1 Chapter

Set

1.1 Basic ideas about sets - Review

1. Notation of sets

A set is a collection of 'well-defined' objects. Sets are usually denoted by capital letters and the elements or members are enclosed in the braces { }. The membership of an element of a set is denoted by the symbol $\in$ and the non-membership is denoted by '$\notin$'. For example, if A = {1, 2, 3, ..., 10}, then $10 \in$ A but $15 \notin$ A.

2. Specification of sets

A set can be described by three methods.

Methods	Examples
Description	A set of even numbers less than 10.
Listing or Roster	A = {2, 4, 6, 8}
Set-builder or Rule	A = {x : x $\in$ even number, x < 10}

3. Types of sets

On the basis of the number of elements of sets, there are four types of sets.

Type of sets	Identification	Examples
Empty or null set	It does not contain any elements. It is denoted by ϕ (Phi) or empty braces { }.	The set of whole numbers less than 0.
Unit or singleton set	It contains only one element.	The set of whole numbers between 6 and 8,
Finite set	It contains finite number of elements.	W = {1, 2, 3, ..., 100}
Infinite set	It contains infinite number of elements.	W = {1, 2, 3, ...}

4. Types of relationship between sets

On the basis of the types of elements contained by two or more sets, their relationship can be defined in the following ways.

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Type of relationship	Identification	Examples
Equal sets	They have exactly the same elements.	A = {a, e, i, o u} B = {o, i, a, e, u} ∴ A = B
Equivalent sets	They have equal number of elements.	P = {1, 3, 5, 7} Q = {2, 4, 6, 8} ∴ P ~ Q
Overlapping sets	They have at least one element common.	X = {1, 2, 3, 4, 5} Y = {2, 3, 5, 7} ∴ X and Y are overlapping sets.
Disjoint sets	They do not have any element common.	M = {b, c, d, f} N = {a, e, i, o u} ∴ M and N are disjoint sets.

5. Cardinal number of set

The number of elements contained by a set is called its cardinal number. For example,

In A = {1,3, 5, 7, 9}, n(A) = 5

6. Subset, proper and improper subsets

Between two sets A and B, the set B is said to be a subset of A if every element of B is contained by A. For example, If A = {1, 2, 3, ... 10} and B = {2, 4, 6, 8}, then B is a subset of A. It is denoted as B ⊂ A.

If B is a subset of A and n(B) ≠ n(A), then set B is said to be the proper subset of A and denoted as B ⊂ A. In the above example, B is the proper subset of A.

On the other hand, if n(B) = n(A), then set B is said to be the improper subset of A. It is denoted as B ⊆ A.

7. Universal set

A set under the consideration from which many other subsets can be formed is called a universal set. For example, a set of natural numbers less than 20 is a universal set. From this sets, we can make many other subsets such as set of odd numbers less than 20, set of multiple of 3 less than 20 and so on.

1.2 Venn-diagrams

Sets and set operations can also be represented by diagrams like rectangle, circle or oval. The idea of representation of sets in diagrams was first introduced by Swiss Mathematician Euler. It was further developed by the British Mathematics John Venn. So, the such diagrams are famous as Venn Euler diagrams or simply Venn-diagrams.

In Venn-diagram, the universal set is represented by rectangle and its subsets are represented by circles or ovals inside the rectangle.
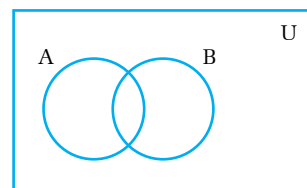
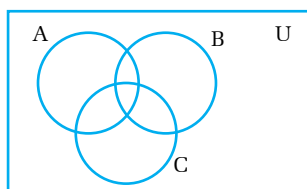Study the following set relationship by using Venn-diagrams.
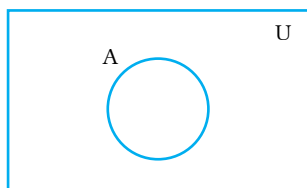
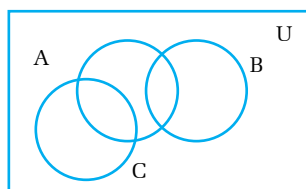
A ⊂ U (A is a subset of U).
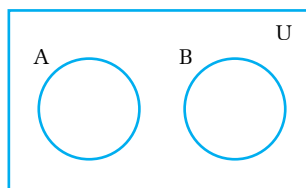
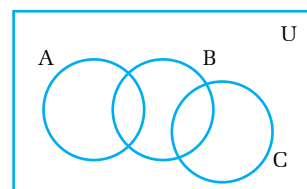

A and B are disjoint sets.

A and B are overlapping sets.

A, B and C are overlapping sets.

A and B are overlapping,
A and C are overlapping,
but B and C are disjoint sets.

A and B are overlapping,
B and C are overlapping,
but A and C are disjoint sets.

1.3 Set operations by using Venn diagrams

There are four types of set operations.

(i) Union of sets   (ii) Intersection of sets

(iii) Difference of sets   (iv) Complement of a set

(i) Union of sets

The union of two sets A and B denoted by A ∪ B is the set of all members that belong to either to A or to B or to both A and B. Mathematically, union of A and B is defined as

A ∪ B = {x : x ∈ A or x ∈ B}

For example,

if A = {2, 4, 6, 8} and B = {1, 2, 3, 4, 5}, then A ∪ B = {1, 2, 3, 4, 5, 6, 8}

Thus, the union of two or more sets is made just by grouping their elements together. In case of overlapping sets, the common elements are mentioned only once while making the union. The shaded regions in the following Venn-diagrams represent the union of the sets.

A ∪ B
A and B are disjoint sets.
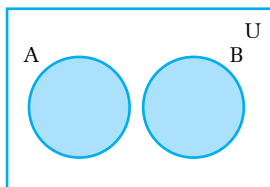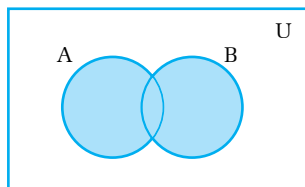
A ∪ B
A and B are overlapping sets.

A ∪ B ∪ C
A, B and C are disjoint sets.

A ∪ B ∪ C
A, B and C are overlapping sets.

A ∪ B ∪ C
A and B are overlapping,
A and C are overlapping,
but B and C are disjoint sets.

A ∪ B ∪ C
A and B are overlapping,
B and C are overlapping,
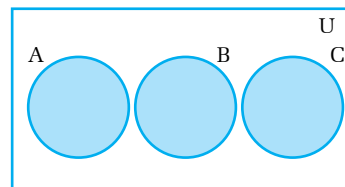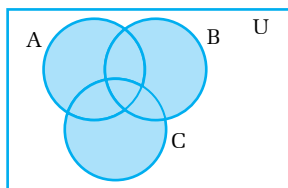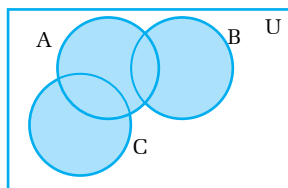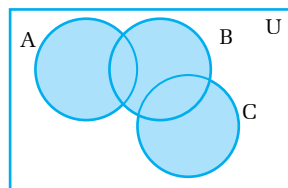but A and C are disjoint sets.

(ii)   Intersection of sets

The intersection of two sets A and B denoted by A ∩ B is the set of the members which are common to both the sets.

Mathematically, intersection of sets A and B is defined as

A ∩ B = {x : x ∈ A and x ∈ B}

For example,

if A = {1, 3, 5, 7, 9} and B = {2, 3, 5, 7, 11}, then A ∩ B = {3, 5, 7}

The shaded regions in the following Venn-diagrams represent the intersection of sets.
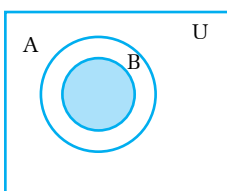
A ∩ B
B is the subset of A.

A ∩ B
A and B are overlapping sets.
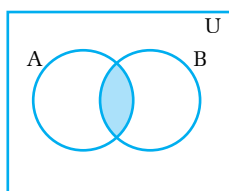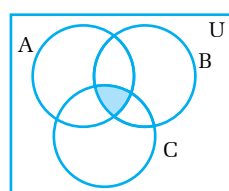
A ∩ B ∩ C
A, B and C are overlapping sets.

(iii)   Difference of sets

The difference of two sets A and B, denoted by A – B is the set of the elements of only A which do not belong to B.

Similarly, the difference of sets B and A denoted by B – A is the set of the elements of only B which do not belong to A.

Mathematically,

A – B = {x : x ∈ A, but x ∉ B}

B – A = {x : x ∈ B, but x ∉ A}

For example,

if A = {1, 2, 3, 4, 5} and B = {2, 4, 6, 8}, then

A – B = {1, 3, 5} and B – A = {6, 8}

Thus,   A – B = A – (A ∩ B) ← Removing the common elements from A

          B – A = B – (A ∩ B) ← Removing the common elements from B

The shaded regions in the following Venn-diagrams represent the difference of sets.

| **A – B**
A and B are disjoint sets. | **A – B**
A and B are overlapping sets. | **B – A**
A and B are disjoint sets. | **B – A**
A and B are overlapping sets. |
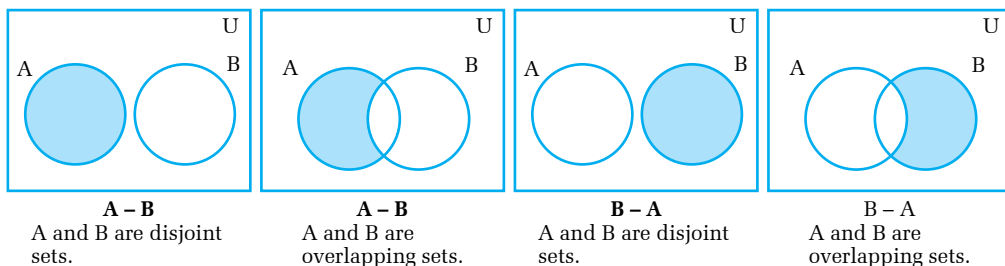
(iv) Complement of a set

If A be a subset of a universal set U, then the complement of A denoted by $\bar{A}$ or A^c or A' is the set of the elements of U which do not belong to A.

Mathematically,

$\bar{A} = \{x : x \in U, \text{ but } x \notin A\}$

For example,

if U = {1, 2, 3, ... 10} and A = {2, 4, 6, 8}, then $\bar{A}$ = {1, 3, 5, 7, 9, 10}

Thus, the complement of the set A is the difference of U and A.

i.e. $\bar{A} = U - A$.

The shaded regions in the following Venn-diagrams represent the complements of the given sets.

| $\bar{A}$ | $\overline{A \cup B}$ | $\overline{A \cap B}$ | $\overline{A - B}$ |
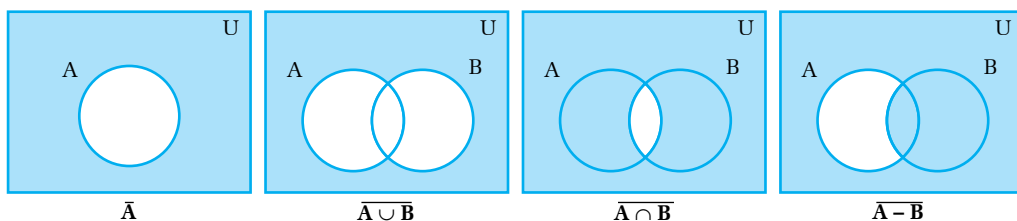
Worked out examples

Example 1: A and B are the subsets of the universal set U. If U = {1, 2, 3, ... 10}, A = {2, 3, 5, 7} and B = {1, 3, 5, 7, 9}, find

a) $A \cup B$ and $\overline{A \cup B}$ b) $A \cap B$ and $\overline{A \cap B}$

c) $A - B$ and $\overline{A - B}$ d) $B - A$ and $\overline{B - A}$

Solution:

Here, U = {1, 2, 3, ... 10}, A = {2, 3, 5, 7} and B = {1, 3, 5, 7, 9}

a) Now, $A \cup B$ = {1, 2, 3, 5, 7, 9}

   And $\overline{A \cup B}$ = U – (A ∪ B)

   = {4, 6, 8, 10}

A ∪ B

$\overline{A \cup B}$
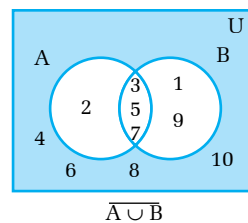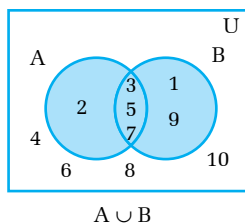
b) $A \cap B \quad = \{3, 5, 7\}$

$\overline{A \cap B} \quad = U - (A \cap B)$

$\qquad\qquad = \{1, 2, 4, 6, 8, 9, 10\}$

$A \cap B$

$\overline{A \cap B}$
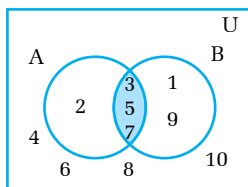
c) $A - B \quad = \{2\}$

$\overline{A - B} \quad = U - (A - B)$

$\qquad\qquad = \{1, 3, 4, 5, 6, 7, 8, 9, 10\}$

$A - B$

$\overline{A - B}$
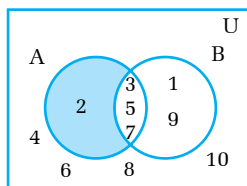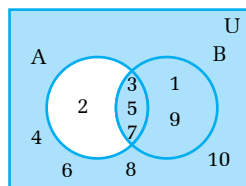
d) $B - A \quad = \{1, 9\}$

$\overline{B - A} \quad = U - (B - A)$

$\qquad\qquad = \{2, 3, 4, 5, 6, 7, 8, 10\}$
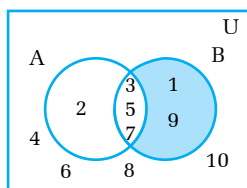
$B - A$
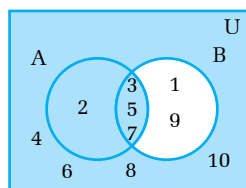
$\overline{B - A}$

