Revised Edition

Physics

For Middle Classes

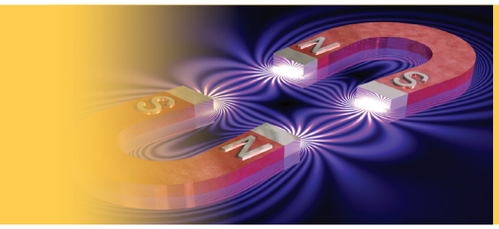
(Book III)
For Class - VIII

8

R.P. RANA

S. CHAND School

Based on the Syllabus of Inter-State Board for Anglo-Indian Education and the Guidelines prescribed by the Council for the Indian School Certificate Examinations, New Delhi.



PHYSICS

FOR MIDDLE CLASSES

BOOK III

CLASS VIII

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S. CHAND SCHOOL BOOKS

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PREFACE TO THE REVISED EDITION

This **multicoloured edition** of the book, Physics for Middle Classes for Class VIII, has been revised according to the latest syllabus of the Inter-State Board for Anglo-Indian Education and the guidelines prescribed by the Council for the Indian School Certificate Examinations, New Delhi. Multicoloured photographs have been added at suitable places which will help the students to understand the topics easily and in an interesting manner. Care has been taken to present the subject matter in the simplest form.

Unique features of the book are :

- Lucid language
- Multicoloured photographs and figures
- Text questions and exercises
- A list of key words and summary
- Answers to the objective questions at the end of each chapter
- Project work
- To facilitate teachers, a Unit Test Paper has been added at the end of each unit

The book has been designed to give ample exercises on :

- Objectivity (multiple choice questions)
- Fill in the Blanks
- Match Makings
- Finding out True or False
- Differentiate Between the Following
- Subjective Questions
- Numerical Problems

To enhance the utility of the book and having educational aspects in mind the following four types of questions have been added :

- Knowledge-based Questions
- Understanding-based Questions
- Application-based Questions
- Skill-based Questions

My special thanks to Mr. Aley Ahmad, Principal, Spring Dale College, Lucknow and Mr. C.J. Varghese whose kind cooperation has been very helpful during revision of this book.

I'm thankful to the Management Team and the Editorial Department of S. Chand & Company Pvt. Ltd., New Delhi for all help and support in the publication of this book.

Awaiting further feedback, comments and suggestions from the learned teachers, and our loving students.

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Inter-State Board for Anglo-Indian Education

*New Syllabus

UNIT 1 : THE UNIVERSE

1. The sun – some simple facts about it – the names of the nine planets, in correct order.
2. Natural satellites – the moon and its phases – tides.
3. Galaxy, constellations, comets, meteors, meteorites - in brief.
4. Eclipses of the sun and the moon (revision).
5. Artificial satellites and their uses.

   Caution: Explain to students that watching the sun directly, even through a darkened glass, can seriously damage their eyes. To observe a solar eclipse, it can be projected through a pinhole on a wall or a reflected image can be obtained using a mirror.

   - Observe and record the phases of the moon (E)
   - Project work – develop research and presentation skills – using encyclopaedia. Internet and other sources

UNIT 2 : LIGHT

1. Definitions/explanation of the terms: refraction, angles of incidence and refraction, refractive index (ratio of the speed of light in vacuum to the speed of light in a medium), concave and convex lenses, focus of a lens, real and virtual images.
2. Ray diagrams showing the passage of a ray of light through a parallel-sided glass block and a prism.
3. Dispersion of light by a prism.
4. Ray diagrams showing the formation of images by a convex lens for different positions of the object.
5. Brief, simple explanation of long sight and short sight and how they may be corrected.
6. Some optical instruments that use lenses – magnifying glass, simple camera, microscope and telescope – ray diagrams need not be drawn by students.
   - Observing the refraction of a narrow beam of light through a parallel-sided glass block (E)
   - Observing the formation of images by a convex lens for different positions of the object – no measurements required (E)

     (*Note*: A simple convex lens, as obtained in a dissection set, will suffice to set up this improvised experiment; a white card can serve as a screen. Ensure students understand the difference between real and virtual images.)

