Challenger

SAMPLE CONTENT

NEET-UG & JEE (Main)

PHYSICS Vol - II

As per latest syllabus issued by NMC

2000+ MCQs with Hints

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Salient Features

- Concise theory for every topic
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- Exhaustive coverage of questions including selective questions from previous years' NEET (UG) and JEE (Main) examinations updated upto year 2024:
  - **2000+** MCQs
  - **90+** Numerical Value type (NVT)
  - Solutions to the questions are provided for better understanding
- Inclusion of '**Problems To Ponder**' to engage students in scientific enquiry.
- Includes **Smart Keys:** Multiple study techniques to enhance understanding and problem solving:
  - ***Time Saver*** - ***Smart tip*** - ***Caution***
  - ***Learning Pointers*** - ***Think out of the box*** - ***Mind Over Matter***
- Includes Question Paper and Answer Keys (Solution through Q.R. code) of:
  - JEE (Main) 2024 31st Jan (Shift - I)
  - NEET (UG) 2024
- Q.R. codes provide:
  - Video links for boosting conceptual retention
  - Solutions of JEE (Main) 2024 31st Jan (Shift - I) and NEET (UG) 2024 question paper

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PREFACE

'Challenger Physics Vol - II' is a compact guidebook, extremely handy for preparation of various competitive exams like NEET, JEE (Main). This edition provides an unmatched comprehensive amalgamation of theory with MCQs. The chapters are aligned with the latest syllabus for **NEET (UG) and JEE (Main) 2024** examinations. Although the alignment runs parallel to NCERT curriculum, the structure of the chapters prioritizes knowledge building of the students. The book provides the students with scientifically accurate context, several study techniques and skills required to excel in these examinations.

In this book the Theoretical Concepts are presented in the form of pointers, tables, charts and diagrams that form a vital part of preparation of any competitive examination.

Multiple Choice Questions have been specially created and compiled with the following objective in mind – to help students solve complex problems which require strenuous effort and understanding of multiple-concepts. The assortment of MCQs is a beautiful blend of questions based on higher order thinking, theory, and multiple concepts.

MCQs in each chapter are segregated into following sections.

- **Concept Building Problems** section is designed to boost prerequisite understanding of concepts.
- **Practice Problems** section contains questions crafted for thorough revision .
- **Numerical Value Type** section caters to newly added NVT questions in JEE (Main).
- **Problems to Ponder** section offers questions of diverse pattern created to instil the attitude of concentrating on the problems and to understand the application of various concepts in Physics.

All the features of this book pave the path of a student to excel in examination. The features are designed keeping the following elements in mind: Time management, easy memorization or revision and non-conventional yet simple methods for MCQ solving.

To keep students updated, the book covers selective solved questions of **JEE (Main) 2024 27th Jan (Shift - I)**. Question Papers along with Answers and Solutions (through Q.R. code) of **JEE (Main) 2024 31st Jan (Shift -I) and NEET (UG) 2024** have been provided to offer students glimpse of the complexity of questions asked in entrance examinations. These papers have been split unit-wise to let the students know which of the units were more relevant as per latest Question papers.

We hope the book benefits the learner as we have envisioned.

A book affects eternity; one can never tell where its influence stops.