Example 2: **A, B and C are the subsets of the universal set U. If U = {1, 2, 3, ... 15},**
A = {2, 4, 6, 8, 10, 12}, B = {3, 6, 9, 12, 15}, and C = {1, 2, 3, 4, 5, 6},
find

a) $A \cup B \cup C$ b) $A \cap B \cap C$ c) $(A \cap B) \cup C$ d) $\overline{(A \cup B) \cap C}$

Solution:

Here, $U = \{1, 2, 3, ... 15\}$

$\qquad A = \{2, 4, 6, 8, 10, 12\}, B = \{3, 6, 9, 12, 15\}$ and $C = \{1, 2, 3, 4, 5, 6\}$

a) $\quad A \cup B = \{2, 3, 4, 6, 8, 9, 10, 12, 15\}$

$A \cup B \cup C = \{1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15\}$
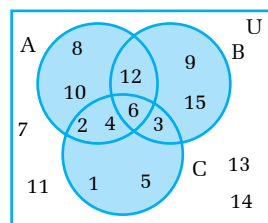
$A \cup B \cup C$

b) $\quad A \cap B = \{6, 12\}$

$A \cap B \cap C = \{6\}$
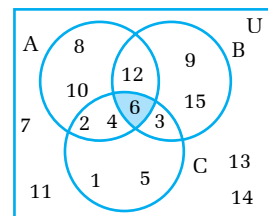
$A \cap B \cap C$

c) $A \cap B = \{6, 12\}$
  $(A \cap B) \cup C = \{1, 2, 3, 4, 5, 6, 12\}$

$(A \cap B) \cup C$
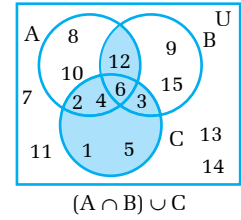
d) $A \cup B = \{2, 3, 4, 6, 8, 9, 10, 12, 15\}$
  $(A \cup B) \cap C = \{2, 3, 4, 6\}$
  $\overline{(A \cup B) \cap C} = \{1, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$

$\overline{(A \cup B) \cap C}$
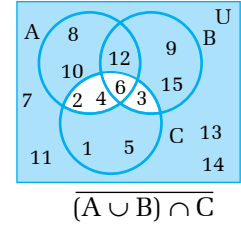
EXERCISE 1.1

General section

1.   Write the set operations represented by shaded regions shown in the following Venn-diagrams.
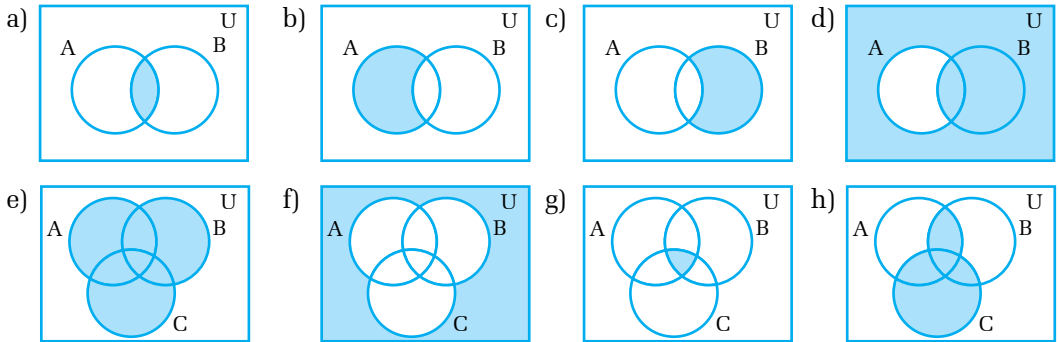
2.   A, B and C are the subsets of the universal set U. From the given diagrams, list the elements of the following set operations.

a) (i) $\overline{A \cup B}$ (ii) $\overline{A \cap B}$ (iii) $A - B$

    (iv) $B - A$ (v) $\overline{A - B}$ (vi) $\overline{B - A}$
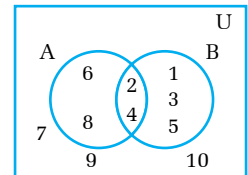
b) (i) $A \cup B \cup C$ (ii) $A \cap B \cap C$ (iii) $\overline{A \cup B \cup C}$

    (iv) $\overline{A \cap B \cap C}$ (v) $(A \cup B) \cap C$ (vi) $(A \cap B) \cup C$

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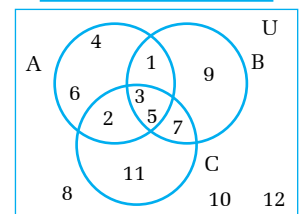
3. Write the set operations for the following mathematical expressions.
   a) $\{x : x \in P \text{ and } x \in Q\}$
   b) $\{x : x \in P, \text{ but } x \notin Q\}$
   c) $\{x : x \in P \text{ or } x \in Q\}$
   d) $\{x : x \in U, \text{but } x \notin P\}$

Creative section

4. A and B are the subsets of the universal set U. If $U = \{1, 2, 3, ... 10\}$, $A = \{1, 2, 3, 4, 5\}$ and $B = \{2, 4, 6, 8\}$, list the elements of the following set operations and represent them by shading in Venn-diagrams.
   a) $A \cup B$ and $\overline{A \cup B}$
   b) $A \cap B$ and $\overline{A \cap B}$
   c) $A - B$ and $\overline{A - B}$
   d) $B - A$ and $\overline{B - A}$
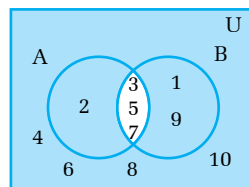   e) $\overline{A} \cup \overline{B}$
   f) $\overline{A} \cap \overline{B}$

5. A, B and C are the subsets of the universal set U. If $U = \{1, 2, 3, ... 15\}$, $A = \{1, 3, 5, 7, 9, 11\}$, $B = \{1, 2, 3, 4, 5, 6, 7\}$ and $C = \{3, 6, 9, 12, 15\}$, list the elements of the following set operations and illustrate them in Venn-diagrams by shading.
   a) $A \cup B \cup C$ and $\overline{A \cup B \cup C}$
   b) $A \cap B \cap C$ and $\overline{A \cap B \cap C}$
   c) $(A \cup B) \cap C$ and $\overline{(A \cup B) \cap C}$
   d) $A \cap (B \cup C)$ and $\overline{A \cap (B \cup C)}$
   e) $(A - B) \cup C$ and $\overline{(A - B) \cup C}$
   f) $A \cup (B - C)$ and $\overline{A \cup (B - C)}$

6. If $U = \{1, 2, 3, ... 10\}$, $A = \{2, 3, 5, 7\}$, $B = \{1, 2, 3, 4, 5\}$ and $C = \{1, 3, 5, 7, 9\}$, verify the following operations.
   a) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
   b) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
   c) $\overline{A \cup B} = \overline{A} \cap \overline{B}$
   d) $\overline{A \cap B \cap C} = \overline{A} \cup \overline{B} \cup \overline{C}$

1.4 Cardinality relations of sets

The number of members of a set is called its cardinality. Certain relations can be generalised by taking the cardinalities of different sets.

(i) Cardinality relations of union of two disjoint sets

Let $U = \{a, b, c, d, e, f, g, h\}$ is a universal set. $A = \{a, b, c\}$ and $B = \{e, f, g, h\}$ are the subsets of U.

Now, $A \cup B = \{a, b, c, e, f, g, h\}$

Here, $n(U) = 8$

$n(A) = 3$

$n(B) = 4$

$n(A \cup B) = 7 = 3 + 4 = n(A) + n(B)$

Also, $n(\overline{A \cup B}) = 1 = 8 - 7 = n(U) - n(A \cup B)$

Thus, if A and B are any two disjoint subsets of a universal set U,

$n(A \cup B) = n(A) + n(B)$

$n(\overline{A \cup B}) = n(U) - n(A \cup B)$
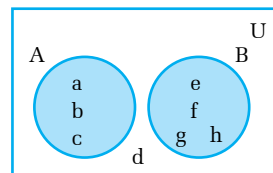
(ii) Cardinality relations of union of two overlapping sets

Let U = {a, b, c, d, e, f, g, h} is a universal set. A = {a, b, c, d} and
B = {c, d, e} are the subsets of U.

Now, A ∪ B = {a, b, c, d, e}

$\qquad$ A ∩ B = {c, d}

$\qquad$ $\overline{A \cup B}$ = {f, g, h}

$\qquad$ only A = {a, b}

$\qquad$ only B = {e}

Here, n (U) = 8

$\qquad$ n (A) = 4

$\qquad$ n (B) = 3

$\qquad$ n (A ∩ B) = 2

$\qquad$ n (A ∪ B) = 5 = 4 + 3 − 2 = n (A) + n (B) − n (A ∩ B)

$\qquad$ n ($\overline{A \cup B}$) = 3 = 8 − 5 = n (U) − n (A ∪ B)

$\qquad$ n (only A) = n_o(A) = 2 = 4 − 2 = n(A) − n(A ∩ B)

$\qquad$ n (only B) = n_o(B) = 1 = 3 − 2 = n(B) − n(A ∩ B)

Thus, if A and B are any two overlapping subsets of a universal set U,

n (A ∪ B)   = n (A) + n (B) − n (A ∩ B)

n ($\overline{A \cup B}$)   = n (U) − n (A ∪ B)

n (A ∩ B)   = n (A) + n (B)− n (A ∪ B)

n (only A) = n_o(A) = n(A) − n(A ∩ B)

n (only B) = n_o(B)   = n(B) − n(A ∩ B)

Furthermore, if the universal set U contains only the members of A and B,
then,

n ($\overline{A \cup B}$) = 0 and n (U) = n (A ∪ B)
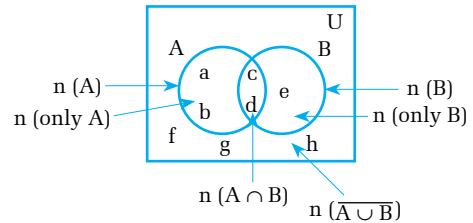
Worked out examples

Example 1: **From the adjoining Venn-diagram, find   the
cardinal numbers of the following sets.**

a) n (A) $\qquad$ **b) n (B)** $\qquad$ **c) n (A ∪ B)**

d) n (A ∩ B) $\qquad$ **e) n ($\overline{A \cup B}$)** $\qquad$ **f) n ($\overline{A}$)**

g) n ($\overline{B}$) $\qquad$ **h) n_o (A)** $\qquad$ **i) n_o (B)**
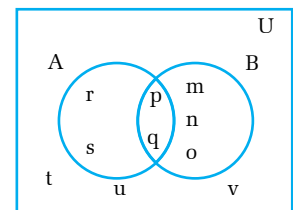
Solution:

a) n (A) = 4 $\qquad$ b) n (B) = 5 $\qquad$ c) n (A ∪ B) = 7

d) n (A ∩ B) = 2 $\qquad$ e) n ($\overline{A \cup B}$) = 3 $\qquad$ f) n ($\overline{A}$) = n (U) − n (A) = 10 − 4 = 6

g) n ($\overline{B}$) = n (U) − n (B) = 10 − 5 = 5 $\qquad$ h) n_o (A) = 2 $\qquad$ i) n_o (B) = 3

Example 2: If n (U) = 100, n (A) = 65, n (B) = 50, n (A ∩ B) = 35, find
a) n (A ∪ B)   b) n ($\overline{A \cup B}$)   c) n_o (A)   d) n_o (B)

Solution:

Here, n (U) = 100,   n (A) = 65,   n (B) = 50,   n (A ∩ B) = 35

a) Now, n (A ∪ B) = n (A) + n (B) − n (A ∩ B)

$\qquad\qquad\qquad$ = 65 + 50 − 35

$\qquad\qquad\qquad$ = 80

b) n ($\overline{A \cup B}$) = n (U) − n (A ∪ B)   = 100 − 80 = 20

c) n_o (A)   = n (A) − n (A ∩ B) = 65 − 35   = 30

d) n_o (B)   = n (B) − n (A ∩ B) = 50 − 35   = 15

Example 3: P and Q are the subsets of a universal set U where n (U) = 75, n (P) = 50, n (Q) = 40 and n (P ∩ Q) = 20.
(i) Illustrate this information in a Venn-diagram.
(ii) Find n ($\overline{P \cup Q}$)

Solution:

(i) Illustration in a Venn-diagram
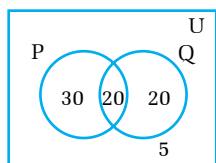
(ii) From the Venn-diagram,

$\qquad$ n (P ∪ Q)   = 30 + 20 + 20

$\qquad\qquad\qquad$ = 70

$\qquad$ ∴ n ($\overline{P \cup Q}$) = n (U) − n (P ∪ Q)

$\qquad\qquad\qquad$ = 75 − 70 = 5

Alternative process of (ii)

$\qquad$ n (P ∪ Q)   = n (P) + n (Q) − n (P ∩ Q)

$\qquad\qquad\qquad$ = 50 + 40 − 20

$\qquad\qquad\qquad$ = 70

∴ n ($\overline{P \cup Q}$) = n (U) − n (P ∪ Q) = 75 − 70 = 5

Example 4: If n (U) = 96, n (A) = 55, n (B) = 48 and n (A ∪ B) = 80, then
(i) find n ($\overline{A \cup B}$), n (A ∩ B), n_o (A) and n_o (B).
(ii) Illustrate the information in a Venn-diagram.

