CAREER POINT

Study Material for Pre foundation Class 8

Prepared by Career Point Kota Experts

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Class VIII

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Note to the Students

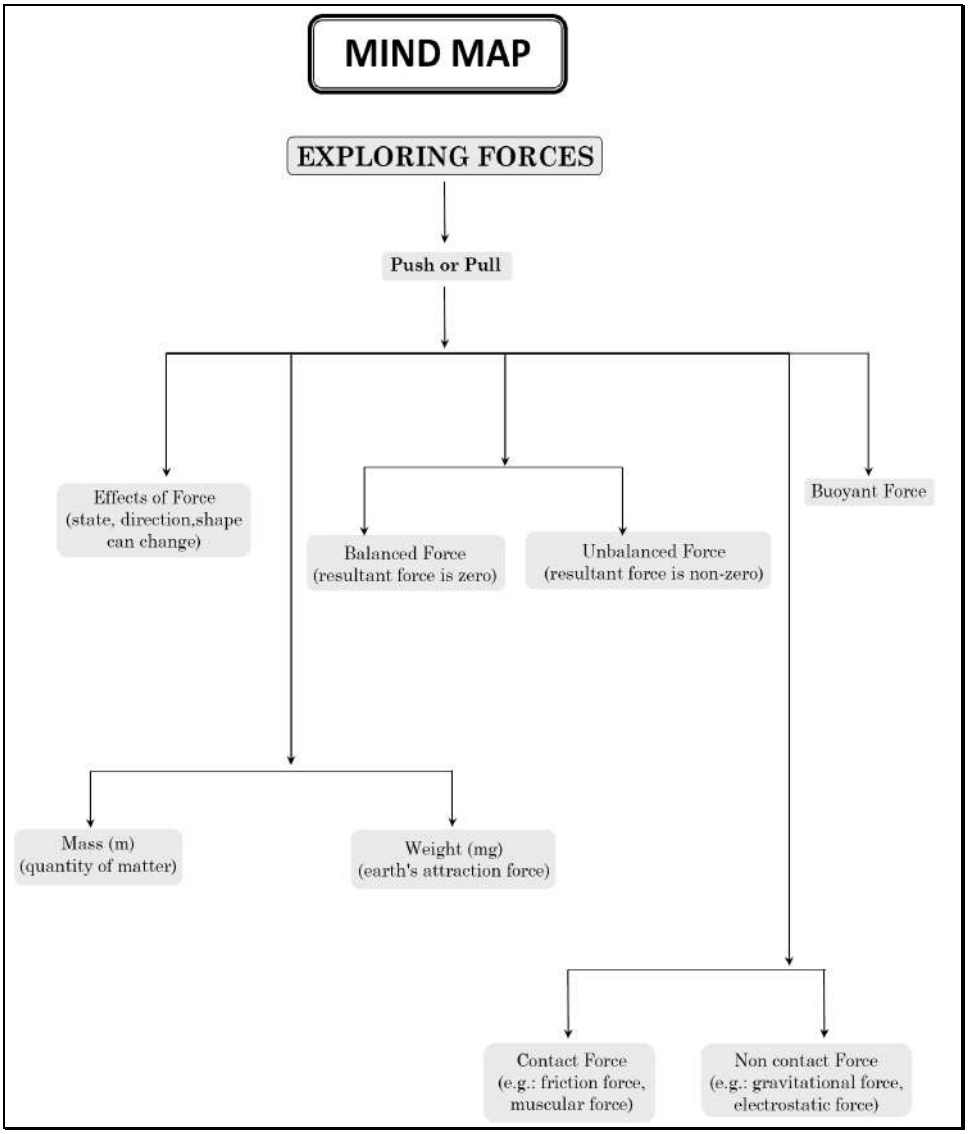
Career Point offers this Class 8 Study Package to support complete learning for school curriculum as well as Olympiad and foundation-level exams. This sample represents our set of nine books: **Physics**, **Chemistry**, **Biology**, two **Mathematics** books, two **Social Science** books, **English** and **Mental Ability**. Each book provides clear concepts, illustrative examples and ample practice to strengthen understanding and build analytical skills. The material is designed to develop a strong academic base and prepare students with confidence for higher classes and future competitive studies.

COMPONENTS OF EACH CHAPTER

These books are designed with an engaging and preparation-focused pedagogy and offer a perfect balance of conceptual learning and problem solving skills.

Mind Map

Each chapter contains many articles (Concepts, Theories etc.). Mind map interconnect all these articles logically. By this student can understand whole chapter articles interconnectivity clearly in a single picture frame.



Theory & Concepts

Each chapter consist of exhaustive theory which gives conceptual clarity and command over topics. Appropriate explanation of theory with the help of images, diagrams, flowcharts, mind maps, info graphics, and tables.

EXPLORING FORCES

Force

Activity (NCERT)

Aim : To understand that force is a push or pull.

Procedure : Move a cardboard box in different ways—push, pull, lift, carry.

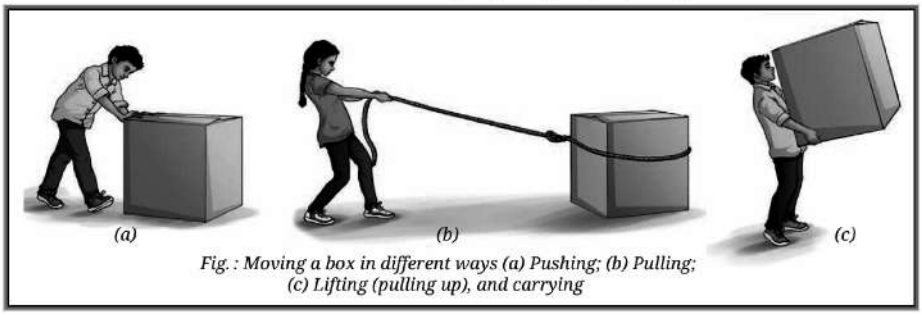


Fig. : Moving a box in different ways (a) Pushing; (b) Pulling; (c) Lifting (pulling up), and carrying

Observations :

- The box moves only when a push or pull is applied.
- The movement stops when force is no longer applied.

Conclusion :

A force is a push or pull applied on an object.

◈ **Definition of Force**

Force is a push or pull that can change an object's state of rest, its motion, its direction or even its shape.

S.I. Unit of force is **Newton (N)**.

Competitive Level

Competitive level is specially designed for competition exam rquirements and to better understanding the concepts, well explained theory, clearly explained formulas with good number of quality examples are given in this.

COMPETITIVE LEVEL

◈ **Mathematical Representation of Force**

Mathematically, force F is equal to the product of mass 'm' of a body and acceleration 'a' produced in the body due to that force.

i.e. $F = ma$

Where a = (final velocity – initial velocity)/time

- **Units of Force:**

(i) In C.G.S. system:

$F = ma \rightarrow$ gram $\times$ cm/s^2 = dyne

If m = 1 gram and a = 1 cm/s^2 then by F = ma,

$F = 1 \times 1 = 1\ g \times cm/s^2 = 1$ dyne

When a force is applied on a 1 gram body and the acceleration produced in the body is 1 cm/s^2 then the force acting on the body will be one dyne.

(ii) In S.I. system:

$F = ma \rightarrow kg \times m/s^2$ = Newton

If m = 1 kg and a = 1 m/s^2 then by F = ma

In Chapter Example

To understand the application of concepts, there is ***in chapter solved example*** are given. It contains large variety of all types of solved examples with explaination to ensure understanding the application of concepts.

Ex.1 Calculate the force required to produce an acceleration of 5 m/s² in a body of mass 2.4 kg.

Sol. We know that force = mass × acceleration = 2.4 kg × 5 m/s² = 12.0N

Ex.2 A force acts for 0.2 s on a body of mass 2.5 kg initially at rest. The force then ceases to act and the body moves through 4m in the next one second. Calculate the magnitude of force.

Sol. When the force ceases to act, the body will move with a constant velocity. Since it moves a distance of 4 m in 1 s, therefore, its uniform velocity = 4m/s.

Now, initial velocity, $u = 0$

Final velocity, $v = 4$ m/s

Time interval, $\Delta t = 0.2$ s

$\therefore$ Acceleration, $a = \frac{v-u}{\Delta t} = \frac{4-0}{0.2} = 20 m/s^2$

From the relation,

$F = ma$, we get

Force, $F = 2.5 \times 20 = 50$ N

Practice Exercises

Includes three sets of exercises covering all the topics. Helps the students to assess their strengths and weaknesses and work on them accordingly. Separate exercises for subjective as well as objective questions and previous year competitive exams questions (NTSE, Olympiads)

NCERT Exercise

[Keep the curiosity alive]

Q.1 Match items in Column A with the items in Column B.

Column A (Type of force)		Column B (Example)	
(i)	Muscular force	(a)	A cricket ball stopping on its own just before touching the boundary line
(ii)	Magnetic force	(b)	A child lifting a school bag
(iii)	Frictional force	(c)	A fruit falling from a tree
(iv)	Gravitational force	(d)	Balloon rubbed on woollen cloth attracting hair strands
(v)	Electrostatic force	(e)	A compass needle pointing North

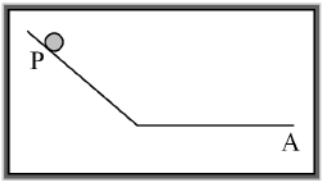
Q.2 State whether the following statements are True or False.

(i) A force is always required to change the speed of motion of an object.

(ii) Due to friction, the speed of the ball rolling on a flat ground increases.

(iii) There is no force between two charged

(ii) after crossing the point A.



Q.7 Why do we sometimes slip on smooth surfaces like ice or polished floors? Explain.

Q.8 Is any force being applied to an object in a non-uniform motion?

Q.9 The weight of an object on the Moon becomes one-sixth of its weight on the Earth. What causes this change? Does the mass of the object also become one-sixth of its mass on the Earth?

Q.10 Three objects 1, 2, and 3 of the same size and shape but made of different materials are placed in the water.
They dip to different depths as shown in Figure.

Exercise -1

➢ Very Short Answer Type Questions

Q.1 How many minimum number of objects should be present for a force to come into play?

Q.2 What happens to the speed of a body when a force is applied?

Q.3 Is it possible that a force changes the direction of motion but not the speed of an object?

Q.4 What do you mean by resultant force?

Q.5 In a tug of war, side A applies 10 Newton force and side B applies 8 Newton force. Which side will the rope move?

➢ Short Answer Type Questions

Q.6 What do you mean by the direction of force? What is the standard unit of force?

Q.7 If the force is applied opposite to the motion, what will happen to the speed of the object?

➢ Long Answer Type Questions

Q.13 Force can change the direction of a moving body. Explain with the help of some examples.

Q.14 Differentiate between contact and non-contact forces.

Q.15 Name the forces acting on a plastic bucket containing water held above ground level in your hand. Discuss why the forces acting on the bucket do not bring a change in its state of motion.

Q.16 Name the type of force in the following cases.
(a) Raindrops falling on the earth.
(b) Holding a book on your hand.
(c) Running a comb through your dry hair.
(d) A bar magnet suspended freely.
(e) Bullocks ploughing the field.

Q.17 How do the mud particles fly off the wheel of a vehicle moving on the wet road?

Q.18 You are swimming in a pool and you feels lighter in water than on land.
(i) What is the reason behind this sensation ?

Exercise -2

Q.1 A force applied on a moving body may :
(A) bring it to rest
(B) increase its speed
(C) decrease the speed
(D) all of the above

Q.2 A hockey player uses his hockey stick :
(A) to push the ball
(B) to pull the ball
(C) to change its direction
(D) all of these

Q.3 C.G.S unit of force is :
(A) Dyne (B) Newton
(C) gf (D) can't say

Q.4 How many dynes are equal to 1N?
(A) 10^6 (B) 10^4 (C) 10^5 (D) 10^3

Q.5 When an object undergoes acceleration :
(A) its speed always increases
(B) its velocity always increases
(C) it always falls towards the earth
(D) a force always acts on it

Q.6 The net force acting on a body of mass 1 kg moving with a uniform velocity of 5 ms^{-1} is :
(A) 5 N (B) 0.2 N (C) 0 N (D) None

Q.10 Which of the following is the action-at-distance force?
(A) muscular force (B) frictional force
(C) magnetic force (D) mechanical force

Q.11 The force exerted by one object on another by virtue of their masses is :
(A) magnetic force
(B) electrostatic force
(C) gravitational force
(D) frictional force

Q.12 Earth always pull everything towards it due to :
(A) muscular force
(B) mechanical force
(C) gravitational force
(D) electrostatic force

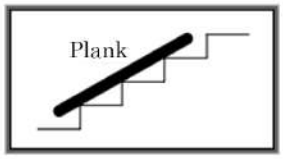
Q.13 A cart being carried by a horse is an example of :
(A) muscular force
(B) mechanical force
(C) gravitational force
(D) electrostatic force

Exercise -3

(Previous Year Olympiad Questions)

Q.1 Match Column-I with Column-II and select the correct option from the codes given below.

Column-I		Column-II	
(a)	A child running to catch the school bus	(i)	Force can make a stationary object to move
(b)	A man blowing a balloon	(ii)	Force can stop a moving object



(A) 4 (B) 5 (C) 6 (D) 7

Q.4 When a constant force acts on a mass, and the mass starts moving from rest, then the :

(i) Acceleration is constant

(ii) Velocity increases at a constant rate

(iii) Distance traveled is directly proportional to the time.

Answer key

Answer key is provided at the end of the exercise sheets.

EXERCISE - 1

➢ **Fill in the Blanks :**

16. (i) pull
(ii) attracts
(iii) push
(iv) repels
(v) newton

➢ **True & False :**

17. (i) False
(ii) True
(iii) False
(iv) True
(v) False

➢ **Match the Column :**

18. a → (iv) ; b → (iii) ; c → (v) ; d → (i) ; e → (ii)

EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	D	A	C	D	C	D	A	A	C	C	C	A	D	C
Ques.	16	17	18	19	20	21	22	23							
Ans.	D	A	B	B	A	C	C	C							

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8	9
Ans.	A	A	D	B	C	B	B	C	B

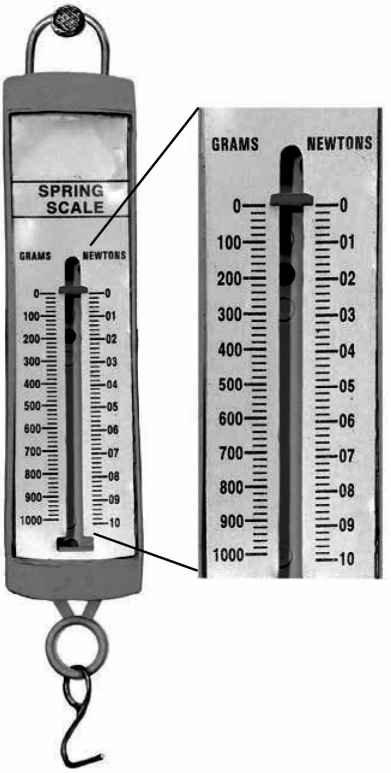
SCIENCE

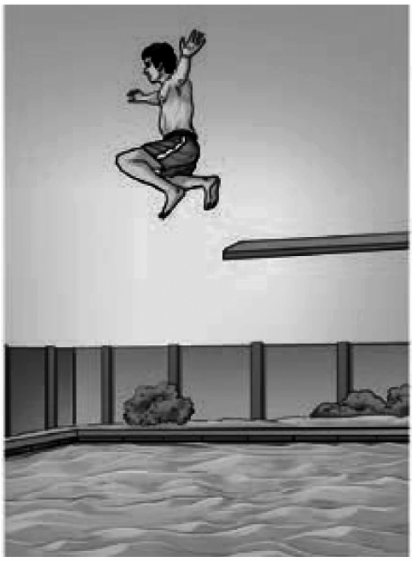
Chapter 2

EXPLORING FORCES

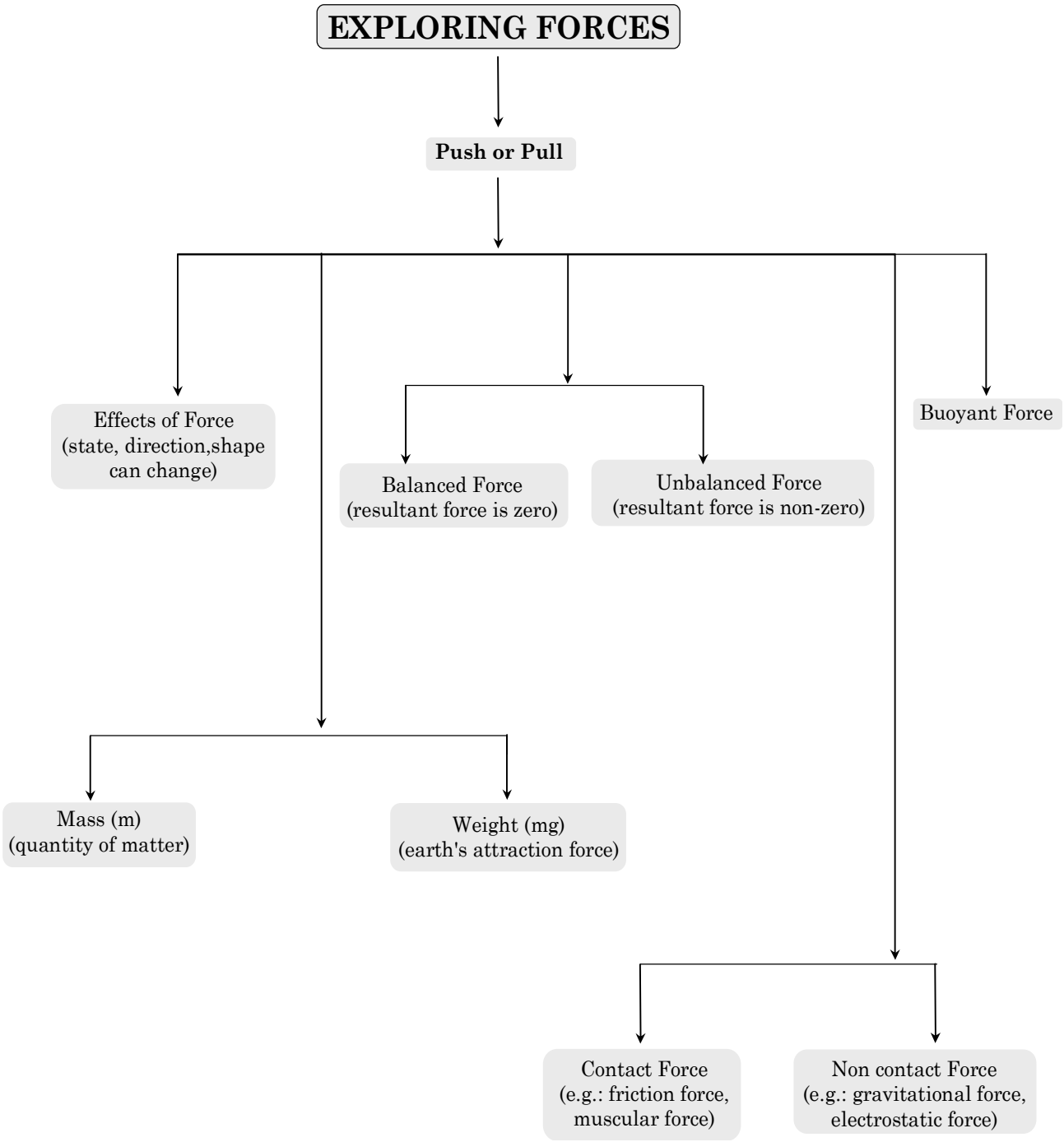
Chapter Outline

- Force
- Balanced and Unbalanced force
- Types of Force
- Floating and Sinking





MIND MAP


EXPLORING FORCES
Push or Pull
Effects of Force (state, direction,shape can change)
Balanced Force (resultant force is zero)
Unbalanced Force (resultant force is non-zero)
Buoyant Force
Mass (m) (quantity of matter)
Weight (mg) (earth's attraction force)
Contact Force (e.g.: friction force, muscular force)
Non contact Force (e.g.: gravitational force, electrostatic force)

EXPLORING FORCES

Force

Activity (NCERT)

Aim : To understand that force is a push or pull.

Procedure : Move a cardboard box in different ways—push, pull, lift, carry.

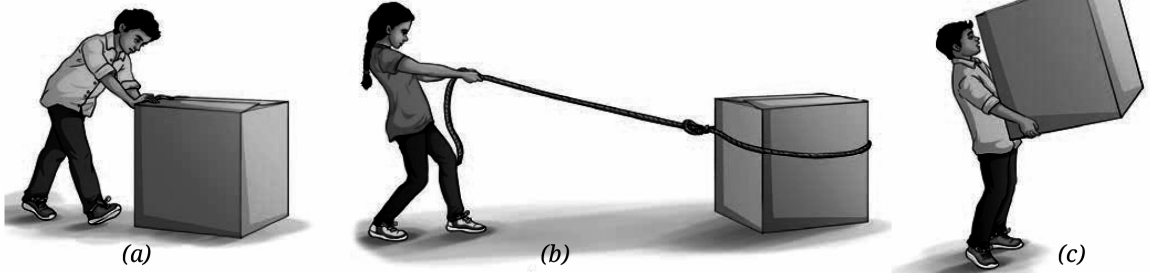


Fig. : Moving a box in different ways (a) Pushing; (b) Pulling; (c) Lifting (pulling up), and carrying

Observations :

- The box moves only when a push or pull is applied.
- The movement stops when force is no longer applied.

Conclusion :

A force is a push or pull applied on an object.

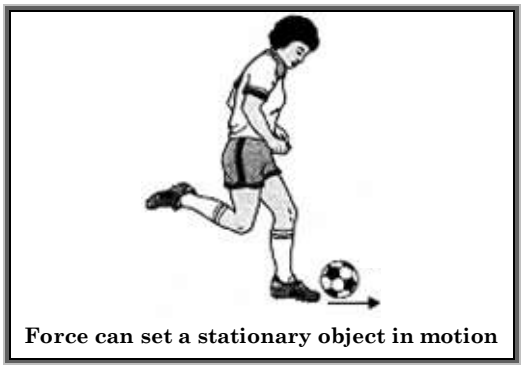
◈ Definition of Force

Force is a push or pull that can change an object's state of rest, its motion, its direction or even its shape.

S.I. Unit of force is **Newton (N)**.

◈ Effects of Force

- **Force can set a stationary object in motion:** When force is applied to a stationary object, it can make it move. For example, if you push a book placed on a table, it starts moving. When you pull a chair, it starts moving. When you push a handcart, it starts moving. However, it is not necessary that force always makes a stationary body move. For example, if you try to push the wall of your classroom, it will not move. For that matter even if all the boys in your class push the wall, it will not move. The reason is that the force applied by all of you is not sufficient to move the wall.

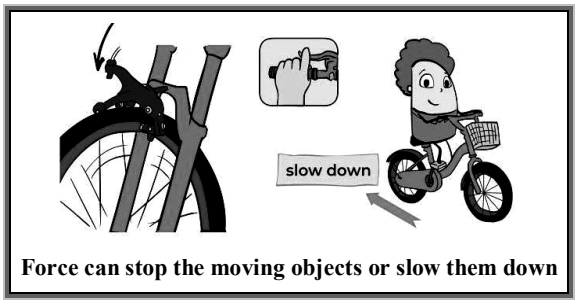


Force can set a stationary object in motion

- **Force can stop the moving objects or slow them down :** Imagine your friend is riding a bicycle. If you pull his bicycle from behind, it is going to slow down. It means that if you apply a force in the direction opposite to the direction of the moving body, the body slows down.

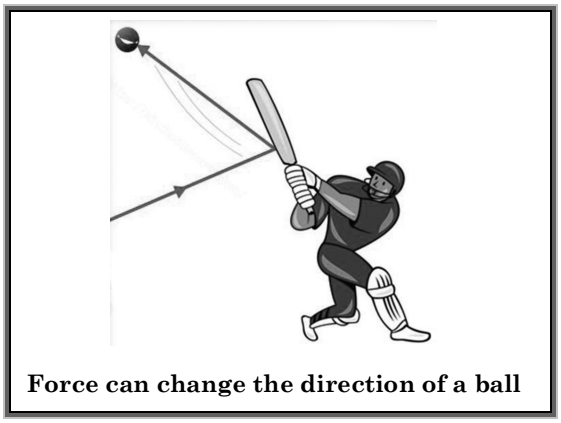
  Similarly, if we apply brakes to a moving bicycle, it first slows down and then stops. We ourselves have to apply force to stop our bodies while running. A cricket ball is stopped by a player by applying a force in the direction opposite to that of the ball.

  From the above examples, it is clear that a force may stop a moving body or may reduce the speed of the moving body.



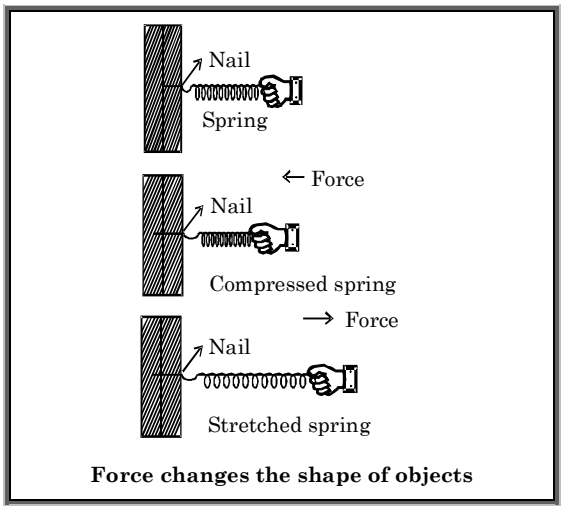
Force can stop the moving objects or slow them down

- **Force can change the direction of moving objects:** When a cricket player hits the ball with a bat, his force changes the speed as well as the direction of the ball. Similarly, a football player changes the direction of a moving ball by angling his foot. You change the direction of your moving bicycle by applying force on its handle in the desired direction.



