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BHOPAL REGION
Competency Based Test (2024-25)
Class XII Month: Junel-2024
Topic: Electrostatics Potential and Capacitance

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| 1 | Equipotential at a great distance from a collection of charges whose total sum is not zero are approximately<br>(A) Spheres.<br>(B) Planes.<br>(C) Paraboloids.<br>(D) Ellipsoids. |
| Ans | Option (A) is correct.<br>Explanation: For equipotential surfaces, these surfaces are perpendicular to the field lines. So there must be an electric field, which cannot be without charge. So the algebraic sum of all charges must not be zero. Equipotential surface at a great distance<br>means that space of charge is negligible as compared to distance. So the collection of charges is considered as a point charge.<br>Electric potential due to point charge is, V= Kq/r<br>which explains that electric potentials due to point charge is same for all equidistant points. The locus of these equidistant points, which are at the same potential, forms a spherical surface. |
| 2. | A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge<br>(A) remains a constant because the electric field is uniform.<br>(B) increases because the charge moves along the electric field.<br>(C) decreases because the charge moves along the electric field.<br>(D) decreases because the charge moves opposite to the electric field. |
| Ans | Option (C) is correct.<br>Explanation: As we know, an equipotential surface is always perpendicular to the direction of the electric field. Positive charge experiences the force in the direction of the electric field. When a positive charge is released from rest in uniform electric field, its velocity increases in the direction of electric field. So K.E. increases, and the P.E. decreases due to the law of conservation of energy. |
| 3. | The shape of equipotential surfaces due to an isolated charge is<br>a. Concentric spherical shells and the distance between the shells increases with the decrease in electric field<br>b. Concentric spherical shells and the distance between the shells decreases with the decrease in electric field<br>c. Equi-spaced concentric spherical shells<br>d. Changes with the polarity of the charge. |

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| Ans | Option (A) is correct.<br>Explanation: Concentric spherical shells and the distance between the shells increases with the decrease in electric field. It does not depend on the polarity of the charge.Q. |
| 4. | Capacitance of a parallel plate capacitor can be increased by<br>(A) Increasing the distance between the plates.<br>(B) Decreasing the distance between the plates.<br>(C) Decreasing the area of plates.<br>(D) Increasing the thickness of the plates. |
| Ans | Option (B) is correct.<br>Explanation: $C = k\varepsilon_0 A / d$ |
| 5. | A parallel plate capacitor is charged by connecting it to a battery. Which of the following will remain constant if the distance between the plates of the capacitor is increased in this situation?<br>(A) Energy stored<br>(B) Electric field<br>(C) Potential difference<br>(D) Capacitance |
| Ans | Option (C) is correct.<br>Explanation: As the battery remains connected with the capacitor, the potential difference remains constant. |
| 6. | A parallel plate condenser has a capacitance 50 μ F in air and 110 μF when immersed in an oil. The dielectric constant of the oil is<br>(A) 0.45<br>(B) 0.55<br>(C) 1.10<br>( D) 2.20 |
| Ans | Option (D) is correct.<br>Explanation: $k = C/C_0 = 110\ \mu F / 50\ \mu F = 2.20$ |
| 7. | A soap bubble is given negative charge, its radius will<br>a. Increase<br>b. decrease<br>c. remains unchanged<br>d. fluctuate |
| Ans | Option (A) is correct.<br>Explanation: Due to mutual repulsion of charges distributed on the surface of the bubble, the radius will increase. |