Solution:

Here,   n (U) = 96,   n (A) = 55,   n (B) = 48 and   n (A ∪ B) = 80

(i) Now, n ($\overline{A \cup B}$) = n (U) − n (A ∪ B)

$\qquad\qquad\qquad$ = 96 − 80

$\qquad\qquad\qquad$ = 16

Again, n (A ∪ B) = n (A) + n (B) − n (A ∩ B)

or,   80 $= 55 + 48 - n(A \cap B)$
or, $n(A \cap B)$ $= 103 - 80$
                              $= 23$
Also, $n_o(A)$ $= n(A) - n(A \cap B)$
                              $= 55 - 23 = 32$
And $n_o(B)$ $= n(B) - n(A \cap B)$
                              $= 48 - 23 = 25$

(ii) Illustration in Venn-diagram
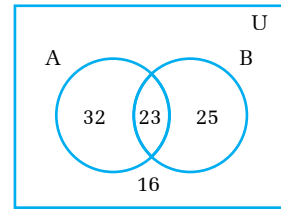
Example 5: **In a group of 200 students who like games, 120 of them like cricket and 105 like football. By drawing Venn-diagram, find**
(i) how many students like both the games.
(ii) How many students like only cricket?

Solution:

Let **C** and **F** be the sets of the students who like cricket and football respectively.

Venn-diagram
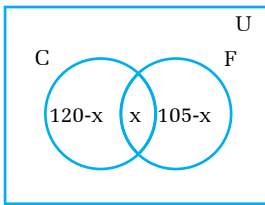
From the Venn-diagram,

(i) $n(C \cup F) = 120 - x + x + 105 - x$

or, $200 = 225 - x$

or, $x = 225 - 200 = 25$

So, 25 of them like both the games.

(ii) $n_o(C) = 120 - x = 120 - 25 = 95$

So, 95 students like only cricket.

Example 6: **In a survey, 80 students were asked what they would like milk or tea. 60 said tea, 50 said milk and 10 said they would like neither tea nor milk.**
(i) Find the number of students who like both drinks.
(ii) Find the number of students who like only one drink.
(iii) Illustrate the result in Venn-diagram.

Solution:

Let T and M be the sets of the students who like tea and milk respectively.

Here, $n(U) = 80$, $n(T) = 60$, $n(M) = 50$ and $n(\overline{T \cup M}) = 10$

(i) Now, $n(T \cup M) = n(U) - n(\overline{T \cup M})$

                $= 80 - 10$

                $= 70$

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Again, n (T ∪ M) = n (T) + n (M) – n (T ∩ M)

or, 70 = 60 + 50 – n (T ∩ M)

or, n (T ∩ M) = 110 – 70 = 40

So, 40 students like both tea and milk.

(iii) Venn-diagram
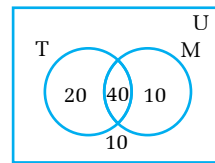
(ii) Also , the number of students who like tea only = n_o (T)

= n (T) – n (T ∩ M)

= 60 – 40 = 20

And, the number of students who like milk only = n_o (M)

= n (M) – n (T ∩ M)

= 50 – 40 = 10

Example 7: **In a survey conducted among some people of a group, it was found that 40 % of them liked literature, 65 % liked music and 10 % of them like none.**

(i) Represent the above information in Venn-diagram.

(ii) If there were 30 people who liked both items, find the number of people participated in the survey.

Solution:

Let L and M be the sets of the people who liked literature and music respectively.

Here, n (U) = 100 %, n (L) = 40 %, n (M) =65 % and n ($\overline{L \cup M}$) = 10 %

(i) Now, n (L ∪ M) = n (U) – n ($\overline{L \cup M}$)

= 100 % – 10 %

= 90 %

Again, n (L ∪ M) = n (L) + n (M) – n (L ∩ M)

or, 90 % = 40 % + 65 % – n (L ∩ M)

or, n (L ∩ M) = 105 % – 90 % = 15 %
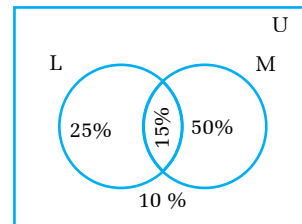
(ii) Let the number of people participated in the survey be x.

Now, 15 % of x = 30

or, $\dfrac{15}{100} \times x$ = 30

or, x = 200

So, 200 people participated in the survey.

Example 8: **In a survey of 300 people, 90 liked folk songs but not modern songs, 110 liked modern songs but not folk songs and 40 of them did not like both songs.**

(i) Find the number of people who liked both songs.

(ii) How many of them liked folk songs?

(iii) How many of them liked modern songs?

(iv) Represent the result in Venn-diagram.

Solution:

Let F and M be the sets of the people who liked folk songs and modern songs respectively.

Here, $n(U) = 300$, $n_o(F) = 90$, $n_o(M) = 110$ and $n(\overline{F \cup M}) = 40$

(i) Now $n(F \cup M) = n(U) - n(\overline{F \cup M})$

$= 300 - 40$

$= 260$

Let the number of people who liked both songs be x.

Then, $n(F \cup M) = n_o(F) + n_o(M) + x$

or, $260 = 90 + 110 + x$

or, $x = 60$

So, 60 people liked both songs.

(ii) The number of people who liked folk songs

$= n_o(F) + 60 = 90 + 60 = 150$

(iii) The number of people who liked modern songs

$= n_o(M) + 60 = 110 + 60 = 170$

(iv) Venn-diagram
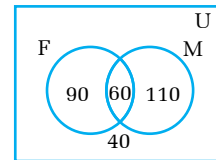
EXERCISE 1.2

General section

1. a) If $n(A) = x$, $n(B) = y$ and $n(A \cap B) = z$, show this information in a Venn-diagram and show that $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.

   b) If A and B are two overlapping subsets of a universal set U, write the relation between $n(U)$, $n(A \cup B)$ and $n(\overline{A \cup B})$.

   c) If P and Q are two overlapping subsets of a universal set U, Write the relation between $n(P)$, $n(P \cap Q)$ and $n_o(P)$.

   d) If X and Y are two overlapping subsets of a universal set U, Write the relation between $n(Q)$, $n(P \cap Q)$ and $n_o(Q)$.

2. From the adjoining Venn-diagram, find the cardinal numbers of the following sets.

   a) $n(U)$ b) $n(A)$ c) $n(B)$
   d) $n(A \cup B)$ e) $n(A \cap B)$ f) $n(\overline{A \cup B})$
   g) $n(\overline{A})$ h) $n(\overline{B})$ i) $n_o(A)$ j) $n_o(B)$
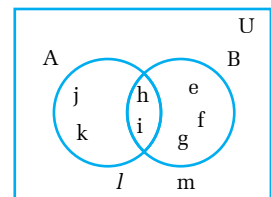
3. a) If $n(U) = 85$, $n(A) = 48$, $n(B) = 50$ and $n(A \cap B) = 28$, find

   (i) $n(A \cup B)$ (ii) $n(\overline{A \cup B})$ (iii) $n_o(A)$ (iv) $n_o(B)$

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b) P and Q are the subsets of a universal set U. If n (P) = 40 %, n (Q) = 55 % and n $(\overline{P \cup Q})$ = 15 %, find

(i) n (P $\cup$ Q)   (ii) n (P $\cap$ Q)   (iii) n (only p)   (iv) n (only Q)

c) A and B are the subsets of a universal set U. If n (U) = 88, n_o (A) = 35, n_o (B) = 30 and n (A $\cap$ B) = 10, find

(i) n (A)   (ii) n (B)   (iii) n (A $\cup$ B)   (iv) n $(\overline{A \cup B})$

d) G and H are the subsets of a universal set U. If n $(\overline{G \cup H})$ = 16 %, n_o (G) = 36 % and n_o (H) = 25 % find,

(i) n (G $\cup$ H)   (ii) n (G $\cap$ H)   (iii) n (G)   (iv) n (H)

4. a) P and Q are the subsets of a universal set U. If n(U) = 75, n_o(P) = 20, n_o(Q) = 25 and n(P $\cap$ Q) = 18, illustrate this information in a Venn-diagram.

b) A and B are the subsets of a universal set U. If n (U) = 40, n (A) = 18, n (B) = 20, n (A $\cap$ B) = 5, illustrate this information in a Venn-diagram.

Creative section

5. a) P and Q are the subsets of a universal set U in which there are n (U) = 43, n (P) = 25, n (Q) = 18 and n (P $\cap$ Q) = 7.

(i) Draw a Venn-diagram to illustrate the above information.

(ii) Find the value of n $(\overline{P \cup Q})$.

b) A and B are the subsets of U. If n (A) = 75 %, n (B) = 60 % and n $(\overline{A \cup B})$ = 0 %,

(i) illustrate this information in a Venn-diagram.

(ii) Find n (A $\cap$ B) , n_o (A) and n_o (B).

6. a) In a survey of 300 people in a village of Rasuwa district, 160 people said they can speak the Tamang language, 150 said the Newari language and 80 of them said they can speak both the languages.

(i) Draw a Venn-diagram to illustrate the above information.

(ii) How many people cannot speak any of two languages?

(iii) How many people can speak the Tamang language only?

(iv) How many people can speak the Newari language only?

b) In a group of 250 music lovers, 135 of them like folk songs and 150 like modern songs. By drawing a Venn-diagram, find

(i) how many people like both the songs?

(ii) How many people like only one song?

c) In a survey of a community, it was found that 85 % people like winter season and 65 % like summer season. If there were not any people who did not like both seasons,
   (i) represent the information in a Venn-diagram.
   (ii) What percent were there who like both the seasons?
   (iii) What percent were there who like only one season?

7. a) In a group of 450 students, 250 like oranges, 280 like apples and 40 dislike both the fruits.
   (i) Find the number of students who like both the fruits.
   (ii) Find the number of students who like only one fruit.
   (iii) Show the result in a Venn-diagram.

   b) In a survey of 900 students in a school, it was found that 600 students liked tea, 500 liked coffee and 125 did not like both drinks.
   (i) Draw a Venn-diagram to illustrate the above information.
   (ii) Find the number of students who like both drinks.
   (iii) Find the number of students who didn't like tea only.

   c) In a survey of some students, it was found that 45 % of them like football, 60 % like cricket and 15 % of them like non of the games.
   (i) Represent the above information in a Venn-diagram.
   (ii) If there are 60 students who like both games, find the number of students who participated in the survey.

8. a) In a group of 60 students, 15 liked maths only, 20 liked science only and 5 did not like any of two subjects?
   (i) How many of them liked at least one subject?
   (ii) Find the number of students who liked both the subjects.
   (iii) How many of them liked maths?
   (iv) How many of them liked science?
   (v) Represent the result in a Venn diagram.

   b) In a group of 150 people, 65 like tea only and 60 like milk only. If each people likes at least one of the two drinks,
   (i) draw a Venn diagram to illustrate the above information.
   (ii) How many people like both drinks?
   (iii) How many people like tea?
   (iv) How many people like milk?

Note: Dear students, for more practice please go through the appendix given at the end of the book.

2 Chapter

Profit and Loss

2.1 Profit and Loss Percent - Review

Case - I

A shopkeeper buys a pen for Rs 100 and sells it for Rs 105.

Could you please tell how much profit does he make?

And, what is his profit percent?

Case - II

Unfortunately, he sells the pen for Rs 90.

Could you please tell how much loss does he have?

And, how much is the loss percent?

Case - III

If the shopkeeper had bought the pen for Rs 200 and sold it for Rs 205, how much profit and profit percent would he have made?

Case - IV

If the shopkeeper had bought the pen for Rs 95 and sold it for Rs 100, how much profit and profit percent would he have made?

From the above given cases I to IV, what conclusion about profit percent and loss percent do you make?

Of course, when the selling price (S.P.) of any item is higher than its cost price (C.P.), there will be profit. But in the case of cost price higher than selling price, there will be loss.

So,   **profit = S.P. – C.P.**   (Also called actual profit)

And,   **loss = C.P. – S.P.**   (Also called actual loss)

Obviously, cost price is the investment to buy any item. So, profit or loss is calculated out of investment (i.e. C.P.). When C.P. is Rs 100 and profit is made, it is called **profit percent**. But if loss is made out of C.P. of Rs 100, it is called **loss percent**.

Let, in a C.P. of a certain sum, the profit be P

Then, in a C.P. of Re 1, the profit is $\dfrac{P}{C.P.}$

And, in a C.P. of Rs 100, the profit is $\dfrac{P}{C.P.} \times 100$.

Here, $\dfrac{P}{C.P.} \times 100$ gives the profit percent.

Thus, $\text{profit percent} = \dfrac{\text{Actual profit}}{\text{C.P.}} \times 100\%$ or, $\dfrac{\text{S.P.} - \text{C.P.}}{\text{C.P.}} \times 100\%$

$\text{loss percent} = \dfrac{\text{Actual loss}}{\text{C.P.}} \times 100\%$ or, $\dfrac{\text{C.P.} - \text{S.P.}}{\text{C.P.}} \times 100\%$

Worked out examples

Example 1: A shopkeeper bought five dozen of pencils for Rs 480. If she sold 5 pencils for 45, find her profit or loss percent on 1 pencil.

Solution:

Here, C.P. of 5 dozen i.e. 60 pencils = Rs 480

$\qquad$ C.P. of 1 pencil $= \text{Rs } \dfrac{480}{60} = \text{Rs } 8$

$\qquad$ S.P. of 5 pencils = Rs 45

$\qquad$ S.P. of 1 pencil $= \text{Rs } \dfrac{45}{5} = \text{Rs } 9$

Since, S.P. > C.P., she made profit.

Actual profit = S.P. – C.P. = Rs 9 – Rs 8 = Re 1

Now, profit percent $= \dfrac{\text{Actual profit}}{\text{C.P.}} \times 100\% = \dfrac{\text{Rs } 1}{\text{Rs } 8} \times 100\% = 12.5\%$.

So, her profit percent on 1 pencil is Rs 12.5%.

Example 2: A fruitseller purchased 1 quintal of organic apples at Jumla for Rs 7500 and paid Rs 5 per kg in transportation from Jumla to Kathmandu. 10 kg of apples were found damage and he sold the remaining quantity at Rs 88 per kg. Fins his profit or loss percent in the total transaction.

