

# JK Board Class 10 Science(Physics) Question Paper with Solutions(Memory Based)

Time Allowed :3 Hour	Maximum Marks :60	Total Questions :24
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## General Instructions

Read the following instructions very carefully and strictly follow them:

- Answers to this Paper must be written on the paper provided separately.
- You will not be allowed to write during the first 15 minutes
- This time is to be spent in reading the question paper.
- The time given at the head of this Paper is the time allowed for writing the answers,
- The paper has four Sections.
- Section A is compulsory - All questions in Section A must be answered.
- You must attempt one question from each of the Sections B, C and D and one other question from any Section of your choice.

### 1. Define principal focus and focal length for a concave mirror.

**Correct Answer:** Principal focus is the point where parallel rays of light meet after reflection from a concave mirror. The focal length is the distance between the pole and the principal focus.

#### Solution:

**Concept:** A concave mirror is a spherical mirror whose reflecting surface curves inward. When parallel rays of light fall on a concave mirror, they converge after reflection at a particular point on the principal axis.

#### Step 1: Principal Focus

The **principal focus** of a concave mirror is the point on the principal axis where all rays of light that are parallel to the principal axis meet after reflection from the mirror.

#### Step 2: Focal Length

The **focal length** of a concave mirror is the distance between the **pole (P)** of the mirror and the **principal focus (F)**.

$$\text{Focal Length} = PF$$

It is usually denoted by  $f$ .

### Quick Tip

For a spherical mirror, the focal length is equal to half of the radius of curvature:

$$f = \frac{R}{2}$$

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## 2. Explain the refraction of light through a rectangular glass slab.

**Correct Answer:** When light passes through a rectangular glass slab, it bends at both surfaces due to refraction, and the emergent ray becomes parallel to the incident ray with a lateral displacement.

### Solution:

**Concept:** Refraction of light is the change in direction of light when it passes from one medium to another due to a change in its speed. In a rectangular glass slab, refraction occurs at both surfaces of the slab.

#### Step 1: Refraction at the first surface

When a ray of light passes from air into the glass slab, it travels from a rarer medium (air) to a denser medium (glass). Therefore, the ray **bends towards the normal**. This bending of light at the boundary is called refraction.

#### Step 2: Refraction at the second surface

When the light ray travels inside the slab and reaches the second surface, it moves from a denser medium (glass) to a rarer medium (air). Hence, the ray **bends away from the normal**.

#### Step 3: Lateral displacement

After emerging from the slab, the emergent ray becomes **parallel to the incident ray**, but it is shifted sideways. This sideways shift of the ray is called **lateral displacement**.

Thus, in a rectangular glass slab, light undergoes refraction at both surfaces and the emergent ray remains parallel to the incident ray with a lateral displacement.

### Quick Tip

In a rectangular glass slab, the **incident ray and emergent ray are parallel**, but the emergent ray is laterally displaced from the original path.

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## 3. Define refractive index and state Snell's law of refraction.

**Correct Answer:** Refractive index is the ratio of the speed of light in vacuum to its speed in a medium. Snell's law states that the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for a given pair of media.

### Solution:

**Concept:** When light travels from one medium to another, its speed changes and the ray bends at the boundary. This phenomenon is known as **refraction of light**. The refractive index and Snell's law describe this behavior quantitatively.

### Step 1: Refractive Index

The **refractive index** of a medium is defined as the ratio of the speed of light in vacuum to the speed of light in that medium.

$$n = \frac{c}{v}$$

where  $n$  = refractive index of the medium  $c$  = speed of light in vacuum  $v$  = speed of light in the medium

### Step 2: Snell's Law of Refraction

Snell's law states that when a ray of light passes from one medium to another, the ratio of the sine of the angle of incidence ( $i$ ) to the sine of the angle of refraction ( $r$ ) remains constant.

$$\frac{\sin i}{\sin r} = \text{constant}$$

This constant is called the **refractive index** of the second medium with respect to the first medium.

#### Quick Tip

Snell's law can also be written as:

$$n_1 \sin i = n_2 \sin r$$

where  $n_1$  and  $n_2$  are the refractive indices of the two media.

## 4. Distinguish between a concave and a convex lens with their uses.

**Correct Answer:** A concave lens diverges light rays while a convex lens converges light rays. They differ in shape, image formation, and uses.

