SUMMATIVE ASSESSMENT (SA-I)

MODEL PRACTICE PAPER NO. 06

Key features of Model Practice Papers:

- **Summative Assessment Papers** are based on the syllabus prescribed by the CBSE Board for **SA I** Examination.
- They are prepared exactly as per the sample papers suggested by the CBSE Board.
- The questions are selected in such a way that students get acquainted with each and every concept of the prescribed syllabus for **SA I**.
- All the questions provided in the **papers**, are supported with detailed and authentic solutions.
- **The Summative Assessment papers** will give you chance to practice more and more before the commencement of actual examination, for obtaining high scores.

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Class X MATHEMATICS

SUMMATIVE ASSESSMENT (SA I)

MODEL PRACTICE PAPER NO. 6

Time allowed: 3 hours **Maximum Marks: 80**

General Instructions:

(i) All questions are compulsory.

(ii) The question paper consists of 34 questions divided into four sections A, B, C and D.

(iii) Section A contains 10 questions of 1 mark each, which are multiple choice type questions, Section B contains 8 questions of 2 marks each, Section C contains 10 questions of 3 marks each, and Section D contains 6 questions of 4 marks each.

(iv) There is no overall choice in the paper. However, internal choice is provided in one question of 2 marks. 3 questions of 3 marks and two questions of 4 marks.

(v) Use of Calculators is not permitted.

SECTION – A

Question numbers 1 to 10 carry 1 mark each. For each of the questions 1-10, four alternative choices have been provided of which only one is correct. You have to select the correct choice.

Q1. Which of the following relation is false?

(a) HCF $(391,\ 425) = 17$

(b) LCM $(a,\ b) \times$ HCF $(a,\ b) = a \times b$

(c) LCM $(391,\ 527)$ =12121

(d) None of these.

Q2. Which one of the following is true?

(a) Sum of two irrational numbers is a rational number.

(b) Sum of rational and irrational numbers is a rational number.

(c) Product of two different irrational number is an irrational number.

(d) Product of rational and irrational numbers is a rational number.

Q3. Which of the following statement is false?

(a) A real number α is zero of a polynomial $f(x)$, if $f(\alpha) = 0$.

(b) A fourth degree polynomial is called a biquadratic polynomial.

(c) A Polynomial of degree zero is called a constant polynomial.

(d) None of these.

Q4. If the product of zeros of a polynomial $f(x) = ax^3 - 6x^2 + 11x - 6$ is 4, then value of $(a + 1)$ is

(a) $\frac{3}{2}$

(b) $-\frac{3}{2}$

(c) $\frac{5}{2}$

(d) None of these.

Q5. Sum of two numbers is 35 and their difference is 13, then the numbers are

(a) 34, 1 (b) 23, 12

(c) 24, 11 (d) None of these.

Q6. The given pair of linear equations are $ax + y = b$ and $ax - by = 1$, the value of x is

(a) $\frac{b^2+1}{a(1+b)}$ (b) $\frac{b^2+1}{1+b}$

(c) $\frac{b+1}{a(1+b)}$ (d) None of these.

Q7. In a ΔABC, D and E are the points on the sides AB and AC respectively such that AD $= 1.3\ cm$, DB $= 2.6\ cm$, AE $= 4.3\ cm$ and EC $= 8.6\ cm$, then relation between DE and BC is

(a) Parallel (b) Perpendicular

(c) Intersecting (d) None of these.

Q8. In a ΔABC, D and E are the points on the sides AB and AC respectively such that DE || BC. If AD $= x\ cm$, DB $= x - 2\ cm$, AE $= x + 2\ cm$ and EC $= x - 1\ cm$, then value of x is

(a) 1 (b) 2

(c) 3 (d) 4

Q9. If $x = a\sec\theta$, $y = b\sec\theta$ and $z = c\tan\theta$ then $\frac{x^2}{a^2} + \frac{y^2}{b^2}$ is equal to

(a) $2\left(1 - \frac{z^2}{c^2}\right)$ (b) $2\left(1 + \frac{z^2}{c^2}\right)$

(c) $1 + \frac{z^2}{c^2}$ (d) None of these.

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Q10. Median of a given frequency distribution is found graphically with the help of

(a) Ogive (b) Histogram

(c) Frequency curve (d) None of these.

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SECTION – B

Question numbers 11 to 18 carry 2 marks each.

Q11. Find the largest positive integer that will divide 396, 434 and 540 leaving remainders 5, 9 and 13 respectively.

Q12. If the zeros of the polynomial $f(x) = x^3 - 3x^2 + x + 1$ are $a - b$, a, $a + b$, prove that $b = \pm\sqrt{2}$.

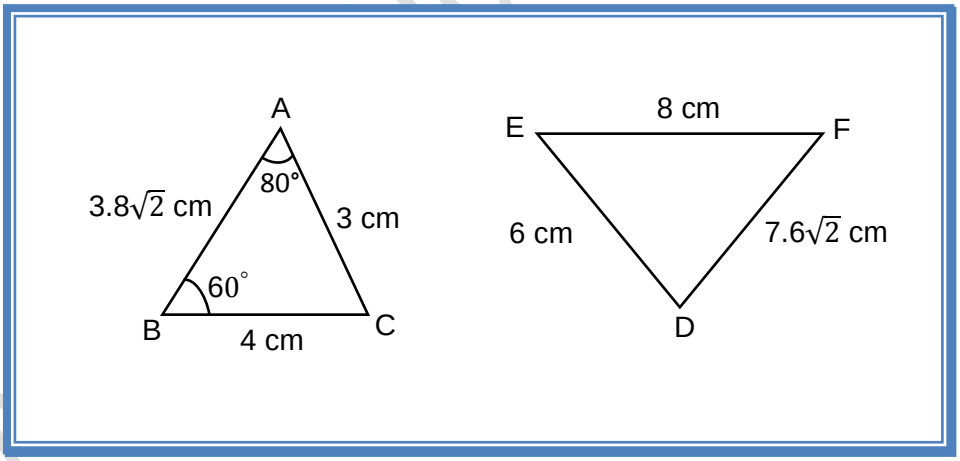
Q13. Solve: $3x - 5y = -1$ and $x - y = -1$; find p if $y = px - 1$.

