# ICSE Board <br> Class IX Mathematics <br> Paper 1 - Solution 

## SECTION - A (40 Marks)

Q. 1.
(a) Here,

$$
\begin{aligned}
& \text { C.I. }=\text { Rs. } 287, r=5 \% \text { p.a., } n=2 \text { years } \\
& \text { C.I. }=P\left[\left(1+\frac{\mathrm{r}}{100}\right)^{\mathrm{n}}-1\right]=287 \\
& \Rightarrow \mathrm{P}\left[\left(1+\frac{5}{100}\right)^{2}-1\right]=287 \\
& \Rightarrow \mathrm{P}\left[\left(\frac{105}{100}\right)^{2}-1\right]=287 \\
& \Rightarrow \mathrm{P}\left[\left(\frac{21}{20}\right)^{2}-1\right]=287 \\
& \Rightarrow \mathrm{P}\left[\frac{441}{400}-1\right]=287 \\
& \Rightarrow \mathrm{P}\left[\left(\frac{441-400}{400}\right)\right]=287 \\
& \Rightarrow \mathrm{P} \times \frac{41}{400}=287 \\
& \Rightarrow \mathrm{P}=\frac{287 \times 400}{41}=2800
\end{aligned}
$$

Thus P = Rs. 2,800
(b) Let us assume that $\sqrt{2}$ is a rational number.

Then, $\sqrt{2}=\frac{p}{q}$
Where p and q are integers, co-prime to each other and $\mathrm{q} \neq 0$.
On squaring both sides, we get

$$
\begin{equation*}
2=\frac{\mathrm{p}^{2}}{\mathrm{q}^{2}} \Rightarrow \mathrm{p}^{2}=2 \mathrm{q}^{2} \tag{2}
\end{equation*}
$$

By equation (2), we can say that $\mathrm{p}^{2}$ is an even integer.
$\therefore \mathrm{p}$ is also an even integer $\quad(\because$ the square of an even integer is always even $)$ Let $\mathrm{p}=2 \mathrm{k}$, where k is an integer.

From (2),
$p^{2}=2 q^{2}$
$(2 \mathrm{k})^{2}=2 \mathrm{q}^{2}$
$4 \mathrm{k}^{2}=2 \mathrm{q}^{2}$
$\Rightarrow q^{2}=2 \mathrm{k}^{2}$
$q^{2}$ is an even integer, $q$ is also an even integer.
Thus, $p$ and $q$ have a common factor 2 which contradicts the hypothesis that $p, q$ are co-prime to each other.
$\therefore \sqrt{2}$ is an irrational number.
(c)
$\left.\begin{array}{l}\frac{\cos 37^{\circ} \cdot \operatorname{cosec} 53^{\circ}}{\tan 5^{\circ} \cdot \tan 25^{\circ} \cdot \tan 45^{\circ} \cdot \tan 65^{\circ} \cdot \tan 85^{\circ}} \\ =\frac{\cos 37^{\circ} \cdot \operatorname{cosec}\left(90^{\circ}-37^{\circ}\right)}{\tan 5^{\circ} \cdot \tan 25^{\circ} \cdot \tan 45^{\circ} \cdot \tan \left(90^{\circ}-25^{\circ}\right) \cdot \tan \left(90^{\circ}-5^{\circ}\right)} \\ =\frac{\cos 37^{\circ} \cdot \sec 37^{\circ}}{\tan 5^{\circ} \cdot \tan 25^{\circ} \cdot \tan 45^{\circ} \cdot \cot 25^{\circ} \cdot \cot 5^{\circ}} \\ =\frac{1}{\tan 5^{\circ} \cdot \cot 5^{\circ} \cdot \tan 25^{\circ} \cdot \cot 25^{\circ} \cdot 1} \\ =\frac{1}{1} \\ =1\end{array} \quad\left[\begin{array}{c}\left.\because \operatorname{cosec}\left(90^{\circ}-\theta\right)=\sec \theta\right] \\ \tan \left(90^{\circ}-\theta\right)=\cot \theta\end{array}\right] \quad \begin{array}{l}\left.\tan 45^{\circ}=\frac{1}{\cos \theta}\right]\end{array}\right]$
Q. 2
(a) In $\triangle A B D$ and $\triangle B C D$
$\mathrm{m} \angle \mathrm{A}=\mathrm{m} \angle \mathrm{C}=90^{\circ}$
$\mathrm{AB}=\mathrm{DC} \quad$ [Given]
$\mathrm{BD}=\mathrm{BD} \quad$ [Common]
$\triangle \mathrm{ABD} \cong \triangle \mathrm{CDB} \quad$ [R.H.S.]
$\Rightarrow \angle \mathrm{CBD}=\angle \mathrm{ADB} \quad$ [C.P.C.T.]
$\therefore \angle \mathrm{CBD}=\mathrm{x}^{\circ}=50^{\circ}$
Also, $\mathrm{BC}=\mathrm{AD} \quad$ [C.P.C.T.]
$\Rightarrow 3 y-20=y-10$
$\Rightarrow 3 y-y=20-10$
$\Rightarrow 2 \mathrm{y}=10$
$\Rightarrow \mathrm{y}=5 \mathrm{~cm}$
(b) $2 \log 3-\frac{1}{2} \log 16+\log 12=\log 3^{2}-\log (16)^{\frac{1}{2}}+\log 12$

