# UP Board Class 12 Physics Question Paper 2026 with Solutions Memory Based

| Time Allowed :3 Hours | Maximum Marks :70 | Total Questions :21 |
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**General Instructions**

1. Please read the instructions carefully.
2. This Question Paper consists of 21 questions in two sections : Section-A Section-B.
3. Section-A has Objective type questions, whereas Section-B contains Subjective type questions.
4. Please read the instructions carefully. Out of the given (5 + 16) = 21 questions, a candidate has to answer (5+ 10) = 15 questions in the allotted (maximum) time of 2 hours.
5. Please read the instructions carefully. All questions of a particular section must be attempted in the correct order

**1. How a galvanometer be converted into an ammeter and a voltmeter? Express by the correct circuit.**

**Correct Answer:** By connecting a low resistance shunt in parallel for an ammeter and a high resistance in series for a voltmeter.

**Solution:**
**Step 1: Understanding the Concept:**
A galvanometer is a device used to detect small currents.
Due to its high sensitivity and resistance, it cannot measure large currents or high voltages directly without modification.

**Step 2: Key Formula or Approach:**
1. **Conversion to Ammeter:** Connect a low resistance $S$ (called a shunt) in parallel.
Formula: $S = \left(\frac{I_g}{I-I_g}\right) G$, where $I$ is total current and $I_g$ is full-scale deflection current.
2. **Conversion to Voltmeter:** Connect a high resistance $R$ in series.
Formula: $R = \frac{V}{I_g} - G$, where $V$ is the voltage range.

**Step 3: Detailed Explanation:**
**(a) Conversion into Ammeter:**
To measure current, the device must have low resistance so it doesn't significantly change the circuit's total current.
A low resistance "shunt" ($S$) is connected in parallel with the galvanometer ($G$).
The majority of the current bypasses through the shunt, protecting the sensitive coil.
*Circuit Layout:* Current $I$ splits at a junction; $I_g$ goes through $G$ and $(I - I_g)$ through $S$.

**(b) Conversion into Voltmeter:**
To measure potential difference, the device must have very high resistance so it draws negligible current.
A high resistance ($R$) is connected in series with the galvanometer ($G$).
This limits the current flowing through the galvanometer to $I_g$.
*Circuit Layout:* Terminal $A$, resistor $R$, galvanometer $G$, and terminal $B$ are all in a single series line.

**Step 4: Final Answer:**
Conversion to ammeter requires a **low resistance shunt in parallel**.
Conversion to voltmeter requires a **high resistance in series**.

Quick Tip

Remember the acronyms: **PAL** (Parallel-Ammeter-Low) and **SHV** (Series-High-Voltmeter) to keep the conversion methods straight.

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**2. Explain the construction and working theory of a transformer.**

**Correct Answer:** It works on the principle of mutual induction using a primary coil, secondary coil, and a soft iron core.

**Solution:**
**Step 1: Understanding the Concept:**
A transformer is a static electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.
It is used to increase (step-up) or decrease (step-down) alternating voltage levels.

**Step 2: Key Formula or Approach:**
The fundamental relationship in an ideal transformer is given by the turns ratio:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = K$$

Where $V_s, V_p$ are secondary and primary voltages, and $N_s, N_p$ are the number of turns in coils.

**Step 3: Detailed Explanation:**
**Construction:**
1. **Core:** Made of laminated soft iron sheets to minimize energy losses like eddy currents.
2. **Primary Coil:** Connected to the input alternating current (AC) source.
3. **Secondary Coil:** Connected to the output load where the modified voltage is obtained.
Both coils are insulated from each other and wound around the common iron core.

**Working Theory:**
1. When an alternating voltage is applied to the primary coil, an alternating current flows through it.
2. This produces a continuously changing magnetic flux in the iron core.
3. Since the secondary coil is also wound on the same core, it is linked by this changing magnetic flux.
4. According to Faraday's Law of Electromagnetic Induction, an alternating electromotive force (EMF) is induced in the secondary coil.
5. This process is known as **mutual induction**.

**Step 4: Final Answer:**
A transformer consists of a **laminated iron core** with **primary and secondary coils**, operating on the principle of **mutual induction**.

> Quick Tip
>
> Transformers only work with Alternating Current (AC) because Direct Current (DC) does not create the changing magnetic flux necessary for induction.

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**3. What are electromagnetic waves? By drawing its propagation diagram, show the electric field and magnetic field component in it.**

**Correct Answer:** Waves consisting of oscillating electric and magnetic fields perpendicular to each other and the direction of propagation.