Force can change the direction of a ball

- **Force can change the shape of objects:** Imagine a spring fixed in a wall with a nail. When we pull the spring, it gets stretched and hence, its shape changes, similarly, when we crumple a paper, its shape changes. Thus by applying force, we can change the shape of object.



Force changes the shape of objects

Are Forces an Interaction Between Two or More Objects ?

- If we try to push a table, we have to push it with our hands. This means our hands and the table are two objects interacting with each other.
- So, **at least two objects must interact** for a force to come into play.
- Whenever two objects interact, each object experiences a force from the other in the **mutually opposite direction**. As soon as the interaction ceases, the two objects no longer experience the force.

COMPETITIVE LEVEL

◈ Mathematical Representation of Force

Mathematically, force F is equal to the product of mass 'm' of a body and acceleration 'a' produced in the body due to that force.

i.e. $F = ma$

Where a = (final velocity – initial velocity)/time

- **Units of Force:**

(i) In C.G.S. system:

$F = ma \rightarrow$ gram × cm/s^2 = dyne

If m = 1 gram and a = 1 cm/s^2 then by F = ma,

$F = 1 \times 1 = 1$ g × cm/s^2 = 1 dyne

When a force is applied on a 1 gram body and the acceleration produced in the body is 1 cm/s^2 then the force acting on the body will be one dyne.

(ii) In S.I. system:

$F = ma \rightarrow$ kg × m/s^2 = Newton

If m = 1 kg and a = 1 m/s^2 then by F = ma

$F = 1 \times 1 = 1$ kg × m/s^2 = 1 Newton.

If a force is applied on a body of mass 1 kg and acceleration produced in the body is 1 m/s^2 then the force acting on the body will be one Newton.

- **Relationship between the Newton and dyne:**

$1\ N = 1\ kg \times 1\ m\ s^{-2} = 1000\ g \times 100\ cm\ s^{-2} = 100000\ g\ cm\ s^{-2} = 10^5$ dyne

Thus $1\ N = 10^5$ dyne

Ex.1 Calculate the force required to produce an acceleration of 5 m/s^2 in a body of mass 2.4 kg.

Sol. We know that force = mass × acceleration = 2.4 kg × 5 m/s^2 = 12.0N

Ex.2 A force acts for 0.2 s on a body of mass 2.5 kg initially at rest. The force then ceases to act and the body moves through 4m in the next one second. Calculate the magnitude of force.

Sol. When the force ceases to act, the body will move with a constant velocity. Since it moves a distance of 4 m in 1 s, therefore, its uniform velocity = 4m/s.

Now, initial velocity, $u = 0$

Final velocity, $v = 4$ m/s

Time interval, $\Delta t = 0.2$ s

$\therefore$ Acceleration, $a = \dfrac{v - u}{\Delta t} = \dfrac{4 - 0}{0.2} = 20 m/s^2$

From the relation,

F = ma, we get

Force, $F = 2.5 \times 20 = 50$ N

Ex.3 A ball of mass 20 gm is initially moving with a velocity of 100 m/s. On applying a constant force on the ball for 0.5s, it acquires a velocity of 150 m/s. Calculate the following:

(i) Acceleration of the ball (ii) Magnitude of the force applied

Sol. Given, m = 20 gm = 0.02 kg

Initial velocity, u = 100 m/s

Time interval, t = 0.5 s

Final velocity, v = 150 m/s

(i) Acceleration, $a = \frac{v - u}{t} = \frac{150 - 100}{0.5} = 100 ms^{-2}$

(ii) Force, F = mass × acceleration

= 0.02 × 100 = 2.0 N

Ex.4 A cricket ball of mass 200 gm moving with a speed of 40 m/s is brought to rest by a player in 0.04s. Calculate the average force applied by the player.

Sol. Mass, $m = 200 \text{ gm} = \frac{200}{1000} \text{ kg} = 0.2 \text{ kg}$

Initial velocity, u = 40 m/s

Final velocity, v = 0

Time, t = 0.04s

Average force $= \frac{\text{Change in momentum}}{\text{Time}} = \frac{-8.0}{0.04} = -200 \text{ N}$

(The negative sign shows that the force is applied in a direction opposite to the direction of motion of the ball).

Ex.5 A motorcycle is moving with a velocity of 108 km/hr and it takes 5 s to stop it after the brakes are applied. Calculate the force exerted by the brakes on the motorcycle if its mass along with the rider is 250 kg.

Sol. Given that initial velocity of the motorcycle

= 108 km/hr = 30 m/s

Final velocity = 0 m/s

Time taken to stop = 5s, the mass of the motorcycle with rider = 250 kg.

The change in the velocity of the motorcycle in 5s = 0 – 30 = –30 m/s

Therefore, the acceleration of the motorcycle, $a = \frac{-30}{5} = -6 \text{ m/s}^2$

The magnitude of the force applied by the brakes is given by the equation,

F = mass × acceleration

= 250 kg × (6)m/s² = 1500 N

Ex.6 A force produces an acceleration of 5.0 cm/s² in a body of mass 20g. Then find out the force acting on the body in Newton.

Sol. Acceleration of the body,

$a = 5 cm/s^2 = 0.05 \text{ m/s}^2$

Mass of the body, m = 20 g = 0.02 kg

F = ma

$\Rightarrow$ $F = 0.05 \times 0.02 = 10^{-3} \text{ N}$

Ex.7 A force of 15 N acts on a body of mass 5 kg for 2s. What is the change in velocity of the body?

Sol. Given: F = 15 N , t = 2s, m = 5 kg

$$F = ma$$

$$a = \frac{F}{m} = \frac{15}{5} = 3 \text{ m/s}^2$$

$$a = \frac{v - u}{t}$$

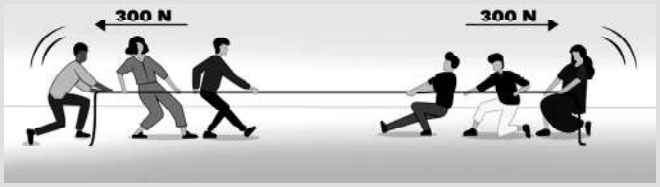
$$\Rightarrow v - u = at = 3 \times 2 = 6 \text{m/s}$$

Balanced and Unbalanced Forces

A number of forces acting on an object may either be balanced or unbalanced.

◈ Balanced Forces

If a number of forces acting on an object does not produce any change in its state of rest or uniform motion or direction of motion then they are known as balanced forces.



Balanced Force

Other examples :

(i) A person holding a briefcase in hand.

(ii) A book resting on a table.

◈ Unbalanced Forces

If a number of forces acting on an object produce a change in its state of rest or uniform motion or direction of motion, then they are termed as unbalanced forces.

Unbalanced Force

Other examples :

(i) A briefcase released from a persons hand.

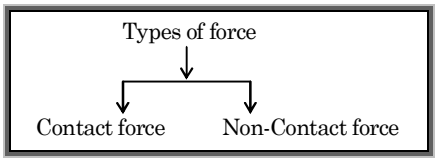
(ii) A stone dropped, etc.

◈ Resultant Force

If a number of forces act on an object then a single force that produces same change in the state of rest or motion is called resultant force. For example, if a number of people push a large almirah and the same almirah can also be pushed by a single person then the force of this single person is the resultant force of all these people. If two forces act on an object in the same direction then the resultant force is obtain by adding them. If two forces act on an object in the opposite direction then the resultant force is obtain by subtracting them.

Note: *If resultant force is zero it means either object is at rest or in uniform motion.*

Types of Force



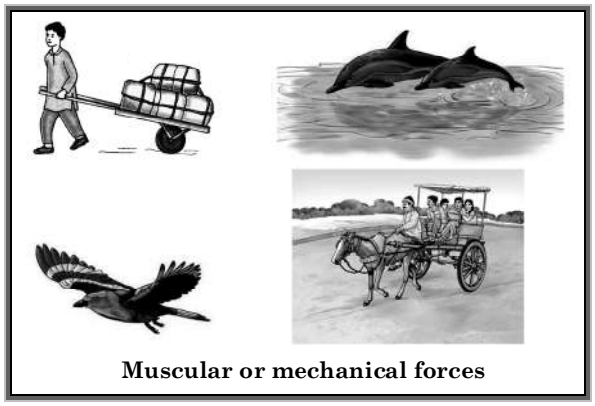
◈ Contact Force

Force which acts on a body only when the body is in contact with another body (exerting force), the force is known as contact force.

- **Types of contact force :**

(i) Muscular force : The force resulting due to the action of muscles is known as muscular force. Muscular force occurs when muscles contract and elongate while doing any activity.

Animals, birds, fish, and insects use muscular forces for movement and survival.

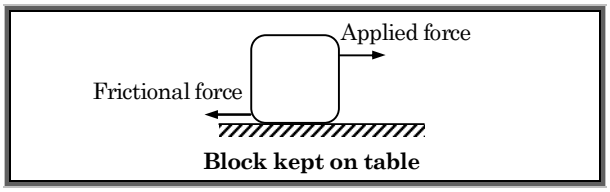


Muscular or mechanical forces

Do You Know ?

Muscular force plays an important role in many functions inside our body too. This force helps us chew food and push it through the alimentary canal during the process of digestion. The expansion and contraction of our heart muscles allows the blood to circulate in our body — a process essential for survival.

(ii) Force of friction : Two bodies placed in contact can also exert forces parallel to the surfaces in contact; such a force is called force of friction or simply friction. It always opposes relative motion of object.



Block kept on table

Friction arises due to the irregularities in the two surfaces in contact. Even surfaces which appear smooth, have a large number of minute irregularities. When placed in contact, the irregularities of two surfaces lock into each other and oppose any effort to move one surface over the other.

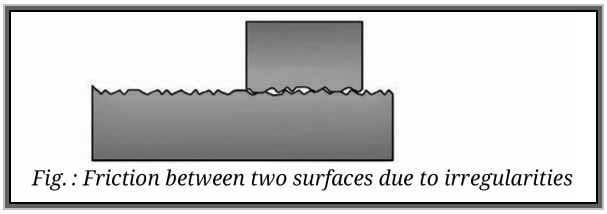


Fig. : Friction between two surfaces due to irregularities

Activity (NCERT)

Aim: To observe frictional force.

Procedure: Push an object (like a box) on a flat surface and note how it stops.

Fig. : Friction acts between two surfaces and opposes the motion of the object.

Observations :

The object slows down and stops after moving some distance.

Conclusion :

A force of friction acts opposite to the direction of motion, bringing the object to rest.

Activity (NCERT)

Aim: To study the dependence of friction on surface type.

Procedure: Push the same object on different surfaces (glass, wood, sand, etc.).

Observations :

The object moves farther on smooth surfaces but less on rough surfaces.

Conclusion :

Friction depends on surface texture—greater on rough surfaces and lesser on smooth surfaces.

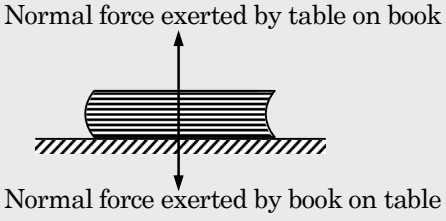
Science Insight :

Frictional force not only acts between solid objects but also act in fluids as well as gases. This is the reason why aeroplanes, ships and high speed trains are designed with a specific shape to reduce this friction.

COMPETITIVE LEVEL

Normal force: If contact forces between the bodies are perpendicular to the surfaces in contact, then the forces are known as normal forces.

e.g.: Consider a book on a table. The table pushes the book upwards and book pushes the table downwards, these forces are perpendicular to the surfaces of book and table. Thus, the table applies a normal force on book in the upward direction and book applies a normal force on table in downward direction.

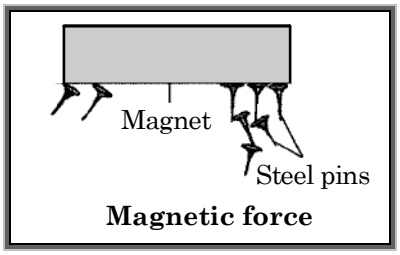


◈ Non-Contact force

Force which acts on a body when the body is not in contact with any other body (exerting force), is known as non-contact force.

- **Types of non-contact force :**

  (i) Magnetic force: The force exerted by a magnet on another magnet or a magnetic material is called magnetic force. Since a magnet can exert a force from a distance without being in contact it is called a non-contact force.



Magnetic force

Activity (NCERT)

Aim: To study magnetic (non-contact) force.

Procedure: Place two ring magnets on a stick with like poles facing each other.

Fig.: Force between two ring magnets

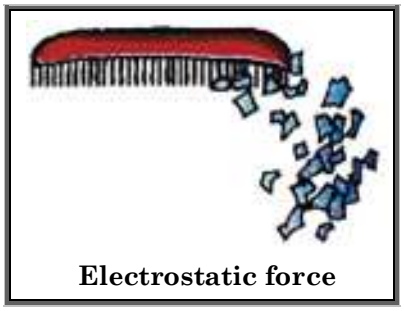
Observations :

The upper magnet floats above the lower one and repels when pushed.

Conclusion :

Magnetic force acts without contact and can cause repulsion or attraction depending on pole orientation.

(ii) Electrostatic force: The force exerted by a charged body on another charged or uncharged body is known as electrostatic force. When a plastic comb is rubbed with silk, it can pick up small bits of paper. This is because the comb acquires an electric charge because of which it can exert a force called electrostatic force. Electrostatic force can also act from a distance and is therefore a non contact force. A body with electrostatic charge can either attract or repel another charged body. Electrostatic force is used to separate solid pollutant particles from smoke given out from factories.



Electrostatic force

Activity (NCERT)

Aim : To explore interaction between charged bodies.

Procedure : Rub two balloons with woollen cloth and bring them near each other.

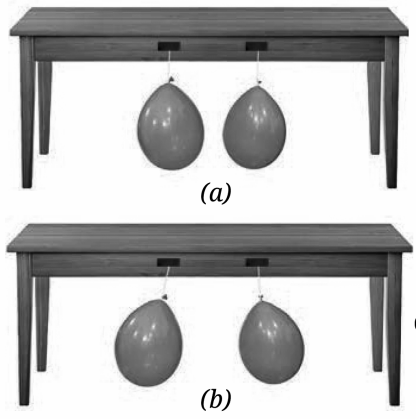


Fig.: (a) Two uncharged balloons; (b) Two charged balloons repelling each other

Observations :

The two balloons repel each other; balloon and cloth attract each other.

Conclusion :

Like charges repel, and unlike charges attract each other.

Point to Remember...

When the charges move, they constitute an electric current in an electrical circuit. It is the same current which makes a lamp glow or generates a heating effect or a magnetic effect.

(iii) Gravitational force : Newton said that every object in this universe attracts every other object with a certain force. The force with which two objects attract each other is called the force of gravitation. The force of gravitation acts even if the two objects are not connected by any means. If, however, the masses of the objects are small, the force of gravitation between them is small and cannot be detected easily. The force of attraction between any two particles in the universe is called gravitation or gravitational force.

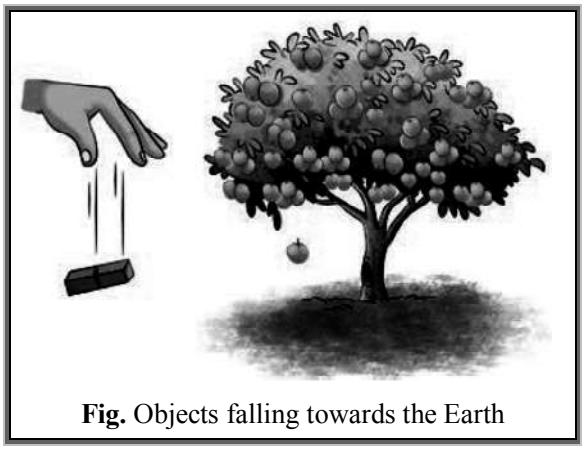


Fig. Objects falling towards the Earth

Activity (NCERT)

Aim : To study gravitational force.

Procedure : Throw a ball vertically upward and observe its motion.

Fig. Throwing an object vertically upwards

Observations :

The ball always comes back to the ground regardless of how high it is thrown.

Conclusion :

The Earth attracts all objects towards itself — this force is gravitational force.

Weight & It's Measurement

The earth attracts all the bodies towards its centre. The force exerted by the earth on the body is known as weight of the body or force of gravity. It acts in vertically downward direction. If mass of the body is m and acceleration due to gravity is g. Then, force of gravity or weight = mg.

The value of g is 9.8 m/s^2. For a body moving downward, g is taken as positive while for a body moving upward, g is taken as negative.

COMPETITIVE LEVEL

◈ **Gravitational units of force:** The force due to gravity on a body of mass m at a place where acceleration due to gravity is g, is given as

$$F = mg$$

The above relation can be used to define the gravitational units of force.

- In **M.K.S.** system, the unit of force is the **kilogram force (kgf)**. One kilogram force is the force due to gravity on a mass of 1 kilogram.

  Thus, 1 kgf = force due to gravity on a mass of 1 kg

  1 kgf = 1 kg mass × acceleration due to gravity g (ms^{-2}) = g Newton.

  Since, the average value of g is 9.8 m s^{-2},

  1 kgf = 9.8 newton (or 9.8N).

- In **C.G.S.** system, the gravitational unit of force is the **gram force (gf)**. One gram force is the force due to gravity on a mass of 1 gram.

  Thus, 1 gf = force due to gravity on a mass of 1 g

  1 gf = 1g mass × acceleration due to gravity g (cms^{-2}) = g dyne.

  Since, the average value of g is 980 cms^{-2}, 1 gf = 980 dyne.

  Further, 1 kgf = 1000 gf.

Ex.8 Find out the weight of an object of mass 25kg in Newton, dyne, kgf and gf. (g=10 m /s^2).

Sol. Mass = 25 kg

Weight = mg

$W = 25 \times 10 = 250$ N

$= 250 \times 10^5$ dyne (1N = 10^5 dyne)

$= 250/10 = 25$ kgf (1kgf = 10 N)

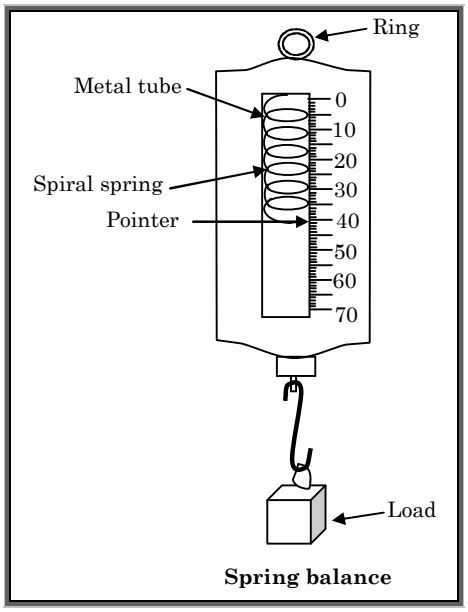
$= 25 \times 1000 = 25000$ gf (1kgf = 1000 gf)

◈ Difference between Mass and Weight

Mass		Weight	
(i)	It is the quantity of matter possessed by a body. It is represented by **m**.	(i)	It is the force with which a body is attracted towards the centre of the earth. It is represented by W = mg.
(ii)	A mass is a constant quantity and is same (for a body) everywhere.	(ii)	It varies from place to place due to variation in value of **g**.
(iii)	Mass is never zero.	(iii)	A body has zero weight at the centre(g = 0) of the earth .
(iv)	Its unit is kg.	(iv)	Its unit is Newton.
(v)	It is a scalar quantity.	(v)	It is a vector quantity.

◈ Spring Balance

Spring balance is a device used for measuring the force acting on an object. It consists of a coiled spring which gets stretched when a force is applied to it. Stretching of the spring is measured by a pointer moving on a graduated scale. The reading on the scale gives the magnitude of the force.



Spring balance

Activity (NCERT)

Aim : To observe the scale of a spring balance.

Materials Required : A spring balance.

Procedure :

1. Observe the scale of the spring balance as indicated in the figure.
2. Find the maximum weight that the spring balance can measure.

Conclusion : The spring balance can measure the maximum weight of an object up to 10 N.

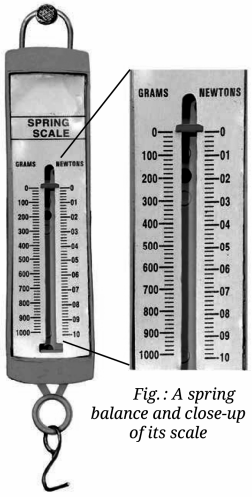


Fig. : A spring balance and close-up of its scale

Activity (NCERT)

Aim : To identify the smallest weight the spring balance can measure.

Materials Required : A spring balance.

1. Observe the bigger marks on the spring balance indicated in activity 10.
2. Now observe how many smaller marks are there between the bigger marks.

Conclusion : The weight difference indicated from 0N to 1N or from 1 N to 2N is 1N and there are five small divisions between two bigger divisions and one small division can read 0.2N. Hence the smallest weight the spring balance can measure is 0.2 N.

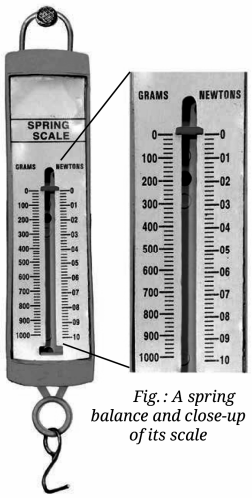


Fig. : A spring balance and close-up of its scale

Activity (NCERT)

Aim : To measure the weights of a few objects using a spring balance.

Materials Required : A spring balance, some materials having weight.

Procedure :

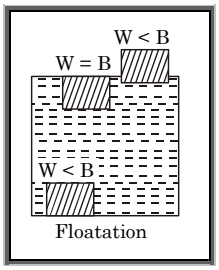
1. hang a pencil box with a string from the book as the lower end of a spring balance and note down its weight as shown in the spring balance.
2. Now, hang another material, like a partially filled water bottle and again note its weight as shown in the spring balance.

Conclusion : The readings of the spring balance is different for the two different objects which indicates that the weight of different materials are different.

Fig. : Object suspended from a spring balance

Floating and Sinking

- A liquid exerts an upward force called **buoyant force** or **upthrust** on object placed in it. Gravity pulls the object down, while buoyant force pushes it up.
- If gravity is stronger, the object sinks and if buoyant force is equal to or greater, it floats.
- Buoyant force depends on the density of the liquid.
- According to **Archimedes Principle**, an object immersed in a liquid experiences an upward force equal to the weight of the liquid it displaces. If this force is less than the object's weight, it sinks and if equal, it floats.



(i) When W > B, the body will sink in the liquid.

(ii) When W = B, then the body will remain in equilibrium inside the liquid.

(iii) When W < B, then the body will come up to the surface of the liquid in such a way that the weight of the liquid displaced due to it balance the weight of body immersed inside the liquid.

Activity (NCERT)

Aim : To understand the concept of upthrust.

Materials Required : An empty platic bottle, a bucket full of water.

Procedure :

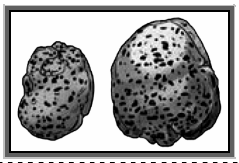
1. Place an empty plastic bottle on the surface of bucket filled with water.
2. Try to push the bottle inwards.

Fig. : Plastic bottle in water

Conclusion :

The bottle bounces up indicating that there is some kind of an upward force acting oni the bottle when it is pushed down inside a liquid such as water. This force is known as the upthrust.

Some rocks can also float on water. The reason is that when they are formed, such as during volcanic eruptions, they cool quickly and gases and air gets trapped inside them making them porous and hence decreasing their overall density. An example of such kind of a stone is a Pumice stone.



Chapter at a glance

- A force is a push or a pull that can change the state of motion or the shape of an object.
- A force always comes into play when two objects interact with each other.
- Force can make a stationary object move, stop a moving object, increase or decrease its speed, change its direction, or change its shape.
- The formula for force is **F = ma**, meaning force is the product of mass and acceleration.
- The SI unit of force is the Newton (N), and the CGS unit is the dyne; both measure the strength of a force.
- When the forces acting on an object are equal in magnitude and opposite in direction, they cancel each other, resulting in no change in the object's state of motion. Such forces are called balanced forces.
- When the forces acting on an object are unequal and do not cancel each other, they cause a change in the object's motion, such as starting, stopping, speeding up or changing direction. These forces are called unbalanced forces.
- If multiple forces act on a body, the single force that replaces all of them and produces the same effect is called the resultant force.
- Contact forces act only when objects are touching, such as muscular force, frictional force, and normal force.
- Friction is a contact force that always opposes motion and is greater on rough surfaces and smaller on smooth surfaces.
- Normal force is the perpendicular force exerted by a surface on an object placed on it.
- Non contact forces act without physical contact and include gravitational force, magnetic force, and electrostatic force.
- Gravitational force is the force with which the Earth attracts all objects toward its center.
- Magnetic force is the attraction or repulsion between magnets and magnetic materials such as iron.
- Electrostatic force is the force between charged bodies and can cause attraction or repulsion.
- Mass is the quantity of matter in an object and remains the same everywhere, whereas weight is the gravitational force acting on the object and changes from place to place.
- Weight is calculated using the formula **W = mg**, where m is mass and g is acceleration due to gravity.
- A spring balance is a device that measures force by the stretching of a spring.
- Liquids exert an upward force called buoyant force on objects placed in them.
- An object sinks if its weight is greater than the buoyant force and floats if the buoyant force is equal to or greater than its weight.
- According to Archimedes' Principle, a body immersed in a liquid experiences an upward force equal to the weight of the liquid displaced by it.

NCERT Exercise

[Keep the curiosity alive]

Q.1 Match items in Column A with the items in Column B.

Column A (Type of force)		Column B (Example)	
(i)	Muscular force	(a)	A cricket ball stopping on its own just before touching the boundary line
(ii)	Magnetic force	(b)	A child lifting a school bag
(iii)	Frictional force	(c)	A fruit falling from a tree
(iv)	Gravitational force	(d)	Balloon rubbed on woollen cloth attracting hair strands
(v)	Electrostatic force	(e)	A compass needle pointing North

Q.2 State whether the following statements are True or False.