Solution:

Here, C.P. of 1 quintal i.e. 100 kg of apples = Rs 7,500

$\quad$ C.P. of apples with transportation charge = Rs 7,500 + 100 × Rs 5 = Rs 8,000

$\qquad$ Remaining quantity of apples = 100 kg – 10 kg = 90 kg

$\qquad$ S.P. of 90 kg of apples = 90 × Rs 88 $\quad$ = Rs 7920

Since, C.P. > S.P., he made loss.

Actual loss = C.P. – S.P. = Rs 8,000 – Rs 7920 = Rs 80

Now, loss percent $= \dfrac{\text{Actual loss}}{\text{C.P.}} \times 100\% = \dfrac{\text{Rs } 80}{\text{Rs } 8,000} \times 100\% = 1\%$

So, his loss percent is 1%.

Example 3: A shopkeeper sells 5 kg of rice for the cost price of 4 kg of rice. Find his loss percent.

Solution:

Let, C.P. of 1 kg of rice = Rs x

$\qquad$ C.P. of 4 kg of rice = Rs 4x

$\qquad$ C.P. of 5 kg of rice = Rs 5x

According to the question,

$\qquad$ S.P. of 5 kg of rice = C.P. of 4 kg of rice

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S.P. of 5 kg of rice $= $ Rs $4x$

Actual loss in 5 kg of rice $=$ C.P. $-$ S.P. $=$ Rs $5x - 4x =$ Rs x

Now, loss percent $= \dfrac{\text{Actual loss}}{\text{C.P.}} \times 100\% = \dfrac{x}{5x} \times 100\% = 20\%$

So, his loss percent is 20%.

Example 4: **A woman bought a second hand car for Rs 12,50,000. He spent Rs 75,000 to repair it. At what price should she sell it to gain 7 % on her total outlay?**

Solution:

Here, C.P. of the car with repairment charge $=$ Rs 12,50,000 $+$ Rs 75,000 $=$ Rs 13,25,000

Profit percent $= 7\%$

Now,

S.P. of the car $=$ C.P. $+$ P% of C.P.

$=$ Rs 13,25,000 $+$ 7% of Rs 13,25,000

$=$ Rs $\left(13,25,000 + \dfrac{7}{100} \times 13,25,000\right)$

$=$ Rs 14,17,750

Alternative process

S.P. of the car $= (100 + P)\%$ of C.P.

$= 107\%$ of C.P.

$= \dfrac{107}{100} \times 13,25,000$

$=$ Rs 14,17,750

So, the required selling price of the car is Rs 14,17,750.

Example 5: **A retailer bought 10 dozen of glass plates. 12 glass plates were broken during transportation. If she sold the remaining plates at the rate of Rs 60 and gained 20%, at what rate of cost did she buy the plates?**

Solution:

Here, the total number of glass plates $= 10$ dozen $= 120$

The remaining number of plates $= 120 - 12 = 108$

S.P. of 1 glass plate $=$ Rs 60

S.P. of 108 glass plates $= 108 \times$ Rs 60

Now, S.P. $=$ C.P. $+$ P% of C.P.

or, $108 \times 60 =$ C.P. $+$ 20% of C.P.

or, $108 \times 60 = \dfrac{6 \text{ C.P.}}{5}$

or, C.P. $=$ Rs 5,400

Alternative process

S.P. $= (100 + P)\%$ of C.P.

or, $108 \times 60 = 120\%$ of C.P.

or, $108 \times 60 = \dfrac{120}{100} \times$ C.P.

C.P. $=$ Rs 5400

Again, C.P. of 120 glass plates is Rs 5,400

C.P. of 1 glass plate is Rs $\dfrac{5,400}{120} =$ Rs 45

So, she bought the glass plates at the rate of Rs 45 each.

Example 6: **Mr. Jha bought some fruits for Rs 2,500 and sold them at 4% profit. If he had bought them for Rs 2,560, what would be his profit or loss percent?**

Solution:

Here, the first cost price of fruits (C.P.$_1$) $=$ Rs 2,500

Profit percent (P%) $= 4\%$

Selling price (S.P.) = ?

the second cost price (C.P.$_2$) = Rs 2560

Profit or loss percent = ?

Now, S.P. of fruits = C.P.$_1$ + 4% of C.P.$_1$

$$= \text{Rs } 2{,}500 + \frac{4}{100} \times \text{Rs } 2{,}500$$

$$= \text{Rs } 2{,}600$$

Again, C.P.$_2$ = Rs 2,560 and S.P. = Rs 2,600. So, he made profit.

Profit = S.P. – C.P. = Rs 2,600 – Rs 2,560 = Rs 40

Also, profit percent = $\dfrac{\text{Actual profit}}{\text{C.P.}} \times 100\% = \dfrac{\text{Rs } 40}{\text{Rs } 2{,}560} \times 100\% = 1.56\%$

So, his profit percent would be 1.56%.

Example 7: **Mrs. Sharma sold a cosmetic item for Rs 550 and made a profit of 10%. If she had sold it for Rs 495, what would be her profit or loss percent?**

Solution:

Here, the first selling price of cosmetic item (S.P.$_1$) = Rs 550

Profit percent (P%) = 10%

cost price of the cosmetic item (C.P.) = ?

the second selling price of the cosmetic item (S.P.$_2$) = Rs 495

Profit or loss percent = ?

Now,

C.P. + P% of C.P. = S.P.$_1$

or, C.P. + 10% of C.P. = Rs 550

or, $\dfrac{11 \text{ C.P.}}{10}$ = Rs 550

or, C.P. = Rs 500

Again, S.P.$_2$ = Rs 495 and C.P. = Rs 500. So, there is a loss.

Now, actual loss = C.P. – S.P.$_2$ = Rs 500 – Rs 495 = Rs 5

Also, loss percent = $\dfrac{\text{Actual loss}}{\text{C.P.}} \times 100\% = \dfrac{\text{Rs } 5}{\text{Rs } 500} \times 100\% = 1\%$

So, her loss percent would be 1%.

Example 8: **Mr. Rai sold a mobile set for Rs 38,000 at 5% loss. At what price should he sell it to gain 5%?**

Solution:

Here, the first selling price of the mobile set (S.P.$_1$) = Rs 38,000

Loss percent (L%) = 5%

Cost price of the mobile set (C.P.) = ?

Profit percent (P%) = 5%

Second selling price of the mobile set (S.P.$_2$) = ?

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Now,

C.P. – L% of C.P. = S.P.$_1$

or,   C.P. – 5% of C.P. = Rs 38,000

or, $\dfrac{19 \text{ C.P.}}{20}$ = Rs 38,000

or,   C.P. = Rs 40,000

Again,

S.P.$_2$ = C.P. + P% of C.P.

= Rs 40,000 + 5% of Rs 40,000

= Rs 42,000

So, he should sell the mobile set for Rs 42,000.

> **Alternative process**
>
> S.P. = (100 – L)% of C.P.
>
> or, 38,000 = 95% of C.P.
>
> or, 38,000 = $\dfrac{95}{100}$ × C.P.
>
> C.P. = Rs 40,000

Example 9:   **A shopkeeper sold a pen at a loss of 10%. If she had sold it at Rs 14 more, she would have gained 25%. Find the cost price of the pen.**

Solution:
Let,   the cost price of the pen be Rs x.
Now, S.P. of the pen   = C.P. – L% of C.P.
= Rs (x – 10% of x)
= Rs (x – $\dfrac{x}{10}$) = Rs $\dfrac{9x}{10}$
According to question, new S.P. of the pen = Rs $\dfrac{9x}{10}$ + Rs 14 = Rs $\dfrac{9x + 140}{10}$
Again,   C.P. = S.P. – P% of C.P.

or,   x = $\dfrac{9x + 140}{10}$ – 25% of C.P.

or,   x + $\dfrac{x}{4}$ = $\dfrac{9x + 140}{10}$

or, $\dfrac{5x}{4}$ = $\dfrac{9x + 140}{10}$

or,   x = Rs 40

So, the cost price of the pen is Rs 40.

Example 10:   **A man bought two calculators for Rs 1,000. He sold one of them at 10% profit and the other at 10% loss. Find his gain or loss percent in this transaction if the selling price of both calculators are the same.**

Solution:
Let,   the C.P.$_1$ of one calculator be Rs x.
∴   The C.P.$_2$ of the other calculator is Rs (1,000 – x).

In 10% profit,

S.P.$_1$ = C.P.$_1$ + 10% of C.P.$_1$

= Rs x + 10% of Rs x

= Rs $\dfrac{11x}{10}$

In 10% of loss,

S.P.$_2$ = C.P.$_2$ – 10% of C.P.$_2$

= Rs (1,000 – x) – 10% of Rs (1,000 – x)

= Rs $\dfrac{9,000 - 9x}{10}$

According to the question,

$$S.P._1 = S.P._2$$

or, $\dfrac{11x}{10} = \dfrac{9,000 - 9x}{10}$

or, $x = Rs\ 450$

Now, $S.P._1 = \dfrac{11x}{10} = \dfrac{11 \times 450}{10} = Rs\ 495$

Since, $S.P._1 = S.P._2$, the total S.P. = 2 × Rs 495 = Rs 990

Actual loss = C.P. – S.P. = Rs 1,000 – Rs 990 = Rs 10

Again, loss percent = $\dfrac{\text{Actual loss}}{\text{C.P.}} \times 100\% = \dfrac{Rs\ 10}{Rs\ 1,000} \times 100\% = 1\%$

So, his loss percent in this transaction is 1%.

EXERCISE 2.1

General section

1. a) If profit is P% and cost price is C.P., what will be the selling price?
   b) If loss is L% and cost price is C.P. , what will be the selling price?
   c) If gain is G% and selling price is S.P., what will be the cost price?
   d) If loss is L% and selling price is S.P., what will be the cost of price?

2. From the table given below, calculate the unknown variables.

	C.P.	S.P.	Actual profit or loss	profit or loss percent
a)	Rs 250	Rs 300	?	?
b)	Rs 640	Rs 608	?	?
c)	Rs 800	?	?	4% (profit)
d)	Rs 520	?	?	10% (loss)
e)	?	Rs 1,008	?	5% (profit)
f)	?	Rs 558	?	7% (loss)
g)	?	Rs 448	Rs 48 (profit)	?
h)	?	Rs 756	Rs 108 (loss)	?
i)	Rs 1,200	?	?	2% (profit)
j)	Rs 980	?	?	5% (loss)

3. a) A shopkeeper purchased an electric fan for Rs 1,560 and sold it at 5% profit. Find his actual profit and selling price of the fan.
   b) Mrs. Chaudhari bought a camera for Rs 6,250. If she sold it at 4% loss, how much was her actual loss? Find the selling price of the camera.

4. a) A man sells a mobile set for Rs 5,994 at a loss of 7.5%. How much money has he paid to buy the mobile. Also find his loss amount.

b) Mrs. Shrestha sold a 'Palpali Dhaka Topi' for Rs 858 and made a profit of 10%. Find her buying price of the 'Dhaka Topi'. How much is her actual profit?

Creative section

5. a) A stationer purchased one dozen of geometry boxes for Rs 900. If she sold 5 boxes for Rs 390, find her gain or loss percent on one box.

b) Raju Tamang bought 40 kg of rice at Rs 80 per kg. He sold 25 kg of rice at Rs 84 per kg and the remaining quantity at Rs 76 per kg. Find his profit or loss percent in the transaction.

c) A shopkeeper bought 500 glass tumblers at Rs 40 each. 20 glass tumblers were broken and he sold the rest at Rs 45 each. Find his profit or loss percent.

d) A woman bought 2 quintals of apples in Mustang for Rs 16,000. She paid Rs 10 per kg for the transportation from Jomsom to Pokhara. 5 kg of apples were damage and she sold the remaining quantity at Rs 90 per kg. Calculate her profit or loss percent in the total transaction.

e) A grocer sells 40 *l* of oil for the cost price of 42 *l*, find his gain percent.

f) A fruitseller bought 50 kg of fruits. He sold 30 kg of fruits for the cost price of 35 kg of fruits and he sold the remaining quantity for the cost price of 16 kg of fruits. Calculate his profit or loss percent in the total transaction.

6. a) Mr. Gurung bought a secondhand bike for Rs 1,25,200. He spent Rs 5,300 to repair it. At what price should he sell it to gain 5% on his total investment?

b) A book seller purchased 100 story books at Rs 135 each. She donated 10 books to a school library. If she sold remaining books at 2% loss, find the selling price of each book.

7. a) A retailer sold 3 cameras for Rs 28,500 and had a loss of 5%. Find the cost price of each camera.

b) Mrs. Thapa bought 150 kg of oranges. 18 kg of oranges were rotten and not fit for selling. If she sold the remaining quantity of oranges at the rate of Rs 80 per kg and gained 10%, find the rate of cost price or oranges.

c) A man purchased 10 pens. He sold 5 pens at 25% profit and the remaining 5 pens at $16\frac{2}{3}$% loss. If he received Rs 625 in total, find the cost price of each pen.

8. a) Debashis bought a mountain bike for Rs 7,600 and sold it at 10% profit. If he had bought it for Rs 8,000, what would be his profit or loss percent?

b) Mrs. Joshi bought a saree for Rs 1,750. She sold it at a profit of 4%. What would be her profit or loss percent if she had bought it for Rs 2,000?

9. a) Sabita sold a bag for Rs 1,368 at 5% loss. Calculate her profit or loss percent if she had sold it for Rs 1,512.

b) A grocer sold 5 kg of wheat flour at Rs 30 per kg and gained 20%. If he had sold it at Rs 27 per kg, what would be his gain or loss percent?

10. a) A retailer sold a mobile set for Rs 8,330 and made a loss of 2%. For what price should he sell it to gain 7%?

b) At a profit of 8% a shopkeeper sold a calculator for Rs 1,382.40. If he wants to increase his profit by 2%, at what price should he sell the calculator?

11. a) Ramesh buys a pen for Rs 20 and sells it at 20% profit. For what price should he buy it so that he can make 25% profit by selling for the same selling price.

    b) A fruit seller bought some mangoes for Rs 500. He sold them at 10% loss. If he wants to make a profit of 12.5% without increasing the selling price, by how much should the cost price of the mangoes be reduced?

