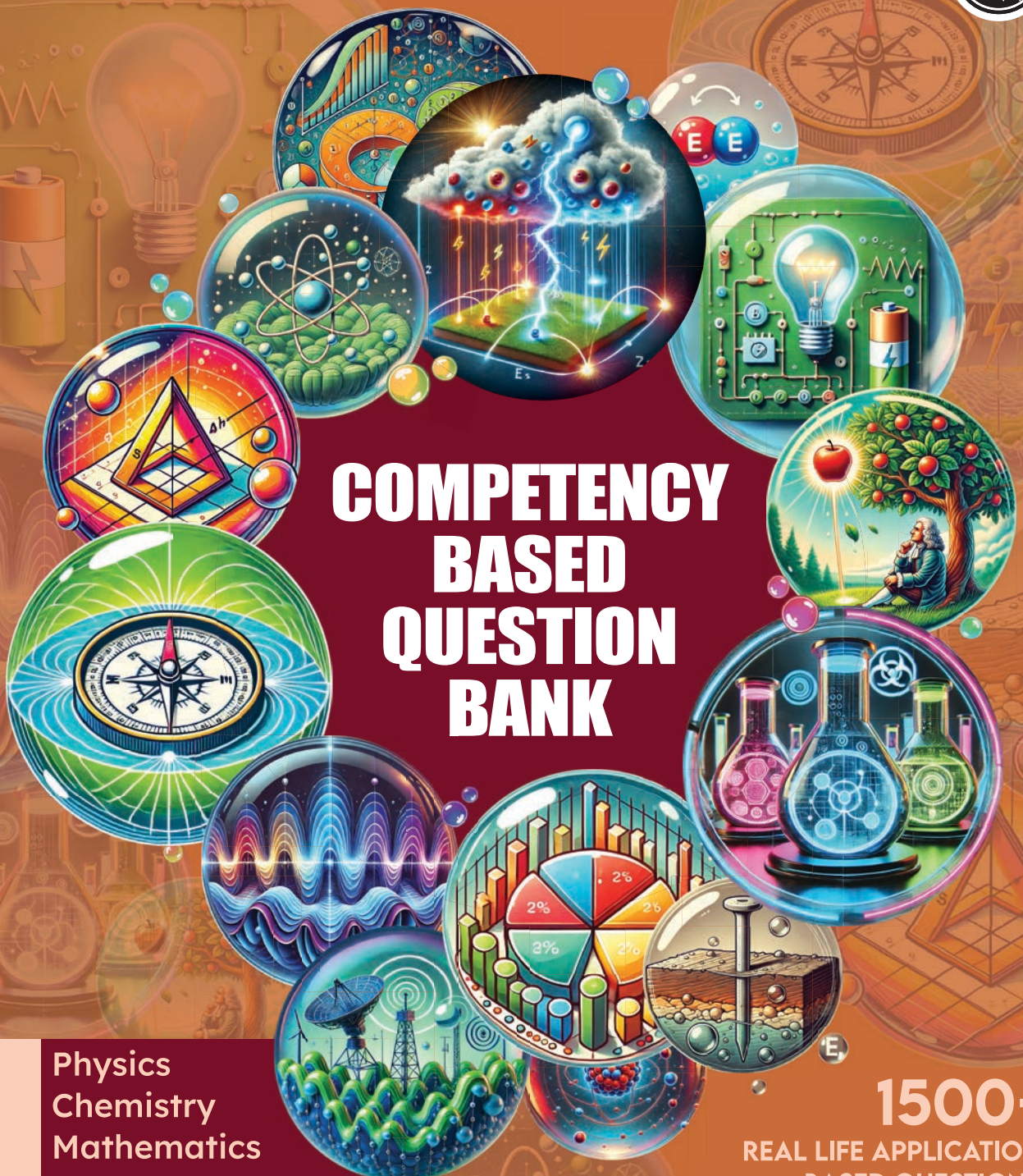
Class-12

CBSE



COMPETENCY BASED QUESTION BANK

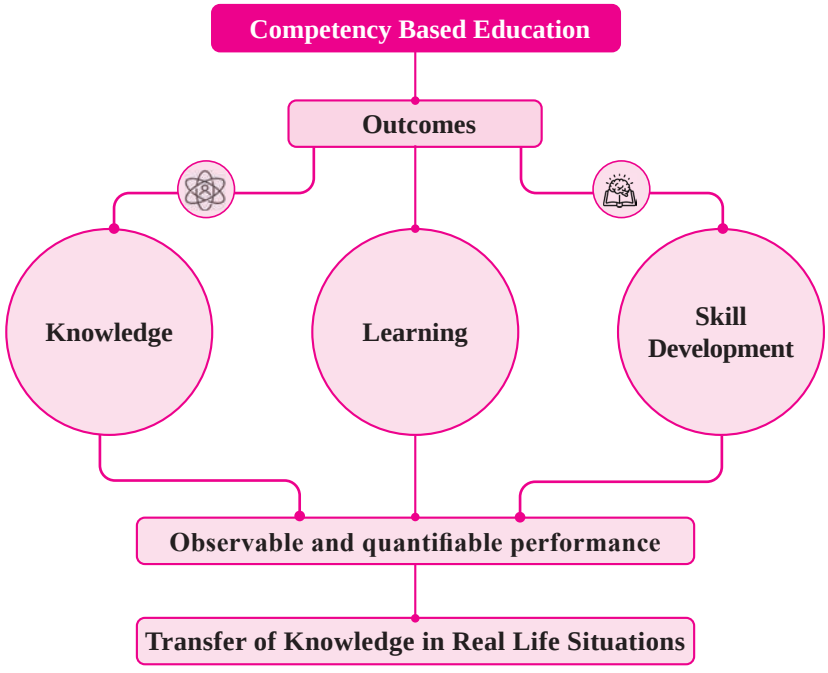
Physics
Chemistry
Mathematics

1500+
REAL LIFE APPLICATION BASED QUESTIONS

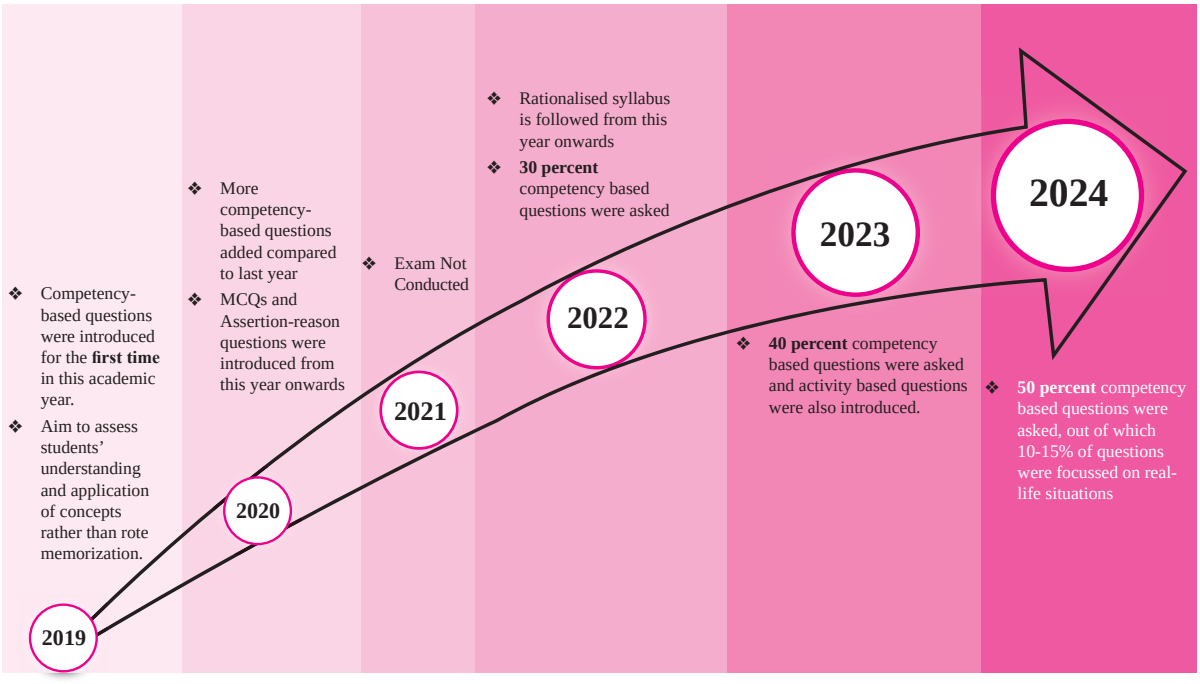
Your Guide to Attain Full Marks in 50% Competency Based Questions

Competency-Based Education as per NEP 2020

The National Education Policy (NEP) 2020 introduced competency-based education as a revolutionary shift in