**Solution:**
**Step 1: Understanding the Concept:**
Electromagnetic (EM) waves are synchronized oscillations of electric and magnetic fields that propagate through space.
Unlike mechanical waves, they do not require a medium to travel.

**Step 3: Detailed Explanation:**
**Definition:**
EM waves are transverse waves produced by accelerating charged particles.
The electric field vector ($\vec{E}$) and the magnetic field vector ($\vec{B}$) vibrate in planes perpendicular to each other.
Both are also perpendicular to the direction of wave propagation.

**Propagation Diagram (Descriptive Representation):**
Imagine a 3D coordinate system $(x, y, z)$:
1. Let the wave travel along the **x-axis** (direction of propagation).
2. The electric field component $E_y$ oscillates along the **y-axis** (up and down).

3. The magnetic field component $B_z$ oscillates along the **z-axis** (in and out).
In the diagram, if you draw a sine wave on the vertical plane (xy) for E, the B field would be another sine wave drawn on the horizontal plane (xz).

**Step 4: Final Answer:**
EM waves are **transverse waves** where $\vec{E}$, $\vec{B}$, and the direction of propagation are **mutually perpendicular**.

Quick Tip

The speed of all EM waves in a vacuum is a constant, $c \approx 3 \times 10^8$ m/s, regardless of their frequency or wavelength.

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**4. How is p-n junction diode used as a half-wave rectifier? Explain its working by circuit diagram. Also show input and output waveforms.**

**Correct Answer:** By using its unidirectional current property to block the negative half-cycles of an AC input.

**Solution:**
**Step 1: Understanding the Concept:**
Rectification is the process of converting Alternating Current (AC) into Direct Current (DC). A p-n junction diode acts as a valve, allowing current to flow only in one direction (forward bias).

**Step 3: Detailed Explanation:**
**Circuit Construction:**
A transformer (step-down) is connected to an AC source. The secondary coil is connected in series with a diode and a load resistor ($R_L$).

**Working:**
1. **Positive Half-Cycle:** The terminal connected to the p-region becomes positive, and the n-region becomes negative. The diode is in **Forward Bias**. It conducts current, and a voltage appears across the load resistor.
2. **Negative Half-Cycle:** The polarities reverse. The p-region is negative and the n-region is positive. The diode is in **Reverse Bias**. It acts as an open switch and does not conduct current. No voltage appears across the load.

**Waveforms:**
- **Input:** A continuous sinusoidal sine wave showing both positive and negative peaks.
- **Output:** A series of positive pulses separated by gaps where the negative cycle was blocked.

**Step 4: Final Answer:**
A half-wave rectifier uses **one diode** to permit only the **positive halves** of the AC cycle to

pass to the load.

> 💡 Quick Tip
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> The efficiency of a half-wave rectifier is low (around 40.6%). To utilize both half-cycles, a full-wave rectifier with two or four diodes is used.

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**5. What is wavefront? Explain refraction of waves by the principle of Huygens secondary wavelets.**

**Correct Answer:** A wavefront is the locus of all points in a medium vibrating in the same phase. Refraction is explained by the change in wavelet speed across a boundary.

**Solution:**
**Step 1: Understanding the Concept:**
Huygens' Principle provides a geometrical method to determine the position of a new wavefront at any time.

**Step 3: Detailed Explanation:**
**Wavefront:**
Defined as the surface passing through all points of a wave that have the same phase of vibration at a given instant. For a point source, it's spherical; for a distant source, it's planar.

**Refraction using Huygens' Principle:**
1. Consider a plane wavefront $AB$ incident on a surface separating medium 1 (speed $v_1$) and medium 2 (speed $v_2$).
2. Let the wave take time $t$ to travel from point $B$ to $C$ in the first medium, covering distance $v_1 t$.
3. According to Huygens, point $A$ acts as a secondary source. In the same time $t$, the wavelet from $A$ travels into the second medium a distance $v_2 t$.
4. If the second medium is denser ($v_2 < v_1$), the wavelet from $A$ travels a shorter distance.
5. The new wavefront is the tangent envelope to these secondary wavelets.
6. Geometrically, this construction proves Snell's Law: $\frac{\sin i}{\sin r} = \frac{v_1}{v_2} = \mu$.

**Step 4: Final Answer:**
A **wavefront** is a surface of constant phase. Refraction occurs because **secondary wavelets** travel at **different speeds** in different media, causing the new wavefront to tilt.

Quick Tip

Think of Huygens' wavelets as tiny expanding ripples starting from every point on a wave. The "actual" wave is just the front edge of all those overlapping ripples.