12. a) An article when sold at a profit of 5% yields Rs 50 more than when sold at a loss of 5%. What was the cost price of the article?

    b) Mrs. Shakya sold a jewellery at a loss of 5%. If she had sold it at Rs 5,200 more, she would have gained 8%. Find the cost price of the jewellery.

    c) Raj Mandal sold a computer at a profit of 15%. If he had sold it at Rs 10,000 less, he would have a loss of 1%. At what price did he purchase the computer?

13. a) A man bought two watches for Rs 2,500 each. He sold one of them at 10% profit and the other at 4% loss. What was his gain or loss percent on the whole?

    b) Bina Chand bought two kettles for Rs 1,625. She sold one of them at 20% profit and the other at 20% loss. If the selling price of both kettles are same, find the cost price of each kettles. Also calculate her gain or loss percent in the total transaction.

    c) The cost price of a box and a pen is Rs 80. The box is sold at 10% profit and the pen is sold at 10% loss. If the selling price of the box is Rs 28 more than that of the pen, calculate the profit or loss percent in the whole.

    d) A shopkeeper bought two radios for Rs 6,000. He sold one of them at a profit of 20% and the other at a loss of 10%. If he gained 2% on his total outlay, at what price did he buy each radio?

14. a) A wholesaler purchased an electric item for Rs 2,700 and sold to retailer at 10% profit. The retailer sold it at 20% profit to a consumer. How much did the consumer pay for it.

    b) Ram Baral sold a pen to Kamala at 25% profit. Kamala sold the pain to Roshan at 10% loss. If Roshan paid Rs 72 to Kamala, how much did Ram pay to buy the pen?

2.2 Marked Price (M.P.) and discount

The price of an article for sale as indicated by an attached label is called marked price (M. P.). It is the normal price of the thing without a discount.

When a shopkeeper reduces price from the marked price of any article and sells it to customers, the reduced amount is called discount. Discount is usually given as a certain percent of marked price.

The formulae given below are useful to workout the problems of marked price and discount.

Discount amount = discount percent of M.P. (D% of M.P.)

Selling price = M.P. – D% of M.P.

Discount percent (D%) = $\dfrac{\text{Discount amount}}{\text{M.P.}} \times 100\%$

2.3 Value Added Tax (VAT)

A value-added tax (VAT) or general sales tax is a form of consumption tax. So, it is a tax on consumer spending. VAT is levied on the cost of goods and services. The VAT rate is given in percent and it is decided by the concerned authority of the government. The VAT rate may vary from country to country. Even in a particular country it may be changed from time to time. For example, when VAT was introduction in Nepal for the first time on 16 November, 1997, the VAT rate was 10% and it is now 13%.

VAT is levied on the actual selling price.

VAT amount = Rate of VAT (in %) × selling price

S.P. with VAT = S.P. + VAT amount

If goods are sold by giving a certain discount, at first the amount of discount is to be deducted from the given marked price to find actual selling price. Then, VAT is levied on the actual selling price.

i.e. **Actual S.P. = M.P. – D% of M.P.**

S.P. with VAT = S.P. + VAT% of S.P.

Worked out examples

Example 1: **A family had three plates of Mo. Mo., two plates of meat ball and a few bottles of cold drink in a restaurant. If the cost of these items amounts to Rs 610, how much should be paid with 10 % service charge and 13 % VAT to clear the bill?**

Solution:

Here, the cost of items with 10 % service charge = Rs 610 + 10 % of Rs 610

= Rs 671

Again, the total cost with 13 % VAT   = Rs 671 + 13 % of Rs 671

= Rs 758.23

So, Rs 758.23 should be paid to clear the bill.

Example 2: **The marked price of a radio is Rs 1,500 and 10 % discount is allowed. How much should a customer pay for it with 13 % VAT?**

Solution:

Here, M.P. of the radio = Rs 1,500

Discount percent = 10 %

S.P. of the radio   = M.P. – 10 % of M.P.

= Rs $1,500 - \frac{10}{100} \times$ Rs $1,500 =$ Rs 1,350

Now, S.P. with VAT = S.P. + VAT % of S.P.

= Rs 1,350 + 13 % of Rs 1,350

= Rs 1,525.50

So, the customer should pay Rs 1,525.50

Example 3: **The marked price of an article is Rs 2,750. If it is sold for Rs 2,420 by giving a discount, calculate the discount percent.**

Solution:

Here, M.P. of the article = Rs 2,750

S.P. of the article = Rs 2,420

Now, discount amount = M.P. – S.P.

= Rs 2,750 – Rs 2,420

= Rs 330

Again, discount percent = $\dfrac{\text{Discount amount}}{\text{M.P.}} \times 100\%$

= $\dfrac{330}{2,750} \times 100\%$

= 12%

So, the required discount percent is 12%.

Example 4: **A mobile set is sold for Rs 6,630 after a discount of 15%. Find the marked price of the mobile set.**

Solution:

Let, the marked price of the mobile set be Rs x.

Now, S.P. of the mobile set = M.P. – 15% of M.P.

or, Rs 6,630 = $x - \dfrac{15}{100} x$

or, Rs 6,630 = $\dfrac{17x}{20}$

or, x = Rs 7,800

So, the marked price of the mobile set is Rs 7,800.

Example 5: **Mrs. Tajpuriya paid Rs 6,780 for a television set with a discount of 20 % including 13 % VAT. What is the marked price of the television?**

Solution:

Let the marked price of the TV be Rs x.

Now, S.P. of the TV = M.P. – discount % of M.P.

= $x - 20\%\ of\ x = \dfrac{4x}{5}$

Again, S.P. with VAT = $\dfrac{4x}{5} + 13\%\ of\ \dfrac{4x}{5} = \dfrac{113x}{125}$

Also, the given S.P. = Rs 6,780

or, $\dfrac{113x}{125}$ = Rs 6,780

or, x = Rs 7,500

So, the marked price of the TV is Rs 7,500.

Alternative process

Let, S.P. without VAT be Rs x.

Then, S.P. without VAT = S.P. with VAT − 13 % of x

or, $x = Rs\ 6,780 - \dfrac{13x}{100}$

or, $x + \dfrac{13x}{100} = Rs\ 6,780$

or, $x = Rs\ 6,000$

Again, let M.P. be Rs y.

Then, M.P. − discount % of M.P. = S.P. (without VAT)

or, $y - 20\% \text{ of } y = Rs\ 6,000$

or, $y = Rs\ 7,500$

So, the required marked price is Rs 7,500.

> **Alternative process**
>
> 113 % of S.P. = Rs 6,780
>
> or, $S.P. = \dfrac{Rs\ 6,780}{13\%}$
>
> S.P. = Rs 6,000
>
> Again, (100 − 20)% of M.P. = S.P.
>
> or, $\dfrac{80}{100} \times M.P. = Rs\ 6,000$
>
> or, M.P. = Rs 7,500

Example 6: **The price of a radio is fixed 20% above its cost price. When it is sold allowing 10% discount, there is a gain of Rs 360. Find the marked price of the radio.**

Solution:

Let, C.P. of the radio be Rs x.

Now, M.P. of the radio = x + 20% of x

$= x + \dfrac{x}{5}$

$= \dfrac{6x}{5}$

Also, S.P. of the radio = M.P. − 10% of M.P.

$= \dfrac{6x}{5} - \dfrac{10}{100} \times \dfrac{6x}{5}$

$= \dfrac{27x}{25}$

Again, profit = S.P. − C.P.

or, $Rs\ 360 = \dfrac{27x}{25} - x$

or, $Rs\ 360 = \dfrac{2x}{25}$

or, $x = Rs\ 4,500$

∴ M.P. of the ratio $= \dfrac{6x}{5} = \dfrac{6 \times Rs\ 4,500}{5} = Rs\ 5,400$

So, the marked price of the radio is Rs 5,400.

> **Alternative process**
>
> M.P. = 120% of x = $\dfrac{6x}{5}$
>
> S.P. = (100 − 10)% of M.P.
>
> S.P. = 90% of M.P.
>
> $= \dfrac{90}{100} \times \dfrac{6x}{5} = \dfrac{27x}{25}$
>
> Profit = S.P. − C.P.
>
> Rs 360 $= \dfrac{27x}{25} - x$
>
> or, x = Rs 4,500
>
> And, $\dfrac{6x}{5} = \dfrac{6 \times Rs\ 4,500}{5}$
>
> = Rs 5,400

Example 7: **When a watch is sold at a discount of 10%, there is a profit of Rs 200. If it is sold at 15% discount, there is a loss of Rs 175. Find the marked price of the watch.**

Solution:

Let, the marked price (M.P.) of the watch be Rs x.

In 10% discount, S.P. of the watch = M.P. – 10% of M.P.

$$= x - 10\% \text{ of } x = \frac{9x}{10}$$

∴   C.P. of the watch   = S.P. – profit

$$= \frac{9x}{10} - \text{Rs } 200$$

Again, in 15% discount, S.P. = x – 15% of x = $\frac{17x}{20}$

From the question,

C.P. – S.P. = Loss

or, $\frac{9x}{10}$ – Rs 200 – $\frac{17x}{20}$ = Rs 175

or, $\frac{x}{20}$ = Rs 375

or,   x   = Rs 7,500

So, the marked price of the watch is Rs 7,500.

EXERCISE 2.2

General section

1. a) The marked price of an article is Rs 250 and 10% discount is allowed. How much is the discount amount?

    b) The labelled price of a bag is Rs 1,580. If 5% discount is allowed, calculate the selling price of the watch.

    c) If 20% discount on an item amounts to Rs 160, find the marked price of the item.

    d) When 12% discount is given a calculator is sold for Rs 1,760, find the marked price of the calculator.

2. a) The selling price of a watch is Rs 1800 and 13 % VAT is levied on it. How much should a customer pay for it?

    b) The price of an article is Rs 1200 and a customer pays Rs 1380 with VAT. Find the rate of VAT.

    c) When the VAT rate is 15 %, a customer pays Rs 1,610 to buy an electric iron. Find the cost of the iron without VAT.

    d) When Sunayana purchased a video-game she paid Rs 162.50 as VAT at the rate of 13 %. Find its cost without levying VAT.

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Creative section

3. a) In a restaurant, you and your friends had three plates of Mo:Mo at Rs 90 per plate, and three bottles of cold drink at Rs 30 per bottle. If 13 % VAT is levied on the bill after 10 % service charge,

   (i)   Calculate the service charge.

   (ii) How much is the VAT amount?

   (iii) How much do you need to pay to clear the bill?

   b) A family had two plates of chicken chilly, two plates of french fry, two plates of Mo:Mo and a few glasses of fresh juice in a restaurant. If the cost of these items amounts to Rs 750, how much should be paid with 10 % service charge and 13 % VAT to clear the bill?

4. a) The marked price of a table fan is Rs 1,400 and 10 % discount is allowed on it. Find its cost with 15 % VAT.

   b) The price of a radio is marked as Rs 7,500. If the shopkeeper allows 20 % discount and adds 13 % VAT, how much will a customer pay for the radio?

   c) Mr. Thapa bought a motorbike for Rs 1,25,000 and fixed its price 20 % above the cost price. Then, he allowed 10 % discount and sold to Mr. Gurung. How much Mr. Gurung paid for it with 13 % VAT?

5. a) A shopkeeper allows 10 % discount on the marked price of a bicycle. If a customer pays Rs 4,068 with 13 % VAT, find the marked price of the bicycle.

   b) Allowing 20 % discount on the marked price of an article and levying 15 % VAT, a buyer has to pay Rs 9,200 for the article. Find the marked price of the article.

6. a) After allowing 5 % discount on the marked price of a radio 10 % VAT is charged on it, then its price became Rs 1,672. How much amount was given in the discount?

   b) A shopkeeper sold her goods for Rs 16,950 allowing 25 % discount and then levied on 13 % VAT, what was the amount of discount?

7. a) After allowing 20 % discount on the marked price of a computer, 15 % VAT was levied on it. If its price becomes Rs 22,080, what amount was levied in the VAT?

   b) After allowing 16 % discount on the marked price of an article and levying 13 % value added tax, the price of the article becomes Rs 9,492. Find the value added tax.

8. a) The marked price of an article is 25% above its cost price. When it is sold at a discount of 15%, there is a gain of Rs 200. Find,

(i)   the cost price of the article

(ii)   the marked price of the article

b) The price of an electric fan is fixed 20% above its cost price. When it is sold allowing 18% discount, there is a loss of Rs 20. Calculate the marked price and the selling price of the fan.

9. a) The marked price of a mobile is 25% above its cost price, When it is sold at a gain of 10%, the profit amounts to Rs 725. Find the marked price of the mobile.

b) The price of a laptop is fixed 20% above its cost price and sold it at 13% discount to gain Rs 1,980. How much should a customer pay for it?

10. a) When a pen is sold at a discount of 15%, there is a gain of Rs 10. But if it is sold at 25% discount, there is a loss of Rs 2. Find the marked price of the pen.

b) A retailer allowed 12% discount and sold a T-shirt at a loss of Rs 16. If he had sold it at 10% discount he would have gained Rs 20. For what price did he purchase the T-shirt?

c) A shopkeeper made a loss of Rs 20 when he sold a bag at 20% discount. If he had sold it at 10% discount, he would have gained 8%. Find the marked price of the bag.

11. a) A shopkeeper marked the price of an article a certain percent above the cost price and he allowed 16% discount to make 5% profit. If a customer paid Rs 9,492 with 13% VAT to buy the article, by what percent is the marked price above the cost price of the article?

b) After getting 10% discount a customer paid Rs 2,034 with 13% VAT to buy a bag from a retailer. If the retailer made a profit of 20%, by how many percent did he mark the price of the bag above the cost price?