(i) A force is always required to change the speed of motion of an object.

(ii) Due to friction, the speed of the ball rolling on a flat ground increases.

(iii) There is no force between two charged objects placed at a small distance apart.

Q.3 Two balloons rubbed with a woollen cloth are brought near each other. What would happen and why?

Q.4 When you drop a coin in a glass of water, it sinks, but when you place a bigger wooden block in water, it floats. Explain.

Q.5 If a ball is thrown upwards, it slows down, stops momentarily, and then falls back to the ground. Name the forces acting on the ball and specify their directions.

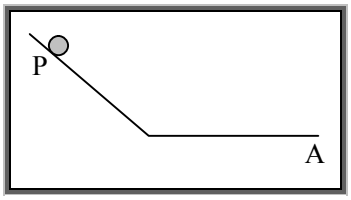
(i) During its upward motion

(ii) During its downward motion

(iii) At its topmost position

Q.6 A ball is released from the point P and moves along an inclined plane and then along a horizontal surface as shown in the Fig. It comes to stop at the point A on the horizontal surface. Think of a way so that when the ball is released from the same point P, it stops (i) before the point A

(ii) after crossing the point A.



Q.7 Why do we sometimes slip on smooth surfaces like ice or polished floors? Explain.

Q.8 Is any force being applied to an object in a non-uniform motion?

Q.9 The weight of an object on the Moon becomes one-sixth of its weight on the Earth. What causes this change? Does the mass of the object also become one-sixth of its mass on the Earth?

Q.10 Three objects 1, 2, and 3 of the same size and shape but made of different materials are placed in the water.
They dip to different depths as shown in Figure.

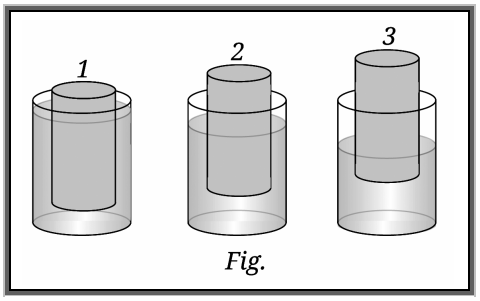


Fig.

If the weights of the three objects 1, 2, and 3 are w_1, w_2, and w_3, respectively, then

(i) $w_1 = w_2 = w_3$

(ii) $w_1 > w_2 > w_3$

(iii) $w_2 > w_3 > w_1$

(iv) $w_3 > w_1 > w_2$

Exercise -1

Very Short Answer Type Questions

Q.1 How many minimum number of objects should be present for a force to come into play?

Q.2 What happens to the speed of a body when a force is applied?

Q.3 Is it possible that a force changes the direction of motion but not the speed of an object?

Q.4 What do you mean by resultant force?

Q.5 In a tug of war, side A applies 10 Newton force and side B applies 8 Newton force. Which side will the rope move?

Short Answer Type Questions

Q.6 What do you mean by the direction of force? What is the standard unit of force?

Q.7 If the force is applied opposite to the motion, what will happen to the speed of the object?

Q.8 What is meant by contact force? Name the different types of contact forces.

Q.9 What is meant by non-contact forces? Name the different types of non contact forces.

Q.10 State the two factors, which describe the state of motion of an object.

Q.11 A gas filled balloon moves up. Is the upward force acting on it larger or smaller than the force of gravity ?

Q.12 Why does wooden log float on water but an iron nail sinks, even if both are placed gently on the water surface?

Long Answer Type Questions

Q.13 Force can change the direction of a moving body. Explain with the help of some examples.

Q.14 Differentiate between contact and non-contact forces.

Q.15 Name the forces acting on a plastic bucket containing water held above ground level in your hand. Discuss why the forces acting on the bucket do not bring a change in its state of motion.

Q.16 Name the type of force in the following cases.
(a) Raindrops falling on the earth.
(b) Holding a book on your hand.
(c) Running a comb through your dry hair.
(d) A bar magnet suspended freely.
(e) Bullocks ploughing the field.

Q.17 How do the mud particles fly off the wheel of a vehicle moving on the wet road?

Q.18 You are swimming in a pool and you feels lighter in water than on land.
(i) What is the reason behind this sensation ?
(ii) Name the force responsible and explain how it acts.
(iii) Also, relate this to the concept of upthrust.

Fill in the Blanks

Q.19 (i) To draw water from a well we have to …….. the rope.

(ii) A charged body……an uncharged body towards it.

(iii) To move a loaded trolley we have to …….. it.

(iv) The north pole of a magnet …….. the north pole of another magnet.

(v) S.I. unit of force is ……..

➢ True or False

Q.20 (i) Gravitational force is a type of contact force.

(ii) A force cannot be seen but the effect of the force can be felt.

(iii) When we lift a bucket of water, we use gravitational force.

(iv) Newton and kg.m/s^2 both are the units of force

(v) Only the earth exerts gravitational force on all objects.

➢ Match the Column

Q.21

Column-A		**Column-B**	
(a)	Falling object	(i)	friction force
(b)	Magnet	(ii)	non-contact force
(c)	Muscular force	(iii)	Steel pins
(d)	Force which opposes the relative motion	(iv)	gravitational force
(e)	Electrostatic force	(v)	contact force

Exercise -2

Q.1 A force applied on a moving body may :
(A) bring it to rest
(B) increase its speed
(C) decrease the speed
(D) all of the above

Q.2 A hockey player uses his hockey stick :
(A) to push the ball
(B) to pull the ball
(C) to change its direction
(D) all of these

Q.3 C.G.S unit of force is :
(A) Dyne (B) Newton
(C) gf (D) can't say

Q.4 How many dynes are equal to 1N?
(A) 10^6 (B) 10^4 (C) 10^5 (D) 10^3

Q.5 When an object undergoes acceleration :
(A) its speed always increases
(B) its velocity always increases
(C) it always falls towards the earth
(D) a force always acts on it

Q.6 The net force acting on a body of mass 1 kg moving with a uniform velocity of 5 ms^{-1} is :
(A) 5 N (B) 0.2 N (C) 0 N (D) None

Q.7 A body is moving with certain velocity towards right. A force of 5N is applied on it towards right and a force of 6N is applied on it towards left then :
(A) speed of body increases towards right
(B) speed of body increases towards left
(C) speed of body remains the same
(D) speed of body decreases

Q.8 A contact force cannot act through :
(A) empty space
(B) touching
(C) touching with a metal rod
(D) touching with a wooden rod

Q.9 If you press an inflated balloon, it deforms due to a type of :
(A) contact force
(B) non-contact force
(C) gravitational force
(D) none of these

Q.10 Which of the following is the action-at-distance force?
(A) muscular force (B) frictional force
(C) magnetic force (D) mechanical force

Q.11 The force exerted by one object on another by virtue of their masses is :
(A) magnetic force
(B) electrostatic force
(C) gravitational force
(D) frictional force

Q.12 Earth always pull everything towards it due to :
(A) muscular force
(B) mechanical force
(C) gravitational force
(D) electrostatic force

Q.13 A cart being carried by a horse is an example of :
(A) muscular force
(B) mechanical force
(C) gravitational force
(D) electrostatic force

Q.14 Force exerted by the muscles is known as :
(A) mechanical force
(B) gravitational force
(C) electrostatic force
(D) muscular force

Q.15 The force you will use to collect the iron nails scattered on a sandy ground is :
(A) frictional force
(B) gravitational force
(C) magnetic force
(D) none of these

Q.16 The force you use to stretch a rubber band is :
(A) frictional force
(B) gravitational force
(C) magnetic force
(D) muscular force

Q.17 Which of the following is weakest force in nature?
(A) gravitational force
(B) electrostatic force
(C) magnetic force
(D) all of these

Q.18 If a rock is brought from the surface of the moon :
(A) its mass will change
(B) its weight will change, but not mass
(C) both mass and weight will change
(D) its mass and weight will remain the same

Q.19 How much force is required to lift a mass of 100g :
(A) 10 N (B) 1 N
(C) 100 N (D) 1000 N

Q.20 A spring balance is used for measuring :
(A) weight
(B) speed
(C) acceleration
(D) mass

Q.21 The reason a stone sinks in water but a plastic ball floats is :
(A) stone is heavier
(B) plastic ball is larger
(C) stone has greater density than water
(D) stone is smooth

Q.22 An object will float in water if :
(A) its weight is more than upthrust
(B) its density is more than water
(C) its weight is equal to upthrust
(D) there is no gravity

Q.23 Which of the following is true for an object that sinks in water?
(A) Buoyant force is greater than the weight
(B) Buoyant force equals weight
(C) Weight is greater than buoyant force
(D) There is no force acting

Exercise -3

(Previous Year Olympiad Questions)

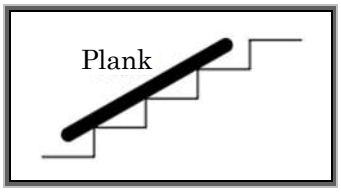
Q.1 Match Column-I with Column-II and select the correct option from the codes given below.

Column-I		Column-II	
(a)	A child running to catch the school bus	(i)	Force can make a stationary object to move
(b)	A man blowing a balloon	(ii)	Force can stop a moving object
(c)	A woman pushing a table	(iii)	Force can change the shape of an object
(d)	A cricketer catching a ball	(iv)	Force can make an object move faster

(A) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
(B) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
(C) (a)-(i), (b)-(ii), (c)-(iii), (d)-(ii)
(D) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Q.2 A ball is dropped from a spacecraft revolving the earth at a height of 100 km. What will happen to the ball?
(A) It will continue to move with the same speed along the original orbit of spacecraft
(B) It will move with the same speed, tangentially to the spacecraft
(C) It will go very far in the space
(D) It will fall down to earth gradually.

Q.3 A plank is supported on the steps of a staircase as shown in the figure. How many forces are acting on the plank?

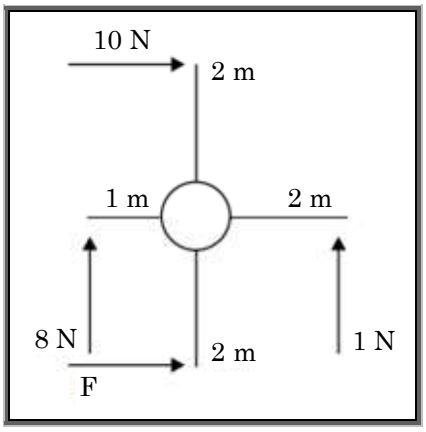


(A) 4 (B) 5 (C) 6 (D) 7

Q.4 When a constant force acts on a mass, and the mass starts moving from rest, then the :
(i) Acceleration is constant
(ii) Velocity increases at a constant rate
(iii) Distance traveled is directly proportional to the time.
(A) (i) only (B) (i) and (ii) only
(C) (i) and (iii) only (D) (ii) and (iii) only

Q.5 Which of the following objects experience balanced forces?
(A) A ball dropping vertically
(B) A car accelerating uniformly from rest
(C) A trolley moving at a constant velocity down an inclined plane
(D) A plane flying in a circle with constant speed

Q.6 A windmill s pushed by four external forces as shown in the given figure. The force F required to make the windmill stand still is :



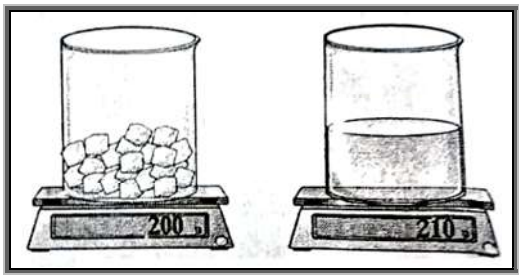
(A) 10 N (B) 13 N
(C) 15 N (D) 18 N

Q.7 Given below are the actions in the form of push or pull and the effect of the force for each action is given. Select the option which correctly identifies then as true (T) and false (F) ones.

	Action	Pull	Push	Effect of Force
(i)	Squeezing a sponge	✓	–	Changes the shape of the sponge
(ii)	Lifting the lid of a box	✓	–	Moves the lid to a different location
(iii)	Pedalling a bicycle	–	✓	Moves the bicycle forward
(iv)	Fliking away a beetle crawling towards you	✓	–	Changes the direction of the beetle

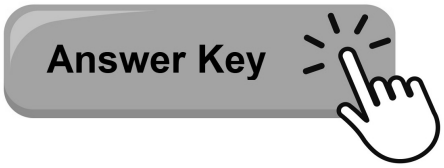
	(i)	(ii)	(iii)	(iv)
(A)	F	F	T	T
(B)	F	T	T	F
(C)	T	T	F	F
(D)	T	F	F	T

Q.8 Preeti pouts a beaker containing ice cubes on a weighing scale, before and after rice melts as shown in the given figures.
Which of the following statements correct the changes ?



(A) The melted ice has more mass compared to ice cubes.
(B) The change in volume of melted ice results in change in the weight of melted ice.
(C) The water vapour in the surrounding an condensed on the beaker.
(D) Weighing scale shows different masses for solids and liquids.

Q.9 What is a characteristic of electrostatic force?
(A) It only acts when bodies are in contact
(B) It acts even when bodies are not in contact
(C) It requires a magnetic field to work
(D) It only acts on uncharged bodies



EXERCISE - 1

➢ **Fill in the Blanks :**

16. (i) pull
(ii) attracts
(iii) push
(iv) repels
(v) newton

➢ **True & False :**

17. (i) False
(ii) True
(iii) False
(iv) True
(v) False

➢ **Match the Column :**

18. a → (iv) ; b → (iii) ; c → (v) ; d → (i) ; e → (ii)

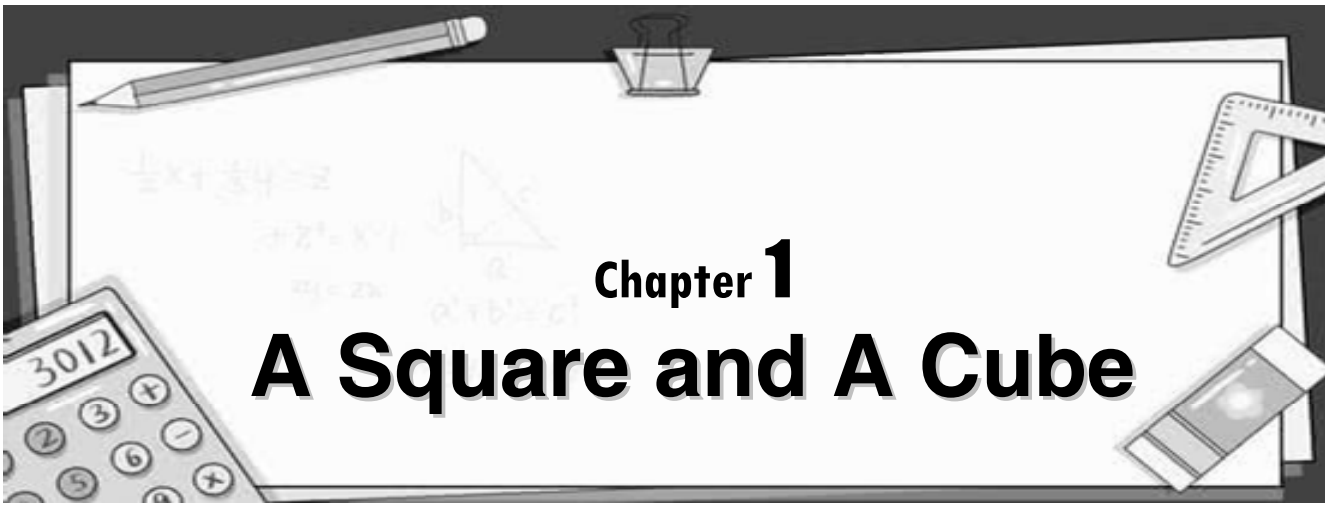
EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	D	A	C	D	C	D	A	A	C	C	C	A	D	C
Ques.	16	17	18	19	20	21	22	23							
Ans.	D	A	B	B	A	C	C	C							

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8	9
Ans.	A	A	D	B	C	B	B	C	B

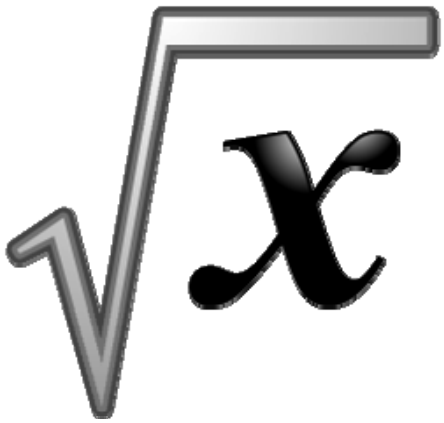
Mathematics



Chapter 1
A Square and A Cube

Chapter Outline

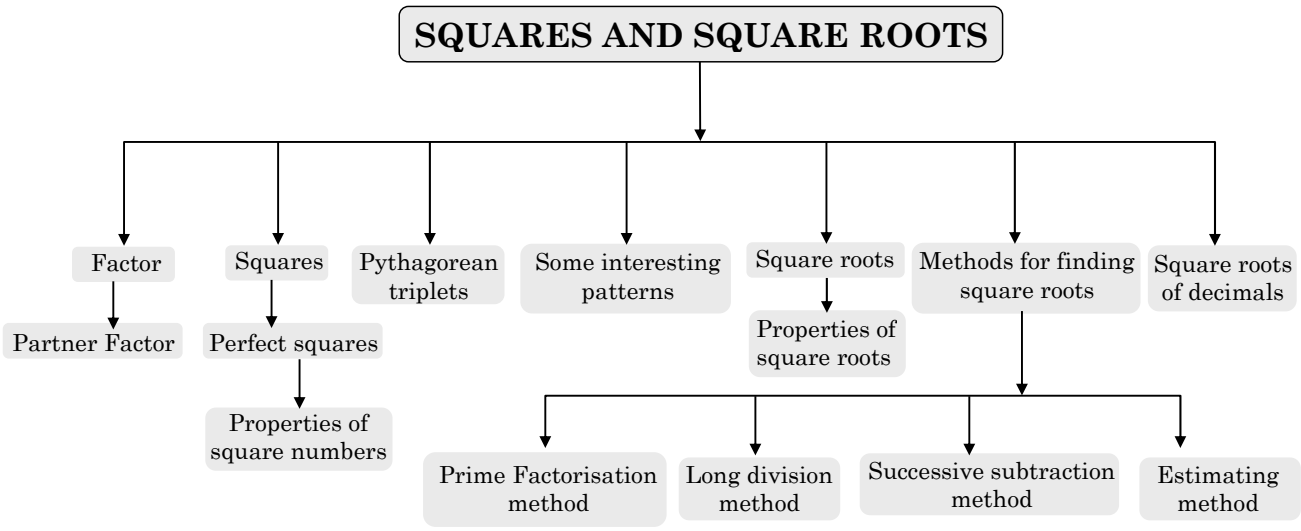
- Factor
- Partner Factor
- Squares
- Perfect Squares
- Properties of Square Numbers
- Some Interesting Patterns
- Methods for finding square of a number
- Square Roots
- Methods for finding square roots

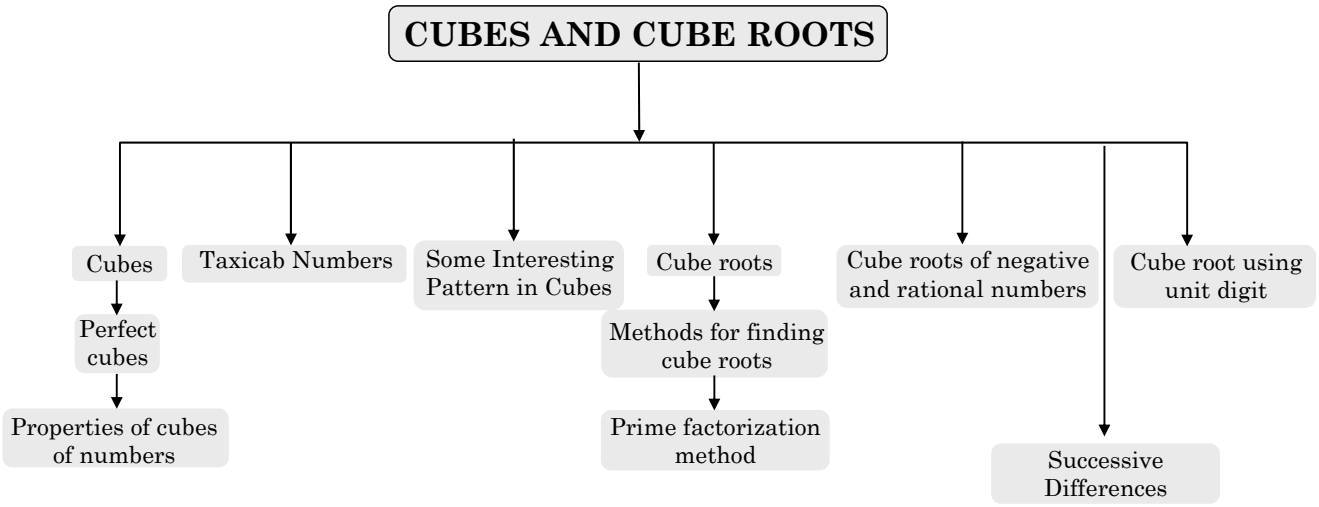


Chapter Outline

- Cubes
- Perfect Cubes
- Properties of Cubes of Numbers
- Taxicab Numbers
- Some Interesting Pattern in Cubes
- Cube Roots
- Methods for finding Cube Roots

MIND MAP


SQUARES AND SQUARE ROOTS
Factor
Partner Factor
Squares
Perfect squares
Properties of square numbers
Pythagorean triplets
Some interesting patterns
Square roots
Properties of square roots
Methods for finding square roots
Prime Factorisation method
Long division method
Successive subtraction method
Estimating method
Square roots of decimals


CUBES AND CUBE ROOTS
Cubes
Perfect cubes
Properties of cubes of numbers
Taxicab Numbers
Some Interesting Pattern in Cubes
Cube roots
Methods for finding cube roots
Prime factorization method
Cube roots of negative and rational numbers
Successive Differences
Cube root using unit digit

SQUARES AND SQUARE ROOTS

Factor

A factor of a number is an exact divisor of that number i.e., the factor divides the number completely without leaving any remainder.

e.g. 1, 2, 3 and 6 are exact divisors of 6.

So, 1, 2, 3 and 6 are factors of 6.

Partner Factor

If the product of two factors of a number is equal to the number itself then those are called partner factor of each other.

e.g. 1, 2, 3 and 6 are factors of 6.

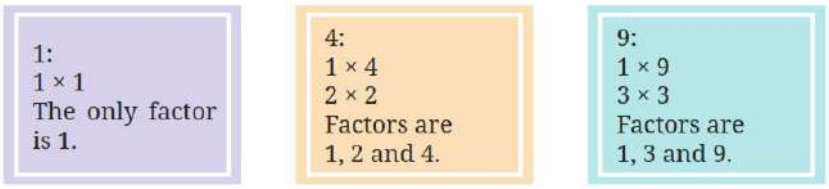
Here $1 \times 6 = 6$ and $2 \times 3 = 6$

So, (1, 6) and (2, 3) are pairs of partner factors of 6.

NCERT Examples

Q. Does every number have an even number of factors?

Ans.



Q. Can you use this insight to find more numbers with an odd number of factors?

For instance, 36 has a factor pair 6×6 where both numbers are 6.

Does this number have an odd number of factors?

Ans. Other numbers having odd number of factors are : 36, its factors are 1, 2, 2, 3, 3. 49, its factors are 1, 7, 7. Hence all the following numbers have an odd number of factors i.e.,

1×1, 2×2, $3 \times 3 \times 3$, 4×4, ….

Squares

When a number is multiplied with itself, the product is called the **square** of that number.

for Ex. $2 \times 2 = 4$ or $2^2 = 4$. We say that the square of 2 is 4. Similarly, $3 \times 3 = 9$ or $3^2 = 9$, etc.

Perfect Squares

A natural number is said to be a perfect square, if it is the square of another natural number.

For Ex., $5 \times 5 = 5^2 = 25$, $6 \times 6 = 6^2 = 36$, $7 \times 7 = 7^2 = 49$, etc.

So 4, 9, 16, 25, 36,……. are all perfect squares.

◈ **The squares of the first 30 natural numbers are:**

$1^2 = 1$ $2^2 = 4$ $3^2 = 9$

$4^2 = 16$ $5^2 = 25$ $6^2 = 36$

$7^2 = 49$ $8^2 = 64$ $9^2 = 81$

$10^2 = 100$ $11^2 = 121$ $12^2 = 144$

$13^2 = 169$ $14^2 = 196$ $15^2 = 225$

$16^2 = 256$ $17^2 = 289$ $18^2 = 324$

$19^2 = 361$ $20^2 = 400$ $21^2 = 441$

$22^2 = 484$ $23^2 = 529$ $24^2 = 576$

$25^2 = 625$ $26^2 = 676$ $27^2 = 729$

$28^2 = 784$ $29^2 = 841$ $30^2 = 900$

NCERT Example

Q. Study the squares in the table above. What are the digits in the units places of these numbers?

Ans. All these numbers end with 0, 1, 4, 5, 6 or 9. None of them end with 2, 3, 7 or 8.

Q. If a number ends in 0, 1, 4, 5, 6 or 9, is it always a square?

Ans. The numbers 16 and 36 are both squares with 6 in the units place. However, 26, whose units digit is also 6, is not a square. Therefore, we cannot determine if a number is a square just by looking at the digit in the units place. But, the units digit can tell us when a number is not a square. If a number ends with 2, 3, 7, or 8, then we can definitely say that it is not a square.

