

Self Access Learning Activities

for

Student Empowerment

(With the curtesy of Provincial Department of Education – Uva)

Mathematics

Bilingual Education Branch

Ministry of Education

2010

First Print-2010

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Message from the Hon Minister of Education

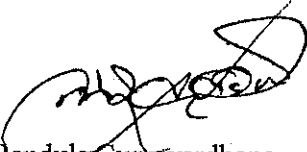
We, the proud Sri Lankans of the 21st century now experience a revival in all spheres of society. Successful implementation of the novel and innovative concepts of 'Mahinda Chinthana' is instrumental in bringing about this change.

Measures taken to uplift the quality of Education are numerous in this regard. One of such constructive measures is to declare year 2010 to be the year of English and ICT. English as a life skill; a programme to strengthen and promote Sri Lankan English has been unique among those strategies.

Bilingual Education programme implemented successfully in 601 schools all over the island too is supportive in improving the standard of English language. Good grades obtained by the Bilingual learners at G.C.E. (O/L) examination are an indicator that signifies this remarkable process.

In order to sustain this achievement further, an effective intervention is necessary. This self Access package translated into English by the Bilingual Education Branch of the Ministry of Education, in this regard, is a praiseworthy attempt.

I wish the Bilingual Education Branch success in all future endeavors.



Bandula Gunawardhana

Minister of Education

Ministry of Education

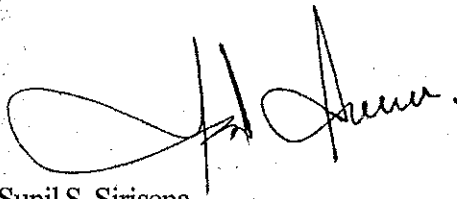
30th July 2010

Message from the Secretary- Ministry of Education

We strongly believe that all learners are talented and creative. The teacher task therefore, is to design learning events for the pupils to blossom in a promising way. The role played by Self Learning packages, in this case is of vital importance.

Learner autonomy or learner independence has been an essential factor in lifelong education. Self Access packages of this nature ensure learner independence.

This includes activities concerning challenging subjects like Mathematics and Science where Self Access materials are rare. I thank Bilingual Education Branch of the Ministry of Education for undertaking and fulfilling this timely important task of translating the Sinhala material prepared in the Uva Province.



Sunil S. Sirisena

Secretary

Ministry of Education

30th July 2010

Message from the Additional Secretary

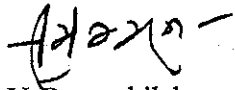
(Education Quality Development)

The Bilingual Education Branch of the Ministry of Education as I am well aware has taken a lot of measures to ensure the sustainability of Bilingual Education.

Preparing “Self Access Learning Activities for Student Empowerment – Mathematics” with the curtesy of Provincial Department of Education, Uva is one of such commendable and admirable initiative under taken by the Bilingual Education Branch.

This collective effort bear witness to the excellent capability of the Branch in managing human and physical resources to the maximum for the betterment of Bilingual Education.

It is the duty of the principals and teachers to make use of this Self Access packages in their respective schools. Authorities at administrative section should see that this Self Access package be utilized properly in the system. I wish Bilingual Education Branch success in all future plans.



H. U. Premathilake

Additional Secretary

Education Quality Development

Ministry of Education

30th July 2010

Message from Director of Education (Bilingual Education)

The Bilingual Branch of the Ministry of Education has launched a lot of initiatives to bring about the qualitative improvement in the teaching learning process of bilingual education. "Self access learning activities for student empowerment" is one remarkable example for this constructive attempt.

"Self access learning activities for student empowerment - Mathematics" is a collaborative work done to scaffold the bilingual learner. It is also a resource book for the teachers to guide their learners.

This resource book was initially designed by the team of resource persons in Uva province to be utilized in the province. The bilingual branch realizing the value of this work made an intervention in making it available to all bilingual teachers and pupils concerned in the island translating it into English. We modified, revised and updated the content of this book when we felt it was necessary.

This, I believe, will be a solution to the dearth of quality materials in the learning teaching process of bilingual education. Teachers and various others who wish the progress of bilingual education can make ventures of this nature in their respective provinces.

I extend our gratitude to all officers and the resource persons in the Uva province for allowing us to make use of this book for a wider pupil population.

I also extend my heartfelt gratitude to all those who supported us in making this effort a success including the World Bank, Director of Education (Planning) and Deputy Director of Education (Planning) in the Ministry of Education.



Priyatha Nanayakkara

Director of Education (Bilingual Education)

Ministry of Education

30th July, 2010

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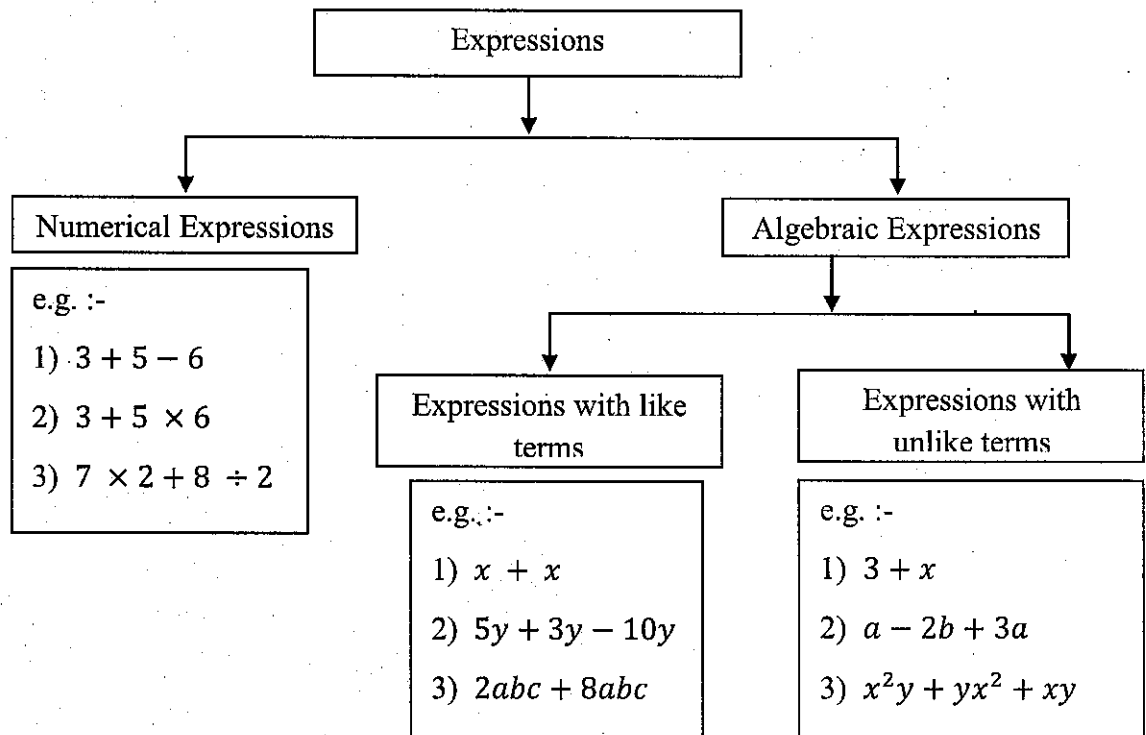
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ALGEBRAIC EXPRESSIONS

Terms :- Any symbol that represents a quantitative value is known as a term. There are two kinds of terms as,

1. Numerical terms.
2. Algebraic terms.

Expressions :- Combination of several terms using mathematical operations are called as expressions.



- Any real number can be substituted for an algebraic term.

Important notes:

Order of Simplification

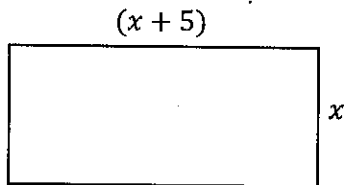
BODMAS

1. Brackets
2. Of
3. Division
4. Multiplication
5. Addition
6. Subtraction

Formulating Algebraic Expressions

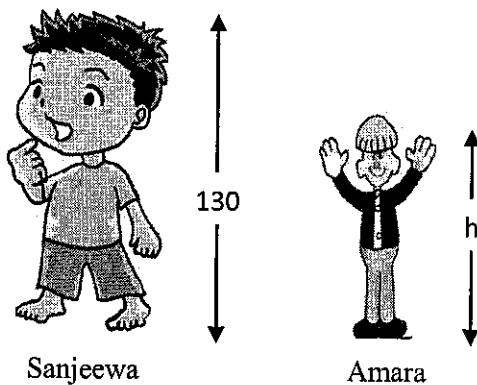
e.g.

1. The length of a rectangle is 5 units greater than its breadth. Let's make an algebraic expression for its length.



The length of the rectangle = $x + 5$

2.



By how much Sanjeewa is taller than Amara?

$$130 - h$$

Exercises

1. Subtract 5 from p . Express this as an algebraic expression.
2. I have Rs. 7. My brother has Rs. m . Form an algebraic expression for the total amount of money.
3. Subtract 4 from three times of x . Express this as an algebraic expression.
4. a) Subtract three times of a from 25.
b) Subtract 25 from three times of a .
5. The length of a side of a square is y . Express the perimeter and area in terms of y .
6. I have Rs. x and my elder brother has twice of that.
a) How much money does my elder brother have?
b) How much is the total amount of money?

7. The cost of a pen is Rs. x and that of a book is Rs. y .
Find, a) the cost of 2 pens.
b) cost of 5 books.
c) cost of 2 pens and 5 books.
8. Nimal bought sugar and tea powder from a boutique. The price of sugar is Rs. x and that of tea powder is Rs. y . Write an expression for the remainder, if he gave Rs. 500 to the vendor.

Simplification of Algebraic Expressions

• Simplify.

- | | |
|---|---|
| 1. $x + 3$ | 2. $5t - 2t$ |
| 3. $3y - y$ | 4. $4x + (-3x)$ |
| 5. $5x^2 - x^2$ | 6. $3ab + 2ab$ |
| 7. $x + 3y + 2x + y$ | 8. $a^2 + 3b - 5 + 2a^2 + 2b + 3$ |
| 9. $4x + 3y$ + $\frac{2x - y}{\underline{\underline{\hspace{1cm}}}}$ | 10. $a^2 + b - 7$ + $\frac{3a^2 - 7b + 2}{\underline{\underline{\hspace{1cm}}}}$ |

• Subtract.

- $2x + y$ from $4x + y$
- $a + 3b - 1$ from $3a + 5b + 11$
- $2m - n - 1$ from $3m - 2n - 7$

Multiplication of Algebraic expressions

- Multiplication of an algebraic expression by a term
e.g.

$$\begin{aligned}(1) \quad & 4(y + 2) \\ & = 4 \times y + 4 \times 2 \\ & = \underline{\underline{4y + 8}}\end{aligned}$$

$$\begin{aligned}(2) \quad & -5(a - 3) \\ & = -5 \times a - (-5) \times 3 \\ & = \underline{\underline{-5a + 15}}\end{aligned}$$

$$\begin{aligned}(3) \quad & 2a(a + b - 2c) \\ & = \underline{\underline{2a^2 + 2ab - 4ac}}\end{aligned}$$

$$\begin{aligned}(4) \quad & 3(3a + 2b) - 2(a - 5) \\ & = 9a + 6b - 2a + 10 \\ & = \underline{\underline{7a + 6b + 10}}\end{aligned}$$

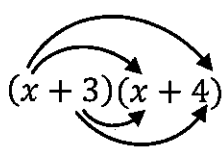
Exercise

Remove the brackets and simplify.

- (1) $3(a + 5)$ (2) $-2(3p - 2)$ (3) $4(a + b - c) - 2(a + b)$
 (4) $5(x^2 + 2x - 1) - 3(x^2 - 3)$ (5) $2xy(2x - y - 3)$

Multiplication of an algebraic expression by another algebraic expression

- Simplify. $(x + 3)(x + 4)$

| | | | | | | | | | | | | | |
|---|---|------|-----------|------|--|-----|------|------|-----------|--|-----|-----|--|
| <p>1st method</p> $(x + 3)(x + 4)$ $= x(x + 4) + 3(x + 4)$ $= x^2 + 4x + 3x + 12$ $= x^2 + 7x + 12$ <p>2nd method</p>  $(x + 3)(x + 4)$ $= x^2 + 4x + 3x + 12$ $= x^2 + 7x + 12$ <p>Multiply as drawn</p> | <p>3rd method</p> <div style="text-align: center; margin-bottom: 10px;">$(x + 3)$</div> <table style="margin: auto; border-collapse: collapse;"> <tr> <td style="border: none; padding-right: 10px;">x</td> <td style="border: 1px solid black; padding: 10px; text-align: center;">x^2</td> <td style="border: 1px solid black; padding: 10px; text-align: center;">$3x$</td> <td style="border: none; padding-left: 10px;"></td> </tr> <tr> <td style="border: none; padding-right: 10px;">4</td> <td style="border: 1px solid black; padding: 10px; text-align: center;">$4x$</td> <td style="border: 1px solid black; padding: 10px; text-align: center;">12</td> <td style="border: none; padding-left: 10px;">$(x + 4)$</td> </tr> <tr> <td style="border: none;"></td> <td style="border: none; text-align: center;">x</td> <td style="border: none; text-align: center;">3</td> <td style="border: none;"></td> </tr> </table> <p style="text-align: center; margin-top: 10px;">Simplification of algebraic expressions using the area of the parts of the lamina.</p> $(x + 3)(x + 4) = x^2 + 4x + 3x + 12$ $= \underline{x^2 + 7x + 12}$ | x | x^2 | $3x$ | | 4 | $4x$ | 12 | $(x + 4)$ | | x | 3 | |
| x | x^2 | $3x$ | | | | | | | | | | | |
| 4 | $4x$ | 12 | $(x + 4)$ | | | | | | | | | | |
| | x | 3 | | | | | | | | | | | |

Exercise

Remove the brackets and simplify.

(1) $(a + 1)(a + 2)$

(6) $(2x + 1)(x + 3)$

(2) $(x - 3)(x + 2)$

(7) $(3y + 5)(y - 2)$

(3) $(y - 2)(y - 3)$

(8) $(3m - 2)(2m - 1)$

(4) $(x + y)(x - y)$

(9) $(5xy + 3)(2y - 7)$

(5) $(5 - a)(2 - a)$

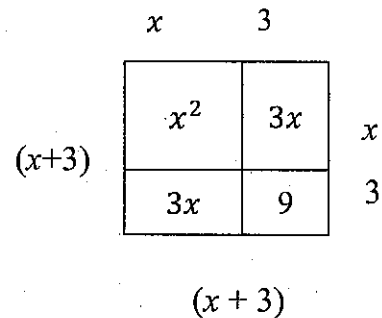
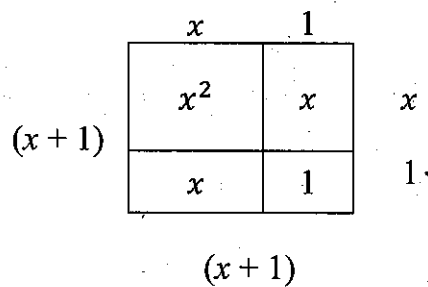
(10) $(3m - 5)(2m - n)$

Square of a binomial expression

e.g.

(1) $(x + 1)^2$

(2) $(x + 3)^2$



Area of the lamina

$$(x + 1)(x + 1) = x^2 + x + x + 1$$

$$(x + 1)^2 = \underline{x^2 + 2x + 1}$$

Area of the lamina

$$(x + 3)(x + 3) = x^2 + 3x + 3x + 9$$

$$(x + 3)^2 = \underline{x^2 + 6x + 9}$$

Accordingly, this can be expressed as,

$$(a + b)^2 = a^2 + 2ab + b^2 \text{ and}$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

Exercise

- Expand the following expressions.

(1) $(x + 2)^2$

(2) $(x - 1)^2$

(3) $(x + 3)^2$

(4) $(x - 3)^2$

(5) $(2x + 1)^2$

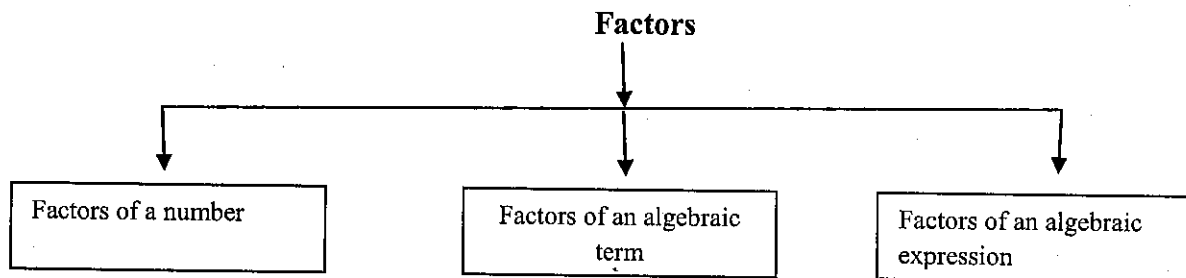
(6) $(3x - 2)^2$

Substitution of Algebraic expressions

- Find the values of the following expression when $a = 5$
 - (1) $a + 5$ (2) $a - 5$ (3) $5a$ (4) $\frac{a}{5}$ (5) a^5
 - (6) $4a + 1$ (7) $3a - 2$ (8) $a^2 + 9a$ (9) $a^2 + 2a + 11$
- Complete the following table

| Expression \ Value | $x + 7$ | $5 - 3x$ | $x^2 + 3x$ | $x^2 - 5x + 4$ |
|--------------------|---------|----------|------------|----------------|
| $x = 2$ | | | | |
| $x = -1$ | | | | |
| $x = \frac{1}{3}$ | | | | |

Factors



| | | |
|---|---|---|
| <p>If a natural number can be divided by another natural number without a remainder, then the second number is a factor of the first number.</p> <p>10 as a product of factors. $10 = 1 \times 10$ $10 = 2 \times 5$ Then factors of 10 = 1, 2, 5, 10</p> <p>Exercise</p> <p>(i) Write the factors of 12 (ii) Write the factors of 18 (iii) Write the factors of 36</p> | <p>$5x$ as a product of factors $5x = 5 \times x$ $= 1 \times 5x$ Factors of $5x = 1, 5, x, 5x$</p> <p>Exercise</p> <p>(i) Write the factors of $6x$ (ii) Write the factors of $9y$ (iii) Write the factors of $2ax$</p> | <p>Factors of $5x + 10$ Factors of $5x \rightarrow 1, x, 5, 5x$ Factors of $10 \rightarrow 1, 2, 5, 10$ Common factors = 1, 5 Highest Common Factor = 5 Accordingly, $5x + 10 = 5(x + 2)$</p> |
|---|---|---|

- Separate into factors

(1) $2x + 2$

(4) $x^2 + x$

(7) $4xy^2 + 16x^2 - 8x^2y$

(2) $3y + 6$

(5) $x^3 - x^3 + x$

(8) $3a^4 - 12a^3b + 15a^2b^2$

(3) $3a + 6b - 9c$

(6) $15a^2 - 5ab$

Separate into factors

$$a(x + 5) + b(x + 5)$$

$$\underbrace{a(x + 5)}_{1^{\text{st}} \text{ part}} + \underbrace{b(x + 5)}_{2^{\text{nd}} \text{ part}}$$

1^{st} and 2^{nd} part can be divided by $(x + 5)$.

$\therefore (x + 5)$ is a factor of the above expression.

Separate it as shown below.

$$a(x + 5) + b(x + 5)$$

$$= \underline{(x + 5)(a + b)}$$

Exercise

- Separate into factors

(1) $y(x - 2) + 2(x - 2)$

(4) $3y(y - 2) + 1(2 - y)$

(2) $a(m - 1) + 3(m - 1)$

(5) $x(2a - 1) + y(1 - 2a)$

(3) $2x(y - 3) + 1(y - 3)$

Separating into factors

Special instance I

Expressions that can be separated into factors by taking pairs

$$\underbrace{ax + bx}_{1^{\text{st}} \text{ pair}} + \underbrace{ay + by}_{2^{\text{nd}} \text{ pair}}$$

$$= x(a + b) + (a + b)$$

$$= x(a + b) + (a + b)$$

$$= \underline{(a + b)(x + y)}$$

Exercise

Separate into factors.

- (1) $ac + ad + bc + bd$
- (2) $(ay + ab - b) + xy - bx$
- (3) $px + 5p - 2x - 10$
- (4) $ax + y^2 - xy - ay$
- (5) $ap + pq - aq + bp$

Special instance II

Separating trinomial quadratic expressions into factors

Select the quadratic trinomial expression out of the following expressions

- (1) $x^2 + 1$ (2) $a^2 + 8a + 12$ (3) $2x + 5y - 12$

- Quadratic trinomial expression with the variable x should be consisted with ,
a term with $\pm x^2$
a term with $\pm x$
 \pm constant term

Exercise

Separate into factors.

(Hint: Separate the common factor first, if there are any)

- | | | |
|---------------------|-----------------------|-----------------------|
| (1) $a^2 + 8a + 12$ | (6) $n^2 + 13n - 14$ | (11) $5n^2 + 11n + 2$ |
| (2) $a^2 + 3a + 10$ | (7) $y^2 - 3y - 10$ | (12) $3x^2 - 8x - 11$ |
| (3) $2m^2 + 8m + 8$ | (8) $3x^2 - 13x + 10$ | (13) $4 + 13x + 3x$ |
| (4) $y^2 + 2y - 15$ | (9) $2x^2 + 5x - 12$ | |
| (5) $3x^2 + 3x + 6$ | (10) $5y + 8y - 4$ | |

Express the following numerical expressions and algebraic expressions as perfect squares.

e.g. : $25 = 5^2$, $4x^2 = 2^2 x^2 = (2x)^2$

- (1) 36 (2) 49 (3) $4y^2$
(4) $25a^2$ (5) $64m^2$ (6) $100x^2$
(7) 1 (8) $16x^2y^2$ (9) $81a^2b^2$
(10) $\frac{a^2}{4}$

Factors of the difference of two squares

$$a^2 - b^2 = (a - b)(a + b)$$

Exercise

Separate into factors

(Hint: Separate the common factor if there are any)

- (1) $a^2 - 36$ (2) $y^2 - 49$ (3) $4y^2 - 49$
(4) $100x^2 - 1$ (5) $25a^2 - 36$ (6) $\frac{a^2}{4} - 1$
(7) $81a^2b^2 - 1$ (8) $64m^2 + 16x^2y^2$ (9) $50a^2 - 2$

- Simplify the following expressions using the knowledge of factors.

- (1) $123 \times 42 - 23 \times 42$ (2) $48^2 - 2^2$
(3) $102^2 - 2^2$ (4) 101×99
(5) 52×48 (6) $\frac{22}{7} \times 15^2 - \frac{22}{7} \times 5^2$
(7) $\sqrt{102 \times 98 + 4}$ (8) $\sqrt{17 \times 3 + 49}$

Algebraic fraction

Algebraic fractions can be seen in various forms.

- (1) Denominator with algebraic terms
- (2) Numerator with algebraic terms
- (3) Denominator with algebraic expressions
- (4) Numerator with algebraic expressions
- (5) Numerator and denominator with algebraic expressions

- Finding Least common multiple (L.C.M.) is important when simplifying algebraic fractions.

e.g.

e.g.

- (1) Let's find the L.C.M. of $3y, 18y^2$ (2) Let's find the L.C.M. of $6x, \text{ and } 12x^2$

| | | |
|---|-------|--------|
| 3 | $3y,$ | 18^2 |
| 3 | $y,$ | $6y^2$ |
| 2 | $y,$ | $2y^2$ |
| y | $y,$ | y^2 |
| y | $1,$ | y |
| | $1,$ | 1 |

| | | |
|---|-------|---------|
| 2 | $6x,$ | $12x^2$ |
| 2 | ---- | ---- |
| 3 | $3x,$ | ---- |
| x | ---- | x^2 |
| x | $1,$ | ---- |
| | $1,$ | 1 |

L.C.M. = $3 \times 3 \times 2 \times y \times y$
 $= 18y^2$

L.C.M. of $6x, \text{ and } 12x^2$
 $= \text{---} \times \text{---} \times \text{---} \times \text{---} \times \text{---}$

e.g.

- (3) Let's find the L.C.M. of $9x, 3x^2$ and $5y^2$

| | |
|-----|--------------------------------------|
| 3 | $9x, 3x^2, 5y$ |
| --- | $3x, \text{---}, 5y$ |
| 5 | $x, x^2, 5y$ |
| x, | $x, x^2, \text{---}$ |
| --- | $\text{---}, \text{---}, \text{---}$ |
| | $\text{---}, \text{---}, \text{---}$ |

- (4) $3mn^2, m^2a, 4m^2n^2,$
- (5) $4a^2y^2, 3a^2, 6x^2y^2$
- (6) mp, mp^2, m^2p

L.C.M. = $\text{---} \times \text{---} \times \text{---} \times \text{---}$
 $= \text{-----}$

Another method to find Least Common Multiple

Study the method that has been introduced for finding the L.C.M of $4x^2y$, $12xz$, $16xyz$.

| | 2 | 3 | x | y | z |
|---------|--------------------------------|---|--------------|---|---|
| $4x^2y$ | 2×2 | - | $x \times x$ | y | - |
| $12xz$ | 2×2 | 3 | x | - | z |
| $16xyz$ | $2 \times 2 \times 2 \times 2$ | - | x | y | z |

Obtain the L.C.M using the largest powers indicated by each column of the above table.

$$\begin{aligned} \text{L.C.M of } 4x^2y, 12xz, 16xz &= 2^4 \times 3^1 \times x^2 \times y \times z \\ &= 16 \times 3 \times x^2 \times y \times z \\ &= \underline{48x^2yz} \end{aligned}$$

- Find the L.C.M of the following expressions using any method.

(1) $5(p+2)$, 20 , $25(p+2)$

(2) $(m+n)$, $2(n-m)$, $n^2 - m^2$

(3) $(9-x)^2$, $(3-x)$, $(3+x)$

(4) $(x-3)$, $(x^2 + 5x - 2)$

(5) $(x^2 + 3x + 2)$, $(x^2 + 6x + 5)$

(6) $(x^2 + 5x + 6)$, $(x^2 - x - 6)$

Note: $(x-3) = -1(1-x)$

$(a-b) = -1(b-a)$

Simplification of algebraic fractions

• Addition and subtraction

Study the following examples.

e.g. (1) $\frac{2x}{5} + \frac{2x}{5}$ (2) $\frac{a}{5} + \frac{2a}{10}$ (3) $\frac{3}{y} + \frac{5}{y}$

$$= \frac{2x+2x}{5}$$

$$= \frac{4x}{5}$$

$$= \frac{2 \times a + 1 \times 2a}{10}$$

$$= \frac{2a+2a}{10}$$

$$= \frac{4a}{10}$$

$$= \frac{2a}{5}$$

$$= \frac{3+5}{y}$$

$$= \frac{8}{y}$$

(4) $\frac{3}{5} + \frac{3}{x+2}$

$$= \frac{3(x+2)+3 \times 5}{5(x+2)}$$

$$= \frac{3x+6+15}{5(x+2)}$$

$$= \frac{3x+21}{5(x+2)}$$

(5) $\frac{4a}{7} + \frac{2a}{21}$

$$= \frac{3 \times 4a - 1 \times 2a}{21}$$

$$= \frac{12a-2a}{21}$$

$$= \frac{10a}{21}$$

Exercise

(1) $\frac{3}{2x} + \frac{5}{2x}$

(2) $\frac{4}{5y} + \frac{2}{y}$

(3) $\frac{4}{x} + \frac{3}{2x+1} + \frac{3}{x}$

(4) $\frac{8}{m-2} + \frac{2}{m+4}$

(5) $\frac{8}{m} - \frac{6}{m}$

(6) $\frac{4}{m+2} - \frac{5}{2-m}$

(7) $\frac{8}{4x+3} - \frac{2}{7x-3}$

(8) $\frac{3}{2xy} - \frac{1}{4x} + \frac{1}{6y}$

• **Multiplication and division of Algebraic fractions**

$$\begin{aligned} \text{e.g. (1)} \quad & \frac{x^2 - 4a^2}{ax + a^2} \times \frac{2a}{x^2 - 2ax} \\ &= \frac{(x-2a)(x+2a)}{a(x+a)} \times \frac{2a}{x(x-2a)} \\ &= \frac{2(x+2a)}{\underline{\underline{x(x+a)}}} \end{aligned}$$

$$\begin{aligned} \text{(2)} \quad & \frac{2x}{3(x+y)} \div \frac{6y}{7(x+y)} \\ &= \frac{2x}{3(x+y)} \times \frac{7(x+y)}{6y} \\ &= \frac{7x}{\underline{\underline{9y}}} \end{aligned}$$

Exercise

Simplify,

$$\text{(1)} \quad \frac{2x}{3(x+y)} \times \frac{6(x+y)}{5y}$$

$$\text{(2)} \quad \frac{3a}{2(2a+b)} \times \frac{6(2a+b)}{5b}$$

$$\text{(3)} \quad \frac{4a}{5(3a-b)} \times \frac{7(3a-b)}{5b}$$

$$\text{(4)} \quad \frac{4xy}{7(2x-y)} \times \frac{2(2x-y)}{3y}$$

$$\text{(5)} \quad \frac{4a}{3(a-2b)} \div \frac{3b}{5(a-2b)}$$

$$\text{(6)} \quad \frac{x^2 - y^2}{2x} \div \frac{x-y}{x+y}$$

$$\text{(7)} \quad \frac{2x}{5(2x-3y)} \div \frac{3y}{7(2x-3y)}$$

$$\text{(8)} \quad \frac{2a}{3a-2b} \div \frac{5b}{2(3a-2b)}$$

LINEAR EQUATIONS

$x + 5 = 12,$ $3a + 5 = a + 11$ $3(m - 2) = 12$

Above equations contain only one unknown term. The index of that unknown term is "1". Such equations are known as linear equations.

Solving linear equations

Method 1

(1) When 5 is added to x , the result is 12.

$$x + 5 = 12,$$

$$\therefore x = 12 - 5 \quad (\text{subtraction is the inverse of addition})$$

$$\therefore x = 7$$

| Mathematical operation | Inverse mathematical operation |
|------------------------|--------------------------------|
| Addition | Subtraction |
| Subtraction | Addition |
| Multiplication | Division |
| Division | Multiplication |

Exercise 1

Accordingly, solve the following equations.

(1) $y + 7 = 10$

(2) $m - 5 = 3$

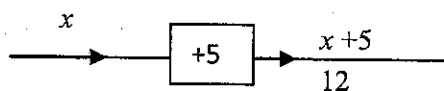
(3) $3a = 12$

(4) $\frac{n}{5} = 4$

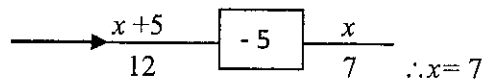
Method 2

(1) $x + 5 = 12$

Flow diagram



Inverse flow diagram



Exercise 2

Solve the above equations in exercise 1, using flow diagrams.