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**6. Establish an expression of relation between resistance of arms of Wheatstone bridge in its equilibrium position with the help of Kirchhoff's law.**

**Correct Answer:** $\frac{P}{Q} = \frac{R}{S}$ (where P, Q, R, and S are the resistances of the four arms)

**Solution:**

**Step 1: Understanding the Concept:**
A Wheatstone bridge is an electrical circuit network consisting of four resistors arranged in a diamond shape, primarily used for measuring an unknown resistance.
The bridge is in its "equilibrium position" or "balanced state" when there is no potential difference between the two nodes where the galvanometer is connected.
In this specific state, the current through the galvanometer is zero ($I_g = 0$).

**Step 2: Key Formula or Approach:**
We derive the balanced condition using **Kirchhoff's Laws**:
1. **Kirchhoff's Current Law (KCL):** The total current entering a junction is equal to the total current leaving it ($\sum I = 0$).
2. **Kirchhoff's Voltage Law (KVL):** The algebraic sum of all potential differences in a closed loop is zero ($\sum V = 0$).

**Step 3: Detailed Explanation:**
Consider a bridge circuit with resistors $P, Q, R$, and $S$ forming the quadrilateral $ABCD$.
- A galvanometer of resistance $G$ is connected between points $B$ and $D$.
- A cell or battery of EMF $E$ is connected across points $A$ and $C$.

Let a current $I$ from the battery reach junction $A$. It divides into $I_1$ flowing through arm $AB$ (resistance $P$) and $I_2$ flowing through arm $AD$ (resistance $R$).
At junction $B$, current $I_1$ splits into $I_g$ through the galvanometer and $I_3$ through arm $BC$ (resistance $Q$). By KCL: $I_1 = I_g + I_3$.
At junction $D$, currents $I_2$ and $I_g$ combine to form current $I_4$ through arm $DC$ (resistance $S$). By KCL: $I_2 + I_g = I_4$.

**For the equilibrium position (Balanced Bridge):**
No current flows through the galvanometer, meaning $I_g = 0$.
This implies:

$$I_1 = I_3 \quad \text{and} \quad I_2 = I_4$$

Now, apply KVL to the two closed loops of the network:

**Loop $ABDA$:** Following a clockwise direction:

$$-I_1P - I_gG + I_2R = 0$$

Since $I_g = 0$:

$$-I_1P + I_2R = 0 \implies I_1P = I_2R \quad \ldots\text{(Equation 1)}$$

**Loop $BCDB$:** Following a clockwise direction:

$$-I_3Q + I_4S + I_gG = 0$$

Substituting the balance conditions $I_g = 0$, $I_3 = I_1$, and $I_4 = I_2$:

$$-I_1Q + I_2S = 0 \implies I_1Q = I_2S \quad \ldots\text{(Equation 2)}$$

Dividing Equation 1 by Equation 2:

$$\frac{I_1P}{I_1Q} = \frac{I_2R}{I_2S}$$

The current terms cancel out, leaving the final balanced expression:

$$\frac{P}{Q} = \frac{R}{S}$$

**Step 4: Final Answer:**
The expression relating the resistances in the equilibrium position of a Wheatstone bridge is:

$$\frac{P}{Q} = \frac{R}{S}$$

> Quick Tip
>
> To solve bridge problems quickly, remember that if the bridge is balanced, you can effectively "remove" the middle arm (the galvanometer) from the circuit diagram because no current flows through it. This simplifies the circuit into two parallel branches of series resistors.

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**9. A force of 80 Newton acts between two point charges placed at a certain distance in air. When these same charges are placed in a dielectric medium at the same distance, the force becomes 8 Newton. The dielectric constant of the medium will be:**

(A) 10
(B) zero
(C) 0.1
(D) 8

**Correct Answer:** (A) 10

**Solution:**

**Step 1: Understanding the Concept:**
According to Coulomb's Law, the electrostatic force between two point charges is inversely proportional to the absolute permittivity of the medium. When the medium changes from air (or vacuum) to a dielectric medium, the force decreases due to the presence of the dielectric constant ($K$).

**Step 2: Key Formula or Approach:**
The relationship between the force in air ($F_{\text{air}}$), the force in a dielectric medium ($F_{\text{medium}}$), and the dielectric constant ($K$) is:

$$F_{\text{medium}} = \frac{F_{\text{air}}}{K} \quad \text{or} \quad K = \frac{F_{\text{air}}}{F_{\text{medium}}}$$

**Step 3: Detailed Explanation:**
From the problem description, we have the following data:
- Force between charges in air, $F_{\text{air}} = 80$ N
- Force between the same charges in the dielectric medium, $F_{\text{medium}} = 8$ N

Using the formula for the dielectric constant:

$$K = \frac{80 \text{ N}}{8 \text{ N}}$$

$$K = 10$$

This result indicates that the permittivity of the medium is 10 times the permittivity of free space.