teaching and learning in India. This student-focused approach prioritises the development of skills and knowledge over the conventional emphasis on rote memorisation.

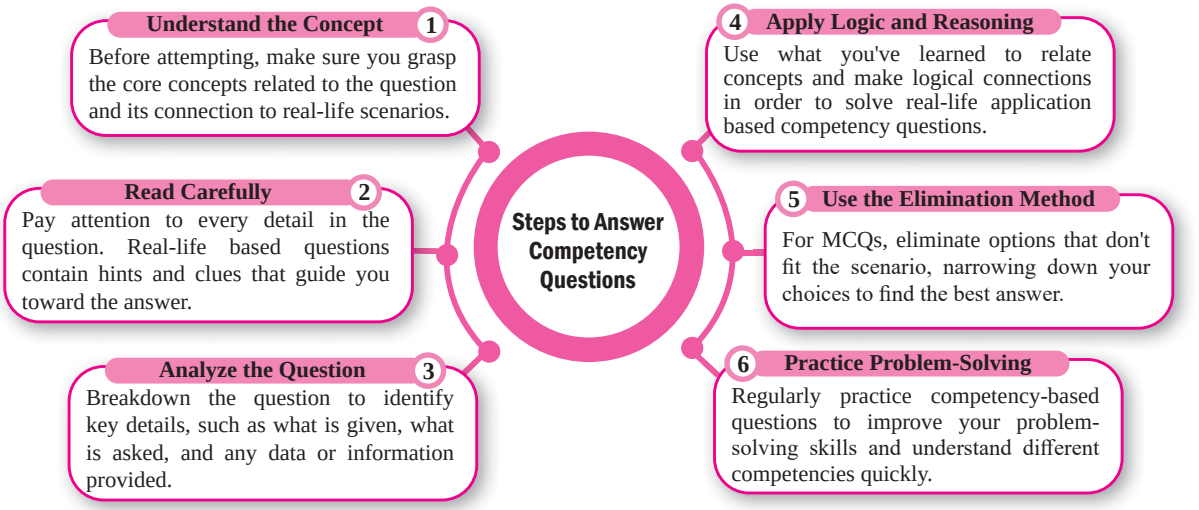


Evolving Trends of Competency-Based Questions



Answer Competency-based Questions Like a Pro

By following these tips, you'll become more confident and efficient in handling competency-based questions, especially those involving real-life applications.