Method 3

(1) $x + 5 = 12$

Subtracting 5 from both sides of the equation,

$$x + 5 - 5 = 12 - 5$$

$$x = 7$$

Exercise 3

Solve the equations in exercise 1 using the above method.

Study the following examples (Given with negative variables)

Solve $-x = -8$

| Method 1 | Method 2 |
|---|--|
| $-x \times (-1) = -8 \times (-1)$ Multiplying both sides by (-1) $-x \times (-1) = -8 \times (-1)$ $x = 8$ | $-x = -8$ Dividing both sides by (-1) $\frac{-x}{-1} = \frac{-8}{-1}$ $x = 8$ |

Solve the following equations.

(1) $-a = -3$

(2) $-y = -7$

(3) $-m = 12$

(4) $-n = 11$

(5) $-p = 2\frac{1}{2}$

Solve the following.

(1) $x + 7 = 12$

(2) $m - 1 = 6$

(3) $7x = 42$

(4) $\frac{a}{5} = 3$

(5) $2a + 3 = 7$

(6) $-3x - 1 = 5$

(7) $\frac{x}{2} + 3 = 4$

(8) $-\frac{x}{3} + 7 = -5$

(9) (i) $3(x - 3) = 6$

(ii) $2(3a - 4) = 16$

(10) (i) $\frac{2(a+3)}{3} + 1 = 5$

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

(11)

(i) $\frac{x}{2} + \frac{x}{2} = 6$

(ii) $\frac{a}{2} + \frac{2a}{3} - \frac{a}{6} = 12$

(Multiply both sides by the common denominator)

(12)

(i) $3(2x - 1) - x = 3x + 7$

(ii) $2a - 3(3a - 1) = a - 17$

Formulation and solving linear equations

Formulate equations for the following relations using a suitable unknown term.

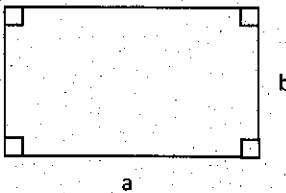
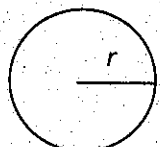
- (1) Sujeewa says that 'The result is 23, when 7 is added to twice of a particular number. Find the number.
- (2) Amali says that 'The result is 16, when 5 is subtracted from three times of a particular number' Find the number.
- (3) The result will be Rs. 11, when subtracted four times of money that Kamal has, from 31. Find the amount of money with Kamal.
- (4) When 3 is subtracted from a certain number and the result is multiplied by 6, the answer is 24. Find the number.
- (5) Leela is one year older than Neetha. Kamala is one year older than Leela. If the sum of ages of Kamala, Neetha and Leela is 39 years, Find the ages of each person.
- (6) Sum of the three successive even numbers is 102.

Find the above 3 numbers by formulating equations,

- (i) by taking the first number as x .
 - (ii) by taking the second number as x .
 - (iii) by taking the third number as x .
- (7) Sarath is four years older than Anula. $\frac{5}{7}$ of Anula's age is 4 years less than $\frac{3}{4}$ of Sarath's age. Find the ages of each.
 - (8) The difference between the squares of two successive numbers is 49. Find the two numbers.
 - (9) The length of a rectangular shaped building is 3m less than the thrice of its breadth. If the perimeter is 64 m. Calculate the length and the breadth of the building.
 - (10) Viraj and Nimesh have got Rs.175 and Rs. 125 respectively. When Nimesh gave certain amount of money to Viraj, the amount of money given to Nimesh becomes $\frac{1}{3}$ of the money that Viraj has got. What is the amount of money given to Viraj by Nimesh?

Formulae

Study the following formulae.

| | |
|--|---|
| <div style="text-align: center;">  </div> <p>If the perimeter of a rectangle is p, in which length is a units and breadth is b units.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> $p = 2(a + b)$ </div> <p>(P is the subject)</p> <p>If the area of the above rectangle is A, the formula of its area is,</p> <div style="border: 1px solid black; height: 20px; width: 100%; margin-top: 5px;"></div> | <div style="text-align: center;">  </div> <p>If the radius of a circle is r and area is A, Then,</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> $A = \pi r^2$ </div> <p>(A is the subject)</p> <p>If the circumference of the circle is C, the formula of the circumference is,</p> <div style="border: 1px solid black; height: 20px; width: 100%; margin-top: 5px;"></div> |
|--|---|

Exercise 1

Solve the following problems using the above formulae.

- (1) The length and the breadth of a rectangle are 30 cm and 20 cm, respectively. Calculate its perimeter and area.
- (2) The radius of a circle is 7 cm. Calculate its area and circumference.
- (3) Make a the subject of the formula, $p = 2(a + b)$
- (4) Make r the subject of the formula, $c = 2\pi r$. Calculate the radius of a circle with circumference 88 cm.

Exercise 2

Make the term given in the brackets as the subject of the following formulae.

- (1) $l = a + 5d$ (a)
- (2) $l = -4a + 3d$ (d)
- (3) $l = a + (n - 1)d$ (n)
- (4) $v = 1R$ (J)
- (5) $E = VIT$ (V)
- (6) $v = u + at$ (a)
- (7) $s = \frac{n}{2}(a + l)$ (l)
- (8) $s = \frac{n}{2}(a + l)$ (n)

Exercise 3

Make the term given in the brackets the subject of the following formulae.

- (1) $I = \frac{PRT}{100}$ (R)
- (2) $F = \frac{9}{5}C + 32$ (C)
- (3) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ (f)
- (4) $p = \frac{4}{7}(s + t)$ (t)
- (5) $n(R - r) = 2r$ (R)
- (6) $d = y - x$ (x)
- (7) $A = P + \frac{1}{5}I$ (I)

Exercise 4

Make the term given in the brackets as the subject of the following formulae.

$$(1) A = \pi r^2 \quad (r)$$

$$(2) K = \frac{1}{2}mv^2 \quad (v)$$

$$(3) T = 2\pi \sqrt{\frac{l}{g}} \quad (l)$$

$$(4) v = P(a + \sqrt{b+1}) \quad (b)$$

Exercise 5

Calculate following,

(1) the value of T of the formula $T = a + (n - 1)d$, when $a = -2$, $n = 5$, $d = -1$

(2) the value of n of the formula $s = \frac{n}{2}(a + l)$, when $s = -1220$, $a = 28$, $l = -89$

(3) the value of f of the formula $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$, when $v = 3$, $u = 5$.

(4) the value of I of the formula $I = \frac{nE}{R + nr}$, when $n = 3$, $E = 15$, $R = 9$, $u = 1$, $r = 2$

(5) the value of x , when $b = 3$, $a = 2$, $c = 1$ and the value of x , when $b = -2$, $a = -1$,
 $c = 3$ in the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Simultaneous Equations

- (1) The sum of two numbers is 13 and the difference is 5. Formulate two equations and solve them to find the numbers.

Take the numbers as x and y .

$$x + y = 13 \quad \text{_____} \quad \textcircled{1}$$

$$x - y = 5 \quad \text{_____} \quad \textcircled{2}$$

$$\textcircled{1} + \textcircled{2}, \quad x + y + x - y = 13 + 5$$

$$2x = 18$$

$$x = \frac{18}{2}$$

$$x = 9$$

By substituting $x = 9$ in ①

$$x + y = 13$$

$$9 + y = 13$$

$$y = 13 - 9$$

$$y = 4$$

Answer $x = 9, y = 4$

- (2) Piyal bought 4 mangoes and one orange for Rs. 44. Amal bought one mango and 4 oranges for Rs. 56. Find the value of x and y by taking the price of a mango as Rs. x and that of an orange as Rs. y .

$$4x + y = 44 \quad \text{————— ①}$$

$$x + 4y = 56 \quad \text{————— ②}$$

$$\text{①} \times 4, 16x + 4y = 176 \quad \text{————— ③}$$

$$\text{①} - \text{②} \quad 16x + 4y - (x + 4y) = 176 - 56$$

$$16x + 4y - x - 4y = 120$$

$$15x = 120$$

$$x = 8$$

By substituting $x = 8$ in ①

$$4x + y = 44$$

$$4 \times 8 + y = 44$$

$$32 + y = 44$$

$$y = 44 - 32$$

$$y = 12$$

Answer :

Price of a mango = Rs.8

Price of an orange = Rs.12

Solve the following simultaneous equations

(1) $a + b = 7$

$a - b = 1$

(2) $x + y = 15$

$2x + y = 23$

(3) $3p - 2q = 11$

$2p + 2q = 24$

(4) $3m + 2n = 18$

$4m + 3n = 27$

(5) $\frac{x+2y}{7} = \frac{x+3}{4} = \frac{3x+y}{6}$

Find the value of x and y by formulating two equations using above relationships.

- (6) Father's age is 3 years more than seven times of his son's age. After five years father's age would be four times of son's age. Find the ages of son and the father by formulating two equations.

(Take son's age as ' x ' years and father age as ' y ' years.)

Quadratic Equations

$$x^2 - 4 = 0$$

$$(x + 3)(x - 2) = 0$$

$$a^2 + 7a = 0$$

$$x^2 + 7x + 12 = 0$$

$$a(a + 5) = 0$$

$$3p^2 = 5p + 2$$

Solving Quadratic Equations

(A)

(1) $x^2 - 16 = 0$

$$x^2 - 4^2 = 0$$

$$(x - 4)(x + 4) = 0$$

$$x - 4 = 0 \text{ or } x + 4 = 0$$

$$\underline{x = 4, x = -4}$$

(2) $5m^2 - 45 = 0$

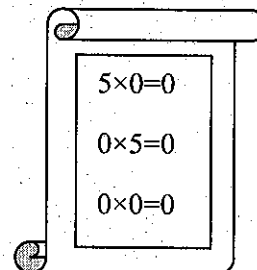
$$5(m^2 - 9) = 0$$

$$5(m^2 - 3^2) = 0$$

$$5(m - 3)(m + 3) = 0$$

$$m - 3 = 0 \text{ or } m + 3 = 0$$

$$\underline{m = 3, m = -3}$$



Exercise 1

Solve following.

- (1) $x(x - 2) = 0$
- (2) $(a - 3)(a - 4) = 0$
- (3) $(p + 5)(p - 2) = 0$
- (4) $x^2 - x - 20 = 0$
- (5) $x^2 + 3x = 40$
- (6) $(x - 2)^2 = 0$
- (7) $(x + 3)^2 = 0$
- (8) $x + \frac{7}{x} + 12 = 0$

(B) Form the quadratic equation for the roots 5 and -3.

$$\begin{aligned}x &= 5, x = -3 \\x - 5 &= 0 \text{ or } x + 3 = 0 \\(x - 5)(x + 3) &= 0 \\x^2 + 3x - 5x - 15 &= 0 \\x^2 - 2x - 15 &= 0\end{aligned}$$

Exercise 2

Form the quadratic equations for the roots given below.

- (1) 8 and -3
- (2) 2 and 5
- (3) -4 and -7
- (4) $\frac{1}{2}$ and 3

(C) Find the constant term which should be added to $x^2 + 6x$ to make a perfect square.

$$\begin{aligned}\text{The coefficient of } x &\longrightarrow 6 \\ \text{Constant term is } &\longrightarrow \frac{6}{2} \longrightarrow 3^2 = 9 \\ \therefore \text{ Expression is } &x^2 + 6x + 9\end{aligned}$$

Then it could be expressed as a perfect square $\longrightarrow (x + 3)^2$

e.g. 1

$$x^2 + 5x + \square$$
$$5 \longrightarrow \frac{5}{2} \longrightarrow \left(\frac{5}{2}\right)^2 \longrightarrow \frac{25}{4}$$
$$x^2 + 5x + \square \frac{25}{4}$$

Then it could be expressed as a perfect square $\left(x + \frac{5}{2}\right)^2$

e.g. 2

$$x^2 - 4x + \square$$

$$-4 \longrightarrow \frac{-4}{2} \longrightarrow -2 \longrightarrow (-2)^2 \longrightarrow 4$$

$$x^2 - 4x + \square \quad \square \quad 4$$

Then it could be expressed as a perfect square $(x - 2)^2$

Exercise

Find the constant terms and complete the following table.

| Expression | Constant to be added | As a perfect square |
|----------------------|----------------------|---------------------|
| $x^2 + 8x$ | | |
| $x^2 - 12a$ | | |
| $m^2 + 7m$ | | |
| $x^2 + 4x + 1$ | | |
| $x^2 - 6x - 3$ | | |
| $x^2 + \frac{1}{2}x$ | | |
| $x^2 + \frac{5}{2}x$ | | |

Solving quadratic equations by completing squares

Solve $x^2 + 6x + 3 = 0$ and write the answer to the first decimal place.

(A)

$$x^2 + 6x + 3 = 0$$

$$(x + 3)^2 - 9 + 3 = 0$$

$$(x + 3)^2 - 6 = 0$$

$$(x + 3)^2 - (\sqrt{6})^2 = 0$$

$$(x + 3 + \sqrt{6})(x + 3 - \sqrt{6}) = 0$$

$$x + 3 + \sqrt{6} = 0 \text{ or } x + 3 - \sqrt{6} = 0$$

$$x = -3 - \sqrt{6} \quad x = -3 + \sqrt{6}$$

$$x = -3 - 2.449 \quad x = -3 + 2.449$$

$$x = -5.449 \quad x = -0.551$$

$$\underline{x = -5.4 \quad x = -0.6} \text{ (To the first decimal place)}$$

| |
|-----------------------------------|
| $\sqrt{6}$ |
| $x = \sqrt{6}$ |
| $\log x = \frac{1}{2} \log 6$ |
| $= \frac{1}{2} \times 0.7782$ |
| $\log x = 0.3891$ |
| $x = \text{antilog } 0.3891$ |
| $x = 2.449$ |
| $\therefore \sqrt{6} = \pm 2.449$ |

(B)

$$x^2 + 7x + \frac{1}{2} = 0$$

$$\left(x + \frac{7}{2}\right)^2 - \left(\frac{7}{2}\right)^2 + \frac{1}{2} = 0$$

$$\left(x + \frac{7}{2}\right)^2 - \left[\frac{49-2}{4}\right] = 0$$

$$\left(x + \frac{7}{2}\right)^2 - \left[\frac{47}{4}\right] = 0$$

$$\left(x + \frac{7}{2}\right)^2 - \left(\frac{\sqrt{47}}{2}\right)^2 = 0$$

$$\left(x + \frac{7}{2}\right)^2 - \left(\frac{\sqrt{47}}{2}\right)^2 = 0$$

$$\left\{x + \frac{7}{2} + \frac{\sqrt{47}}{2}\right\} \left\{x + \frac{7}{2} - \frac{\sqrt{47}}{2}\right\} = 0$$

$$x + \frac{7}{2} + \frac{\sqrt{47}}{2} = 0 \text{ or } x + \frac{7}{2} - \frac{\sqrt{47}}{2} = 0$$

$$x = -\frac{7}{2} - \frac{\sqrt{47}}{2} \text{ or } x = -\frac{7}{2} + \frac{\sqrt{47}}{2}$$

$$x = -\frac{7+\sqrt{47}}{2} \text{ or } x = \frac{-7+\sqrt{47}}{2}$$

$$x = -\left(\frac{7+6.855}{2}\right) \text{ or } x = -\left(\frac{-7+6.855}{2}\right)$$

$$x = -\frac{-13.855}{2} \text{ or } x = -\frac{-0.145}{2}$$

$$x = -6.927 \text{ or } x = -0.0725$$

$$\sqrt{47}$$

$$x = \sqrt{47}$$

$$\log x = \frac{1}{2} \log 47$$

$$= \frac{1}{2} \times 1.6720$$

$$\log x = 0.8360$$

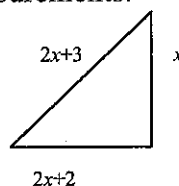
$$x = \text{antilog} 0.8360$$

$$x = 6.855$$

$$\therefore \sqrt{47} = 6.855$$

Problems related to quadratic equations

- Find the number of terms from the first term, to get 345 as the sum of the progression 2, 5, 8, ...
- Sum of the squares of two successive numbers is 41. Formulate an algebraic equation, when the smallest number is x . Find the values of the numbers by solving the equation.
- The result is 1, when 12 times of the reciprocal of a certain number subtracted from that particular number.
Formulate an equation by taking the number as x .
Solve the equation and find the value of x .
- A lamp post is fixed vertically to a leveled ground in a school garden. It is fixed to the ground with a metal wire. One end of the wire is tied up to the top of the lamp post and the other end is fixed tightly to a point on the ground away from the base of the lamp post. The following diagram shows the relevant measurements.



- i. Write a geometrical theorem to obtain the relationship among the length of the sides.
- ii. Formulate a quadratic equation containing x , by using the above theorem.
- iii. Solve the above equation and find the value of x .

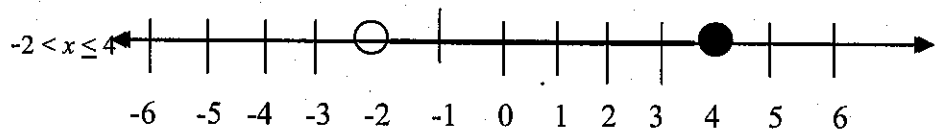
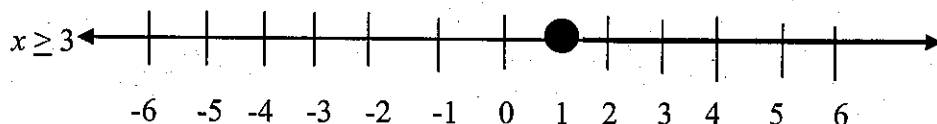
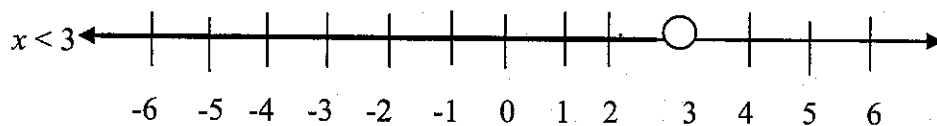
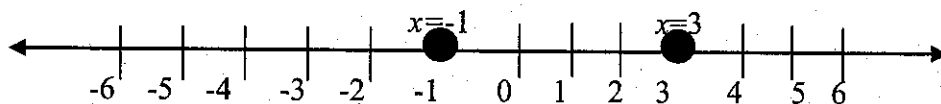
Formula to find the roots of $ax^2 + bx + c = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

5) Solve following equations using both, completing squares and substituting values to the above mentioned formula. Compare the answers.

- i. $x^2 + 6x + 3 = 0$
- ii. $x^2 = 4x - 1$
- iii. $x^2 + 7x - 3 = 0$

Graphs



1) Represent each of the followings on number lines.

- i. $x = -3$
- ii. $x > -4$
- iii. $x \leq 2$
- iv. $-3 \leq x < 2$

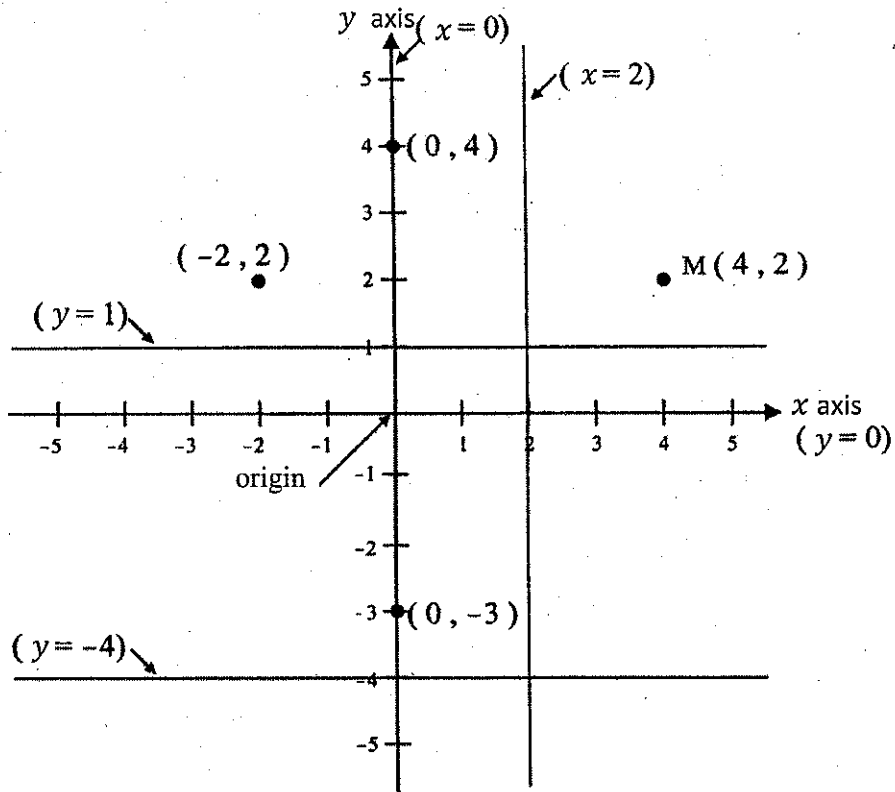
- 2) Write the solution set of the integers of following inequalities.
- $2 < x \leq 5$
 - $-3 < x < 2$
 - $-1 \leq x < 5$
- 3) Write coordinates of 4 points with whole numbers on the line, $x = 2$.
- 4) Write coordinates of 4 points with whole numbers on the following lines
- $y = -1$
 - $y = x$
 - $y = 2x$
 - $y = x + 3$
 - $y = 2x - 1$

$y = mx + c$ is the common formula of a straight line.
 $m =$ Gradient
 $c =$ Intercept
(The coefficient of y should be 1.)

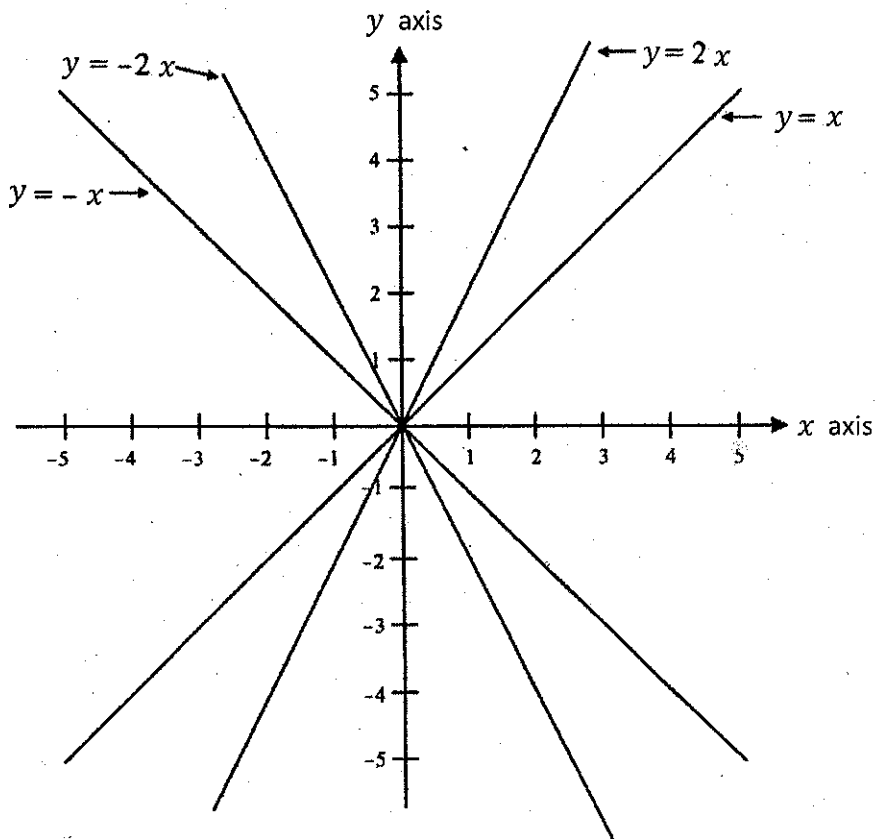
- 5) Complete the following table.

| Equation | Gradient (m) | Intercept (c) |
|-------------------|------------------|-------------------|
| $y = 3x + 2$ | | |
| $y - 2x = 5$ | | |
| $2y - 8x = 6$ | | |
| $3y + 9x - 1 = 0$ | | |
| | 5 | -2 |
| | -2 | 3 |

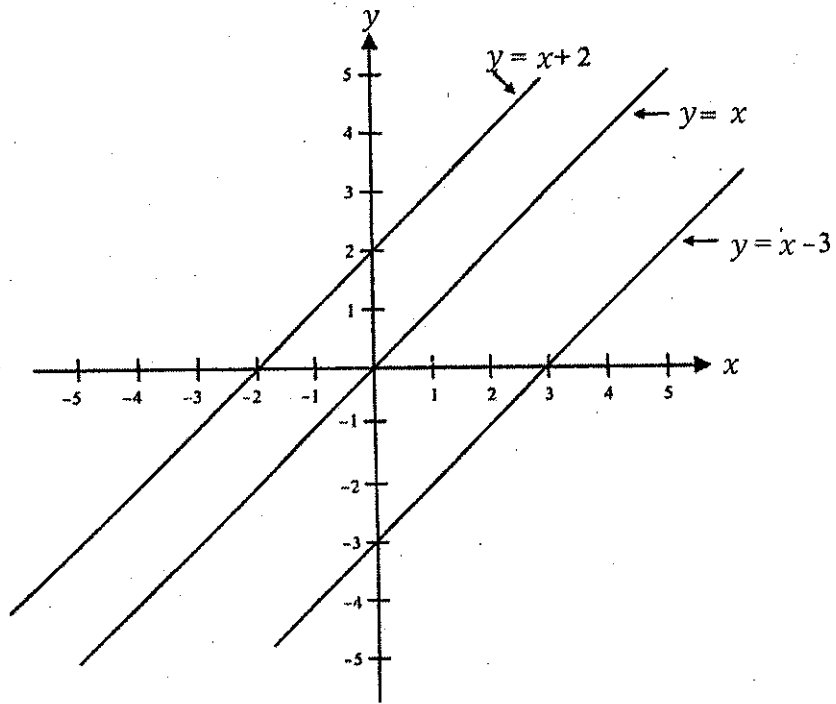
(a)



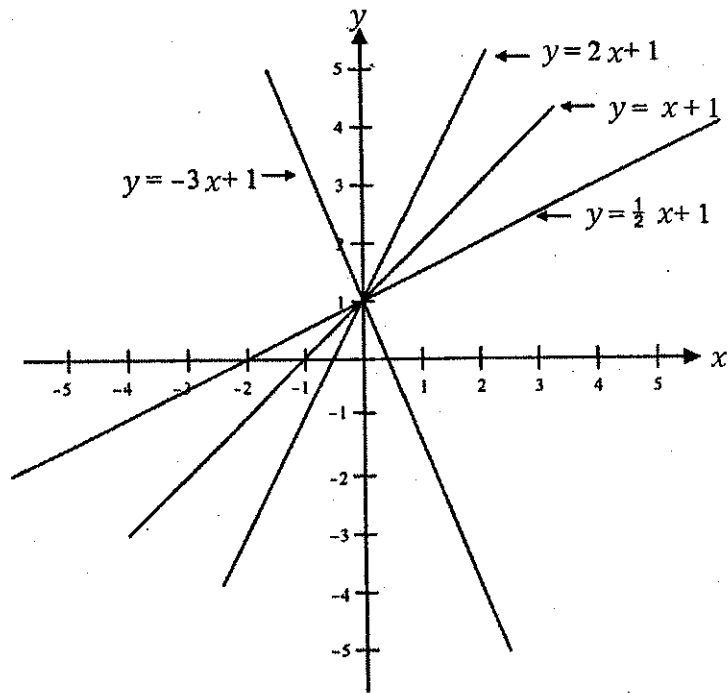
(b)



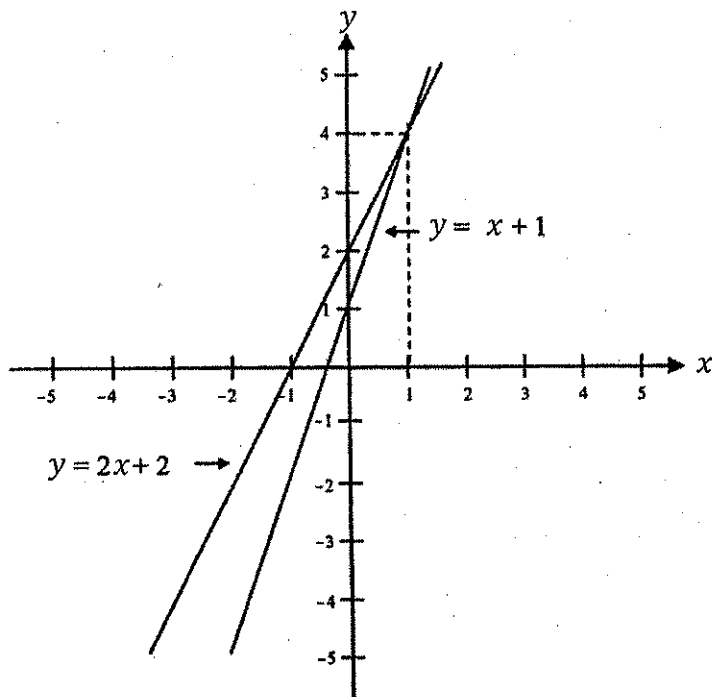
(c)



(d)



The simultaneous equations can be solved using graphs.



The point of intersection of the lines $y = 3x + 1$ and $y = 2x + 2$ is (1,4).