12. a) The marked price of an item is Rs 1,500 and 10% discount is given to make 20%, profit. By what percent is the discount to be increased to get only 12% profit?

b) The price of a watch is marked Rs 11,250. When it is sold allowing 20% discount, 20% profit is made. By what percent is the discount to be reduced to increase the profit by 3%?

Note: ***Dear students, for more practice please go through the appendix given at the end of the book.***

Chapter 3

Commission and Taxation

3.1 Commission – Introduction

In many business activities, usually a third party (which is called an agent) is involved between a company or a manufacturer and a customer for selling goods or any other properties. In this case, the agent is paid a certain sum for its service. The sum paid to the agent is called commission.

For example,

- A cold-drink company pays to its dealer a commission of 2.5 % of the total sales that the dealer makes in a year.
- A land owner pays 5 % commission to a real estate agent for selling his 5 ropanis of land at the rate of Rs 2,50,000 per ropani.

From the above example, it is clear that a commission is calculated as a certain percent of the total selling price.

i.e. **commission = percent of commission × total selling price.**

$$\text{Also, } \textbf{commission percent} = \frac{\textbf{Commission Amount}}{\textbf{S.P.}} \times \textbf{100\%}$$

Worked out examples

Example 1:   **An agent is given 2 % commission on selling a piece of land for Rs 12,00,000 and 2.5 % commission for additional amount of selling price above the fixed price. If the agent sold the land for Rs 13,50,000, how much commission did he/she receive from the owner?**

Solution:

Here, the fixed selling price of the land   = Rs 12,00,000

The selling price of the land   = Rs 13,50,000

Now, the commission received by the agent

$$= 2 \text{ % of Rs } 12,00,000 + 2.5 \text{ % of (Rs } 13,50,000 - \text{Rs } 12,00,000)$$

$$= \frac{2}{100} \times \text{Rs } 12,00,000 + \frac{2.5}{100} \times \text{Rs } 1,50,000$$

$$= \text{Rs } 24,000 + \text{Rs } 3,750$$

$$= \text{Rs } 27,750$$

So, the agent received the commission of Rs 27,750.

Example 2: **A publication house provides commission to its distributors on the basis of the following monthly transactions.**

Sales up to Rs 50,000, 5 % commission.

Sales from Rs 50,000 to Rs 75,000, 6 % commission.

Sales more than Rs 75,000, 7 % commission.

Calculate the commissions of the following monthly sales.

(i) Rs 45,000   (ii) Rs 68,000   (iii) Rs 90,000

Solution:

(i)   Commission of the sale of Rs 45,000 = 5 % of Rs 45,000

= Rs 2,250

(ii) Commission of the sale of Rs 68,000

= 5 % of Rs 50,000 + 6 % of (Rs 68,000 – Rs 50,000)

= Rs 2,500 + Rs 1,080 = Rs 3,580

(iii) Commission of the sale of Rs 90,000

= 5 % of Rs 50,000 + 6 % of (Rs 75,000 – Rs 50,000) + 7 % of (Rs 90,000 – Rs 75,000)

= Rs 2,500 + Rs 1,500 + Rs 1,050

= Rs 5,050

Example 3: **The monthly salary of an employee in an electronic shop is Rs 16,500 and 1.25 % commission is provided when the monthly sales is more than 5 lakh rupees. If the sales of the shop in a month is Rs 7,50,000, find the income of the employee in the month.**

Solution:

Here,   the monthly salary of the employee = Rs 16,500

Commission percent = 1.25%

Sales of the month = Rs 7,50,000

Now,   eligible sales for the commission = Rs 7,50,000 – 5,00,000

= Rs 2,50,000

∴   amount of commission = 1.25 % of Rs 2,50,000

$= \dfrac{1.25}{100} \times$ Rs 2,50,000

= Rs 3,125

Again, the income of the employee of the month   = Rs 16,500 + Rs 3,125

= Rs 19,625

So, the income of the employee in the month is Rs 19,625.

Example 4: **The monthly salary of an employee in a wholesale cosmetic shop is Rs 15,700 and a certain commission is given as per the monthly sales. If the sales of a month is Rs 6,00,000 and the total income of the employee of the month including commission is Rs 24,700, calculate the rate of commission.**

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Solution:

Here, the monthly salary of the employee = Rs 15,700

Sales of the month = Rs 6,00,000

Total income of the employee of the month = Rs 24,700

Now, the amount of commission of the month = Rs 24,700 – Rs 15,700

= Rs 9,000

Again, the rate of commission $= \dfrac{\text{Amount of commission}}{\text{Sales of the month}} \times 100\%$

$= \dfrac{9,000}{6,00,000} \times 100\% = 1.5\%$

So, the required rate of commission is 1.5%.

3.2 Bonus

When a factory or a company or any other business organisation increases its annual net profit, it may give a certain percent of the profit to the employees as incentive besides their fixed salaries. Such incentive amount is called bonus. Thus, bonus is calculated as a certain percent of profit and it is decided by the management.

Example 5: **A noodle-factory made a profit of Rs 18,50,00 in the last year. If the management decided to distribute 25 % bonus from the profit to its 20 employees equally, find the bonus amount received by each employee.**

Solution:

Here, the profit of the factory = Rs 18,50,000

The total amount of bonus = 25 % of Rs 18,50,000

= Rs 4,62,500

Now, the amount of bonus received by each employee $=$ Rs $\dfrac{462500}{20}$

= Rs 23,125

So, each employee received the bonus of Rs 23,125.

EXERCISE 3.1

General section

1. a) If a real estate agent sold a piece of land for Rs 5,80,000, how much commission did he/she get at 2.5 %?

   b) At 5 % commission, an agent received Rs 32,500 by selling a second-hand car. At what price did he/she sell the car?

   c) A building owner fixed the cost of his building as Rs 15,84,000 and the price above the fixed cost goes to an agent as his commission. If the agent sold it for Rs 16,71,120, find his commission percent.

2. a) If a company distribute 15 % bonus equally to its 25 employees from the net profit of Rs 12,50,000 at the end of a year, find the bonus received by each employee.

   b) A factory announced 10 % bonus to its 40 workers from the net profit at the end of last year. If every worker received Rs 6,125, how much was the profit of the factory?

   c) A business company distributed bonus to its 24 employees from the net profit of Rs 16,48,000. If every employee received Rs 8,240, what was the bonus percent?

Creative section

3. a) A real estate agent is given 3 % commission on selling a piece of land for Rs 8,75,000 and 4 % commission for the additional amount of selling price above the fixed price. If the agent sold the land for Rs 10,40,000, how much commission did he/she receive from the owner?

   b) An insurance company offered 1 % commission for the first 10 lakh and 1.5 % for the rest sum of money collected from new clients by its agents. If an agent is able to collect a sum of Rs 12,64,000 from his new clients, find his total commission.

   c) A business company provides commission to its sales agents on the basis of the following monthly transactions.

   Sales up to Rs 40,000, 3 % commission

   Sales from Rs 40,000 to Rs 70,000, 4 % commission

   Sales above Rs 70,000, 5 % commission

   Now, calculate the commission of the following monthly sales.

   (i) Rs 36,000   (ii) Rs 55,000   (iii) Rs 92,000

4. a) The monthly salary of a salesman of a departmental store is Rs 12,500, and an additional payment of 0.5 % on the total monthly sale is provided as commission.

   (i) Calculate his total income in a month if he makes a total sale of Rs 7,20,000 in that month.

   (ii) What should be his total sale in the next month so that he can receive a total income of Rs 20,000 in the month?

   b) The monthly salary of an employee in a hardware shop is Rs 17,400 and 1% commission is provided when the monthly sales is more than 7 lakhs rupees. If the sales of the shop in a month is Rs 12,50,000, find the income of the employee of the month.

   c) An employee draws Rs 12,750 as monthly salary in a wholesale stationery shop. A certain commission is given as per the monthly sales. If the sales of a month is Rs 10,00,000 and the total income of the employee of the month including commission is Rs 25,250, find the rate of commission.

5. a) A business company made a profit of Rs 24,00,000 in the last year. The management decided to distribute 20 % bonus from the profit to its 30 employees.

  (i) Find the bonus amount received by each employee.

  (ii) By what percent should the bonus be increased so that each employee can receive Rs 20,000?

  (iii) What should be the profit of the company so that it can provide Rs 20,000 to each employee at 20 % bonus?

  b) When a business company increased its profit from 20 % to 25 % the amount of profit increased to Rs 26,04,000. If the company decided to distribute 50 % bonus to its 20 employees equally from the increased amount of profit, how much bonus will each employee receive?

3.3 Taxation

Taxation is the practice of a government collecting money from citizens and corporate entities base on their earnings and property. The government does not have its own money. Its receipts come from individual income taxes, corporate income taxes, estate and gift taxes, social insurance taxes, excise taxes, etc. The taxes we pay are used by government for transport, education, health, law and order, culture, media and sport, trade and industry, environment, etc.

The Inland Revenue Department (IRD) under the Ministry of Finance of Government of Nepal is responsible for the administration of Value Added Tax, Income Tax and Excise Duty.

We have already discussed about Value Added Tax (VAT) in the previous chapter. Here we shall discuss about the Income Tax.

3.4 Income Tax

When the annual income of an individual or any other business organisations is above a certain specified limit, a tax is levied as a certain percent of the income which is above the specified limit. It is called **income tax**. The specified limit of income above which tax is levied is decided by the government on the basis of minimum needs of individuals. The minimum needs of an individual are justified according to his/her personal details, e.g. marital status, number of dependents, etc. The annual income up to the certain limit as per the minimum needs is nominal taxable income and 1% **Social Security Tax** is levied on it. The income above the given limit is called **taxable income**. Different rates of income tax are levied as per the annual income above the given limit.

In this way, to calculate the income tax, at first the social security taxable income is deducted from the total income to find the taxable income above the minimum limit. Then, the tax is levied as per the rate of tax in percent.

Taxable income = Total income – Social security taxable income

Income tax   = Rate of tax (in %) × Taxable income

The table given below shows the taxable income and the tax rate in percent for the unmarried individuals and married couples based on Nepal Income Tax Rates 2016.

Individuals		Couples	
Taxable Income (Annual)	**Tax Rate**	**Taxable Income (Annual)**	**Tax Rate**
Upto Rs 3,50,000	1%	Upto Rs 4,00,000	1%
Rs 3,50,001 - Rs 4,50,000	15%	Rs 4,00,001 - Rs 5,00,000	15%
Rs 4,50,001 - Rs 25,00,000	25%	Rs 5,00,001 - Rs 25,00,000	25%
Above Rs 25,00,000	35%	Above Rs 25,00,000	35%

The following incomes are entitled for the Tax rebate

(i)   The premium paid to the insurance company

(ii)   Provident fund

(iii)   Citizen investment trust

(iv)   Donation

(v)   Religious functions

(vi)   Remote area allowance

(vii)   75% of the foreign allowance

(viii) Medical expenditure

Note: We can find the detail about taxation in the website http://www.ird.gov.np.

Worked out examples

Example 1:   **There are 750 students in an Institutional School (Private school) and the average monthly fee per student is Rs 1,350. How much tax should be paid by the school in a year at the rate of 1% Education Service charge?**

Solution:

Here, the average monthly fee of 1 student   = Rs 1,350

∴ The average monthly fee of 750 students   = 750 × Rs 1,350 = Rs 10,12,500

Also, the average fee of 750 students in 1 year = 12 × Rs 10,12,500

                                                            = Rs 1,21,50,000

Now, the Education Service charge in a year   = 1 % of Rs 1,21,50,000

                                                            = $\frac{1}{100}$ × Rs 1,21,50,000

                                                            = Rs 1,21,500

So, the school should pay Rs 1,21,500 in a year as an Education Service Charge.

Example 2: The monthly income of an unmarried individual is Rs 32,500. If 1 % social security tax is charged upto the annual income of Rs 3,50,000 and 15% tax is charged above the annual income of Rs 3,50,000 to Rs 4,50,000, how much income tax should be paid by the individual in a year?

Solution:

Here, the annual income of the individual	= Rs 12 × Rs 32,500
	= Rs 3,90,000
The social security tax for the first Rs 2,50,000	= 1% of Rs 3,50,000
	= Rs 3500
Again, the taxable income of the individual	= Rs 3,90,000 – Rs 3,50,000
	= Rs 40,000
Now, the annual income tax	= 15% of Rs 40,000
	= Rs 6,000
∴ The total tax paid by the individual in a year	= Rs 3,500 + Rs 6,000
	= Rs 9,500

So, the individual should pay the income tax of Rs 9,500 in a year.

Example 3: The monthly income of a married woman is Rs 80,000 and 10% of her monthly salary is deducted and deposited as provident fund. If 1% social security tax is levied upto the annual income of Rs 4,00,000, 15% tax is levied on Rs 4,00,000 to Rs 5,00,000 and 25% tax is levied above Rs 5,00,000, how much income tax should she pay in a year?

Solution:

Here, her monthly income after deducting the provident fund	= Rs 80,000 – 10% of Rs 80,000
	= Rs 72,000
Her annual income after deducting provident fund	= 12 × Rs 72,000
	= Rs 8,64,000
The social security tax for the first Rs 3,00,000	= 1% of 4,00,000
	= Rs 4,000
The taxable income of the woman	= Rs 8,64,000 – Rs 4,00,000
	= Rs 4,64,000
Now, the income tax for Rs 1,00,000 (i.e. Rs 4,00,000 to Rs 5,00,000)	= 15% of Rs 1,00,000
	= Rs 15,000
The income tax for Rs (4,64,000 – 1,00,000) i.e. Rs 3,64,000	= 25% of Rs 3,64,000
	= Rs 91,000
∴ The total income tax paid by her	= Rs 4,000 + Rs 15,000 + Rs 91,000
	= Rs 1,10,000

So, she should pay the income tax of Rs 1,10,000 in a year.