$$
\begin{aligned}
& =\log 9-\log 4+\log 12 \\
& =\log \frac{9 \times 12}{4} \\
& =\log 27
\end{aligned}
$$

(c) Steps of construction for constructing parallelogram:

1) Draw a line AB of measure 6 cm .
2) Draw an angle of measure $45^{\circ}$ at point A such that $\angle \mathrm{DAB}=45^{\circ}$ and $\mathrm{AD}=5 \mathrm{~cm}$.
3) Now draw a line CD parallel to line $A B$ of measure 6 cm .
4) Join $B C$. Join diagonals $A C$ and $B D$. Let them intersect at 0 .

Thus, $A B C D$ is the required parallelogram.

Q. 3.
(a)

$$
\begin{aligned}
\left(\frac{8}{27}\right)^{-\frac{2}{3}}-\left(\frac{1}{3}\right)^{-2}-(7)^{0} & =\left[\left(\frac{2}{3}\right)^{3}\right]^{-\frac{2}{3}}-\left(\frac{1}{3}\right)^{-2}-1 \quad\left[\text { Since } \mathrm{a}^{\circ}=1\right] \\
& =\left(\frac{2}{3}\right)^{-2}-\left(\frac{1}{3}\right)^{-2}-1 \\
& =\left(\frac{3}{2}\right)^{2}-(3)^{2}-1 \\
& =\frac{9}{4}-9-1 \\
& =\frac{9}{4}-10 \\
& =\frac{9-40}{4} \\
& =\frac{-31}{4}
\end{aligned}
$$

(b) Given, $(2 a+b, a-2 b)=(7,6)$

$$
\begin{gather*}
\Rightarrow 2 a+b=7  \tag{1}\\
a-2 b=6 \tag{2}
\end{gather*}
$$

Multiplying equation (1) by 2 , we get
$4 a+2 b=14$
Adding equations (2) and (3), we get
$5 \mathrm{a}=20$
$\Rightarrow \mathrm{a}=4$
Substituting $\mathrm{a}=4$ in equation (1), we get
$2(4)+b=7$
$\Rightarrow \mathrm{b}=-1$
$\therefore \mathrm{a}=4$ and $\mathrm{b}=-1$
(c) Let $A \equiv(0,0), B \equiv(5,0), C \equiv(8,4)$ and $D \equiv(3,4)$

$$
\begin{aligned}
& \mathrm{AB}=\sqrt{(5-0)^{2}+(0-0)^{2}}=\sqrt{25+0}=5 \\
& \mathrm{BC}=\sqrt{(8-5)^{2}+(4-0)^{2}}=\sqrt{9+16}=\sqrt{25}=5 \\
& \mathrm{CD}=\sqrt{(8-3)^{2}+(4-4)^{2}}=\sqrt{25+0}=5 \\
& \mathrm{DA}=\sqrt{(0-3)^{2}+(0-4)^{2}}=\sqrt{9+16}=\sqrt{25}=5 \\
& \mathrm{AC}=\sqrt{(8-0)^{2}+(4-0)^{2}}=\sqrt{64+16}=\sqrt{80}=4 \sqrt{5} \\
& \mathrm{BD}=\sqrt{(3-5)^{2}+(4-0)^{2}}=\sqrt{4+16}=\sqrt{20}=2 \sqrt{5} \\
& \text { Now, } \mathrm{AB}=\mathrm{BC}=\mathrm{CD}=\mathrm{DA} \text { and } \mathrm{AC} \neq \mathrm{BD} .
\end{aligned}
$$