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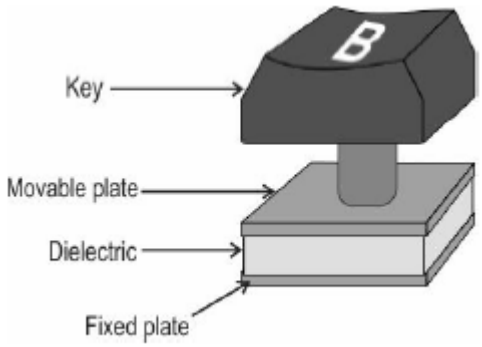
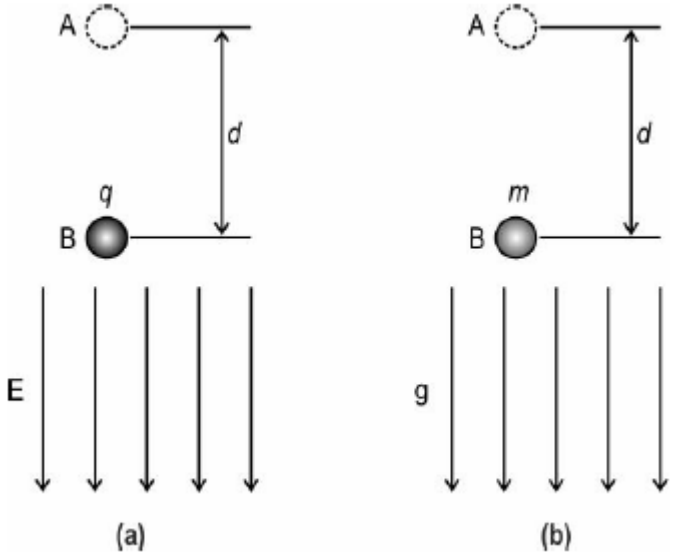
| 8. | In one kind of computer keyboard, each key is mounted on one end of a plunger. The other end of the plunger is attached to a movable metal plate. Refer to the figure given.<br>  <br><br>The dielectric material between the two plates is made of a soft material and is compressible. The combination of the two plates and the dielectric between them constitutes a capacitor.<br>Each key on the keyboard when pressed is recognized due to which one of the following factors?<br>A. The pressing of the key increases the capacitance of the capacitor below the key due to a decrease in separation between the plates.<br>B. The decrease in the thickness of the soft dielectric layer decreases the capacitance of the capacitor below the key.<br>C. The momentary decrease in the space between the plates of the capacitor is detected as a mechanical sound signal of a specific frequency.<br>D. all of the above |
| Ans | A. The pressing of the key increases the capacitance of the capacitor below the key due to a decrease in separation between the plates. |
| 9. | Given below are the representations of uniform electric and gravitational fields.<br>  <br> |

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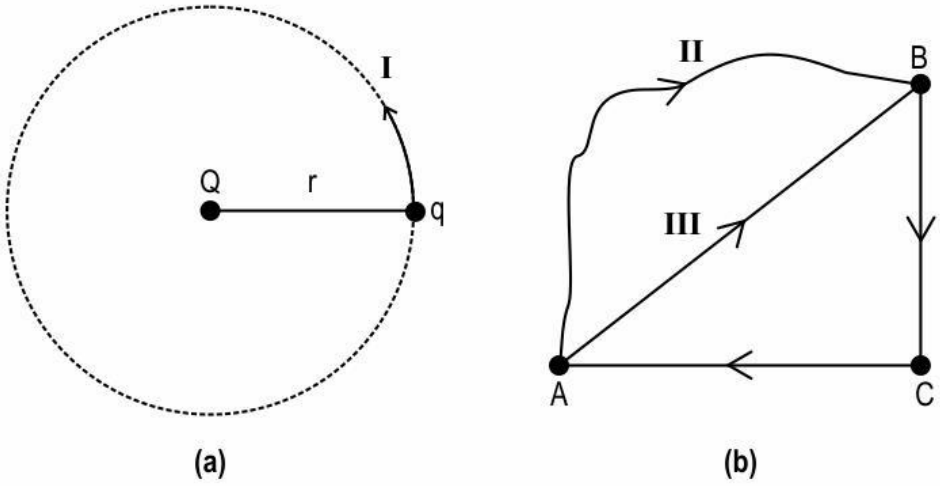
| | In fig (a), a positive charge q moves from A to B in the direction parallel to electric field E. The charge-field system undergoes a change in its electrical potential energy.<br>In fig (b), a mass particle m moves from A to B in the direction parallel to gravitational field g. The mass-field system undergoes a change in gravitational potential energy.<br>Identify the statement that correctly states the changes in the energies of the above two systems.<br>A. The charge-field system loses electrical potential energy whereas the mass-field system gains gravitational potential energy.<br>B. The charge-field system gains electrical potential energy whereas the mass-field system loses gravitational potential energy.<br>C. Both the charge-field system and the mass-field system lose their respective potential energies.<br>D. Both the charge-field system and the mass-field system gain their respective potential energies. |
| Ans | C. Both the charge-field system and the mass-field system lose their respective potential energies. |
| 10. | In Fig (a), a positive charge Q is located at a point. A unit test charge q moves along path I in one complete circle around Q.<br>In Fig (b), II and III represent the paths along which a unit test charge is moved from point A to B in the presence of an electrostatic field.<br>  <br><br>(a) (b)<br>Which of the following statements INCORRECTLY describes the work done in moving the unit test charge in the presence of an electric field in the above context?<br>A. Work done along path I is zero.<br>B. Total work done along path II and then along B – C – A is zero.<br>C. Work done along path II is more than the work done along path III.<br>D. Total work done along path III and then along B – C – A is EQUAL to the total work done along path II and then along B – C – A. |
| Ans | C. Work done along path II is more than the work done along path III. |