Q. Write 5 numbers such that you can determine by looking at their units digit that they are not squares.

Ans. The numbers ending with digits 2, 3, 7 and 8 are not definitely the square numbers. Do, 5 such numbers can be 32, 53, 77, 98, 102,

Q. Which of the following numbers have the digit 6 in the units place?

(i) 38^2 (ii) 34^2 (iii) 46^2 (iv) 56^2 (v) 74^2 (vi) 82^2

Ans. (i) $38^2 = 144$

(ii) $34^2 = 1156 \rightarrow$ Unit's digit : 6

(iii) $46^2 = 2116 \rightarrow$ Unit's digit : 6

(iv) $56^2 = 3136 \rightarrow$ Unit's digit : 6

(v) $74^2 = 5476 \rightarrow$ Unit's digit : 6

(vi) $82^2 = 6724$

We can also find it out by looking at their unit digit. If unit of a number is 4 or 6, then its square ends with 6.

◈ **To test a given number is a perfect square or not :**

For testing a given number is a perfect square or not we write the given number as the product of prime factors then we make pairs of same factors. If there are factors all of which have pair, then given number is a perfect square otherwise not.

Ex.1 Is 336 a perfect square ?

Sol. Given number is 336

First we factorise it

2	336
2	168
2	84
2	42
3	21
7	7
	1

$336 = \underline{2 \times 2} \times \underline{2 \times 2} \times 3 \times 7$

Clearly 3 and 7 have no pair therefore it is not a perfect square.

Ex.2 Is 1575 a perfect square ?

Sol. Given number is 1575, resolve it into prime factors.

3	1575
3	525
5	175
5	35
7	7
	1

$\therefore 1575 = \underline{3 \times 3} \times \underline{5 \times 5} \times 7$

7 has no pair, therefore 1575 is not a perfect square.

Ex.3 Is 4050 a perfect square ? If not then find the smallest number by which it should be multiplied to make it a perfect square.

Sol. First we write it as the product of prime factors

2	405
5	202
5	40
3	8
3	2
3	9
3	3
	1

Prime factorisation are $4050 = 2 \times 5 \times 5 \times 3 \times 3 \times 3 \times 3 = 2 \times 5^2 \times 3^2 \times 3^2$

No, 4050 is not a perfect square

Now, to make 4050 a perfect square, it should be multiplied by 2, so that the pairing can be complete.

Thus, the new number is $4050 \times 2 = 8100$.

Ex.4 Is 9408 a perfect square ? Find the smallest number by which it should be divided to make it a perfect square.

Sol. First we write it as the product of prime factors

2	940
2	470
2	235
2	117
2	58
2	29
3	14
7	4
7	7
	1

Prime factorisation are : $9408 = \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{7 \times 7} \times 3$

Now, 9408 is not a perfect square

To make 9408 a perfect square, we divide 9408 by 3.

Then the new number is 3136.

COMPETITIVE LEVEL

◈ **Pythagorean Triplet :**

A triplet (x, y, z) of three natural numbers x, y, and z is called a **Pythagorean triplet**, if $x^2 + y^2 = z^2$.

Ex : $3^2 + 4^2 = 9 + 16 = 25 = 5^2$

$6^2 + 8^2 = 36 + 64 = 100 = 10^2$

General Form : For any natural number $m > 1$, we have

$(2m)^2 + (m^2 - 1)^2 = (m^2 + 1)^2$.

$\therefore$ $2m, m^2 - 1, m^2 + 1$ forms a Pythagorean triplet.

Ex.5 Write a Pythagorean triplet whose smallest number is 8

Sol. We can get Pythagorean triplets by using general form $2m, m^2 - 1, m^2 + 1$

Let $m^2 - 1 = 8$

So $m^2 = 8 + 1 = 9$

Which gives $m = 3$

Therefore, $2m = 6$ and $m^2 + 1 = 10$

The triplet we get 6, 8, 10 but 8 is not the smallest number.

Now let $2m = 8$

which gives $m = 4$.

Therefore, $m^2 - 1 = 16 - 1 = 15$

$m^2 + 16 + 1 = 17$

The triplet is 8, 15, 17 with 8 as the smallest number.

Properties of Square Numbers

(i) A number ending with 2, 3, 7 or 8 can never be a perfect square.

e.g. 162, 3293 are not perfect squares.

(ii) The only numbers that have an odd number of factors are the squares.

e.g. The factors of 16 are 1, 2, 4, 8, 16 (5 factors- an odd number).

(iii) If a number has 1 or 9 at unit's place then its square ends with 1.

e.g. $(1)^2 = 1$. $(9)^2 = 81$, $(11)^2 = 121$, $(19)^2 = 361$

(iv) The number of zeros at the end of a perfect square is always even.

For Ex. : $100^2 = 10000$, $50^2 = 2500$, $700^2 = 490000$

(v) The numbers ending in an even number of zeros may or may not be a perfect square.

e.g. 2500 is a perfect square, but 2600 not a perfect square.

(vi) A number ending in an odd number of zeros is never a perfect square.

e.g. 40, 4000 are not perfect squares.

(vii) If a numbers has n zeros at the end, its square will have 2n zeros at the end.

e.g. I a number contains 2 zeros then the number of zeros in its square = $2n = 2 \times 2 = 4$

(viii) The unit digit of the square of a natural numbers is the unit digit of the square of the digit at the unit place of given natural number.

Unit digit of the number	Unit digit of the square of the number
0	0
1 or 9	1
2 or 8	4
3 or 7	9
4 or 6	6
5	5

(ix) There are 2n non-perfect square numbers between the squares of the numbers n and (n + 1).

e.g. The number of non-perfect square numbers between 8^2 and $9^2 = 2 \times 8 = 16$ [$\because$ n = 8]

(x) Squares of even numbers is always even and square of odd numbers is always odd.

For Ex. : $2^2 = 4$, $8^2 = 64$, $40^2 = 1600$

$5^2 = 25$, $9^2 = 81$, $17^2 = 289$

(xi) Square of any real number is always positive.

(xii) The square of a natural number m is equal to the sum of the first m odd numbers.

Thus,

$1^2 = 1$ = sum of the first 1 odd number.

$2^2 = 4 = 1 + 3$ = sum of the first 2 odd numbers.

$3^2 = 9 = 1 + 3 + 5$ = sum of the first 3 odd numbers. $5^2 = 25 = 1 + 3 + 5 + 7 + 9$ = sum of the first 5 odd numbers and so on.

(xiii) The nth odd number is 2n–1.

NCERT Examples

Q. Using the pattern above, find 36^2, given that $35^2 = 1225$.

Ans. The n^{th} odd number is 2n–1.

Therefore, the 36^{th} odd number is $= 2 \times 36 - 1$

$= 72 - 1 = 71$

By adding 71 to 1225, we get 1296, which is 36^2.

Q. How many square numbers are there between 1 and 100? How many are between 101 and 200? Using the table of squares you filled earlier, enter the values below, tabulating the number of squares in each block of 100. What is the largest square less than 1000?

1 –100	101 – 200	201 – 300	301 – 400	401 – 500
_____	_____	_____	_____	_____
501 – 600	601 – 700	701 – 800	801 – 900	901 – 1000
_____	_____	_____	_____	_____

Ans.

Range	Squares in this range	Count
1 – 100	1^2 to 10^2 = 1 to 100	10
101–200	121, 144, 169, 196	4
201–300	225, 256, 289	3
301–400	324, 361, 400	3
401–500	441, 484	2
501–600	529, 576	2
601–700	625, 676	2
701–800	729, 784	2
801–900	841, 900	2
901–1000	961	1

31^2 = 961

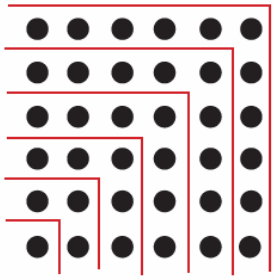
32^2 = 1024 (too big)

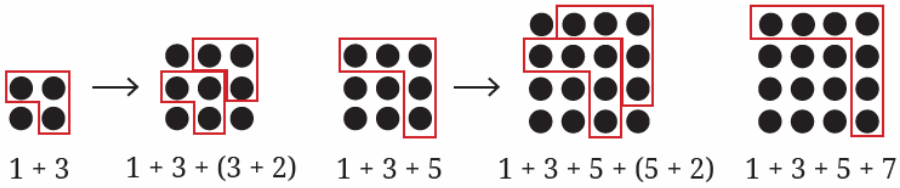
Largest square less than 1000 is 961.

Some Interesting Patterns

(i) Adding consecutive odd numbers

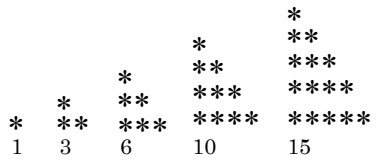
1 = **1**
1 + 3 = **4**
1 + 3 + 5 = **9**
1 + 3 + 5 + 7 = **16**
1 + 3 + 5 + 7 + 9 = **25**
1 + 3 + 5 + 7 + 9 + 11 = **36.**



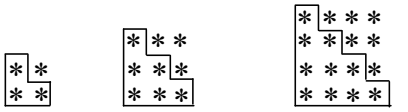


(ii) Adding triangular numbers.

Triangular Numbers : Numbers whose dot patterns can be arranged as triangles.



If we combine two consecutive triangular numbers, we get a square number, like



(iii) Some more patterns in square numbers

Observe the squares of numbers : 1, 11, 111 … etc. They give a beautiful pattern :

$1^2 =$ 1

$11^2 =$ 1 2 1

$111^2 =$ 1 2 3 2 1

$1111^2 =$ 1 2 3 4 3 2 1

$11111^2 =$ 1 2 3 4 5 4 3 2 1

$11111111^2 =$ 1 2 3 4 5 6 7 8 7 6 5 4 3 2 1

Another interesting pattern.

$7^2 = 49$

$67^2 = 4489$

$667^2 = 444889$

$6667^2 = 44448889$

$66667^2 = 4444488889$

$666667^2 = 444444888889$

(iv) One more pattern given below :

$1\ 2\ 1 \times (1 + 2 + 1) = 4\ 8\ 4 = 22^2$

$1\ 2\ 3\ 2\ 1 \times (1 + 2 + 3 + 2 + 1) = 110889 = 333^2$

i.e.,

$11^2 \times$ (sum of digits in 11^2) $= 22^2$

$111^2 \times$ (sum of digits in 111^2) $= 333^2$

111111111^2 x (sum of digit in 111111111^2) $= 999999999^2$

(v) The difference of squares of two consecutive numbers is equal to their sum.

e.g. $5^2 - 4^2 = 5 + 4 = 9$

◈ Some Particular Methods :

(i) The square of a number of the form a5 (where a is ten's digit and 5 is unit's digit) is the number which ends in 25 and has the number a (a + 1) before 25.

For example :

$85^2 = 8 \times (8 + 1)\ 25\ (\therefore\ a = 8) = 7225$

$105 = 10 \times (10 + 1)\ 25 = 11025\ \ (\therefore\ a = 10)$

(ii) The square of a number of the form 5a where a is unit's digit and 5 is ten's digit is equal to $(25 + a) \times 100 + a^2$.

Squares Roots

Since

$2^2 = 4$, or square root of 4 is 2.

$3^2 = 9$, or square root of 9 is 3.

$9^2 = 81$, or square root of 81 is 9.

So the square root of a number x is that number which when multiplied by itself gives the number x itself. The number x under consideration is a perfect square.

The symbol of square root is $\sqrt{\ }$

Thus, the facts such as the square root of 4 is 2, of 81 is 9, etc., can be mathematically represented as :

$\sqrt{4} = 2,\ \sqrt{81} = 9.$

Every perfect square has two integer square roots. One is positive and the other is negative.

In general, $\sqrt{n^2} = \pm n$.

Thus, $\sqrt{64} = \pm 8$ and $\sqrt{100} = \pm 10$.

In this chapter, we shall only consider the positive square root.

NCERT Examples

Q. The area of a square is 49 sq. cm. What is the length of its side?

Ans. We know that $7 \times 7 = 49$, or $\sqrt{49} = 7$

So, the length of the side of a square with an area of 49 sq. cm is 7 cm.

We call 7 the square root of 49.

In general, if $y = x^2$ then x is the square root of y.

Q. What is the square root of 64?

Ans. We know that 8×8 is 64. or $\sqrt{64} = 8$

◈ Properties of Square Root :

(i) If the unit digit of a number is 2, 3, 7 or 8, then it does not have a square root in N. Where N is the set of Natural number.

(ii) If a number ends in an odd number of zeros, then it does not have a square root in N.

(iii) The square root of an even number is even and square root of an odd number is odd.

For example : $\sqrt{49} = 7,\ \sqrt{225} = 15,\ \sqrt{441} = 21$ etc.

(iv) Negative numbers have no square root in set of real numbers.

Methods for Finding Square Roots

◈ Prime Factorisation Method :

Step I : Find the prime factors of the given perfect square number.

Step II : Since the number is a perfect square, therefore, we get pairs of similar prime numbers. Then, choose one prime number from each pair.

Step III : Find the product of all such prime number so taken. This gives the square root of the given number.

NCERT Examples

Q. Is 324 a perfect square?

Ans. $324 = 2 \times 2 \times 3 \times 3 \times 3 \times 3$.
These can be grouped as
$324 = (2 \times 3 \times 3) \times (2 \times 3 \times 3)$.
$= (2 \times 3 \times 3)^2 = 18^2$.
We can also write the prime factors in pairs. That is,
$324 = (2 \times 2) \times (3 \times 3) \times (3 \times 3)$,
which shows that 324 is a perfect square. Thus,
$324 = (2 \times 3 \times 3)^2 = 18^2$.
Therefore, $\sqrt{324} = 18$.

Q. Is 156 a perfect square?

Ans. The prime factorisation of 156 is $2 \times 2 \times 3 \times 13$.
We cannot pair up these factors.
Therefore, 156 is not a perfect square.

Ex.7 Find the square root of 441.

Sol.

3	441
3	147
7	49
	7

$441 = \underline{3 \times 3} \times \underline{7 \times 7}$

Taking out one factor from every pair,

$\sqrt{441} = \sqrt{3 \times 3 \times 7 \times 7} = 3 \times 7 = 21$

Verification : $21^2 = \underline{21 \times 21} = 441$.

Ex.8 Find the square root of 1764.

Sol.

2	1764
2	882
3	441
3	147
7	49
	7

$1764 = \underline{2 \times 2} \times \underline{3 \times 3} \times \underline{7 \times 7}$

Taking out one factor from every pair,

$\sqrt{1764} = \sqrt{2 \times 2 \times 3 \times 3 \times 7 \times 7} = 2 \times 3 \times 7 = 42$

◈ Long Division Method :

Step I : The digits of the number are paired-off, starting from the units place. Each pair is called a period.

Step II : Find a digit whose square is less than or equal to the left most period which is the first dividend. This digit is the divisor as well as the quotient.

Step III : Subtract the product of the divisor and the quotient from the first period. Bring down the next period to the right of the remainder. This is the new dividend.

Step IV : Now double the quotient to get the new divisor with a blank space on the right and assign a largest possible digit both in the quotient and in the blank space, such that the product of this digit with the new divisor having the same digit in the blank space is equal to or less than the dividend.

Repeat steps 3 and 4 till all the periods are over. The quotient thus obtained is the square root of the given number.

Ex.9 Find the square root of 5476 by using long division method.

Sol.

$$\begin{array}{r|l} & 74 \\ \hline 7 & \overline{54}\,\overline{76} \\ & -49 \\ \hline 144 & 576 \\ & -576 \\ \hline & 0 \end{array}$$

Step I : Pair the digits starting from the units digit.

Step II : Find a whole number whose square is just equal to or less than 54, i.e. 7 is the divisor and the quotient.

Step III : Subtract the product ($7 \times 7 = 49$) from 54.

Step IV : Double the quotient ($7 \times 2 = 14$) and bring down the next pair, i.e. 76 the new dividend.

Step V : Now think of a digit to be placed on the right of 14, such that the digit multiplied by the divisor will give 576.

Since $4 \times 144 = 576$; the square root is 74.

$\therefore \sqrt{5476} = 74$

Ex.10 Find the square root of 7744 by using long division method.

Sol.

$$\begin{array}{r|l} & 88 \\ \hline 8 & \overline{77}\,\overline{44} \\ & -64 \\ \hline 168 & 1344 \\ & -1344 \\ \hline & 0 \end{array}$$

Step I : $8 \times 8 = 64 < 77$

Step II : $77 - 64 = 13$

Step III : Double of 8 is 16 and bring down the next period, i.e. 44.

Step IV : Since $168 \times 8 = 1344$, 8 is the next digit of the quotient.

$\therefore \sqrt{7744} = 88$

Ex.11 Find the square root of 529 by using long division method.

Sol. Observe that 5 does not have a pair, so

Step I : $2 \times 2 = 4$ and $5 - 4 = 1$

Now bring down 29.

Step II : $43 \times 3 = 129$

$$\begin{array}{r|l} & 23 \\ \hline 2 & \overline{5}\overline{29} \\ & -4 \\ \hline 43 & 129 \\ & -129 \\ \hline & 0 \end{array}$$

$\therefore \sqrt{529} = 23$

Ex.12 What must be added to 7581 to make it a perfect square ?

Sol. First finding the square root of 7581.

Now, 87^2 is 12 less than 7581, so we choose the square of 88.

Thus, $7581 < 88^2$.

Now, $88^2 = 88 \times 88 = 7744$

$$\begin{array}{r|l} & 87 \\ \hline 8 & \overline{7}\overline{5}\overline{81} \\ & -64 \\ \hline 167 & 1181 \\ & -1169 \\ \hline & 12 \end{array}$$

The least number to be added = 7744 – 7581 = 163

So, 163 should be added to 7581 to make it a perfect square.

Ex.13 Find what is the least number that should be added to 2361 to make it a perfect square ?

Sol. Now, 48^2 is 57 less than 2361, so we choose the square of 49.

Thus, $2361 < 49^2$.

Now, $49^2 = 49 \times 49 = 2401$

$$\begin{array}{r|l} & 48 \\ \hline 4 & \overline{2}\overline{3}\overline{61} \\ & -16 \\ \hline 8 & 761 \\ & -704 \\ \hline & 5 \end{array}$$

The number to be added is 2401 – 2361 = 40

Ex.14 Find the biggest 4-digit number which is a perfect square.

Sol. The biggest 4-digit number is 9999.

Now $99^2 < 9999$, while $100^2 = 100 \times 100$

$= 10000$

$\therefore 99^2 = 99 \times 99 = 9801$

$\therefore$ 9801 is the largest 4-digit number which is a perfect square

Divisor	Working
	99
9	$\overline{99}\,\overline{99}$
	− 81
18	1899
	−1701
	198

◈ Square Roots of Decimals :

Make the number of decimal places even by affixing a zero, if necessary. Now, mark period and find out the square root by the long-division method. Put the decimal point in the square root as soon as the integral part is exhausted.

Ex.15 Find the square root of 17.64

Sol. Here, the number of decimal places is already even. So, mark the periods and proceed as follows :

Divisor	Working
	4.2
4	17.64
	− 16
8	164
	164
	0

$\therefore \sqrt{17.64} = 4.2$

Ex.16 Find the value of $\sqrt{2}$ correct up to three places of decimal.

Sol. Since we have to find the value of $\sqrt{2}$ correct up to three decimal places. We shall find its value up to four decimal places.

We may write 2 = 2.00000000.

Now, mark the period and proceed as follows.

Divisor	Working
	1.4142
1	$\overline{2}.\ \overline{00}\,\overline{00}\,\overline{00}\,\overline{00}$
	−1
24	100
	−96
281	400
	− 281
2824	11900
	− 11296
28282	60400
	− 56564
	3836

$\sqrt{2}$ = 1.4142 up to four places of decimal.

=1.414 correct up to three places of decimal.

Hence, $\sqrt{2}$ = 1.414

◈ Square Roots of Fractions :

For any positive numbers a and b, we have

(i) $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$ (ii) $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

Ex.17 Find the square root of $\sqrt{\frac{484}{1024}}$.

Sol. We have $= \sqrt{\frac{484}{1024}} = \frac{\sqrt{484}}{\sqrt{1024}}$

Now, we find the square roots of 484 and 1024 separately.

$\therefore \sqrt{484} = 22$; $\sqrt{1024} = 32$

$\therefore \sqrt{\frac{484}{1024}} = \frac{\sqrt{484}}{\sqrt{1024}} = \frac{22}{32} = \frac{11}{16}$

◈ Square Roots by Successive Subtractions :

If the number is a perfect square, it can be expressed as the sum of successive odd numbers starting from 1. So, by subtracting the successive odd numbers starting from 1 from given perfect square we can find the square root of that number.

The number of times the subtraction is performed to arrive at zero is the square root of given number.

NCERT Examples

Q. Find the square root of 81 by successive subtraction method.

An. Here, 81 – 1 = 80
80 – 3 = 77
77 – 5 = 72
72 – 7 = 65
65 – 9 = 56
56 – 11 = 45
45 – 13 = 32
32 – 15 = 17
17 – 17 = 0

Clearly, we have performed subtraction nine times

$\sqrt{81}$ = 9

Q. Now consider another number 38, and again do as above.

Ans. (i) $38 - 1 = 37$ (ii) $37 - 3 = 34$

(iii) $34 - 5 = 29$ (iv) $29 - 7 = 22$

(v) $22 - 9 = 13$ (vi) $13 - 11 = 2$

(vii) $2 - 13 = -11$

This shows that 38 cannot be expressed as a sum of consecutive odd numbers starting with 1.

Ex.18 Consider the number 25. Successively subtract 1,3,5,7,9,….. from it

Sol. (i) $25 - 1 = 24$ (ii) $24 - 3 = 21$

(iii) $21 - 5 = 16$ (iv) $16 - 7 = 9$ (v) $9 - 9 = 0$

This means, $25 = 1 + 3 + 5 + 7 + 9$. Also, 25 is a perfect square.

◈ Estimating Square Root of a Number

To estimate the square root of a number, follow the following steps.

Step. I. Identify two consecutive perfect squares between which the given number lies.

This gives an approximate range for the square root.

e.g. for $\sqrt{1936}$,

we know that $40^2 = 1600$

and $50^2 = 2500$.

$\therefore \sqrt{1936}$ lies between 40 and 50.

Step II. Observe the last digit of the number. For perfect squares, the last digit of the square root must correspond.

e.g. 1936 ends in 6, so its square root may end in 4 or 6, making, making it likely 44 or 46.

Step III. Square a number from within the interval (like 45) and compare it with the original number to refine the estimate.

e.g. $45^2 = 2025$, which is greater than 1936 so ,

$\sqrt{1936} < 45$.

Step IV. Based on comparison, adjust the interval.

eg. $40 < \sqrt{1936} < 45$.

Step V. Use the logical reasoning and verification to guess the exact square root.

e.g. $\sqrt{1936} = 44$.

CUBE AND CUBE ROOTS

Cubes

The cube of a number is the number raised to the power 3. Thus,

cube of $2 = 2^3 = 2 \times 2 \times 2 = 8$,

cube of $5 = 5^3 = 5 \times 5 \times 5 = 125$,

Perfect Cubes

A natural number is said to be a perfect cube if it is the cube of some natural number.

Ex.1 $27 = 3^3$, $216 = 6^3$,

$343 = 7^3$, $1000 = 10^3$.

NCERT Examples

Q. How many cubes of side 1 cm will make a cube of side 2 cm?

Ans. Volume of big cube $= 2 \times 2 \times 2 = 8\ cm^3$

Volume of small cube $= 1 \times 1 \times 1 = 1\ cm^3$

$$\text{Number of small cubes} = \frac{\text{Volume of big cube}}{\text{Volume of small cube}}$$

$$= \frac{8}{1} = 8$$

$= 8$ cubes.

Q. How many cubes of side 1 cm will make a cube of side 3 cm?

Ans. Volume of big cube $= 3 \times 3 \times 3 = 27\ cm^3$

Volume of small cube $= 1 \times 1 \times 1 = 1\ cm^3$

$$\text{Number of small cubes} = \frac{\text{Volume of big cube}}{\text{Volume of small cube}}$$

$$= \frac{27}{1} = 27$$

$= 27$ cubes.

Q. Is 9 a cube ?

Ans. We see that $2 \times 2 \times 2 = 8$ and $3 \times 3 \times 3 = 27$.

This shows that 9 is not a perfect cube. Nor is nay number from 10 to 26.

◈ The Cubes of First 15 Natural Numbers are :

$1^3 = 1$	$2^3 = 8$	$3^3 = 27$
$4^3 = 64$	$5^3 = 125$	$6^3 = 216$
$7^3 = 343$	$8^3 = 512$	$9^3 = 729$
$10^3 = 1000$	$11^3 = 1331$	$12^3 = 1728$

$13^3 = 2197$ $14^3 = 2744$ $15^3 = 3375$

$16^3 = 4096$ $17^3 = 4913$ $18^3 = 5832$

$19^3 = 6859$ $20^3 = 8000$

NCERT Examples

Q. What patterns do you notice in the table above?

Ans. Cubes grow fast, follow parity of the base number, and their last digit repeat in a pattern.

Q. We know that 0, 1, 4, 5, 6, 9 are the only last digits possible for squares. What are the possible last digits of cubes?

Ans. $0^3 = 0$

$1^3 = 1$

$2^3 = 8$

$3^3 = 27 \rightarrow$ ends in 7

$4^3 = 64 \rightarrow$ ends in 4

$5^3 = 125 \rightarrow$ ends in 5

$6^3 = 216 \rightarrow$ ends in 6

$7^3 = 343 \rightarrow$ ends in 3

$8^3 = 512 \rightarrow$ ends in 2

$9^3 = 729 \rightarrow$ ends in 9

Possible last digits : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

So, cube of a number can end with any possible digit.

Q. Similar to squares, can you find the number of cubes with 1 digit, 2 digits, and 3 digits? What do you observe?

Ans. 2 cubes with 1-digit,

e.g. $1^3 = 1$, $2^3 = 8$

2 cubes with 2-digit

e.g. $3^3 = 27$, $4^3 = 64$

5 cubes with 3-digit.

e.g. $5^3 = 125$, $6^3 = 216$, $7^3 = 343$, $8^3 = 512$, $9^3 = 729$

Cubes increase rapidly in number of digits.

Q. Can a cube end with exactly two zeroes (00)? Explain.

Ans. A cube ending with 00 must be divisible by 1000, so , it will have at least three zeros, not two.