### Solution:

**Concept:** Lenses are transparent optical devices that refract light and form images. The two main types of lenses are **concave lens** and **convex lens**. They differ in shape, behavior of light rays, and their applications.

### Step 1: Difference between Concave and Convex Lens

Feature	Concave Lens	Convex Lens
Shape	Thinner at the center and thicker at the edges	Thicker at the center and thinner at the edges
Nature of rays	Diverges light rays	Converges light rays
Image formation	Always forms virtual, erect, and smaller image	Can form real or virtual images depending on the object distance

### Step 2: Uses of Concave Lens

- Used in spectacles to correct **myopia (short-sightedness)**.
- Used in door viewers or peepholes.

### Step 3: Uses of Convex Lens

- Used in spectacles to correct **hypermetropia (long-sightedness)**.
- Used in magnifying glasses, cameras, microscopes, and telescopes.

#### Quick Tip

A **concave lens** is also called a **diverging lens**, while a **convex lens** is called a **converging lens**.

### 5. Define the power of a lens and state its S.I. unit.

**Correct Answer:** The power of a lens is the reciprocal of its focal length (in meters). The S.I. unit of power is dioptre (D).

**Solution:**

**Concept:** The power of a lens indicates the ability of the lens to converge or diverge light rays. A lens with a shorter focal length has greater power, while a lens with a longer focal length has less power.

**Step 1: Definition of Power of a Lens**

The **power of a lens** is defined as the reciprocal of its focal length measured in meters.

$$P = \frac{1}{f}$$

where  $P$  = Power of the lens  $f$  = Focal length in meters

**Step 2: S.I. Unit**

The S.I. unit of power of a lens is the **dioptre (D)**.

$$1 \text{ dioptre} = 1 \text{ m}^{-1}$$

A **convex lens** has positive power, whereas a **concave lens** has negative power.

#### Quick Tip

Power of a lens increases when the focal length decreases:

$$P = \frac{1}{f}$$

Shorter focal length  $\rightarrow$  Greater power.

### 6. Calculate the focal length of a lens with power $-2.0 \text{ D}$ and identify its type.

**Correct Answer:** The focal length of the lens is  $-0.5 \text{ m}$  (or  $-50 \text{ cm}$ ), and it is a concave lens.

**Solution:**

**Concept:** The power of a lens is related to its focal length by the formula:

$$P = \frac{1}{f}$$

where  $P$  = power of the lens (in dioptre)  $f$  = focal length (in meters)

**Step 1:** Substitute the given value.

Given power of the lens:

$$P = -2.0 D$$

Using the formula:

$$f = \frac{1}{P}$$

$$f = \frac{1}{-2.0}$$

$$f = -0.5 m$$

**Step 2:** Convert into centimeters.

$$f = -0.5 m = -50 cm$$

**Step 3:** Identify the type of lens.

Since the power and focal length are **negative**, the lens is a **concave lens**.

$$f = -0.5 m \text{ (or } -50 cm)$$

#### Quick Tip

If the power of a lens is **positive**, the lens is **convex**. If the power of a lens is **negative**, the lens is **concave**.

## 7. Explain the causes and correction methods for Myopia (Short-sightedness) and Hypermetropia (Long-sightedness).

**Correct Answer:** Myopia and Hypermetropia are common defects of vision caused due to improper focusing of light on the retina. They can be corrected using suitable lenses.

**Solution:**

**Concept:** Defects of vision occur when the eye is unable to focus light properly on the retina. Two common defects are **Myopia (short-sightedness)** and **Hypermetropia (long-sightedness)**.

**Step 1: Myopia (Short-sightedness)**

**Definition:** Myopia is a defect of vision in which a person can see **near objects clearly** but **distant objects appear blurred**.

**Causes:**

- The eyeball becomes **elongated**.

- The focal length of the eye lens becomes **too short**.

As a result, light rays from distant objects focus **in front of the retina** instead of on it.

**Correction:**

Myopia is corrected by using a **concave lens (diverging lens)** which diverges the incoming light rays so that the image forms on the retina.

**Step 2: Hypermetropia (Long-sightedness)**

**Definition:** Hypermetropia is a defect of vision in which a person can see **distant objects clearly** but **near objects appear blurred**.