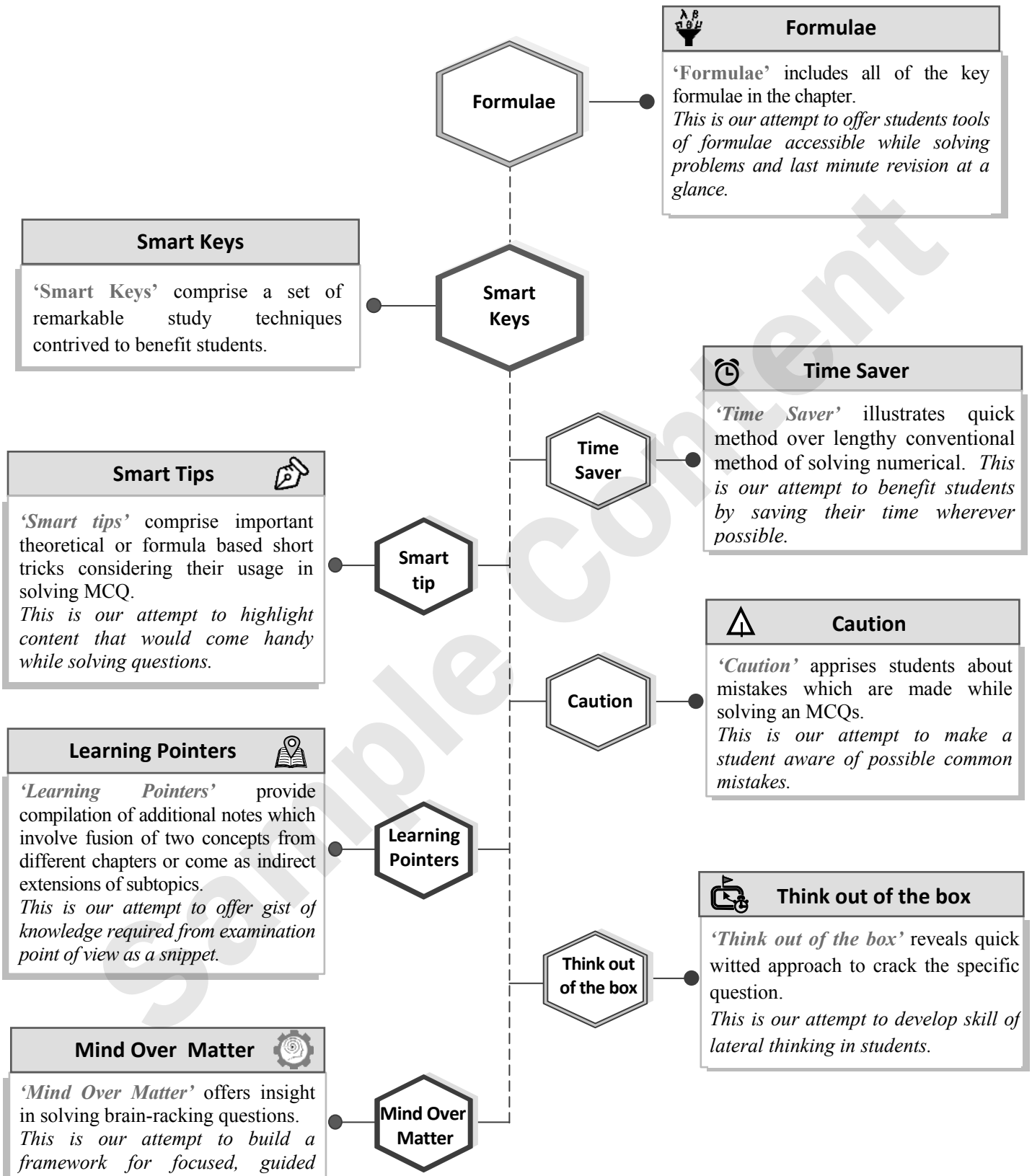
Publisher

Edition: Sixth

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

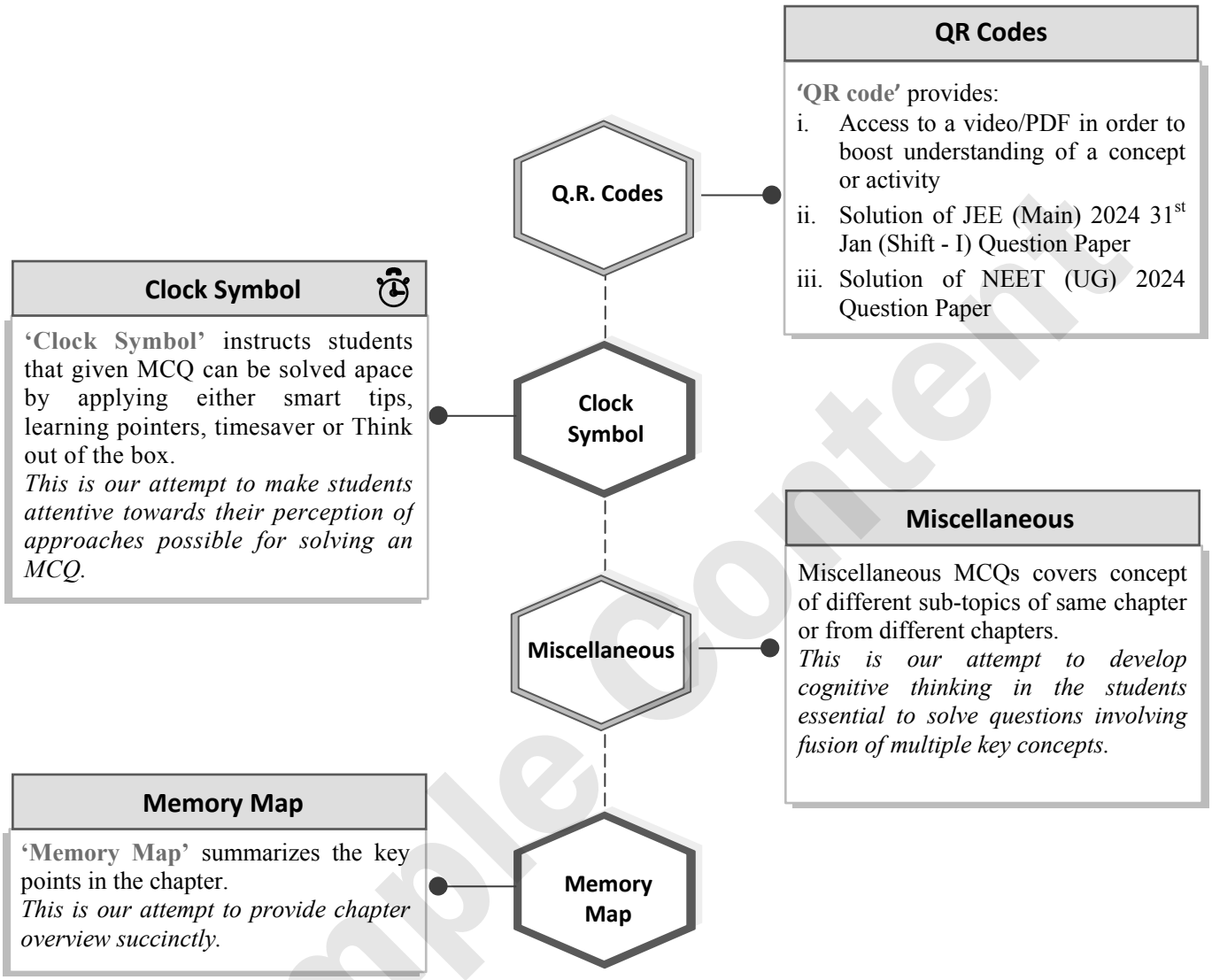
Please write to us on: mail@targetpublications.org

KEY FEATURES



To be continued…

KEY FEATURES



QR Codes

'QR code' provides:

i. Access to a video/PDF in order to boost understanding of a concept or activity

ii. Solution of JEE (Main) 2024 31st Jan (Shift - I) Question Paper

iii. Solution of NEET (UG) 2024 Question Paper

Clock Symbol

'Clock Symbol' instructs students that given MCQ can be solved apace by applying either smart tips, learning pointers, timesaver or Think out of the box.

This is our attempt to make students attentive towards their perception of approaches possible for solving an MCQ.

Miscellaneous

Miscellaneous MCQs covers concept of different sub-topics of same chapter or from different chapters.

This is our attempt to develop cognitive thinking in the students essential to solve questions involving fusion of multiple key concepts.

Memory Map

'Memory Map' summarizes the key points in the chapter.

This is our attempt to provide chapter overview succinctly.

Frequently Asked Questions

- **Why Challenger Series?**

  Gradually, every year the nature of competitive entrance exams is inching towards conceptual understanding of topics. Moreover, it is time to bid adieu to the stereotypical approach of solving a problem using a single conventional method.

  To be able to successfully crack the NEET examination, it is imperative to develop skills such as data interpretation, appropriate time management, knowing various methods to solve a problem, etc. With Challenger Series, we are sure, you'd develop all the aforementioned skills and take a more holistic approach towards problem solving. The way you'd tackle advanced level MCQs with the help of solutions, Smart tips, Time Savers and Think out of the box section would give you the necessary practice that would be a game changer in your preparation for the competitive entrance examinations.

- **What is the intention behind the launch of Challenger Series?**

  The sole objective behind the introduction of Challenger Series is to severely test the student's preparedness to take competitive entrance examinations. With an eclectic range of critical and advanced level MCQs, we intend to test a student's MCQ solving skills within a stipulated time period.

- **What do I gain out of Challenger Series?**

  After using Challenger Series, students would be able to:

  a. assimilate the given data and apply relevant concepts with utmost ease.
  b. tackle MCQs of different pattern such as match the columns, diagram based questions, Statement based questions, multiple concepts and assertion-reason efficiently.
  c. garner the much needed confidence to appear for competitive exams.
  d. easy and time saving methods to tackle tricky questions will help ensure that time consuming questions do not occupy more time than you can allot per question.

- ***Can the Questions presented in Problems to Ponder section be a part of the NEET Examination?***

  No, the questions would not appear as it is in the NEET Examination. However, there are fair chances that these questions could be covered in parts or with a novel question construction.

Best of luck to all the aspirants!

CONTENTS

1 Electrostatics: Electric Charges, Fields and Potential

- Electric charges and their conservation, Conductors and insulators, Free and bound charges inside a conductor
- Coulomb's law–force between two point charges
- Superposition principle, Forces between multiple charges
- Continuous distribution of charges
- Electric field, Electric field lines, Electric field due to a point charge
- Electric dipole and electric field due to a dipole
- Torque on a dipole in uniform electric field, Work of an electric dipole
- Electric potential and Potential difference
- Electric potential due to a point charge, a dipole and a system of charges
- Equipotential surface
- Electric potential energy of a system of two point charges and of Electric dipoles in electrostatic field
- Electric Flux
- Gauss' theorem and its applications
- Energy density of charged conductor

Electric charges and their conservation, Conductors and insulators, Free and bound charges inside a conductor

➢ **Electrostatics:**

The study of electricity or electric charges at rest is known as electrostatics.

➢ **Charge:**

The property of particles like protons and electrons which produces electrical influence is called as charge.

Formula: q = It **where**, q is charge, I is current, t is time.
Unit: coulomb (SI), stat coulomb or electrostatic unit (e.s.u.) (CGS) **Dimensions:** $[M^0 L^0 T^1 A^1]$
Conversion factor: 1 C = 3×10^9 stat coulomb **Type:** Scalar

i. There are two types of charges: positive and negative.
ii. The electric charge is additive and quantised in nature and is invariant. For an isolated system, the net charge always remains constant. It can neither be created nor be destroyed in any isolated system. i.e., charge is always conserved in isolated system.
iii. Accelerated charge radiates energy.
iv. Charge cannot exist without mass.

➢ **Point charge:** *An electric charge which can be considered to exist at a single point is known as point charge.* A point charge is much smaller in dimensions.

➢ **Test charge:** It is generally a unit positive charge used to test the strength of the electric fields. Test charge is imagined to be of very small value so that it does not alter the charge configurations causing fields it is measuring.

Smart tip - 1

When two identical conductors having charges q_1 and q_2 are kept in contact and separated later then each has charge of $\left(\frac{q_1 + q_2}{2}\right)$. If charges are q_1 and $-q_2$, then, each has charge $\left(\frac{q_1 - q_2}{2}\right)$.