Ex.2 Examine that (i) 200 (ii) 864 are perfect cubes or not.

Sol. (i) First we resolve 200 into prime factors

2	200
2	100
2	50
5	25
5	5
	1

$200 = \underline{2 \times 2 \times 2} \times 5 \times 5$

If we form triplets of equal factors, the number 2 forms a group of three while the factor 5 does not do so, therefore , 200 is not perfect cube.

(ii)

2	864
2	432
2	216
2	108
2	54
3	27
3	9
3	3
	1

$864 = \underline{2 \times 2 \times 2} \times 2 \times 2 \times \underline{3 \times 3 \times 3}$

Here, the second group of 2's does not form a triplet, hence 864 is not a perfect cube.

Ex.3 What is the smallest number by which 1323 may be multiplied so that the product is a perfect cube?

Sol. First we resolve 1323 into prime factors

3	1323
3	441
3	147
7	49
7	7
	1

$1323 = \underline{3 \times 3 \times 3} \times 7 \times 7$

Since one more 7 is required to make a triplet of 7, the smallest number by which 1323 should be multiplied to make it a perfect cube is 7.

Ex.4 What is the smallest number by which 1375 should be divided so that the quotient may be a perfect cube ?

Sol. First we resolve 1375 into prime factors

5	1375
5	275
5	55
1	11
	1

$1375 = \underline{5 \times 5 \times 5} \times 11$

The factor 5 makes a triplet, and 11 is left out. So, clearly 1375 should be divided by 11 to make it a perfect cube.

Properties of Cubes of Numbers

- Cubes of all odd natural numbers are odd. Thus,

  $3^3 = 27$, $5^3 = 125$, $7^3 = 343$, $9^3 = 729$, etc.

- Cubes of all even natural numbers are even. Thus,

  $2^3 = 8$, $4^3 = 64$, $6^3 = 216$, $8^3 = 512$, etc.

- The cube of a negative integer is always negative

  Ex., $(-1)^3 = (-1) \times (-1) \times (-1) = (1) \times (-1) = -1$

  $(-2)^3 = -2 \times -2 \times -2 = (-2 \times -2) \times -2 = 4 \times -2 = -8$

- For any rational number $\frac{a}{b}$, we have $\left(\frac{a}{b}\right)^3 = \frac{a^3}{b^3}$.

  Thus, $\left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3} = \frac{8}{27}$, $\left(\frac{-4}{5}\right)^3 = \frac{(-4)^3}{5^3} = \frac{-64}{125}$

- The sum of the cubes of first n natural numbers is equal to the square of their sum.

  i.e. $1^3 + 2^3 + 3^3 + \ldots\ldots\ldots\ldots + n^3 = (1 + 2 + 3 + \ldots\ldots\ldots\ldots + n)^2$

- Cubes of the numbers ending in digits 1, 4, 5, 6 and 9 are the number ending in the same digit. Cubes of numbers ending in digit 2 ends in 8, and cubes of numbers ending in digit 8 ends in 2. The cubes of the numbers ending in digits 3 and 7 ends in 7 and 3 respectively.

Taxicab Numbers

Taxicab numbers are the smallest numbers that can be expressed as the sum of two cubes in two different ways.

e.g. 1729 is a taxicab numbers, which is the smallest number that can be written as the sum of two cubes in two different ways.

$1729 = 1^3 + 12^3$, $1729 = 9^3 + 10^3$

Note → The next two taxicab numbers after 1729 are 4104 and 13832.

NCERT Example

Q. The next two taxicab numbers after 1729 are 4104 and 13832. Find the two ways in which each of these can be expressed as the sum of two positive cubes.

Ans.
- $4104 = 2^3 + 16^3 = 9^3 + 15^3$
- $13832 = 2^3 + 24^3 = 18^3 + 20^3$

Some Interesting Pattern in Cubes

(i) Adding consecutive odd numbers

(Numbers as a sum of odd numbers) In this pattern, sum of consecutive odd numbers are used to obtain the cubes

i.e. $n^3 = [n(n-1) + 1] + [n(n-1) + 3] + [n(n-1) + 5] + \ldots\ldots + n$ terms

where, n is the number whose cube is to find.

e.g.

$$1 = 1 = 1^3$$

$$3 + 5 = 8 = 2^3$$

$$7 + 9 + 11 = 27 = 3^3$$

$$13 + 15 + 17 + 19 = 64 = 4^3$$

$$21 + 23 + 25 + 27 + 29 = 125 = 5^3$$

$$31 + 33 + 35 + 37 + 39 + 41 = 216 = 6^3.$$

NCERT Example

Q. Can you tell what this sum is without doing the calculation?

$91 + 93 + 95 + 97 + 99 + 101 + 103 + 105 + 107 + 109.$

Ans. Given : an odd number series : 91, 93, 95, 97, 99, 101, 103, 105, 107, 109

Pair the numbers from start and end.

- $91 + 109 = 200$
- $93 + 107 = 200$
- $95 + 105 = 200$
- $97 + 103 = 200$
- $99 + 101 = 200$
- Sum $= 200 \times 5 = 1000$

Cube Roots

The cube root of a number ***a*** is that number which when multiplied by itself three times gives *a*,

The symbol of cube root is $\sqrt[3]{\ }$

i.e., If $a \times a \times a = a^3$, then $\sqrt[3]{a^3} = a$

Methods for Finding Cube Roots

◈ Prime Factorisation Method for Finding the Cube Root of A Perfect Cube :

Step I : Resolve the given number into prime factors.

Step II : Form groups of three similar factors.

Step III : Take out one factor from each group and multiply. The product will be the cube root of the given number.

NCERT Examples

Q. Let us check if 3375 is a perfect cube.

Ans. $3375 = 3 \times 3 \times 3 \times 5 \times 5 \times 5$.

We can form three groups of (3×5).

So, $3375 = (3 \times 5) \times (3 \times 5) \times (3 \times 5) = (3 \times 5)^3 = 15^3$

Another way is to check if the factors can be grouped into triplet(s).

$3375 = (3 \times 3 \times 3) \times (5 \times 5 \times 5) = 3^3 \times 5^3$

This means $\sqrt[3]{3375} = 15$.

Q. Is 500 a perfect cube?

Ans. $500 = 2 \times 2 \times 5 \times 5 \times 5$.

We see that the factors cannot be split into three identical groups. Therefore, 500 is not a perfect cube.

Q. Find the cube roots of these numbers:

(i) $\sqrt[3]{64}$ (ii) $\sqrt[3]{512}$ (iii) $\sqrt[3]{729}$

Ans. (i) $\sqrt[3]{64} = \sqrt[3]{4 \times 4 \times 4}$

$= \sqrt[3]{4^3}$

$= 4$

(ii) $\sqrt[3]{512} = \sqrt[3]{8 \times 8 \times 8}$

$= \sqrt[3]{8^3}$

$= 8$

(iii) $\sqrt[3]{729} = \sqrt[3]{9 \times 9 \times 9}$

$= \sqrt[3]{9^3}$

$= 9$

Ex.5 Find the cube root of 1728.

Sol. First we resolve 1728 into prime factors

$\sqrt[3]{1728} = \sqrt[3]{\underline{2 \times 2 \times 2} \times \underline{2 \times 2 \times 2} \times \underline{3 \times 3 \times 3}}$

$= 2 \times 2 \times 3 = 12$

2	1728
2	864
2	432
2	216
2	108
2	54
3	27
3	9
3	3
	1

Ex.6 Find the cube root of : 531441.

Sol. Resolving 531441 into prime factors, we get

3	531441
3	177147
3	59049
3	19683
3	6561
3	2187
3	729
3	243
3	81
3	27
3	9
3	3
	1

$531441 = \underline{3 \times 3 \times 3} \times \underline{3 \times 3 \times 3} \times \underline{3 \times 3 \times 3} \times \underline{3 \times 3 \times 3}$

$\therefore \sqrt[3]{531441} = 3 \times 3 \times 3 \times 3 = 81$

◈ Cube Roots of Negative and Rational Numbers :

(i) Cube Root of a Negative Perfect Cube :

If a is a positive integer then – a is a negative integer.

We know that $(-a)^3 = -a^3$.

So, $\sqrt[3]{-a^3} = -a$

In general, we have $\sqrt[3]{-a} = -\sqrt[3]{a}$.

(ii) Cube Roots of Rational Numbers :

We know that $\left(\frac{a}{b}\right)^3 = \frac{a^3}{b^3}$

Similarly, $\sqrt[3]{\frac{a}{b}} = \frac{\sqrt[3]{a}}{\sqrt[3]{b}}$

Ex. 7 Find the cube root of (i) $4\frac{12}{125}$ (ii) $\sqrt[3]{\frac{216}{2197}}$

Sol. (i) $4\frac{12}{125} = \frac{512}{125}$

2	512
2	256
2	128
2	64
2	32
2	16
2	8
2	4
2	2
	1

$$= \frac{(2\times2\times2)\times(2\times2\times2)\times(2\times2\times2)}{5\times5\times5}$$

$$\therefore \sqrt[3]{4\frac{12}{125}} = \sqrt[3]{\frac{512}{125}} = \frac{\sqrt[3]{512}}{\sqrt[3]{125}} = \frac{2\times2\times2}{5} = \frac{8}{5}$$

(ii) $\frac{216}{2197} = \frac{6\times6\times6}{13\times13\times13} = \left(\frac{6}{13}\right)^3$

$\Rightarrow \sqrt[3]{216} = \sqrt[3]{6\times6\times6} = 6$

And, $\sqrt[3]{2197} = \sqrt[3]{13\times13\times13} = 13.$

$\therefore \frac{\sqrt[3]{216}}{\sqrt[3]{2197}} = \frac{6}{13}$.

Hence, $\sqrt[3]{\frac{216}{2197}} = \frac{\sqrt[3]{216}}{\sqrt[3]{2197}} = \frac{6}{13}$

Ex.8 Find the cube root of 5.832.

Sol. $\sqrt[3]{5.832} = \sqrt[3]{\frac{5832}{1000}} = \frac{\sqrt[3]{5832}}{\sqrt[3]{1000}}$

Resolving 5832 into prime factors, we get

$5832 = \underline{2 \times 2 \times 2} \times \underline{3 \times 3 \times 3} \times \underline{3 \times 3 \times 3}$

$\sqrt[3]{5.832} = (2 \times 3 \times 3) = 18.$

Also, $\sqrt[3]{1000} = \sqrt[3]{10 \times 10 \times 10} = 10.$

So, $\dfrac{\sqrt[3]{5832}}{\sqrt[3]{1000}} = \dfrac{18}{10} = 1.8$

Hence, $\sqrt[3]{5.832} = 1.8$

Successive Differences

NCERT Example

Q. Compute successive differences over levels for perfect cubes until all the differences at a level are the same. What do you notice

Perfect Cubes

Ans. First differences :

$8 - 1 = 7$

$27 - 8 = 19$

$64 - 27 = 37$

$125 - 64 = 61$

$216 - 125 = 91$

Second differences :

$19 - 7 = 12$

$37 - 19 = 18$

$61 - 37 = 24$

$91 - 61 = 30$

Third differences :

$18 - 12 = 6$

$24 - 18 = 6$

$30 - 24 = 6$

Third difference are equal. This confirms the pattern is a cube sequence.

◈ Cube Roots Using Unit Digits

a	1	2	3	4	5	6	7	8	9	10
a^3	1	8	27	64	125	216	343	512	729	1000

This method can be used to find cube roots of perfect cubes having at the most six digits. By looking at table, we observe that the cube of a number ending in 0, 1, 4, 5, 6 and 9 ends in 0, 1, 4, 5, 6 and 9 respectively. However, the cube of number ending in 2 ends in 8 and vice versa. Similarly, the cube of a number ending in 3 & 7 ends in 7 & 3 respectively. Thus, by looking the unit digit of a perfect cube number, we can determine the unit digit of its cube root.

Now consider a number which is a perfect cube and has at the most six digits. The cube root of such a number has at the most two digits, because the least seven digit number is 1000000 (= 100^3) and its cube root 100 is a three digit number. We determine the two digits of the cube root as follows

Step (I) : Look at the digit at the unit place of the perfect cube and determine the digit at the unit place in the cube root as discussed above.

Step (II) : Strike out from the right, last three (i.e., units, tens and hundreds) digits of the number. If nothing is left, we stop. The digit in Step 1 is the cube root.

Step (III) : Consider the number left from Step 2. Find the largest single digit number whose cube is less than or equal to this left over number. This is the ten's digit of the cube root.

Ex.9 Find the cube roots of the following numbers :

(i) 729 (ii) 4913 (iii) 117649

Sol. (i) **729** The unit digit of 729 is 9. Therefore, the digit at the unit place in the cube root is 9. Since no number is left after striking out the units, tens and hundreds digits of the number, the required cube root is 9.

(ii) **4913** Here, unit digit is 3. Therefore, unit digit of the cube root is 7. After striking out the last three digits from the right, we are left with the number 4. Now 1 is the largest number whose cube is less than 4. Therefore, the ten's digit is 1.

Thus, the required cube root is 17.

(iii) 117649 : Here, unit digit is 9. Therefore, the unit digit of the cube root is 9. Striking out the last three digit from the right, the number left is 117.

Now $4^3 = 64 < 117$ and $5^3 = 125 > 117$.

Hence, the tens digit of the cube root is 4.

$\therefore \quad \sqrt[3]{117649} = 49$

NCERT EXERCISE (FIGURE IT OUT)

Q.1 Which of the following numbers are not perfect squares?

(i) 2032 (ii) 2048

(iii) 1027 (iv) 1089

Q.2 Which one among 64^2, 108^2, 292^2, 36^2 has last digit 4?

Q.3 Given $125^2 = 15625$, what is the value of 126^2?

(i) 15625 + 126 (ii) 15625 + 26^2

(iii) 15625 + 253 (iv) 15625 + 251

(v) 15625 + 51^2

Q.4 Find the length of the side of a square whose area is 441 m^2.

Q.5 Find the smallest square number that is divisible by each of the following numbers: 4, 9, and 10.

Q.6 Find the smallest number by which 9408 must be multiplied so that the product is a perfect square. Find the square root of the product.

Q.7 How many numbers lie between the squares of the following numbers?

(i) 16 and 17 (ii) 99 and 100

Q.8 In the following pattern, fill in the missing numbers:

$1^2 + 2^2 + 2^2 = 3^2$

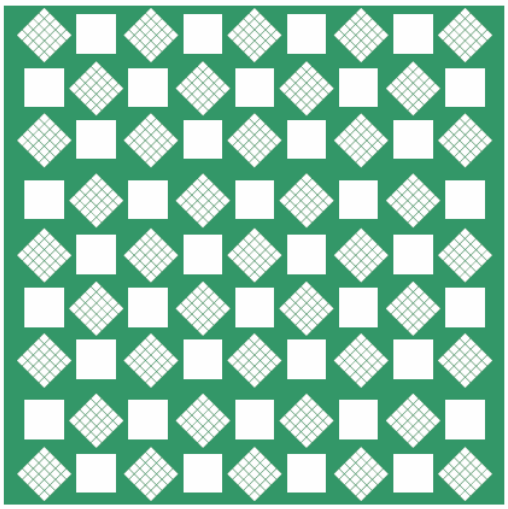
$2^2 + 3^2 + 6^2 = 7^2$

$3^2 + 4^2 + 12^2 = 13^2$

$4^2 + 5^2 + 20^2 = (\_\_\_)^2$

$9^2 + 10^2 + (\_\_\_)^2 = (\_\_\_)^2$

Q.9 How many tiny squares are there in the following picture? Write the prime factorisation of the number of tiny squares.



Q.10 Find the cube roots of 27000 and 10648.

Q.11 What number will you multiply by 1323 to make it a cube number?

Q.12 State true or false. Explain your reasoning.

(i) The cube of any odd number is even.

(ii) There is no perfect cube that ends with 8.

(iii) The cube of a 2-digit number may be a 3-digit number.

(iv) The cube of a 2-digit number may have seven or more digits.

(v) Cube numbers have an odd number of factors.

Q.13 You are told that 1331 is a perfect cube. Can you guess without factorisation what its cube root is? Similarly, guess the cube roots of 4913, 12167, and 32768.

Q.14 Which of the following is the greatest? Explain your reasoning.

(i) $67^3 - 66^3$

(ii) $43^3 - 42^3$

(iii) $67^2 - 66^2$

(iv) $43^2 - 42^2$

Exercise -1

SQUARES AND SQUARE ROOTS

➢ Very Short Answer Type Questions

Q.1 Which of 123^2, 77^2, 82^2, 161^2, 109^2 would end with digit 1 ?

Q.2 What will be the "one's digit" in the square of the following numbers ?
(i) 1234 (ii) 26387 (iii) 52698
(iv) 99880 (v) 21222 (vi) 9106

Q.3 How many natural numbers lie between 9^2 and 10^2 ? Between 11^2 and 12^2 ?

Q.4 Find whether each of the following numbers is a perfect square or not ?
(i) 121 (ii) 55 (iii) 81 (iv) 49 (v) 69

Q.5 Find the value of $17^2 - 12^2 + 15^2 - 10^2$

➢ Short Answer Type Questions – Type I

Q.6 Observe the following pattern and find the missing digits.

$11^2 = 121$
$101^2 = 10201$
$1001^2 = 1002001$
$100001^2 = 1$ …… 2 …… 1
$10000001^2 =$ ……..

Q.7 Observe the following pattern and supply the missing numbers.

(i) $11^2 = 1\ 2\ 1$
$101^2 = 1\ 0\ 2\ 0\ 1$
$10101^2 = 102030201$
$1010101^2 =$ ……^{2}
$= 10203040504030201$

(ii) $1^2 + 2^2 + 2^2 = 3^2$
$2^2 + 3^2 + 6^2 = 7^2$
$3^2 + 4^2 + 12^2 = 13^2$
$4^2 + 5^2 + \_^2 = 21^2$
$5^2 + \_^2 + 30^2 = 31^2$
$6^2 + 7^2 + \_^2 = \_^2$

Q.8 (i) Express 49 as the sum of first 7 odd numbers.
(ii) Express 121 as the sum of first 11 odd numbers.

➢ Short Answer Type Questions – Type II

Q.9 Find the square roots of the following numbers by the prime Factorisation Method.
(i) 729 (ii) 400 (iii) 1764
(iv) 4096 (v) 7744 (vi) 9604
(vii) 5929 (viii) 9216 (ix) 529
(x) 8100

Q.10 For each of the following numbers, find the smallest whole number by which it should be multiplied so as to get a perfect square number. Also find the square root of the square number so obtained.
(i) 252 (ii) 180 (iii) 1008
(iv) 2028 (v) 1458 (vi) 768

Q.11 For each of the following numbers, find the smallest whole number by which it should be divided so as to get a perfect square. Also find the square root of the square number so obtained.
(i) 252 (ii) 2925 (iii) 396
(iv) 2645 (v) 2800 (vi) 1620

Q.12 The students of Class VIII of a school donated Rs 2401 in all, for Prime Minister's National Relief Fund. Each student donated as many rupees as the number of students in the class. Find the number of students in the class.

➢ Long Answer Type Questions

Q.13 Find the greatest 5-digit number which is a perfect square.

Q.14 Find the square root of each of the following numbers by Division method.
(i) 2304 (ii) 4489 (iii) 576
(iv) 1024 (v) 3136 (vi) 2.56
(vii) 7.29 (viii) 51.84 (ix) 42.25
(x) 31.36

Q.15 Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.
(i) 402 (ii) 1989 (iii) 3250 (iv) 825
(v) 4000

Q.16 Find the least number which must be added to each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.
(i) 525 (ii) 1750 (iii) 252
(iv) 1825 (v) 6412

Q.17 There are 500 children in a school. For a P.T. drill they have to stand in such a manner that the number of rows is equal to number of columns. How many children would be left out in this arrangement.

➢ Fill in the Blanks

Q.18 (i) There are ..... perfect squares between 1 and 100.
(ii) The units digit in the square of 1294 is.....
(iii) There are ..... Natural numbers between n^2 and $(n + 1)^2$.
(iv) The square root of 24025 will have ... digits.
(v) The square of 5.5 is ..... .

➢ True or False

Q.19 (i) The sum of two perfect squares is always a perfect square.
(ii) The product of two perfect squares is always a perfect square.
(iii) The square root of 1521 is 31.
(iv) The square of 2.8 is 78.4.
(v) A perfect square can have 8 as its unit digit.

➢ Match the Column

Q.20 Match the following :

Column-I	Column-II
(i) $\sqrt{\frac{16}{49}} = \frac{x}{49}$	(a) 1
(ii) $\sqrt{\left(1+\frac{27}{169}\right)} = \left(1+\frac{x}{13}\right)$	(b) 8
(iii) $(2401)^2 = 7^x$	(c) 28
(iv) $\sqrt{\frac{1}{16}+\frac{1}{9}} = \frac{5}{x}$	(d) 12

CUBE AND CUBE ROOTS

➢ Very Short Answer Type Questions

Q.1 Find the value of $\sqrt{117+\sqrt[3]{19683}}$.

Q.2 Which of the following are perfect cube ?
(i) 10 (ii) 100
(iii) 1000 (iv) 10^4
(v) 10^5 (vi) 10^6

Q.3 Find the sum of cubes of first 10 natural numbers.

Q.4 Find the value of
$1^3 + 2^3 + 3^3 + 4^3 + ...+ 15^3) - (1^2 + 2^2 + 3^2 + ...+ 10^2)$

Q.5 Find the cube root of the following numbers by inspection.
(i) 12167 (ii) 46.656 (iii) 6859
(iv) 912673 (v) 29791

➢ Short Answer Type Questions – Type I

Q.6 Solve:

(i) $[5\sqrt{100} + \sqrt{49} + (79507)^{1/3}]$.

(ii) $\dfrac{(2)^3 + (10)^3}{\sqrt{1016064}}$

Q.7 Find cube root by prime factorisation
(i) 4913 (ii) 13824 (iii) 175616 (iv) 456533

Q.8 Find the cube root of 0.002197.

Q.9 Find the least number by which when multiply the following numbers, such that the number become perfect cube.
(i) 2048 (ii) 1029 (iii) 45 (iv) 23328

Q.10 Find the least number by which when divide the following numbers, the number become perfect cube also find cube root of new numbers,
(i) 4394 (ii) 8575 (iii) 7986 (iv) 28672

➢ Short Answer Type Questions – Type II

Q.11 Find the volume of a cube whose surface area is 150 m^2.

Q.12 Three numbers are in the ratio 2 : 3 : 4. The sum of their cubes is 33957. Find the numbers.

Q.13 The volume of a cube is 9261000 m^3. Find the side of the cube.

Q.14 Find the cube root of the following -

(i) -2300×5290 (ii) $\dfrac{4096}{-2197}$

Q.15 What is the smallest number by which 3087 must be divided so that the quotient is a perfect cube?

➢ Fill in the Blanks

Q.16
(i) There are ……. Perfect cubes between 1 and 1000.
(ii) The cube of 100 will have ….. zeroes.
(iii) The cube of an odd number is always an …… number.
(iv) The least number by which 72 be multiplied to make it a perfect cube is …… .
(v) If a number ending in 7 then the cube of that number will end in the digit …… .

➢ True or False

Q.17
(i) The cube of 0.4 is 0.064
(ii) There are five perfect cubes between 1 and 100.
(iii) If a^2 ends in 5, then a^3 ends in 50.
(iv) The cube of a single digit number cannot be a two digit number.
(v) If the square of a number is positive, so the cube of that number will also be positive.

➢ Match the Column

Q.18

Column-I	Column-II
(i) $\sqrt{\frac{1}{9}} \times \sqrt[3]{\frac{1}{27}}$	(a) 3^{-2}
(ii) $\sqrt[3]{0.729} - \sqrt[3]{0.343}$	(b) 10
(iii) $\sqrt[3]{\frac{1000}{512}} \div \sqrt[3]{\frac{125}{64}}$	(c) 0.2
(iv) $1^3 + 2^3 + 3^3 + 4^3 = x^2$, then x =	(d) 1

Exercise -2

SQUARES AND SQUARE ROOTS

Q.1 The least 4 digit number which is a perfect square is
(A) 1024 (B) 1016
(C) 1036 (D) 1044

Q.2 An odd number when multiplied by itself gives 2401. Find the number.
(A) 41 (B) 39
(C) 49 (D) 51

Q.3 Which of the following is not a perfect square?
(A) 12544 (B) 3136
(C) 23832 (D) 1296

Q.4 The greatest 3 digit number which is a Perfect square is
(A) 729 (B) 927
(C) 961 (D) 972

Q.5 The value of $\sqrt{117^2 - 108^2}$ is
(A) 55 (B) 45
(C) 35 (D) 65

Q.6 The square root of $\frac{36}{5}$ correct to two decimal places is
(A) 2.68 (B) 2.69
(C) 2.67 (D) 2.66

Q.7 The least number which must be added to 1200, so that the sum is a perfect square, is
(A) 52 (B) 25
(C) 35 (D) 45

Q.8 A number is multiplied by half of itself and then 32 added to the product. If the final result is 130, then find the original number.
(A) 4 (B) 7
(C) 5 (D) 14

Q.9 The least positive integer with which 661.25 should be multiplied so that the product is a perfect square, is_____ .
(A) 4 (B) 5
(C) 20 (D) None of these

Q.10 The smallest number by which 980 must be multiplied so that the product is a perfect square is
(A) 7 (B) 5
(C) 3 (D) 6

Q.11 For every natural number 'n', $(n + 1)^2 - n^2$ equals
(A) n – (n + 1) (B) (n + 1) – n
(C) (n – 1) + n (D) (n + 1) + n

Q.12 Which of the following is not correct?
(A) $\sqrt{0.4096} = 0.64$ (B) $\sqrt{40.96} = 6.4$
(C) $\sqrt{0.04096} = 0.064$ (D) $\sqrt{4096} = 64$

Q.13 The value of $\frac{3}{\sqrt{0.09}}$ is :
(A) $\frac{1}{10}$ (B) $\frac{3}{10}$
(C) 1 (D) 10

Q.14 Of the numbers $0.16, \sqrt{0.16}$, $(0.16)^2$ and 0.016, the least number is
(A) $(0.16)^2$ (B) $\sqrt{0.16}$
(C) 0.016 (D) 0.16

Q.15 If $\frac{x}{\sqrt{2.25}} = 550$, then the value of x is
(A) 825 (B) 82.5
(C) 3666.66 (D) 2

Q.16 The least perfect square , which is divisible by each of 21, 36 and 66 is :
(A) 213444 (B) 214344
(C) 214434 (D) 231444

Q.17 Find the value of $\left(49\frac{1}{2}\right)^2$:

(A) $2450\frac{1}{4}$ (B) $2540\frac{1}{2}$

(C) $2530\frac{3}{4}$ (D) $2440\frac{1}{4}$

Q.18 If $3\sqrt{5}+\sqrt{125}$ = 17.88, then what will be the value of $\sqrt{80}+6\sqrt{5}$ = ?