**Causes:**

- The eyeball becomes **shorter than normal**.
- The focal length of the eye lens becomes **too large**.

Therefore, light rays from nearby objects focus **behind the retina** instead of on it.

**Correction:**

Hypermetropia is corrected by using a **convex lens (converging lens)** which converges the light rays before they enter the eye so that the image forms on the retina.

Quick Tip

Myopia → Corrected by Concave Lens  
Hypermetropia → Corrected by Convex Lens

**8. State Ohm’s law and derive the mathematical expression for it.**

**Correct Answer:** Ohm’s law states that the current flowing through a conductor is directly proportional to the potential difference across its ends, provided the temperature and other physical conditions remain constant.

**Solution:**

**Concept:** The relationship between electric current, potential difference, and resistance in an electric circuit is explained by **Ohm’s Law**. It was proposed by the German physicist **Georg Simon Ohm**.

**Step 1: Statement of Ohm’s Law**

Ohm’s law states that the **current (I)** flowing through a conductor is **directly proportional** to the **potential difference (V)** across its ends, provided the temperature and other physical conditions remain constant.

$$I \propto V$$

**Step 2: Introducing the constant of proportionality**

To convert the proportionality into an equation, we introduce a constant called **resistance (R)**.

$$V \propto I$$

$$V = IR$$

where  $V$  = Potential difference (in volts)

$I$  = Electric current (in amperes)

$R$  = Resistance (in ohms)

**Step 3: Final mathematical expression**

Thus, the mathematical expression of Ohm's law is:

$$\boxed{V = IR}$$

This equation shows that the potential difference across a conductor is equal to the product of the current flowing through it and its resistance.

#### Quick Tip

The formula  $V = IR$  can also be rearranged as:

$$I = \frac{V}{R}, \quad R = \frac{V}{I}$$

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### 9. Define electric power and derive the relation $P = VI$ .

**Correct Answer:** Electric power is the rate at which electrical energy is consumed or converted in an electric circuit.

**Solution:**

**Concept:** Electric power represents the rate at which electrical energy is converted into other forms of energy such as heat, light, or mechanical energy in an electric circuit.

**Step 1: Definition of Electric Power**

**Electric power** is defined as the rate at which electrical energy is consumed or used in a circuit.

$$P = \frac{W}{t}$$

where  $P$  = electric power

$W$  = electrical work or energy

$t$  = time

**Step 2: Relation between electrical work and potential difference**

Electrical work done in moving a charge  $Q$  through a potential difference  $V$  is given by:

$$W = VQ$$

Substituting this in the power equation:

$$P = \frac{VQ}{t}$$

**Step 3: Using the definition of current**

Electric current is defined as:

$$I = \frac{Q}{t}$$

Substituting this in the equation:

$$P = V \left( \frac{Q}{t} \right)$$

$$P = VI$$

**Step 4: Final expression**

Thus, the electric power in a circuit is given by:

$$\boxed{P = VI}$$

where  $P$  = power (in watts)

$V$  = potential difference (in volts)

$I$  = current (in amperes)

**Quick Tip**

Other forms of electric power are:

$$P = I^2R \quad \text{and} \quad P = \frac{V^2}{R}$$

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**10. Define 1 kilowatt-hour (kWh) and state its relationship with Joules.**

**Correct Answer:** One kilowatt-hour is the energy consumed when a device of power 1 kilowatt operates for 1 hour. It is equal to  $3.6 \times 10^6$  Joules.

**Solution:**

**Concept:** Electrical energy consumed by appliances is commonly measured in **kilowatt-hour (kWh)**. It is a practical unit of electrical energy used in households and electricity billing.

**Step 1: Definition of 1 kWh**

**1 kilowatt-hour (kWh)** is defined as the amount of electrical energy consumed when an electrical appliance of power **1 kilowatt** operates for **1 hour**.

$$1 \text{ kWh} = 1 \text{ kW} \times 1 \text{ hour}$$

**Step 2: Conversion into Joules**

$$1 \text{ kW} = 1000 \text{ W}$$

$$1 \text{ hour} = 3600 \text{ s}$$

Using the formula for energy:

$$E = P \times t$$

$$E = 1000 \times 3600$$

$$E = 3,600,000 \text{ J}$$

$$E = 3.6 \times 10^6 \text{ J}$$

**Step 3: Final relation**

$$1 \text{ kWh} = 3.6 \times 10^6 \text{ J}$$

#### Quick Tip

1 kWh is commonly called **one unit of electricity** used in electricity bills.