Hence, $A B C D$ is a rhombus.
$\therefore$ Area of rhombus $=\frac{1}{2} \times \mathrm{AC} \times \mathrm{BD}=\frac{1}{2} \times 4 \sqrt{5} \times 2 \sqrt{5}=20$ sq. units

## Q. 4.

(a) Given side of an equilateral triangle $=a$

Let, $\mathrm{AD} \perp \mathrm{DC} \therefore \mathrm{BD}=\mathrm{DC}=\frac{\mathrm{a}}{2}$
In right $\triangle A B D, A B^{2}=A D^{2}+B D^{2}$ [Using Pythagoras theorem]

$\mathrm{a}^{2}=\mathrm{AD}^{2}+\left(\frac{\mathrm{a}}{2}\right)^{2} \Rightarrow \mathrm{AD}^{2}=\mathrm{a}^{2}-\frac{\mathrm{a}^{2}}{4}=\frac{3 \mathrm{a}^{2}}{4} \Rightarrow \mathrm{AD}=\frac{\mathrm{a} \sqrt{3}}{2}$
Now, Area of $\triangle \mathrm{ABC}=\frac{1}{2} \times$ Base $\times$ height $=\frac{1}{2} \times \mathrm{BC} \times \mathrm{AD}=\frac{1}{2} \times \mathrm{a} \times \frac{\mathrm{a} \sqrt{3}}{2}=\frac{\sqrt{3}}{4} \mathrm{a}^{2}$
(b) We know, each exterior angle $=\frac{360^{\circ}}{n}$

$$
\begin{aligned}
& \therefore \frac{360^{\circ}}{\mathrm{n}}-\frac{360^{\circ}}{\mathrm{n}+2}=6 \\
& \Rightarrow 360^{\circ}\left[\frac{\mathrm{n}+2-\mathrm{n}}{\mathrm{n}(\mathrm{n}+2)}\right]=6 \\
& \Rightarrow \frac{360^{\circ} \times 2}{\mathrm{n}^{2}+2 \mathrm{n}}=6 \\
& \Rightarrow \mathrm{n}^{2}+2 \mathrm{n}=\frac{360^{\circ} \times 2}{6} \\
& \Rightarrow \mathrm{n}^{2}+2 \mathrm{n}=120 \\
& \Rightarrow \mathrm{n}^{2}+2 \mathrm{n}-120=0 \\
& \Rightarrow \mathrm{n}^{2}+12 \mathrm{n}-10 \mathrm{n}-120=0 \\
& \Rightarrow \mathrm{n}(\mathrm{n}+12)-10(\mathrm{n}+12)=0 \\
& \Rightarrow(\mathrm{n}+12)(\mathrm{n}-10)=0 \\
& \Rightarrow \mathrm{n}=-12 \text { or } \mathrm{n}=10
\end{aligned}
$$

Neglecting $\mathrm{n}=-12$ as number of sides cannot be negative.
$\therefore \mathrm{n}=10$
Thus, number of sides are 10.
(c) $\frac{4}{\tan ^{2} 60^{\circ}}+\frac{1}{\cos ^{2} 30^{\circ}}-\tan ^{2} 45^{\circ}$

$$
\begin{aligned}
& =\frac{4}{(\sqrt{3})^{2}}+\frac{1}{(\sqrt{3} / 2)^{2}}-(1)^{2} \\
& =\frac{4}{3}+\frac{4}{3}-1 \\
& =\frac{5}{3}
\end{aligned}
$$

## SECTION - B (40 Marks)

Q. 5
(a) $3 x-5 y+1=0$
$\Rightarrow \mathrm{y}=\frac{3 \mathrm{x}+1}{5}$

| x | 1 | 3 | -2 |
| :---: | :---: | :---: | :---: |
| y | 0.8 | 2 | -1 |

And $2 \mathrm{x}-\mathrm{y}+3=0$
$\Rightarrow \mathrm{y}=2 \mathrm{x}+3$

| x | 0 | 1 | -1 |
| :---: | :---: | :---: | :---: |
| y | 3 | 5 | 1 |



From the graph, we find that the two lines intersect at the point $(-2,-1)$
Therefore, the solution is $x=-2, y=-1$
(b) Let his starting salary be Rs. x and the fixed annual increment be Rs. y