(A) 13.41 (B) 20.46

(C) 21.66 (D) 22.35

Q.19 If $\sqrt{0.04\times0.4\times a}$ = $0.4\times0.04\times\sqrt{b}$, then $\frac{a}{b}$ is :

(A) 1 (B) 16

(C) 0.16 (D) 0.016

Q.20 If $\sqrt{1+\frac{x}{144}}=\frac{13}{12}$, then x is equal to :

(A) 1 (B) 12

(C) 25 (D) 15

CUBE AND CUBE ROOTS

Q.1 The digit in the units place of the cube of 47 is:

(A) 9 (B)7 (C) 3 (D) 1

Q.2 The least possible value of A for which 90 × A is a perfect cube is

(A) 200 (B) 300 (C) 500 (D) 600

Q.3 The sum of the digit of the smallest number by which 8748 is to be divided, so that the quotient becomes a perfect cube is

(A) 2 (B) 3 (C) 5 (D) 6

Q.4 $\sqrt[3]{5-\frac{10}{27}}$ is

(A) $\frac{4}{3}$ (B) $\frac{3}{4}$ (C) $\frac{5}{3}$ (D) $\frac{3}{5}$

Q.5 $\sqrt[3]{-1728}+\sqrt{324}$ =

(A) 30 (B) 6 (C) 4 (D) 32

Q.6 The cube root of 0.000512 is :

(A) 0.5 (B) 0.08

(C) 0.008 (D) 8

Q.7 The largest four digit number which is a perfect cube is:

(A) 9999 (B) 9261

(C) 8000 (D) 9899

Q.8 If $\frac{\sqrt[3]{0.512}}{x}=\sqrt[3]{1000000}$, then the value of x is . (A) 0.008 (B) 800

(C) 0.0008 (D) 8000

Q.9 $\sqrt[3]{2.197}+\sqrt{0.0049}$ equals

(A) 3 (B) 1.37

(C) 13.7 (D) 1.7

Q.10 The cube of number p is 16 times the number. Then find p where $p \neq 0$ and $p \neq -4$.

(A) 4 (B) 3 (C) 8 (D) 2

Q.11 The digit in the units place for the cube of the number 1234568 is _____ .

(A) 8 (B) 2 (C) 4 (D) 6

Q.12 If a = 2b and b = 4c, then $\sqrt[3]{\frac{a^2}{16bc}}$ =

(A) 1 (B) 2 (C) 3 (D) 4

Q.13 Find the value of $\sqrt[3]{6075}\times\sqrt[3]{88935}\times\sqrt[3]{9625}$.

(A) 17355 (B) 17255

(C) 17315 (D) 17325

Q.14 $\sqrt[3]{1+3+5+7.....+53}$ = _____.

(A) 11 (B) 13 (C) 7 (D) 9

Q.15 What is the least positive integer that should be subtracted from 2750 so that the result is perfect cube?

(A) 15 (B) 14 (C) 9 (D) 6

Q.16 If $36a^4 = a^6$, then a^3 equals to :

(A) $\frac{1}{6}a^6$ (B) $6a^4$ (C) $\frac{1}{6}a^2$ (D) $6a^2$

Q.17 If the edge of a cube is increased by 100 %, then surface area of the cube will be increased by :

(A) 100 % (B) 200 %

(C) 300 % (D) 400 %

Q.18 $\sqrt[3]{5-\frac{10}{27}}$ is equal to :

(A) $\frac{4}{3}$ (B) $\frac{3}{4}$ (C) $\frac{5}{3}$ (D) $\frac{3}{5}$

Q.19 Find the value of $125\sqrt[3]{a^6} - \sqrt[3]{125a^6}$, when a = 2 :

(A) 490 (B) 640
(C) 480 (D) 360

Q.20 $\sqrt{1^3+2^3+3^3+.....+10^3}$ equals to :

(A) 40 (B) 45
(C) 50 (D) 55

Exercise -3

(Previous Year Questions – NSO)

SQUARES AND SQUARE ROOTS

Q.1 What is the approximate value of $(15.01)^2 \times \sqrt{730} = ?$

(A) 6125 (B) 6225
(C) 6200 (D) 6100

Q.2 If one member of a Pythagorean triplet is 2m, then the other two members are ____

(A) m, $m^2 + 1$ (B) $m^2 + 1$, $m^2 - 1$
(C) m^2, $m^2 - 1$ (D) m^2, $m + 1$

Q.3 4096 soldiers are arranged in an auditorium in such a manner that there are as many soldiers in a row as there are rows in the auditorium. How many rows are there in the auditorium ?

(A) 94 (B) 58 (C) 44 (D) 64

Q.4 The square root of $\dfrac{\left(3\frac{1}{4}\right)^4 - \left(4\frac{1}{3}\right)^4}{\left(3\frac{1}{4}\right)^2 - \left(4\frac{1}{3}\right)^2}$ is :

(A) $1\frac{7}{12}$ (B) $1\frac{1}{12}$
(C) $5\frac{5}{12}$ (D) $7\frac{1}{12}$

Q.5 If $\sqrt{0.01 + \sqrt{0.0064}} = x$, then $x^2 + x + 1 =$ _____ .

(A) 1.39 (B) 13.9
(C) 0.39 (D) 0.3

Q.6 The value of

$$\sqrt{1197 + \sqrt{760 + \sqrt{556 + \sqrt{385 + \sqrt{206 + \sqrt{361}}}}}}$$

is :

(A) Fifth multiple of 5
(B) Fifth multiple of 7
(C) Seventh multiple of 6
(D) Fourth multiple of 5

Q.7 Estimate, correct to 1 significant figure, the value of $\dfrac{\sqrt{37.997} \times 24.9078}{49.5346}$.

(A) 3 (B) 3.1
(C) 0.3 (D) None of these

Q.8 Find the square root of $21\frac{2797}{3364}$.

(A) $4\frac{33}{58}$ (B) $4\frac{39}{58}$
(C) $4\frac{29}{57}$ (D) $4\frac{27}{52}$

Q.9 During a mass drill exercise, 6250 students of different schools are arranged in rows such that the number of students in each row is equal to the number of rows. In doing so, the instructor finds out that 9 children are left out. Find the number of children in each row.

(A) 46 (B) 79 (C) 85 (D) 69

Q.10 What is the least number which should be subtracted from 0.000326 to make it a perfect square?

(A) 0.000002 (B) 0.000004
(C) 0.02 (D) 0.04

CUBE AND CUBE ROOTS

Q.1 If $\sqrt[3]{3\left(\sqrt[3]{x} - \dfrac{1}{\sqrt[3]{x}}\right)} = 2$, then the value of $\left(x - \dfrac{1}{x}\right)$ is –

(A) $\frac{728}{9}$ (B) $\frac{520}{27}$
(C) $\frac{728}{27}$ (D) $\frac{328}{15}$

Q.2 Match the following :

Column-I	**Column-II**
P. $\sqrt[3]{288} \times \sqrt[3]{1296} \times \sqrt[3]{45} \times \sqrt[3]{600}$ =	i. 2
Q. $24^3 - 13^3 - 11^3$ =	ii. 140
R. $\frac{(946+157)^2 + (946-157)^2}{946 \times 946 + 157 \times 157}$ =	iii. 2160
S. $(64)^2 - (36)^2 = 20\times$ x, then x =	iv. 10296

(A) P → (iii); Q → (iv); R → (i); S → (ii)

(B) P → (iv); Q → (iii); R → (i); S → (ii)

(C) P → (iii); Q → (iv); R → (ii); S → (i)

(D) P → (iv); Q → (iii); R → (ii); S → (i)

Answer Key

EXERCISE - 1

Squares and Square Roots

1. 161^2 and 109^2 **2.** (i) 6, (ii) 9, (iii) 4, (iv) 0, (v) 4, (vi) 6 **3.** (i) 18(ii) 22

4. (i) Yes, (ii) No, (iii) Yes, (iv) Yes, (v) No **5.** 270 **6.** 10000200001, 100000020000001

7. (i) 1020304030201, 101010101^2 (ii) 20, 6, 42, 43

8. (i) 1 + 3 + 5 + 7 + 9 + 11 + 13
(ii) 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 + 19 + 21

9. (i) 27(ii) 20 (iii) 42 (iv) 64 (v) 88 (vi) 98 (vii) 77 (viii) 96(ix) 23 (x) 90

10. (i) 7; 42 (ii) 5; 30 (iii) 7, 84 (iv) 3; 78 (v) 2; 54 (vi)3; 48

11. (i) 7; 6 (ii) 13; 15 (iii) 11; 6 (iv) 5; 23 (v) 7; 20 (vi) 5; 18

12. 49 **13.** 99856

14. (i) 48, (ii) 67, (iii) 24, (iv) 32, (v) 56, (vi) 1.6, (vii) 2.7, (viii) 7.2, (ix) 6.5, (x) 5.6

15. (i) 2; 20, (ii) 53; 44 (iii) 1; 57, (iv) 41; 28, (v) 31; 63

16. (i) 4; 23 (ii) 14; 42 (iii) 4; 16 (iv) 24; 43 (v) 149; 81

17. 16 children **18.** (i) 8, (ii) 6, (iii) 2n, (iv) 3, (v) 30.25

19. (i) False, (ii) True, (iii) False, (iv) False, (v) False

20. (i) → (c); (ii) → (a); (iii) → (b); (iv) → (d)

Cube and Cube Roots

1. 12 **2.** (iii), (vi) **3.**3025 **4.** 14015

5. (i) 23 (ii) 3.6 (iii) 19 (iv) 97 (v) 31 **6.** (i) 100 (ii) 1 **7.** (i) 17 (ii)24 (iii) 56 (iv) 77

8. 0.13 **9.** (i) 2 (ii) 9 (iii) 75 (iv) 2 **10.** (i) 2, 13 (ii) 25, 7 (iii) 6, 11 (iv) 7, 16

11. 125 m^3 **12.** 14, 21, 28 **13 .** 210 m **14.** (i) –230, (ii) –16/13 **15.** 9

16. (i) 8 (ii) 6 (iii) Odd (iv) 3 (v) 3

17. (i) True (ii) False (iii) False (iv) False (v) False

18. (i) → (a); (ii) → (c); (iii) → (d); (iv) → (b)

EXERCISE - 2

Squares and Square Roots

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	A	C	C	C	B	A	B	D	C	B	D	C	D	C	A	A	A	D	D	C

Cube and Cube Roots

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	B	B	C	B	B	B	A	B	A	B	A	D	D	D	D	C	C	C	D

EXERCISE - 3

Squares and Square Roots

Ques.	1	2	3	4	5	6	7	8	9	10
Ans.	D	B	D	C	A	B	A	B	B	A

Cube and Cube Roots

Ques.	1	2
Ans.	C	A

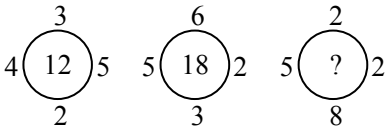
Mental Ability

Chapter 3

MISSING TERMS IN FIGURES

In such type of questions, a figure, a set of figures, an arrangement or a matrix is given each of which bears certain numbers, letters or a group or combination of letters or numbers, following a certain pattern. We have to observe the pattern and find the missing term.

◈ FIND THE MISSING TERM

Ex.1 

(A) 12 (B) 14 (C) 16 (D) 18

Sol. **(C)** i.e. 16, because the numbers inside the first two circles are obtained by multiplying the outside numbers and dividing by 10, i.e.

$$\frac{5\times3\times4\times2}{10} = \frac{120}{10} = 12$$

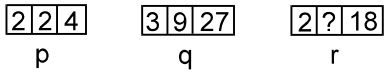
The same follows for the second and third circles.

Ex.2

17	15	8
99	95	64
36	45	?

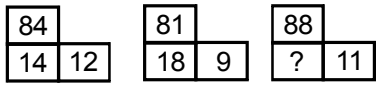
(A) 729 (B) 1331 (C) –729 (D) –343

Sol. **(C)** The rule is that in a row as $(17 - 15)^3 = 8$.
Therefore $(36 - 45)^3 = (-9)^3 = -729$

Ex.3 

(A) 10 (B) 9
(C) 8 (D) 6

Sol. **(B)** In the first set, $2 \times 2 = 4$,
In the second set, $3 \times 9 = 27$
$\therefore 2 \times x = 18, x = 9$

Ex.4 

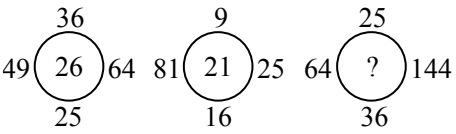
(A) 16 (B) 21
(C) 61 (D) 81

Sol. **(A)** In figure (I), $12\times\frac{14}{2} = 84$.

In figure (II), $9\times\frac{18}{2} = 81$.

Let the missing number in figure (III) be x.

Then, $11\times\frac{x}{2} = 88$ or $x = \frac{88\times2}{11} = 16$.

Ex.5 

(A) 24 (B) 25 (C) 23 (D) 31

Sol. **(D)** i.e. 31, because the numbers inside the first two circles are obtained by taking the sum of the square roots of the four numbers outside the circles, e.g.

$\sqrt{49} + \sqrt{64} + \sqrt{25} + \sqrt{36}$
$= 7 + 8 + 5 + 6 = 26$ (I^{st} Circle)
and $\sqrt{16} + \sqrt{25} + \sqrt{9} + \sqrt{81}$
$= 4 + 5 + 3 + 9 = 21$ (II^{nd} Circle)

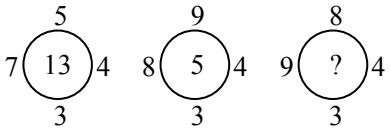
Ex.6

? / 108	2
18	3 / 6

(A) 1 (B) 36
(C) 216 (D) 1944

Sol. **(D)** The answer is 1944 as the numbers are arranged in the following way,
$2 \times 3 = 6$, $3 \times 6 = 18$, $6 \times 18 = 108$,
$18 \times 108 = 1944$

Ex.7



(A) 4 (B) 8 (C) 12 (D) 15

Sol. **(C)** i.e. 12 because

$(7 \times 4) - (5 \times 3) = 28 - 15 = 13$ (I^{st} Circle)

$(8 \times 4) - (9 \times 3) = 32 - 27 = 05$ (II^{nd} Circle)

So, $(9 \times 4) - (8 \times 3) = 36 - 24 = 12$ (III^{rd} Circle)

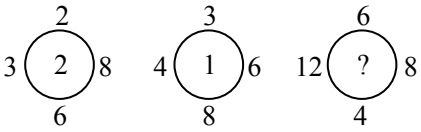
Ex.8

7	6	5
3	3	4
2	3	?

(A) 12 (B) 3 (C) 4 (D) 5

Sol. **(B)** The answer is 3 because the sum of the numbers in each column is 12.

Ex.9



(A) 3 (B) 4 (C) 5 (D) 6

Sol. **(B)** i.e. 4 because

$(3 \times 8) \div (2 \times 6) = 24 \div 12 = 2$ (I^{st} Circle)

$(4 \times 6) \div (8 \times 3) = 24 \div 24 = 1$ (II^{nd} Circle)

So, $(12 \times 8) \div (6 \times 4) = 96 \div 24 = 4$ (III^{rd} Circle)

Ex.10

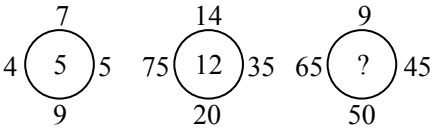
B	C	?
O	Q	S
M	N	R

(A) A (B) D

(C) G (D) P

Sol. **(A)** In each column, the sum of top & bottom letter is equal to the order of the middle letter in that column.

Ex.11



(A) 7 (B) 9 (C) 13 (D) 15

Sol. **(C)** i.e. 13 because

$\sqrt{4+7+5+9} = \sqrt{25} = 5$

$\sqrt{65+45+9+50} = \sqrt{169} = 13$ Ans.

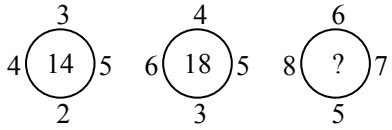
Ex.12

7	9	16
4	15	?
13	8	21

(A) 29 (B) 19 (C) 23 (D) 25

Sol. **(B)** The answer is 19 because the sum of the first two numbers in each row gives the third number, i.e. $7 + 9 = 16$, $4 + 15 = 19$, $13 + 8 = 21$

Ex.13



(A) 24 (B) 26 (C) 28 (D) 22

Sol. **(B)** i.e. 26, because

$(5^2 - 4^2) + (3^2 - 2^2) = 14$ (I^{st} circle)

$(6^2 - 5^2) + (4^2 - 3^2) = 18$ (II^{nd} circle)

Ex.14

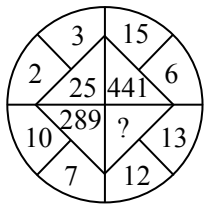
21	56	70
45	87	84
115	180	?

(A) 130 (B) 195 (C) 295 (D) 150

Sol. **(A)** The rule is that in each row the difference of first two numbers is doubled.

i.e. $(56 - 21) \times 2 = 70$. Hence the required number is $(180 - 115) \times 2 = 130$

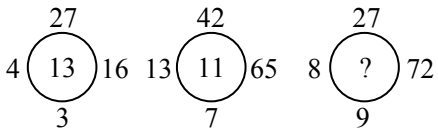
Ex.15



(A) 625 (B) 25 (C) 125 (D) 156

Sol. **(A)** Clearly, $(3 + 2)^2 = 25$; $(15 + 6)^2 = (21)^2 = 441$; $(10 + 7)^2 = (17)^2 = 289$. So, missing number $= (12 + 13)^2 = (25)^2 = 625$.

Ex.16



(A) 9 (B) 12 (C) 15 (D) 18

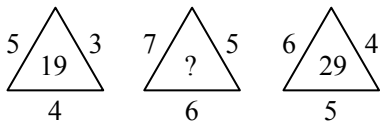
Sol. **(B)** i.e. 12, because

$(16 \div 4) + (27 \div 3) = 13$ (I^{st} Circle)

$(65 \div 13) + (42 \div 7) = 11$ (II^{nd} Circle)

So, $(72 \div 8) + (27 \div 9) = 12$ (III^{rd} Circle)

Ex.17



(a) (b) (c)

(A) 25 (B) 37

(C) 41 (D) 47

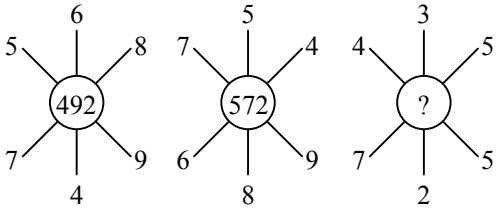
Sol. **(C)** Clearly, in fig. (a), $5 \times 3 + 4 = 19$.

In fig (c) $= 6 \times 4 + 5 = 29$.

$\therefore$ In fig.(b), missing number

$= 7 \times 5 + 6 = 35 + 6 = 41$.

Ex.18



(i) (ii) (iii)

(A) 115 (B) 130

(C) 135 (D) 140

Sol. **(B)** Clearly, the number inside the circle is equal to the sum of the product of the upper three numbers and the product of the lower three numbers. Thus,

In fig. (i), $(5 \times 6 \times 8) + (7 \times 4 \times 9) = 240 + 252$

$= 492$.

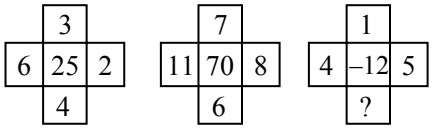
In fig. (ii), $(7 \times 5 \times 4) + (6 \times 8 \times 9) = 140 + 432$

$= 572$.

$\therefore$ In fig (iii), missing number

$= (4 \times 3 \times 5) + (7 \times 2 \times 5) = 60 + 70 = 130$.

Ex.19



(i) (ii) (iii)

(A) 10 (B) 6 (C) 2 (D) 1

Sol. **(C)** The arrangement is as follows :

In fig.(i), $(3^2 + 6^2) - (2^2 + 4^2)$

$= (9 + 36) - (4 + 16)$

$= 45 - 20$

$= 25$

In fig. (ii), $(7^2 + 11^2) - (8^2 + 6^2)$

$= (49 + 121) - (64 + 36)$

$= 170 - 100$

$= 70$.

In fig. (iii), let the missing number be x.

Then, $(1^2 + 4^2) - (5^2 + x^2)$

$= -12$

or $17 + 12 = (5^2 + x^2)$ or x^2

$= 29 - 25$

$= 4$

or $x = 2$.

Ex.20

3C	2B	4A
27A	?	64B
9C	4A	16B

(A) 8C (B) 12B

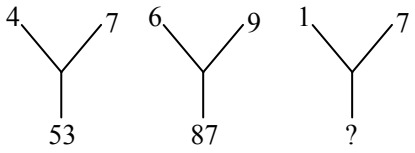
(C) 16C (D) 18C

Sol. **(A)** In each row, out of the letters A, B and C, each of these must appear once. Also, in each column, the product of first and third numbers is equal to the second number. So the missing number will be (2×4) i.e. 8 and the letter be C. Thus, the answer is 8C.

EXERCISE

Direction : (Q.1 to Q.20) Find the missing Term

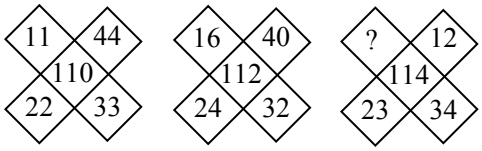
Q.1



(A) 49 (B) 50

(C) 48 (D) 55

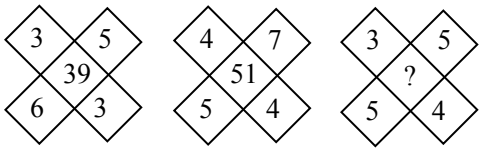
Q.2



(A) 35 (B) 37

(C) 45 (D) 46

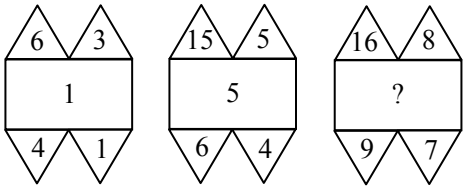
Q.3



(A) 35 (B) 37

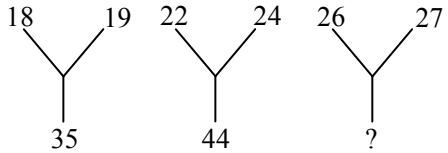
(C) 45 (D) 47

Q.4



(A) 6 (B) 4 (C) 3 (D) 5

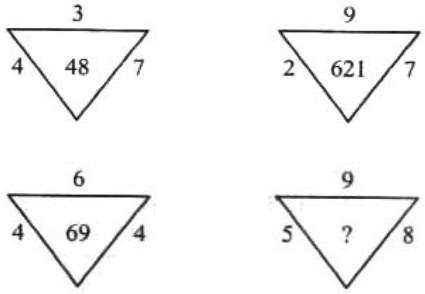
Q.5



(A) 51 (B) 76

(C) 89 (D) 94

Q.6



(A) 027 (B) 330

(C) 360 (D) 063

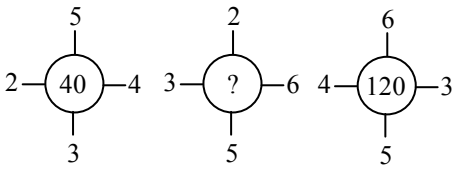
Q.7

3	5	16
7	9	32
11	13	(?)

(A) 48 (B) 64

(C) 24 (D) 143

Q.8



(A) 50 (B) 55

(C) 60 (D) 70

Q.9

1	5	9
4	8	12
7	(?)	15

(A) 11 (B) 12

(C) 13 (D) 16

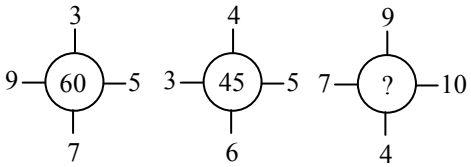
Q.10

E	?	O
C	H	M
A	F	K

(A) L (B) J

(C) G (D) N

Q.11



(A) 75 (B) 70

(C) 65 (D) 60

Q.12

N	O	P
S	R	?
T	U	V

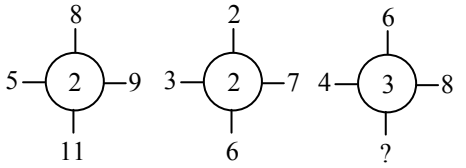
(A) T (B) K
(C) F (D) Q

Q.13

12	8	10	7
14	16	13	15
9	11	?	13

(A) 12 (B) 11
(C) 8 (D) 15

Q.14

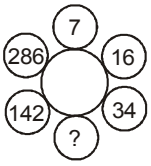


(A) 4 (B) 6 (C) 2 (D) 8

Q.15

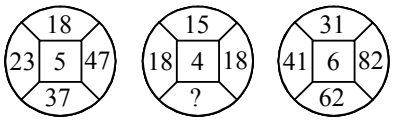
(A) Z (B) A (C) E (D) F

Q.16



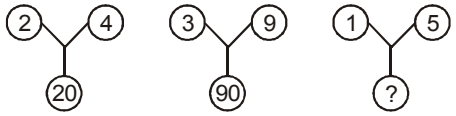
(A) 72 (B) 70
(C) 68 (D) 66

Q.17



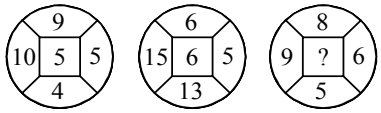
(A) 13 (B) 15
(C) 17 (D) 14

Q.18



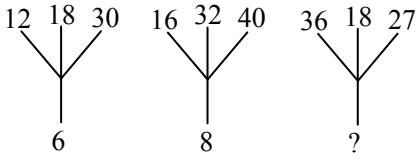
(A) 75 (B) 26
(C) 25 (D) 20

Q.19



(A) 4 (B) 5 (C) 6 (D) 8

Q.20



(A) 6 (B) 9
(C) 12 (D) 18

ANSWER KEY

MISSING TERMS IN FIGURES

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	B	C	B	B	A	D	A	C	A	B	A	D	A	B	C	B	A	B	B	B

Social Science

Chapter

3

THE RISE OF THE MARATHAS

In this chapter, we will learn how Marathas became powerful in Indian history how they protected their reign from foreign powers. We will learn about Great Shivaji also.