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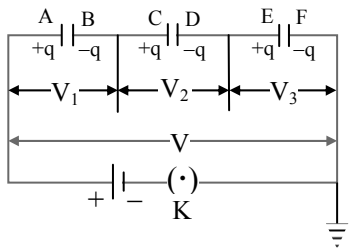
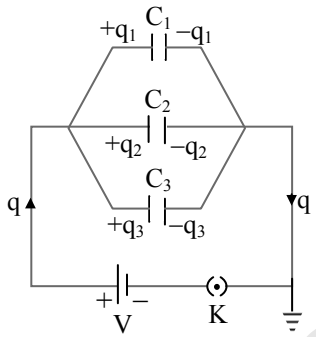
To see complete chapter buy **Target Notes** or **Target E-Notes**

COMBINATION OF CAPACITORS

	Capacitors in series	Capacitors in parallel
Diagram		
Explanation	i. Potential across capacitors is V_1, V_2 and V_3. ii. Total potential across the capacitors is V, $V = V_1 + V_2 + V_3$ iii. $V_1 = \frac{q}{C_1}$, $V_2 = \frac{q}{C_2}$, $V_3 = \frac{q}{C_3}$, $V = \frac{q}{C_S}$ where, C_S is equivalent capacitance in series. $\frac{q}{C_S} = \frac{q}{C_1} + \frac{q}{C_2} + \frac{q}{C_3}$	i. Potential across each capacitor is V. ii. Charges on each plates of capacitors are q_1, q_2, q_3. iii. Total charge $q = q_1 + q_2 + q_3$ $q_1 = C_1V$, $q_2 = C_2V$, $q_3 = C_3V$ and $q = C_pV$ where, C_P is equivalent capacitor in parallel. $C_pV = C_1V + C_2V + C_3V$
Formula	$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$	$C_P = C_1 + C_2 + C_3$

Time saver - 1

When the difference in the effective capacity of two identical capacitors when joined in series and then in parallel is given as C′, then capacity of each capacitor say C is given by, $C = \frac{2C'}{3}$

Example:

The difference in the effective capacity of two similar capacitors when joined in series and then in parallel is 6 μF. The capacity of each capacitor is

(A) 2 μF (B) 4 μF (C) 8 μF (D) 16 μF

Conventional Method:

$C_P = C_1 + C_2$

$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{C_1 + C_2}{C_1C_2}$

$\therefore \quad C_S = \frac{C_1C_2}{C_1 + C_2}$

According to given condition

$C_P - C_S = 6\ \mu F$

$C_1 + C_2 - \frac{C_1C_2}{C_1 + C_2} = 6$

As $C_1 = C_2 = C$

$2C - \frac{C^2}{2C} = 6$

$4C^2 - C^2 = 12C$

$3C^2 = 12C$

$C = 4\ \mu F$

Ans: (B)

Quick method:

Capacity of each capacitor,

$C = \frac{2C'}{3} = \frac{2 \times 6}{3} = 4\ \mu F$

Ans: (B)

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To see complete chapter buy **Target Notes** or **Target E-Notes**

MEMORY MAP

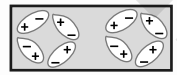
Scan the adjacent QR code in *Quill - The Padhai App* for chapter revision and relevant additional information

ELECTROSTATICS: CAPACITANCE

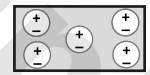
Dielectrics

1. **Dielectrics:** Dielectrics are (non-conducting) material that transmit electric effect without conducting.

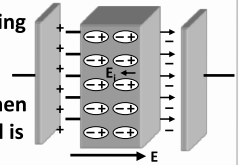
2. **Polar dielectrics :** It has permanent electric dipole moment even if the electric field is absent.



3. **Non polar dielectrics:** Every molecule has zero dipole moment in its normal state.



4. **Electric polarisation:** The process of inducing equal and opposite charges, in the two faces of dielectric when external electric field is applied. $E' = E - E_i$



5. **Dielectric constant:** It is the strength of the applied electric field to the strength of the reduced value of the electric field on placing dielectric between the plates of the capacitor.

i. $\frac{E}{E'} = K$ ii. $K > 1$

6. **Polarisation:** It involves a relative displacement of charges in the dielectric.

i. $P = \frac{q_i x}{Ax} = \frac{q_i}{A} = \sigma_i$

ii. $P = \chi \varepsilon_0 E$

Capacitors and Capacitance

1. **Capacitance:** The ability of a conductor to store charge.

$C = \frac{q}{V}$

SI system ⇒ farad

CGS system ⇒ statfarad

1 farad = 9×10^{11} statfarad

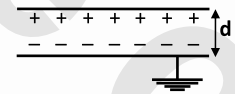
2. i. **Capacitors:** Capacitor is a device which increases charge storing capacity of a conductor at a relatively low potential.

ii. **Principle of a capacitor:** The capacity of a charged conductor increases if another conductor connected to earth is kept near it.

3. **Types of capacitor**

i. **Parallel plate capacitor:**

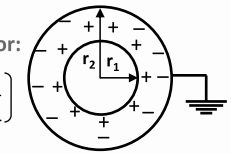
a. $C = \frac{K \varepsilon_0 A}{d}$



b. $C_m = K C_{air}$

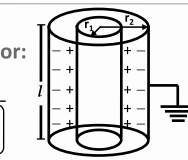
ii. **Spherical capacitor:**

$C = 4\pi K \varepsilon_0 \left(\frac{r_1 r_2}{r_2 - r_1} \right)$



iii. **Cylindrical capacitor:**

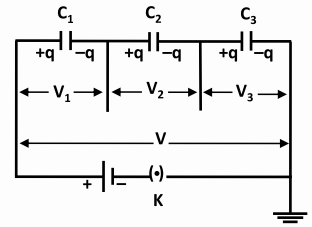
$C = \frac{2\pi K \varepsilon_0 l}{2.303 \log \left(\frac{r_2}{r_1} \right)}$



Combination of capacitors

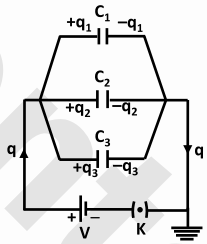
1. **Capacitors in series:**

$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$



2. **Capacitors in parallel:**

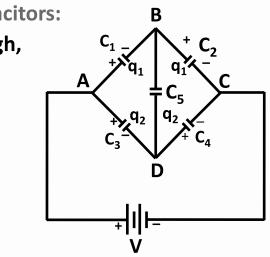
$C_P = C_1 + C_2 + C_3$



3. **Wheatstone's bridge of capacitors:**

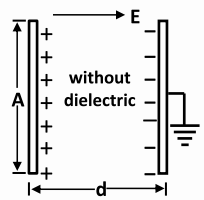
When charge flowing through, $C_5 = 0$, then

$\frac{C_1}{C_2} = \frac{C_3}{C_4}$



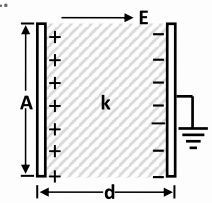
Capacitance of parallel plate capacitor

1.



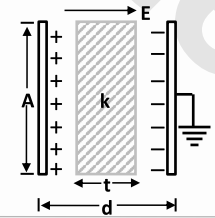
$C = \frac{\varepsilon_0 A}{d}$

2.



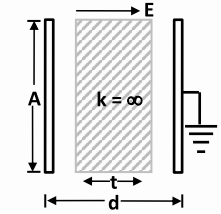
$C = \frac{\varepsilon_0 K A}{d}$

3.



$C = \frac{\varepsilon_0 K A}{d - t + \frac{t}{K}}$

4.



$C = \frac{\varepsilon_0 A}{(d - t)}$

Energy stored in capacitor

1. **Energy:** $U = \frac{1}{2} \frac{q^2}{C} = \frac{1}{2} qV = \frac{1}{2} CV^2$

2. **Energy loss in form of heat:** $\Delta U = U - U' = \frac{C_1 C_2 (V_1 - V_2)^2}{2 (C_1 + C_2)}$

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To see complete chapter buy **Target Notes** or **Target E-Notes**

Smart tip - 5

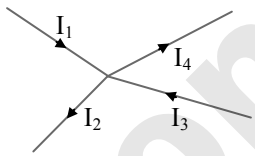
Sr.no	Cases	Condition	Maximum power
i.	For n identical cells in series	R = nr	$P_{max} = n\left(\frac{E^2}{4r}\right)$
ii.	For n identical parallel cells	R = r/n	$P_{max} = n\left(\frac{E^2}{4r}\right)$
iii.	For mixed combination of cells (m = number of rows, n = number of cells in a row)	$R = \frac{nr}{m}$	$P_{max} = (mn)\frac{E^2}{4r}$

KIRCHHOFF'S LAW AND ITS APPLICATIONS

➢ **Kirchhoff's first law or Kirchhoff's current law (KCL):**

The sum of currents flowing towards the junction is equal to sum of currents leaving the junction.

$$\sum I = 0$$
$$I_1 + I_3 = I_2 + I_4$$



i. This law represents conservation of energy.
ii. Sign convention:
   a. The current flowing (through a conductor) towards the junction is taken as positive.
   b. The current flowing away from the junction is taken as negative.