∴ The solutions of above simultaneous equations are $x = 1$ and $y = 4$.

$$y = 3x + 1 \quad \text{---} \quad \textcircled{1}$$
$$y - 2x = 2 \quad \text{---} \quad \textcircled{2}$$

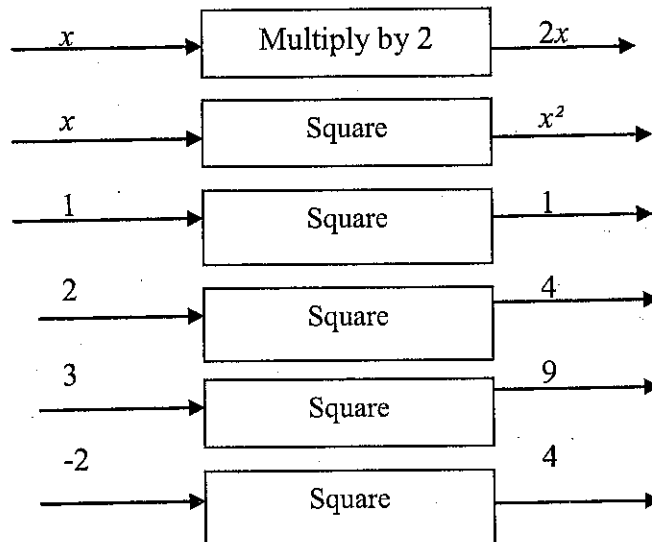
From ① and ② ,

$$3x + 1 - 2x = 2$$
$$x + 1 = 2$$
$$x = 1$$

By substituting $x = 1$ in ①

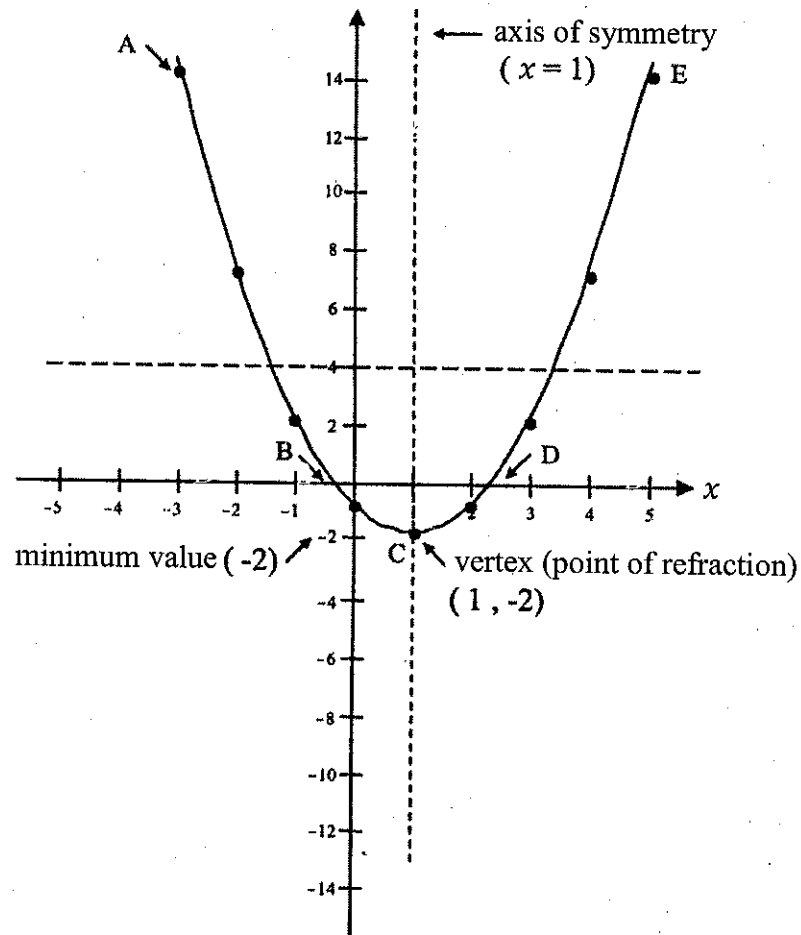
$$y = 3 \times 1 + 1$$
$$y = 4$$

- 6)
- Write the equation of the straight line, which passes through the origin and parallel to the line $y = 3x - 2$
 - Write the equation of the straight line, which passes through the point $(1, 5)$ and parallel to the line $y = 3x - 2$
- 7) Solve following simultaneous equations using graphs.
- $$y = x - 1$$
- $$2y + x = 7$$



Study the following.

$$y = (x-1)^2 - 2$$



The above function,

- Decreases positively from A to B.
- Decreases negatively from B to C.
- Increases negatively from C to D.
- Increases positively from D to E.
- Range of the values of x when $y < 0$, $-0.4 < x < 2.4$
- Range of the values of x when $y \leq 4$, $-1.5 < x < 3.5$

Exercise

1)

i. Complete the following table.

$$y = -(x + 2)^2 + 3$$

| | | | | | | | |
|-----|----|----|----|----|----|----|---|
| x | -5 | -4 | -3 | -2 | -1 | 0 | 1 |
| y | | | 2 | | | -1 | |

| |
|--|
| <p>Hints</p> <p>$x = -3$</p> <p>$y = -(-3+2)^2 + 3$</p> <p>$= -(-1)^2 + 3$</p> <p>$= 1 + 3$</p> <p>$= 2$</p> |
|--|

| |
|---|
| <p>Hints</p> <p>$x = 0$</p> <p>$y = -(0+2)^2 + 3$</p> <p>$= -(2)^2 + 3$</p> <p>$= -4 + 3$</p> <p>$= -1$</p> |
|---|

- ii. Name the axes.
- iii. Draw the graph on a coordinate plane.
- iv. Is the curve minima or maxima?
- v. Write minimum/maximum value.
- vi. Write the coordinates of the vertex.
- vii. Draw the axis of symmetry and write its equation.
- viii. Write the range of values of x of the inequality $-(x+2)^2 + 3 > 0$
- ix. Draw the line $y=4$ on the graph and write two values of x when y is 4.
- x. Find the roots of the equation $-(x + 2)^2 + 3 = 0$ using the graph.
- xi. Find following without drawing the graph of the function $y = (x+2)^2 - 3$.
 - a) Coordinates of the vertex.
 - b) Equation of the axis of symmetry.
- xii. Is the curve maxima or minima?
- xiii. Write maximum/minimum value.

NUMBERS

Mathematical operations used in mathematics.

| | | | |
|---|---|---|----------------|
| • | + | → | Addition |
| • | - | → | Subtraction |
| • | × | → | Multiplication |
| • | ÷ | → | Division |
| • | √ | → | Square root |

1) Complete the table

| | | | |
|---|-------|-------|-------|
| + | 5 | 3 | 7 |
| 2 | 7 | ..... | ..... |
| 8 | ..... | ..... | ..... |
| 0 | ..... | ..... | ..... |

2) $9 \times \square = 72$

3) $3 \square$

$$\begin{array}{r} \square \\ \underline{\square} \end{array} 5$$

4) Nipun divides 80 'Weralu'-sinhala/ Werali palam- tamil equally among his 20 friends. Find the number of 'Weralu'/Werali palam received by a friend.

When writing numbers in the standard form, the numbers are divided into zones with 3 digits from the right side of the number.

5) Complete the table

| zone | Zone | Thousand zone | zone | The way of reading |
|---------------|---------------|------------------|---------------|---|
| 06 | 380 | 002 | 104 | Six billion three hundred eighty million two thousand one hundred and four. |
| 24 | 000 | 917 | 173 | ..... |
| ..... | ..... | ..... | ..... | One hundred fifty million eight hundred five thousand and forty. |

- 6) What is the value represented by the digit 4 in the following numbers?
- 604 238 560
 - 400 000
 - 4 000 000
 - 4 238 000
 - 400

7) simplify

i. $50.2 + 4.1 \longrightarrow \begin{array}{r} 5.02 \\ + 4.1 \\ \hline \hline \end{array}$

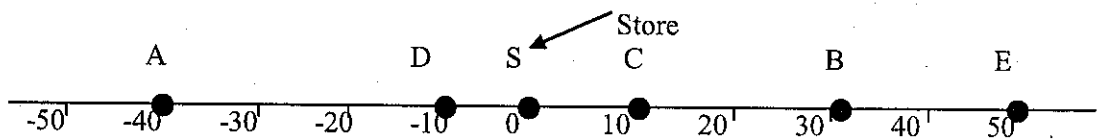
ii. $11.8 + 903.421 \longrightarrow$

iii. Subtract five rupees and four cents from eight rupees and eighty one cents.

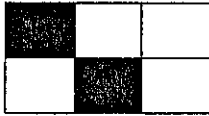
8) Ramesh bought a book for Rs. 72.50 and a pen for Rs.11.25 from a super market. He gave Rs. 500 note to the cashier.

- What is the total cost of the book and the pen?
- Calculate the balance he received.
- Round off the balance to the nearest rupee.

9) The diagram shows a track used to transport goods using a trolley in a site. 'S' represents the store.



- Find the distance between C and B.....
Accordingly, calculate,
 $(+ 30) - (+10) =$
- Find the distance between E and D.....
Accordingly, calculate,
 $(+ 50) - (-10)$
 $= (+ 50) + 10$
 $= \dots\dots\dots$
- What is the end point when the trolley travels + 50 from the point A?
- Find the distance between A and D.
- Accordingly calculate $(-40) - (-10)$
 $= \dots\dots\dots$
 $= \dots\dots\dots$



Shaded part of the diagram as a fraction of the whole $\longrightarrow \frac{2}{6}$

10) Select suitable fractions from the given box and write in the relevant figure.

$\frac{5}{7}$

$\frac{3}{10}$

$7\frac{1}{2}$

$\frac{5}{9}$

$\frac{1}{5}$

$\frac{3}{2}$

$\frac{43}{30}$

$\frac{1}{19}$

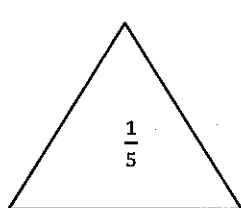
$100\frac{1}{2}$

$\frac{7}{7}$

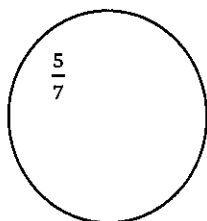
$\frac{13}{12}$

$\frac{1}{25}$

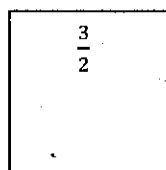
$3\frac{2}{5}$



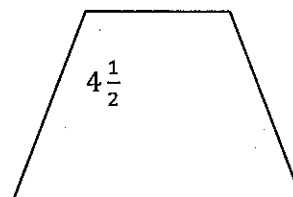
Unit fractions



proper fractions



Improper Fractions



Mixed Numbers

Hint

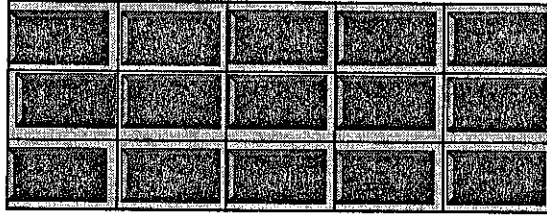
Fractions with equal values are called equivalent fractions. We can get an equivalent fraction by multiplying or dividing both denominator and the numerator of the fraction by the same number.

11)

$$\frac{2}{3} = \frac{2 \times \dots}{3 \times \dots} = \frac{8}{12}$$

$$\frac{200}{500} = \frac{200 \div 10}{500 \div 10} = \frac{\dots + 10}{\dots + 10} = \frac{2}{5}$$

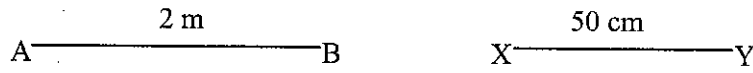
12)



Geethika ate $\frac{1}{5}$ of a chocolate and kept the remaining portion in the refrigerator.

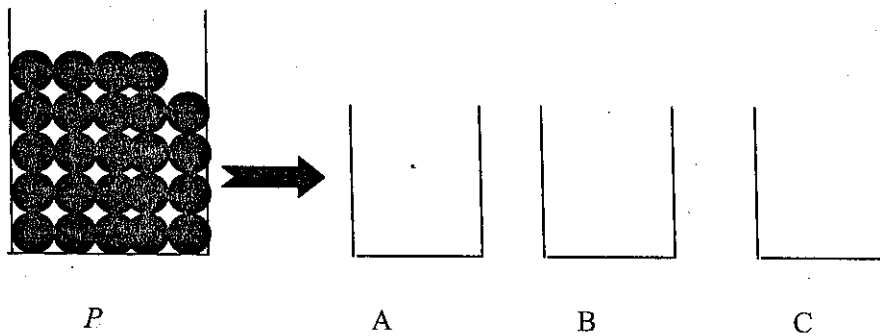
- i. Write the portion which has kept in the refrigeration as a fraction.
- ii. What is the fraction of the whole chocolate received by the sister, if Geethika has given half of the remainder to her sister?
- iii. What is total fraction which has eaten by Geethika and her sister?
- iv. What is the remaining portion at last?

13)

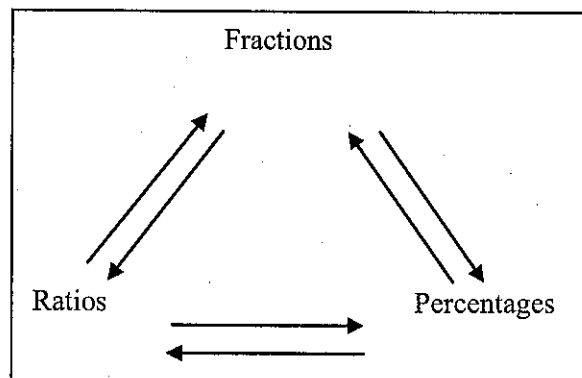


- i. Write the length of AB in centimeters.
- ii. $AB:XY = \dots : 50 = \dots : 1$

14)



Draw balls in vessels A,B and C, when Kamal put the balls from the vessel 'P' into other vessels in the ratio of 1:2:3 respectively.



15)

| Ratio | Fraction | Percentage |
|-------|----------------|-----------------------------------|
| 2:5 | $\frac{2}{5}$ | $\frac{2}{5} \times 100\% = 40\%$ |
| 3:4 | ..... | .....=..... |
| ..... | $\frac{3}{10}$ |=..... |
| ..... | ..... | .....= 60 % |

16) Select suitable value for 'P' from the values given in the bracket.

$$100 : 85 = P : 17 \quad (25, 20, 15, 20)$$

17) A fruit drink could be prepared by mixing water and fruit juice in the ratio 6 : 1. Calculate the amount of water and fruit juice needed to prepare 14 l of fruit drink.

The ratio between A, B and C can be calculated, when the ratio between A and B and the ratio between B and C have been given.

18) Father has decided to divide the income of his business among his 3 sons, Ranjan, Neranjan and Suranjan. Fill the blank spaces if father divided the income as follows.

$$\text{Ranjan} : \text{Neranjan} = 2 : 3$$

$$\text{Neranjan} : \text{Suranjan} = 6 : 5$$

| Ranjan | Neranjan | Suranjan |
|--------------------|--------------------|----------|
| $2 \times (\dots)$ | $3 \times (\dots)$ | ..... |
| ..... | 6 | 5 |
| | | |

19) 'The price of a packet of milk is Rs 200.

The price will be increased as

$$\text{old price} : \text{new price} = 5 : 6$$

- i. Write the ratio between prices as a fraction
- ii. Find the new price of a packet of milk powder.

$$\text{Rs. } 200 \times \frac{\dots}{\dots} = \text{Rs. } \dots$$

20) Eight days are needed for 10 men to dig a well. Two men got absent after 4 days of the work.

- i. Calculate the number of man days needed to complete the above task.
 $10 \times \dots = \dots$
- ii. Find the remaining number of man days after working four days.
 $10 \times \dots = \dots$
- iii. Find the numbers of man days needed to complete the remaining work.
 $10 \times \dots = \dots$

21) Mohamed and Ahamed invested money in a business as follows.

| Mohamed | | Ahamed | |
|----------------|----------------------------|----------------|--------------------------|
| Money invested | Date of investment | Money invested | Date of investment |
| Rs.9 000 | 1 st of January | Rs.15 000 | 1 st of March |

- i. Find the ratio of dividing profit between Mohamed and Ahamed at the end of the year.
 $9000 \times 12 : \dots \times \dots$
- ii. Write the ratio in the simplest form.
- iii. Calculate the amount of money received by each person, if the profit is Rs. 4 300.

Hint

Ratio between the product of the money invested and the period of investment is considered, when dividing the profit among shareholders.

Hint

$$\text{Percentage profit} = \frac{\text{Profit}}{\text{Buying Price(Cost of production)}} \times 100\%$$

Hint

$$\text{Percentage Loss} = \frac{\text{Loss}}{\text{Buying Price(Cost of production)}} \times 100\%$$

- 22) Sameera brought a wrist watch for Rs. 700 and sold it for Rs. 840.
- Find his profit.
 - Find the percentage profit.
- 23) Suraj brought a bicycle for Rs. 5 000. He sold it with 5% reduction because of the damages.
- Find the loss.
 - Find the selling price.
- 24) The selling price of a clay pot is Rs. 110 and the buying price of it is Rs.100.
- Find the buying price when the selling price of a clay pot is Rs. 550.
 - Find the percentage profit obtained by selling the above clay pot.

Hint

$$I = \frac{Ptr}{100}$$

I = Interest

P = principal

t = Time(years)

r = Annual rate of interest

- 25) Piumal borrowed Rs.50 000 loan at 5% annual rate of interest.
- Find following,
- Interest that has to pay after 2 years.
 - The total amount of money he has to be pay after 2 years.
 - The annual interest that Pumal will obtain after 2 years, if he deposited the above loan in a bank at 6% annual compound interest.
- 26) Find following, if the taxes for motor cars is 40%.
- Tax needed to declare a motor car which cost is Rs. 1 500 000.
 - Cost of the above motor car after paying the tax.

Hint

$$\text{Number of shares} = \frac{\text{Money invested}}{\text{Selling price of a share}}$$

$$\text{Nominal value of shares} = \text{Number of shares} \times \text{Nominal value of a share}$$

$$\text{Income} = \text{Nominal value of shares} \times \text{Percentage}$$

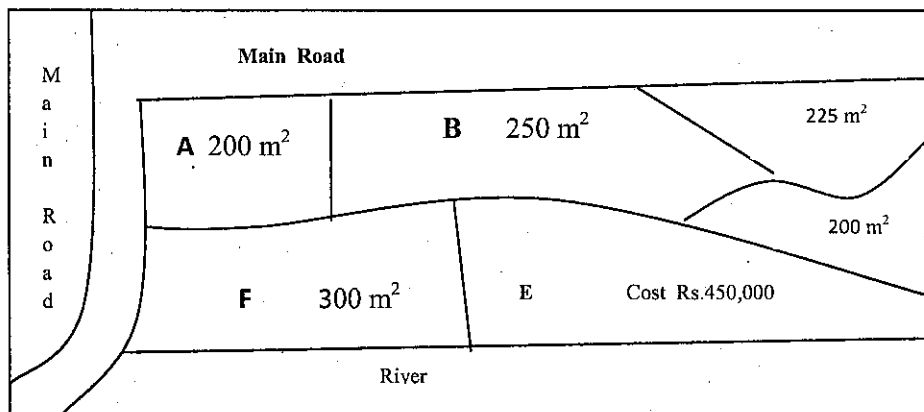
27)

| Money invested | Nominal Value of a share | Selling price of a share | Number of shares bought | Nominal value of shares | Dividend | Income |
|----------------|--------------------------|--------------------------|-------------------------|-------------------------|----------|--------|
| Rs. 6,000 | 10 | 15 | | ...×.... | 8% | |
| ..... | 10 | 12 | 2 000 | ...×... | 6% | |
| Rs.12,500 | 20 | ... | 500 | ...×... | 10% | |
| Rs.8,400 | 10 | 8 | ..... | 700 × ... | 12% | |

28) Thirty five students in Grade 11 collected money to pay term test fees for one of their class mates. Each student gave Rs. 2.

- Find the total amount of money collected, if the total number of students in the class is 36.
- Find the excess amount of money collected, if the term test fee for a student is Rs.60.
- State that amount as a percentage of the term test fee.
- Convert the answer in question number (ii) into a decimal number.
- State whether it is an infinite decimal / finite decimal or a recurring decimal.

29)



Above diagram shows a rough sketch of a land which has noticed for sale. The price of the block 'E' and the area of the others have been mentioned.

- Find the price of 'B', if the price of 'A' is Rs 400,000.
- Area of the block 'E' is 250 m^2 . A man says that buying 'E' is more profitable when comparing area and prices of A, B and E.

Do you agree with the above statement? Give reasons.

Hints

- A number is divisible by 2, if the digit in the unit place is either 0 or an even number.
- A number is divisible by 3, if the digital index of the number is divisible by 3.
- A number is divisible by 4, if the number formed by the last two digits is either 00 or divisible by 4.
- A number is divisible by 5, if the digit in the unit place is either 0 or 5.
- $\sqrt{12} = \sqrt{4 \times 3} = 2\sqrt{3}$

- i. Write all the digits suitable for the blank, if the number $53\Box3$ is divisible by 3.
- ii. Write all the digits suitable for the blank, if the number $432\Box$ is a multiple of 4.
- iii. Write two numbers which remains 1, 2 and 4, if it is divided by 2, 3 and 5 respectively
- iv. Amal said that a prime number cannot be an even number. Do you agree with Amal? Give Reasons.
- v. Show that $\sqrt{108} = 10.392$, if $\sqrt{3} = 1.1732$

31) Following poster was observed by Kalpani, when she visited Kurunagala.

Speed Loan

Get a loan of Rs.10,000 on the basis of higher purchasing..... before 7th, December

Following table shows the details of this loan.

| | | | | | |
|----------------------------------|---------------|---------------|-------|-------|-------|
| Balance of the loan (Rs.) | 10 000 | 8 000 | ..... | ..... | ..... |
| Interest | 40×5 | 40×4 | ..... | ..... | ..... |

- i. Fill in the blanks in the table.
- ii. What is the period of time given for settling the loan?
- iii. How many month units are there?
- iv. How much is the monthly payment of the loan?
- v. Find the annual rate of interest according to the following equation.

$$\frac{\text{Interest for a month unit}}{\text{Monthly payment}} \times 100 \times 12$$

32)

- i. The answer is 5, when a number with one decimal place is rounded off to the nearest whole number. Write all the possible numbers that you can get the above answer.
- ii. Teacher said that the total amount of money given to buy quality inputs for school is Rs. 4.5×10^4 per year. Write this in general/normal form.
- iii. If Rs. 3 575 is given to Mathematics, write the amount of money given for Mathematics in scientific notation.

$$3^5 = 3 \times 3 \times 3 \times 3 \times 3$$

$$= 243$$

$$5^0 = 1$$

$$5^1 = 5$$

33) Match the equal values.

$$5^4$$

$$3^4$$

$$2^8$$

$$4^4$$

$$25^2$$

$$6^3$$

$$1^{19}$$

$$19^0$$

$$1$$

$$19$$

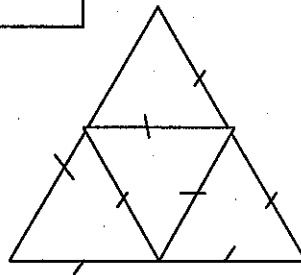
$$625$$

$$216$$

$$81$$

$$256$$

34)



Above diagrams shows a grill pattern used to decorate a house. A mechanic made one such pattern in the first day and 2 in the next day and completed his work within 5 days.

- i. Find,
 - a. the number of pieces of iron rods needed to construct one pattern.
 - b. the number of pieces of iron rods needed for each day to construct the whole frame and represent it as a number pattern.
 - c. total number of iron pieces required to construct all grill patterns, using the knowledge of progressions.
 - d. the total length of all iron pieces required, if the length of a piece is 18 cm.
- ii. What is the type of pattern? Give reasons.
- iii. There are two types of iron bars available in the market as length 1.97 m and 3.65 m. Which bar is more suitable?

In a numerical progression,

- Common difference (d) = consequence term- antecedent term
- Common ratio (r) = $\frac{\text{Consequence term}}{\text{antecedent term}}$
- First term (a)

Arithmetic Progression

$$T_n = a + (n - 1)d$$

$$S_n = \frac{n}{2} + \{2a + (n - 1)d\}$$

Geometric Progression

$$T_n = ar^{(n-1)}$$

$$S_n = \frac{a(r^n - 1)}{r - 1}$$

$$S_n = \frac{a(1 - r^n)}{(r - 1)}$$

35) Following table shows a request made by a son to his father asking for story books after passing year 5 scholarship examination.

“One story book should be given in the first week and the number of books should be doubled every week.”

Complete the table using the information given.

| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 1 | 2 | 4 | 8 | | | | | |

- What is the progression denoted, when number of books are written in order?
- Write the number of books received in the first day as a power of 2.
- Find the total number of books given to the son by his father within the given period.

36) Following shows a part of a logarithmic table.

| | | | | | | | |
|----------------|------|-----|---|----|-----|------|-------|
| Number | 0.01 | 0.1 | 1 | 10 | 100 | 1000 | 10000 |
| Characteristic | -2 | -1 | 0 | 1 | 2 | 3 | 4 |

- Find the characteristics of following log values.
 - $\log 45$.
 - $\log 2375$.
 - $\log 0.15$.

ii. Write the relationship between the number of digits of the whole number part of the number and the characteristic of the log value of that number under following conditions.

- a. A number greater than 1
- b. A number between 0 - 1
(e.g. 0.1, 0.01, 0.001, 0.0001)

iii. Find the logarithmic values of following numbers.

- a. 4.53
- b. 45.32
- c. 4539
- d. 0.0451
- e. 0.0004578

0,1,2,3,4,5,6,7,8,9 digits are used when writing numbers with different bases

e.g.

| | | |
|--------------------------------------|--------|---------------------|
| Numbers in base two (Binary numbers) | —————→ | 0,1 |
| Numbers in base four | —————→ | 0,1,2,3 |
| Numbers in base eight | —————→ | 0, 1,2,3,4,5,6,7 |
| Numbers in base ten (Decimal Number) | —————→ | 0,1,2,3,4,5,6,7,8,9 |

37) Follow this method to convert 42_{ten} to a binary number.

| | | |
|---|----|-----|
| 2 | 42 | |
| 2 | 21 | → 0 |
| 2 | 10 | → 1 |
| 2 | 5 | → 0 |
| 2 | 2 | → 1 |
| 1 | | → 0 |

Accordingly fill in the blanks.

$42 = \square \square \square \square \square \square_{two}$

38) Write the order of following matrix.

$$\begin{pmatrix} a & b \\ c & d \\ e & f \end{pmatrix} \dots \times \dots$$

39) Teacher gave 3 blue pens and 2 red pens to group A and 4 blue pens and 3 red pens to group B.

- i. Express above information by a matrix and name it as 'P'.
- ii. What is the order of 'P'?
- iii. Groups 'C' and 'D' are given twice of pens as given to Group 'A' and 'B' respectively. Express the number of pens given to groups 'C' and 'D' by matrices.

40) Ruwan, Ram and Ahamed hope to sit for the G.C.E. (O/L) examination this year. The marks obtained by them for Mathematics and Science in first and second term test are given below.

First term test

| | Mathematics | Science | |
|--------|-------------|---------|---|
| Ruwan | 65 | 60 | } |
| Nuwan | 75 | 76 | |
| Ramani | 68 | 75 | |
| | | | → |
| | | | A = |
| | | | $\begin{pmatrix} 65 & 60 \\ 75 & 76 \\ 68 & 75 \end{pmatrix}$ |

Second term test

| | Mathematics | Science | |
|--------|-------------|---------|---|
| Ruwan | 70 | 72 | } |
| Nuwan | 78 | 74 | |
| Ramani | 65 | 73 | |
| | | | → |
| | | | B = |
| | | | $\begin{pmatrix} 70 & 72 \\ 78 & 74 \\ 65 & 73 \end{pmatrix}$ |

i. Write the matrix A+B

ii.
$$\begin{pmatrix} 24 & x \\ y & 32 \end{pmatrix} + \begin{pmatrix} 10 & 5 \\ 4 & 3 \end{pmatrix} = \begin{pmatrix} 34 & 15 \\ 24 & 35 \end{pmatrix}$$

Find the values of x and y.

It is defined that if a number is divisible by another number without a remainder, the second number is a factor of the first number.

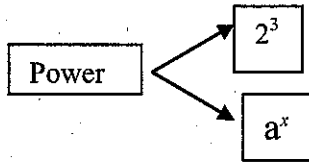
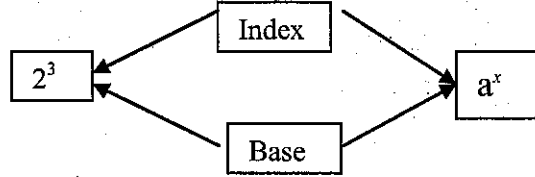
- All the factors of 36 → 1,2,3,4,6,9,12,18,36
 - All the factors of 24 → 1,2,3,4,6,8,12,24
- i. Write all the Common Factors of 36 and 24.
 - ii. Write the Highest Common Factor of 36 and 24.
- First ten multiples of 18 → 18,36,54,72,90,108,126,144,162,180
 - First twelve multiples of 12 → 12,24,36,48,60,72,84,96,108,120,132,144
- i. Write all the Common Multiples of 18 and 12.
 - ii. What is the Least Common Multiple (L.C.M.) of 18 and 12?

- 41) Fill in the blanks of the following table, in order to distribute 143 toffees among students to get equal number of toffees in different ways.

| | | | | |
|-------------------------------------|-------|-------|-------|-------|
| Number of students | ..... | ..... | ..... | ..... |
| Number of toffees given per student | ..... | ..... | ..... | ..... |

- 42) Select the fractions that can be expressed as a finite decimal.

$\frac{4}{5}$ $\frac{1}{9}$ $\frac{3}{10}$ $\frac{5}{17}$ $\frac{7}{15}$ $\frac{3}{125}$



- 43) Find the following values.
- $\log_2 64$
 - $\log_5 625$
 - The logarithm of to the base 3 is 5.

- 44) Put $>$, $<$ or $=$ into suitable places.

- 528 001 203 528 100 203
- 6.943 6.94
- $\frac{3}{10}$ $\frac{3}{7}$
- $\sqrt{2}$ $\sqrt{3}$
- $4\frac{1}{2}$ $2\frac{1}{4}$
- 2 m 25 cm
- 2.2 kg 2 200 g
- 13 mg 0.13 g
- 1437 ml 1.5 l
- Rs 0.43 8 cents
- 54% 45%
- 2 ha 15 000 cm^2

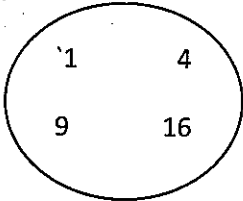
- 45) Simplify

(i) $1 - (0.2 \times 0.8)$ (ii) $\frac{1-1.004}{1.2}$ (iii) $\frac{420}{7} \times \frac{1}{10}$ (iv) $\frac{52.75}{10}$ (v) $(100 \times 0.25) + 100$

SETS AND PROBABILITY

- (1) i. $A = \{\text{Even numbers from 2 to 10}\}$
 Write the set 'A' with elements.
- ii. Write the set of letters of the word "COMMISSION"
- iii. Write the set of digits of the number "354547"

(2) Write the following sets in other set notations.

- i. $R = \{\text{Prime numbers between 0 and 10}\}$
- ii. $S = \{1,3,6,10\}$
- iii. $T \longrightarrow$ 
- iv. $U = \{x : x \text{ is an odd number, } 0 < x < 10\}$

(3) Fill in the blank using the signs $\in, \notin, \subset, \not\subset$

- i. Parrot $\{\text{Crow, Mynah, Parrot}\}$
- ii. 9 $\{\text{Prime numbers}\}$
- iii. $\{3,5\}$ $\{1,3,5,7,9\}$
- iv. $\{\text{Hexagon}\}$ $\{\text{Triangle, Square, Hexagon}\}$

(4) Write the cardinality of the following sets.

- i. $A = \{\text{Multiples of 3 between 0 and 10}\}$
- ii. $B = \{\text{The letters of the word "COMMUNICATION"}\}$
- iii. $C = \{x : x \text{ is a multiple of 7, } 0 < x < 5\}$

(5) Separate the finite sets, infinite sets and null-sets out of the following sets.

- i. $A = \{\text{Even numbers from 2 to 12}\}$
- ii. $B = \{\text{Counting numbers}\}$
- iii. $C = \{x : x \text{ is a prime number, } 0 < x < 2\}$

(6) Write a universal set for each of the following sets.