QUESTION PAPER DESIGN
CLASS-XII (2024-25)

PHYSICS

(Code No. 042)

S. NO.	Title	Total Marks	Percentage
1.	**Remembering and Understanding:** Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers. Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas	27	38
2.	**Applying:** Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	22	32
3.	**Analysing, Evaluating and Creating:** Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations. Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.	21	30
	Total	**70**	**100**

CHEMISTRY

(Code No. 043)

S. No.	Domains	Total Marks	Percentage %
1.	**Remembering and Understanding:** Exhibit memory of previously learned material by recalling facts, terms, basic concepts and answers. Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions and stating main ideas.	28	40
2.	**Applying:** Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	21	30
3.	**Analysing, Evaluating and Creating:** Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations. Present and defend opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria. Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.	21	30
	Total	**70**	**100**

MATHEMATICS

Code No. (041)

Time: 3 Hours **Max. Marks: 80**

S.No.	Typology of Questions	Total Marks	% Weightage (approx.)
1.	**Remembering:** Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers. **Understanding:** Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas	44	55
2.	**Applying:** Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	20	25
3.	**Analysing:** Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations **Evaluating:** Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. **Creating:** Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions	16	20
	Total	**80**	**100**

Chapter-wise Weightage and Trend Analysis of

CBSE Past 5 Years' Papers

PHYSICS

CHAPTERS	2020	2021	2022	2023	2024
Electric Charges and Fields	6	Exam not conducted	7	9	11
Electrostatic Potential and Capacitance	8		8	9	10
Current Electricity	8		7	9	1
Moving Charges and Magnetism	8		5	5	10
Magnetism and Matter	-		9	1	1
Electromagnetic Induction	3		3	5	1
Alternating Current	8		11	3	5
Electromagnetic Waves	4		-	3	4
Ray Optics and Optical Instruments	8		6	8	7
Wave Optics	5		10	8	7
Dual Nature of Radiation and Matter	4		4	5	4
Atoms	5		6	3	4
Nuclei	7		4	6	1
Semiconductor Electronics: Materials, Devices and Simple Circuits	5		5	4	5

CHEMISTRY

CHAPTERS	2020	2021	2022		2023	2024
			Term-I	Term-II		
Solutions	7	Exam not conducted	11.5	-	7	7
Electrochemistry	9		-	5	9	9
Chemical Kinetics	5		-	5	7	7
The d-and f-Block Elements	3		-	6	7	7
Coordination Compounds	4		-	3	7	7
Haloalkanes and Haloarenes	4		11.5	-	7	6
Alcohols, Phenols and Ethers	1		9	-	5	6
Aldehydes, Ketones and Carboxylic Acids	9		-	8	8	8
Amines	4		-	5	6	6
Biomolecules	4		9	-	7	7

MATHEMATICS

CHAPTERS	2020		2021	2022		2023		2024	
	DL	ODL		DL	ODL	DL	ODL	DL	ODL
Relations and Functions	3	7	Exam not conducted	-	-	5	5	5	6
Inverse Trigonometric Functions	5	1		-	-	3	3	3	2
Matrices	3	3		-	-	9	7	9	9
Determinants	7	7		-	-	1	3	1	1
Continuity and Differentiability	8	7		-	-	8	4	10	6
Application of Derivatives	8	9		-	4	6	10	11	10
Integrals	8	8		8	9	11	11	4	9
Application of Integrals	6	6		4	-	5	5	6	5
Differential Equations	5	5		6	5	5	5	4	5
Vector Algebra	6	4		5	5	7	5	5	7
Three Dimensional Geometry	8	10		9	9	7	9	9	7
Linear Programming	5	5		-	-	5	5	5	5
Probability	8	8		8	8	8	8	8	8
Total Marks	**80**	**80**		**40**	**40**	**80**	**80**	**80**	**80**

CONTENTS

Questions have been categorized according to the Bloom's Taxonomy (as per CBSE Board).
The following abbreviations have been used in the book:

(*Un*) - Understanding (*Re*) - Remembering (*Ap*) - Applying
(*An*) - Analysing (*Cr*) - Creating (*Ev*) - Evaluating

Electric Charges and Fields

Myth Busters: To Sharpen Your Concepts

- ❒ **Myth: Only conductors can be charged.**

  Fact: Both conductors and insulators can be charged. However, in conductors, the charge distributes over the surface, while in insulators, the charge remains localized.

- ❒ **Myth: Electric charge can exist without any mass.**

  Fact: Electric charge is always associated with matter, which has mass. There are no free charges without mass.

- ❒ **Myth: Charges always move easily in all materials.**

  Fact: Charges move easily only in conductors due to the presence of free electrons. In insulators, charges do not move freely because the electrons are tightly bound to their atoms.