Q14. Evaluate: $\tan 5^o \tan 25^o \tan 30^o \tan 65^o \tan 85^o$

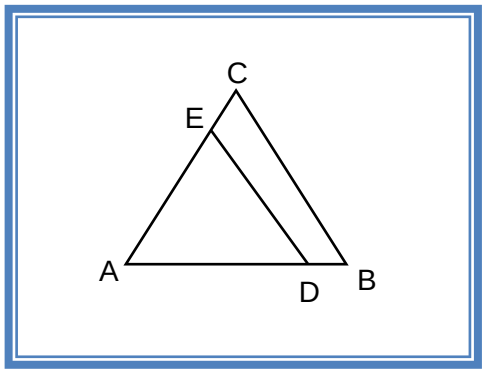
OR

If A, B, C are the interior angles of a triangle ABC, prove that: $\cot\frac{B+C}{2} = \tan\frac{A}{2}$

Q15. Given two triangles are ABC and DEF, Find ∠E



Q16. In ΔABC, if $DE \parallel BC$. If $AD = x, DB = x - 2, AE = x + 2$ and $EC = x - 1$, find the value of AC.



Q17. The following distribution gives the daily income of 45 workers of a factory:

Daily income (in rupees)	150 – 250	250 – 350	350 – 450	450 – 550	550 – 650
Number of Workers	11	13	7	5	9

Write the above distribution as less than type cumulative frequency distribution.

Q18. Find the mode of the following distribution of marks obtained by 60 students:

Marks obtained	0 – 15	15 – 30	30 – 45	45 –60	60 – 75
Number of Students	10	13	18	5	14

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SECTION – C

Question numbers 19 to 28 carry 3 marks each.

Q19. Find the HCF and LCM of 288, 360 and 834 by prime factorization method.

Q20. Show that $7\sqrt{7}$ is irrational.

OR

Prove that $\sqrt{7}$ is irrational.

Q21. A man walks a certain distance with certain speed. If he walks ½ km an hour faster, he takes 1 hour less. But, if he walks 1 km an hour slower, he takes 3 more hours. Find the distance covered by the man and his original rate of walking.

OR

2 men and 7 boys can finish a piece of work in 4 days while 4 men and 4 boys can finish it in 3 days. Find the time taken by one man along and that by one boy alone to finish the work.

Q22. Find the value of a and b so that $2x^4 + x^3 + 8x^2 + ax + b$ is divisible by $x^2 + 2$.

Q23. In a ΔABC, right angled at B, if AB $= 12\ cm$ and BC $= 5\ cm$,

Prove that $\sin^2 A + \cos^2 A = 1$

Q24. Given that $\sin(A - B) = \sin A \cos B - \cos A \sin B$, find the value of $\sin 15°$.

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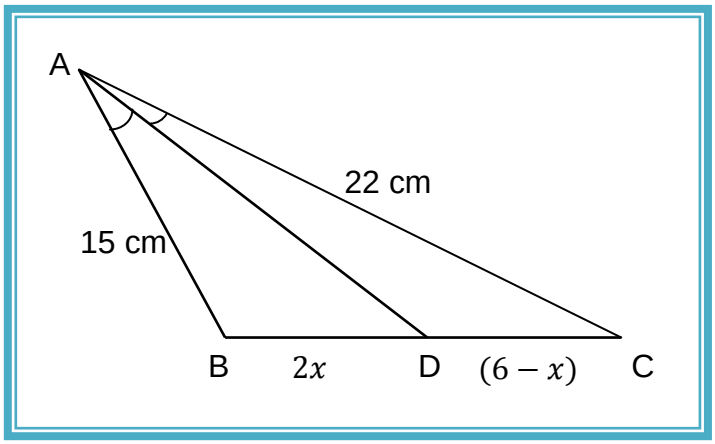
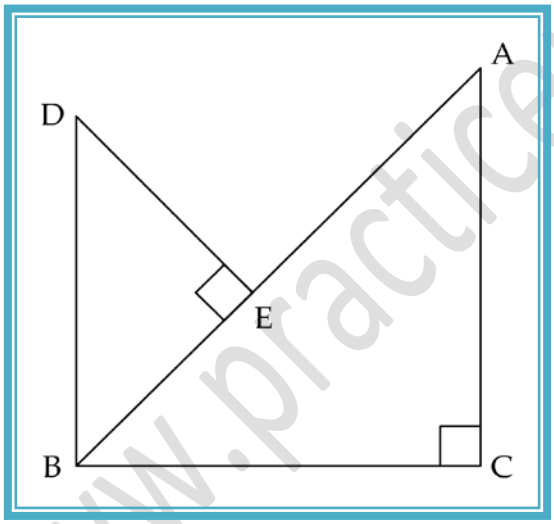
Q25. AD is the bisector of $\angle BAC$. If $AB = 15\ cm,\ AC = 22\ cm\ ,\ BD = 2x\ cm$ and $DC = (6 - x)\ cm$, find BD and DC.



Q26. If $DB \perp \mathrm{BC},\ \mathrm{DE} \perp \mathrm{AB}$ and $AC \perp \mathrm{BC}$, prove that $\frac{BE}{DE} = \frac{AC}{BC}$.



Q27. If the mean of the following distribution is 16, find the value of t.

x	4	6	10	$t+1$	14
f	1	3	4	2	2

OR

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Find the median of the following data:

Class interval	Frequency
25.5 – 34.5	4
35.5 – 44.5	5
45.5 – 54.5	6
55.5 – 64.5	9
65.5 – 74.5	11
75.5 – 84.5	12
85.5 – 94.5	8
95.5 – 104.5	5

Q28. The mean of the following frequency distribution is 30. Find the value of r.

Class	0.5 – 19.5	20.5 – 39.5	40.5 – 59.5	60.5 – 79.5	80.5 – 99.5
Frequency	5	r	10	2	5

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SECTION – D

Question numbers 29 to 34 carry 4 marks each.

