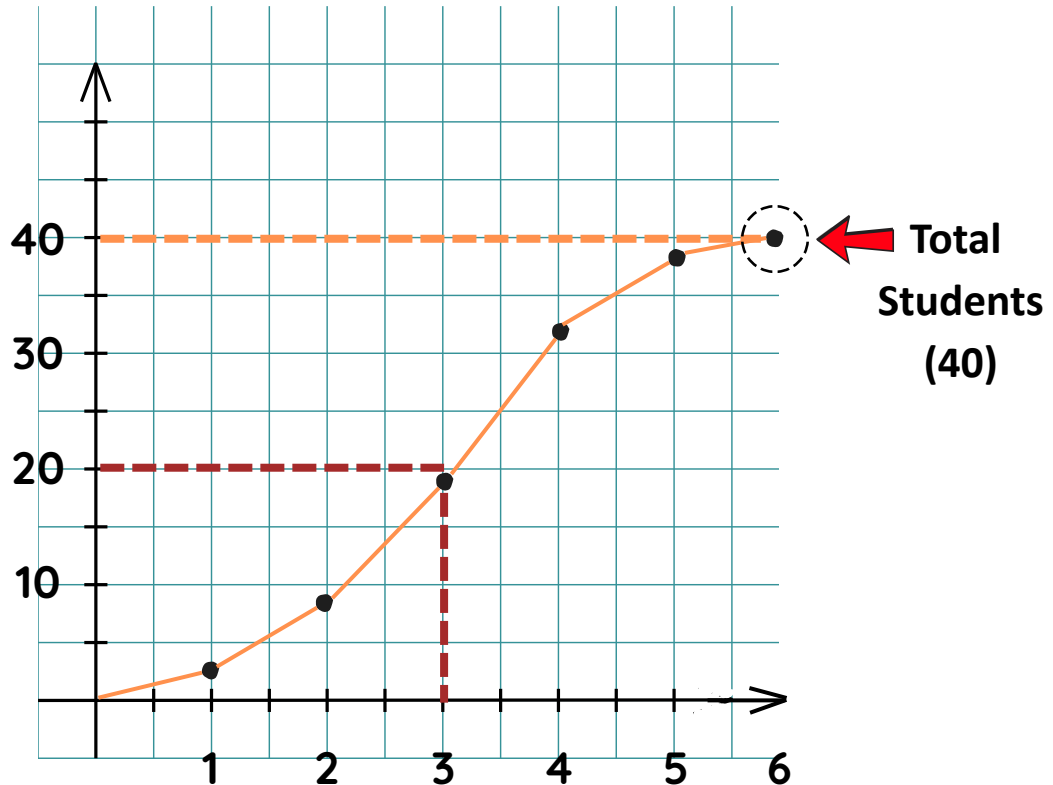
$$\text{Half of total} = 20$$

$$\text{Median} = 20\text{th value}$$

Now, plot the half on the graph to get the median of pocket money

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(b)



As we can see on the graph that it points to CF 3, and hence the median of pocket money the teenagers get is 3£.

$$\text{Median} = 3\text{£}$$

(c) Estimate the range from the cumulative frequency diagram

$$\text{Highest Possible Value} = 6\text{£}$$

$$\text{Lowest Possible Value} = 0\text{£}$$

$$\text{Range} = 6\text{£} - 0\text{£}$$

$$\text{Range} = 6\text{£}$$

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Example:

Leo drives to work. The table gives information about the time it took him to get to work on each of 100 days.

Time t (minutes)	Frequency
$0 < x \leq 10$	16
$10 < x \leq 20$	34
$20 < x \leq 30$	32
$30 < x \leq 40$	14
$40 < x \leq 50$	4