### 11. State Fleming's Left-Hand Rule and Right-Hand Thumb Rule.

**Correct Answer:** Fleming's Left-Hand Rule gives the direction of force on a current-carrying conductor in a magnetic field, while the Right-Hand Thumb Rule gives the direction of magnetic field around a current-carrying conductor.

**Solution:**

**Concept:** In electromagnetism, certain rules are used to determine the direction of magnetic field, current, and force acting on a conductor placed in a magnetic field. Two important rules are **Fleming's Left-Hand Rule** and the **Right-Hand Thumb Rule**.

**Step 1: Fleming's Left-Hand Rule**

Fleming's Left-Hand Rule helps to determine the direction of the **force (motion)** acting on a current-carrying conductor placed in a magnetic field.

According to this rule, if the **thumb, forefinger, and middle finger of the left hand** are stretched so that they are mutually perpendicular to each other:

- The **forefinger** represents the direction of the magnetic field.
- The **middle finger** represents the direction of the current.
- The **thumb** represents the direction of the force or motion of the conductor.

**Step 2: Right-Hand Thumb Rule**

The Right-Hand Thumb Rule is used to determine the direction of the **magnetic field** around a straight current-carrying conductor.

According to this rule, if we hold a straight conductor in the **right hand** such that the **thumb points in the direction of current**, then the **curled fingers** represent the direction of the magnetic field around the conductor.

#### Quick Tip

**Fleming's Left-Hand Rule** → Direction of force on conductor

**Right-Hand Thumb Rule** → Direction of magnetic field around current

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## 12. Differentiate between Direct Current (DC) and Alternating Current (AC).

**Correct Answer:** Direct Current flows in one direction only, while Alternating Current changes its direction periodically.

**Solution:**

**Concept:** Electric current is the flow of electric charge through a conductor. Based on the direction of flow, electric current is classified into **Direct Current (DC)** and **Alternating Current (AC)**.

### Step 1: Direct Current (DC)

Direct Current is the type of electric current that flows **only in one direction**. The magnitude of current usually remains constant with time.

**Examples:**

- Electric cells
- Batteries
- Solar cells

### Step 2: Alternating Current (AC)

Alternating Current is the type of electric current that **changes its direction periodically**. Its magnitude also varies with time.

**Examples:**

- Household electricity supply
- Power generated in power stations

### Step 3: Comparison between DC and AC

Feature	Direct Current (DC)	Alternating Current (AC)
Direction of flow	Flows in one direction only	Changes direction periodically
Magnitude	Usually constant	Varies with time
Sources	Cells and batteries	Power stations and generators

#### Quick Tip

**DC** is commonly used in electronic devices, while **AC** is used for household and industrial power supply.

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## 13. Define scattering of light and explain the Tyndall effect with an example.

**Correct Answer:** Scattering of light is the phenomenon in which light is deviated in different directions when it strikes small particles in a medium. The Tyndall effect is the scattering of light by colloidal particles.

**Solution:**

**Concept:** When light travels through a medium containing very small particles, it interacts with these particles and spreads in different directions. This process is known as **scattering of light**. It is responsible for many natural phenomena such as the blue color of the sky.

**Step 1: Scattering of Light**

**Scattering of light** is defined as the phenomenon in which light rays are **deflected or spread in different directions** when they strike small particles present in a medium such as dust, smoke, or tiny water droplets.

**Step 2: Tyndall Effect**

The **Tyndall effect** is the scattering of light by **colloidal particles** present in a medium. Due to this effect, the path of light becomes visible when it passes through such a medium.

**Step 3: Example**

An example of the Tyndall effect is when a beam of sunlight enters a dusty room through a small window. The particles of dust scatter the light and make the **path of the light beam visible**.

#### Quick Tip

The **Tyndall effect** occurs only in **colloidal solutions** where particles are large enough to scatter light but small enough to remain suspended.