UNIT 3 : HEAT

1. (a) Heat flows from a body at a higher temperature to one at a lower temperature

   (*b*) Factors on which the quantity of heat required to raise the temperature of a body depends – its mass, the rise in temperature, the substance of which it is made.

   (*c*) Definition/explanation of the terms: calorie, kilocalorie. specific heat capacity, heat capacity.
2. Heat is a form of energy and can also be measured in joules (J).

   (*Note*: It is essential for students to know the correct units for these quantities, in the SI system.)
3. Using given data to solve simple numericals based on the formulae:

   (*a*) Quantity of heat = mass × specific heat × rise in temperature

   (*b*) Heat capacity = mass × specific heat capacity
4. Conductors and insulators (revision) – link with specific heat capacity of material
5. Change of state occurs at a fixed temperature – melting point or boiling point – and it takes up heat. This heat does not cause a rise in temperature and is called latent heat. (qualitative explanation only)

UNIT 4 : MORE ABOUT SOLIDS, LIQUIDS AND GASES

1. Kinetic Theory of Matter: The three states of matter – intermolecular forces (cohesion) and the arrangement of molecules in each state – explaining the general properties of solids, liquids and gases. (revision)
   Liquids: surface tension, formation of droplets and a meniscus.
   What happens when a substance is heated – conduction, convection.
   Gases and Liquids exert a pressure – what happens to the pressure when a gas is compressed or allowed to expand.
2. Facts about pressure in liquids.
3. Archimedes' Principle and the Law of Floatation.
4. Atmospheric pressure – the mercury barometer - the lift pump.
   - Exploring facts about pressure in liquids at the same and different levels (E)
   - Archimedes' Principle (D)
   - The Law of Floatation (D) - why ice floats on water?
   - Mercury/Fortin barometer (D)
   - The Lift Pump - model- if possible (D/E)

UNIT 5 : MORE ABOUT ENERGY

1. Different forms of energy – interconvertibility – energy chains starting from the sun. (brief revision)
2. Why coal and oil are called fossil fuels? (revision)
3. Electricity is the most widely used form of energy – simple ideas about generation in thermal and hydroelectric power stations – location of some major power projects in the country.
4. Renewable and non-renewable sources of energy - non-conventional or alternative sources of energy: solar energy, biomass, nuclear energy, wind energy, geothermal and tidal energy.
   Brief explanations of:
   (*a*) Direct use of solar energy for heating/cooking – use of solar photovoltaic cells – examples of their use in India, especially in their own state/their own lives.
   (*b*) Nuclear power stations – location in India – dangers associated with these, need for careful use and strict observance of precautions.
   (*c*) Biomass – produces both biogas (methane) and fertilizer.
   (*d*) Wind energy – wind farms.
   (*e*) Geothermal and tidal energy.
5. Air pollution caused by the use of fossil fuels in industry and transport. The use of CNG.
6. Personal steps in the conservation of all forms of energy and reduction in consumption of fuels and materials of all kinds (Energy is used in the preparation of all materials.) (Link with Biology, Class VIII, Unit 5) .
   - Identifying local situations where energy is wasted and steps to be taken to reduce the same.
   - Practising small but significant changes in life style through participation in campaigns at school, home and outside. e.g. "Say 'No' to plastic", Save water, Switch off Something (to save electricity), setting up compost pits in gardens, collecting garbage, recycling materials, creating useful products from waste, etc.

UNIT 6 : STATIC ELECTRICITY

1. Charged and uncharged bodies – types of charges – charging by friction – simple electrostatic phenomena observed in everyday life.
2. The particles found inside the atom - basic facts about them.
3. The law of Electrostatic Attraction and Repulsion.