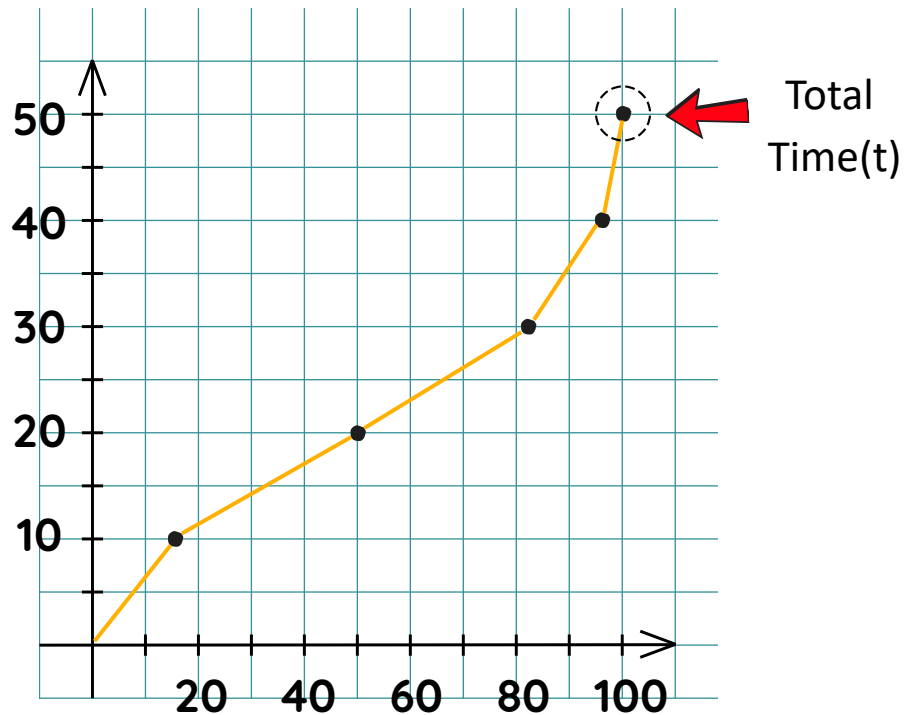
(a) Cumulative Frequency diagram -



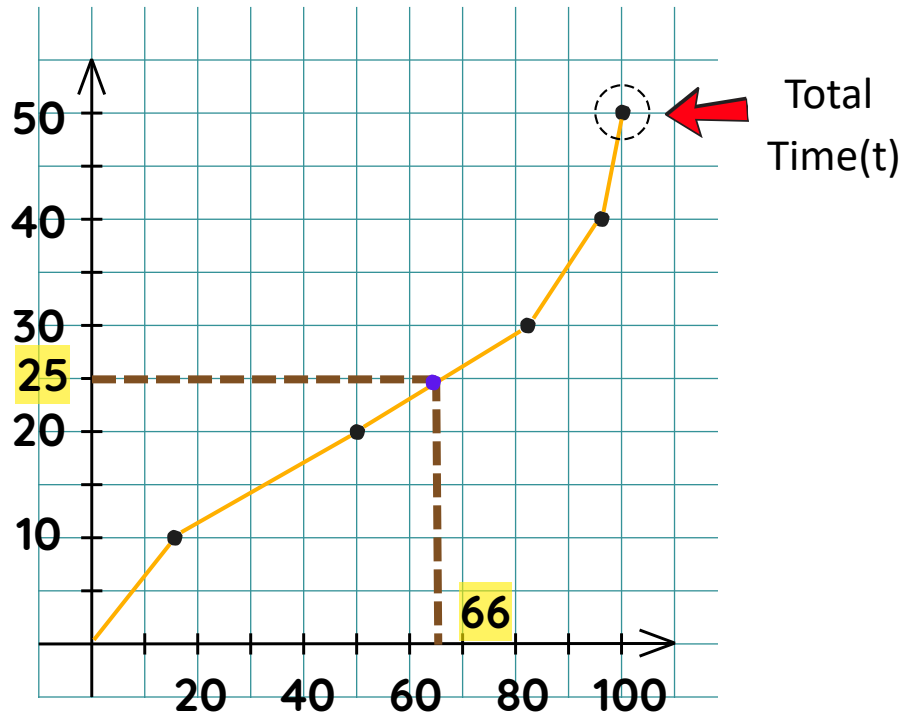
Frequency	CF
16	16
34	$16 + 34 = 50$
32	$50 + 32 = 82$
14	$82 + 14 = 96$
4	$96 + 4 = 100$

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(C) Draw the Cumulative Frequency diagram -



(D) Through your diagram estimate the median -



$$\text{half of the total} = \frac{50}{2} = 25$$

$$\text{Median} = 66$$

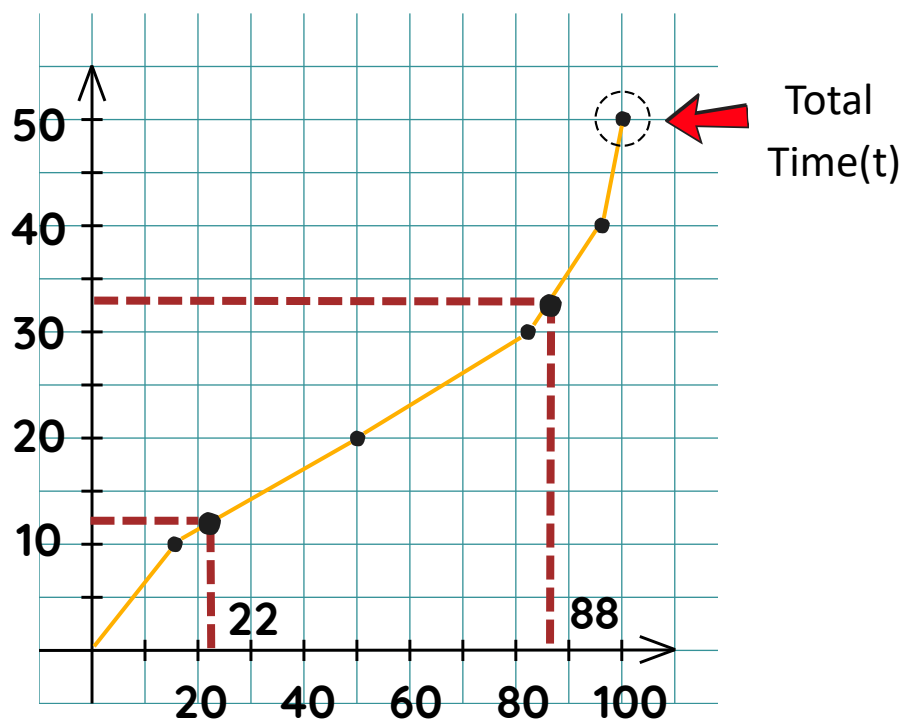
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(E) Find out the Upper and Lower Quartile values -

$$\text{Upper Quartile} = \frac{50}{4} = 12.2$$

$$\text{Lower Quartile} = 3\left(\frac{50}{4}\right) = 36.6$$

Let us find the values of Quartiles from the cumulative frequency table -



$$\text{Upper Quartile} = 22$$

$$\text{Lower Quartile} = 88$$