TOPIC TO BE COVERED .....

- Marathas and their emergence
- Features of Marathas governance
- Impact of Maratha Emperor in Indian history.

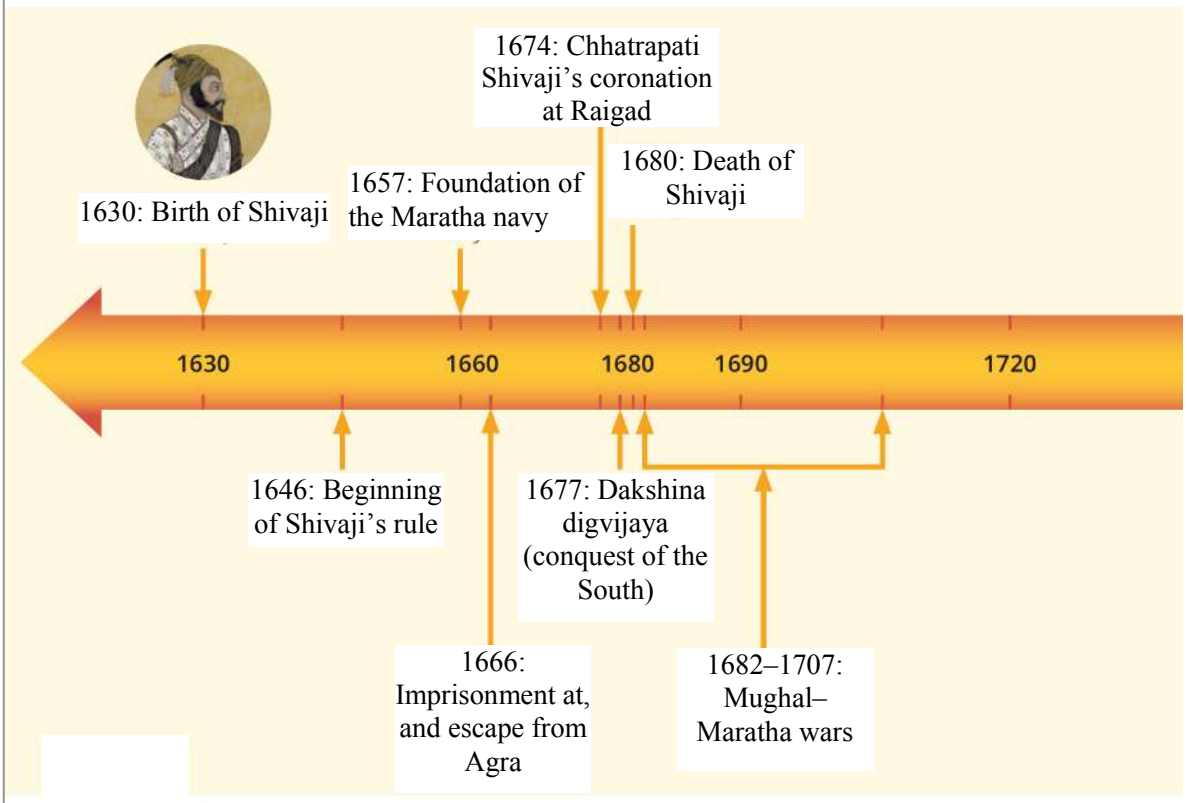


Fig. 3.1

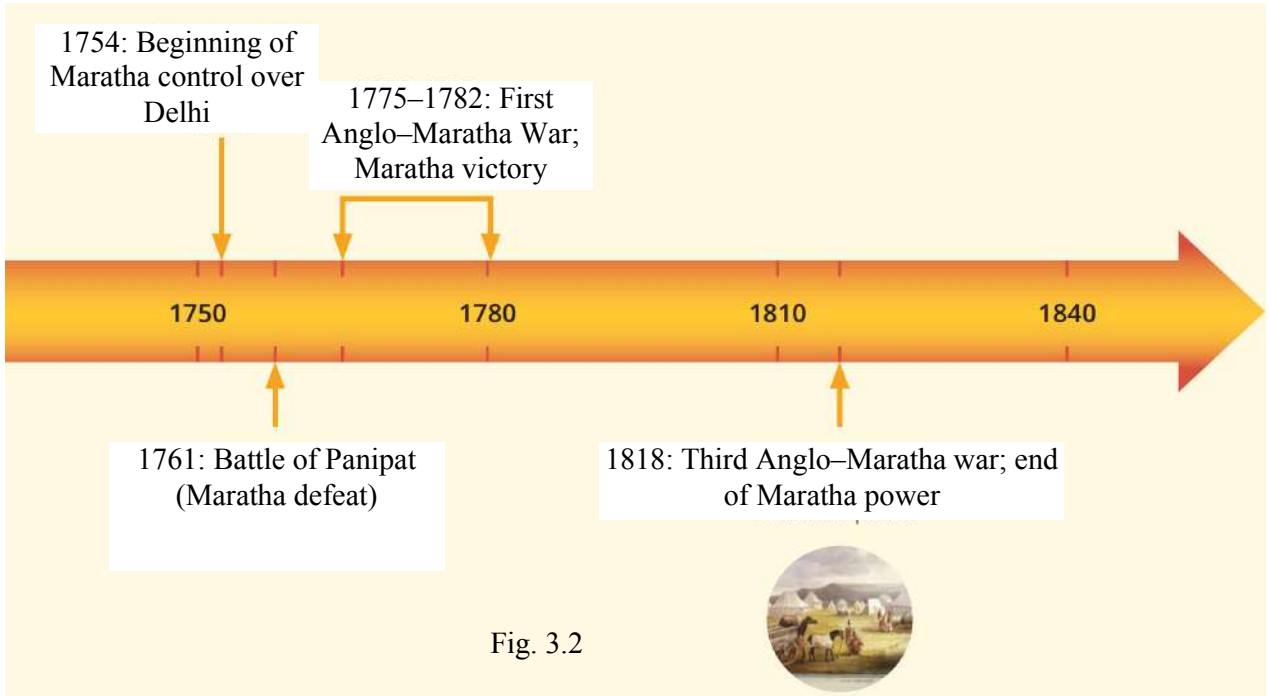


Fig. 3.2

I. Marathas

Matathas are group of people from the Deccan platau which is present-day maharashtra these people speak Marathi which has had a rich and continuous literary history. Since 12th century.

- During the 13th century, most of Maharashtra was ruled by the Yadava dynasty with Devagiri (present-day Daulatabad) as its capital.
- In the 14th century Yadava dynasty was defeated by Khilji sultanate

Even after this political instability marathi culture and traditional continued to flourish.

Fig.3.3 Grand Entrance of Raigad Fort, Maharashtra where Chhatrapati Shivaji Maharaj was crowned in 1674 marking the formal beginning the Maratha Empire.

Literary history: The historical Development of writings in prose or poetry in a particular language.

Marathi Bhakti Movement

(i) From 7th and the 17th centuries, for spiritual

(ii) These saints, coming from diverse sections of society, composed devotional songs and poetry in the languages of the masses, which allowed their messages to travel far and wide.

(iii) Famous Marathi saints were Dnyaneshwar Namdev, Tukaram, Ramdas

(iv) These saints translated important texts like the Upaniṣhads and the Bhagavad Gītā into Marathi, making their philosophy accessible to the people.

(v) These teaching help Marathas to organize themselves into a political power and acquire a solid cultural foundation.

Fig. 3.4 Sant Ramdas

Fig. 3.5 Postal stamp showing Sant Tukaram

In 17th century some maratha chiefs tried to establish their sovereignty but they were unsuccessful until Shivaji rose to power and united marathas by laying the foundation of strong and independent maratha kingdom.

II. Foundation Of Maratha Power And The Rise of Shivaji

Early Life of Shivaji

(i) Shivaji was born in 1630 in the Bhonsle clan to Shahji and Jijabai. His father, Shahji, served the Deccan Sultans and was often away from the family.

(ii) Shivaji was raised in his father's ***Jagir*** at Pune by his mother Jijabai and some trusted officials. He was given good values and a strong education.

(iii) During this time, the Pune region suffered greatly due to continuous battles between the Deccan sultans, which caused great hardship for the local people.

(iv) At the young age of 16, Shivaji began his military campaigns. He first captured unguarded forts around Pune and strengthened their defences.

(v) His vision of Swarajya (self-rule) grew stronger over time and included political, economic and cultural goals.

Jagir

A jagir was a piece of land given by a king or ruler to someone (usually a noble or soldier) as a reward for their service.The person who got the jāgīr could collect taxes from the land and use the money to take care of their needs or help the king when needed.

Expansion of Kingdom

Shivaji kingdom expanded till India's west coast and to protect resources and control the trade he established a navy. Which was revolutionary step at that time.

(i) The Bijapur Sultanate had merchant ships but no strong navy. The Mughal navy was also weak and poorly organised. Shivaji saw this as an opportunity and created the Maratha navy.

(ii) Shivaji's navy became famous for its bravery. His ships protected the coastline, stopped enemy ships, and controlled sea trade.

(iii) This was one of India's earliest strong naval forces.

(iv) Shivaji also used guerrilla warfare, a smart war strategy. It used small groups, fast attacks, and deep knowledge of local land. This helped him fight with larger and stronger armies successfully

Bijapur Sultanate and Shivaji

Bijapur Sultanate which was ruled by adil Shahi dynasty. Success of Shivaji invited wrath of Bijapur sultanate. They sent their veteran general Afzal Khan to capture Shivaji. Shivaji agreed to meet him near Pratapgad Fort.

During the meeting, Shivaji killed Afzal Khan, and his soldiers attacked and defeated Afzal Khan's army using guerrilla attacks.

The wāgh nakh is a small weapon shaped like a tiger's claw, which Shivaji used to kill Afzal Khan in close combat.

Fig. 3.6 Wāgh nakh or the 'tiger's claw'.

Shivaji and Shaista Khan

Shaista Khan invaded Shivaji's territories with a big army for three years. Finally, with only a few soldiers, Shivaji raided Shaista Khan's camp at night. The Khan barely escaped from the raid, losing a few fingers, and promptly left Maharashtra. This daring raid resembles the modern-day **surgical strike.**

Surgical strike: A military attack intended to damage only a specific target, with no or minimal damage to other people or infrastructure.

Shivaji and Surat Sacks (Loot)

Surat was a wealthy port city under the mughal empire to take the revenge of mughal attack which had been there for three years. Shivaji sacked surat and obtained enormous treasure worth almost one crore of rupees, an extremely large sum for the time.

During Surat sack Shivaji was careful not to attack religious places. He even spared the house of Mohandas Parekh, a generous and kind-hearted man.

Shivaji attacked Surat again after a few years.

Sacking of Surat was a great insult to the prestige of Mughal Empire. Mughal emperor Aurangzeb was furious and sent a strong army. He chose Raja Jai Singh, a brave Rajput general, to lead the campaign.

Shivaji was defeated at Purandar Fort (near pune) he had to sign **Treaty of Purandar.**

According to this treaty –

(i) He had to give up some territory

(ii) His son Sambhaji was sent to serve in the Mughal court.

Quick Glance

These Surat sacks became so famous that they appeared in the London Gazette, an English newspaper of the time, which conveyed how Shivaji wrote to all European diplomatic agents in Surat, demanding 'immediate presents of money', failing which he would 'return and ruin that city'.

Shivaji's visit to Aurangzeb's Court

Jai Singh persuaded Shivaji to visit to mughal court at Agra, where Aurangzeb insulted him by making him stand before a general he had defeated earlier. Due to this incident Shivaji walked out of the mughal court after that Aurangzeb put him under the house arrest.

(i) Shivaji devised a strategy to escape from Agra through the fruit basket with his son Sambhaji.

(ii) Aurangzeb was not able to capture Shivaji again.

Coronation and Title

In 1674, Shivaji was coronated with Vedic rituals at the mountain fortress of Raigad. He took the title of 'Shri Raja Shiva Chhatrapati'. Then he started a new calendar era ***Rajyabhisheka Shaka***.

After coronation Shivaji started his campaign of the south.

After his coronation, Shivaji began the Dakshina Digvijaya (Southern Conquest). He conquered parts of Northern Tamil Nadu and Karnataka, gaining more territory and resources.

Shivaji passed away at the age of fifty due to fever. Shivaji was known as a great warrior, a brilliant planner, and a visionary leader. His brave acts made him legendary all over India and even in Europe.

European writers compared him to ancient generals like Alexander the Great.

Chhatrasal, a Bundela prince, was inspired by Shivaji and formed his kingdom in Bundelkhand (now in Uttar Pradesh and Madhya Pradesh).

The poet Bhushan visited Shivaji and wrote famous poems in his praise, which are still remembered today.

Fig. 3.7. A court scene with Shivaji on his throne receiving visitors (panel in Chhatrapati Shivaji Maharaj Park, Mumbai)

3.1 | Check your Learning

Q.1 Yadava dynasty was overcome by –
(a) Tuglhaq dynasty (b) Khilji Sultanate
(c) Mughal Sultanate (d) Bhonsle clan

Q.2 In which clan Shivaji was born?

Q.3 Name two Marathi Bhakti Saints.

Q.4 where did Shivaji met Afzal Khan?

Q.5 Which Mughal city did Shivaji looted and Why?

Quick Glance

In the South, Shivaji forbade the Dutch from trading slaves. At the time, most Europeans were capturing and selling Indians as slaves. His stance on this abuse showed his deep concern for his subjects.

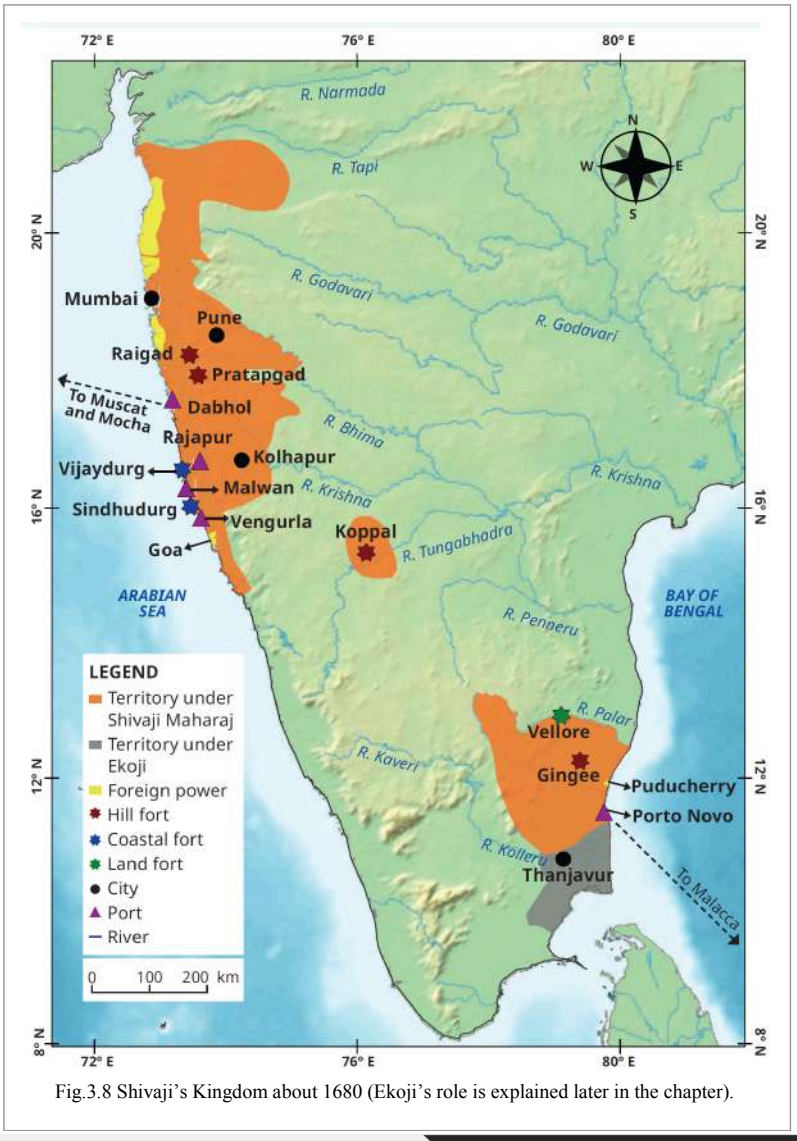


Fig.3.8 Shivaji's Kingdom about 1680 (Ekoji's role is explained later in the chapter).

III. The Marathas After Shivaji

(i) Shivaji had two sons, Sambhaji and Rajaram. After Shivaji's death, Sambhaji became the Chhatrapati.

(ii) The Marathas were the only ones who stopped the Mughals from fully taking control of the Deccan.

(iii) Aurangzeb attacked the Deccan and conquered the Bijapur (Adil Shahi) and Golconda (Qutb Shahi) kingdoms.

(iv) He then captured and cruelly executed Sambhaji. After this, he took over Raigad, the Maratha capital.

(v) Rajaram became Chhatrapati after Sambhaji. He escaped to Gingee (in present-day Tamil Nadu). This spread the Mughal-Maratha war to South India.

(vi) The Marathas fiercely defended their forts and frequently gained the upper hand in battles and skirmishes against the Mughals.

(vii) Aurangzeb remained trapped in the Deccan and died without achieving his goal of subduing the Marathas.

(viii) After Rajaram, his wife Tarabai led the Marathas. She made large attacks on Mughal areas, and conquered large part of India.

Fig. 3.9 Chhatrapati Shahu Maharaj (Sambhaji's son), seated right and sporting a falcon, in counsel with Nanasaheb Peshwa

Expansion of Maratha Rule

Earlier Maratha rule was centralised but after Shivaji it changed to decentralised. Though Chhatrapati was the head of the power but other maratha chiefs also gained power.

(i) Peshwa Bajirao I and his son Nanasaheb helped expand the empire across India.

(ii) They ruled many areas and tried to govern them well. As regional chiefs gained more power, discipline weakened, and abuses increased.

(iii) Marathas briefly ruled areas like Lahore, Attock and Peshawar (now in Pakistan).

(iv) They fought the Afghans, but were badly defeated in the Battle of Panipat (1761).

(v) Peshwa Madhavrao I helped the Marathas recover their strength. Under Mahadji Shinde (Scindia), the Marathas recaptured Delhi in 1771.

(vi) Delhi stayed under Maratha control until the British captured it 30 years later.

(vii) In the late 1700s, the British and Marathas became major rivals. They fought three Anglo-Maratha wars between 1775 and 1818.

(viii) Due to internal Maratha conflicts and the British having better weapons and organisation, the British defeated the Marathas.

Fig.3.10 The extent of the Maratha empire in 1759.

Quick Glance

Nana Phadnavis, a powerful official under the Peshwas, is credited with organising the first pan-Indian anti-British alliance. He even united with old adversaries like Hyder Ali of Mysore and the Nizam of Hyderabad in this endeavour.

Fig. 3.11 A mural of a British officer surrendering before Nana Phadnavis and Mahadji Shinde after the first Anglo-Maratha war.

IV. Maratha Administration

Civilian administration

Shivaji had a strong centralised administration, Hereditary posts were abolished, land assignments and salaries were paid to every government official out of the state treasury.

(i) There were transfers on the regular basis, so that officials can't become powerful and misuse their power.

(ii) Shivaji took special care of soldiers, If a soldier died in battle, his widow received a pension and was also given a job in the army to the sons of dead soldiers.

(iii) Shivaji had ashta pradhana mandala (Council of eight ministers) to assist him with administration, they were

- Pradhan – Prime Minister
- Sachiv – Land Revenue Minister
- Nyayadhish – Chief Justice
- Panditrao – Head of Religious Affairs
- Senapti – Commander in Chief
- Sumant – Minister for Foreign Affairs
- Mantri – Intelligence Minister
- Amatya – Finance Minister

Fig. 3.12 Shivaji minted gold and copper coins in his own name, signifying his sovereignty. The use of the Devanagari script was also an assertion of his cultural identity.

(iv) The Marathas collected two special types of taxes
- Chauth – 25% of the revenue
- Sardeshmukhi – An extra 10% tax

(v) In return of the tax the Marathas protected those regions and did not intervene in their internal matters. Even the Mughals accepted this arrangement through some treaties.

(vi) In the 18th century, the Marathas started using Mughal-style coins because they were very popular. But they added their symbols, like Lord Ganapati (Ganesha) and Marathi titles.

(vii) The coin had writing in both Devanagari and Persian scripts, one side praised Lord Ganapati, and the other side showed loyalty to the Peshwa, who was also called.

Quick Glance

In the 18th century, the Marathas often adopted the Mughal style of coinage owing to its popularity, but added their own cultural symbols to it. For instance, this rare Maratha coin known as the 'Gaṇapatī-Pantapradhān rupee', minted in the early 19th century by the Patwardhans (generals under the Peshwa), features inscriptions in two scripts — Devanagari and Persian. One side is an invocation to Gaṇapati (Gaṇeśha) while the other declares loyalty to the Peshwa (often referred to as 'Pantapradhān' in Marathi).

Fig. 3.13

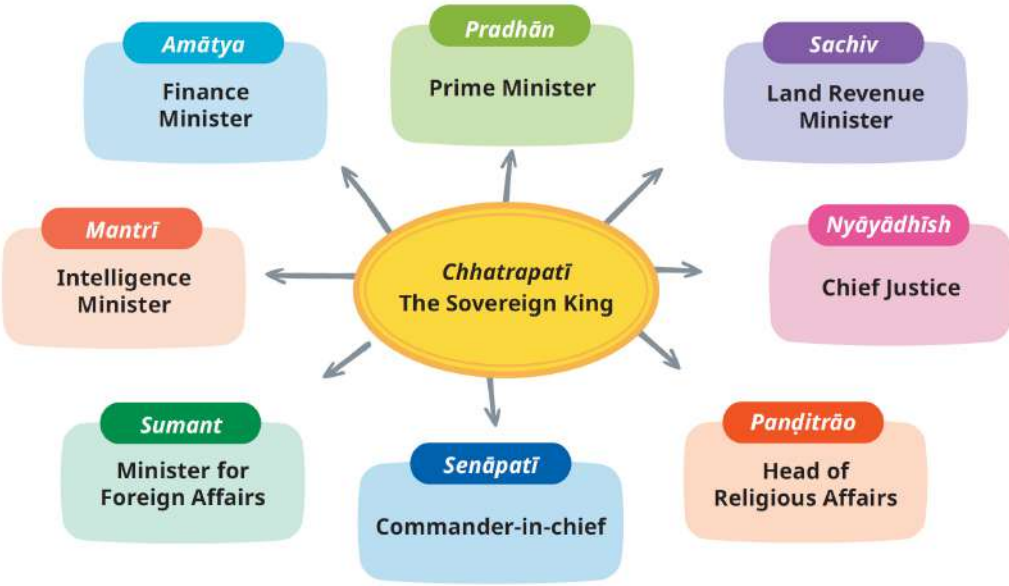


Fig. 3.14

Military administration

Marathas had a divided there army into three parts –

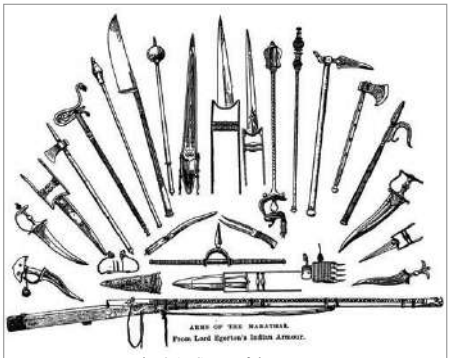
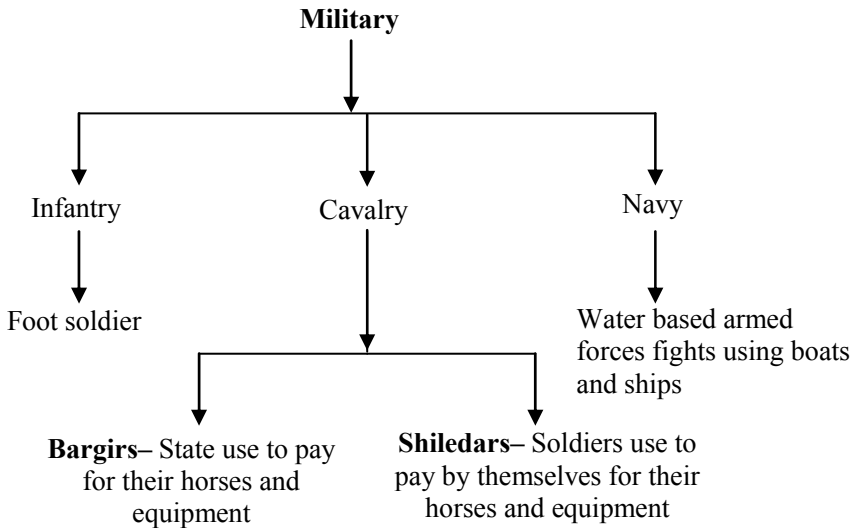


Fig. 3.15 Some of the weapons used by the Marathas.