Q29. Applying the division algorithm to find the quotient and remainder on dividing

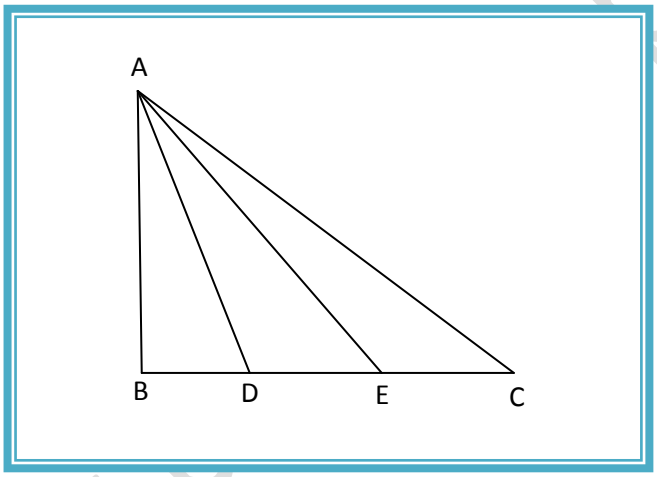
$f(x) = x^3 - 3x^2 + 5x - 3$ by $g(x) = x^2 - 2$.

Q30. In an equilateral triangle ABC the side BC is trisected at D.

Prove that $9AD^2 = 7AB^2$

OR

In figure, D and E trisect BC. Prove that $8AE^2 = 3AC^2 + 5AD^2$



Q31. Prove that $\frac{\cos A}{1-\tan A} + \frac{\sin A}{1-\cot A} = \cos A + \sin A$

OR

Prove that $\frac{1}{\operatorname{cosec} A - \cot A} - \frac{1}{\sin A} = \frac{1}{\sin A} - \frac{1}{\operatorname{cosec} A + \cot A}$

Q32. If $x \sin^3 A + y \cos^3 A = \sin A \cos A$ and $x \sin A = y \cos A$, prove that $x^2 + y^2 = 1$.

Q33. Solve: $x + 2y + z - 7 = 0$

$x + 3z - 11 = 0$

$2x - 3y - 1 = 0$

Q34. Compute the median from the following data:

Mid-value	Frequency
115	6
125	25
135	48
145	72
155	116
165	60
175	38
185	22
195	3

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SOLUTION OF MODEL PRACTICE PAPER - DEMO

SECTION – A

A1. Correct option: d

Explanation: Prime factorization are $391 = 23 \times 17$, $425 = 25 \times 17$ and

$527 = 31 \times 17$

$\therefore$ HCF $(391, 425) = 17$, LCM $(391, 527) = 23 \times 17 \times 31 = 12121$

and LCM $(a, b) \times$ HCF $(a, b) = a \times b$ are correct.

A2. Correct option**:** c

Explanation: Product of two different irrational number is irrational number.

A3. Correct option: d

A4. Correct option: c

Explanation: Given polynomial $f(x) = ax^3 - 6x^2 + 11x - 6$

$\therefore$ product of zeros $= 4 = \dfrac{-(-6)}{a}$

$4 = \dfrac{6}{a} \Rightarrow a = \dfrac{6}{4}$

$\Rightarrow a + 1 = \dfrac{6}{4} + 1 = \dfrac{10}{4} = \dfrac{5}{2}$

A5. Correct option: c

Explanation: Let two numbers are x and y,

Then $x + y = 35$ …(i)

and $x - y = 13$ …(ii)

Adding (i) and (ii) equations after that we get $2x = 48$ or $x = 24$

Substituting the value of $x = 24$ in (i)

$24 + y = 35$ or $y = 11$

A6. Correct option: a

Explanation: $ax + y = b$ …(i)

and $ax - by = 1$ …(ii)

multiply (i) by b, we get

$abx + by = b^2$ …(iii)

Adding equation (ii) and (iii), we get $abx + ax = 1 + b^2$

or $ax(b + 1) = 1 + b^2$

$$x = \frac{b^2 + 1}{a(1 + b)}$$

A7. Correct option: a

Explanation: Given, $AD = 1.3\ cm,\ DB = 2.6\ cm,\ AE = 4.3\ cm$ and $EC = 8.6\ cm$

$$\frac{AD}{DB} = \frac{1.3}{2.6} = \frac{1}{2} \text{ and } \frac{AE}{EC} = \frac{4.3}{8.6} = \frac{1}{2}$$

$$\therefore \frac{AD}{DB} = \frac{AE}{EC}$$

Hence, $DE \parallel BC$ (by basic proportional theorem)

A8. Correct option: d

A9. Correct option: b

Explanation: If $x = a\sec\theta$, $y = b\sec\theta$ and $z = c\tan\theta$

Then $$\frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{(a\sec\theta)^2}{a^2} + \frac{(b\sec\theta)^2}{b^2}$$

$$= \sec^2\theta + \sec^2\theta$$

$$= 2\sec^2\theta$$

$$= 2(1 + \tan^2\theta)$$

$$= 2\left(1 + \frac{z^2}{c^2}\right) \qquad \text{[where } z = c\tan\theta\text{]}$$

A10. Correct option: a

Explanation: Median of a given frequency distribution is found graphically with the help of ogive.

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SECTION – B

A11. According to question, largest positive integer is a factor of 396 – 5, 434 – 9 and 540 – 13.

Clearly, required number is the HCF of 391, 425 and 527.

Using the factor tree the prime factorizations of 391, 425 and 527 are as follows:

$391 = 17 \times 23$, $425 = 5^2 \times 17$ and $527 = 17 \times 31$

$\therefore$ HCF of 391, 425 and 527 is 17

Hence, required number is 17.

A12. Given $a - b, a, a + b$ are the zeros of the $f(x) = x^3 - 3x^2 + x + 1$

$\therefore$ Sum of the zeros $= a - b + a + a + b = -\frac{-3}{1} = 3 \quad \Rightarrow 3a = 3$

$\Rightarrow \quad a = 1$ …(i)

Product of the zeros $= (a - b)\ a\ (a + b) = -\frac{1}{1} = -1$

$\Rightarrow \quad a(a^2 - b^2) = -1$ …(ii)

From (i) and (ii), we get

$1 \times (1^2 - b^2) = -1$

$\Rightarrow \quad 1 - b^2 = -1 \quad \Rightarrow \quad b^2 = 2 \quad \Rightarrow \quad b = \pm\sqrt{2}$ Proved.