- ❒ **Myth: The electric field is a property of the test charge.**

  Fact: The electric field is a property of the source charge and exists independently of the test charge. The test charge experiences a force due to the electric field created by the source charge.

- ❒ **Myth: The force on a charge due to multiple other charges can be found by considering all charges together.**

  Fact: The force on a charge due to multiple other charges is found by considering the force due to each charge separately and then adding these forces vectorially (superposition principle).

- ❒ **Myth: Coulomb's Law applies only to point charges.**

  Fact: Coulomb's Law can be applied to spherical charge distributions as well, provided the distance between them is much larger than the size of the spheres.

- ❒ **Myth: The electric field inside a conductor is always zero.**

  Fact: The electric field inside a conductor is zero only in electrostatic equilibrium. When charges are moving or there is a current, an electric field exists inside the conductor.

- ❒ **Myth: The electric flux depends on the shape of the surface.**

  Fact: The electric flux through a closed surface depends only on the charge enclosed by the surface, not on the shape or size of the surface, according to Gauss's law.

- ❒ **Myth: A dipole always experiences a net force in a uniform electric field.**

  Fact: A dipole in a uniform electric field experiences no net force but does experience a torque that aligns it with the field.

- ❒ **Myth: The electric field at a point due to a charge is dependent on the presence of other charges.**

  Fact: The electric field at a point due to a charge is independent of the presence of other charges and is determined solely by the charge creating the field.

- ❒ **Myth: All electric fields are caused by point charges.**

  Fact: Electric fields can also be caused by continuous charge distributions, such as lines of charge, surfaces of charge, and volumes of charge.

- ❒ **Myth: Charge is always quantized and discrete.**

  Fact: While charge is fundamentally quantized, in practical scenarios involving large numbers

of charges, the distribution can be treated as continuous for simplicity and accuracy in calculations.

- ❒ **Myth: Only point charges create electric fields.**

  Fact: Extended objects with continuous charge distributions also create electric fields, which can be calculated using integration.

- ❒ **Myth: Electric fields are always uniform in a continuous charge distribution.**

  Fact: The electric field depends on the geometry and distribution of the charge. It can vary significantly at different points in space.

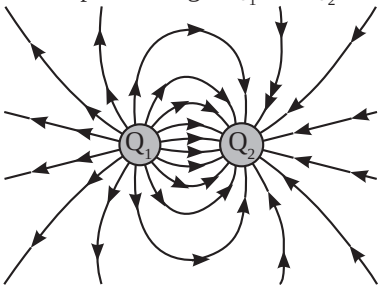
- ❒ **Myth: The total charge of a continuous distribution is infinite.**

  Fact: The total charge of a continuous distribution is finite and is determined by integrating the charge density over the entire volume.

Competency Based Exercise

Multiple Choice Questions (1M)

1. The diagram below shows the electric field lines due to two point charges Q_1 and Q_2:



Which of the following is correct? **(*An*)**

(*a*) Q_1 and Q_2 are both positive.

(*b*) Q_1 is positive and Q_2 is negative.

(*c*) Q_1 is negative and Q_2 is positive.

(*d*) Q_1 and Q_2 are both negative.

2. The following statements could be true for a Gaussian surface with zero net flux.

P. No charges are inside the Gaussian surface.

Q. The net charge inside the surface is zero.

R. The electric field is zero everywhere on the surface.

S. The number of field lines entering is equal to the number of lines exiting the surface. Which of the statements is/are true?

(*An*) (CBSE CFPQ, 2023)

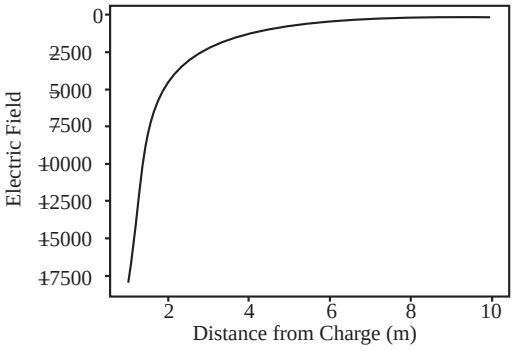
(*a*) Only statement *Q*

(*b*) Both statements *P* and *S*

(*c*) Both statements *Q* and *R*

(*d*) Both statements *Q* and *S*

3. The graph below shows the variation of electric field *E* with distance *r* from a point charge.



What is the nature of the charge generating this field? **(*An*)**

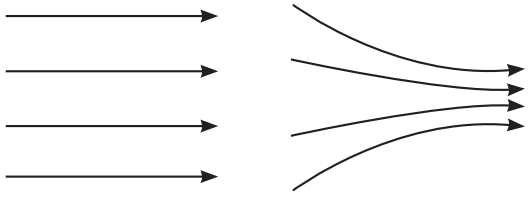
(*a*) Positive

(*b*) Negative

(*c*) Zero

(*d*) Cannot be determined

4. The image below shows two examples of electric field lines.



I *II*

Which of the following statements is true? **(*An*)**

(*a*) The electric fields in both *I* and *II* arise due to a single positive point charge located somewhere on the left.

(*b*) The electric fields in both *I* and *II* can be created by negative charges located somewhere on the left and positive charges somewhere on the right.