**Step 4: Final Answer:**
The dielectric constant of the medium is **10**.

> Quick Tip
>
> Dielectric constant ($K$) is always a dimensionless quantity greater than or equal to 1. If your calculation yields a value less than 1, check if you have inverted the ratio of the forces.

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**8. In a parallel resonant (L-C) circuit, at the condition of resonance, the current flowing from the source is:**

(A) infinite
(B) zero
(C) definite
(D) none of these

**Correct Answer:** (B) zero

**Solution:**

**Step 1: Understanding the Concept:**
A parallel resonant circuit (often called a "tank circuit") consists of an inductor ($L$) and a capacitor ($C$) connected in parallel. At resonance, the inductive reactance ($X_L$) and the capacitive reactance ($X_C$) become equal in magnitude.

**Step 2: Key Formula or Approach:**
The total impedance ($Z$) of an ideal parallel L-C circuit is given by:

$$\frac{1}{Z} = \left| \frac{1}{X_L} - \frac{1}{X_C} \right| = \left| \frac{1}{\omega L} - \omega C \right|$$

**Step 3: Detailed Explanation:**
At the condition of resonance:

$$X_L = X_C \implies \omega L = \frac{1}{\omega C}$$

Substituting this into the impedance equation:

$$\frac{1}{Z} = |\omega C - \omega C| = 0$$

This implies that the impedance $Z$ becomes infinite ($\infty$).
Using Ohm's law for AC circuits, $I = \frac{V}{Z}$, where $V$ is the source voltage.
As $Z \to \infty$, the source current $I$ becomes:

$$I = \frac{V}{\infty} = 0$$

Physically, this means that the energy circulates back and forth between the inductor and capacitor, drawing no current from the external power source in the ideal case.

**Step 4: Final Answer:**
In an ideal parallel resonant circuit, the current drawn from the source is **zero**.

Quick Tip

Remember that a parallel resonant circuit is known as a **rejector circuit** because it provides maximum impedance (rejects current) at the resonant frequency. Conversely, a series resonant circuit is an **acceptor circuit** because it provides minimum impedance (accepts maximum current) at resonance.

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**9. In which part of the electromagnetic spectrum is the Lyman series of hydrogen found?**

(i) Infrared
(ii) Visible
(iii) X-rays
(iv) Ultraviolet

**Correct Answer:** (iv) Ultraviolet

**Solution:**
**Step 1: Understanding the Concept:**
The hydrogen emission spectrum consists of various groups of spectral lines. Each series is characterized by electronic transitions from various higher energy levels to a specific fixed lower energy level.

**Step 2: Key Formula or Approach:**
The wavelength ($\lambda$) of the emitted radiation is determined by the Rydberg formula:

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

For the Lyman series, the final energy level is always the ground state ($n_1 = 1$), while $n_2 = 2, 3, 4, \ldots$.

**Step 3: Detailed Explanation:**
Electronic transitions in the Lyman series involve an electron falling from higher shells ($n > 1$) back to the innermost shell ($n = 1$).
Because the energy gap between $n = 1$ and other shells is very large, these transitions release high-energy photons.
Based on the Planck-Einstein relation ($E = \frac{hc}{\lambda}$), higher energy results in shorter wavelengths.
The calculated wavelengths for the Lyman series range from approximately 91 nm to 122 nm.
In the electromagnetic spectrum, this specific range of wavelengths corresponds precisely to the Ultraviolet (UV) region.

**Step 4: Final Answer:**
The Lyman series is found in the **Ultraviolet** part of the spectrum.

Quick Tip

To remember the spectral series quickly:
1. Lyman $\rightarrow$ Ultraviolet (Highest energy)
2. Balmer $\rightarrow$ Visible (Intermediate energy)
3. Paschen, Brackett, Pfund $\rightarrow$ Infrared (Lowest energy)

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**10. On immersing a convex lens in water, its focal length and nature will be:**

(i) will increase, convex lens
(ii) will decrease, convex lens
(iii) will increase, concave lens
(iv) will decrease, concave lens

**Correct Answer:** (i) will increase, convex lens

**Solution:**
**Step 1: Understanding the Concept:**
The focal length of a lens is determined by the refractive index of the lens material relative to the surrounding medium. Changing the medium from air to water alters the lens's ability to bend light.