- i. $P = \{\text{Anthurium, Rose, Jasmine}\}$
- ii. $Q = \{2, 4, 6, 8, 10\}$
- iii. $A = \{4\}$, $B = \{9, 16\}$

(7) Select the pair of equivalent set.

- i. $X = \{\text{Factors of 6}\}$
- ii. $Y = \{1, 2, 4, 8\}$
- iii. $Z = \{\text{Prime factors of 8}\}$

(8) Select the pair of equal sets out of the following sets.

- i. $A = \{\text{Digits of the number 43321}\}$
- ii. $B = \{\text{Digits of the number 34312}\}$
- iii. $C = \{\text{The multiples of 2 between 0 and 10}\}$

(9) Write all the subsets of each of the following sets.

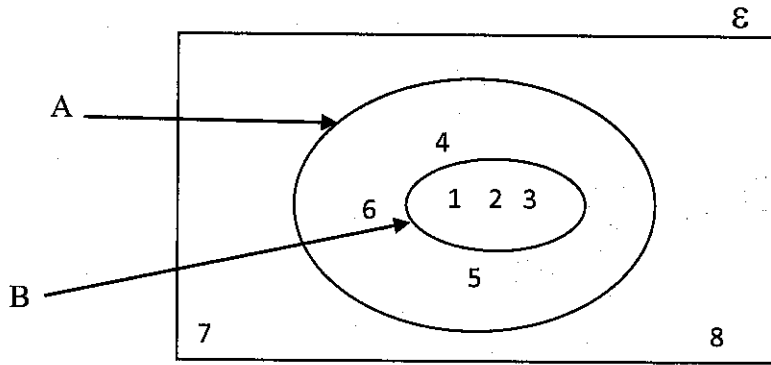
- i. $A = \{2\}$
- ii. $B = \{3, 5\}$
- iii. $A = \{R, S, M\}$
- iv. Write the relationship between the number of subsets and the cardinality of each set.
- v. Build up a general form for the number of subsets in which the cardinality is "n".

(10)

- i. Write the set, including common elements of the following sets.
 $P = \{2, 4, 6, 8, 10\}$
 $Q = \{1, 3, 6, 10\}$
- ii. Illustrate the data in Venn diagram and shade the set $P \cap Q$.

(11) Write the following sets using the Venn diagram.

- i. A
- ii. B
- iii. $A \cap B$
- iv. \mathcal{E}
- v. $n(A)$
- vi. $n(A \cap B)$

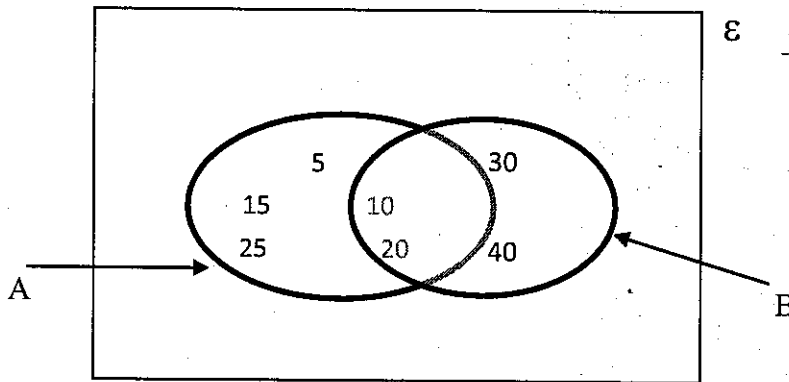


(12) $A = \{ 3, 6, 9, 12 \}$

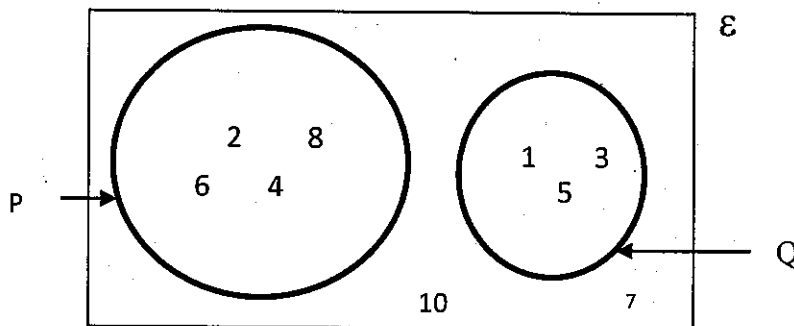
$B = \{ 2, 4, 6, 8, 10, 12 \}$

- i) Write the set including all the elements of the above two sets.
- ii) Represent it in a Venn diagram.

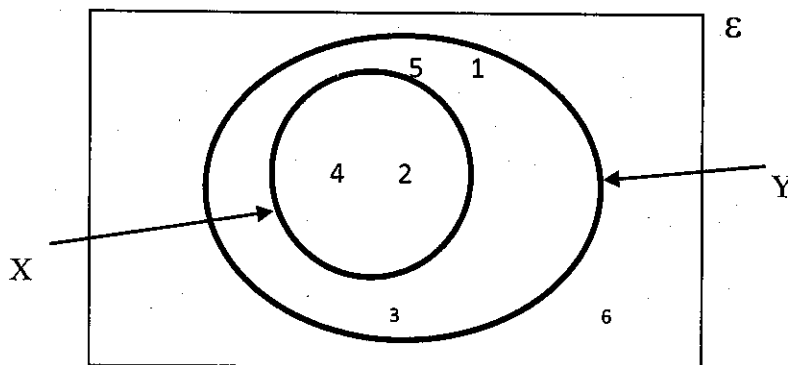
(13) Write the elements of the sets using each of the following Venn diagram.



- a) $A \cup B$
- b) $A \cap B$
- c) A



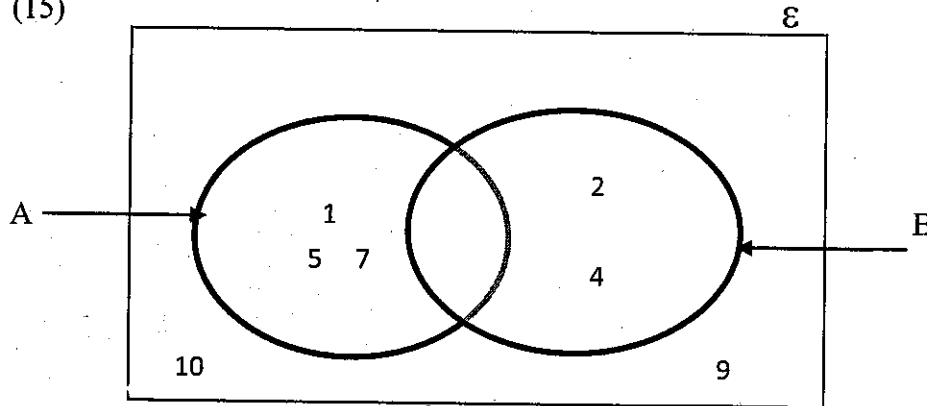
- a) $P \cup Q$
- b) $P \cap Q$
- c) E



- a) $X \cup Y$
- b) $X \cap Y$
- c) X

(14) Write the set A' , If $\epsilon = \{1,2,3,4,5,6,7,8,9,10\}$ and $A = \{2,4,6,8,10\}$.

(15)

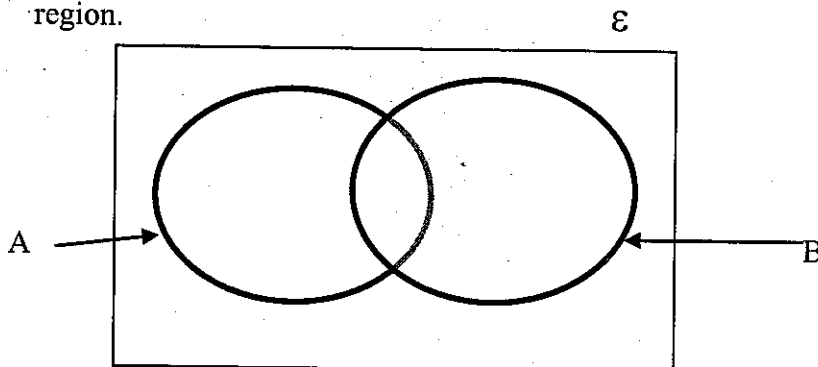


Write the elements of the following sets.

- | | | |
|---------|------------------|-----------------|
| a) A' | c) $(A \cap B)'$ | e) $A' \cap B$ |
| b) B' | d) $(A \cup B)'$ | f) $A' \cup B'$ |

(16)

i. Draw the Venn diagrams as shown in the diagram for each set and shade the relevant region.



- | | | | |
|---------------|---------|-----------------|------------------|
| a) $A \cap B$ | c) A' | e) $A' \cap B$ | g) $(A \cup B)'$ |
| b) $A \cup B$ | d) B' | f) $A' \cap B'$ | h) $(A \cap B)'$ |

ii. Shade the regions belong to each of the above set by drawing the Venn diagrams for the case $B \subset A$.

iii. Shade the regions belong to each of the above set by drawing the Venn diagrams for the case $A \cap B = \phi$.

(17) If $A = \{2,3,5,7,11\}$ and $B = \{1,2,3,4,5,6,7,8\}$

i. Write the elements of $A \cap B$ and $A \cup B$.

ii. Write $n(A)$, $n(B)$, $n(A \cap B)$, $n(A \cup B)$.

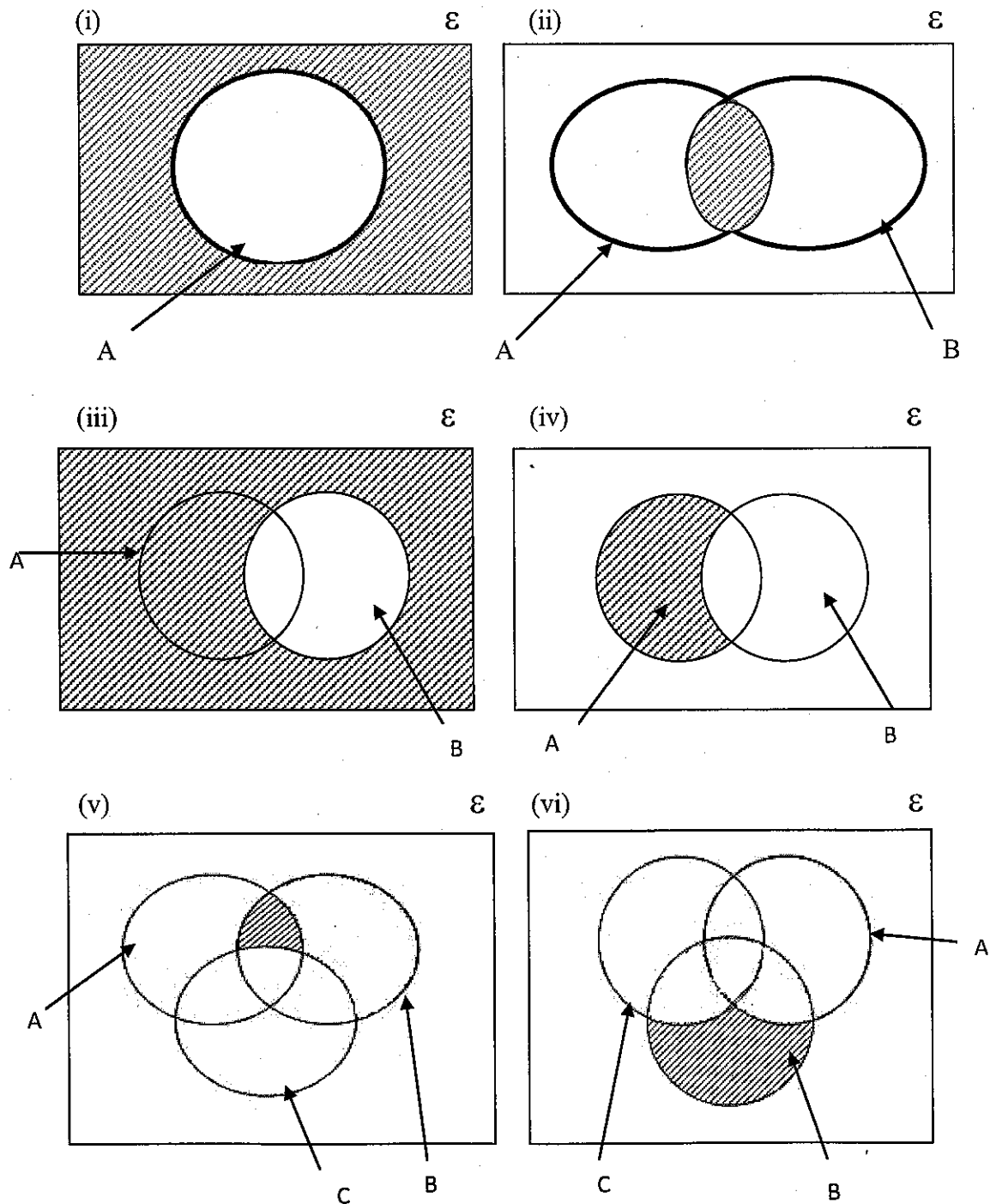
iii. Verify that $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ using the results in part (ii).

(18)

- i. Find $n(A \cup B)$ when $n(A) = 25$, $n(B) = 32$, $n(A \cap B) = 10$.
- ii. Find $n(P \cap Q)$ when $n(p) = 12$, $n(Q) = 19$, $n(P \cup Q) = 25$
- iii. Find $n(Y)$ when $n(X) = 20$, $n(X \cap Y) = 7$ and $n(X \cup Y) = 30$

(19) 28 students like football and 35 like volleyball out of 40. Find the number of students who like both games.

(20) Write the shaded regions in set notation.



(21) Given below is the information about 80 passengers in a bus, who can speak Sinhala, Tamil or English.

Number of passengers who can speak Sinhala = 50

Number of passengers who can speak Tamil = 43

Number of passengers who can speak Tamil only = 10

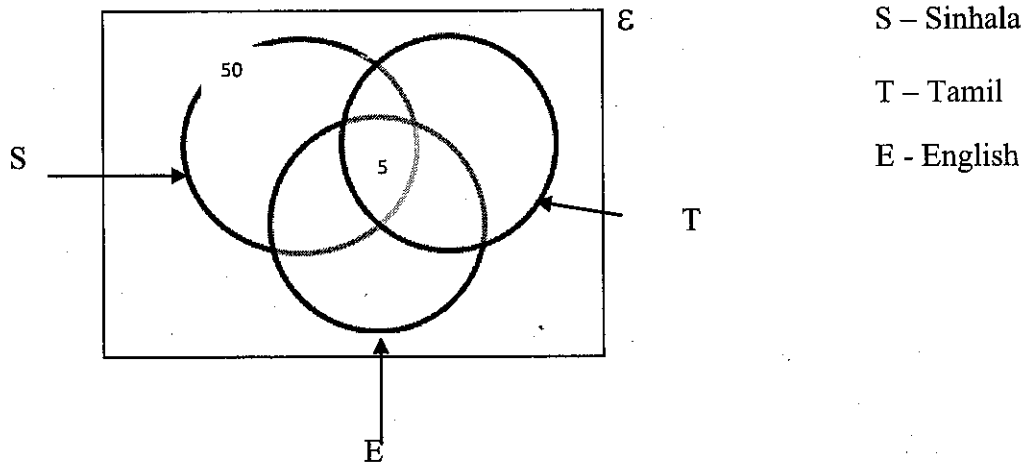
Number of passengers who can speak Sinhala and English = 20

Number of passengers who can speak Sinhala and Tamil = 25

Number of passengers who can speak all three languages = 5

Represent the data in the Venn diagram given below.

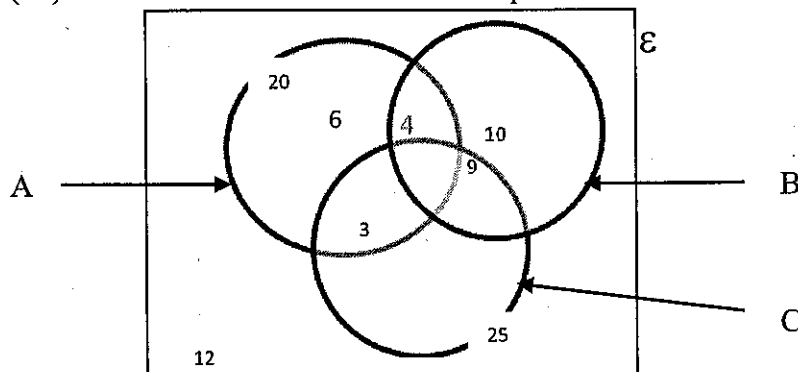
(Assume that all the passengers can speak at least one language)



Find following using the Venn diagram.

- i. Number of people who can speak Sinhala only.
- ii. Number of people who can speak English and Tamil only.
- iii. Number of people who can speak English only.
- iv. Number of people who can speak at least two languages.

(22) The cardinalities of the sets are represented in the following Venn diagram.



Find the following,

- i. $n(A \cap B \cap C)$
- ii. $n(B)$
- iii. $n\{(A \cup B) \cap C\}$
- iv. $n(\mathcal{E})$

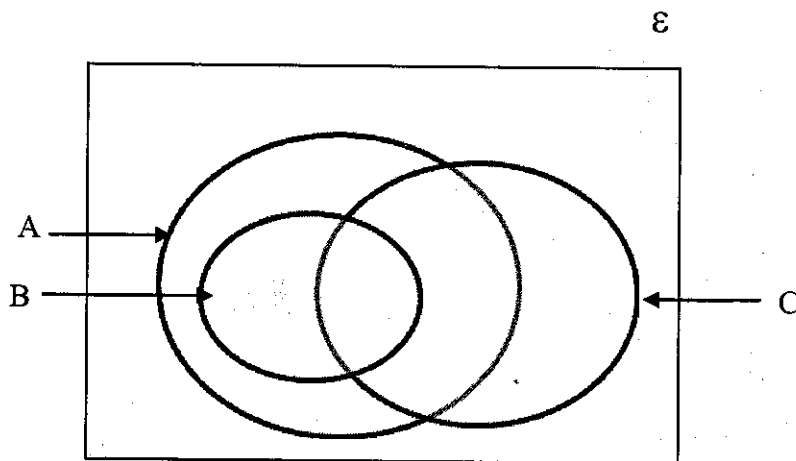
(23) $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$A = \{1, 3, 5, 7, 9\}$

$B = \{3, 9\}$

$C = \{2, 3, 5, 7\}$

Represent above data in the given Venn diagram.



Write following using the above information.

- i) $A \cap B \cap C$
- ii) $B \cap C$
- iii) $A \cap C$
- iv) The relationship between A and B
- v) The set $(A \cup B \cup C)^c$

PROBABILITY

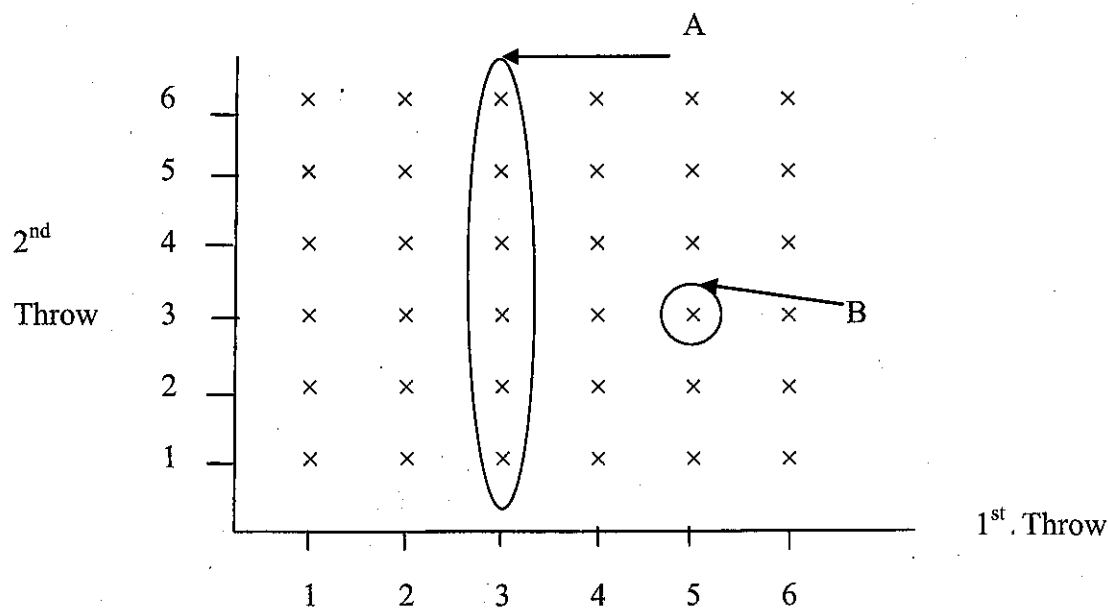
- (1) Write the set of all outcomes of the following events.
- Tossing an unbiased coin.
 - Rolling an unbiased cubical die numbered from 1 to 6.
 - Taking a card from a card pack of the same shape and the same size numbered 1 to 15.
 - Taking a pen from a bag having 3 red pens and 4 blue pens of the same size and same shape.
- (2) Mark the numbers which touch the horizontal plane, when a regular tetrahedron die numbered 1 to 4 is rolled.
- Write all the elements of 'S', if the sample space is denoted by 'S'.
 - Write all the sub-sets of 'S'.
 - Write the sub sets that can't be separated further out of the above.
 - What is the name of the above sub sets mentioned in (iii)?
 - What is the name of the remaining subsets other than the part (iii)?
 - Can any compound event be written as the union of simple events?
- (3) Answer the following when taking a card at random out of a card pack numbered 1 to 10.
- Write the sample space.
 - Write the elements of set 'A', if the event of getting a prime number is 'A'.
 - Write the elements of set 'B', if the event of getting a composite number is 'B'. Find $P(A \cap B)$.
 - Are the sets 'A' and 'B' mutually exclusive or not. Give reasons.
- (4) There are ten identical balls numbered from 0 to 9 for drawing of a lottery.

Write following when selecting a number randomly.

- All the elements of 'S' if the sample space is 'S'.
- $n(S)$.
- Elements of set 'E', if the event of getting an even number is 'E'.
- $n(E)$
- Find $P(E)$, if the probability of getting an even number is
$$P(E) = \frac{n(E)}{n(S)}$$
- Find $P(G)$, If the event of getting a prime number is 'G'.

- (5) Write the sample space of the following instances and mark it on a Cartesian plane.
- Tossing an unbiased coin only once.
 - Rolling an unbiased cubical shaped die numbered 1 to 6 once.
 - There are 2 orange flavored toffees and 3 tamarind flavored toffees having same size and same shape in a box. Taking out of a toffee randomly.
- (6) Answer the following for the event of tossing unbiased one rupee coin and two rupee coin at once.
- Write the sample space as ordered pairs.
 - Indicate the sample space graphically.
 - Encircle the event of both coins getting the 'Tail' according to the graph.
 - Draw a square around the event of getting the head of one rupee coin.
- (7) Answer following for the event of rolling a cubical die numbered 1 to 6 once.
- Write the sample space.
 - Indicate the sample space graphically.
 - The event obtaining 2 of the die and head of the coin is 'A', Mark that event on the graph and find $P(A)$.
 - The event obtaining 6 of the die is 'B'. Mark this event on the graph and find $P(B)$.
 - Find $P(C)$ if 'C' is the event of obtaining the tail of the coin.

- (8) A cubical die numbered 1 to 6 is thrown twice. The sample space of it is given in the Cartesian plane (The point 'A' shows the event of getting 3 in the first throw.)

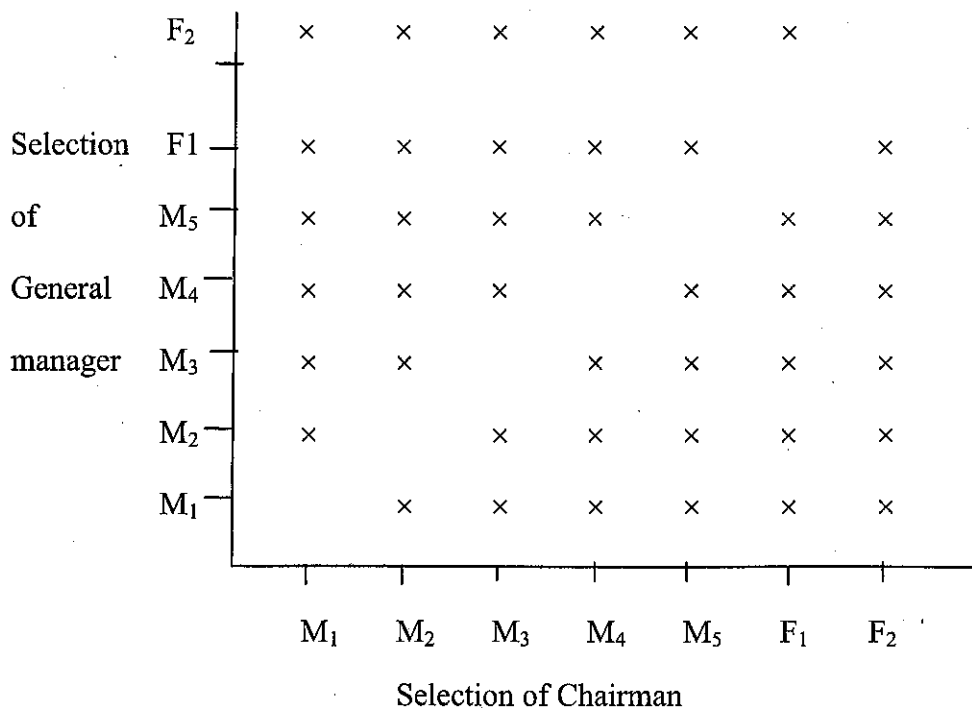


- i. What is the event denoted by 'B'.
- ii. Mark the point of event getting 1 of the 1st throw and it as 'C'. Find the value of P(C).
- iii. Name the event of getting the same value in both throws as 'D' and find P(D).
- iv. How many points are likely to get even numbers in both throws?

(9) A bag contains 3 red erasers and 2 green erasers of the same size. An eraser is taken out from the bag randomly. After observing the colour, another eraser is taken out replacing the former and its colour is observed.

- i. Denote the sample space in a Cartesian plane.
- ii. Mark the event 'A' on the graph and find P(A), if 'A' is the event of getting red eraser in both times.
- iii. Mark the event 'B' on the graph and find P(B), if 'B' is the event of getting same colour eraser in both times.
- iv. Mark the event 'C' on the graph and find P(C), if 'C' is the event of getting green colour eraser first and red colour eraser second.

(10) There are 5 male members and 2 female members in a board of directors of certain cooperation. The following graph is represented the way of selecting a male or female Chairman and General Manager out of them.



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- i. Mark the event that the Chairman and the General Manager being a male as 'A'.
- ii. Calculate the value of $P(A)$.
- iii. Mark the event that the Chairman is being a male and the General Manager being a female as 'B'.
- iv. Calculate the value of $P(B)$.
- v. Mark the event that the Chairman is being a female and General Manager being a female as 'C'.
- vi. Calculate the value of $P(C)$.

(11) A flower bed has 4 white flowers, 3 yellow flowers and 2 red flowers. A butterfly and a bee suck nectar from flowers. Assume that the butterfly and bee do not lie on same flower at once.

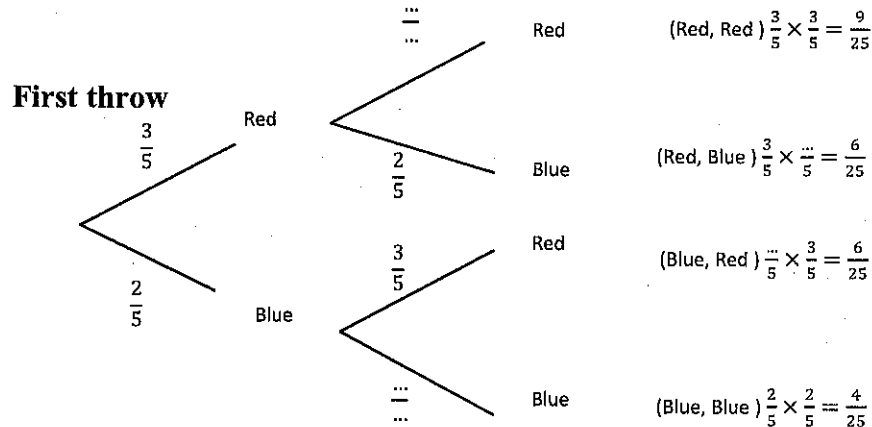
- i. Draw the graph of the sample space.
- ii. Find the probability of the event that the butterfly and the bee lie on a white flower.
- iii. Find the probability of the event that both insects lie on a flower of same colour.
- iv. Find the probability of the event that two insects lie on a flower of different colours.
- v. Find the probability of the event that the bee lies on a yellow flower and the butterfly lies on another flower with a different colour.

(12)

- i. Draw a tree diagram to show the results, when tossing a coin once.
- ii. What is the probability of obtaining head?
- iii. What is the probability of obtaining tail?
- iv. Extend the above tree diagram for tossing the coin twice.
- v. Find the probability of obtaining the head in both times using the tree diagram in part (iv).

- (13) There are 3 identical red balls and 2 identical blue balls in a box. A ball is taken out from the box randomly. After observing the colour another ball is taken replacing the former.

Following incomplete tree diagram shows the above data.



- Fill in the blanks of the tree diagram.
- Find the probability of obtaining a red ball in both instances.
- Find the probability of obtaining a red ball first and a blue ball second.

- (14) There are 5 black pens and 3 blue identical pens in a bag. Pen is taken out of the bag randomly. After observing the colour of the pen another pen is taken out from the bag with replacing.

- Represent the above data in a tree diagram.
- Find the probability of the event of obtaining a blue pen at both instances.
- Find the probability of the event of obtaining a red pen at least once.

- (15) There are four apples and 3 oranges of the same size in a box. A fruit is taken out of the box randomly. After observing it without replacement, another fruit is taken out from the box.

- Represent the above data in a tree diagram.
- Find the probability of an event of obtaining an apple at two instances.
- Find the probability of an event of obtaining an orange at first and an apple at second.

(16) The probability of passing Mathematics in G.C.E.(O/L) examination of Ravi and Anusha are $\frac{7}{10}$ and $\frac{4}{10}$ respectively.

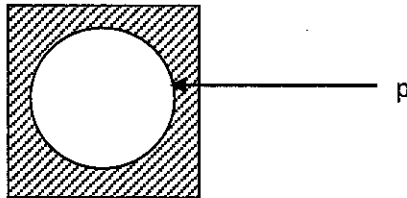
- i. Represent the above data in a tree diagram.
- ii. Find the probability of the event that Ravi does not pass.
- iii. Find the probability of both of them passing the exam.
- iv. Find the probability of passing Anusha and not passing Ravi.