(*c*) The electric field in *I* is the same everywhere but the electric field in *II* becomes stronger as we move from left to right.

(*d*) As you move from left to right, the electric fields in both *I* and *II* become stronger.

5. In a given region of an electric field, there is no charge present. A closed container is placed in this region of the electric field.

What is the requirement for the total flux through the closed container to be zero? **(*Ap*)**

(*a*) The field must be uniform.

(*b*) The container must be symmetric.

(*c*) The container must be oriented in a particular direction.

(*d*) There is no such requirement. The total flux through the container is zero no matter what.

6. If the linear charge density $\lambda(x) = a + bx^2$ along a rod increases with distance x from one end of the rod, which of the following statements about the electric field created by the rod is most accurate? **(*An*)**

(*a*) The electric field strength at points near the center of the rod is stronger than at the ends.

(*b*) The electric field strength at points closer to the end with higher x-values will be stronger than near the other end.

(*c*) The electric field strength is uniform along the length of the rod.

(*d*) The electric field strength does not depend on the charge distribution along the rod.

7. A permanent dipole is placed in a uniform electric field E. The torque on the dipole is given by $\tau = p \times E$. Which of the following statements is true regarding the torque experienced by the dipole? **(*Ap*)**

(*a*) The torque is maximum when the dipole is aligned with the field.

(*b*) The torque is zero when the dipole is perpendicular to the field.

(*c*) The torque is maximum when the dipole is perpendicular to the field.

(*d*) The torque is constant regardless of the orientation of the dipole.

8. A permanent dipole is placed in a non-uniform electric field at on angle 30° with it. Which of the following statements best describes the behavior of the dipole in this situation? **(*Un*)**

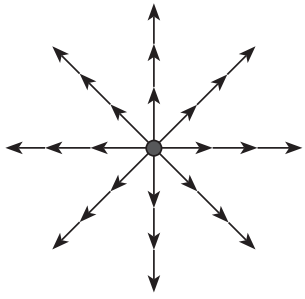
(*a*) The dipole experiences only a torque but no net force.

(*b*) The dipole experiences both a torque and a net force.

(*c*) The dipole experiences neither a torque nor a net force.

(*d*) The dipole experiences only a net force but no torque.

9. Which of the following statements is correct regarding the electric field lines of a point charge as shown in Figure? **(*An*)**



(*a*) Electric field lines are closer together near the charge, indicating a weaker electric field.

(*b*) Electric field lines are evenly spaced, indicating that the electric field is uniform in all directions.

(*c*) The density of electric field lines decreases with distance from the charge, indicating a weakening electric field.

(*d*) The direction of electric field lines depends on the magnitude of the charge but not its sign.

Assertion Reason Type Questions (1M)

Direction: The following questions consist of two statements – Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below:

(*a*) Both A and R are true, and R is the correct explanation of A.

(*b*) Both A and R are true, but R is not the correct explanation of A.

(*c*) A is true, but R is false

(*d*) A is false, but R is true.

10. **Assertion (A):** When a positively charged particle is placed in a uniform electric field, it experiences a force in the direction of the field.

Reason (R): The electric field exerts a force on the charge that is proportional to the magnitude of the charge. **(*Un*)**

11. **Assertion (A):** Electric flux through a surface depends on the charge enclosed.

Reason (R): Electric flux is proportional to the strength of the electric field. **(*Un*)**

12. **Assertion (A):** An electric dipole is in stable equilibrium when placed in a uniform electric field with its dipole moment opposite to the field.

Reason (R): No torque acts on an electric dipole when its dipole moment is in a direction opposite to the uniform electric field. **(*An*)**

13. **Assertion (A):** Water molecules (H_2O) have a permanent dipole moment even in the absence of an external electric field.

Reason (R): In water molecules, the centers of positive and negative charges do not coincide, causing the molecule to be polar. **(*Un*)**

14. **Assertion (A):** For a closed surface, if the electric field is uniform. The net electric flux through the surface can still be zero.

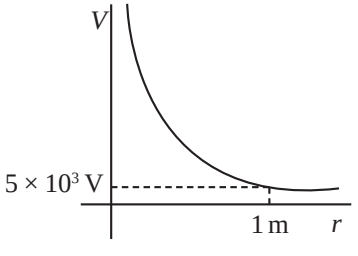
Reason (R): The net electric flux through a closed surface depends only on the total charge enclosed by the surface, not on the orientation of the field with respect to the surface elements. **(*Un*)**

15. **Assertion (A):** The electric field strength at a point on the surface of a sphere centered around a point charge is the same, regardless of the radius of the sphere.

Reason (R): The number of electric field lines passing through a given sphere remains constant, regardless of the distance from the charge. **(*Re*)**

Very Short Answer Type Questions (2M)

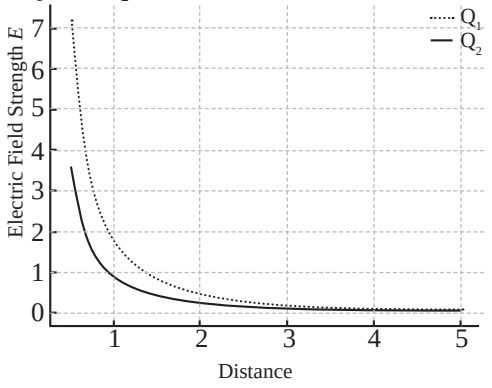
16. The graph below represents the electric potential V as a function of distance r from a point charge.