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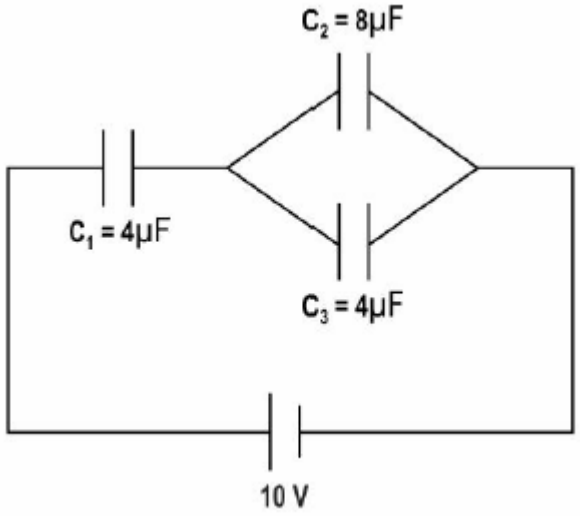
| 11. | Three capacitors C1, C2 and C3 are connected in a combination as shown below. Identify the correct statement(s).<br>  <br><br>(i) The charge on capacitor C1 is greater than that on capacitor C2.<br>(ii) The charge on capacitor C1 is the same as that on capacitor C3.<br>(iii) The charge on capacitor C1 is 30 μC.<br>A. Only (i) is correct.<br>B. Only (iii) is correct.<br>C. Both (i) and (iii) are correct.<br>D. Both (i) and (ii) are correct. |
| Ans | C. Both (i) and (iii) are correct. |
| 12. | Two statements are given below. One is labeled Assertion (A) and the other is labeled Reason (R). Read the statements carefully and choose the option that correctly describes statements A and R.<br>Assertion (A): The charge-to-voltage ratio increases on insertion of a dielectric material between the capacitor plates, when either the voltage or charge is kept constant.<br>Reason (R): The capacitance of a capacitor increases when it is filled with a dielectric material with a dielectric constant greater than 1.<br>A. Both assertion and reason are true and reason is the correct explanation for assertion.<br>B. Both assertion and reason are true and reason is not the correct explanation for assertion.<br>C. Assertion is true but the reason is false.<br>D. Assertion is false but reason is true. |
| Ans | A. Both assertion and reason are true and reason is the correct explanation for assertion. |
| 13. | Assertion: The electric potential is constant everywhere inside a charged conductor and is equal to its value at the surface.<br>Reason: A constant work has to be done to move a test charge from the interior of a charged conductor to its surface.<br>Select the correct option.<br>A. Both A and R are true and R is the correct explanation of A<br>B. Both A and R are true but R is NOT the correct explanation of A<br>C. A is true but R is false<br>D. A is false and R is also false |
| Ans | C. A is true but R is false |

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| 14. | An electron is introduced in a region of an electric field. The charge starts accelerating in the direction opposite to that of the field.<br>Which of the following statements is true?<br>A. The field does positive work on the electron and its potential energy increases.<br>B. The field does positive work on the electron and its potential energy decreases.<br>C. The field does negative work on the electron and its potential energy increases.<br>D. The field does negative work on the electron and its potential energy decreases. |
| Ans | B. The field does positive work on the electron and its potential energy decreases. |
| 15. | Assertion: The potential at a point is characteristic of the electric field at a point only whereas electric potential energy at a point is characteristic of the charge–field system.<br>Reason: The potential is independent of a charged test charge placed in the field and the electric potential energy is due to an interaction between the electric field at the point and the charged particle placed in the field at that point.<br>Select the correct option.<br>A. Both A and R are true and R is the correct explanation of A<br>B. Both A and R are true but R is NOT the correct explanation of A<br>C. A is true but R is false<br>D. A is false and R is also false |
| Ans | A. Both A and R are true and R is the correct explanation of A |