**Step 2: Key Formula or Approach:**
According to the Lens Maker's Formula:

$$\frac{1}{f} = \left(\frac{\mu_{lens}}{\mu_{medium}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

where $\mu_{lens}$ is the refractive index of glass and $\mu_{medium}$ is the refractive index of the surrounding environment.

**Step 3: Detailed Explanation:**
1. **Focal Length Change:** When a glass lens is moved from air ($\mu \approx 1$) into water ($\mu \approx 1.33$), the ratio $\frac{\mu_{lens}}{\mu_{medium}}$ decreases. Consequently, the term $\left(\frac{\mu_{lens}}{\mu_{medium}} - 1\right)$ becomes significantly smaller. Since the power of the lens ($P = \frac{1}{f}$) is directly proportional to this term, the power decreases. A decrease in power leads to an **increase in the focal length**.
2. **Nature of the Lens:** The converging or diverging nature of a lens only reverses if it is placed in a medium that is more optically dense than the lens material itself. Since glass is still denser than water ($\mu_{glass} > \mu_{water}$), the focal length remains positive, and it **remains a convex (converging) lens**.

**Step 4: Final Answer:**
The focal length **will increase** and it will remain a **convex lens**.

Quick Tip

A general rule of thumb: When a lens is immersed in any liquid with a refractive index less than the lens material, its focal length always increases but its nature stays the same.

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**11. The energy gap between the valence band and conduction band in a semiconductor is approximately:**

(i) 5 eV
(ii) 1 eV
(iii) 15 eV
(iv) Zero

**Correct Answer:** (ii) 1 eV

**Solution:**
**Step 1: Understanding the Concept:**
In solid-state physics, materials are classified by the "forbidden" energy gap ($E_g$) between the valence band (lower, filled with electrons) and the conduction band (higher, empty at absolute zero).

**Step 2: Key Formula or Approach:**
The magnitude of the bandgap ($E_g$) defines the electrical properties:
- **Conductors:** $E_g \approx 0$ eV (bands overlap).
- **Semiconductors:** $E_g \approx 1$ eV (small gap).
- **Insulators:** $E_g > 3$ eV to 5 eV (large gap).

**Step 3: Detailed Explanation:**
Semiconductors have a narrow energy gap. This small gap allows electrons to be thermally excited from the valence band into the conduction band at room temperature, facilitating controlled conduction.
Typical semiconductor materials have the following gaps at room temperature:
- Silicon (Si) $\approx 1.1$ eV
- Germanium (Ge) $\approx 0.7$ eV
These values are best approximated by the option **1 eV**. Options like 5 eV and 15 eV characterize insulators where the gap is too wide for standard electronic excitation.

**Step 4: Final Answer:**
The approximate energy gap for a typical semiconductor is **1 eV**.

💡 Quick Tip

Remember the 1 eV threshold. If the gap is around this value, the material is a semiconductor. If it's much larger, it's an insulator; if there is no gap, it's a conductor.

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**13. Force of 80 newton works between two point charges placed in air at a fixed distance between them. When these charges are placed at the same distance in a dielectric medium, the value becomes 8 newton. The dielectric constant of the medium will be**

(A) 10
(B) zero
(C) 0.1
(D) 8

**Correct Answer:** (A) 10

**Solution:**

**Step 1: Understanding the Concept:**
According to Coulomb's Law, the electrostatic force between two point charges depends on the permittivity of the medium in which they are placed.
When a dielectric material (insulator) is placed between the charges, it partially cancels the electric field between them, thereby reducing the net force.

**Step 2: Key Formula or Approach:**
The ratio of the force between two point charges in vacuum (or air) to the force between the same charges in a medium is defined as the dielectric constant ($K$) or relative permittivity ($\epsilon_r$) of that medium.

$$K = \frac{F_{\text{air}}}{F_{\text{medium}}}$$

**Step 3: Detailed Explanation:**
Given in the problem:
- Force in air ($F_{\text{air}}$) = 80 N
- Force in the dielectric medium ($F_{\text{medium}}$) = 8 N

Substituting these values into the formula for the dielectric constant:

$$K = \frac{80 \text{ N}}{8 \text{ N}}$$

$$K = 10$$

Since Newton (N) cancels out, the dielectric constant is a dimensionless quantity.

**Step 4: Final Answer:**
The dielectric constant of the medium is **10**.

Quick Tip

The dielectric constant ($K$) for any insulating medium is always greater than 1. If you ever calculate a value less than 1 for $K$, you have likely accidentally divided the smaller force by the larger one.

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