(*a*) Explain how the graph illustrates the inverse relationship between potential and distance. **(1 M)**

(*b*) Calculate the charge of the point charge using data from the graph. **(*An*) (1 M)**

17. The graph shows the variation of electric field strength E with distance r for two point charges Q_1 and Q_2.



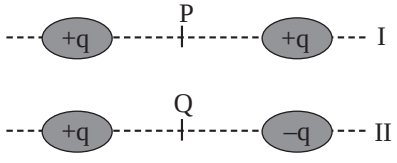
(*a*) From the graph, identify which charge is larger, Q_1 or Q_2. Justify your answer. **(1 M)**

(*b*) If the distance is doubled, how does the electric field change? **(*An*) (1 M)**

18. Condiser two charges $q_1 = 10^{-6}$C and $q_2 = -10^{-6}$C place at a distance of 0.1 m. Sketch the electric field lines. Also, describe the pattern and explain why they look that way. **(*Cr*)**

19. (*a*) If electric field strength at a point is zero at a given point, then what can you conclude about the arrangement of charges at that point? **(1 M)**

(*b*) In the two instances below, state whether electric field intensity is zero or non-zero at the mid-point joining the two-point charges. **(*An*) (1 M)**



20. A thundercloud carries a charge of +50 C at a height of 4000 m and a charge of –50 C at a height of 2000 m from the ground. An airplane crosses through the charged thundercloud at a height of 3000 m from the ground.

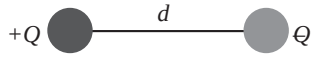
Find the magnitude and the direction of the electric field acting on the airplane as its crosses through the charged-up thundercloud.

(*Ap*) (CBSE CFPQ, 2024)

21. (*a*) Why does the electric field of a dipole fall off as $\frac{1}{r^3}$, while the field of a point charge decreases as $\frac{1}{r^2}$? **(1 M)**

(*b*) How does magnitude of electric field vary with distance on axial and equatorial lines of dipole? **(1 M)**

22. An electric dipole consists of charges $+q$ and $-q$ separated by a distance $2a$.



(*a*) Why is the net charge of the dipole zero, yet it still produces an electric field? **(1 M)**

(*b*) How does the cancellation of fields between $+q$ and $-q$ change as you move further away from the dipole? **(*Un*) (1 M)**

23. In a system of three charges, q_1, q_2, and q_3 placed at different positions in space, the force on q_1 given by Coulomb's law as the sum of the forces from q_2 and q_3.

(*a*) How would the forces on q_1 due to q_2 & q_3 change if q_2 is moved further away from q_1 but q_3 remains in its position? **(1 M)**

(*b*) Why does the total force on a charge depend on both the magnitude and direction of the individual forces exerted by other charges?

(*An*) (1 M)

24. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and of magnitude 17.7×10^{-22} C/m^2. What is electric field intensity E:

(*a*) in the outer region of the first plate, and

(*b*) between the plates? **(*Ap*) (CBSE SQP, 2023)**

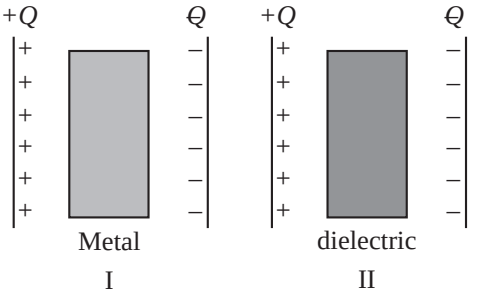
Short Answer Type Questions (3M)

25. Two point charges Q_1 = +5 μC and Q_2 = 5 μC are placed 10 cm apart.

(*a*) Calculate the force of interaction between them using Coulomb's law. What type of force (attractive or repulsive) will it be? **(1 M)**

(*b*) If both charges are doubled, how will the force change? **(2 M) (*Ev*)**

26. Given is a pair of parallel charged metal plates in the arrangement as shown.

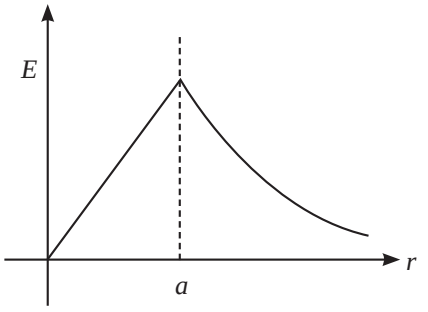


(*a*) Sketch the electric field lines between the plates in I and II. **(2 M)**

(*b*) Mention whether net electric field intensity is zero or non-zero in each case. **(1 M)**

(*An*) (CBSE CFPQ, 2024)

27. Study the graph between electric field intensity E versus the distance r.



(*a*) Describe the nature of variation of electric field intensity between r = 0 and $r \leq$ a. **(1 M)**

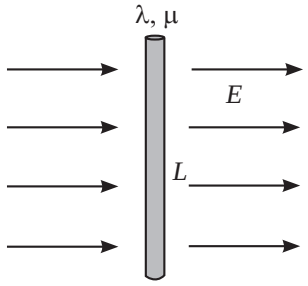
(*b*) Describe the nature of variation of electric field intensity for r > a. **(1 M)**

(*c*) Give an example of the body of charge distribution that can exhibit the above studied electric field distribution. **(1 M)**

(*An*) (CBSE CFPQ, 2024)

28. A thin rod of length L of the uniform mass density of μ kg/m and linear charge density λ C/m is initially at rest.

A uniform electric field E is applied in the direction perpendicular to the length of the rod. The rod begins to move in the direction of the applied electric field.