➢ **Kirchhoff's second law or Kirchhoff's voltage law (KVL):**

In any closed part (loop) of an electrical circuit, the algebraic sum of e.m.f.s is equal to the algebraic sum of product of the resistances and currents flowing through them.

$$\Sigma E = \Sigma IR$$

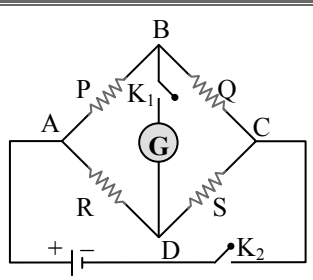
i. This law represents conservation of energy.
ii. Sign convention:
   a. The current flowing in anticlockwise direction is taken as positive and that in clockwise direction is taken as negative.
   b. The e.m.f sending current in the circuit in anticlockwise direction is taken as positive and the one sending current in the circuit in clockwise direction is taken as negative.

Students can scan the adjacent QR code in *Quill - The Padhai App* to get information about **Kirchhoff's voltage law (KVL)** with the aid of a linked video

WHEATSTONE BRIDGE

➢ **Wheatstone bridge:**

i. Wheatstone bridge is the accurate arrangement of four resistances, used to measure one (unknown) of them in terms of the rest of them.
ii. The Wheatstone bridge is balanced when in closed circuit, the deflection in galvanometer is zero i.e., no current flows through the galvanometer.
iii. The condition for a balanced bridge is, $\frac{P}{Q} = \frac{R}{S}$



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To see complete chapter buy **Target Notes** or **Target E-Notes**

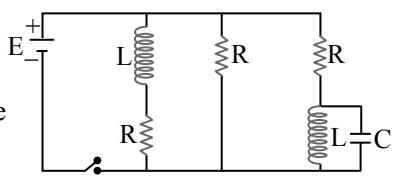
8. A galvanometer of resistance 200 Ω reads a current of 2 mA. To read a current of 40 mA across the circuit galvanometer is shunt by a resistance of S Ω. If shunt alone is connected to an ac source of 6 V, then the maximum current flowing through shunt will be,

(A) 0.5 A (B) 0.8 A
(C) 1.2 A (D) 1 A

9. Figure shows a circuit that contains three identical resistors with resistance R = 9.0 Ω each, two identical inductors with inductance L = 2.0 mH each, and an ideal battery with emf E = 18 V. The current 'i' through the battery just after the switch closed is _____

[NEET (UG) 2017]

(A) 0.2 A
(B) 2 A
(C) 0 ampere
(D) 2 mA



10. An 1 μF capacitor C is connected to a battery of 10 V through a resistance 1 MΩ. The voltage across C after 1 sec is approximately

(A) 5.6V (B) 7.8V
(C) 6.3 V (D) 10V

Mind over Matter

The key to crack this question lies in comprehending that, during charging of a capacitor, the voltage across it varies exponentially with time.

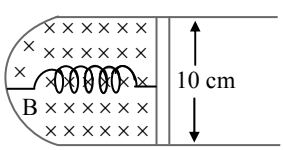
11. When the frequency of the AC voltage applied to a series LCR circuit is gradually increased from a low value, the impedance of the circuit

(A) monotonically increases
(B) first increases and then decreases
(C) first decreases and then increases
(D) monotonically decreases

12. A thin strip 10 cm long is on a U shaped wire of negligible resistance and it is connected to a spring of spring constant 0.5 Nm^{-1} (see figure). The assembly is kept in a uniform magnetic field of 0.1 T. If the strip is pulled from its equilibrium position and released, the number of oscillations it performs before its amplitude decreases by a factor of e is N. If the mass of the strip is 50 grams, its resistance 10 Ω and air drag negligible, N will be close to:

[JEE (Main) April 2019]

(A) 1000
(B) 50000
(C) 5000
(D) 10000



13. A long solenoid of radius R carries a time (t) – dependent current $I(t) = I_0t(1 - t)$. A ring of radius 2R is placed coaxially near its middle. During the time interval $0 \le t \le 1$, the induced current (I_R) and the induced EMF (V_R) in the ring change as: **[JEE (Main) Jan 2020]**

(A) Direction of I_R remains unchanged and V_R is zero at t = 0.25
(B) At t = 0.5 direction of I_R reverses and V_R is zero
(C) At t = 0.25 direction of I_R reverses and V_R is maximum.
(D) Direction of I_R remains unchanged and V_R is maximum at t = 0.5

14. A LCR circuit behaves like a damped harmonic oscillator. Comparing it with a physical spring-mass damped oscillator having damping constant 'b', the correct equivalence would be:

[JEE (Main) Jan 2020]

(A) $L \leftrightarrow k, C \leftrightarrow b, R \leftrightarrow m$
(B) $L \leftrightarrow m, C \leftrightarrow k, R \leftrightarrow b$
(C) $L \leftrightarrow m, C \leftrightarrow \frac{1}{k}, R \leftrightarrow b$
(D) $L \leftrightarrow \frac{1}{b}, C \leftrightarrow \frac{1}{m}, R \leftrightarrow \frac{1}{k}$

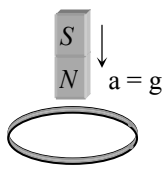
15. An ideal solenoid has 1000 turns per metre and 8 cm radius. The current in it varies at a uniform rate of 0.02 As^{-1}. A circular coil of radius 2 cm is placed inside the solenoid such that its axis coincides with that of the solenoid. Find the induced electric field at a point on the circumference of the coil and that at a point outside the solenoid at a distance of 12.8 cm from its axis.

(A) $8\pi \times 10^{-8}$ V m^{-1} and $2\pi \times 10^{-7}$ V m^{-1}
(B) $7\pi \times 10^{-7}$ V m^{-1} and $5\pi \times 10^{-7}$ V m^{-1}
(C) $6\pi \times 10^{-7}$ V m^{-1} and $2\pi \times 10^{-7}$ V m^{-1}
(D) $8\pi \times 10^{-8}$ V m^{-1} and $28\pi \times 10^{-7}$ V m^{-1}

Practice Problems

FARADAY'S LAWS OF ELECTROMAGNETIC INDUCTION

1. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet while it is passing through the ring is



(A) equal to that due to gravity
(B) less than that due to gravity
(C) more than that due to gravity
(D) depends on the diameter of the ring and the length of the magnet

vi. A_1R and B_1R_1 are refracted rays.

vii. Let c_1 and c_2 be the velocities of light in air and glass respectively.

viii. At any instant of time 't' distance covered by incident wavefront from P to $B_1 = PB_1 = c_1t$
Distance covered by secondary wave from A_1 to $R = A_1R = c_2t$.

ix. From figure, $\angle AA_1M + \angle MA_1P = 90°$ ....(1)
and $\angle MA_1P + \angle PA_1B_1 = 90°$ ....(2)
From equations (1) and (2), we have, $\angle AA_1M = \angle PA_1B_1 = i$

x. Similarly, $\angle NA_1R = \angle N_1B_1R_1 = r$
We have, $\angle N_1B_1R_1 + \angle N_1B_1R = 90°$ ....(3)
and $\angle N_1B_1R + \angle A_1B_1R = 90°$ ....(4)
From equations (3) and (4), $\angle N_1B_1R_1 = \angle A_1B_1R = r$

xi. In ΔA_1PB_1, $\sin i = \frac{PB_1}{A_1B_1} = \frac{c_1t}{A_1B_1}$ ....(5)

xii. In ΔA_1RB_1, $\sin r = \frac{A_1R}{A_1B_1} = \frac{c_2t}{A_1B_1}$ ....(6)

xiii. Dividing equation (5) by (6), $\frac{\sin i}{\sin r} = \frac{c_1t / A_1B_1}{c_2t / A_1B_1} = \frac{c_1t}{c_2t}$

$\therefore \quad \frac{\sin i}{\sin r} = \frac{c_1}{c_2}$ ....(7)

Also, $\frac{c_1}{c_2} = \frac{\mu_2}{\mu_1} = {}_1\mu_2$ ....(8)

Where, ${}_1\mu_2$ = R.I. of glass w.r.t air.

xiv. From the explanation, it is clear that incident rays AA_1, BB_1, refracted rays A_1R, B_1R_1 and normal MN and M_1N_1 lie on the same plane XY.