Salary after 4 years $=x+4 y$
According to question,
$x+4 y=1500 \quad$....(i)
And salary after 10 years $=x+10 y$
$\Rightarrow \mathrm{x}+10 \mathrm{y}=1800$
Subtracting (i) from (ii), we get
$6 y=300$
$\Rightarrow \mathrm{y}=50$
Substituting the value of $y$ in (i), we get
$x+4 y=1500$
$\Rightarrow \mathrm{x}+4 \times 50=1500$
$\Rightarrow \mathrm{x}=1300$
$\therefore$ Starting salary $=$ Rs. 1300 and Annual increment $=$ Rs. 50
(c)

$$
\begin{aligned}
& x=\frac{1}{\sqrt{2}-1}=\frac{1}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1}=\frac{\sqrt{2}+1}{2-1}=\sqrt{2}+1 \\
& \therefore x^{2}=(\sqrt{2}+1)^{2}=2+1+2 \sqrt{2}=3+2 \sqrt{2}
\end{aligned}
$$

Therefore,

$$
\begin{aligned}
x^{2}-6+\frac{1}{x^{2}} & =(\sqrt{2}+1)^{2}-6+\frac{1}{(\sqrt{2}+1)^{2}} \\
& =3+2 \sqrt{2}-6+\frac{1}{3+2 \sqrt{2}} \\
& =3+2 \sqrt{2}-6+3-2 \sqrt{2} \\
& =0
\end{aligned}
$$

Q. 6.
(a) Let the sum be Rs. $\mathrm{P}, \mathrm{A}=$ Rs. $3630, \mathrm{r}=10 \%, \mathrm{n}=2$ years We know that,
$\mathrm{A}=\mathrm{P}\left(1+\frac{\mathrm{r}}{100}\right)^{\mathrm{n}}$
$\Rightarrow 3630=\mathrm{P}\left(1+\frac{10}{100}\right)^{2}$
$\Rightarrow 3630=\mathrm{P}\left(\frac{110}{100}\right)^{2}$
$\Rightarrow \mathrm{P}=\frac{3630 \times 10 \times 10}{11 \times 11}$
$\Rightarrow \mathrm{P}=$ Rs. 3000
(b) In right $\triangle P Q S$,
$\mathrm{PS}^{2}+\mathrm{QS}^{2}=\mathrm{PQ}^{2} \quad$ [By Pythagoras theorem $]$
$\Rightarrow \mathrm{PS}^{2}=(10)^{2}-(6)^{2}=100-36=64$
$\Rightarrow \mathrm{PS}=8 \mathrm{~cm}$
$\therefore \mathrm{RS}=\mathrm{RQ}+\mathrm{QS}=9+16=15 \mathrm{~cm}$
Now in $\triangle \mathrm{PSR}$,
$\Rightarrow \mathrm{PR}^{2}=\mathrm{PS}^{2}+\mathrm{RS}^{2}$
$\Rightarrow \mathrm{PR}^{2}=(8)^{2}+(15)^{2}=64+225=289$
$\Rightarrow \mathrm{PR}=17 \mathrm{~cm}$
(c) Consider the following figure:


Distance of smaller chord AB from centre of circle $=4 \mathrm{~cm}$
i.e., $\mathrm{OM}=4 \mathrm{~cm}$
$\mathrm{MB}=\frac{\mathrm{AB}}{2}=\frac{6}{2}=3 \mathrm{~cm}$
In $\triangle \mathrm{OMB}$,
$\mathrm{OM}^{2}+\mathrm{MB}^{2}=\mathrm{OB}^{2}$
$\therefore 4^{2}+3^{2}=\mathrm{OB}^{2}$
$\therefore 16+9=\mathrm{OB}^{2}$
$\therefore \mathrm{OB}^{2}=25$
$\therefore \mathrm{OB}=\sqrt{25}=5 \mathrm{~cm}$
In $\triangle$ OND,
$O D=O B=5 \mathrm{~cm}$....(radii of the same circle)
$\mathrm{ND}=\frac{\mathrm{CD}}{2}=\frac{8}{2}=4 \mathrm{~cm}$
$\mathrm{ON}^{2}+\mathrm{ND}^{2}=\mathrm{OD}^{2}$
$\therefore \mathrm{ON}^{2}=\mathrm{OD}^{2}-\mathrm{ND}^{2}$
$\therefore \mathrm{ON}^{2}=5^{2}+4^{2}=25-16=9$
$\therefore \mathrm{ON}=\sqrt{9}=3 \mathrm{~cm}$