A13. Given system of equation is

$3x - 5y = -1$ …(i)

$x - y = -1$ …(ii)

Substitute the value of y from (ii) in (i), we get

$$3x - 5(x+1) = -1 \quad \Rightarrow \quad 3x - 5x - 5 = -1$$

$\Rightarrow \quad x = -2$

Putting $x = -2$ in $y = x + 1$, we get

$$y = x + 1 = -2 + 1 = -1$$

Putting $x = -2$, $y = -1$ in $y = px - 1$, we get

$$-1 = p(-2) - 1 \quad \Rightarrow \quad p = 0$$

A14. We have, $\tan 5^o \tan 25^o \tan 30^o \tan 65^o \tan 85^o$

$$= (\tan 5^o \tan 85^o)\ (\tan 25^o \tan 65^o) \tan 30^o$$

$$= \{\tan 5^o \tan(90^o - 5^o)\}\ \{\tan 25^o \tan(90^o - 25^o)\} \tan 30^o$$

$$= \{\tan 5^o \cot 5^o\}\ \{\tan 25^o \cot 25^o\} \tan 30^o$$

$$= 1 \times 1 \times \frac{1}{\sqrt{3}} = \frac{1}{\sqrt{3}}$$

OR

In triangle ABC, we have

$$A + B + C = 180^o \qquad \Rightarrow B + C = 180^o - A$$

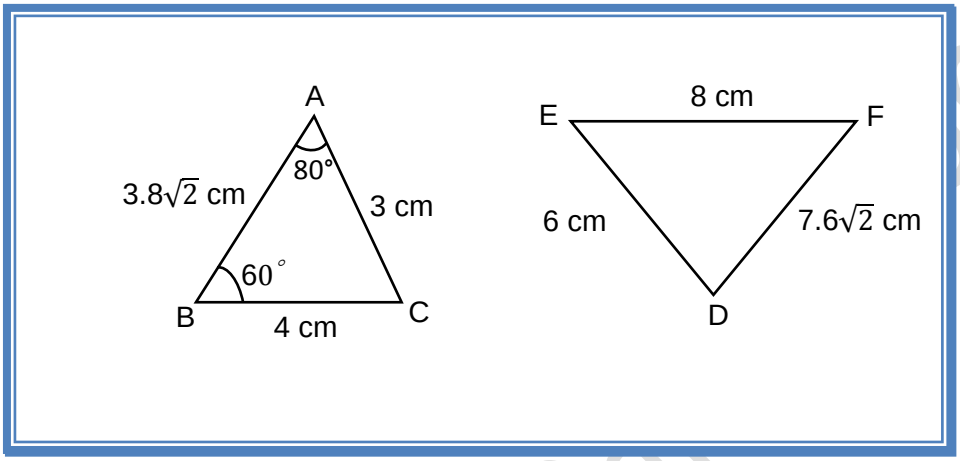
$$\Rightarrow \frac{B+C}{2} = \frac{180^o - A}{2} \qquad \Rightarrow \cot\left(\frac{B+C}{2}\right) = \cot\left(\frac{180^o - A}{2}\right)$$

$$\Rightarrow \cot\frac{B+C}{2} = \cot\left(90^o - \frac{A}{2}\right)$$

$\Rightarrow \cot\frac{B+C}{2} = \tan\frac{A}{2}$ Proved.

A15. In triangles ABC and DEF, we have

$$\frac{AB}{DF} = \frac{BC}{FE} = \frac{CA}{ED} = \frac{1}{2}$$

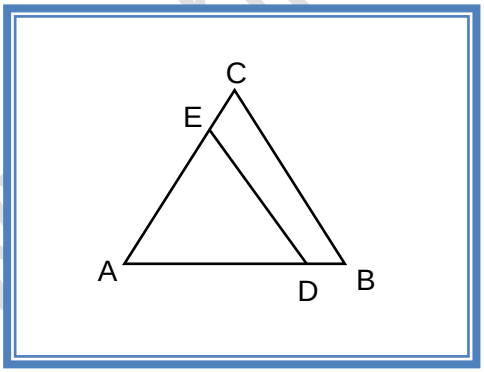


Therefore, by SSS-criterion of similarity, we have

$\Rightarrow$ ∠A = ∠D, ∠B = ∠F and ∠C = ∠E, $\Rightarrow$ ∠D = 80°, ∠F = 60°

Hence, ∠C = ∠E = 60° (Since, ∠A + ∠B + ∠C = 180°)

A16. In ΔABC, we have $DE \parallel BC$.



$\Rightarrow$ By Thale's Theorem, $\frac{AD}{DB} = \frac{AE}{EC}$ $\Rightarrow$ $\frac{x}{x-2} = \frac{x+2}{x-1}$ $\Rightarrow$ $x = 4\ cm.$

$\therefore$ $AC = AE + EC = x + 2 + x - 1 = 2x + 1 = 2 \times 4 + 1 = 9\ cm.$

A17. Less than type cumulative frequency distribution:

Daily income (in rupees)	Number of Workers or Frequency (f)	Less than	
		Daily income	Number of Workers or $(c.f.)$
150 – 250	11	250	11
250 – 350	13	350	24
350 – 450	7	450	31
450 – 550	5	550	36
550 – 650	9	650	45

A18. Given frequency table

Marks obtained	0 – 15	15 – 30	30 – 45	45 –60	60 – 75
Number of Students	10	13	18	5	14

Here, maximum frequency is 18 and the corresponding class is 30 – 45.

So, 30 – 45 is the modal class. We have,

Lower limit of modal class $= l = 30$

Size of the class interval $= h = 15$

Frequency of the modal class $= f_1 = 18$

Frequency of the class preceding the modal class $= f_0 = 13$

Frequency of the class succeeding the modal class $= f_2 = 5$

Formula of obtain the mode $= l + \left[\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right] \times h$

$$= 30 + \left[\frac{18 - 13}{2 \times 18 - 13 - 5}\right] \times 15$$

$$= 30 + \left[\frac{5}{18}\right] \times 15$$

$$= 30 + \frac{75}{18} = 34.16$$

SECTION – C

A19. Using the factor tree for the prime factorization of 288, 360 and 834

$288 = 2^5 \times 3^2$,

$360 = 2^3 \times 3^2 \times 5$ and

$834 = 2^7 \times 3$

$\therefore$ HCF of 288, 360 and 834 $= 2^3 \times 3 = 24$ and

LCM of 288, 360 and 834 $= 2^7 \times 3^2 \times 5 = 5760$.

A20. Let us assume, on contrary, that $7\sqrt{7}$ is rational.