4. An electroscope – charging an electroscope by conduction and induction – determining the nature of its charge (positive/negative).
5. Lightning and lightning conductors. :
6. Static electricity, the flow of electrons in a conductor, direction of conventional current.
   - Observing simple electrostatic phenomena (E)
   - Electrostatic attraction and repulsion (D/E)
   - Making an improvised electroscope (E)
   - Charging it by conduction - testing its charge (E)

UNIT 7 : MAGNETISM AND ELECTRICITY

1. Revision of properties of magnets.
2. Magnetic fields around a bar magnet -lines of force.
3. Brief and simple explanation of the magnetic field of the Earth - magnetic compass.
4. (*a*) Making electromagnets - their strength depends on the number of coils and the current in the circuit (increase in the number of cells).
   (*b*) Uses of electromagnets.
   (*c*) Structure and functioning of an electric bell.
5. (*a*) Magnetic field associated with a straight current carrying conductor.
   (*b*) The Right Hand Rule
   (*c*) Clockwise and anti-clockwise current - determining the polarity of a solenoid.
6. (*a*) Electromagnetic Induction
   (*b*) A brief, simple introduction to the meaning of an alternating current – how it differs from a direct current.
   (*c*) Devices that work on this principle - dynamo, transformer.
   (*d*) Electric motor (Note: Devices are not to be studied in detail.)

CONTENTS

UNIT 1

The Universe

Sir William Herschel
(1738 – 1822)

Herschel was a German-born British astronomer who in 1781 discovered the planet Uranus using a telescope. After discovering Uranus, he identified nearly 2000 nebulae and catalogued 800 double stars.

Learning Objectives

- The Night Sky
- The Stars
- Galaxy
- Constellations
- An Eclipse of the Sun
- Planets
- Difference between Star and Planet
- Satellites or Moons
- An Eclipse of the Moon
- Asteroids
- Comets
- Meteors and Meteorites
- Artificial Satellites

The Universe has always attracted the attention of the people. In fact, the people have very little knowledge about the universe. But later, the scientists explored the objects and phenomena occurring in the universe. As a result, we now know many more things about the universe. Still, however, scientists are going ahead in exploring the universe.

The sun, the planets and the stars are some of the commonly known heavenly bodies. Besides these, there are many other heavenly objects about which very few people know. You will be learning about these objects in this unit. Do you know the vastness of our universe ?

The vast surrounding space is called universe. The universe includes everything that exists : the most distant stars, planets, satellites, our own earth and all the heavenly bodies in it.

Look up at the sky on a clear cloudless night, when the moon is not visible. You will see a large number of stars (Figure 1.2). Some of them are brighter and some are dim while some others are hardly visible to us. In ancient times, when no clocks or watches were available, the position of stars guided our ancestors in keeping time and also in determining their position. The knowledge about the position of stars was particularly important for travellers in finding directions for navigation. These days, we seldom use stars for this purpose but it is still important to study about them. Study of stars helps us to know how different celestial bodies were formed and how the universe came into existence. You shall study all this in detail in higher classes.

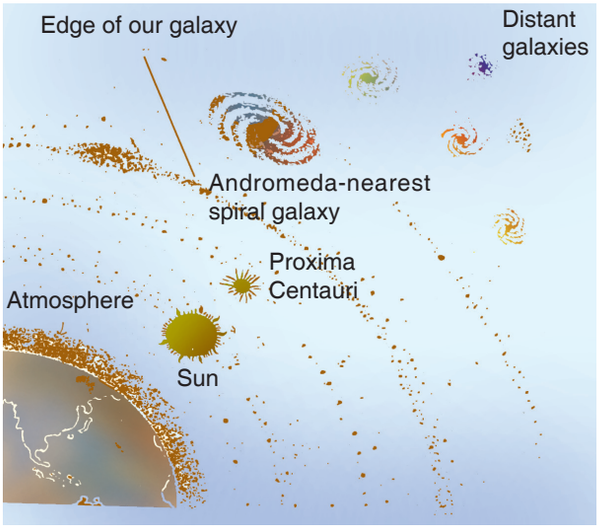

Fig. 1.1. Our universe—earth and sky

The stars are spherical *i.e.*, having the shape of a ball and are very large objects. They are much bigger than the earth and some of them are even larger than the sun. They appear so small because they are far away from us.