## Q. 7.

(a) Arranging the numbers in ascending order:
$1,2,3,3,3,4,5,5,6,7$
Number of terms $=\mathrm{n}=10$ (even)
$\therefore$ Mean $=\frac{1+2+3+3+3+4+5+5+6+7}{10}=\frac{39}{10}=3.9$
And median $=\frac{5^{\text {th }} \text { term }+6^{\text {th }} \text { term }}{2}=\frac{3+4}{2}=\frac{7}{2}=3.5$
(b) Area of room $=(8 \times 5) \mathrm{m}^{2}=40 \mathrm{~m}^{2}$

Let the length of carpet be ' x ' m.
Area of carpet $=\mathrm{l} \times \mathrm{b}=\left(\mathrm{x} \times \frac{80}{100}\right)=0.80 \mathrm{x} \mathrm{m}^{2}$
Area of carpet $=$ Area of floor
$\Rightarrow 0.80 \mathrm{x}=40$
$\Rightarrow \mathrm{x}=\frac{40}{80} \times 100=50 \mathrm{~m}$
$\therefore$ Cost of carpet $=50 \times$ Rs. $22.50=$ Rs. 1125
(c) $\mathrm{PR}=\mathrm{PQ}$ [Given]
$\Rightarrow \angle 1=\angle 2 \quad$ [angles opposite to equal sides]
$\because$ Exterior angle of a triangle is greater than any one of the interior opposite angles.
$\therefore \angle 1>\angle 3$
$\Rightarrow \angle 2>\angle 3 \quad[\because \angle 1=\angle 2]$
In $\triangle \mathrm{PSR}, \angle \mathrm{R}>\angle \mathrm{S}$
$\Rightarrow \mathrm{PS}>\mathrm{PR} \quad$ [sides opposite to greater angle is longer]
$\Rightarrow P S>P Q \quad[\because P R=P Q]$

Q. 8.
(a) Length (l) of the greenhouse $=30 \mathrm{~cm}$

Breadth (b) of the greenhouse $=25 \mathrm{~cm}$
Height (h) of the greenhouse $=25 \mathrm{~cm}$
i. Total surface area of the greenhouse $=2[\mathrm{lb}+\mathrm{lh}+\mathrm{bh}]$

$$
\begin{aligned}
& =[2(30 \times 25+30 \times 25+25 \times 25)] \\
& =[2(750+750+625)] \\
& =(2 \times 2125) \\
& =4250 \mathrm{~cm}^{2}
\end{aligned}
$$

Thus, the area of the glass is $4250 \mathrm{~cm}^{2}$.
ii. Total length of tape $=4(\mathrm{l}+\mathrm{b}+\mathrm{h})$

$$
\begin{aligned}
& =[4(30+25+25)] \mathrm{cm} \\
& =320 \mathrm{~cm}
\end{aligned}
$$

Thus, 320 cm of tape is required for all the 12 edges.
(b) Given,

1. AOC is the diameter
2. $\operatorname{Arc} \mathrm{AXB}=\frac{1}{2} \operatorname{Arc} \mathrm{BYC}$

From $\operatorname{Arc} A X B=\frac{1}{2} \operatorname{Arc}$ BYC we can see that
Arc AXB : Arc BYC $=1: 2$
$\Rightarrow \angle \mathrm{BOA}: \angle \mathrm{BOC}=1: 2$


Since AOC is the diameter of the circle,
hence, $\angle \mathrm{AOC}=180^{\circ}$
Now,
Assume that $\angle \mathrm{BOA}=\mathrm{x}^{\circ}$ and $\angle \mathrm{BOC}=2 \mathrm{x}^{\circ}$
$\angle \mathrm{AOC}=\angle \mathrm{BOA}+\angle \mathrm{BOC}=180^{\circ}$
$\Rightarrow \mathrm{x}+2 \mathrm{x}=180$
$\Rightarrow 3 \mathrm{x}=180$
$\Rightarrow \mathrm{x}=60$
Hence $\angle \mathrm{BOA}=60^{\circ}$ and $\angle \mathrm{BOC}=120^{\circ}$
(c)

| Age in years | $10-20$ | $20-30$ | $30-40$ | $40-50$ | $50-60$ | $60-70$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Number of patients | 90 | 40 | 60 | 20 | 120 | 30 |