EXERCISE 3.2

General section

1. a) There are 500 students in a private school. The average annual fee of a student is Rs 14,400. How much tax should be paid by the school in a year at the rate of 1% Education Service Charge?

    b) An Institutional school paid Rs 48,600 as the annual Education Service Charge at 1% tax rate. If there are 450 students in the school, calculate the average annual fee of each student.

    c) Every Institutional school should pay 1% Education Service Charge from its annual enrolment to the government. If the average annual fee of each student in a school is Rs 12,600 and it pays the ESC of Rs 1,10,250 in a year, how many students are there in the school?

2. a) 1% social security tax is charged upto the annual income of Rs 3,50,000 to an unmarried individual. If the monthly salary of an individual is Rs 16,400, how much social security tax should he pay in a year?

    b) The monthly income of a couple is Rs 24,500. If 1% social security tax is levied upto the annual income of Rs 4,00,000 to a married couple, how much tax should the couple pay in a year?

Creative section

3. a) The average monthly fee of each student in an Institutional School is Rs 950 and the average annual admission fee is Rs 6,500. If there are 540 students in the school, how much tax should the school pay in a year at 1% Education Service Charge?

   b) The table given below shows the number of students, monthly fee and annual admission fee structures of every class in a Institutional primary school. How much tax should be paid by the school in its annual enrolment at 1% Education Service Charge?

Class	No. of students	Monthly fee	Annual admission fee
1	45	Rs1,450	Rs 4,500
2	48	Rs 1,500	Rs 4,500
3	42	Rs 1,550	Rs 4,500
4	35	Rs 1,600	Rs 5,000
5	30	Rs 1,700	Rs 5,000

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4. See the following income tax table and workout the problems given below.

Individuals		Couples	
Taxable Income (Annual)	**Tax Rate**	**Taxable Income (Annual)**	**Tax Rate**
Upto Rs 3,50,000	1%	Upto Rs 4,00,000	1%
Rs 350,001 - Rs 4,50,000	15%	Rs 4,00,001 - Rs 5,00,000	15%
Rs 4,50,001 - Rs 25,00,000	25%	Rs 5,00,001 - Rs 25,00,000	25%
Above Rs 25,00,000	35%	Above Rs 25,00,000	35%

a) The monthly income of an individual is Rs 29,500. How much income tax should he/she pay in a year?

b) The monthly salary of a married man is Rs 37,400. How ,much income tax should he pay in a year?

c) The monthly salary of an unmarried employee in a bank is Rs 45,000. How much income tax should he pay in a year.

d) The monthly income of a married couple is Rs 3,25,000. Calculate the income tax paid by the couple in a year.

5. From the income tax table given above, compute the following problems.

a) The monthly salary of a married civil servant is Rs 25,700 and 10% of his salary is deducted as his provident fund. How much income tax should he pay in a year?

b) The monthly income of an individual is Rs 65,000. 10% of his salary is deducted as provident fund, another 10% is deducted as citizen investment trust and he pays Rs 15,000 annually as the premium of his insurance. How much income tax does he pay in a year?

3.5   Dividend

A dividend is a distribution of a portion of a profit making company's earning, decided by the board of directors, to its shareholders. Dividend can be issued as cash payments, as shares of stock, or other property.

For example, a man has bought 2,000 shares out of total of 1,00,000 shares of Rs 100 per share from a bank. If the bank earned a net profit of Rs 2,00,00,000 in a certain year and it decided to distribute 10% of the net profit to its shareholders, the amount received by the man as per his number of shares is called his dividend.

Workout examples

Example 1: **Mr. Tharu bought 1,000 shares out of 50,000 shares at Rs 200 per share from a Finance Company. If the company earned a net profit of Rs 1,50,00,000 and it decided to distribute 15% dividend to its shareholders, how much money did Mr. Tharu receive?**

Solution:

Here, the net profit of the company = Rs 1,50,00,000

Now, 15% of Rs 1,50,00,000 $= \frac{15}{100} \times$ Rs 1,50,00,000

$= $ Rs 22,50,000

Again,

The profit of 50,000 shares = Rs 22,50,000

The profit of 1 share $=$ Rs $\frac{22,50,000}{50,000} = $ Rs 45

The profit of 1,000 shares $= 1,000 \times$ Rs 45
$= $ Rs 45,000

So, he received Rs 45,000 as his dividend.

Example 2: **A hydro power company sold 25,000 shares. The company earned a net profit of Rs 75,00,000 in a year and distributed a certain percent of profit as dividend. If a shareholder, who has bought 500 shares, received Rs 30,000 dividend, find what percent of profit was distributed as divided?**

Solution:

Here, the dividend of 500 shares $= $ Rs 30,000

the dividend of 1 share $= $ Rs $\frac{30,000}{500} = $ Rs 60

the dividend of 25,000 shares $= $ Rs 25,000 $\times$ Rs 60 $= $ Rs 15,00,000

$\therefore$ The total dividend $= $ Rs 15,00,000

The net profit $= $ Rs 75,00,000

Now, the percent of net profit as dividend $= \frac{\text{Dividend}}{\text{Net profit}} \times 100\%$

$= \frac{\text{Rs 15,00,000}}{\text{Rs 75,00,000}} \times 100\%$

$= 20\%$

So, 20% of the net profit was distributed as dividend.

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Alternative process:

The dividend of 500 shares	$= $ Rs 30,000
The dividend of 1 share	$= $ Rs $\frac{30,000}{500} = $ Rs 60
Also, the net profit for 25000 shares	$= $ Rs 75,00,000
the net profit for 1 share	$= \frac{\text{Rs } 75,00,000}{25,000} = $ Rs 300

Now, the percent of profit as dividend $= \dfrac{\text{Dividend for 1 share}}{\text{Profit for 1 share}} \times 100\%$

$$= \frac{\text{Rs } 60}{\text{Rs } 300} \times 100\%$$

$$= 20\%$$

Example 3: **Mrs. Limbu bought 1,000 shares out of 40,000 shares sold by a bank. When the bank distributed 20% of its net profit, she received Rs 1,00,000 as her dividend in a year. Calculate the net profit of the bank.**

Solution:

Here, the profit of 1,000 shares	$= $ Rs 1,00,000
the profit of 1 share	$= $ Rs $\frac{1,00,000}{1,000} = $ Rs 100
the profit of 40,000 shares	$= 40,000 \times$ Rs 100
	$= $ Rs 40,00,000

Let, the net profit of the bank be Rs x.

Now, 20% of Rs x $= $ Rs 40,00,000

or, $\quad\quad \dfrac{20x}{100} = $ Rs 40,000

$\therefore \quad\quad x = $ Rs 2,00,00,000

So, the net profit of the bank is Rs 2,00,00,000.

EXERCISE 3.3

General section

1. a) The net profit of a finance company in a year is Rs 56,00,000 and the Board of Directors announces 8% dividend from the net profit. If the company has sold 500 shares, find the dividend of each share.

    b) A commercial bank sold 20,000 shares in a year. The bank made a net profit of Rs 1,80,00,000 in the year and decided to distribute 10% dividend from the net profit. Calculate the amount of divided received by the shareholders whose number of shares are (i) 750   (ii) 1000 and   (iii) 1700.

2. a) A business company earned a net profit of Rs 36,00,000 in a year and it decided to distribute a certain percent of profit as dividend. If the total dividend amount to Rs 5,40,000, what percent of profit did the company distributed?

   b) When 18% dividend from the net profit was distributed by a Publication House, the total dividend amounts to Rs 13,64,400. Find the net profit of the Publication House.

Creative section

3. a) A man bought 350 shares out of 25,000 shares at Rs 150 per share from a bank. If the bank earned a net profit of Rs 2,75,00,000 and it decided to distribute 7.5% dividend to its shareholder, how much money did the man get?

   b) A Hydro Power Company sold 5,000 shares at Rs 100 per share. Sunayana bought 1,500 shares. If the company earned a net profit of Rs 84,00,000 in a year and it decided to distribute 12% dividend to its shareholders. Find the amount of dividend received by Sunayana.

4. a) A bank sold 10,000 shares. The bank earned a net profit of Rs 1,60,00,000 in a year and distributed a certain percent of profit as dividend. If a shareholder who has bought 1,000 shares received Rs 80,000 dividend, what percent of profit was distributed as dividend?

   b) Mrs. Chhetri bought 700 shares out of 12,000 shares sold by a Finance Company. The company earned a net profit of Rs 60,00,000 and it decided to distribute a certain percent dividend to its shareholders. If she received Rs 1,40,000, what percent of profit was distributed as dividend?

5. a) A man bought 800 shares out of 20,000 shares sold by a bank. The bank earned some profit and it distributed 13% of the net profit as dividend. If the man received Rs 95,680 in the year, find the net profit of the bank.

   b) A Hydro Power Company earned some profit and announced to distribute 25% dividend to its shareholders. If a shareholder who bought 1,200 shares out of 15,000 shares sold by the company received Rs 2,40,000, calculate the net profit of the company.

Note: *Dear students, for more practice please go through appendix given at the end of the book.*

4 Chapter

Household Arithmetic

4.1 Introduction

Household Arithmetic, in a broad sense, may deal with the regular financial activities of a household. In this chapter, among these activities, we will discuss the expenses of a household for utilising some facilities such as electricity, telephone, etc. Besides, we will discuss about taxi fare of metered taxi.

4.2 Electricity bill

The consumption of electricity by a household is measured in the number of units. Digital meter and dial meter are two types of electric meters which are used to find the number of units of electricity consumed.

1 unit of electricity = 1 kilowatt hour or 1000 watt hour

So, 1 unit of electricity means, it is the amount of consumption of electricity by an electric appliance of 1000 watt power in 1 hour.

The number of units of electricity consumed is calculated as:

Reading of the recent month – Reading of the previous month

The table given below shows the capacity of meter box of the lower voltage limit 230-400 volt connected in our houses and the minimum energy charges.

Meter capacity	Minimum Charge	Minimum Unit
Upto 5 A	Rs 80	20
6 A to 15 A	Rs 365	50
16 A to 30 A	Rs 795	100
31 A to 60 A	Rs 1765	200

For the payment of an electricity bill, the Electricity Authority of Nepal has implemented the following rules.

1. Minimum charge upto 20 units is Rs 4 per unit
2. Charge from 21 units to 50 units is Rs 7.30 per unit
   (i) If 30 units is consumed, Rs 4 per unit is charged upto 20 units and Rs 7.30 per unit is charged from 21 units to 30 units.
   (ii) If more than 30 units is consumed Rs 7.30 per unit is charged for the whole units of consumption of electricity.

3. Charge from 51 units to 150 units is Rs 8.60 per unit
    (i) In this case, charge from 0-50 units is Rs 7.30 per unit
    (ii) Charge from 51-150 units is Rs 8.60 per unit.
4. Charge from 151 units to 250 units is Rs 9.50 per unit
    (i) In the case, charge from 0-150 units is Rs 8.60 per unit
    (ii) Charge from 151 - 250 units is Rs 9.50 per unit
5. Charge above 250 units is Rs 11.00 per unit
    (i) In this case, charge from 0-250 units is Rs 9.50 per unit
    (ii) Charge above 250 units is Rs 11.00 per unit

The payment schedule after the meter reading are as follows.

1. within 7 days of meter reading 3 % discount is allowed, but if minimum bill amounts to Rs 80, the flat discount of Rs 4 is allowed.
2. From 8th day to 22nd day, the payment will be according to the bill
3. from 23rd day to 30th day, 5 % extra fine
4. from 31st day to 40th day, 10 % extra fine
5. from 41st day to 60th day, 25 % extra fine
6. If the bill is not paid upto 60th day, the electricity line will be disconnected.

Worked out examples

Example 1: **The charge of electricity is Rs 80 for the first 20 units and Rs 7.30 per unit from 21 units to 30 units. Find the charge of the consumption of 27 units of electricity.**

Solution:

Here, the minimum charge up to 20 units = Rs 80

The excessive number of units = (27 – 20) units = 7 units

Now, the charge of 7 units = 7 × Rs 7.30 = Rs 51.10

∴ Total charge of electricity = Rs 80 + Rs 51.10 = Rs 131.10

So, the required charge of electricity is Rs 131.10.

Example 2: **The meter readings for the consumption of electricity of a household was 1130 units on 1st Falgun and 1275 units on 1st Chaitra. If the customer made the payment of the bill on 28th Chaitra, calculate the total charge with fine under the following conditions.**
Charge (up to 50 units) = Rs 7.30 per unit
Charge per unit (51 – 150 units) = Rs 8.60 per unit
Payment up to 30th day of the next month 5 % extra fine.

Solution:

Here, the consumption of electricity = (1275 – 1130) units = 145 units

Charge up to 50 units = 50 × Rs 7.30 = Rs 365

The excessive number of unit = (145 – 50) units = 95 units

Now, the charge of 95 units = 95 × Rs 8.60 = Rs 817

∴ The charge of 145 units = Rs 365 + Rs 817 = Rs 1182

Again, the extra fine = 5 % of Rs 1182 = Rs 59.10

∴ The total charge with fine = Rs 1182 + Rs 59.10 = Rs 1241.10

So, the household should pay Rs 1241.10 to clear the bill.

4.3 Telephone bill

Here, we will discuss about the telephone bill of PSTN/Land line

Study the following rules of payment of the telephone bills implemented by Nepal Telecome.

- Minimum charge of 175 calls is Rs 200.
- Rate of charge above 175 calls is Re 1 per call
- Tariff (C) = Minimum charge (c) + charge of additional number of calls

$$\textbf{C} = \textbf{c} + \textbf{n} \times \textbf{r}$$

Telecome service charge (TSC) = 10 % of C

$$\text{VAT} = 13 \text{ \% of (C + TSC)}$$

Total charge = **C + TSC + VAT**

	Nepal Telecome		
No. :	**Nepal Doorsanchar Company Ltd.**	PAGE NO. :	
Date :		C. VAT :	
	Statement For The Month:	CHARGES SUMMARY RS.	

TEL NO. :		LOCAL :
NAME :		STD :
ADDRESS :	ACCOUNT CODE:	ISD :
CLASS :		NAT. OA :
TYPE :	STATUS:	INT. OA :

LOCAL CALL DETAILS

PREVIOUS	CURRENT	TOT. CALL	RENTAL RS.	EX. CALL	TOTAL RS.