(i) In the 18th century, the Marathas saw that European-style troops and artillery were stronger. So, they began raising such forces. Mahadji Shinde, especially, had a large European-style army.

(ii) The Marathas mainly used swords and lances but also used many guns and Cannons. Which were rare part of their warfare since Shivaji's time and by 1770, they began using metal tube rockets.

(iii) Forts were the strongest part of Maratha power. Shivaji built and controlled many forts, which helped them to control important routes and hide the army safely when engaging in guerrilla warfare.

(iv) Ramachandrapant, Shivaji's Finance Minister, wrote in his book Adnyapatra, "Forts are the heart of the kingdom. Without them, the land gets destroyed during invasions".

Maritime Supremacy

(i) Shivaji created a very strong navy base to protect western cost.

(ii) Kanhoji Angre guided Marathas in their naval battles. Though Marathas did not have technologically advance weapons still they one battles due to use of best geography.

(iii) During this time, the biggest power of the Europeans in India was their navy. They forced Indian traders to buy naval trade passes (called cartaz in Portuguese). If any ship did not have a pass, it would be seized by European forces.

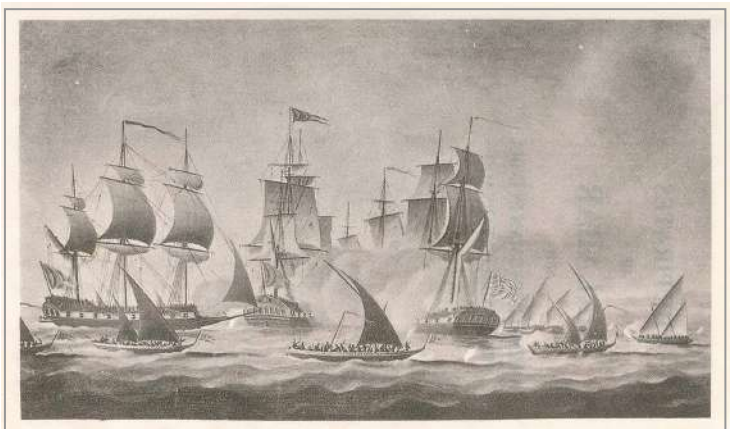


Fig. 3.16 Maratha Ships attacking English ships

(iv) The Marathas opposed this unfair rule and even started asking the Europeans to take passes from them instead.

(v) In 1665, four ships from Shivaji's fleet sailed to Muscat, the capital of Oman. The ruler of Muscat captured the ships and arrested the sailors.

(vi) He also prepared ships to attack Shivaji's coastal areas. But when he heard that Shivaji's navy had more than 100 ships, he became afraid and hid his own ships inside the harbour.

Judicial System

(i) The Marathas set up an efficient and fair judicial system to maintain law and order in the kingdom.
(ii) One of the most special features of this system was that the death penalty (capital punishment) was used very rarely. Justice at the village level was given by a group called the **panchayat.**
(iii) The panchayat was a local group of important people and officials who came together to solve disputes and make fair decisions.
(iv) If someone was not satisfied with the panchayat's decision, they could appeal to a Maratha chief for further justice.
(v) In big towns like Pune and Indore, the kotwal (police officer) was appointed to keep peace and maintain law and order in the city.

Trade Networks

Shivaji encouraged trade and actively participated in maritime foreign trade himself. He and his officials had their own ships, which they regularly sent to ports as far away as Mocha in Yemen, Muscat in Oman, and Malacca in Malaysia. Some of these ships carried cargo like gold, textiles, etc.
Roads were constructed and maintained. In places such as Odisha in the 18th century, a network of ferries was maintained for riverine transport. Bridges were built over rivers and small streams.

3.2 | Check your Learning

Q.1 What was the post of Amatya?
(a) Prime minister
(b) Chief Justice
(c) Finance minister
(d) Head of Religious Affairs

Q.2 Why did Shivaji abolished hereditary posts?

Q.3 What was Sardeshmukhi?

Q.4 How Maratha Armed forces were divided?

Q.5 What was the role of Kanhoji Angre?

V. Cultural Revival

(i) Marathas had a very important role in India's cultural developments.
(ii) Shivaji had a vision of Swarajya which is quiet evident in his seal which had a Sanskrit inscription.
(iii) Shivaji promoted Marathi language and a commission book called Rajya-Vyavahara Kosha, in this book some Sanskrit was used in place of some prevalent Persian words.
(iv) The **Modi script** (a cursive form of Devanagari) was used by the Marathas for writing and correspondence.
(v) He rebuilt temples that had been destroyed. He supported religious institutions, Sanskrit and Marathi literature, and traditional Indian arts. His saffron flag became a symbol for all Marathas.

Fig. 3.17 Shivaji's Seal

(vi) Shivaji's example inspired later Maratha rulers. The Bhonsles of Nagpur became active supporters of Indian traditions.
(vii) They helped revive the worship of Lord Jagannath at Puri in Odisha, which had been interrupted during the Mughal rule

VI. The Mighty Maratha Women

Tarabai

Maratha warrior queen ruled in 18th century after the death of her husband Rajaram. She organized a large Maratha army to protect deccan from Aurangzeb and the Mughal Army. She was the architect of northward Maratha expansion,

Fig. 3.18 Tarabai in battle (painting by M.V. Dhurandhar)

Ahilyabai Holkar

(i) Ahilyabai Holkar was a brave and wise ruler from the Holkar dynasty, which helped in expand of Maratha power in North India.

(ii) She ruled for 30 years in central India (around present-day Indore) after losing her husband and son.

(iii) Ahilyabai built and repaired temples, ghats, wells and roads from Kedarnath to Rameswaram.

(iv) She rebuilt the Kashi Vishwanath temple (destroyed by Aurangzeb) and the Somnath temple (destroyed by Mahmud of Ghazni).

(v) She also supported the Maheshwar weaving industry in Madhya Pradesh, helping handloom crafts survive and grow.

Fig. 3.19 A postage stamp commemorating Ahilyabai Holkar

Quick Glance

The Modi script (a cursive form of Devanagari) was the main script used by Marathas for their correspondence.

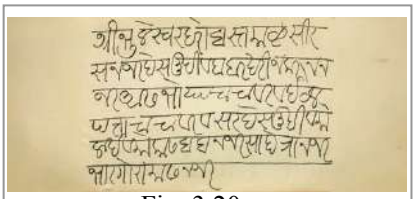


Fig. 3.20

VII. Thanjavur

(i) Ekoji, the half-brother of Shivaji, conquered the Thanjavur region (in present-day Tamil Nadu) in the late 17th century, marking the beginning of Maratha rule in the area.

(ii) The Thanjavur Marathas especially helped create a syncretic culture that was rich and full of innovation. They were great patrons of the arts, and many of the rulers themselves were poets and dramatists.

The cultural environment of Thanjavur was multilingual, with a mix of many influences. The local Tamil culture, the Telugu culture of the former rulers, and the current rulers' Marathi culture interacted with each other freely.

Fig. 3.21 A traditional Thanjavur style painting, featuring delicate gold foil work that lends it a rich, radiant appearance; this style flourished under the patronage of the Marathas

Serfoji II

(i) Among all the Thanjavur Maratha rulers, Serfoji II's contribution was the most important.

(ii) He knew many Indian and European languages. He wrote a Marathi play called Devendra Kuravanji, which described world geography as people knew it at that time.

(iii) Serfoji supported many talented musicians. During his time, Modern Carnatic music started developing. The early form of the Bharatanatyam dance also began taking shape.

(iv) He was also interested in medicine. He set up the Dhanwantari Mahal, a medical centre that gave free treatment using both Indian and Western medicine.

(v) Serfoji started a printing press, which was the first printing press started by an Indian ruler.

(vi) He also got the history of the Bhonsle family written on the walls of the Brihadishwara temple in Thanjavur. This became one of the largest single inscriptions in India, made to last for future generations.

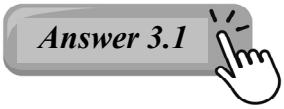
The Maratha Legacy

(i) The Marathas challenged Mughal dominance and created India’s largest pre-British empire.

(ii) They promoted regional autonomy and decentralised governance.

(iii) They inspired the ideal of Swarajya (self–rule), which later became vital to India’s freedom movement.

1. Chhatrapati Shivaji Maharaj founded the Maratha kingdom in the 17th century.
2. The British captured India effectively from the Marathas more than from any other Indian power.
3. Forts were the core of Maratha state; the Marathas controlled hundreds of forts, thus strategically strengthening their control over the region.
4. Their formidable navy resisted European naval supremacy for quite some time
5. The Marathas inspired a new cultural confidence amongst Indians in various regions,



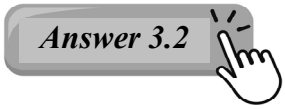
Ans.1 (b) Khilji Sultanate

Ans.2 Shivaji was born in Bhonsle clan.

Ans.3 Dnyaneshwar, Namdev

Ans.4 Shivaji met Afjal Khan at the foot of the Pratapgad fort amid thick forests.

Ans.5 Shivaji sacked a Mughal city Surat twice, because it was wealthy port city which gave Shivaji enormous treasure worth almost one crore of rupees.



Ans.1 (c) Finance minister

Ans.2 Shivaji abolished hereditary posts so that official do not dictate and not become powerful.

Ans.3 Sardeshmukhi was an additional 10 percent tax from provinces that were not directly under Maratha rule.

Ans.4 Maratha armed forces were divided into three parts. (i) Infantry, (ii) Cavalry (iii) Navy

Ans.5 With the help of Kanhoji Angre Marathas won many navy battles by the clever use of geography.

NCERT Exercise

[Let Us Enhance Our Learning]

Q.1 Analyse how geography (particularly mountains and coastlines) guided Maratha military strategy and state formation.

Q.2 Imagine you are creating a short biography of a Maratha leader for younger students. Choose one personality (Kanhoji Angre, Bajirao I, Mahadji Shinde, Ahilyabai Holkar or Tarabai) and write 3-4 paragraphs highlighting what makes them inspirational. Include at least one challenge they overcame.

Q.3 If you could visit one Maratha fort today (such as Raigad, Sindhudurg, Gingee, or Pratapgad), which would you choose and why? Research its history, architecture, and strategic importance. Present your findings as a digital presentation or a poster in class.

Q.4 The chapter states, "The British took India from the Marathas more than from the Mughals or any other power." What do you think this means? What evidence from the chapter supports this idea?

Q.5 Compare how Shivaji and later Marathas treated religious places and people of different faiths. What evidence from the chapter shows their approach to religious diversity?

Q.6 The chapter describes how forts were 'the core of the state' for Marathas. Why were they so important? How did they help the Marathas survive against larger enemies?

Q.7 You have been appointed as the chief designer for Maratha coins. Design a coin that represents Maratha achievements and values. Explain the symbols you chose.

Q.8 After this introduction to the Maratha period, what do you think was their most important contribution to Indian history? Write a paragraph supporting your opinion with examples from the chapter. Then share and discuss your ideas with classmates.

Exercise -1

➢ Fill in the Blanks

Q.1

(i) The Maratha movement for self-rule is called ____.

(ii) Shivaji's council of eight ministers was called ____.

(iii) The fort at which Shivaji was crowned is called ____.

(iv) The script used for Maratha official correspondence was called ____.

(v) The leader credited with uniting Indian powers against the British was ____.

➢ Very Short Answer Type Questions

Q.1 Who was Shivaji and why is he important?

Q.2 What was guerrilla warfare used by the Marathas?

Q.3 What was the 'chauth' tax?

Q.4 How did the Marathas challenge European naval power?

Q.5 Name two cultural contributions of the Marathas.

Q.6 Who was Tarabai and what was her role?

➢ Short Answer Type Questions

Q.1 Who was Shivaji and why is he important in Maratha history?

Q.2 What were the main features of Shivaji's administration?

Q.3 How did the Marathas expand their territory after Shivaji's death?

Q.4 What role did the Peshwas play in the Maratha Empire?

.

Q.5 Describe the significance of the Battle of Panipat (1761) for the Marathas.

➢ Long Answer Type Questions

Q.1 Discuss the role and contributions of prominent women in the rise and survival of the Maratha Empire.

Q.2 Write a note on Maratha Rule in Thanjavur.

Exercise -2

Q.1 Who was the founder of the Maratha Swarajya?
(A) Sambhaji (B) Shahaji Raje
(C) Shivaji (D) Rajaram

Q.2 In which geographical region did the Maratha power primarily emerge?
(A) Malabar Coast
(B) Deccan Plateau
(C) Indo-Gangetic Plain
(D) Thar Desert

Q.3 What was the vision of self-rule established by Shivaji called?
(A) Chauth (B) Mansabdari
(C) Swarajya (D) Sardeshmukhi

Q.4 Which cultural movement helped unify the Maratha society through the teachings of saints?
(A) Renaissance (B) Bhakti Movement
(C) Sufi Movement (D) Arya Samaj

Q.5 Shivaji was born in the year 1630 at which fort?
(A) Raigad (B) Shivneri
(C) Pratapgad (D) Purandar

Q.6 Who was Shivaji's mother and primary source of inspiration?
(A) Tarabai (B) Ahilyabai
(C) Jijabai (D) Putlabai

Q.7 Which military tactic did Shivaji master to defeat larger Mughal and Bijapur armies?
(A) Trench warfare (B) Frontal assault
(C) Guerrilla warfare (D) Naval blockade

Q.8 The council of eight ministers established by Shivaji was known as:
(A) Navaratnas
(B) Ashta Pradhana Mandala
(C) Mansabdari
(D) Peshwa Sabha

Q.9 What was the title of the Prime Minister in Shivaji's administration?
(A) Amatya (B) Sachiv
(C) Peshwa (D) Senapati

Q.10 Shivaji was formally coronated as 'Chhatrapati' in 1674 at which fort?
(A) Pune (B) Raigad
(C) Satara (D) Panhala

Q.11 Which Bijapur general was defeated and killed by Shivaji at Pratapgad?
(A) Shaista Khan
(B) Afzal Khan
(C) Mirza Raja Jai Singh
(D) Dilir Khan

Q.12 Which weapon did Shivaji use to kill the Bijapur general at Pratapgad?
(A) Talwar (Sword)
(B) Wagh nakh (Tiger's claws)
(C) Dhanush (Bow)
(D) Bhala (Spear)

Q.13 In 1663, Shivaji conducted a daring night raid in Pune against which Mughal governor?
(A) Aurangzeb (B) Shaista Khan
(C) Muazzam (D) Jai Singh

Q.14 Which wealthy Mughal port city did Shivaji sack twice to fund his military campaigns?
(A) Bombay (B) Goa
(C) Surat (D) Madras

Q.15 Under the Treaty of Purandar (1665), Shivaji had to cede how many forts to the Mughals?
(A) 12 (B) 23 (C) 35 (D) 10

Q.16 How did Shivaji and his son Sambhaji escape from house arrest in Agra?
(A) Disguised as monks
(B) Hidden in fruit and sweet baskets
(C) Through an underground tunnel
(D) By bribing the guards at the gate

Q.17 The tax levied by the Marathas at 25% of the land revenue in non-Maratha lands was:
(A) Chauth (B) Sardeshmukhi
(C) Zakat (D) Jizya

Q.18 The additional 10% tax claimed by Shivaji as the hereditary head of the land was:
(A) Bali (B) Chauth
(C) Sardeshmukhi (D) Kharaj

Q.19 Who was the legendary Maratha naval commander who challenged European powers?
(A) Kanhoji Angre
(B) Tanaji Malusare
(C) Baji Prabhu Deshpande
(D) Netaji Palkar

Q.20 What was the script used by the Marathas for administrative and business records?
(A) Devanagari (B) Modi
(C) Persian (D) Brahmi

Q.21 Who succeeded Shivaji as the second Chhatrapati of the Maratha Empire?
(A) Rajaram (B) Sambhaji
(C) Shahu (D) Balaji Vishwanath

Q.22 Which Maratha queen led the resistance against Emperor Aurangzeb after 1700?
(A) Jijabai (B) Ahilyabai Holkar
(C) Tarabai (D) Rani Laxmibai

Q.23 Which Peshwa is famous for the policy of "Northward Expansion" and never losing a battle?
(A) Balaji Vishwanath (B) Bajirao I
(C) Balaji Bajirao (D) Madhavrao I

Q.24 The Third Battle of Panipat (1761) was fought between the Marathas and:
(A) The British (B) Ahmad Shah Abdali
(C) Nadir Shah (D) The French

Q.25 Who was the great Maratha stateswoman known for rebuilding temples across India?
(A) Tarabai (B) Rani Chennamma
(C) Ahilyabai Holkar (D) Anandibai

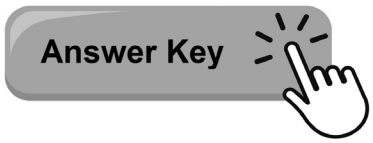
Q.26 Which Maratha general was responsible for restoring Maratha power in Delhi in 1771?
(A) Mahadji Shinde (B) Nana Phadnavis
(C) Malhar Rao Holkar (D) Raghunath Rao

Q.27 What was the name of the administrative treatise written during the Maratha period?
(A) Arthashastra (B) Adnyapatra
(C) Akbarnama (D) Ain-i-Akbari

Q.28 Shivaji's navy was primarily established to protect against which foreign powers?
(A) Portuguese and British
(B) Siddis and Dutch
(C) All of the above
(D) None of the above

Q.29 Which treaty Shivaji had to sign with Mughals in 1665
(A) Treaty of Salbai
(B) Treaty of Purandar
(C) Treaty of Allahabad
(D) Treaty of Lahore

Q.30 Which Peshwa was known as 'Nana Saheb'?
(A) Bajirao I
(B) Balaji Bajirao
(C) Madhavrao I
(D) Baji Rao II



EXERCISE – 1

➢ Fill in the Blanks

(i) Swarajya
(ii) Ashta Pradhana Mandala
(iii) Raigad
(iv) Modi
(v) Nana Phadnavis

➢ Very Short Answer Type Questions

Sol.1 Shivaji was the founder of the Maratha kingdom, celebrated for establishing Swarajya and pioneering guerrilla warfare.

Sol.2 A tactic using swift surprise attacks and mobility to defeat stronger enemies.

Sol.3 A 25% tax imposed on territories protected by the Marathas.

Sol.4 Through their navy led by Kanhoji Angre, who used tactical advantages on the coastline.

Sol.5 Revival of Marathi and Sanskrit literature and rebuilding of Hindu temples.

Sol.6 A warrior queen who led the Maratha resistance after the death of Rajaram

EXERCISE – 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	B	C	B	B	C	C	B	C	B	C	B	B	C	C
Ques.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	B	A	C	A	B	B	C	B	B	C	A	B	C	B	B

English

Chapter 2

PRONOUN

Pronoun

Pronoun is a word used instead of a Noun.

e.g. Look at Jack. He is studying. John and Mary have come to see him. They are glad to see him studying. He is also glad to see them.

The different kinds of Pronouns are as follows.

(a) Personal Pronouns :

They stand for three Persons :

(i) First Person :

- The Pronouns which refer to the person or persons speaking:

e.g. I, we, me, us, mine, ours.

(ii) Second Person:

- The pronouns which refer to the person or persons spoken to.

e.g. you, your, yours, thou, thee

(iii) Third Person:

- The pronouns which refer to the person or thing spoken of.

e.g. he, she, him, her, hers, they, them, theirs, it.

(b) Reflexive or Emphatic Pronouns :

(i) Reflexive pronouns act as Object to the Verb but they refer to the same persons as the Subject of the Verbs.

e.g. myself, ourselves, yourself, yourselves, himself, herself, itself and themselves.

- I blame **myself** for my failure. We often talk to **ourselves**.
  He hanged **himself**. They always talk about **themselves**.
  She put **herself** to trouble for nothing.

(ii) Emphatic Pronouns are used with a Noun or a Pronoun for the sake of emphasis .

e.g. I **myself** was present at the accident site. You **yourself/yourselves** must do the assignment.
She **herself** cooked food for the guests. Boys, you **yourselves** should prepare your timetable.
He **himself** told me the story.

(c) Demonstrative Pronouns :

They are used to point out the object or objects for which they are used.

- **This** & **These** refer to things near at hand.
- **That** & **Those** refer to things lying at a distance.

e.g. **This** is my book. **That** is my house. **These** are your friends. **Those** are her friends.

(d) Distributive Pronouns :

It refers to a number of persons or things, one at a time. These pronouns are always singular and are always followed by a Verb in the singular.

- **Each, Either, Neither** are such pronouns.

e.g. **Each** student secured a reward. **Neither** of your answer is correct.
At **either** end of the road was a Park.

(e) Interrogative Pronouns are used for asking questions.

- **Who, Whom and Whose** are used for asking questions about things.

e.g **Who** is calling you ? **Whom** do you want to meet ? **Whose** book is this ?

- **What** is used for asking questions about things.

e.g. **What** shall you do after graduation ?

- **Which** is used for asking a question about the particular person or thing.

e.g. **Which** is the most intelligent student in this class? (Person)
Which is the best book ? (Thing)

(f) Reciprocal pronoun :

They are pronouns that denote reciprocal or mutual action. They are :

- **Each other:** generally used when two persons or things are referred to.

e.g. Jack and Jill loved **each other**.

- **One another:** generally used when more than two persons or things are referred.

e.g. The people of India love **one another**.

(g) Relative Pronoun :

- The Pronouns 'Who, Whose, Whom, Which, That', which join two sentences and relate or refer to Nouns which have gone before are called Relative Pronouns.
- The Noun to which a Relative Pronoun refers or relates is called its Antecedent.

e.g. This is the boy **who** was punished.
In this example 'boy' is the Antecedent of 'who'.

Use of Relative Pronouns

(i) Who :

- Used for persons only.

e.g. The man **who** is honest succeeds in his life.
The students **who** were lazy were punished.
They **who** live in glass houses should not throw stones at others.
The children **who** work hard always succeed.

(ii) Whose:

- It is the possessive case of 'Who'. It refers to persons but may also refer to things.

e.g. This is the question **whose** solution baffles me.
The school building **whose** roof was damaged, has now been repaired.

(iii) Which:

- Used for animals and for things without life.

e.g. These are the books **which** we purchased yesterday.
The horse **which** won the race is John's.
The things **which** we lost have been found.

(iv) Whom :

- Is used in formal written English. It is common to use 'Who' in place of 'Whom' in ordinary conversation.

e.g. The man **who (m)** the police caught was a dreaded terrorist.
The students **who (m)** we praised were good in their studies.

Note: **'whom'** is often replaced by 'That' except after a preposition. The preposition may be placed at the end and **'that'** used for 'whom'.

e.g. That is the man about **whom** we were speaking.
That is the man **that** we were speaking about.

(v) That : Used for persons, animals and things.

- It may refer to singular or plural.

e.g. These are the boys **that** can be trusted.
This is the book **that** I want to buy.
This is the ring **that** I lost yesterday.
These are the only horses **that** neigh.

Note : 'That' is preferred to 'who' or 'which' though 'who' or 'which' can be equally used.

e.g. a) After the superlative degree of adjectives:
Ashoka was the best king **that** (= who) ruled in India.
This is the best book **that** (= which) I have read.

b) After the words 'all, none, nothing, any, only, same' etc.
All **that** (= which) glitters is not gold.
It is only you **that** (= who) can speak in such a way.
Nothing **that** (= which) we can do now will save him.

Pronouns at a Glance

PERSON	Nominative or Subjective	Objective	Reflexive	Possessive & Vocative
FIRST	I We	Me Us	Myself Ourselves	My, Mine Our, Ours
SECOND	You	You	Yourself/ Yourselves	Your, Yours
THIRD	He She It They	Him Her It Them	Himself Herself Itself Themselves	His, His Her, Hers Its Their, Theirs

EXERCISE

I. Fill in the blanks with suitable pronouns.

One evening, a rich lady sent (a) _____ housemaid to the market to buy some vegetables for (b) _____. The rich lady sat by (c) _____ for some time. Then she saw her maid returning very quickly. "Madam" she said, " I have forgotten (d) _____ you had asked me to bring." The angry lady said, (e)" _____ can bear with such a fool? (f) _____ was such a simple task and you've come back empty-handed."

II. The following passage has not been edited. There is one error in each line. Write the incorrect word and the correction against the correct blank number. Underline the word that you have supplied.

	Incorrect	Correct
We are in very serious times, because they are free. In	**(a)**	
the old days ours task was only to fight, to wrest freedom	**(b)**	
enthuse each other and carry on the freedom struggle.	**(c)**	
Those was easy, as we know, but now that we have freedom	**(d)**	
the entire burden of the future structure of my country is	**(e)**	
on our own shoulders. You must be as true in our conduct	**(f)**	
and thoughts as a brick that supports a building is true.		

III. The following passage has not been edited. There is one error in each line. Write the incorrect word and the correction against the correct blank number. Underline the word that you have supplied.

	Incorrect	Correct
Jack and Michael were fast friends. They loved one another.	**(a)**	
Every tried to make the greatest sacrifice for	**(b)**	
the others. Their parents were equally friendly.	**(c)**	
But what knows the quirks or fate? It was just a	**(d)**	
Trifle that led to a misunderstanding between their.	**(e)**	
The two boys himself remained friendly as ever	**(f)**	
They tried there best to persuade their fathers.	**(g)**	
An ingenuous trick exposed the man which had created the	**(h)**	
bad blood. Jack's father was the one to greet his friend.	**(i)**	
The four stood together and embraced each other.	**(j)**	

ANSWER KEY

I. **a.** her **b.** her. **c.** herself **d.** what **e.** Who **f.** this

II. **a.** they we **b.** ours our **c.** each other one another **d.** those that **e.** my our **f.** you we

III. **a.** one another each other **b.** Every each **c.** Others other **d.** What Who
e. their them **f.** himself themselves **g.** there their **h.** which who
i. one first **j.** each other one another