Take class intervals i.e. age in years along $x$-axis and number of patients of width equal to the size of the class intervals and height equal to the corresponding frequencies to get the required histogram.
In order to draw frequency polygon, we take imaginary intervals $0-10$ at the beginning and 70-80 at the end each with frequency zero and join the mid-points of top of the rectangles. Thus, we obtain a complete frequency polygon, shown below:

Q. 9.
(a)

$$
\begin{aligned}
& 2 \cos ^{2} \theta+\sin \theta-2=0 \\
& \Rightarrow 2 \cos ^{2} \theta+\sin \theta=2 \\
& \Rightarrow \sin \theta=2-2 \cos ^{2} \theta \\
& \Rightarrow \sin \theta=2\left(1-\cos ^{2} \theta\right) \\
& \Rightarrow \sin \theta=2 \times \sin ^{2} \theta \\
& \Rightarrow \frac{\sin ^{2} \theta}{\sin \theta}=\frac{1}{2} \\
& \Rightarrow \sin \theta=\frac{1}{2} \\
& \Rightarrow \sin \theta=\sin 30^{\circ} \\
& \Rightarrow \theta=30^{\circ}
\end{aligned}
$$

(b) Assume $\mathrm{p}^{\frac{1}{x}}=\mathrm{p}^{\frac{1}{y}}=\mathrm{p}^{\frac{1}{z}}=\mathrm{k}$

$$
\begin{aligned}
& \Rightarrow p^{\frac{1}{x}}=k, p^{\frac{1}{y}}=k, p^{\frac{1}{z}}=k \\
& \Rightarrow p=k^{x}, q=k^{y}, r=k^{z}
\end{aligned}
$$

Also, pqr =1
$\Rightarrow \mathrm{k}^{\mathrm{x}} \times \mathrm{k}^{\mathrm{y}} \times \mathrm{k}^{\mathrm{z}}=1$
$\Rightarrow \mathrm{k}^{\mathrm{x}+\mathrm{y}+\mathrm{z}}=\mathrm{k}^{0}$
$\Rightarrow \mathrm{x}+\mathrm{y}+\mathrm{z}=0$
(c) From the given figure,
$\mathrm{XD}=\frac{1}{2} \mathrm{AD}(\because \mathrm{X}$ is the midpoint of AD$)$
And $B Y=\frac{1}{2} B C \quad(\because Y$ is the midpoint of $B C)$
$\therefore \mathrm{XD}=\mathrm{BY} \quad$ (as $\mathrm{AD}=\mathrm{BC}$ opposite sides of $\| \mathrm{gm}$ )


Also, XD || BY ( $\because \mathrm{AD}$ || BC opp. Sides of ||gm)
$\therefore \quad \mathrm{XBYD}$ is a parallelogram (Opposite sides are equal and parallel)
In $\triangle \mathrm{AFD}, \mathrm{X}$ is the midpoint of AD and $\mathrm{XE} \| \mathrm{DF}$
$\therefore \mathrm{E}$ is the midpoint of AF
$\therefore \mathrm{AE}=\mathrm{EF}$
Now in $\triangle C E B, Y$ is the midpoint of $B C$ and $Y F \| B E$.
$\therefore \mathrm{F}$ is the midpoint of CE
$\therefore \mathrm{EF}=\mathrm{FC}$
From (i) and (ii)
$\mathrm{AE}=\mathrm{EF}=\mathrm{FE}$ [Hence proved]
Q. 10.
(a)

$$
\begin{aligned}
& \frac{2 \sqrt{7}+3 \sqrt{5}}{\sqrt{7}+\sqrt{5}} \\
& =\frac{2 \sqrt{7}+3 \sqrt{5}}{\sqrt{7}+\sqrt{5}} \times \frac{\sqrt{7}-\sqrt{5}}{\sqrt{7}-\sqrt{5}} \\
& =\frac{14-2 \sqrt{35}+3 \sqrt{35}-15}{(\sqrt{7})^{2}-(\sqrt{5})^{2}} \quad\left[\because(a+b)(a-b)=a^{2}-b^{2}\right] \\
& =\frac{\sqrt{35}-1}{7-5} \\
& =\frac{\sqrt{35}-1}{2} \\
& =\frac{1}{2} \sqrt{35}-\frac{1}{2}
\end{aligned}
$$