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

Hence, laws of refraction are proved.

DOPPLER EFFECT IN LIGHT

Whenever there is a relative motion between source of light and observer, observer receives apparent frequency of light which is different than true frequency of light emitted from the source. This phenomenon is termed as Doppler effect in light.

i. The apparent frequency of light as perceived by an observer is given by,

$$\nu = \nu_0 \sqrt{\frac{c \pm v}{c \mp v}}$$

Where,
ν_0 = actual frequency of light,
ν = frequency measured by the observer,
v = velocity of source along the line joining the source and the observer,
c = speed of light in vacuum.

$\therefore$ Apparent wavelength $\lambda = \lambda_0 \sqrt{\frac{c \mp v}{c \pm v}}$

ii. If $v << c$, then

$$\frac{\Delta\nu}{\nu_0} = \pm\frac{v}{c}$$

$\Delta\nu = \nu - \nu_0$

i.e., $\frac{\Delta\lambda}{\lambda} = \mp\frac{v}{c}$

$\therefore \quad \frac{\Delta\nu}{\nu_0} = -\frac{\Delta\lambda}{\lambda_0}$

CAUTION

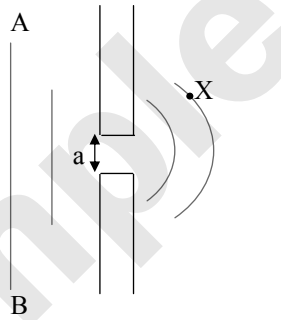
The formulae discussed in point (ii) are valid only when speed of source is very small as compared to speed of light. If speeds approach value close to c, relativistic formulae mentioned in point (i) should be used.

2. Which of the following phenomena distinguishes between diffraction and interference?
   (A) In diffraction, all maxima are of decreasing intensity whereas in interference all the maxima are of equal intensity.
   (B) In diffraction, all maxima are of equal intensity whereas in interference all the maxima are of decreasing intensity.
   (C) In diffraction, all the maxima are of decreasing intensity whereas in interference all the maxima are of increasing intensity.
   (D) In diffraction, all the maxima are of equal intensity whereas in interference only central maxima has different intensity than rest of them.

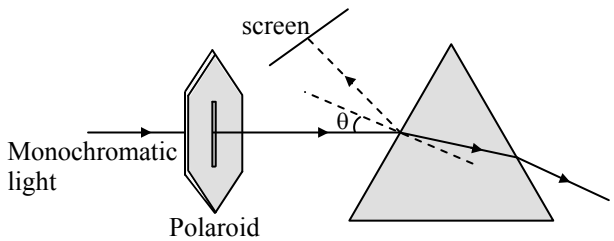
3. In polar regions, for navigation purpose
   (A) magnetic compass is used.
   (B) electric compass is used.
   (C) wind direction is used.
   (D) the polarisation of sunlight by scattering is used.

4. A monochromatic plane wave of speed 'c' and wavelength 'λ' is diffracted at a small aperture 'a'. The diagram illustrates successive wavefronts. After what time will some portion of the wavefront AB reach X?

   (A) $\frac{3\lambda}{2c}$
   (B) $\frac{2\lambda}{9c}$
   (C) $\frac{3\lambda}{c}$
   (D) $\frac{4\lambda}{c}$



5. A monochromatic light is passed through a polaroid and then made incident on a prism of refractive index $\sqrt{3}$, at an angle θ as shown in figure. At what value of angle θ, does the spot of light on screen vanish?



   (A) 30° (B) 45°
   (C) 60° (D) 90°

Numerical Value Type Questions

1. A beam of light of wavelength 550 nm from a distant source falls on a single slit 1.00 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. Assuming angle of diffraction to be small, the distance between the first dark fringes on either is of the central bright fringe in μm is _____ .

2. A single slit of width a is illuminated by violet light of wavelength 400 nm and the width of the diffraction pattern is measured as y_0. When half of the slit width is covered and illuminated by red light of wavelength 640 nm, the ratio of $\frac{y'}{y_0}$ is $\frac{x}{400}$. Find the value of x.

3. If the polarising angle of a piece of glass for green light is 54.74°, then the angle of minimum deviation in degree for an equilateral prism made of same glass is _____.
   (Given: tan 54.74° = 1.414)

4. Light is incident on a glass surface at polarising angle of 53°. Then the angle between the incident ray and the refracted ray in degree is _____.

5. An unpolarized light beam is incident on the polarizer of a polarization experiment and the intensity of light beam emerging from the analyzer is measured as 100 Lumens. Now, if the analyzer is rotated around the horizontal axis (direction of light) by 30° in clockwise direction, the intensity of emerging light will be _____ Lumens.
   [JEE (Main) Feb 2021]

6. A system of three polarisers P_1, P_2, P_3 is set up such that the pass axis of P_3 is crossed with respect to that of P_1. The pass axis of P_2 is inclined at 60° to the pass axis of P_3. When a beam of unpolarised light of intensity I_0 is incident on P_1, the intensity of light transmitted by the three polarisers is I. The ratio (I_0/I) (rounded off to the nearest integer) is

Problems To Ponder

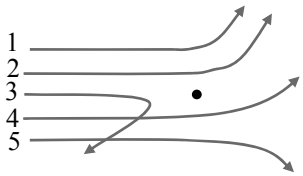
1. Compare the spectra obtained from diffraction gratings and that obtained from prism when a white light is incident on both of them.

2. Why different colours are seen on the surface of compact disk (DVD) at different angles?

Concept Building Problems

α - SCATTERING EXPERIMENT AND RUTHERFORD'S ATOMIC MODEL

1. The diagram shows the path of five α-particles of the same energy being scattered by the nucleus of an atom simultaneously. Which of these are/is not physically possible?



(A) 3 and 4
(B) 2 and 3
(C) 5 only
(D) 4 only

2. The distance of the closest approach of an alpha particle fired at a nucleus with kinetic energy K is r_0. The distance of the closest approach when the α particle is fired at the same nucleus with kinetic energy nK will be

(A) $\frac{r_0}{n}$ (B) nr_0 (C) $\frac{r_0}{\sqrt{n}}$ (D) r_0

3. When an α- particle of mass m moving with velocity v bombards on heavy nucleus of charge 'Ze', its distance of closest approach from the nucleus depends on m as **[NEET (UG) P-I 2016]**

(A) $\frac{1}{m^2}$ (B) m (C) $\frac{1}{m}$ (D) $\frac{1}{\sqrt{m}}$

4. An α - particle of energy 3.2 MeV is scattered through 180° by gold nucleus. The distance of closest approach is of the order of

(A) 10^{-14} cm (B) 10^{-11} cm
(C) 10^{-16} cm (D) 10^{-12} cm

5. In Rutherford scattering experiment, the number of particles observed at an angle of 60° is 1000 per minute. The number of particles/minute at 90° are,

(A) 250 (B) 1200
(C) 10^4 (D) 320

BOHR'S ATOMIC MODEL AND ITS LIMITATIONS

1. Which of the following statements about the Bohr model of the hydrogen atom is FALSE?
   (A) Acceleration of electron in n = 3 orbit is less than that in n = 2 orbit.
   (B) Angular momentum of electron in n = 4 orbit is more than that in n = 2 orbit.
   (C) Kinetic energy of electron in n = 2 orbit is less than that in n = 1 orbit.
   (D) Potential energy of electron in n = 3 orbit is less than that in n = 1 orbit.