The stars are present in the sky even in the daytime but you can see them only at night. You cannot see them during the day because of the light of the sun.

If you see the stars at night you will find them to be twinkling. You may also find some objects in the sky like stars which do not twinkle. In fact, these are not stars. These are planets. The planets are also members of solar system. The basic difference between planets and stars is that **stars are self-lighted whereas the planets shine only when they receive the light of the stars. The planets revolve around the sun.**

In this chapter, you will also learn about some groups of stars which appear to form definite patterns in the night sky. Many such patterns of stars have been given specific names based on their appearance. You might have heard of Zodiac signs, which are some of the star patterns that have been given specific names. In Hindi, we use the term **Rashi** for a **Zodiac sign.**

You have already learnt that the moon is a natural satellite of the earth, which revolves around it. These days many artificial satellites too revolve around the earth, which have many applications. For example, television transmission sending messages through telephones and internet to any part of the world have become possible due to artificial satellites. In this chapter, you will get some basic ideas about them.

Actually, the sun is also a star. It is a model star of the family of our solar system. It looks much bigger and brighter because it is much nearer to us. At the same time many other stars are bigger than the sun while they look small and dim because they are very far away from us. In this unit you will also learn some simple facts about the sun.

You can see nearly 3,000 stars with your naked eyes. You can see many more stars with the help of a telescope. These stars are very far away from one another. Even two nearest stars are crores of kilometres apart.

In fact, nobody knows how big the universe is, whether it has any limits. The famous physicist, Albert Einstein, had defined the universe that, **'The vast unbounded but finite surrounding space is called universe. The universe includes everything that exists : galaxies, stars, planets, satellites, asteroids, comets, meteors and all other heavenly bodies'.**

THE NIGHT SKY

You know that during the day, the sun is the only object visible in the sky. However, as soon as it becomes dark after sunset, the sky appears dotted with millions of bright twinkling stars. One of the characteristics of the stars is that they appear to twinkle when viewed from the earth. (Figure 1.2).

Moon is another prominent object visible to us at night. You can also see some star-like objects at night, which do not appear to twinkle. These are planets like our earth that revolves around the sun. At night, if you look at the sky for a long time, you may be able to see a few shooting stars as well. A bright line (streak) of light that appears for a very short duration in the background of stars, it is likely that you have observed a shooting star. The stars, the sun, the moon, planets and shooting stars are some of the **celestial bodies** that are a part of our universe. Let us know and study more about each of them.

Fig. 1.2. Stars in the night sky.

THE STARS

Stars are heavenly bodies that continuously emit light and heat. Stars are extremely hot and have light of their own. Thus, the sun is also a star. It appears large as compared to other stars because it is nearest to the earth. Stars appear to us like a point object because they are very far away from us, though many of them are much larger than the sun. You might be thinking that the stars appear in the sky only at night. In fact it is not so. The stars are not visible during the day because of the glare of bright sunlight.

Most of the stars are so far away that even light from them takes millions of years to reach the earth.

All the stars including the sun (except the Pole Star) appear to move from east to west in the night sky. However, when viewed from the earth the distance between any two stars does not seem to change in spite of their great speeds. This is so, because the stars are so far away from us that any change in distance between them does not become perceptible in a few years or even during one's lifetime.