On comparing this with $\mathrm{P} \sqrt{35}+\mathrm{Q}, \mathrm{P}=\frac{1}{2}$ and $\mathrm{Q}=\frac{-1}{2}$

$$
\therefore 2 P+Q=2 \times \frac{1}{2}+\left(\frac{-1}{2}\right)=1-\frac{1}{2}=\frac{1}{2}
$$

(c) $3 \cos \mathrm{~A}-4 \sin \mathrm{~A}=0$

$$
\Rightarrow 3 \cos \mathrm{~A}=4 \sin \mathrm{~A}
$$

$$
\Rightarrow \frac{\sin \mathrm{A}}{\cos \mathrm{~A}}=\frac{3}{4}
$$

$$
\Rightarrow \tan A=\frac{3}{4}
$$

By Pythagoras theorem,

$$
\begin{aligned}
\mathrm{AC}^{2} & =\mathrm{AB}^{2}+\mathrm{BC}^{2} \\
& =4^{2}+3^{2} \\
& =16+9=25 \\
\Rightarrow \mathrm{AC} & =\sqrt{25}=5 \\
\sin \mathrm{~A} & =\frac{\mathrm{BC}}{\mathrm{AC}}=\frac{3}{5} \\
\cos \mathrm{~A} & =\frac{\mathrm{AB}}{\mathrm{AC}}=\frac{4}{5} \\
\therefore & \frac{\sin \mathrm{~A}+2 \cos \mathrm{~A}}{3 \cos \mathrm{~A}-\sin \mathrm{A}}=\frac{\frac{3}{5}+2 \times \frac{4}{5}}{3 \times \frac{4}{5}-\frac{3}{5}}=\frac{\frac{3}{5}+\frac{8}{5}}{\frac{12}{5}-\frac{3}{5}}=\frac{\frac{11}{5}}{\frac{11}{9}}=\frac{9}{5}
\end{aligned}
$$

(c) i. $a+\frac{1}{\mathrm{a}}=4$,

On squaring, we get

$$
\begin{aligned}
& a^{2}+\frac{1}{a^{2}}+2=16 \\
& \Rightarrow a^{2}+\frac{1}{a^{2}}=16-2=14
\end{aligned}
$$

ii. By part (i), we have $a^{2}+\frac{1}{a^{2}}=14$

On squaring, we get

$$
\begin{aligned}
& \Rightarrow a^{4}+\frac{1}{a^{4}}+2=196 \\
& \Rightarrow a^{4}+\frac{1}{a^{4}}=196-2=194
\end{aligned}
$$

## Q. 11.

(a) Given: In $\triangle A B C, A D$ is the median

To prove: Area of $\triangle \mathrm{ABD}=$ Area of $\triangle \mathrm{ADC}$
Construction: We draw AE $\perp \mathrm{BC}$
Proof:
Area of $\triangle \mathrm{ABD}=\frac{1}{2} \times \mathrm{BD} \times \mathrm{AE} \quad\left[\because\right.$ Area $=\frac{1}{2} \times$ base $\times$ height $]$
Similarly, area of $\triangle \mathrm{ADC}=\frac{1}{2} \times \mathrm{DC} \times \mathrm{AE}$
Here, we have $B D=D C$
$\therefore$ Area of $\triangle \mathrm{ABD}=$ Area of $\triangle \mathrm{ADC}$
Hence proved.
(b) Given, Area of $\triangle \mathrm{PQR}=44.8 \mathrm{~cm}^{2}$

Since QL is the median and Median divides triangle into two triangles of equal areas
Area of $\triangle \mathrm{LQR}=$ Area of $\triangle \mathrm{PQL}=22.4 \mathrm{~cm}^{2}$
In $\triangle Q L R, L M$ is the median,
Area of $\Delta \mathrm{LMR}=\frac{1}{2} \times 22.4=11.2 \mathrm{~cm}^{2}$

(c) $x^{3}-3 x^{2}-x+3$

$$
=x^{2}(x-3)-1(x-3)
$$

$$
=(x-3)\left(x^{2}-1\right)
$$

$$
=(x-3)(x-1)(x+1)
$$