Suppose $7\sqrt{7} = \frac{a}{b}$, where a and b are co-primes and $b \neq 0$.

Rearranging, we get $\sqrt{7} = \frac{a}{7b}$

Since 7, a and b are integers, $\frac{a}{7b}$ is rational, and so $\sqrt{7}$ is rational. But this contradicts the fact that $\sqrt{7}$ is irrational. So we conclude that $7\sqrt{7}$ is irrational.

OR

Assume that $\sqrt{7}$ is rational.

Then there exist positive integers a and b such that $\sqrt{7} = \frac{a}{b}$,

Where a and b are co-prime and $b \neq 0$.

So, $b\sqrt{7} = a \Rightarrow 7b^2 = a^2$ ….(i)

Therefore, by theorem a^2 is divisible by 7 and so $'a'$ is divisible by 7.

So, we can write $a = 7c$ for some integer c.

Substituting $a = 7c$ in (i) we get; $7b^2 = (7c)^2 \Rightarrow 7b^2 = 49c^2$

$\therefore \quad b^2 = 7c^2$ ….(ii)

So, by theorem b^2 is divisible by 7 and also b is divisible by 7.

Therefore, a and b have at least 7 as a common factor. But this contradicts the fact a and b are co-prime. So our assumption that $\sqrt{7}$ is rational is incorrect Hence. $\sqrt{7}$ is irrational.

A21. Let the original speed be $y\ km/hr$ and total time taken be x hrs. Then,

Distance $= (xy)km.$

According to question, since distance covered in each case is same.

$\therefore \quad \left(y + \frac{1}{2}\right)(x - 1) = xy \quad \Rightarrow \quad \frac{x}{2} - y - \frac{1}{2} = 0 \quad \Rightarrow x - 2y - 1 = 0$ …(i)

and, $\quad (y - 1)(x + 3) = xy \quad \Rightarrow \quad -x + 3y - 3 = 0$ …(ii)

adding (i) and (ii), we get $y = 4\ km/hr$

Substituting the value of $y = 4$ in (ii), we get

$$x - 2 \times 4 - 1 = 0 \quad \Rightarrow \quad x = 9 \text{ hrs}$$

OR

Suppose that one man alone can finish the work in x days and one boy alone can finish it in y days. Then,

One man's one day's work $= \frac{1}{x}$

One boy's one day's work $= \frac{1}{y}$

$\therefore$ 2 men's one day's work $= \frac{2}{x}$

7 boy's one day's work $= \frac{7}{y}$

Since 2 men and 7 boy's can finish the work in 4 days.

$$4\left(\frac{2}{x}+\frac{7}{y}\right) = 1 \quad \Rightarrow \frac{8}{x}+\frac{28}{y} = 1 \qquad \ldots\text{(i)}$$

Again, 4 men and 4 boys can finish the work in 3 days.

$$\therefore \quad 3\left(\frac{4}{x}+\frac{4}{y}\right) = 1 \quad \Rightarrow \frac{1}{x}+\frac{1}{y} = \frac{1}{12} \qquad \ldots\text{(ii)}$$

Putting $\frac{1}{x} = u$ and $\frac{1}{y} = v$ in equations (i) and (ii), we get

$$8u + 28v = 1 \qquad \ldots\text{(iii)}$$

$$u + v = \frac{1}{12} \qquad \ldots\text{(iv)}$$

Substituting the value of $u = \frac{1}{12} - v$ in (iii), we get

$$8\left(\frac{1}{12} - v\right) + 28v = 1$$

$$\frac{8}{12} - 8v + 28v = 1$$

$$\frac{8}{12} + 20v = 1$$

$$20v = 1 - \frac{8}{12} = \frac{4}{12}$$

$$v = \frac{8}{12 \times 20} = \frac{1}{30}$$

and $u = \frac{1}{12} - v = \frac{1}{12} - \frac{1}{30} = \frac{1}{20}$

Therefore, $\frac{1}{x} = u = \frac{1}{20}$ and $\frac{1}{y} = v = \frac{1}{30}$

Thus, one man alone can finish the work in 20 days one boy alone can finish the work in 30 days.

A22. If $2x^4 + x^3 + 8x^2 + ax + b$ is exactly divisible by $x^2 + 2$, then the remainder should be zero.

On dividing, we get

$$
\begin{array}{r|l}
 & 2x^2 + x + 4 \\
\hline
x^2 + 2 & 2x^4 + x^3 + 8x^2 + ax + b \\
 & 2x^4 \qquad\quad + 4x^2 \\
 & - \qquad\qquad\quad - \\
\hline
 & x^3 + 4x^2 + ax + b \\
 & x^3 \qquad\quad + 2x \\
 & - \qquad\qquad - \\
\hline
 & 4x^2 + x(a-2) + b \\
 & 4x^2 \qquad\qquad\quad + 8 \\
 & - \qquad\qquad\qquad - \\
\hline
 & x(a-2) + b - 8
\end{array}
$$

$\therefore$ Remainder $= x(a-2) + b - 8$

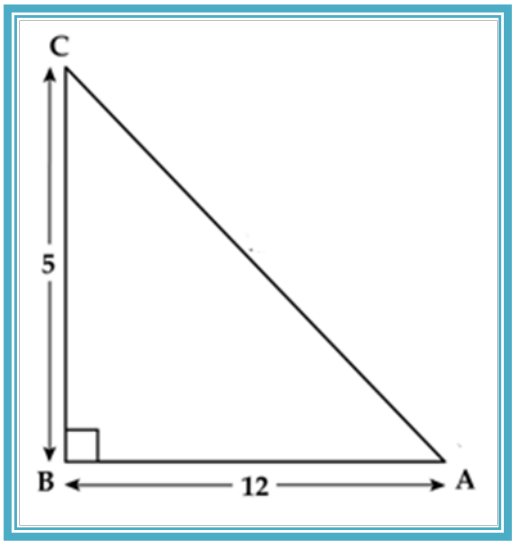
Now, Remainder $= x(a-2) + b - 8 = 0$

$\Rightarrow$ $x(a-2) + (b-8) = x \times 0 + 0$

$\Rightarrow$ $a - 2 = 0$ and $b - 8 = 0$

$\Rightarrow$ $a = 2$ and $b = 8$.