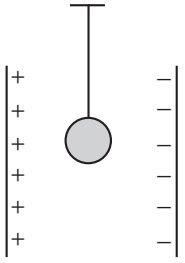


Determine the speed of the rod after it travels through 1 m of distance. Ignore all external forces except the electrostatic forces.

(*Ap*) (CBSE CFPQ, 2024)

29. A very small uncharged metal-coated Styrofoam ball is suspended in the region between two parallel oppositely charged metallic plates. A uniform electric field exists between the two plates. Ball is made to touch one of the plates and released, describe its motion after that.

(*Ap*) (CBSE CFPQ, 2023)



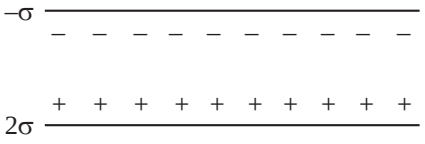
30. A charged particle enters a uniform electric field $\vec{E}$. The particle has charge q and mass m.

(*a*) Write Newton's 2nd law of motion for the particle. **(1 M)**

(*b*) What is the acceleration of the particle due to the electric field? **(1 M)**

(*c*) How does the direction of the force depend on the charge? **(*Un*) (1 M)**

31. Two charged sheets having charge density 2σ and $-\sigma$ are placed parallel and close to each other in a vertical plane as shown in the figure. A particle having positive charge q and mass m is placed between these sheets and released from rest under gravity. What is the acceleration of this particle?



(*An*) (CBSE CFPQ, 2023)

Long Answer Type Questions (5M)

32. Answer the following questions based on your understanding.

(*a*) A charge of $5\mu C$ is placed in an electric field of 2×10^4 N/C. Calculate the force experienced by the charge and describe the direction of motion if the charge is free to move. **(1 M)**

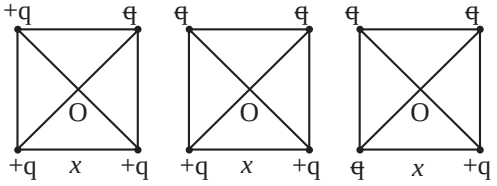
(*b*) A charged particle is placed in a non-uniform electric field, where the field strength increases as you move away from the origin. Analyze how the motion of a positive charge will differ compared to that in a uniform electric field. **(2 M)**

(*c*) Electric fields and gravitational fields both exert forces on particles. Compare these two fields by analyzing how they act on a particle with mass and charge. If you were to place a charged particle in both fields simultaneously, which force would dominate and why? **(*Un*) (2 M)**

33. Complete the table by evaluating electric field at various points. **(*Ev*)**

Geometry	**Charge**	**Distance from charge (*m*)**	**Electric Field (N/C)**
Point Charge	5 μC Charge	2	?
Infinite Rod	10 μC/m linear charge denisty	1	?
Infinite Plane Sheet	8 μC/m² Surface charge density	2	?

34. Given are three different square arrangements of charges.



(*a*) Draw relevant vector diagrams to represent the resultant electric field ER at the center of the square in each case. **(3 M)**

(*b*) Identify the arrangement in which the resultant electric field is the smallest at the center of the square.

(*Cr*) (CBSE CFPQ, 2024) (2 M)

35. The following table shows the electric field at different distances from a point charge. Use the data to answer the following:

(*a*) Identify the pattern of how the electric field changes with distance. **(1 M)**

(*b*) Plot a graph of Electric Field vs. Distance. **(2 M)**

(*c*) Using the table, determine the approximate value of the point charge. **(1 M)**

(*d*) Predict the electric field at a distance of 50 cm from the charge. **(*An*) (1 M)**

Distance (cm)	Electric Field (N/C)
10	5000
20	1250
30	556
40	313

36. A spherical Gaussian surface encloses a positive charge q. Explain with a reason what happens to the net electric flux through the Gaussian surface if:

(*a*) The charge is tripled **(2 M)**

(*b*) The volume of the sphere is tripled **(1 M)**

(*c*) The shape of the Gaussian surface is changed into a cuboid **(1 M)**

(*d*) The charge is moved into another location inside the Gaussian surface

(*An*) (CBSE CFPQ, 2023) (1 M)

37. You are given three charges q_1, q_2, and q_3 placed in an arbitrary arrangement. The charges interact with each other through Coulomb forces. Answer the following questions based on your understanding of electric forces and fields: **(*Ap*)**

(*a*) Explain how the principle of superposition applies to the interaction between these charges. How does this principle ensure that the forces on each charge are independent of the presence of the other charges? **(2 M)**

(*b*) If $q_1 = +5\mu C$, $q_2 = -3\mu C$ and $q_3 = +2\mu C$ located at (0,0), (3m,0), and (0,6m) respectively. Calculate net electric fores on q_1. **(2 M)**

(*c*) In what way does the distance between the charges affect the interaction between them? Critically discuss the role of the inverse square law in the strength of the electric field and force at different distances, even when the charges are not symmetrically placed. **(1 M)**