(17)

1. Find $n(A)$ of the set 'A'

$$A = \{2, 4, 6, 8, 10\}$$

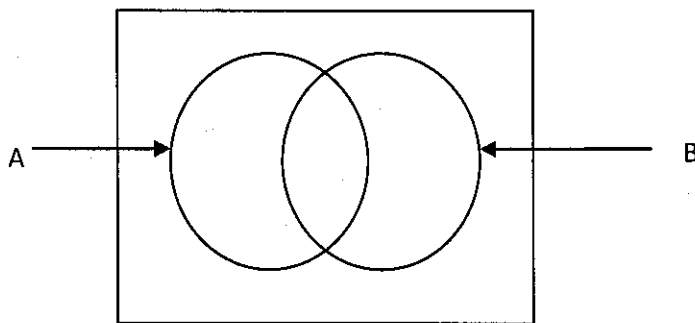
2. Write the shaded region in set notation.



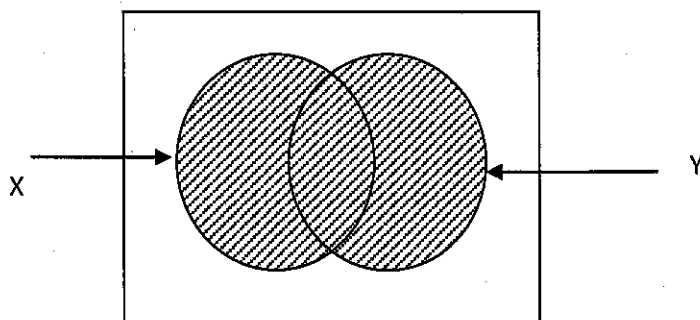
3. $R = \{\text{Multiples of 5 between 10 and 20}\}$

Write the elements.

4. Shade the region $A \cap B$.



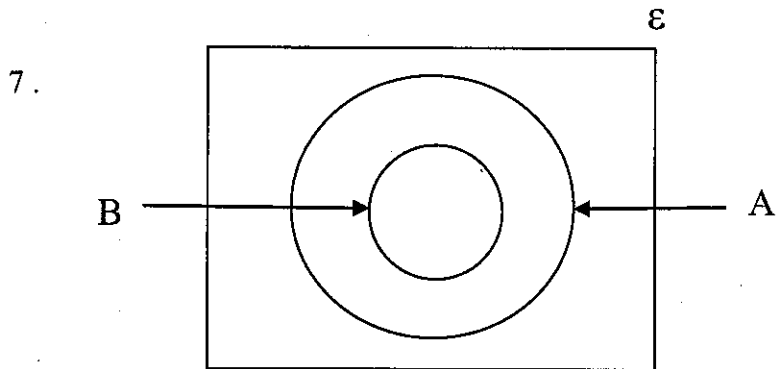
5. Write the shaded region in set notation



6. $\varepsilon = \{1,2,3,4,5,6,7,8,9\}$

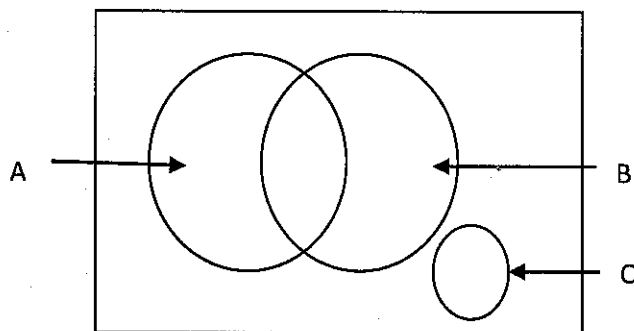
If $C = \{1,2,3,4,5\}$

Write the set C^c



$B \dots A$ Fill in the blanks.

8. Name a pair of disjoint set.



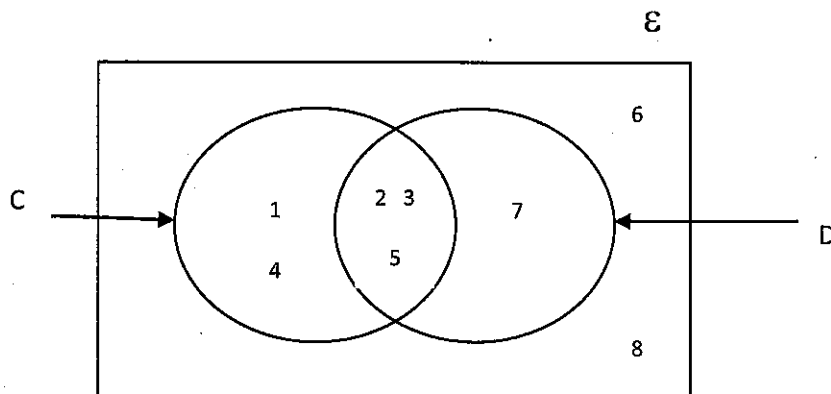
9. Find the probability of Sandun's birthday being Friday or Sunday.

10. Write the sample space of the event of rolling a fair die numbered 1 to 6.

11. Write following according to the Venn diagram given below.

i. $C \cap D$

ii. set C

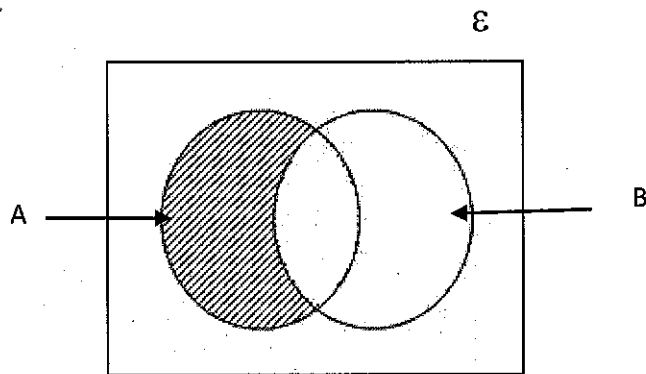


12. Find $n(A \cup B)$, when $n(A) = 25$, $n(B) = 30$ and $n(A \cap B) = 10$.

13. $D = \{x : x \text{ is a whole number, } 0 < x \leq 5\}$

- i. Write the set D with elements.
- ii. Find $n(D)$.

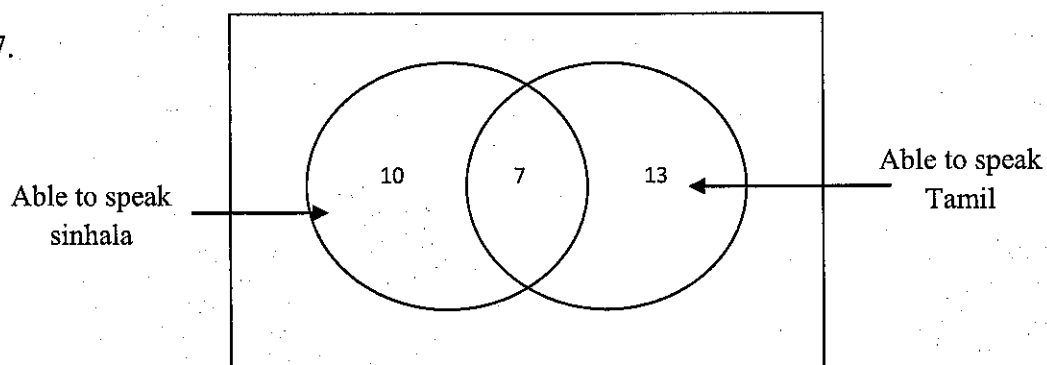
14. Write the shaded region in set notation.



15. There are 20 mangoes in a box. Five mangoes are raw and 3 mangoes are rotten. Remainder is ripe. Find the probability of the event of obtaining a ripe mango, when one mango is taken out randomly.

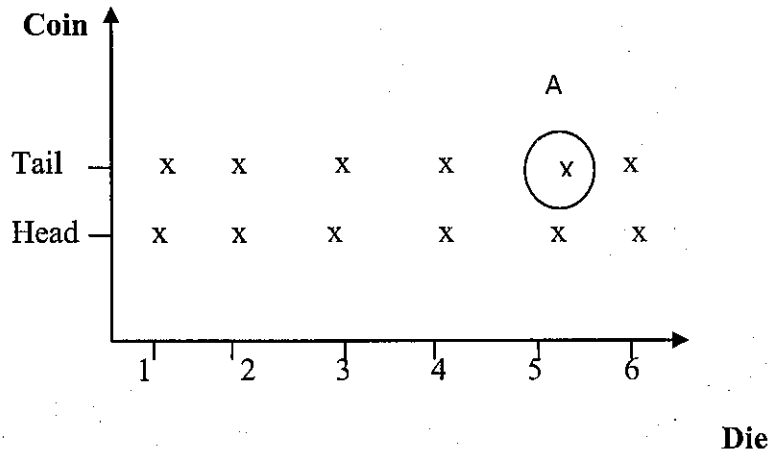
16. A cubical fair die and a fair coin are thrown at once. Find the probability of obtaining a prime number of the die and head of the coin.

17.



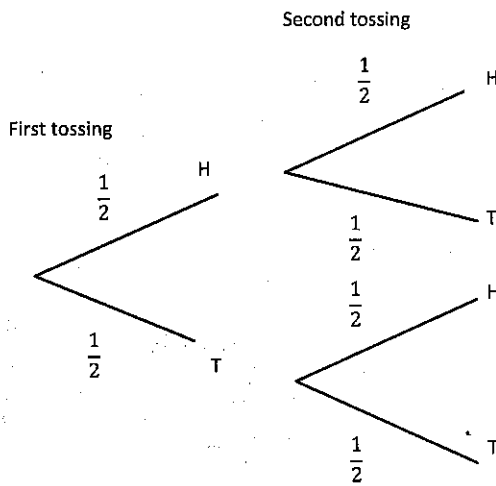
Find the probability of being a person who can speak both languages.

18.



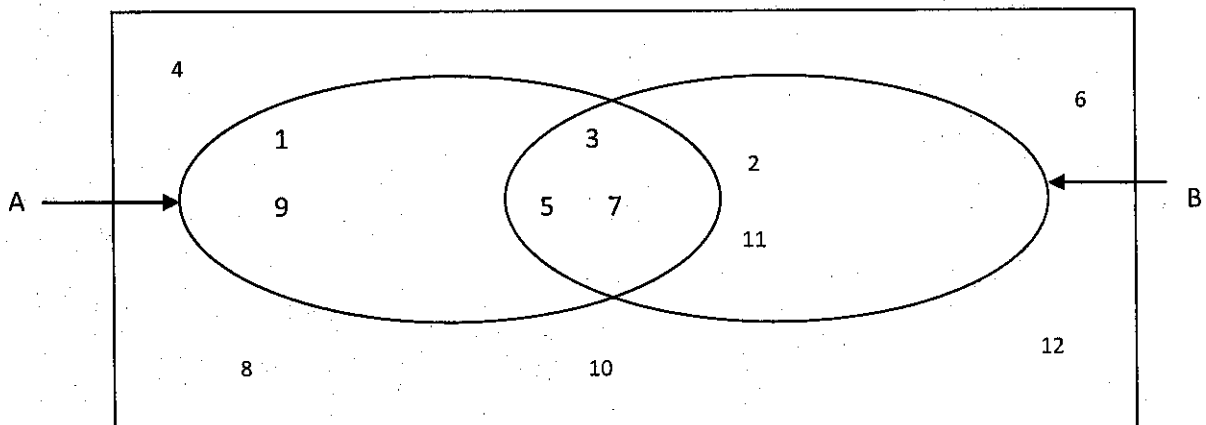
Describe the event indicated by "A"

19.



Find the probability of the event of obtaining the head first and tail second, according to the above tree diagram.

20.



Find the probability of the event that a number is taken out randomly out of the numbers given in the universal set belonging to both A and B.

21.

- i. The number of lottery tickets sold during several days is represented in the following stem and leaf diagram.

| Stem | Leaf |
|------|------------|
| 16 | 0, 5 |
| 18 | 1, 1, 4, 7 |
| 20 | 0, 2, 2, 4 |

Write the largest number indicated by the stem and leaf diagram.

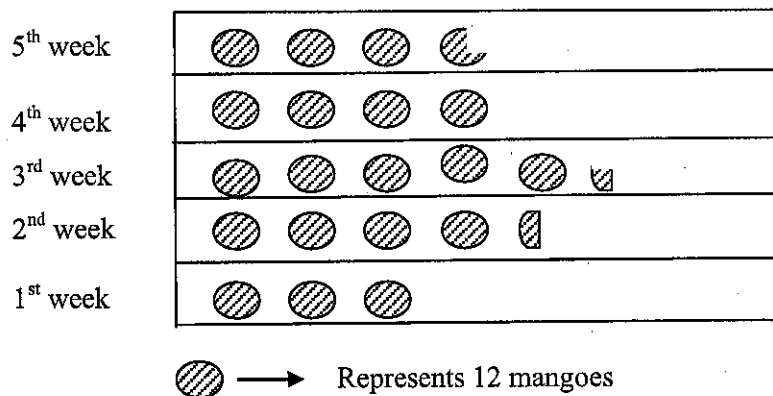
- ii. Indicate 13 by tally marks.
- iii. Find the mode. 4, 2, 8, 6, 7, 6, 9, 6, 10
- iv. What is the representative value denoted by 9 in the following data distribution.
2, 2, 3, 4, 7, 7, 7, 9, 9, 9, 9, 10
- v. Find the median of the distribution. 14, 27, 42, 47, 56, 65, 73
- vi. Find the median of the distribution. 28, 52, 14, 63, 16, 57, 40, 35
- vii. Find the value of 'x', of the distribution 0, 4, 5, x, 8, 9, 10 when the mean of the distribution is 6.
- viii. The mean of the weight of three children is 42 kg. Find the total weight of all children if another child whose weight is 46 kg joined the group.
- ix. The mean weight of tea leaves brought by 3 farmers to a collecting centre is 32 kg. Find the mean weight of tea leaves brought by all 5 farmers when weights of tea leaves brought by another two farmers are 19 kg and 40 kg.

- x. 3, 3, $\textcircled{5}$, 6, 8, 9, 12, 14, 19, 20, 24
- \uparrow
- $\textcircled{Q_1}$

- a. Find Q_3 of this distribution, when Q_1 is 5.
- b. Find the Inter Quartile Range (IQR)

STATISTICS

- 1) The pictograph given below illustrates the number of mangoes brought to the fair weekly by Sunil.



- In which week was the highest number of mangoes were brought to the fair.
 - How many mangoes were brought in the 4th week?
 - How many mangoes were less in the 5th week than the 4th week?
 - Calculate the total number of mangoes brought to the fair by Sunil.
- 2) The table given below shows the food items sold in a school canteen on a certain Monday.

| Food item | Pattis | Wade | Buns | Plantains | Rotti | Hoppers |
|----------------------|--------|------|------|-----------|-------|---------|
| Number of items sold | 20 | 25 | 05 | 08 | 14 | 15 |

- Represent the above data in a bar graph.
- Which is the item with the least number of sales?
- Find the amount of money obtained by selling 'wade', if the cost of a 'wade' is Rs.8.50.
- Calculate the percentage of the hoppers sold out of the total number of foods sold.

3) Scores obtained by a player for 20 tournaments are given below.

15, 08, 28, 33, 14, 0, 62, 53, 48, 16, 06, 38, 33, 26, 12, 25, 40, 56, 04, 29

i. Complete the following stem and leaf diagram using above data.

| Stem | Leaf |
|------|------------|
| 0 | 0, 4, 6, 8 |
| 1 | ..... |
| 2 | ..... |
| | |
| .... | 0 |
| | |
| 6 | 2 |

- ii. What is the range of the scores obtained by the player?
- iii. What is the most frequently obtained score?
- iv. Find the number of tournaments that the player obtained more than 25 scores.

4) Following stem and leaf diagram shows the data about the temperature of days in the month of July.

| Stem | Leaf |
|------|---|
| 5 | 6 |
| 6 | 1. 3. 4. 4. 4. 4. 6. 8. 8. 8. 9. 9 |
| 7 | 0. 0. 0. 0. 2. 2. 2. 3. 3. 3. 3. 7. 7. 9. 9 |
| 8 | 1. 1 |
| 9 | 4 |

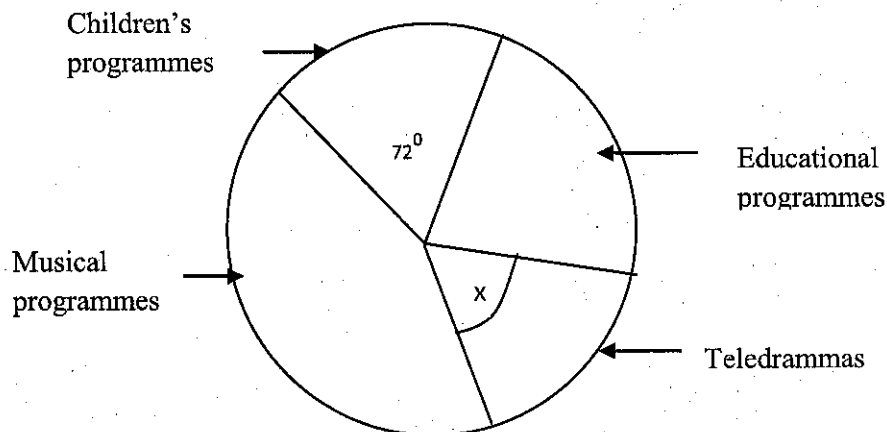
Find the following.

- i. The median temperature.
- ii. The first quartile and the third quartile.
- iii. The Inter Quartile Range.

- 5) The total number of registered voters of a certain Provincial council is 800,000. 90% of the voters were cast and the number of votes received by each party (to the nearest 10,000) is given below.

| Party | Number of votes (to the nearest 10,000) | Angle of the sector | Angle |
|-------|--|--------------------------------------|-------------|
| A | 400,000 | $\frac{400,000}{720,000} \times 360$ | 200° |
| B | 150,000 | | |
| C | 80,000 | | |
| D | 60,000 | | |
| E | 30,000 | | |

- Complete the table.
 - Represent above data in a pie chart.
 - Find the number of votes not cast.
 - Find the number of votes received by the winning party.
 - Find the percentage of votes received by the winning party out of cast votes.
- 6) The pie chart given below shows the type of television programmes watched by a group of 60 students.
- 'x' number of students of the group like to watch teledramas and twice of that like to watch children's programmes. The number of students who like to watch educational programmes is twice of the number of students who like to watch children programmes. Rest of the students in the group likes to watch musical programmes.



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- i. What is the magnitude of the angle of the sector which represents children's programmes.
- ii. How many students like to watch musical programmes.
- iii. Four times of students who like to watch teledramas prefer children's programmes. Express the ratio of students who like to watch children's programme and who like to watch educational programme in the simplest form.

- 7) The Table given below represents the information about the weights of a group of children in a medical clinic.

| Weight (to nearest <i>kg</i>) | 5-7 | 7-9 | 9-11 | 11-13 | 13-15 |
|-----------------------------------|-----|-----|------|-------|-------|
| Number of Children | 4 | 10 | 12 | 5 | 1 |

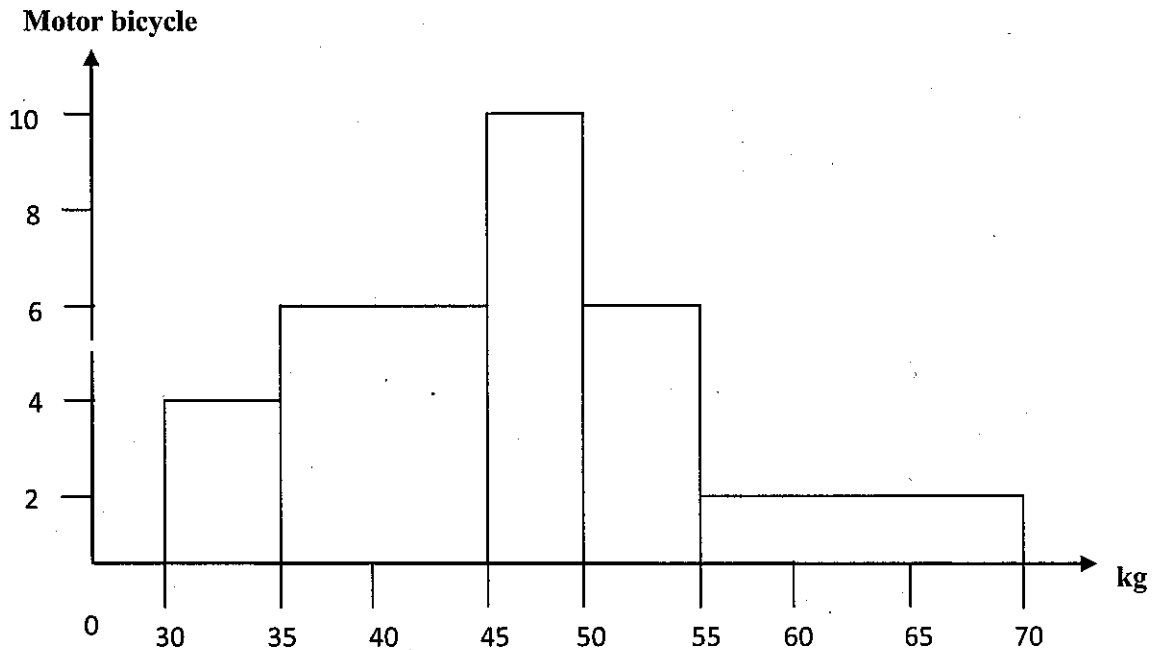
- i. Draw a histogram to represent the above information.
- ii. What is the class interval having the highest number of students.
- iii. Find the total number of students came to the clinic.
- iv. Express the number of students whose weight is greater than 11 *kg* as a fraction.

- 8) The table given below shows the information of daily collection of milk. (to the nearest litre)

| Number of litres (Class- Interval) | 0-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 |
|---------------------------------------|-----|-----|-----|-----|-----|-----|
| Frequency (Number of cows) | 15 | 10 | 20 | 18 | 12 | 05 |

- i. Draw a frequency polygon using histogram.
- ii. Sarath states that the histogram and the frequency polygon are equal in area. Verify the above statement.

- 9) The histogram given below represents the distance that a motor bicycle can travel per litre of fuel.



- How many motor bicycles travel with a speed of 35-45 km.
 - How many motor bicycles travel the minimum distance per litre.
 - How many motor bicycles were used for the experiment?
 - Draw a frequency polygon using the information given in the above histogram.
 - What can you say about the area of the histogram and the frequency polygon?
- 10) The time taken by each competitor of 'Parakum Vidyalaya' to complete the "marathon" in the inter house sports meet, is given in the following table.

| Time (minutes) | $25 \leq t < 30$ | $30 \leq t < 35$ | $35 \leq t < 40$ | $35 \leq t < 50$ | $50 \leq t < 65$ |
|-----------------------|------------------|------------------|------------------|------------------|------------------|
| Number of Competitors | 04 | 12 | 8 | 4 | 3 |

- Prepare a table using the mid value of each class interval to draw a frequency polygon.
- Draw a frequency Polygon using the mid values.

11) Following table shows the time taken to produce an ornament by the workers in a factory.

| | | | | | | |
|--------------------------|----|----|----|----|----|----|
| Time (minutes) | 10 | 20 | 30 | 40 | 50 | 60 |
| Number of workers | 1 | 3 | 11 | 8 | 5 | 2 |

- i. Represent above data in a cumulative frequency table.
- ii. Draw the cumulative frequency curve.
- iii. Find the lowest time taken by 25% of workers using the cumulative frequency table.
- iv. Find the time taken by 75% of the workers using the cumulative frequency table as (iii).
- v. Find the Inter Quartile Range using (iii) and (iv).

12) The table given below shows the number of packets of milk sold by a merchant during 2 months.

| Number of packets of milk sold per day | Number of days (f) | $f x$ |
|---|--|-------------------------|
| 12 | 3 | 36 |
| 13 | 6 | 78 |
| 14 | 10 | 140 |
| 15 | ..... | 240 |
| 16 | 11 | 176 |
| 17 | 9 | ..... |
| 18 | 4 | 72 |
| | 60 | ..... |

- i. Complete the table.
- ii. Find the mode of the above data distribution.
- iii. Calculate the median.
- iv. Calculate the mean value of the number of packets sold per day.
- v. Estimate the number of packet of milk needed for two weeks.

13) Following table shows the numbers of mistakes observed before proof reading at printing a book.

| Mistakes in a page | Number of pages (f) | Deviation (d) | f d |
|--------------------|---------------------|---------------|------|
| 5 | 12 | -3 | -36 |
| 6 | 18 | -2 | -27 |
| 7 | 27 | -1 | .... |
| 8 | 35 | 0 | 0 |
| 9 | 30 | 1 | 30 |
| 10 | 16 | 2 | 32 |
| 11 | ..... | 3 | 24 |
| 12 | 4 | 4 | 16 |
| | | | |

- i. How many pages were there in the book?
- ii. Complete the above table.
- iii. Calculate the mean of the number of mistakes to the nearest whole number.
- iv. Calculate the probability of the number of mistakes being less than 7, when a page is selected randomly.

14) Information collected form a "Ranaviru" housing scheme about the consumption of electricity by each house during a certain month is shown in the table below.

| Number of unit of electricity | number of houses (f) | Mid value (x) | f x |
|-------------------------------|----------------------|---------------|---------------|
| 0-10 | 2 | 5 | 10 |
| 10-20 | 5 | 15 | 75 |
| 20-30 | 8 | - | 200 |
| 30-40 | 10 | 35 | 350 |
| 40-50 | 7 | 45 | 315 |
| 50-60 | 4 | 55 | 200 |
| 60-70 | 3 | 65 | - |
| 70-80 | 1 | 75 | 75 |
| | $\Sigma f =$ | | $\Sigma fx =$ |

- i. What is the maximum number of units consumed by a house?
- ii. What is the modal class of the above distribution
- iii. Complete the above table.
- iv. Calculate the mean of the number of units of the above distribution.
- v. Calculate the average electricity bill of a house, if charge per unit is Rs.3.50 and service charge is Rs 50.00.

15) Following table shows the number of rubber sheets brought by producers to a certain collecting centre in a day.

| Number of Rubber sheets | 30-45 | 46-61 | 62-77 | 78-93 | 94-109 | 110-125 | 126-141 | 142-157 |
|--------------------------------|--------------|--------------|--------------|--------------|---------------|----------------|----------------|----------------|
| Number of Producers | 3 | 15 | 18 | 25 | 22 | 10 | 5 | 2 |

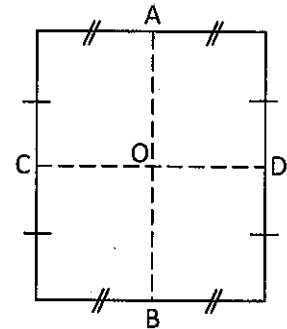
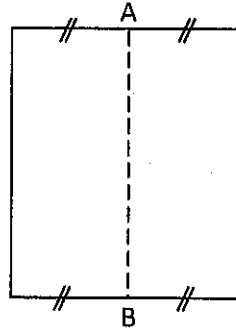
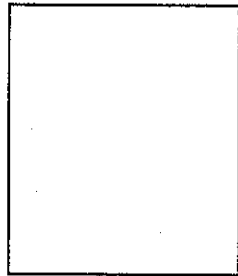
- i. What is the median class of this distribution?
- ii. Calculate the mean of the number of rubber sheets, by taking the mid value of the median class as the assumed mean.
- iii. Find the total weight of the rubber sheets brought to the collecting centre in kilograms, if the average weight of a sheet is 400 g.
- iv. Calculate the total amount of money needed to buy rubber sheets collected to the centre within a day, if 1 kg of rubber sheet is Rs.160.

GEOMETRY

Geometry and Geometrical Constructions

Basic Theorems

01.



Fold a paper as shown in the above diagrams. Mark the folded lines.

- a) Measure the angles at the point O.
- b) Fill in the blanks.

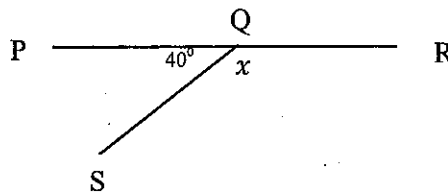
$$\widehat{AOC} + \widehat{AOD} = \dots\dots\dots$$

$$\widehat{DOB} + \widehat{COB} = \dots\dots\dots$$

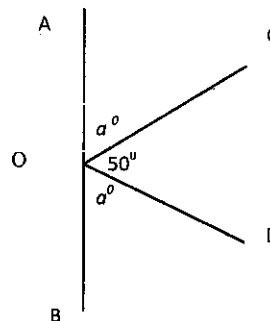
$$\widehat{AOC} + \widehat{AOD} + \widehat{DOB} + \widehat{COB} = \dots\dots\dots$$

- c) Find the following.
 - The sum of the adjacent angles on a straight line =
 - The sum of the angles at a point =

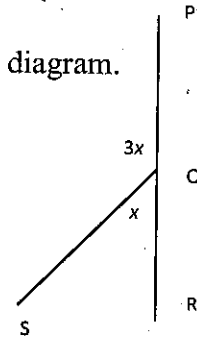
02. Find the value of 'x'.



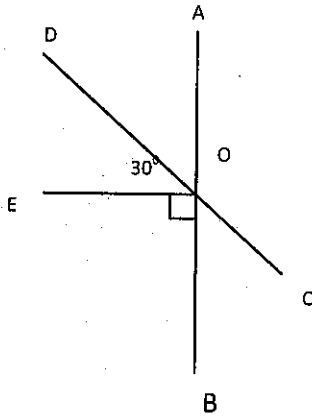
03. AOB is a straight line. Find the value of 'a'.



04. a) Form an equation according to the data given in the diagram.
 b) Find the value of 'x'.
 c) Find the magnitudes of \widehat{SQP} and \widehat{SQR} .



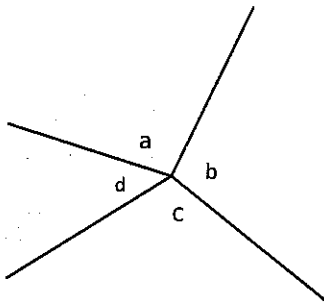
05.



AOB and COD are straight lines.

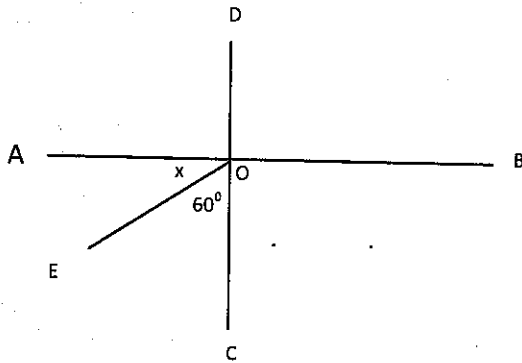
- a) Find the magnitudes of \widehat{BOC} and \widehat{AOD} .
 b) Write the relationship between \widehat{BOC} and \widehat{AOD}

06.