A23. By Pythagoras theorem, we have



$$AC^2 = AB^2 + BC^2$$

$$\Rightarrow \quad AC^2 = 12^2 + 5^2$$

$$\Rightarrow \quad AC^2 = 169 \;\Rightarrow\; AC = 13$$

$\therefore \quad \sin A = \dfrac{\text{Perpendicular}}{\text{Hypotenuse}} = \dfrac{5}{13}$ and $\cos A = \dfrac{\text{Base}}{\text{Hypotenuse}} = \dfrac{12}{13}$.

LHS $\quad \sin^2 A + \cos^2 A$

$= \left(\dfrac{5}{13}\right)^2 + \left(\dfrac{12}{13}\right)^2 = \dfrac{25}{169} + \dfrac{144}{169} = \dfrac{25 + 144}{169} = \dfrac{169}{169} = 1$ RHS Proved.

A24. Let $\quad$ A $= 45°$ and B $= 30°$

$\therefore \quad \sin(45° - 30°) = \sin 15°$

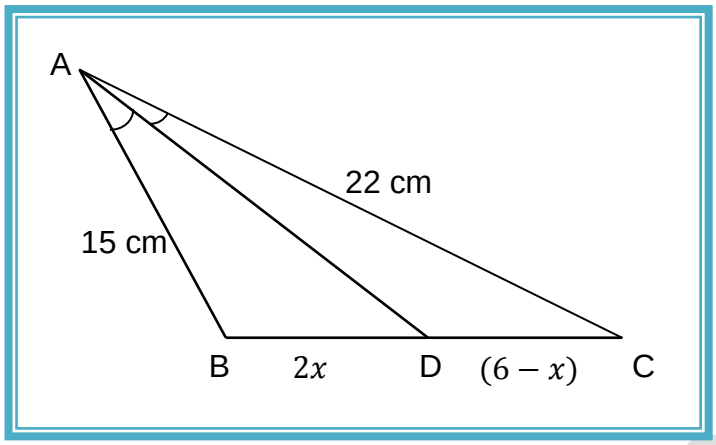
or $\quad \sin 15° = \sin 45° \cos 30° - \cos 45° \sin 30°$

$$= \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}} \cdot \frac{1}{2}$$

$$= \frac{(\sqrt{3} - 1)}{2\sqrt{2}}$$

A25. Let $BD = 2x\ cm$ then $DC = (6 - x)$

Since AD is the bisector of $\angle A$.



$$\frac{AB}{AC} = \frac{BD}{DC}$$

$$\Rightarrow \quad \frac{15}{22} = \frac{2x}{6-x}$$

$$\Rightarrow \quad 44\,x = 90 - 15x$$

$$\Rightarrow \quad 44\,x + 15x = 90$$

$$\Rightarrow \quad 59\,x = 90 \quad \Rightarrow \quad x = \frac{90}{59}$$

$$\Rightarrow \quad x = \frac{90}{59} = 1.53$$

$$\Rightarrow \quad BD = 2 \times 1.53\ cm \text{ and } DC = (6 - 1.53)\ cm = 3.5\ cm.$$

$$\Rightarrow \quad BD = 3.06\ \ cm \text{ and } DC = (6 - 1.53)\ cm = 4.47\ cm.$$

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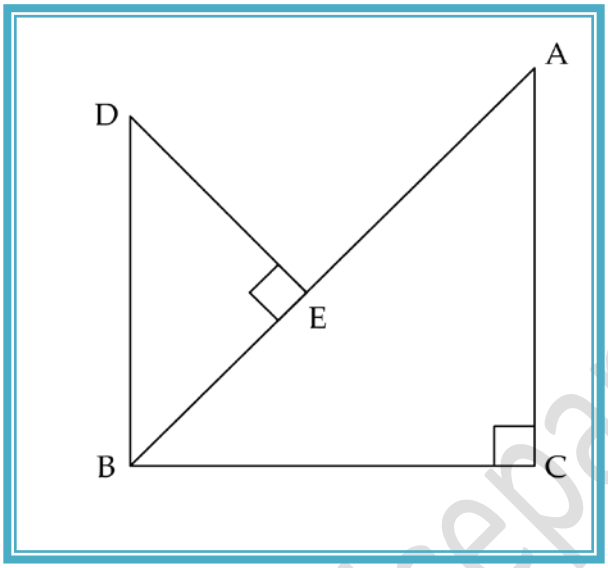
A26. Since $DB \perp \mathrm{BC}$ and $\perp \mathrm{BC}$; hence $DB \parallel \mathrm{AC}$

$\therefore \quad \angle DBE = \angle EAC$ (Alternate Angles)

Now in ΔDBE and ΔABC



$\angle DEB = \angle ACB$ (Both 90°)

$\angle DBE = \angle EAC \quad \Rightarrow \quad \angle DBE = \angle BAC$

Hence $\Delta DBE \sim \Delta ABC$

From AA-criterion, $\frac{BE}{AC} = \frac{DB}{AB} = \frac{DE}{BC}$

$\Rightarrow \quad \frac{BE}{DE} = \frac{AC}{BC}$ Proved.

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A27. Frequency distribution table:

x	f	fx
4	1	4
6	3	18
10	4	40
$t+1$	2	$2t+2$
14	2	28
	$\sum f = 12$	$\sum fx = 92 + 2t$

We have $\sum f = 12$, $\sum fx = 92 + 2t$ and mean $= 16$

$\therefore$ Mean $= \frac{\sum fx}{\sum f}$

$\Rightarrow$ $16 = \frac{92+2t}{12}$ $\Rightarrow 92 + 2t = 192$

$\Rightarrow$ $2t = 192 - 92 = 100$ $\Rightarrow$ $t = 50.$

OR

Classes (Inclusive form)	Classes (Exclusive form)	Frequency (f)	Cumulative frequency (cf)
25.5 – 34.5	25 – 35	4	4
35.5 – 44.5	35 – 45	5	9
45.5 – 54.5	45 – 55	6	15
55.5 – 64.5	55 – 65	9	24
65.5 – 74.5	65 – 75	11	35
75.5 – 84.5	75 – 85	12	47
85.5 – 94.5	85 – 95	8	55
95.5 – 104.5	95 – 105	5	60
		$n = 60$	

$$\frac{n}{2} = \frac{60}{2} = 30$$

$\therefore$ 65 – 75 is the median class. (where $\frac{n}{2} = 30$ lise in cf of 35)

l = 65, f = 11, cf = 24, h = 10

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

= 65 + $\frac{30-24}{11} \times 10 = 70.45$ (approximate)

A28.