2. As an electron makes a transition from an excited state to the ground state of a hydrogen-like atom/ion **[JEE (Main) 2015]**
   (A) its kinetic energy increases but potential energy and total energy decrease.
   (B) kinetic energy, potential energy and total energy decrease.
   (C) kinetic energy decreases, potential energy increases but total energy remains same.
   (D) kinetic energy and total energy decrease but potential energy increases.

3. The simple Bohr model cannot be directly applied to calculate the energy levels of an atom with many electrons. This is because **[NCERT Exemplar]**
   (A) of the electrons not being subject to a central force.
   (B) of the electrons colliding with each other.
   (C) of screening effects.
   (D) the force between the nucleus and an electron will no longer be given by Coulomb's law.

4. The area of the electron orbit for the ground state of hydrogen atom is A. What will be the area of the electron orbit corresponding to the first excited state?

(A) 8A (B) 4A
(C) 16A (D) 2A

5. Taking the Bohr radius as $a_0 = 53$ pm, the radius of Li^{++} ion in its ground state, on the basis of Bohr's model, will be about **[NCERT Exemplar]**

(A) 53 pm (B) 27 pm
(C) 18 pm (D) 13 pm

6. The radius of third stationary orbit of electron for Bohr's atom is R. The radius of fourth stationary orbit will be: **[JEE (Main) Jan 2024]**

(A) $\frac{3}{4}R$ (B) $\frac{9}{16}R$
(C) $\frac{16}{9}R$ (D) $\frac{4}{3}R$

7. The time period of revolution of electron in its ground state orbit in a hydrogen atom is 1.6×10^{-16} s. The frequency of revolution of the electron in its first excited state (in s^{-1}) is: **[JEE (Main) Jan 2020]**

(A) 1.6×10^{14} (B) 7.8×10^{14}
(C) 5.6×10^{12} (D) 6.2×10^{15}

8. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, **[NEET (UG) 2018]**

(A) 1 : 1 (B) 1 : –1
(C) 2 : –1 (D) 1 : –2

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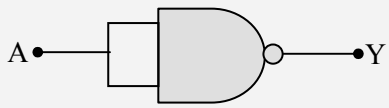
To see complete chapter buy **Target Notes** or **Target E-Notes**

Smart tip - 3

If both inputs of NAND gates are shorted, then it becomes NOT gate (similar is applicable for NOR gate).



NOT gate

Formulae

1. Conductivity of semiconductors :

$\sigma = \sigma_n + \sigma_p = e\,[n_e\mu_e + n_h\mu_h]$

2. Dynamic resistance: $r_d = \frac{\Delta V}{\Delta I}$

3. Half-wave rectifier:

i. Rectified current and voltage,

$I_{dc} = \frac{I_o}{\pi}$, $V_{dc} = \frac{V_o}{\pi}$

ii. Peak loaded current $(I_o) = \frac{V_o}{r_d + R_L}$

4. Full-wave rectifier:

i. Rectified current and voltage,

$I_{dc} = \frac{2I_o}{\pi}$, $V_{dc} = \frac{2V_o}{\pi}$

ii. Peak loaded current $(I_o) = \frac{V_o}{r_d + R_L}$

5. Ripple factor: $r = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$

6. Zener diode:

i. $V_z = V_{in} - I_s R_s$ ii. $I_z = I_s - I_L$

7. Wavelength of radiations (λ) in LED:

$\lambda = \frac{c}{\nu} = \frac{hc}{E_g}$

8. Boolean expressions:

i. For OR gate: $Y = A + B$

ii. For AND gate: $Y = A.B$

iii. For NOT gate: $Y = \overline{A}$

iv. For NAND gate: $Y = \overline{A \cdot B}$

v. For NOR gate: $Y = \overline{A + B}$

Learning Pointers

1. Across depletion layer of a p-n junction diode, potential, electric field intensity and charge density varies with distance as shown in the graphs below:

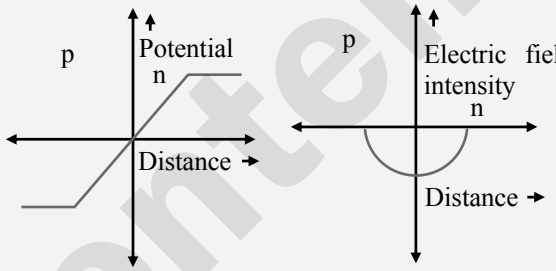


Figure (a) Figure (b)

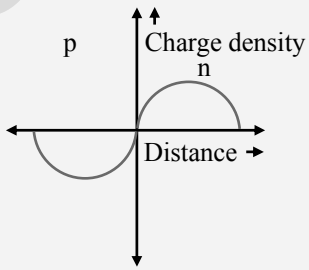


Figure (c)

2. In intrinsic semiconductor, the number of charge carriers reaching from valence band to conduction band, at temperature T kelvin is, $n = CT3/2\, e^{-E_g/2kT}$

3. Current flowing through junction diode is given by $I = I_0\,[e^{eV/kT} - 1]$
where, I_0 = reverse saturation current,
k = Boltzmann constant.

4. When semiconductor is unbiased, drift current and diffusion currents are equal in magnitude and opposite in direction.

5. A p-n junction diode can be considered to be equivalent to a capacitor with p and n regions acting as the plates of the capacitors and depletion layer as the dielectric medium.

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To see complete chapter buy **Target Notes** or **Target E-Notes**

5. **(A)**

$$N = \frac{k}{\sin^4\left(\frac{\theta}{2}\right)}$$

$\therefore \quad N_1 = 10^3 = \frac{k}{\sin^4 30°}$

$\Rightarrow k = \frac{1}{16} \times 10^3$

$\therefore \quad N_2 = \frac{\frac{1}{16}\times 10^3}{\sin^4(45°)} = 250$

BOHR'S ATOMIC MODEL AND ITS LIMITATIONS

1. **(D)**

As n increases, magnitude of P.E. decreases. But as P.E. is negative, P.E. of electron in 3rd orbit is more than that in 1st orbit.

2. **(A)**

$K.E. \propto \left(\frac{Z}{n}\right)^2$ and

K.E. = – (T.E.), P.E. = –2(K.E.)

This implies as K.E. increases, T.E. and P.E. decrease.

3. **(A)**

The electrostatic force of attraction between nucleus and electron is central for single electron atom. When there are many electrons in the atom, they are not being subjected to single central force. Hence, simple Bohr model cannot be directly applied to calculate energy levels of such an atom.

4. **(C)**

$r_n \propto n^2 \Rightarrow A \propto r_n^2 \propto n^4$

$\therefore \quad \frac{A_2}{A_1} = \left(\frac{n_2}{n_1}\right)^4 = \left(\frac{2}{1}\right)^4 = 16$

$\therefore \quad A_2 = 16\, A_1 = 16A$

5. **(C)**

$r \propto \frac{1}{Z}$

For Li^{++}, Z = 3

$\therefore \quad \frac{r_{Li}}{r_0} = \frac{Z}{Z_{Li}} = \frac{1}{3}$

$\therefore \quad r_{Li} = \frac{r_0}{3} = \frac{53}{3} \approx 18$ pm

6. **(C)**

Radius of Bohr orbit, $r_n \propto n^2$

$\therefore \quad \frac{r_3}{r_4} = \frac{9}{16}$

$\therefore \quad r_4 = \frac{16}{9}R \qquad \ldots.(\because r_3 = R)$

7. **(B)**

Period of revolution of electron in n^{th} orbit:

$T_n \propto \frac{n^3}{Z^2}$

For first excited state, n = 2,

$\therefore \quad \frac{T'}{T} = \frac{2^3}{1^3} = \frac{8}{1}$

$\therefore \quad T' = 8T = 8 \times 1.6 \times 10^{-16}$ s

Frequency in first excited state,

$\nu = \frac{1}{T'} = \frac{1}{8\times 1.6\times 10^{-16}} = 7.8 \times 10^{14}\ s^{-1}$

8. **(B)**

For an electron in a Bohr orbit in H-atom,

K.E. = –T.E.

$\therefore \quad \frac{K.E.}{T.E.} = \frac{-1}{1}$

i.e., 1 : –1

9. **(D)**

$K.E. = -T.E = -\frac{1}{2}$ P.E.