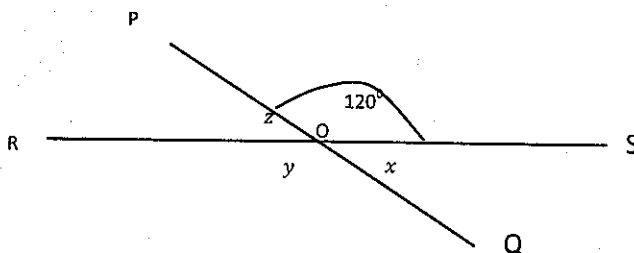


Find the value of $a + b + c + d$

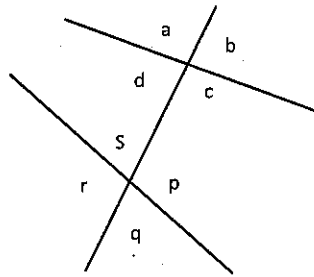
07. AOB and DOC are straight lines. Find the value of x .



08. Find the values of x, y and z .



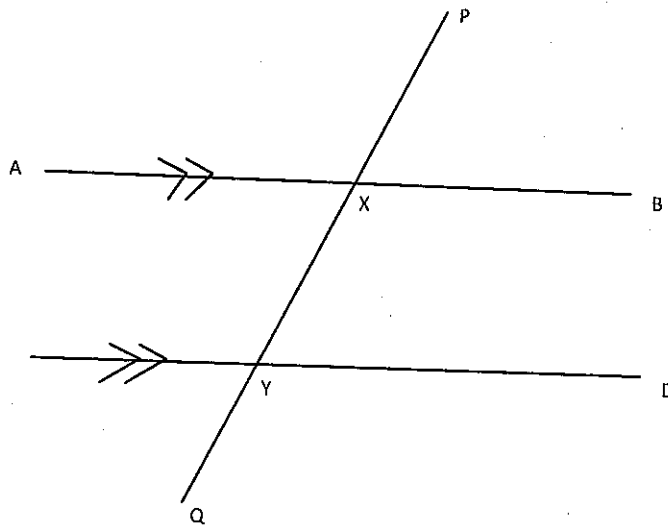
09.



Name the pairs of,

- a) corresponding angles.
- b) alternate angles.
- c) allied angles.

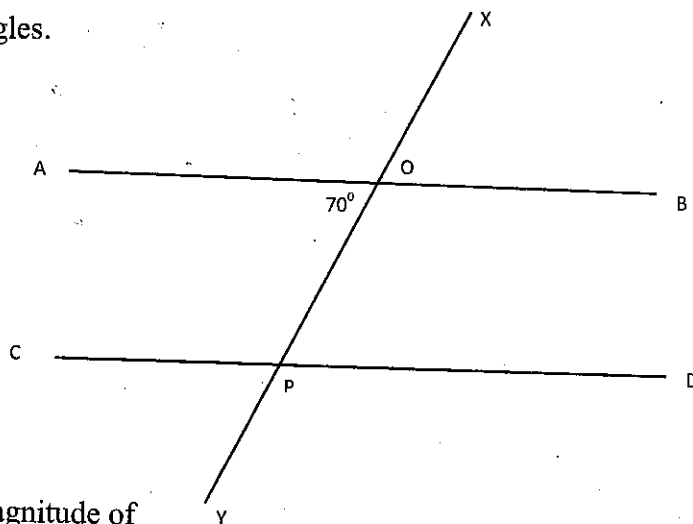
10.



AB // CD

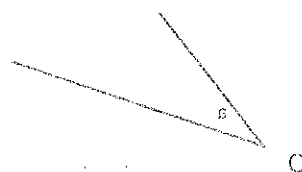
- a) Name the pairs of alternate angles and corresponding angles and write the relationship between them. (Write reasons)
- b) Name the pairs of allied angles and write the relationship between these angles.

11.

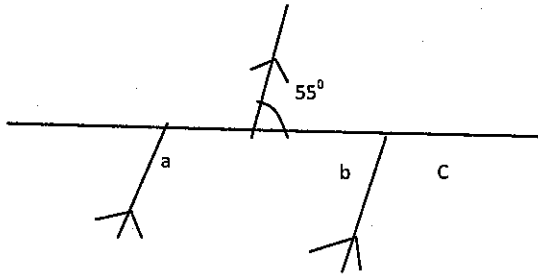


Find the magnitude of

- i. $\angle OPD$
- ii. $\angle CPO$
- iii. $\angle CPY$

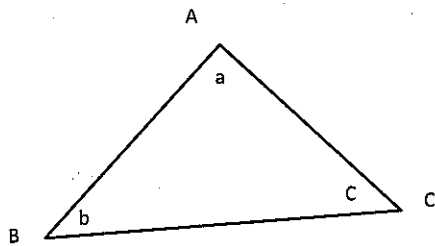


12. Find the values of a , b and c .



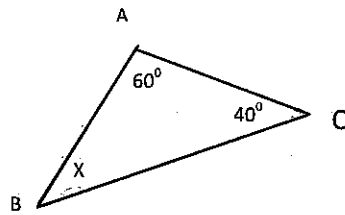
13. a) Draw any triangle and measure the magnitudes of the interior angles.

b)



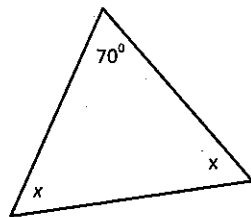
$$a + b + c = \dots\dots\dots$$

c) The sum of the interior angles of any triangle = $\dots\dots\dots$ right angles.



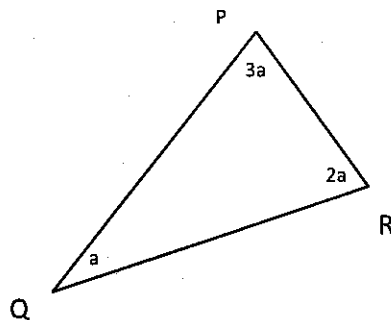
Find the value of 'x'.

d)



Find the value of 'x'.

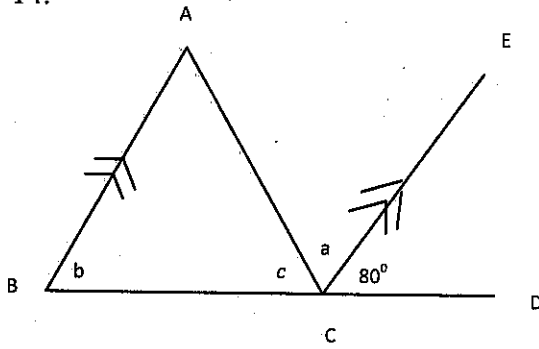
e)



i) Form an equation in terms of a .

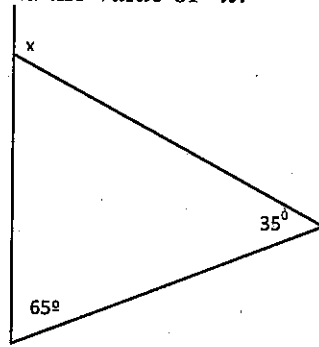
ii) Find the value of a .

14.

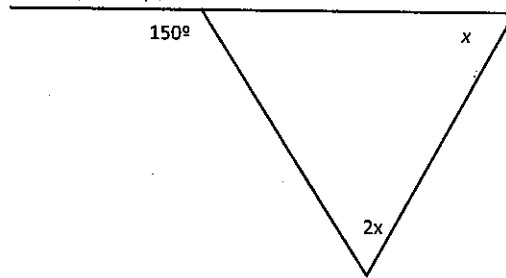


- i. Find the values of a , b and c .
- ii. $\hat{A}BC + \hat{B}AC = \dots\dots\dots$
- iii. $\hat{A}CD = \dots\dots\dots$
- iv. What is the relationship between (ii) and (iii).

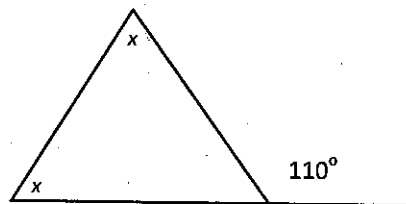
15. a) Find the value of x .



b) Find the value of x .

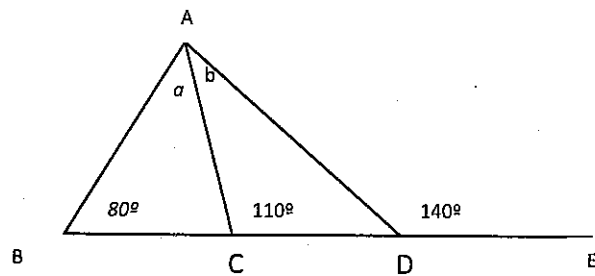


c)



- i. Formulate an equation according to the data shown in the diagram.
- ii. Find the value of x .

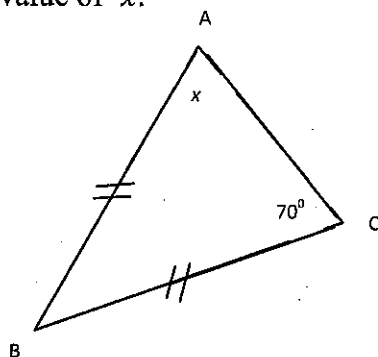
d)



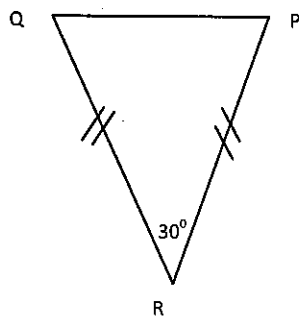
i) Find the value of 'b' considering the triangle ACD.

ii) Find the value of 'a'.

16. a) Find the value of x .

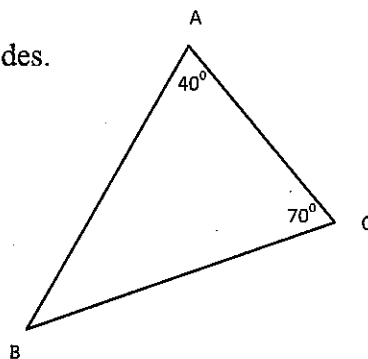


b) Find the magnitude of \widehat{RPQ} .

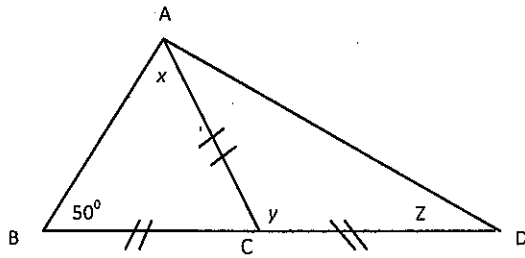


c) i) Find the magnitude of \widehat{ABC} .

ii) Name a pair of equal sides.

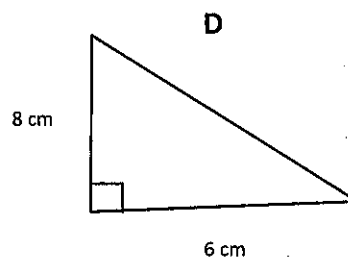
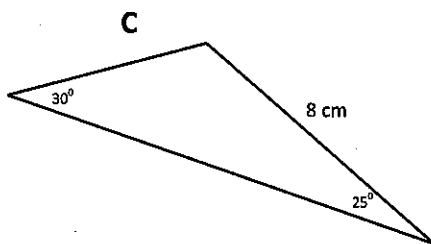
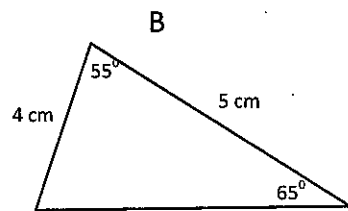
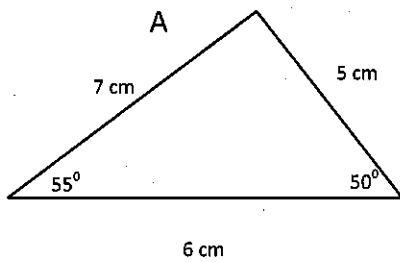


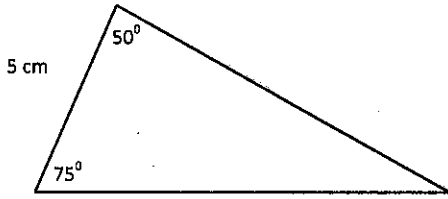
17. a) Find the value of x , y and z .



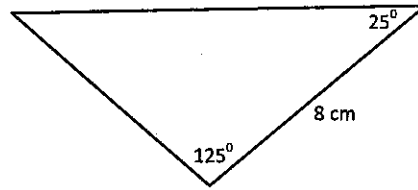
18. How many components are there in a triangle? Name these components?

19. Following are some triangles congruent to the triangles A, B, C and D. Select the congruent triangles out of them and write the case of congruency.

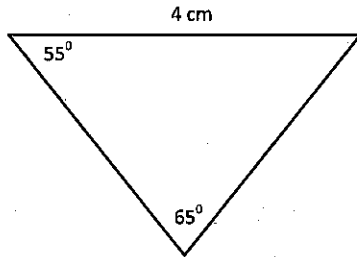




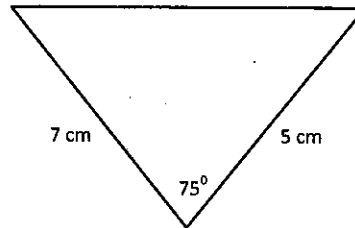
(i)



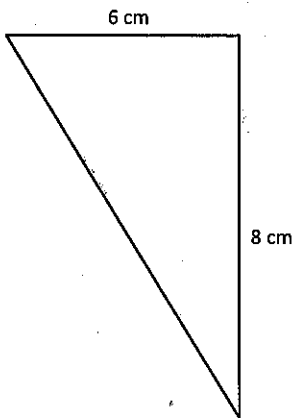
(ii)



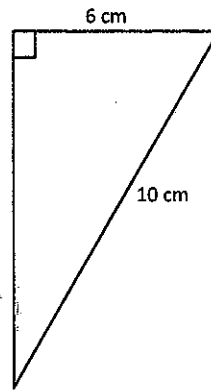
(iii)



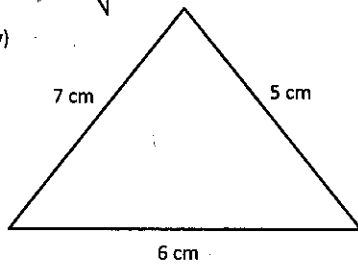
(iv)



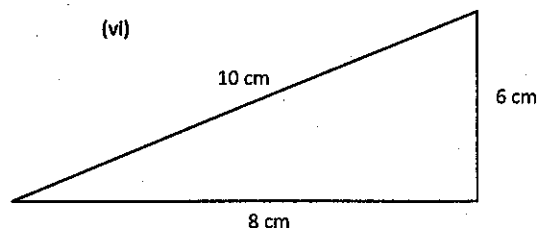
(v)



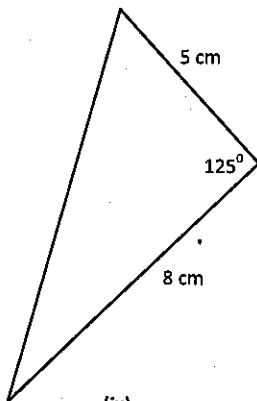
(vi)



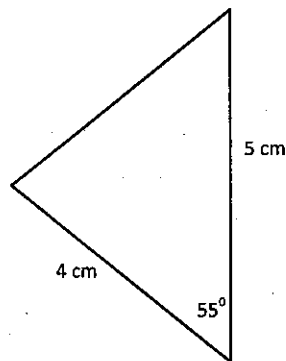
(vii)



(viii)

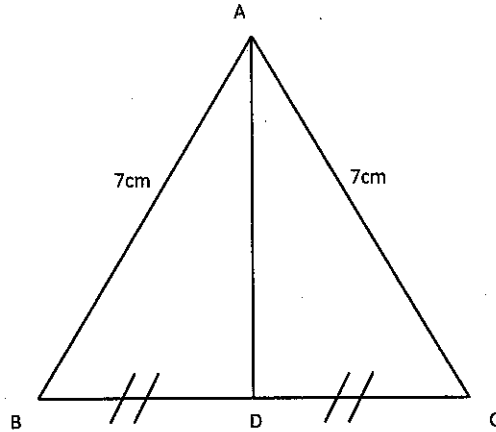


(ix)



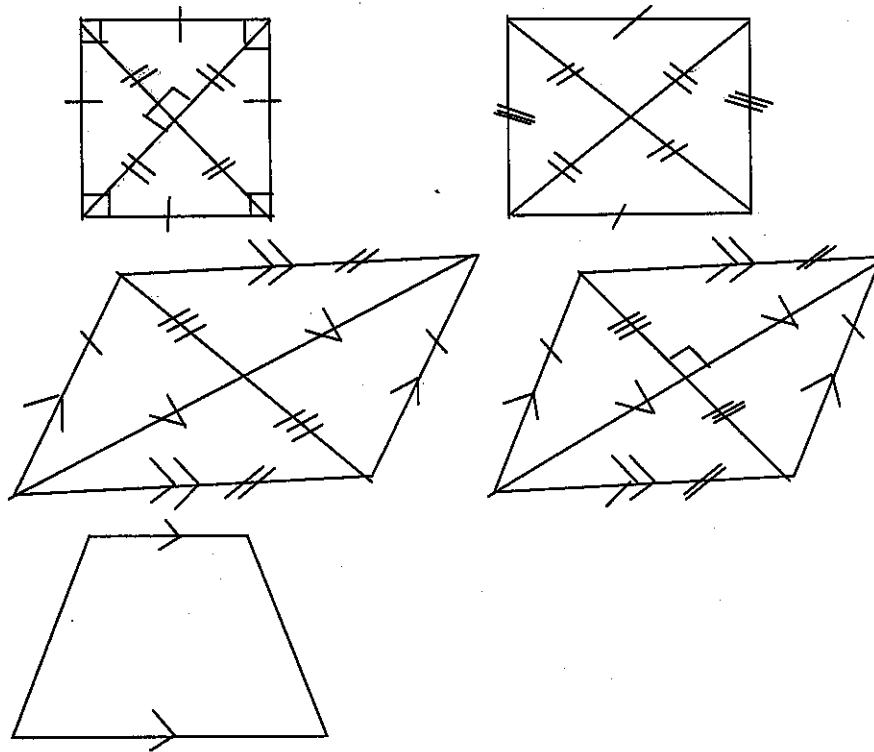
(x)

20. Construct a triangle ABC such that, $AB = AC = 7\text{cm}$ and $BC = 5\text{cm}$.



- a) Prove that the triangles ABD and ADC are congruent.
- b) Name an angle equal to \hat{ABD} .

21.

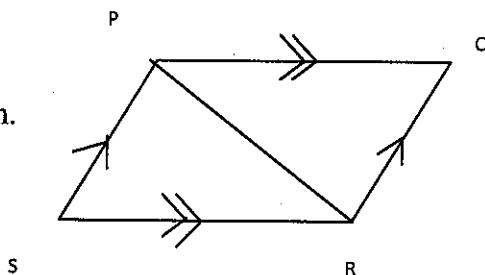


Observe the properties of the above plane figures and complete the following table using (✓) sign.

| Properties | Square | Rectangle | Rhombus | Parallelogram | Trapezium |
|---|--------|-----------|---------|---------------|-----------|
| Sides are equal to each other. | | | | | |
| Opposite sides are equal. | | | | | |
| Opposite sides are parallel. | | | | | |
| Only one pair of opposite sides is parallel. | | | | | |
| All angles are right angles. | | | | | |
| Opposite angles are equal. | | | | | |
| Diagonals bisect each other. | | | | | |
| Diagonals bisect each other perpendicularly. | | | | | |
| Diagonals are equal in length. | | | | | |
| Angles at the vertices are bisected by the diagonals. | | | | | |

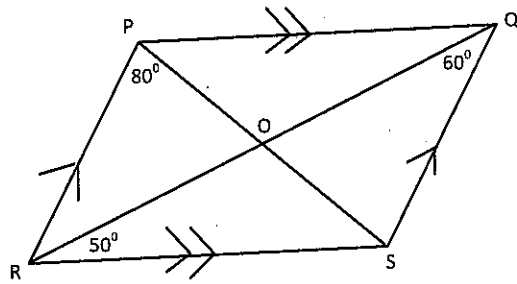
22. Write the compulsory and sufficient conditions of a quadrilateral to be a parallelogram.

23. PQRS is a parallelogram.

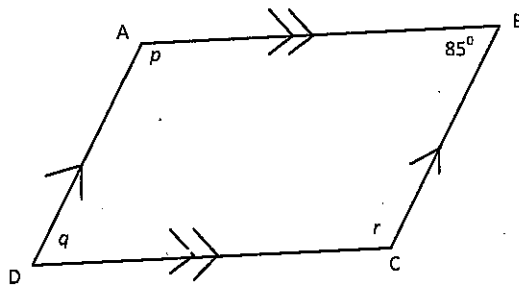


- Verify that the triangles PSR and PQR are congruent.
- Verify that $\hat{PSR} = \hat{PQR}$.
- Name an angle equal to \hat{SPQ} .

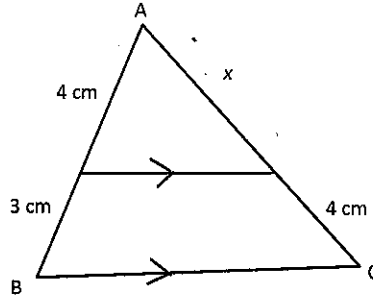
24. Find the value of $P\hat{Q}S$, $S\hat{R}P$, $Q\hat{P}R$, $P\hat{R}Q$, $P\hat{O}Q$ and $P\hat{S}Q$.



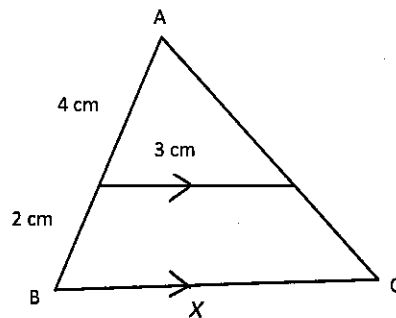
25. $ABCD$ is a parallelogram. Find the magnitudes of the angles indicated by p, q and r .



26. Find the value of x .



27. Find the value of x .

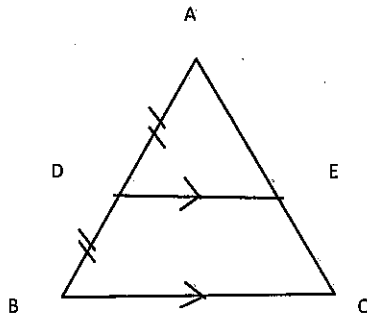


28. a) Construct the triangle ABC in which $AB = 6\text{ cm}$, $AC = 7\text{ cm}$ and $BC = 10\text{ cm}$.
- b) Mark the mid points of AB and AC as X and Y respectively. Join X and Y .
- c) Measure and write the length of XY .
- d) Write the relationship between XY and BC .
- e) Find the value of $\hat{BXY} + \hat{XBC}$.
- f) Write another relationship between XY and BC .

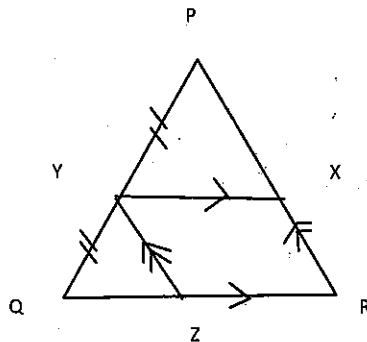
The straight line joining the midpoints of two sides of any triangle is parallel to the third side and is half the length of it.

A straight line drawn from the midpoint of one side of any triangle parallel to another side bisects the third side.

The midpoint of the side AB of the triangle ABC is D . The line DE is drawn through the point D parallel to BC . Then the midpoint of AC is E . Therefore, $AE = EC$.

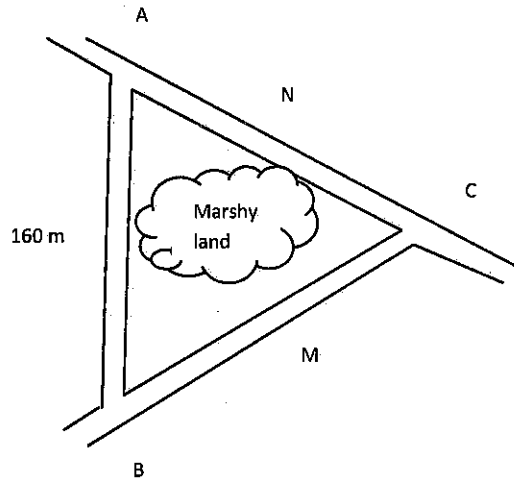


29. $PQ = 30\text{ cm}$, $PR = 44\text{ cm}$ and $QR = 46\text{ cm}$ in the triangle PQR .



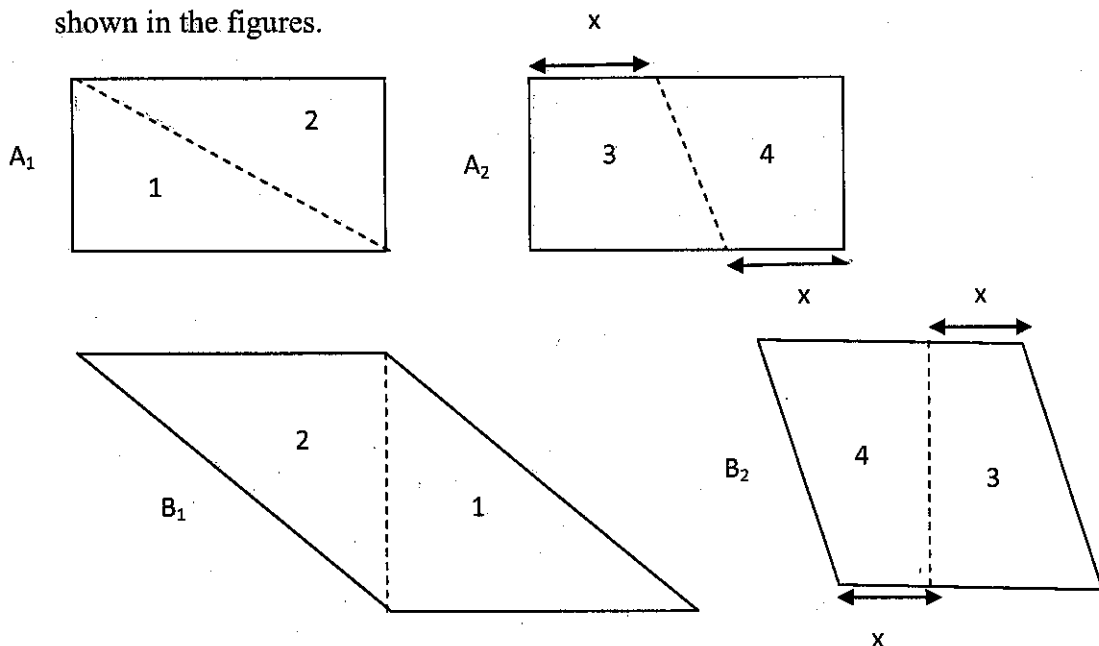
- Find the length of PX .
- Find the length of YZ .
- Find the perimeter of the triangle PQR .
- Find the perimeter of the triangle YZQ .
- Write the lengths of the sides of the parallelogram $XYZR$.

30.

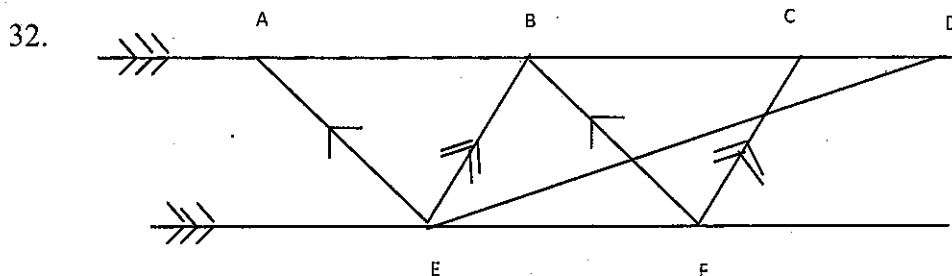


The above figure shows three straight roads around a marshy land. The main junctions are named as A , B and C . $AB = 160\text{ m}$. The midpoints of the roads AC and BC are named as N and M respectively. It is proposed to construct a new road through the marshy land parallel to AB . Find the distance of the new road MN .

31. Draw two equal rectangles on a square ruled paper. Cut and arrange them as shown in the figures.



- a) Write the relationship between the area of the rectangle A_1 and that of the parallelogram B_1 .
- b) Write the relationship between the area of the rectangle A_2 and that of the parallelogram B_2 .
- c) Write the theorem which shows the relationship between the area of the parallelograms B_1 and B_2 .



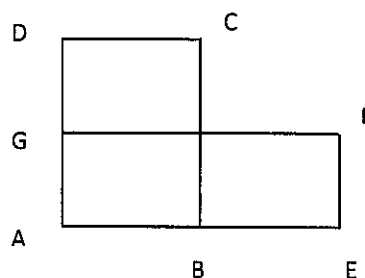
Answer following using the information given in the diagram.

Name,

- a) a pair of parallelograms that are equal in area.
 - b) a triangle that equal in area to the triangle DEF .
 - c) a triangle that equal in area to the triangle BDF .
33. a) The triangles ABC and DBC lie on the same base BC and are in between a pair of parallel lines AD and BC . Prove that the triangles ABC and DBC are equal in area, without using formulae.
- b) $ABCD$ and $A EFG$ are two rectangles of equal area.

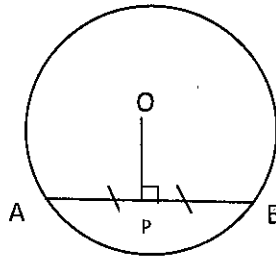
Prove that

- i) $CF \parallel GB$
- ii) $DE \parallel CF$

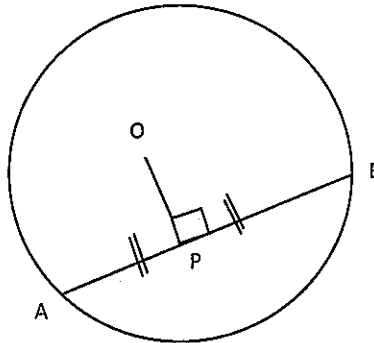


• **Recall the following theorems.**

- The perpendicular drawn from the centre of a circle to a chord bisects the chord.

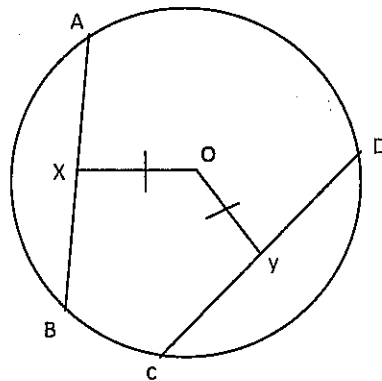


- The line joining the centre of a circle and the midpoint of a chord which is not a diameter is perpendicular to the chord.



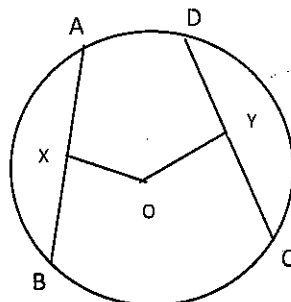
- Equal chords are equidistant from the centre.