Class (Inclusive form)	Class (Exclusive form)	Frequency (f)	Class mark (x)	fx
0.5 – 19.5	0–20	5	10	50
20.5 – 39.5	20–40	r	30	30 r
40.5 – 59.5	40–60	10	50	500
60.5 – 79.5	60–80	2	70	140
80.5 – 99.5	80–100	5	90	450
		$\sum f = 22 + r$		$\sum f = 1140 + 30r$

$\sum f = 22 + r$, $\sum f = 1140 + 30r$, given $\bar{x} = 45$

$$\bar{x} = \frac{\Sigma fd}{\Sigma f} \Rightarrow 45 = \frac{1140 + 30r}{22 + r}$$

$\Rightarrow 45(22 + r) = 1140 + 30r$

$\Rightarrow 990 + 45r = 1140 + 30r$

$\Rightarrow 15r = 150$

$\Rightarrow r = 10$

SECTION – D

A29. We have, $f(x) = x^3 - 3x^2 + 5x - 3$ and $g(x) = x^2 - 2$.

Hence, degree of $f(x)$ is 3 and degree of $g(x)$ is 2.

Therefore, quotient $q(x)$ is of degree 3 – 2= 1 and the remainder $r(x)$ is of degree less then 2.

Suppose that $q(x) = ax + b$ and $r(x) = cx + d$.

Using division algorithm, we have $f(x) = g(x) \times q(x) + r(x)$

$\Rightarrow \quad x^3 - 3x^2 + 5x - 3 = (x^2 - 2)(ax + b) + cx + d$

$\Rightarrow \quad x^3 - 3x^2 + 5x - 3 = ax^3 + bx^2 + (c - 2a)x - 2b + d$

Equating the coefficient of various power of x on both sides, we get

$1 = a$

$-3 = b$

$5 = c - 2a$

$-3 = -2b + d$

Solving these equations, we get

$a = 1,\ b = -3, c = 7$ and $d = -9$

$\therefore$ Required quotient $q(x) = x - 3$ and remainder $r(x) = 7x - 9$.

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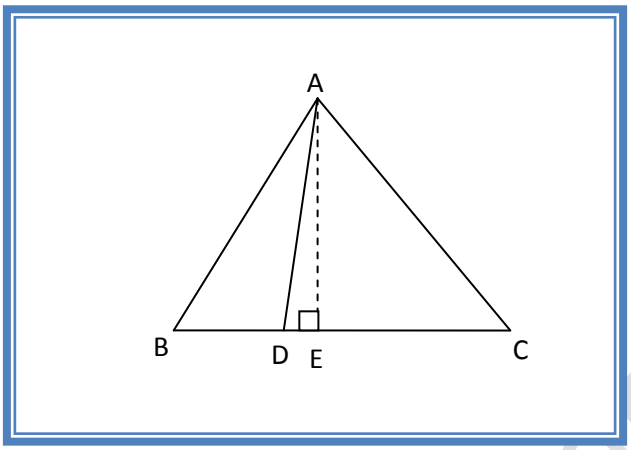
A30. **Given:** In ΔABC, D be a point on BC such that $BD = \frac{1}{3}\ BC$.

To Prove: $9AD^2 = 7AB^2$

Construction: Draw $AE \perp BC$. Join AD.



Proof: In ΔAEB, and ΔAEC, we have $AB = AC$,

$$\angle AEB = \angle AEC = 90^{\circ}$$

and, $AE = AE$

So, by RHS criterion of similarity, we have

$$\Delta AEB \sim \Delta AEC$$

$\Rightarrow$ $BE = EC$

Thus, we have

$$BD = \frac{1}{3}\ BC,\quad DC = \frac{2}{3}\ BC \text{ and } BE = EC = \frac{1}{2}\ BC \qquad \ldots(i)$$

Since $\angle C = 90^{\circ}$. Therefore, ΔADC is an acute triangle.

$\therefore$ $AD^2 = AC^2 + DC^2 - 2\ DC\ \times EC$

$\Rightarrow$ $AD^2 = AC^2 + \left(\frac{2}{3}\ BC\right)^2 - 2\ \times \frac{2}{3}\ BC\ \times \frac{1}{2}\ BC$

$\Rightarrow \quad AD^2 = AC^2 + \frac{4}{9}BC^2 - \frac{2}{3}BC^2$

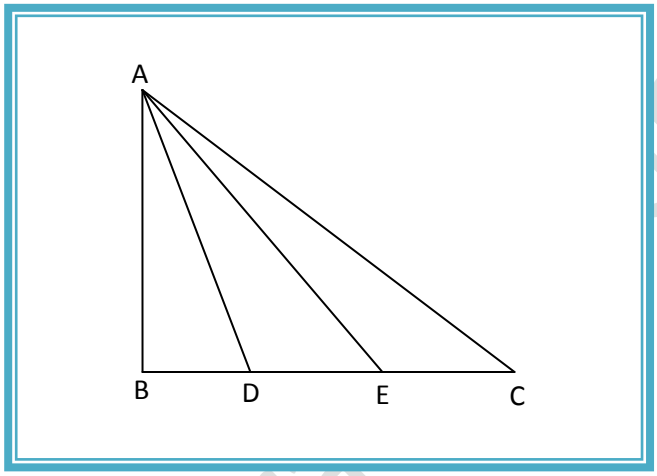
$\Rightarrow \quad AD^2 = AB^2 + \frac{4}{9}AB^2 - \frac{2}{3}AB^2$

$\Rightarrow \quad AD^2 = \frac{7}{9}AB^2$

$\Rightarrow \quad 9AD^2 = 7AB^2$

OR

Given, D and E trisect BC



Therefore, $BD = DE = CE$.

Let $BD = DE = CE = x$.

Then, $BE = 2x$ and $BC = 3x$.