Case-Based Questions (4M)

38. A research team is conducting an experiment to study the effects of Earth's electric field on charged particles. In a laboratory simulation, they place a proton in a uniform vertical electric field directed downward with a magnitude of 1.5×10^4 N/C. The proton, initially at rest, is released at a height of 1.5 m above a charged metallic plate. The proton accelerates toward the plate due to the electric force exerted by the field. Meanwhile, the force of gravity also acts on the proton, pulling it downward. The team records the motion of the proton using high-speed cameras and measures its velocity as it strikes the plate. They are particularly interested in comparing the effect of the electric force to the gravitational force on the proton's motion. The mass of the proton is 1.67×10^{-27} kg and its charge is 1.6×10^{-19} *C*. **(*Ev*)**

(*i*) Calculate the force acting on the proton due to the electric field and compare it with the gravitational force acting on the proton.

(*ii*) Determine the acceleration of the proton due to the net force acting on it (consider both electric and gravitational forces).

(*iii*) Using the calculated acceleration, find the time it takes for the proton to hit the metallic plate.

OR

(*iii*) Compare the proton's final velocity when it reaches the plate with the velocity it would have attained if only gravitational force acted on it.

Hint & Solutions

Multiple Choice Questions

1. (*b*) Q_1 is positive and Q_2 is negative.

2. (*d*) Both statements *Q* and *S*

3. (*b*) Negative

4. (*c*) The electric field in *I* is the same everywhere but the electric field in *II* becomes stronger as we move from left to right.

5. (*d*) There is no such requirement. The total flux through the container is zero no matter what.

6. (*b*) The electric field strength at points closer to the end with higher x-values will be stronger than near the other end.

7. (*c*) The torque is maximum when the dipole is perpendicular to the field.

8. (*b*) The dipole experiences both a torque and a net force.

9. (*c*) The density of electric field lines decreases with distance from the charge, indicating a weakening electric field.

As shown in the figure, the field lines are denser and closer to the charge, representing a stronger field. As you move away, the lines spread out, representing a weakening field due to the inverse-square law.

Assertion Reason Type Questions

10. (*a*) When a charged particle is placed in a uniform electric field, it experiences a force in the direction of the field (if the charge is positive) or opposite to the direction of the field (if the charge is negative). Also, force is proportional to both the electric field and the charge, which correctly explains the assertion.

11. (*b*) According to Gauss's law, the electric flux Φ_E through a closed surface is directly proportional to the net charge *q* enclosed within that surface. This is mathematically expressed as $\Phi_E = \frac{q_{enclosed}}{\varepsilon_0}$, where ε_0 is the permitting of free space.

Also, electric field strength as electric flux is product of electric field and area. Although it does not correctly explain the assertion.

12. (*d*) The assertion is correct because a dipole is in stable equilibrium when its dipole moment is opposite the electric field, meaning a small displacement would cause a restoring torque. However, the reason is incorrect since a torque does act on the dipole when its moment is opposite to the field, trying to rotate it into alignment with the field.

13. (*a*) Assertion is correct because water molecules are polar and exhibit a permanent dipole moment even without an external electric field. Also, reason correctly explains that the dipole moment arises because the centers of positive and negative charges do not coincide, which is the primary reason for the polarity of water molecules.

14. (*a*) Even if the electric field is uniform the net flux depends on the enclosed charge (Gauss's law), and in the absence of charge inside the surface, the flux can be zero.

15. (*d*) While the number of field lines remains constant as per Gauss's law, the electric field strength decreases with the square of the distance, so it is not the same for spheres with different radii.

Very Short Answer Type Questions

16. (*a*) The graph shows that the potential *V* decreases as the distance *r* increases, which is consistent with the formula:

$$V = \frac{kQ}{r}$$ **(½M)**

This illustrates the inverse relationship, as *V* is directly proportional to $1/r$. **(½M)**

(*b*) We are given, $V = 5 \times 10^3$ V at $r = 1$

$\therefore$ Using formula, $V = \frac{kQ}{r}$ **(½M)**

$$Q = \frac{Vr}{k} = \frac{\left(5\times10^3\right)(1)}{9\times10^9} = 5.56\times10^{-7}\,\text{C}$$

$[\because K = 9\times 10^9\ \text{Nm}^2/\text{C}^2]$ **(½M)**

Targeting Higher-Order Competency Based Questions

Competency Type	Un	Re	Ap	An	Cr	Ev
No. of Qns.	387	99	340	326	93	262
Percentage	26%	06%	23%	22%	06%	17%

Students often find it difficult to solve understanding (Un), analysing (An), applying (Ap), creating (Cr), and evaluating (Ev) types of questions. Therefore, we have focused more on these question types and given less attention to remembering (Re) type questions, as the New Education Policy (NEP) encourages reducing the emphasis on rote memorization.

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1. **Limited Market Resources:** There is a scarcity of resources focusing specifically on competency - based questions related to real-life situations, making this book a valuable addition.

2. **Improves Exam Performance:** Since 50% paper consists of competency based questions, having a dedicated resource allows students to focus their study efforts strategically, improving their efficiency by practicing the exact types of questions.

3. **Score More:** To do well in board exams, students must be skilled at answering competency based questions from their chapters. Practicing with specific questions related to CBSE competency-based exams can help achieve this.

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