If $AB = CD$, then $XO = OY$

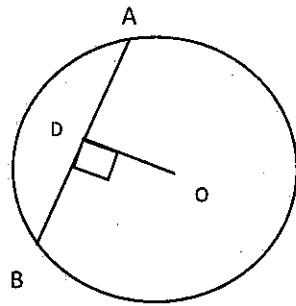


- The chords equidistant from the centre are equal.

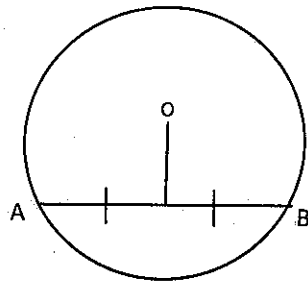
If $XO = OY$, then $AB = CD$.



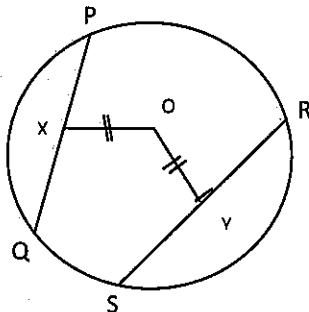
34. a) Write the relationship between AD and BD according to the data given in the diagram. (Write reasons)



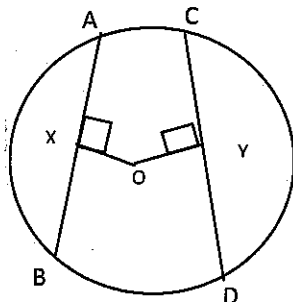
- b) i) Write the relationship between AB and OC .
 ii) Write the magnitude of $\angle C$



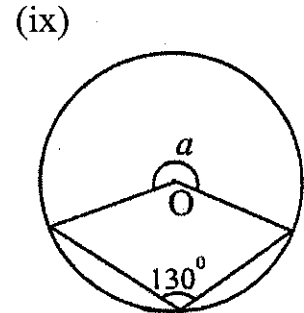
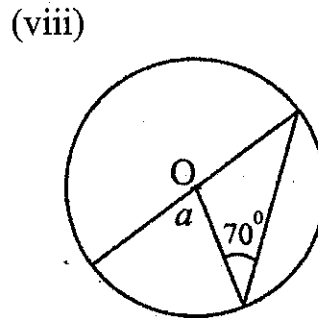
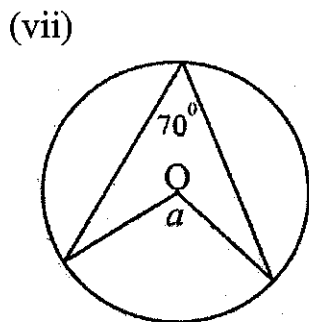
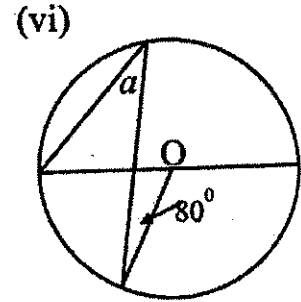
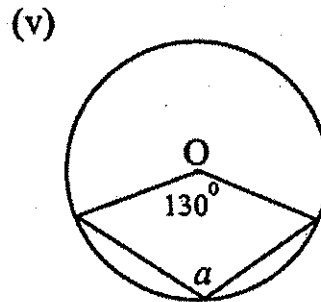
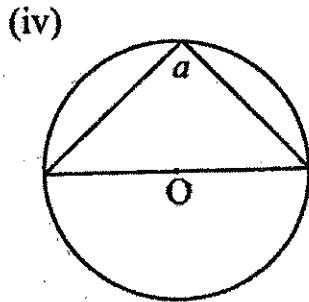
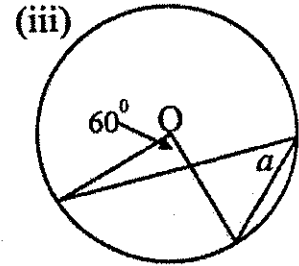
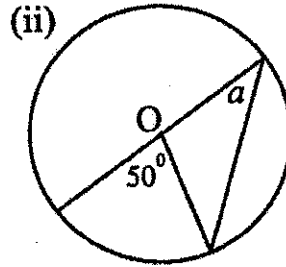
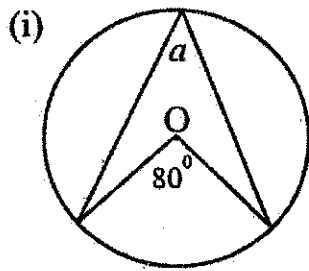
- c) Find the length of RS , when $XO = OY$ and $PQ = 12\text{ cm}$.



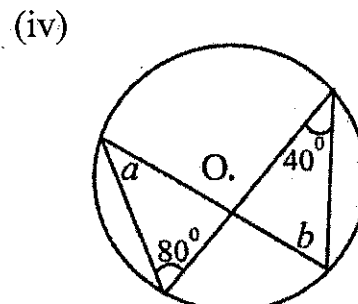
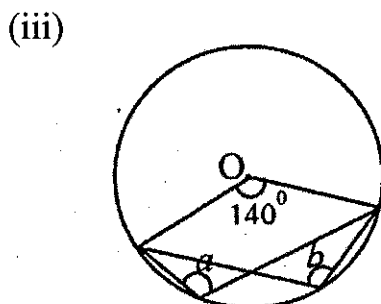
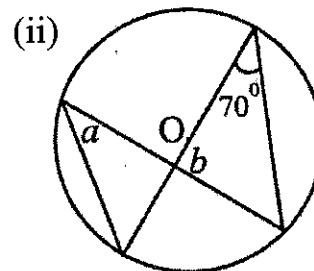
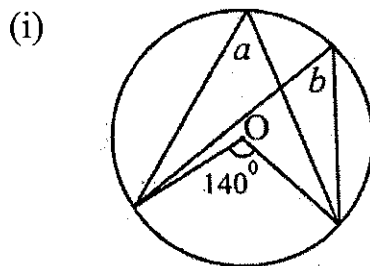
- d) $AB = CD$, $AB = 8\text{ cm}$ and $OY = 3\text{ cm}$ in the diagram.
 i) Find the length of OX .
 ii) Calculate the radius of the circle.



35. Find the magnitude of the angles denoted by 'a' of the following diagrams. (The centres of the circles are denoted by O .)

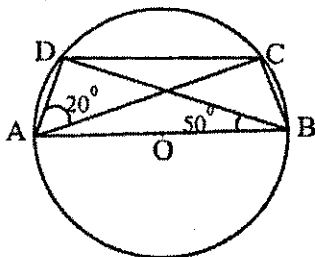


36. Find the magnitude of the angles denoted by a and b of the following circles. (The centres of the circles are denoted by O .)



37. $\widehat{CAD} = 20^\circ$ and $\widehat{ABD} = 50^\circ$ of a circle with centre O .

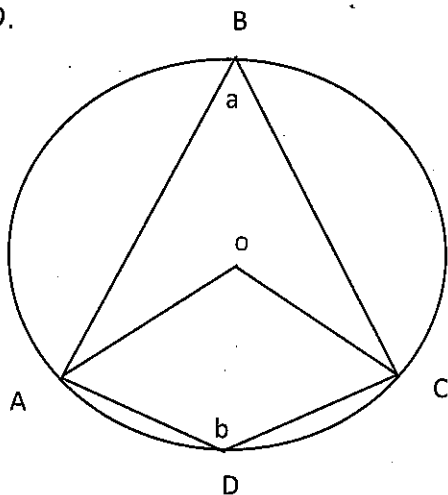
- Name a right angle.
- Find the magnitude of \widehat{ACD} .
- Find the magnitude of \widehat{CBD} .



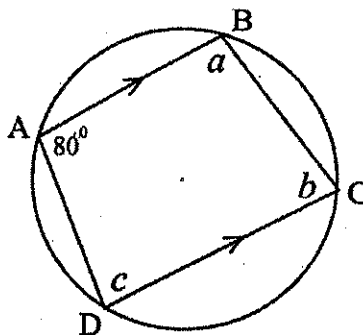
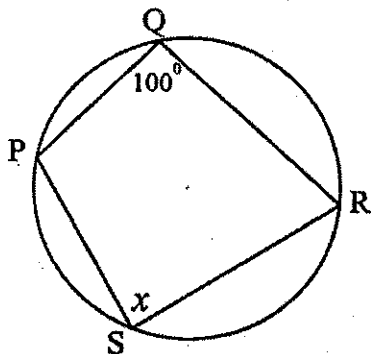
38. If all the vertices of a quadrilateral lie on a circle, such quadrilateral is called as a cyclic quadrilateral.

Answer following using the information given in the diagram.

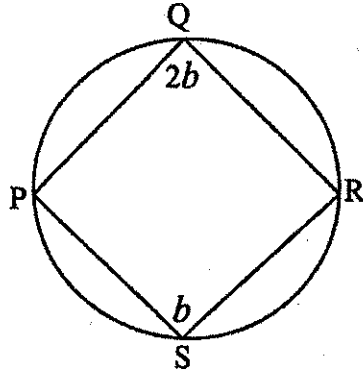
- Magnitude of \widehat{AOC} in terms of ' a '.
- Magnitude of the reflex angle \widehat{AOC} in terms of ' b '.
- Form an equation for the sum of the angles around the point O using the answers in part (i) and part (ii)
- Obtain a value for $(a + b)$ using the above equation.
- Accordingly, find the sum of the opposite angles of the cyclic quadrilateral $ABCD$.



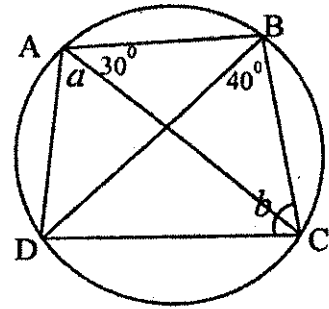
39. a) Find the value of x . b) Find the values of a , b and c .



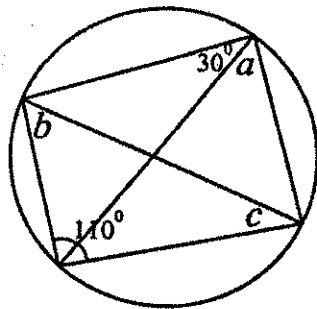
c) Find the value of b .



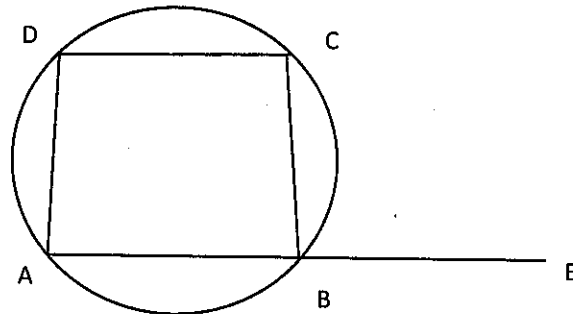
d) Find the values of a and b .



e) Find the values of a , b and c .



40. The side AB of the cyclic quadrilateral $ABCD$ is produced to E .



- Name the exterior angle of the cyclic quadrilateral $ABCD$.
- Name the interior opposite angle of that exterior angle.
- Fill in the following blanks using the above diagram.

$$\widehat{ADC} + \widehat{ABC} = \dots\dots\dots$$

(Opposite angles of a cyclic quadrilateral are supplementary.)

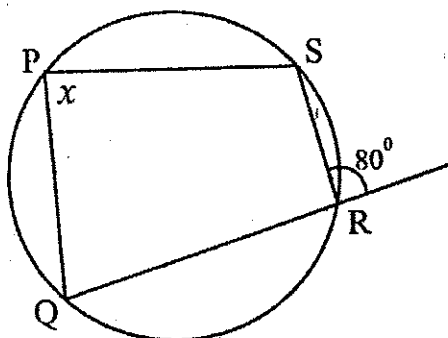
$$\widehat{CBE} + \widehat{ABC} = \dots\dots\dots$$

(The sum of the adjacent angles lies on a straight line.)

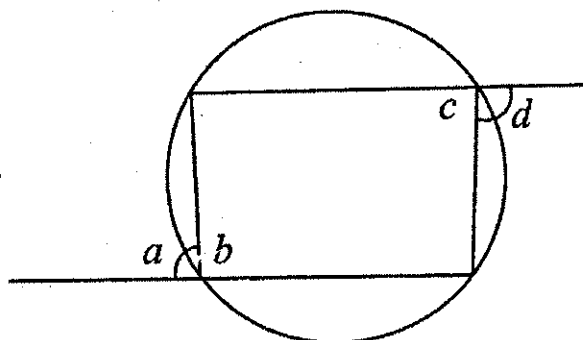
$$\therefore \widehat{ADC} + \widehat{ABC} = \widehat{CBE} + \widehat{ABC}$$

$$\dots\dots\dots = \widehat{CBE} \text{ (By subtracting } \widehat{ABC} \text{ from both sides)}$$

41. a) Find the value of x .



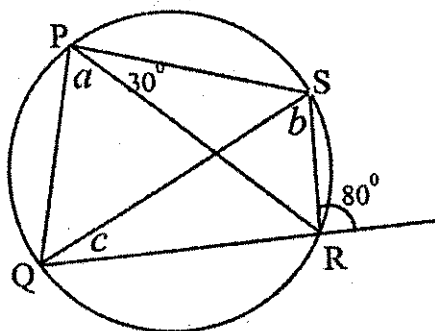
b)



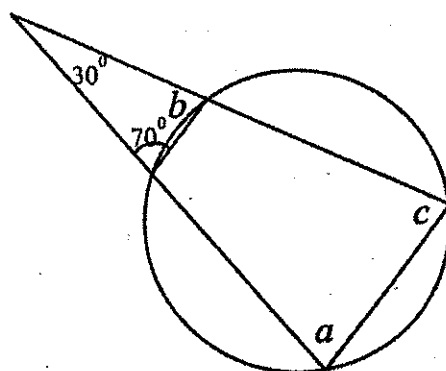
i) Name an angle equal to a .

ii) Name an angle equal to b .

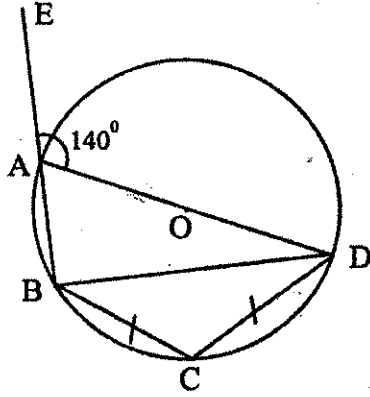
c) Find the value of a , b and c .



d) Find the value of a , b and c .



- e) The side BA of the cyclic quadrilateral $ABCD$ is produced to E . $BC = CD$.
- Find the magnitude of \widehat{DCB} .
 - Find the magnitude of \widehat{DBC} .
 - Find the magnitude of \widehat{ADC} .



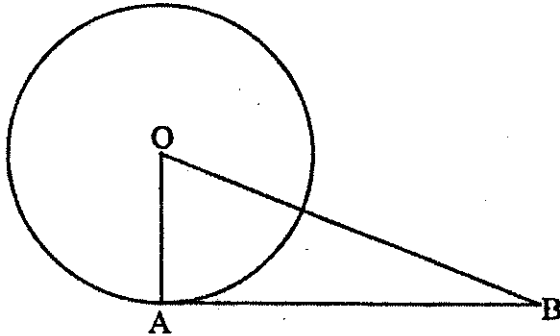
42.

Theorem

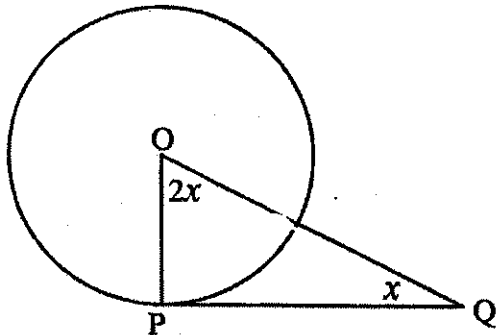
The tangent drawn to a circle is perpendicular to the radius at the point of contact.

- a) AB is a tangent drawn to the circle with centre O .

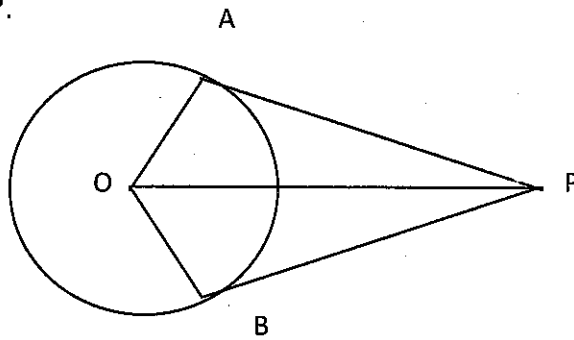
Find the magnitude of \widehat{OAB} .



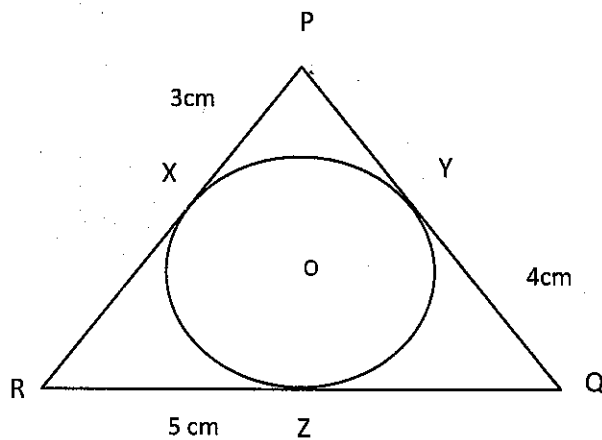
- b) PQ is a tangent drawn to the circle with centre O . Find the value of x .



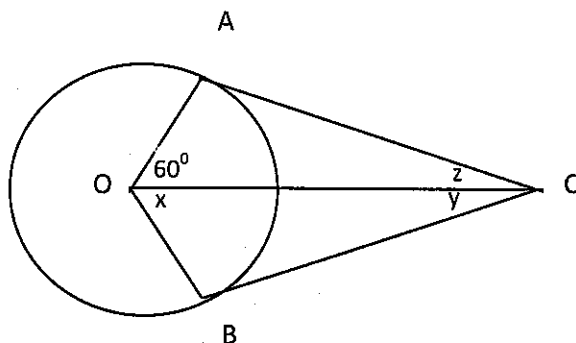
43. PA and PB are two tangents drawn to the circle with centre O from an external point P .



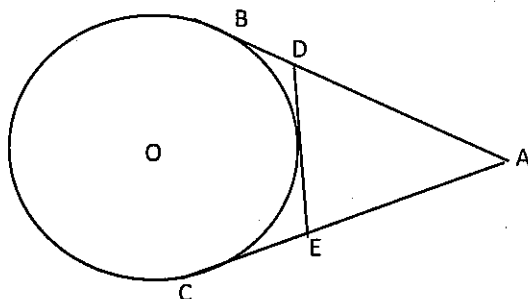
- i. Name a side equal to OA .
 - ii. Name an angle equal to \hat{OAP} .
 - iii. What is the common side of the triangles OAP and BOP .
 - iv. Show that the triangles OAP and BOP are congruent according to the answers in parts (i), (ii) and (iii).
 - v. Accordingly, what can you say about the sides AP and BP ?
 - vi. Select and write an angle equal to \hat{APO} and \hat{AOP} from the triangle BOP .
44. a) The points x , y and z are the points of contact of the tangents PR , PQ and QR respectively, drawn to the circle with centre O . Find the perimeter of the triangle PQR according to the given data.



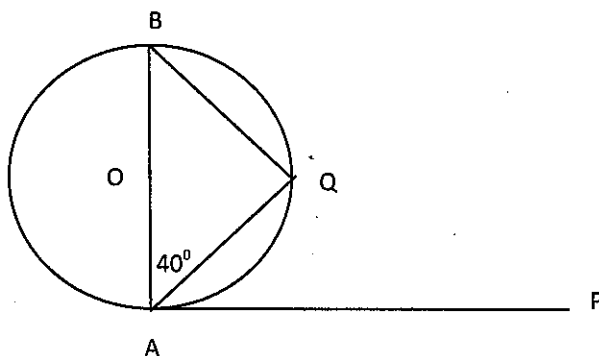
- b) CA and CB are the tangents drawn to the circle with centre O from an external point C . Find the value of x , y and z .



- c) AB , AC and DE are the tangents drawn to the circle with centre O . Find the perimeter of the triangle ADE , if $AB = 20$ cm.



45. a) PA is the tangent drawn to the circle with centre O . $\hat{BAQ} = 40^\circ$.



1. Find the magnitudes of \hat{BAP} and \hat{AQB} .
2. Fill in the blanks of the followings using the information given in the above diagram.

$$\hat{ABQ} + \hat{BAQ} = \dots\dots\dots$$

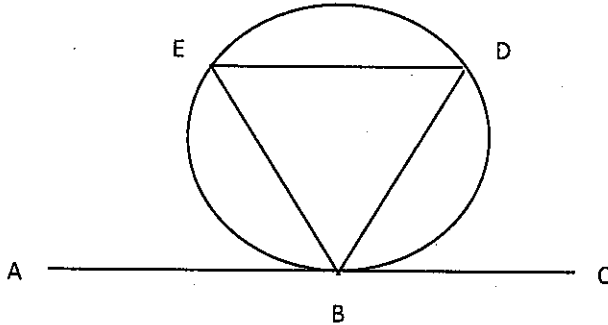
$$\hat{PAQ} + \hat{BAQ} = \dots\dots\dots$$

$$\hat{ABQ} + \hat{BAQ} = \dots\dots\dots + \hat{BAQ}$$

$$\therefore \dots\dots\dots = \hat{PAQ} \text{ (By subtracting } \hat{BAQ} \text{ from both sides)}$$

Theorem

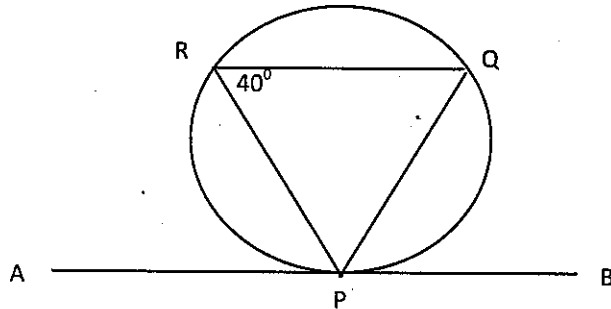
The angle between the tangent drawn to the circle and the chord drawn at the point of contact is equal to the angles on the alternate segment of the circle.



According to the theorem, $\widehat{DBC} = \widehat{BED}$.

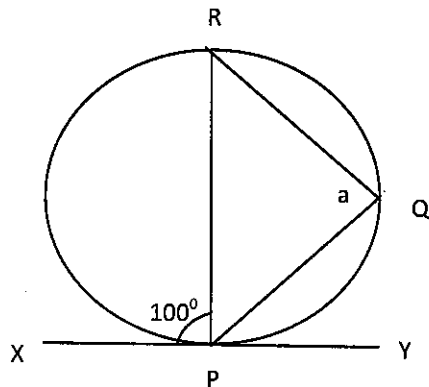
b) APB is a tangent drawn to the circle. P is the point of contact.

Find the magnitude of \widehat{QPB} .



d) XPY is a tangent drawn to the circle. P is the point of contact.

Find the value of a .



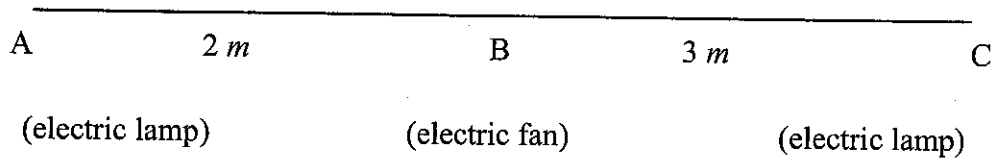
Geometrical Constructions

01. Construct a straight line segment of length 4.5 cm.
02. Draw any angle and name it as \widehat{ABC} . Copy this angle and name it as \widehat{PQR} .
03.
 - a) Construct a straight line segment AB with the length of 6 cm.
 - b) Mark a point P outside the AB .
 - c) Construct a line parallel to AB across P .
04. Construct a straight line segment with the length of 8 cm and construct the perpendicular bisector.
05. Construct a straight line segment with the length of 8.6 cm and name it as AB . Mark any point as P on it. Construct the perpendicular to AB at point P .
06. Construct a straight line segment with the length of 7 cm and name it as AB . Mark any point as P outside AB . Construct the perpendicular from the point P to AB .
07. Draw any angle and bisect it.
08. Construct the following angles.
 - a) 60° b) 90° c) 75° d) 45°
 - e) 30° f) $22\frac{1}{2}^\circ$ g) $37\frac{1}{2}^\circ$
09. Construct an equilateral triangle with the length of a side 8 cm.
10. Construct a triangle ABC such that $AB = 7$ cm and $AC = BC = 5$ cm.
11. Construct a triangle PQR in which $PQ = 6$ cm, $QR = 7$ cm and $PR = 8$ cm.
12. Construct a triangle ABC in which $AB = 7$ cm, $\widehat{CAB} = 60^\circ$ and $BC = 9$ cm.
13. Construct a triangle PQR such that $PQ = 7.5$ cm, $\widehat{RPQ} = 60^\circ$ and $\widehat{PQR} = 30^\circ$.
14. Construct a circle of radius 3.5 cm.
15.
 - a) Construct a triangle ABC in which $AB = 7.2$ cm, $BC = 5.5$ cm and $\widehat{ABC} = 45^\circ$. Construct the circum – circle of the triangle ABC . Name the circum – centre as O . Measure and write the radius of the circle.

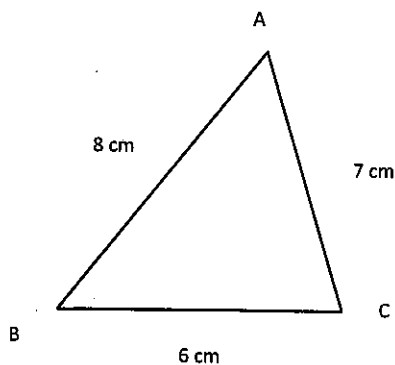
16. Construct a triangle KLM in which $KL = 6\text{ cm}$, $LM = 8\text{ cm}$ and $\widehat{KLM} = 90^\circ$.
Construct the circum – circle of it and name the centre as O .
17. Construct a triangle ABC in which $AB = 5.5\text{ cm}$, $BC = 7\text{ cm}$ and $\widehat{ABC} = 120^\circ$.
Construct the circum – circle of it.
18. Construct a triangle PQR in which $PQ = 6\text{ cm}$, $QR = 7\text{ cm}$ and $PR = 8\text{ cm}$.
Construct the in – circle of it. Measure and write the radius.
19. Construct a straight line segment AB of length 7 cm . Mark a point P on AB 3 cm away from ' A '. Obtain a point Q which is 7 cm away from P and 5 cm away from B .
Construct the circle which touches AB at P and passes through the point Q .
- 20.a) Construct a triangle ABC in which $\widehat{ABC} = 75^\circ$, $BC = 4\text{ cm}$ and $AB = 5\text{ cm}$.
b) Construct a line parallel to BC through A and mark the point D on it such that $AD = 4\text{ cm}$.
c) Complete the quadrilateral $ABCD$ and name the figure.
d) Construct the triangle ABE which is equal to $ABCD$ in area, such that E lies on BC produced.

MEASUREMENTS

1. Two electric bulbs and a fan are fixed to a ceiling on a straight line as shown in the diagram.



- What is the distance between two electric lamps?
 - What is the distance between the electric lamp 'C' and electric fan, if the distance between the fan and lamp 'A' is $4\ m$ and the distance between two lamps is $9\ m$?
 - What is the distance between the electric lamp 'A' and electric fan, if the distance between the fan and the lamp 'C' is $7\ m$ and the distance between two lamps is $13\ m$?
 - Write the geometrical relationships among AB , AC and BC for each of the above instances, separately.
2.
a) Following diagram shows a frame made by a metal wire.



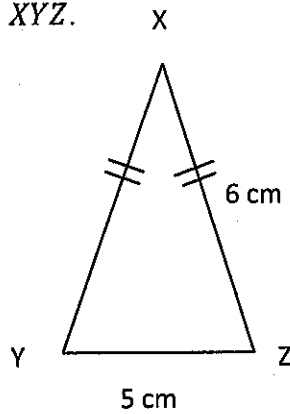
- What is the length of the metal wire needed to make this frame?
- What is the special name of the above measurement?
- Write the relationship that used to find the above measurement using AB , BC and CA .

b)

- A triangle has been made by using a metal wire with the length of $27\ cm$. The lengths of two sides of the triangle are $10\ cm$ and $8\ cm$. What is the length of the remaining side?

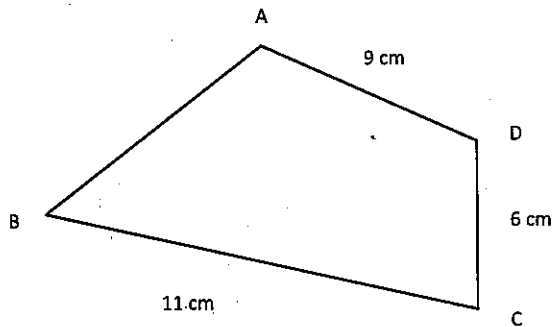
(Sketch a diagram and write the method of obtaining the answer as a geometrical relationship.)

- ii. What is perimeter of the triangle XYZ.

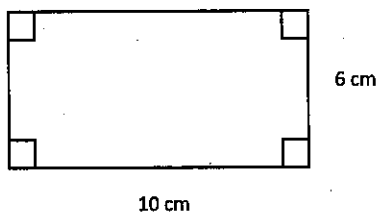


- iii. The perimeter of an isosceles triangle is 36 cm and the length of the smallest side is 10 cm. Find the length of one of the other sides.
- iv. Find the perimeter of an equilateral triangle of which side is 7.5 cm.
- v. The perimeter of an equilateral triangle is 42 cm. Find the length of a side.

3. The perimeter of the quadrilateral ABCD is 33 cm. Find the length of AB.



4.



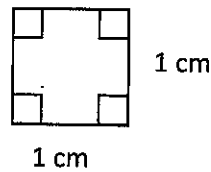
- i. Write the geometrical name of this quadrilateral.
- ii. Calculate the perimeter of it.
- iii. Find the breadth of such a quadrilateral, if the perimeter is 54 cm and the length is 15 cm.

5.

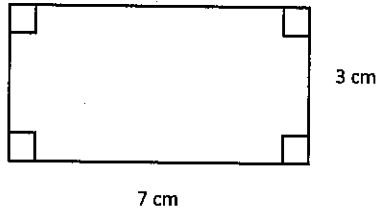
- i. Calculate the length of a side of a square shaped ceiling sheet, in which the perimeter is 4.8 m.
- ii. Find the number of such sheets needed to the ceiling of a room in which length and breadth are 6 m and 4.8 m, respectively.

6.

- i. Find the area of the following figure.