In right triangles ABD, ABE and ABC, we have

$\Rightarrow \quad AD^2 = AB^2 + BD^2$

$\Rightarrow \quad AD^2 = AB^2 + x^2$, …(i)

$AE^2 = AB^2 + BE^2$

$\Rightarrow \quad AE^2 = AB^2 + 4x^2$ …(ii)

and $AC^2 = AB^2 + BC^2$

$\Rightarrow \quad AC^2 = AB^2 + 9x^2$ …(iii)

Now, $8AE^2 - 3AC^2 - 5AD^2$

$= 8(AB^2 + 4x^2) - 3(AB^2 + 9x^2) - 5(AB^2 + x^2)$ [From (i) (ii) and (iii)]

$\Rightarrow \quad 8AE^2 - 3AC^2 - 5AD^2 = 0$

$\Rightarrow \quad 8AE^2 = 3AC^2 + 5AD^2$ Proved.

A31. We have LHS $= \frac{\cos A}{1-\tan A} + \frac{\sin A}{1-\cot A}$

$$\text{LHS} = \frac{\cos A}{1-\frac{\sin A}{\cos A}} + \frac{\sin A}{1-\frac{\cos A}{\sin A}}$$

$$\text{LHS} = \frac{\cos A}{\frac{\cos A - \sin A}{\cos A}} + \frac{\sin A}{\frac{\sin A - \cos A}{\sin A}}$$

$$\text{LHS} = \frac{\cos^2 A}{\cos A - \sin A} + \frac{\sin^2 A}{\sin A - \cos A}$$

$$\text{LHS} = \frac{\cos^2 A}{\cos A - \sin A} - \frac{\sin^2 A}{\cos A - \sin A}$$

$$\text{LHS} = \frac{\cos^2 A - \sin^2 A}{\cos A - \sin A}$$

$$\text{LHS} = \frac{(\cos A - \sin A)(\cos A + \sin A)}{\cos A - \sin A}$$

LHS $= \cos A + \sin A =$ RHS Proved.

OR

We have, LHS $= \frac{1}{\text{cosec } A - \cot A} - \frac{1}{\sin A}$

$$\text{LHS} = \frac{1}{(\text{cosec } A - \cot A)} \times \frac{(\text{cosec } A + \cot A)}{(\text{cosec } A + \cot A)} - \frac{1}{\sin A}$$

$$\text{LHS} = \frac{\text{cosec } A + \cot A}{\text{cosec}^2 \text{A} - \cot^2 A} - \text{cosec } A$$

$$\text{LHS} = \text{cosec } A + \cot A - \text{cosec } A$$

$$\text{LHS} = \cot A \qquad \ldots\text{(i)}$$

and, $$\text{RHS} = \frac{1}{\sin A} - \frac{1}{\text{cosec } A + \cot A}$$

$$\text{RHS} = \frac{1}{\sin A} - \frac{1}{(\text{cosec } A + \cot A)} \times \frac{(\text{cosec } A - \cot A)}{(\text{cosec } A - \cot A)}$$

$$\text{RHS} = \text{cosec } A - \frac{\text{cosec } A - \cot A}{\text{cosec}^2 \text{A} - \cot^2 A}$$

$$\text{RHS} = \text{cosec } A - (\text{cosec } A - \cot A)$$

$$\text{RHS} = \text{cosec } A - (\text{cosec } A - \cot A)$$

$$\text{RHS} = \cot A \qquad \ldots\text{(ii)}$$

From (i) and (ii)

LHS = RHS Proved.

A32. We have,

$$x \sin^3 A + y \cos^3 A = \sin A \cos A$$

$$\Rightarrow (x \sin A) \sin^2 A + (y \cos A) \cos^2 A = \sin A \cos A$$

$$\Rightarrow (x \sin A) \sin^2 A + (x \sin A) \cos^2 A = \sin A \cos A \qquad [\text{where, } x \sin A = y \cos A]$$

$$\Rightarrow (x \sin A)(\sin^2 A + \cos^2 A) = \sin A \cos A$$

$$\Rightarrow x \sin A = \sin A \cos A$$

$\Rightarrow \quad x = \cos A$

Now, $x \sin A = y \cos A \quad \Rightarrow \quad \cos A \sin A = y \cos A$

$\Rightarrow \quad x = \sin A$

Hence, $x^2 + y^2 = \sin^2 A + \cos^2 A = 1$

$x^2 + y^2 = 1$ Proved.

A33. We have, $x + 2y + z = 7$ …(i)

$x + 3z = 11$ …(ii)

$2x - 3y = 1$ …(iii)

From equation (i), we get

$z = 7 - x - 2y$

Substituting $z = 7 - x - 2y$ in equation (ii), we get

$x + 3(7 - x - 2y) = 11 \quad \Rightarrow \quad x + 21 - 3x - 6y = 11$

$\Rightarrow \quad -2x - 6y = -10$ …(iv)

Adding equation (iii) and (iv), we get

$-9y = -9 \quad \Rightarrow \quad y = 1$

Putting $y = 1$ in equation (iii), we get

$2x - 3 \times 1 = 1 \quad \Rightarrow \quad x = 2$

Putting $x = 2$, $y = 1$ in equation (i), we get

$2 + 2 + z = 7 \quad \Rightarrow \quad z = 3$

Hence, $x = 2$, $y = 1$ and $z = 3$.

A34. Here we are given the mid-values. So, we should first find the upper and lower limits of the various classes.

The difference between two consecutive values is $h = 135 - 125 = 10$.

So, lower limit of a class = Mid value $-h/2$, and upper limit = Mid value + $h/2$.

Mid-value	Class groups	Frequency (f)	Cumulative Frequency
125	120 – 130	3	3
135	130 – 140	4	7
145	140 – 150	20	27
155	150 – 160	45	72
165	160 – 170	75	147
175	170 – 180	30	177
185	180 – 190	27	204
195	190 – 200	23	227
205	200 – 210	3	230
		N = $\sum f$ = 230	

We have N = 230.

$\therefore \quad \frac{N}{2} = \frac{230}{2} = 115$

The cumulative frequency just greater than

$\frac{N}{2}$ = 115 is 147 and the corresponding class is 160 – 170.

So, 160 – 170 is the median class.

$\therefore \quad l$ = 160, f = 75, h = 10, $\quad cf$ = 72. $\qquad \therefore \quad$ Median = $l + \frac{\frac{N}{2} - cf}{f} \times h$

$\Rightarrow$ Median = $160 + \frac{115-72}{75} \times 10 = 165.73$