Also, T.E. of 4th state of hydrogen atom is

$E_4 = \frac{-13.6}{4^2}$ eV = –0.85 eV

$\therefore$ P.E = –1.7 eV, K.E = 0.85 eV

Think out of the box - Q.9

As P.E. and T.E. of an electron are always negative while K.E. is always positive, the only possible correct answer is option (D).

10. **(D)**

Energy of electron in H-atom $E_n = \frac{-13.6}{n^2}$ eV

$\therefore \quad -0.85 = \frac{-13.6}{n^2} \Rightarrow n^2 = \frac{13.6}{0.85} = 16 \Rightarrow n = 4$

Now angular momentum,

$L = n\frac{h}{2\pi} = \frac{4\times 6.6\times 10^{-34}}{2\times 3.14} = 4.20 \times 10^{-34}$ J-s

11. **(B)**

First excited state i.e., second orbit (n = 2)

Second excited state i.e., third orbit (n = 3)

The energy of electron, $E \propto \frac{1}{n^2}$

$\therefore \quad \frac{E_2}{E_3} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$

NEET (UG) 2024
QUESTION PAPER & ANSWER KEY

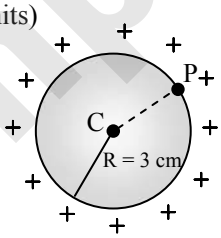
[Note: The following questions belong to chapters of Challenger Physics Volume - I]

Section A

Electrostatics: Electric Charges, Fields and Potential

1. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.
Assertion A: The potential (V) at any axial point, at 2 m distance(r) from the centre of the dipole of dipole moment vector $\vec{P}$ of magnitude, 4×10^{-6} C m, is $\pm 9 \times 10^3$ V.
(Take $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ SI units)
Reason R: $V = \pm \frac{2P}{4\pi\epsilon_0 r^2}$, where r is the distance of any axial point, situated at 2 m from the centre of the dipole.
In the light of the above statements, choose the correct answer from the options given below:
(A) A is true but R is false.
(B) A is false but R is true.
(C) Both A and R are true and R is the correct explanation of A.
(D) Both A and R are true and R is NOT the correct explanation of A.

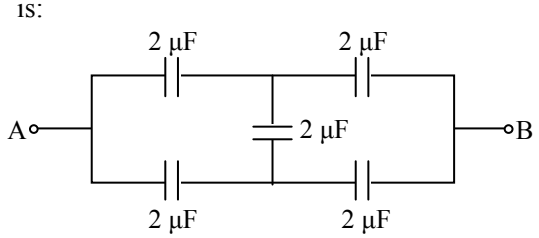
2. A thin spherical shell is charged by some source, The potential difference between the two points C and P (in V) shown in the figure is:
(Take $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ SI units)
(A) 0.5×10^5
(B) zero
(C) 3×10^5
(D) 1×10^5



q = 1 μC

Electrostatics: Capacitance

3. In the following circuit, the equivalent capacitance between terminal A and terminal B is:

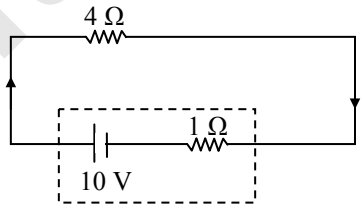


(A) 0.5 μF (B) 4 μF
(C) 2 μF (D) 1 μF

Current Electricity

4. A wire of length '*l*' and resistance 100 Ω is divided into 10 equal parts. The first 5 parts are connected in series while the next 5 parts are connected in parallel. The two combinations are again connected in series. The resistance of this final combination is:
(A) 55 Ω (B) 60 Ω
(C) 26 Ω (D) 52 Ω

5. The terminal voltage of the battery, whose emf is 10 V and internal resistance 1 Ω, when connected through an external resistance of 4 Ω as shown in the figure is:
(A) 8 V
(B) 10 V
(C) 4 V
(D) 6 V

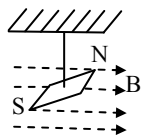


Moving Charges and Magnetism

6. A tightly wound 100 turns coil of radius 10 cm carries a current of 7 A. The magnitude of the magnetic field at the centre of the coil is (Take permeability of free space as $4\pi \times 10^{-7}$ SI units):
(A) 4.4 mT (B) 44 T
(C) 44 mT (D) 4.4 T

Magnetism and Matter

7. In a uniform magnetic field of 0.049 T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of the needle is 9.8×10^{-6} kg m^2. If the magnitude of magnetic moment of the needle is $x \times 10^{-5}$ Am^2; then the value of 'x' is:
(A) $50\pi^2$
(B) $1280\pi^2$
(C) $5\pi^2$
(D) $128\pi^2$

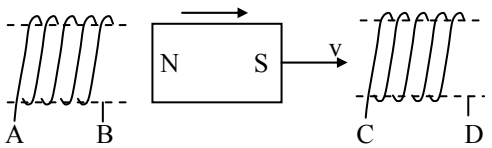


8. Match List-I with List-II.

List – I (Material)		List – II (Susceptibility (χ))	
i.	Diamagnetic	a.	$\chi = 0$
ii.	Ferromagnetic	b.	$0 > \chi > -1$
iii.	Paramagnetic	c.	$\chi >> 1$
iv.	Non-magnetic	d.	$0 < \chi < \varepsilon$ (a small positive number)

Choose the correct answer from the options given below:
(A) i – c, ii – b, iii – a, iv – d
(B) i – d, ii – c, iii – b, iv – a
(C) i – b, ii – c, iii – d, iv – a
(D) i – b, ii – a, iii – c, iv – d

Electromagnetic Induction and alternating current

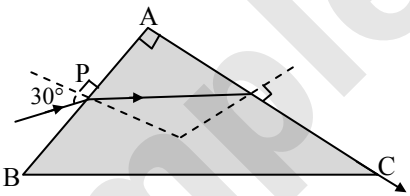
9. 

In the above diagram, a strong bar magnet is moving towards solenoid-2 from solenoid-1. The direction of induced current in solenoid-1 and that in solenoid-2, respectively, are through the directions:
(A) AB and CD (B) BA and DC
(C) AB and DC (D) BA and CD

10. In an ideal transformer, the turns ratio is $\frac{N_P}{N_S} = \frac{1}{2}$. The ratio $V_S:V_P$ is equal to (the symbols carry their usual meaning):
(A) 1 : 1 (B) 1 : 4 (C) 1: 2 (D) 2 : 1

Ray Optics and Optical Instruments

11. A light ray enters through a right angled prism at point P with the angle of incidence 30° as shown in figure. It travels through the prism parallel to its base BC and emerges along the face AC. The refractive index of the prism is:
(A) $\frac{\sqrt{3}}{4}$
(B) $\frac{\sqrt{3}}{2}$
(C) $\frac{\sqrt{5}}{4}$
(D) $\frac{\sqrt{5}}{2}$



Wave Optics: Huygens' Principle and Interference of Light

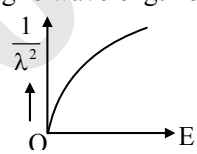
12. If the monochromatic source in Young's double slit experiment is replaced by white light, then
(A) there will be a central bright white fringe surrounded by a few coloured fringes.
(B) all bright fringes will be of equal width.
(C) interference pattern will disappear.
(D) there will be central dark fringe surrounded by a few coloured fringes.

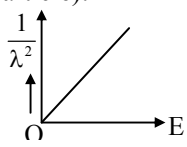
Wave Optics: Diffraction and Polarisation of Light

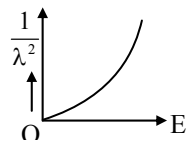
13. An unpolarised light beam strikes a glass surface at Brewster's angle. Then
(A) both the reflected and refracted light will be completely polarised.
(B) the reflected light will be completely polarised but the refracted light will be partially polarised.
(C) the reflected light will be partially polarised.
(D) the refracted light will be completely polarised.