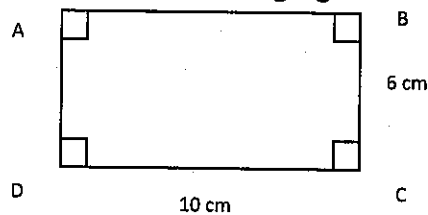
- ii. How many squares with above dimensions (given in part i) can be drawn on the following figure, without keeping gaps?



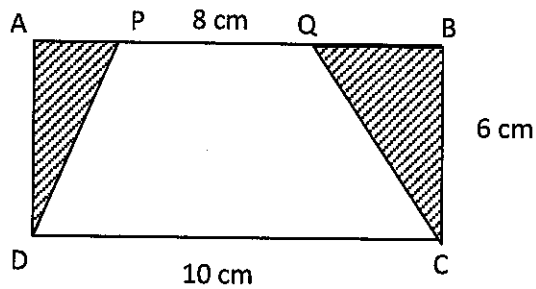
- iii. Which measure of a rectangle is represented by the result in (ii).

7.

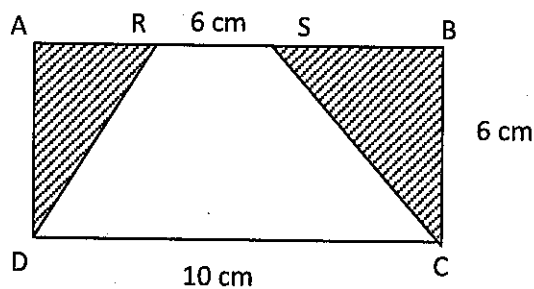
- i. Find the area of the following figure



- ii. Can you get the same answer by substituting value for $\left(\frac{AB+DC}{2}\right) \times BC$
- iii. Obtain the area of $PQCD$ lamina by removing the shaded parts from the rectangle $ABCD$.



- iv. In the same way obtain the area of $RSCD$ lamina.

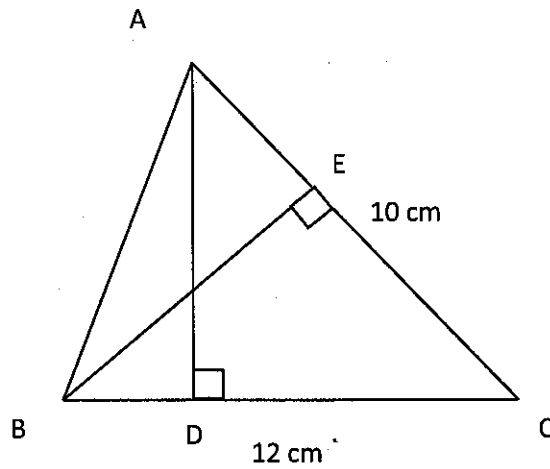


- v. Which geometrical name can be used for the $PQCD$ and $RSCD$ shapes?

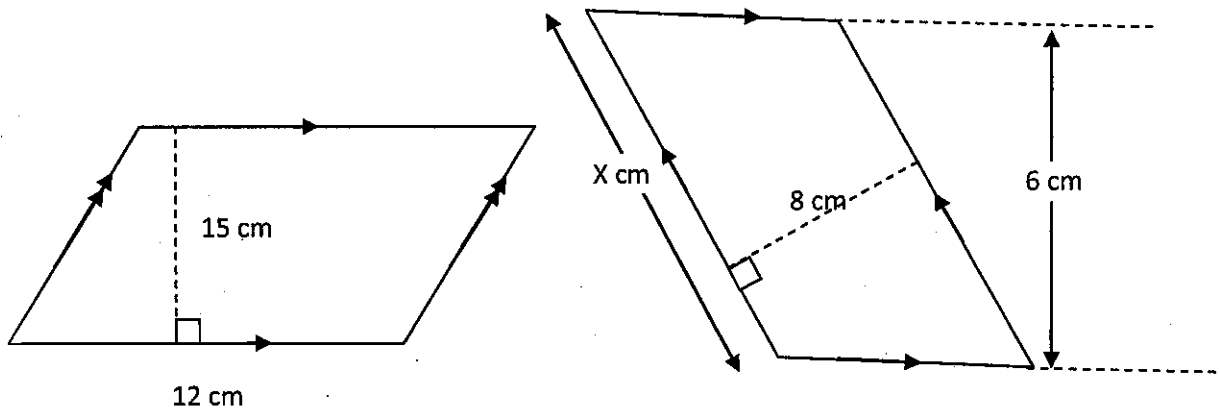
- vi. Obtain an expression for the area of such geometrical shapes.
- vii. Indicate the new lamina gets by decreasing the side parallel to CD to the minimum and without changing the base CD .
- viii. Fill in the blanks of the given expression using the suitable number and the sign to obtain the area. $\left(\frac{10 + \dots}{2}\right) \times 6$
- ix. Accordingly, write an expression for the area of a triangle in your words.

8.

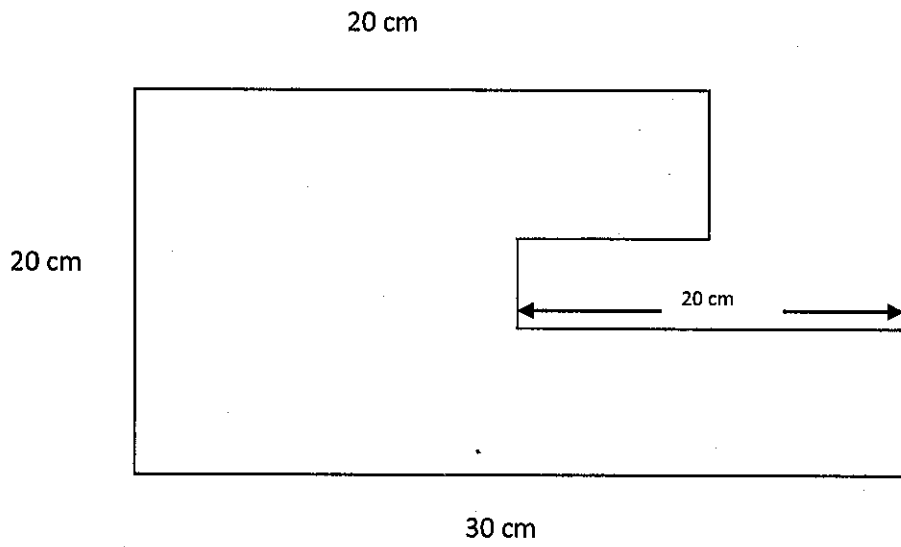
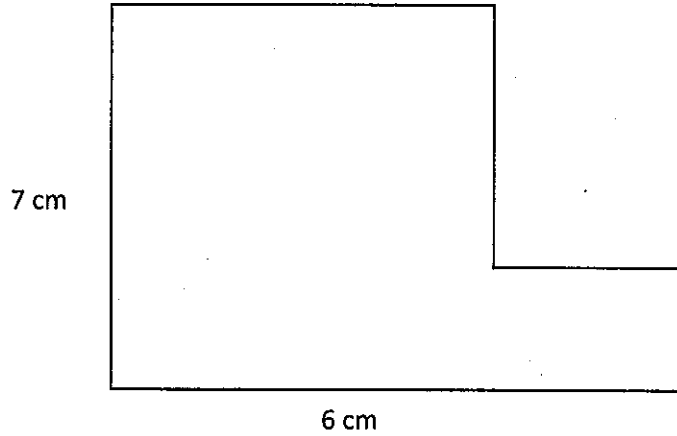
- i. Find the length of BE , when $BC = 12 \text{ cm}$, $AC = 10 \text{ cm}$, and $AD = 6 \text{ cm}$.



- ii. Find the area of the following figure.
- iii. Find the value of 'x' using given data.

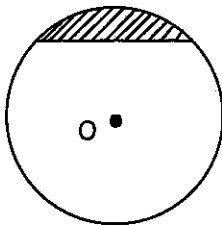


c) Find the perimeter of given figures.

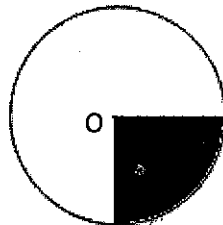


10.

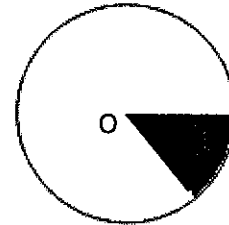
i. The centers of following circles are 'O'. Write the correct name of the shaded part of each circle.



.....

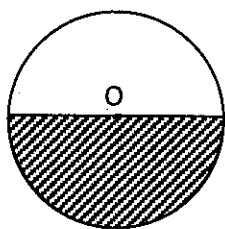


.....



.....

ii.



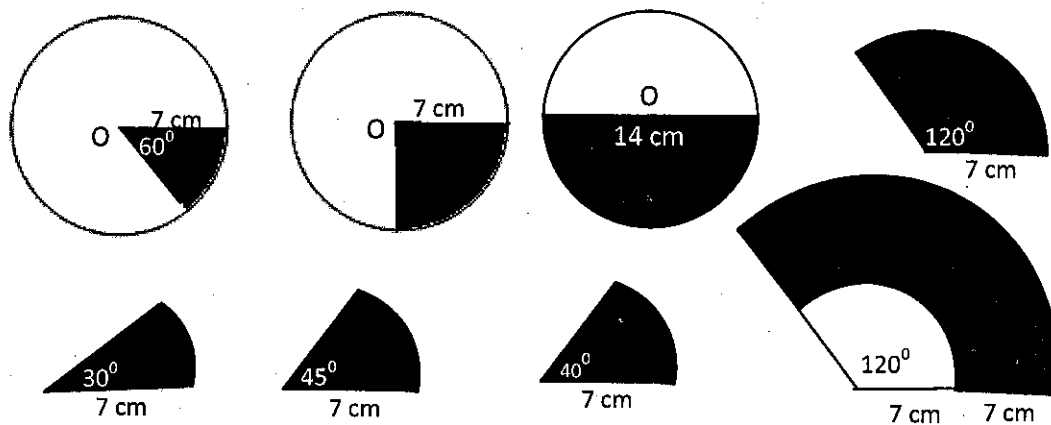
Amal says that 'This is a segment of a circle'.

Sunil says that 'No, this is a sector of a circle'

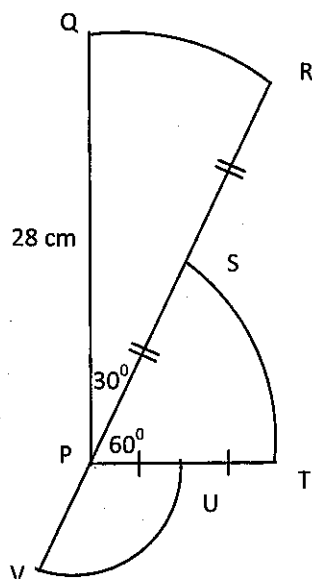
Give your comments on the above dialogue and verify your answer.

iii. Find the circumference and the area of a circle with the radius 14 cm .

iv. Calculate the perimeter and area of the shaded portions of following figures.



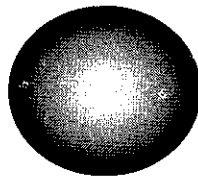
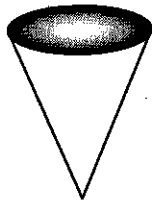
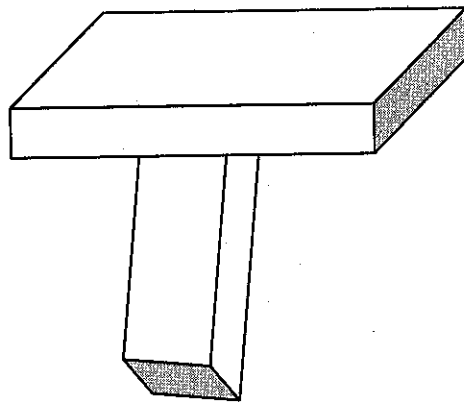
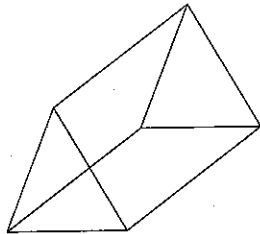
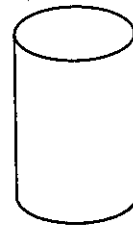
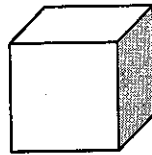
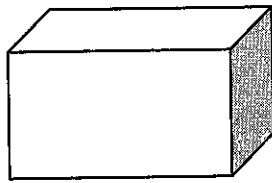
11. Following diagram shows a compound structure built in a school.



Self Access Learning Activities for Student Empowerment

- i. Calculate the perimeter and area of the structure and round of it to the nearest ten.
- ii. Calculate the amount of money required to paint the structure, if the thickness of the structure is 1cm and the cost of painting is 50 cents per 1cm^2 .

12. Select the prisms out of following solids.

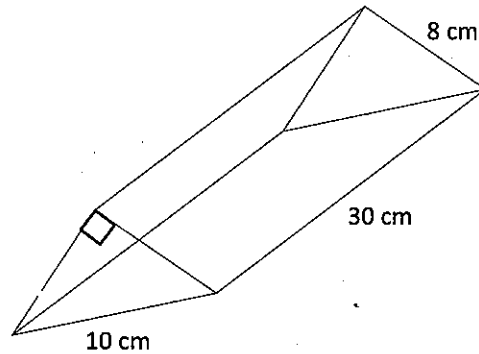


Problems related to the volume

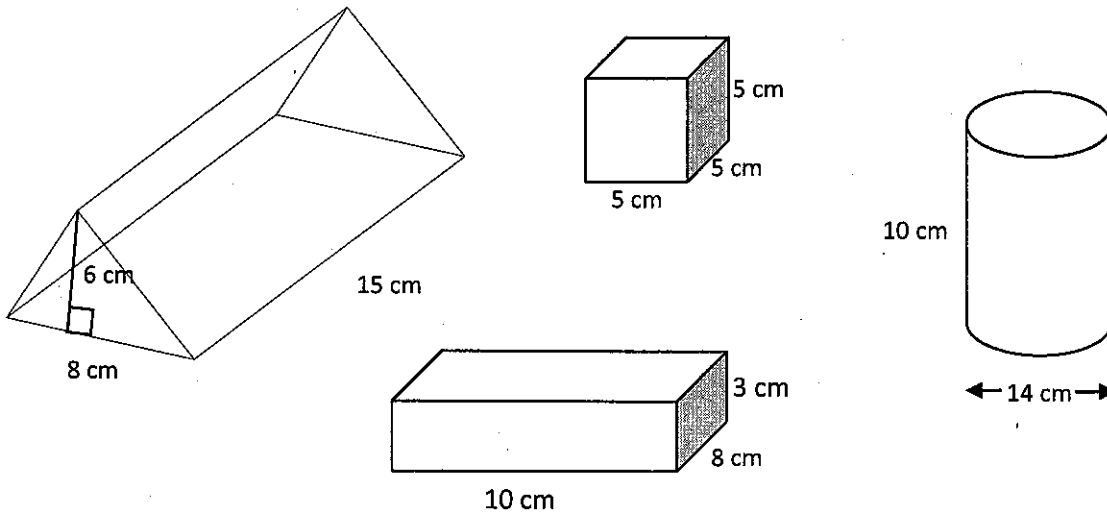
13.

- i. Calculate the volume of a die, when the length of a side is 1 cm .
- ii. Find the volume of the above die, when the length of a side is doubled.
- iii. Explain the variation of the volume, when the length of a side is doubled, trebled, etc. using (i) and (ii).
- iv. Find the volume of a cuboidal shaped pencil box, when length, breadth and height are 20 cm , 8 cm , and 3 cm , respectively.
- v. Raj wants to pack erasers in which the length, breadth and height are 3 cm , 2 cm , 1 cm respectively, in the box mentioned in the (iv).
 - Can he pack all the erasers in this box?
 - If it is not enough to pack all the erasers in one box, how many boxes are needed to pack all erasers.

14. Following figure shows a wooden solid name board.

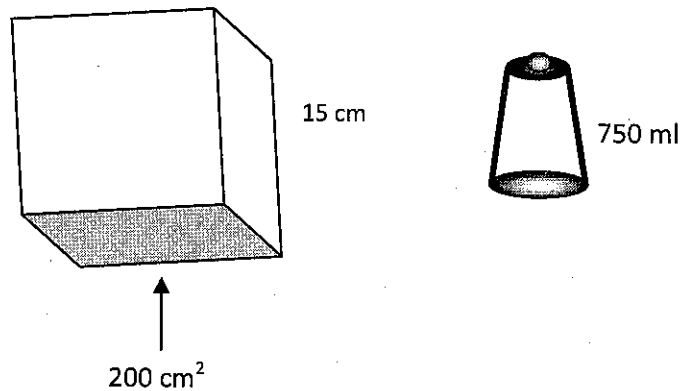


- i. Calculate the volume of wood needed to make such a name board.
- ii. Grade 12 students want to prepare several name boards with the same dimensions. Nimal says that, it is possible to prepare 5 such name boards using a cuboidal wooden block with the length, breadth and height as 120 cm , 8 cm and 6 cm , respectively. Kamal did not agree with that idea. Verify the correct idea and give reasons.
- iii. Calculate the volume of following solids.

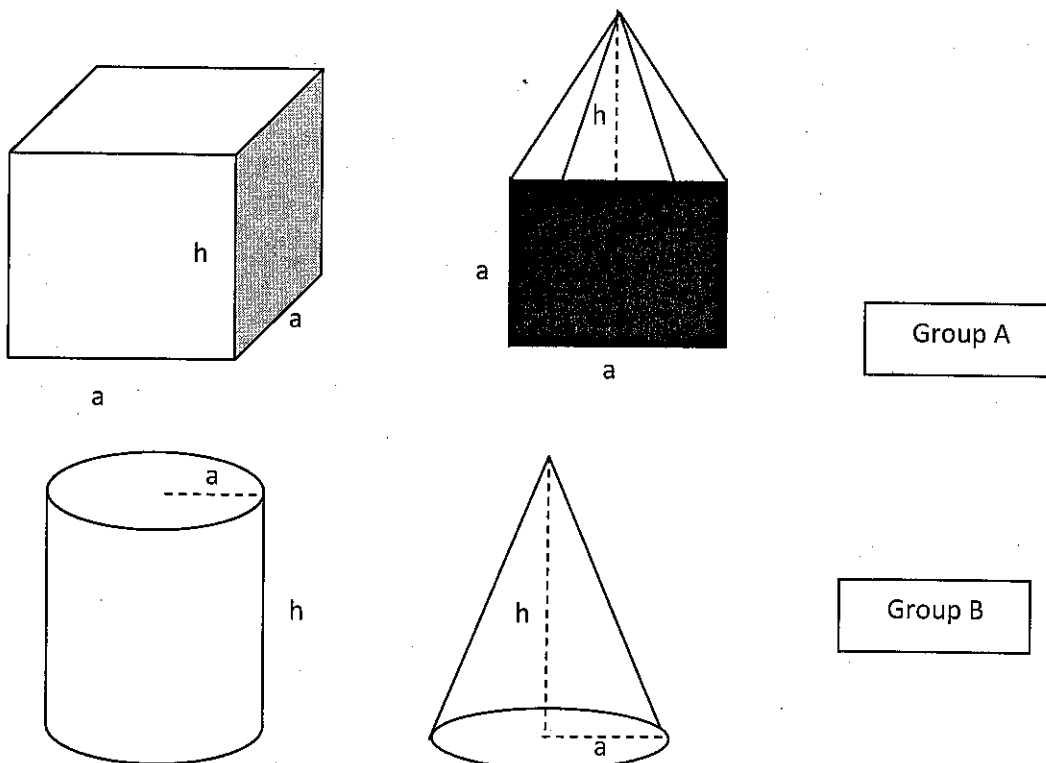


- iv. Obtain the relationship between the volume of a prism, area of the cross section and the height of the prism according to the calculations in (iii).

15. A student wants to fill water to a cuboidal shape vessel using a bottle as shown in the following diagram. Calculate the number of times needed to pour water to fill this cuboidal shape vessel.



16.

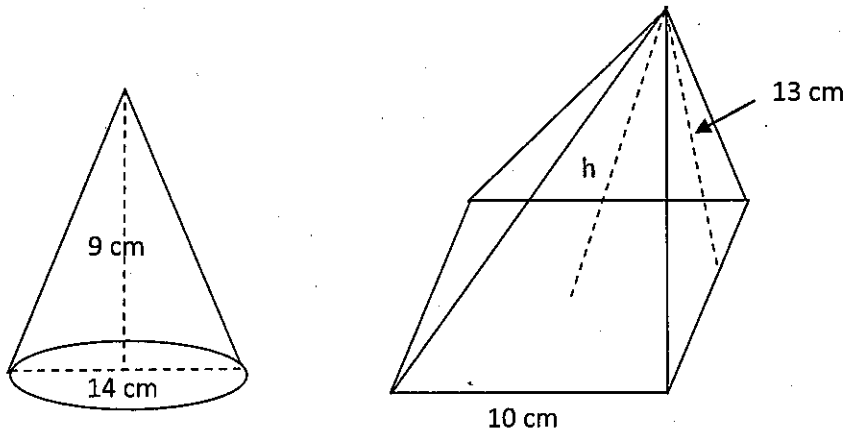


Above diagrams show the rough sketches of containers prepared by two groups of grade 11 students to find the volume of a prism and a cone.

- i Calculate the number of times needed to pour water to fill the cuboidal shape vessel using the pyramid shape vessel, according to the group A.
- ii. Calculate the number of times needed to pour water to fill the cylindrical shape vessel using the conical shape vessel, according to the group B.
- iii Accordingly, obtain the following.

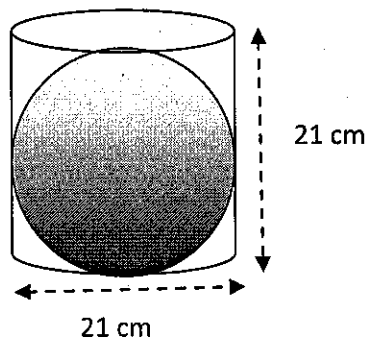
$$\begin{aligned} \text{Volume of a pyramid} &= \dots \times \dots \text{ cubic units} \\ &= \frac{1}{3} \pi r^2 \times h \text{ cubic units} \end{aligned}$$

- b Find the volume of following solids.



c

- i Calculate the volume of the sphere which is kept in the cylinder as shown in the diagram.



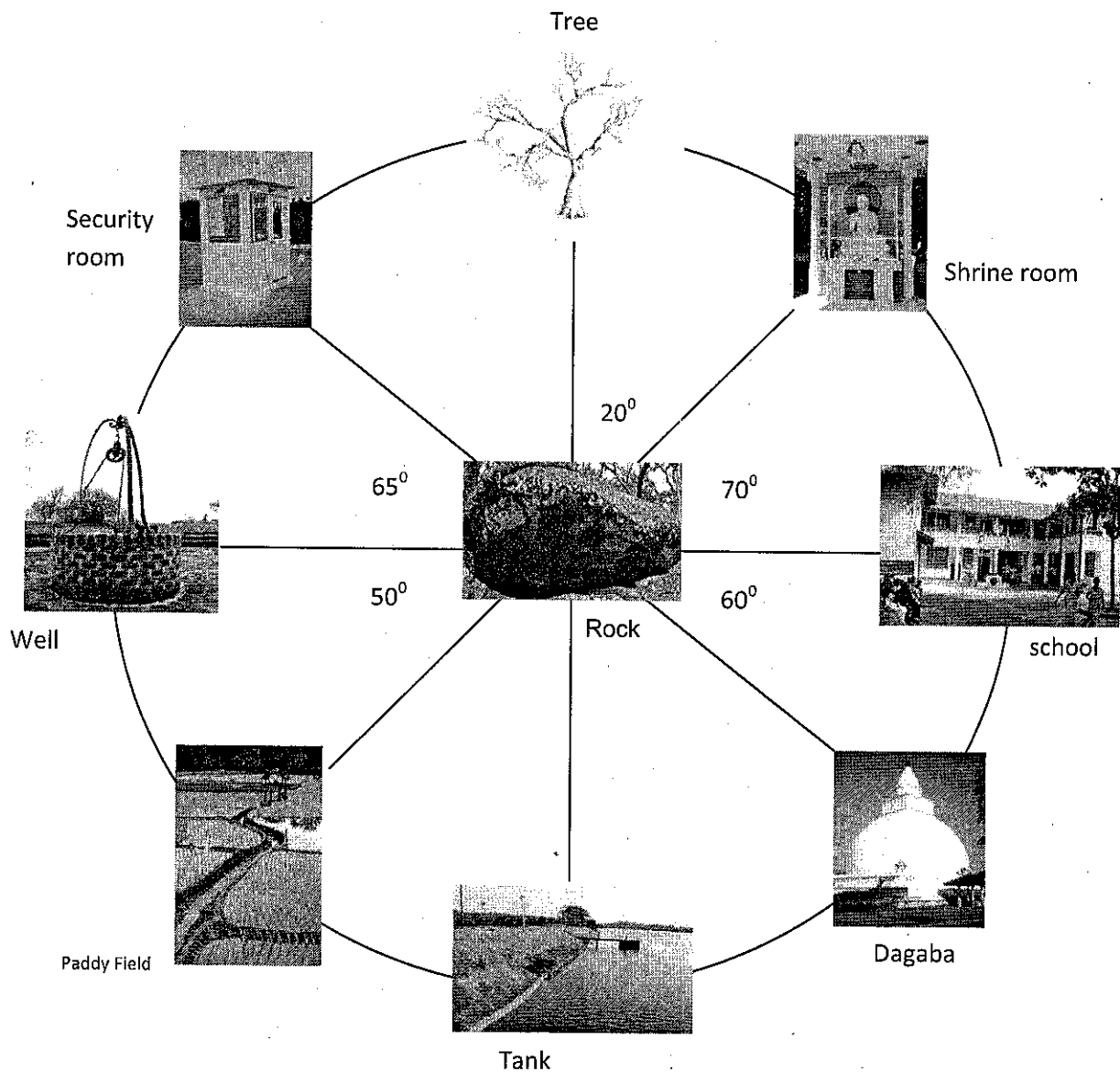
- ii. What is the remaining volume of the cylinder?
- iii Find the height of cone equal to the volume of the remaining space?

17. A person needs to fill a cuboidal shape tank ($2\text{ m} \times 3\text{ m} \times 5\text{ m}$) using a pipe with cross section 200 cm^2 .

- i. Find the time taken to fill the tank, if water flows at a speed of 5 m per second through the pipe.
- ii. A pipe with 300 cm^2 cross section is use to drain water from the tank. Time taken to drain half of the water is 2.5 minutes. Find the speed of water flowing through the pipe.

18. Following sketch shows an aerial photograph. Fill out the direction and bearing when observe the other locations at the rock.

| | Location | |
|-----------------------------------|-----------|---------|
| | Direction | Bearing |
| Tree | | |
| Shrine room | | |
| School | | |
| Dhagaba | | |
| Sinhala;Wewa/ <i>tamil</i> ;kulam | | |
| Paddy field | | |
| Well | | |
| Security room | | |



19. Given below are the information taken by a student to draw a scale diagram.

Two story building - (030° , 10 m)

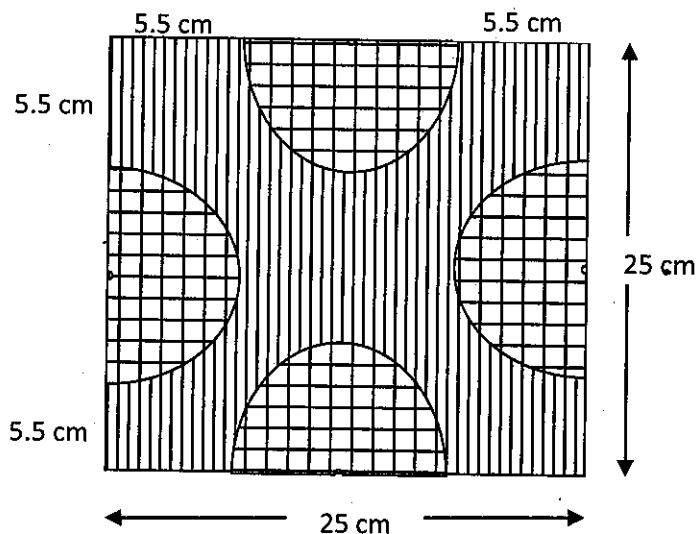
Library - (120° , 35 m)

Toilet - (240° , 45 m)

Shrine room - (300° , 10 m)

- i. Name the instruments that can be used to get this information.
- ii. Draw an appropriate scale diagram to represent this information.
- iii. Find the distance between,
 - a. the toilet and the library
 - b. the building and shrine room.

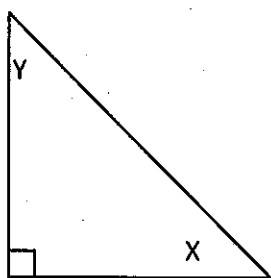
20. Diagram below shows a rough sketch of a design of a cushion cover. A fabric with red colour checks and a fabric with blue colour strips are used in the design.



- Find the number of squares with the size of $25\text{ cm} \times 25\text{ cm}$ could be cut using a $1\text{ m} \times 1\text{ m}$ blue stripped fabric.
- Calculate the length of blue stripped clothes needed to saw 100 such cushion covers.
- Neetha says that, 3.5 m^2 of fabric is needed to saw a cushion cover, if semi circular shapes are cut using a fabric with the breadth of 14 cm . Do you agree with this statement? Give reasons.
- Find the amount of money needed to buy fabrics for 100 cushion covers, if 1 m of blue stripped fabric cost Rs.70 and 1 m of fabric with red colour checks cost Rs.20.

21. $\sin x = \frac{4}{5}$

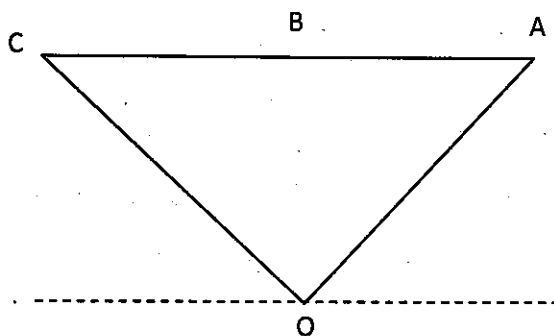
Find following using the information given in the following diagram.



- i. $\cos x$
- ii. $\tan x$
- iii. values of x and y

22. Following is a sketch diagram representing two positions of aircraft traveled from east to west as 'A' and 'C'. 'O' is the point of observation. Speed of the aircraft is 30 km h^{-1} . Copy the sketch and mark the information given.

- The student observes the aircraft at 'A' with an angle of elevation 45° from the point 'O'.
- It has taken 1 minute to reach the aircraft to direct above the student.
- Aircraft was observed in the western sky at point 'C' after $2\frac{1}{2}$ minutes of the first observation.



- i. What is the vertical height of the aircraft?
- ii. What is the angle of elevation at point 'C'?
- iii. What is the distance to be traveled further more from the last observation to see the aircraft with an angle of elevation 45° ? (Calculate using trigonometric ratios)