The stars appear to move from east to west. This is so, because the earth itself rotates on its axis from west to east. So, when the earth rotates on its axis from west to east, the stars appear to move in the opposite direction, from east to west. Thus, **the apparent motion of the stars in the sky is due to the rotation of the earth on its own axis.** However, there is one star, which appears stationary to us. This star is situated in north direction and is known as **Pole Star** or **Polaris** or **Dhruvatara.**

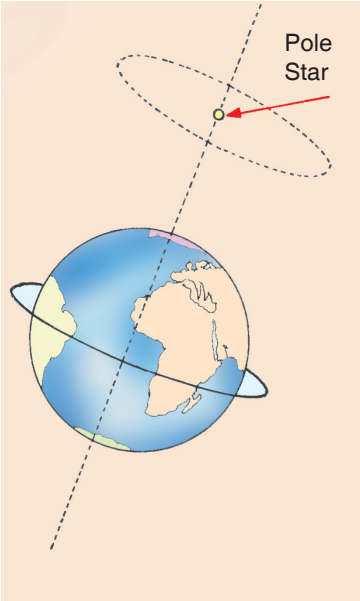

Fig. 1.3. The Pole Star lies on the axis of rotation of the earth.

The Pole Star appears to be stationary and does not change its position with time because it lies on the axis of rotation of the earth which is fixed in space and does not change with time (Figure 1.3). The Pole Star had been one of the most familiar stars to travellers in ancient times to find directions at night.

Galaxy

Look at the sky during a moonless night. You can see a large strip of glowing light from north to south across the sky. (See Fig. 1.4). It is known as the **Milky Way.** It is made up of a cluster of countless stars. There are several such clusters of stars in our universe. These are called **Galaxies.**

A galaxy is a cluster of millions of stars along with hydrogen gas and dust. There are millions of galaxies in the universe. In fact, galaxies are the building bricks of the universe.

We will now discuss our own galaxy.

Fig. 1.4. The Milky Way seen in the night sky.

The Milky Way : Our Own Galaxy

The name of our galaxy is the **Milky Way.** The Milky Way is one of the millions of galaxies which exist in the universe. It contains about a hundred billion stars (or 10^{11} stars). The view of Milky Way galaxy looks like a disc of stars.

All heavenly bodies of the universe are in continuous motion. The Milky Way with the sun and the stars is also moving. It is also revolving slowly on its axis. Because of this, the sun is moving at a speed about 220 kilometres per second.

Traditionally, when people talk of the Milky Way, they are describing the misty band of light which stretches across the night sky. The Italian astronomer Galileo (1564-1642) was the first person to look at the Milky Way with a telescope. He saw that it was composed of countless faint stars.

The sun too (along with the solar system) rotates about the centre of the milky way galaxy. It takes about 250 million years to complete one revolution.

The astronomers have now been able to establish **the spiral shape of our galaxy** by joining together photographs taken from many different directions over many years.

Milky Way Data File

Diameter	:	130,000 light years
Thickness of spiral arms	:	3000 light years (approx.)
Thickness of central bulge	:	10,000 light years
Diameter of central bulge	:	20,000 light years
Total mass	:	110 billion × Sun
Average density (estimate)	:	0.000000000000000000007 (water = 1)
Age	:	14 billion years
Time to rotate once	:	225 million years
Distance of Sun from centre	:	30,000 light years
Satellite galaxies	:	2

THE UNIT OF MEASURING DISTANCES IN THE UNIVERSE

Usually, we express the distance in kilometres. But this unit of distance is extremely small to express the distances between stars and between the other heavenly bodies. They are millions of kilometres away from one another. Most of the stars are so far away that even light from them takes millions of years to reach the earth. Therefore, these distances are expressed in another larger unit of distance called **light year. One light year is the distance travelled by light in one year at a speed of light** which is about 300,000 kilometres per second. Do you know how large this distance is ? To know the distance light travels in one year, multiply the speed of light by the number of seconds in one year. Thus,

$$\text{One light year} = 300{,}000 \times 365 \times 24 \times 60 \times 60 \text{ km}$$
$$= 9460\ 000\ 000\ 000 \text{ kilometres}$$
$$= 9.46 \times 10^{12} \text{ kilometres}$$

The distance between the sun and the earth is about 15 crore kilometres. The light reaches from the sun to the earth in about 8.3 minutes. The next nearest star from the earth is about 4.3 light years away from it known as Proxima Centauri. The brightest star Sirus is about 8.7 light years away from the earth. There are some stars which are even millions of light years away from the earth.

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