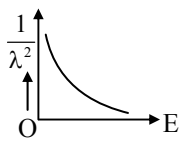
Dual Nature of Radiation and Matter

14. If c is the velocity of light in free space, the correct statements about photon among the following are:
I. The energy of a photon is E = hν.
II. The velocity of a photon is c.
III. The momentum of a photon, $p = \frac{h\nu}{c}$
IV. In a photon-electron collision, both total energy and total momentum are conserved.
V. Photon possesses positive charge.
Choose the correct answer from the options given, below:
(A) I, III and IV only
(B) I, II, IV and V only
(C) I and II only
(D) I, II, III and IV only

15. The graph which shows the variation of $\left(\frac{1}{\lambda^2}\right)$ and its kinetic energy, E is (where λ is de Broglie wavelength of a free particle):
(A) 

(B) 

(C) 

(D) 

Atoms and Nuclei

16. $^{290}_{82}X \xrightarrow{\alpha} Y \xrightarrow{e^+} Z \xrightarrow{\beta^-} P \xrightarrow{e^-} Q$
In the nuclear emission stated above, the mass number and atomic number of the product Q respectively, are:
(A) 288, 82 (B) 286, 81
(C) 280, 81 (D) 286, 80

17. Given below are two statements:
Statement I: Atoms are electrically neutral as they contain equal number of positive and negative charges.
Statement II: Atoms of each element are stable and emit their characteristic spectrum.
In the light of the above statements, choose the most appropriate answer from the options given below:
(A) Statement I is correct but Statement II is incorrect.
(B) Statement I is incorrect but Statement II is correct.
(C) Both Statement I and Statement II are correct.
(D) Both Statement I and Statement II are incorrect.

18. Match List I with List II.

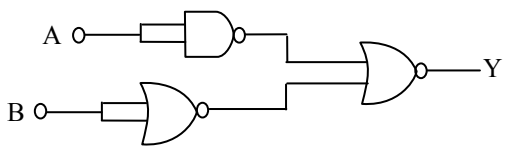
List – I (Spectral Lines of Hydrogen for transitions from)		List – II (Wavelengths (nm))	
i.	$n_2 = 3$ to $n_1 = 2$	a.	410.2
ii.	$n_2 = 4$ to $n_1 = 2$	b.	434.1
iii.	$n_2 = 5$ to $n_1 = 2$	c.	656.3
iv.	$n_2 = 6$ to $n_1 = 2$	d.	486.1

Choose the correct answer from the options given below:

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

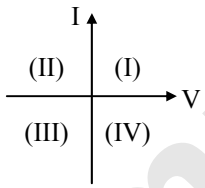
Semiconductor Electronics: Materials, Devices and Simple Circuits

19. The output (Y) of the given logic gate is similar to the output of an/a:



(A) OR gate (B) AND gate
(C) NAND gate (D) NOR gate

20. Consider the following statements P and Q and identify the correct answer:



P. For a solar-cell, the I-V characteristics lies in the IV quadrant of the given graph.
Q. In a reverse biased pn junction diode, the current measured in (μA), is due to majority charge carriers.

(A) Both P and Q are correct.
(B) Both P and Q are incorrect.
(C) P is correct but Q is incorrect.
(D) P is incorrect but Q is correct.

21. A logic circuit provides the output Y as per the following truth table:

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

The expression for the output Y is:

(A) $\overline{B}$ (B) B
(C) $A.B + \overline{A}$ (D) $A.\overline{B} + \overline{A}$

Experimental Skills

22. In a vernier calipers, (N + 1) divisions of vernier scale coincide with N divisions of main scale. If 1 MSD represents 0.1 mm, the vernier constant (in cm) is:

(A) 100N (B) 10(N + 1)
(C) $\frac{1}{10N}$ (D) $\frac{1}{100(N+1)}$

Section B

Electrostatics: Capacitance

23. If the plates of a parallel plate capacitor connected to a battery are moved close to each other, then

I. the charge stored in it, increases.
II. the energy stored in it, decreases.
III. its capacitance increases.
IV. the ratio of charge to its potential remains the same.
V. the product of charge and voltage increases.

Choose the most appropriate answer from the options given below:

(A) II, IV and V only (B) I, II and III only
(C) I, II and V only (D) I, III and V only

Current Electricity

24. Two heaters A and B have power rating of 1 kW and 2 kW, respectively. Those two are first connected in series and then in parallel to a fixed power source. The ratio of power outputs for these two cases is:

(A) 1 : 2 (B) 2 : 3
(C) 1 : 1 (D) 2 : 9

Magnetism and Matter

25. An iron bar of length L has magnetic moment M. It is bent at the middle of its length such that the two arms make an angle 60º with each other. The magnetic moment of this new magnet is:

(A) 2 M (B) $\frac{M}{\sqrt{3}}$ (C) M (D) $\frac{M}{2}$

Electromagnetic Induction and alternating current

26. A sheet is placed on a horizontal surface in front of a strong magnetic pole. A force is needed to :

I. hold the sheet there if it is magnetic.
II. hold the sheet there if it is non-magnetic.
III. move the sheet away from the pole with uniform velocity if it is conducting.
IV. move the sheet away from the pole with uniform velocity if it is both, non-conducting and non-polar.

Choose the correct statement(s) from the options given below:

(A) I, III and IV only (B) III only
(C) II and IV only (D) I and III only

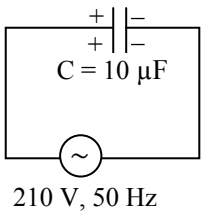
27. A 10 μF capacitor is connected to a 210 V, 50 Hz source as shown in figure. The peak current in the circuit is nearly ($\pi = 3.14$):

(A) 1.20 A

(B) 0.35 A

(C) 0.58 A

(D) 0.93 A



Electromagnetic Waves

28. A parallel plate capacitor is charged by connecting it to a battery through a resistor. If I is the current in the circuit, then in the gap between the plates:

(A) displacement current of magnitude equal to I flows in a direction opposite to that of I.

(B) displacement current of magnitude greater than I flows but can be in any direction.

(C) there is no current.

(D) displacement current of magnitude equal to I flows in the same direction as I.

29. The property which is not of an electromagnetic wave travelling in free space is that:

(A) they travel with a speed equal to $\frac{1}{\sqrt{\mu_0 \in_0}}$

(B) they originate from charges moving with uniform speed.

(C) they are transverse in nature.

(D) the energy density in electric field is equal to energy density in magnetic field.

Ray Optics and Optical Instruments

30. A small telescope has an objective of focal length 140 cm and an eye piece of focal length 5.0 cm. The magnifying power of telescope for viewing a distant object is:

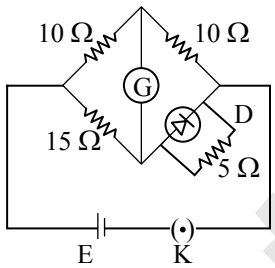
(A) 17 (B) 32

(C) 34 (D) 28

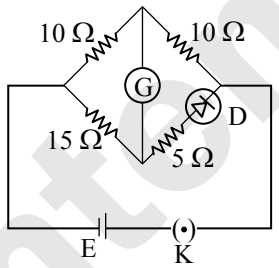
Semiconductor Electronics: Materials, Devices and Simple Circuits

31. Choose the correct circuit which can achieve the bridge balance.

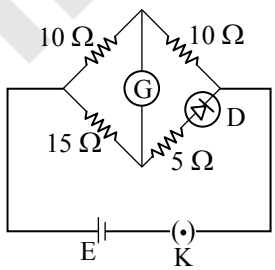
(A)



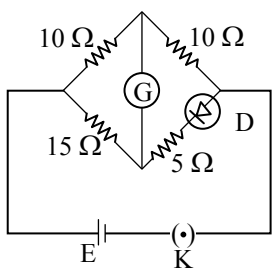
(B)



(C)



(D)



Answer Key

1.	(A)	2.	(B)	3.	(C)	4.	(D)
5.	(A)	6.	(A)	7.	(B)	8.	(C)
9.	(C)	10.	(D)	11.	(D)	12.	(A)
13.	(B)	14.	(D)	15.	(B)	16.	(B)
17.	(A)	18.	(D)	19.	(B)	20.	(C)
21.	(A)	22.	(D)	23.	(D)	24.	(D)
25.	(D)	26.	(D)	27.	(C)	28.	(D)
29.	(B)	30.	(D)	31.	(C)		

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