ADJUSTMENT :
SUB TOTAL :
TSC :
TOTAL :
VAT 10% :
GRAND TOTAL:

Local call, STD call and ISD call are three types of telephone calls. The rates of charge of these calls are different.

Example 3: **The minimum charge up to 175 calls is Rs 200. If the charge for each additional call is Re 1, how much will be the charge for 350 calls with 10 % TSC and 13 % VAT?**

Solution:

Here, the minimum charge for 175 calls = Rs 200

The additional number of calls = 350 − 175 = 175

Charge for additional number of calls = 175 × Re 1 = Rs 175

∴ Charge for 350 calls (C) = Rs 200 + Rs 175 = Rs 375

Again, TSC = 10 % of Rs 375 = Rs 37.50

∴ Charge with TSC = Rs 375 + Rs 37.50 = Rs 412.50

Also, VAT = 13 % of Rs 412.50 = Rs 53.63

Now, total charge = C + TSC + VAT

= Rs 375 + Rs 37.50 + Rs 53.63

= Rs 466.13

So, the total charge of 350 calls is Rs 466.13.

Example 4: The minimum charge of telephone calls up to 175 calls is Rs 200. The charge for each extra call of 2 minutes duration is Re 1. If a man paid Rs 870.10 with 10 % TSC and 13 % VAT for his telephone bill, find the number of extra calls made.

Solution:

Let the charge of telephone calls without VAT be Rs x.

$\therefore$ x + 13 % of x   = Rs 870.10

or, $\dfrac{113x}{100}$ = Rs 870.10

or,   x = Rs 770

Again, let the charge of telephone calls without TSC be Rs y.

y + 10 % of y   = Rs 770

or, $\dfrac{11y}{10}$ = Rs 770

or,   y = Rs 700

The minimum charge up to 175 calls = Rs 200

The charge for the extra calls = Rs 700 – Rs 200 = Rs 500

Now, the number of extra calls = $\dfrac{\text{Rs } 500}{\text{Re } 1}$ = 500

So, the required number of extra calls is 500.

4.4 Water bill

A household having water supply facility may have tap with a meter or without a meter. If a meter is not connected in the tap, a customer should pay a lump sum amount fixed by the Nepal Water Supply Corporation. For the payment of a water bill, Nepal Water Supply Corporation has implemented the following rules.

S. No.	Size of Pipe	Tap with Meter			Tap without Meter	
		Minimum Consumption (litre)	Minimum Charge (Rs)	Additional Consumption per thousand litre (Rs)	Main Tap Charge (Rs)	Branch Tap Charge (Rs)
1	$\dfrac{1}{2}"$	10,000	110	25	560	200
2	$\dfrac{3}{4}"$	27,000	1490	40	3360	1600
3	1"	56,000	3420	40	9200	2700

There is also the compulsory provision of sewerage service charge which is 50% of the water consumption charge.

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On the other hand, Kathmandu Upatyaka Khanepani Limited (KUKL) has implemented a slightly different water tariff rules.

S. No.	Size of Pipe	Tap with Meter			Tap without Meter (Rs)
		Minimum Consumption (litre)	Minimum Charge (Rs)	Additional Consumption per thousand litre (Rs)	
1	$\frac{1}{2}$"	10,000	100	32	785
2	$\frac{3}{4}$"	27,000	1910	71	4595
3	1"	56,000	3960	71	9540

Furthermore, Nepal Water Supply Corporation has implemented the following rules and regulations about the schedule of the payment of the bills.

Payment is made after the bill issued	Rebate/Fine
1. Within the first and second month	3% rebate
2. Within the third month	No rebate and no fine
3. Within the fourth month	10% fine
4. Within the fifth month	20% fine
5. After fifth month	50% fine

Example 5: The meter reading for the consumption of water of a household was 1230 units on the 1ˢᵗ Shrawan and 1275 units on the 1ˢᵗ Bhadra. Calculate the charge to be paid including 50% sewerage service charge, if the payment of the bill is made in the following schedule.
(i) within the second month after the bill issued
(i) within the fourth month after the bill issued
(iii) within the sixth month after the bill issued

Solution:

Here, the meter reading on 1ˢᵗ Shrawan = 1230 units

the meter reading of 1ˢᵗ Bhadra = 1275 units

consumed units of water = (1275 – 1230) units = 45 units

According to water tariff provisions of Nepal Water Supply corporation:

The minimum charge of 10,000 litres (i.e. 10 units) = Rs 110

The additional units of water consumption = (45 – 10) units = 35 units

Now, the charge of 35 units of water = 35 × Rs 25 = Rs 875

∴ The total charge = Rs 110 + Rs 875 = Rs 985

Again, the charge including sewerage service charge = Rs 985 + 50% of Rs 985

= Rs 1477.50

(i)   If the payment is made within the second month,
the required payment = Rs 1477.50 – 3% of Rs 1477.50 = Rs 1433.20

(ii)   If the payment is made within the fourth month,
the required payment = Rs 1477.50 + 10% of Rs 1477.50 = Rs 1625.25

(iii) If the payment is made within the sixth month
the required payment = Rs 1477.50 + 50% of Rs 1477.50 = Rs 2216.25

4.5 Calculation of taxi fare in a taximeter

Now a days, hired taxi is also one of the essential means of transportation, specially in the urban areas of Nepal. A device used in taxis that automatically records the distance travelled and the fare payable is called taximeter.

Nepal Bureau of Standards and Metrology (NBSM) (नेपाल गुणस्तर तथा नापतौल बिभाग) is responsible to implement the rules, regulations and the rates of fare and monitoring that it is carried out fairly or correctly.

Here, we shall discuss about the calculation of fare in a taximeter. Following are the rates of fare in taximeter implemented by NBSM department.

Time	Minimum fare	Fare of per 200 meters
6:00 am to 9:00 pm	Rs 14	Rs 7.20
9:00 pm to 6:00 am	Rs 21 (or, 1.5 times of the fair of 6:00 am to 9:00 pm)	Rs 10.80 (or, 1.5 times of the fair of 6:00 am to 9:00 pm)

While travelling between 6:00 am to 9:00 pm Rs 14 appears in the monitor of the taximeter immediately when it is flagged down. Then, the fare goes on at the rate of Rs 7.20 per 200 m. But, in the case of travelling between 9:00 pm to 6:00 am, when the taximeter is flagged down Rs 21 appears in the monitor and the fare goes on at the rate of Rs 10.80 per 200 m.

If the taxi is asked to wait by a passenger, an additional waiting charge of Rs 7.20 per 2 minutes is to be paid in the case of 6:00 am to 9:00 pm and this waiting charge is Rs 10.80 per 2 minutes in the case of 9:00 pm to 6:00 am.

Example 6: **A man travelled 7.5 km by a metered taxi. The minimum fare of Rs 14 appeared immediately after the meter was flagged down, then the fare went on at the rate of Rs 7.20 per 200 meters. An additional waiting charge of Rs 7.20 per 2 minutes was charged for the waiting of 6 minutes during the journey. Calculate the total fare paid by the man.**

Solution:

Here, the minimum fare   = Rs 14

Distance travelled   = 7.5 km = 7500 m

Now, the fare of 200 meters = Rs 7.20

the fare of 1 meter   = Rs $\frac{7.20}{200}$

the fare of 7500 meters $= \text{Rs.} \frac{7.20}{200} \times 7500 = \text{Rs } 270$

Also, the waiting charge of 2 minutes $= \text{Rs } 7.20$

the waiting charge of 1 minute $= \text{Rs } \frac{7.20}{2}$

the waiting charge of 6 minutes $= \text{Rs } \frac{7.20}{2} \times 6 = \text{Rs } 21.60$

$\therefore$ The total fare $= \text{Rs } 14 + \text{Rs } 270 + \text{Rs } 21.60 = \text{Rs } 305.60$

So, the man paid the total fare of Rs 305.60.

Example 6: **Mrs. Maharjan hired a taxi and travelled a certain distance at 10.30 pm. She paid the total fare of Rs 345 including the additional waiting charge for 10 minutes. If the minimum fare is Rs 21, the fare per 200 m is Rs 10.80 and the waiting charge is Rs 10.80 per 2 minutes, find the distance travelled by her.**

Solution:

Here, the waiting charge for 2 minutes $= \text{Rs } 10.80$

the waiting charge for 1 minute $= \text{Rs } \frac{10.80}{2} = \text{Rs } 5.40$

the waiting charge for 10 minutes $= 10 \times \text{Rs } 5.40 = \text{Rs } 54$

Now, the taxi fare excluding the minimum fare and waiting charge $= \text{Rs } 345 - \text{Rs } 21 - \text{Rs } 54$

$= \text{Rs } 270$

Again,

Rs 10.80 is the fare of 200 metres

Re 1 is the fare of $\frac{200}{10.80}$ metres.

Rs 270 is the fare of $\frac{200}{10.80} \times 270$ meters $= 5000$ meters $= 5$ km

So, she travelled 5 km.

EXERCISE 4.1

Electricity bill

1. a) The charge of electricity is Rs 80 for the first 20 units and Rs 7.30 per unit from 21 units to 50 units. Find the charge of 28 units of consumption of electricity.

   b) The minimum charge of electricity up to 20 units is Rs 4 per unit, Rs 7.30 per unit from 21 units to 50 units, Rs 8.60 per unit from 51-150 units and Rs 9.50 per unit from 151-250 units. If a household consumed 240 units of electricity and the payment was made within 7 days of meter reading, how much was the cost paid by the household?

c)   The minimum charge of electricity up to 20 units is Rs 80, Rs 7.30 per unit from 21 units to 50 units, Rs 8.60 per unit from 51-150 units and Rs 9.50 per unit from 151-250 units. The meter reading of a household was 1568 units on 1ˢᵗ Aswin and 1752 units on 1ˢᵗ Kartik. Calculate the cost of payment of the bill separately under the following schedule.

(i) Payment was made within 7 days of meter reading.

(ii) Payment was made on 15ᵗʰ day of meter reading.

(iii) Payment was made on 27ᵗʰ day of meter reading.

(iv) Payment was made on 35ᵗʰ day of meter reading.

(v) Payment was made on 50ᵗʰ day of meter reading.

d)   The meter reading of a household showed 1260 units on Jestha 1ˢᵗ and 1475 units on Asar 1ˢᵗ. The charge up to 20 units is Rs 80, Rs 7.30 per unit from 21-50 units, Rs 8.60 per unit from 51-150 units and Rs 9.50 per unit from 151-250 units. If the payment of the bill was made on 2ⁿᵈ Shrawan, how much money was paid by the household?

2. a)   The charge of electricity from 0-50 units is at the rate of Rs 7.30 per unit and Rs 8.60 per unit from 51-150 units. If the total normal charge of electricity was Rs 795, how many units of electricity was consumed?

b)   The charge for the consumption of electricity of a household on a month was Rs 283.24 with 3 % rebate. If the charge from 0 to 50 units is Rs 7.30 per unit, how many units of electricity was consumed?

Telephone bill

3. a)   The minimum charge up to 175 calls is Rs 200. If the charge for each additional call is Re 1, how much will be the charge for 420 calls with 10 % TSC and 13 % VAT?

b)   The charge for STD call for Biratnagar from Kathmandu for 1 minute is Rs 1.25. If a man makes a call for 10 minutes, how much should he pay with 10 % TSC and 13 % VAT?

c)   The charge of ISD call for the USA from Dhangadhi is Rs 38 per minute. If a man made a call for 5 minutes, calculate the cost paid by him with 10 % TSC and 13 % VAT.

4. a)   The minimum charge of telephone calls up to 175 calls is Rs 200. The charge for each extra call is Re 1. If a man paid Rs 1056.55 with 10 % TSC and 13 % VAT, find the number of extra calls.

b)   The minimum charge of telephone calls up to 175 calls is Rs 200. The charge for each extra call of 2 minutes duration is Re 1. If a household paid Rs 633.93 with 10 % TSC and 13 % VAT to clear the bill of a month, find the total number of calls made in the month.

Water Bill

5. a) A household consumed 32 units of water in a month. Calculate the payment of the bill including 50% sewerage service charge, if the payment is made within the first month of the bill issued.

    b) 127 units of water is consumed by using $\frac{3"}{4}$ pipe in a hotel. If the payment of the bill is made within the fifth month after the bill issued, how much money is required to clear the bill?

    c) A household uses $\frac{1"}{2}$ water pipe. The meter reading of the household on 1st of Mangsir was 1580 units and on 1st of Paush was 1650 units. Calculate the charge to be paid including 50% sewerage service charge if the payment of the bill is made in the following schedule.

    (i)   within the first month after the bill issued

    (ii)   within the third month after the bill issued

    (iii) within the fifth month after the bill issued

    (iv)   within the seventh month after bill issue

Taxi fare

6. a) A woman hired a taxi and travelled 6 km at 2:00 pm. If the minimum fare is Rs 14 and the fare goes on at the rate of Rs 7.20 per 200 metres, calculate the total fare paid by the woman.

    b) Mr. Karki travelled 10 km by a hired taxi at 4:30 am. The minimum fare of Rs 21 appeared immediately after the meter was flagged down. Then, the fare went on at the rate of Rs 10.80 per 200 metres. An additional waiting charge of Rs 10.80 per 2 minutes was charged for waiting of 10 minutes. Calculate the total fare paid by Mr. Karki.

7. a) Mrs. Rai travelled a certain distance at 9:00 am. by a hired taxi. She paid the total fare of Rs 194. If the minimum fare is Rs 14 and the fare per 200 meters is Rs 7.20, find the distance travelled by her.

    b) Gopal Ghale hired a taxi and travelled a certain distance at 11:15 pm. He paid the total fare of Rs 885 including the additional waiting charge for 10 minutes. Find the distance travelled by him.

Note: Dear students, for more practice please go through the appendix given at the end of the book.