PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

ELEMENTARY PHENOMENA OF ELECTROSTATICS

Example

1. A hollow spherical conductor of radius 2 cm is charged with 62.8 statC. Determine the surface density of charge on the Inner and outer surfaces of the conductor. If the sphere be a solid one what will be the values of the above quantities?

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2. 27 drops of water, each of radius 3 mm and having equal charge are combined to form a

large drop. Find the ratio of the surface density of charge on the large drop to that on each small drop.

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3. A hollow spherical conductor of radius 2 cm is electrified with 20 statC. Determine the surface density of charge on the external surface of the conductor.

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Section Related Questions

1. What do you mean by electrified object ?

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2. What is an electric charge ?

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3. Name the different types of electric charge

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4. What is electrostatic series?

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5. Repulsion is the surer test of electrification - explain

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6. Explain the electronic theory of static electricity

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7. What is meant by quantisation of charge ?

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8. State the principle of conservation of electric charge

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9. What do you mean by electrical conductor and insulator ? Give examples

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10. What is the difference between a conductor and an insulator ?

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11. How can a body be charged by conduction ?

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12. How can free electron theory explain the phenomenon of charging by conduction ?

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13. What purpose a gold - leaf electroscope is used for ?

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14. What is a proof plane ?

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15. What do you mean by electrostatic induction ?

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16. What are inducing charge and induced charge ?

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17. What do you mean by bound charge and free charge?

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18. Induction precedes attraction .Explain

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19. Explain how can you make a hollow metallic body positively charged by the method of induction

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20. Charge always resides on the outer surface of a conductor ' - describe an experiment to prove it .

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21. What is an electric screen ?

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22. State the working principle of an electric screen

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23. Discuss an arrangement where the inner surface of a hollow conductor is charged.

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24. What is meant by surface density of charge ?

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25. Discuss where the surface density of charge will be maximum on a charged metal cube .

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26. What is a lightning arrester ? Explain the working principle of a lightning arrester .

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27. What should be the quanlities of a good lightning conductor ?

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Hots Questions

1. When an insulated charged spherical conductor is brought near a light, small spherical conductor suspended with a silk fibre, (i) it quickly comes and sticks in the

charged sphere and (ii) Instantly moves away and remains stationary In a deflected position explain the phenomena.

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2. State whether attraction can occur between two same kind of charges?

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3. If a charged ebonite rod is made to touch the disc of a gold-leaf electroscope, the leaves diverge. Then the rod is removed from the disc and it is found that the diver gence of the leaves decreases a little-explain.

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4. Why are gold leaves used in a gold-leaf electroscope?

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5. Where will the surface charge density be maximum in a charged cubical conductor?

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6. Why is the metal box of the gold-leaf electroscope earthed?

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7. Why is a drying agent kept inside a gold-leaf electroscope?

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8. Why should not a strongly charged body be brought very close to a gold-leaf electroscope?

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9. Can an alternating static charge at one end of an iso lated conductor, developed by an alternating current, be detected by a gold-leaf electroscope?

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10. Why it is not possible to electrify a metal rod by rub- bing while holding it with bare hand?

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11. How much is one safe while taking shelter in a vehicle for protection during lightning?

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12. How can charge be fully transferred from one spherical call conductor to another?

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13. Why it is not safe to stand under a tree during lightning?

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14. A spherical shell of charge +Q, has outer radius r_2 and inner radius r_1 . If a charge +q is placed at the centre of shell then what are the values of surface charge density of inner and outer surfaces?

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15. Charge of 3.2×10^{-7} C is obtained by rubbing a place of polythene with flannel. How many electrons are transferred? Is any mass transferred from flannel to polythene?

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16. Why does a spherical conductor retain its charge for a longer time in comparison with conductors of any other shape?

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17. Does a solid metallic sphere retain more charge than a hollow sphere of the same diameter?

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18. When a conductor is charged, its charge resides on its outer surface. What is the reason?

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19. What is the minimum amount of charge acquired by a charged body? The charge of a body is 5.6×10^{-14}C - justify It.

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20. Can charge reside on the inner surface of a hollow conductor? Explain.

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21. An isolated metallic conductor is positively charged. Did its mass increase, decrease or remain the same? How will the mass of the conductor change if it is negatively charged?

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22. A sensitive instrument is influenced by a nearby strong electric field. Suggest a possible way to prevent the influence.

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Ncert Textbook Questions

1. Explain the meaning of the statement 'electric charge of a body is quantised'

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2. Why can one ignore quantisation of electric charge when dealing with macroscopic i.e., large scale charges?

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3. A polythene piece rubbed with wool is found to have a negative charge of 3×10^{-7} C. Estimate the number of electrons transferred (from which to which?)

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4. A polythene piece rubbed with wool is found to have a negative charge of 3×10^{-7} C.

Is there a transfer of mass from wool to polythene?

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5. When a glass rod is rubbed with a silk cloth, charges appear on both. A similar phenomenon is observed with many other pairs of bodies. Explain how this observation is consistent with the law of conservation of charge.

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Exercise

1. A positively charged glass rod attracts a light hanging body and thereafter repels it. The hanging body initially was

A. negatively charged

B. positively charged

C. uncharged

D. earth-connected

Answer: C

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2. Five balls marked by numbers from 1 to 5 are hung by different threads. It is seen that the pairs of the balls (1,2), (2, 4), (4,1) attract each other. Again the pairs (2,3) and (4,5) repel each other. So the ball marked by 1 is

A. positively charged

B. negatively charged

C. uncharged

D. made by a metal

Answer: C

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3. The charges of the clouds responsible for lightning are duced due to

A. conversion of raindrops into electrons

B. the electric field of the earth

C. creation of ions by the sun

D. friction among the water drops

Answer: D

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4. 10^6 electrons are given to a pith ball. The charge of the ball will be

A. $1.6 \times 10^{-13} C$

B. $1.6 \times 10^{-19} C$

C. 1.6×10^{-25} C

D. none of the above

Answer: A

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5. A glass rod rubbed with silk becomes positively charged because

A. protons are added to the glass rod

B. protons are removed from the glass rod

C. electrons are added to the glass rod

D. electrons are removed from the glass rod

Answer: D

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6. Two identical metallic spheres of the same mass are taken. Positive Q C charge is developed on one and an equal amount of

negative charge is developed on the other. After charging

A. the two spheres will have equal mass

B. the sphere charged negatively will have a greater mass

C. the sphere charged positively will have a greater mass

D. the sphere charged negatively will have a smaller mass

Answer: B

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7. If a body is charged by rubbing, its weight

A. does not charge

B. increase a little

C. decrease a little

D. may increase or decrease a little

Answer: D

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8. If the charge of an electron be 1.6×10^{-19} C, which one of the following cannot be the charge of a body?

A. 3.2×10^{-10} C

B. 4.8×10^{-12} C

C. 5.6×10^{-19} C

D. 1.6×10^{-19} C

Answer: C

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9. Electrostatic induction can be brought about

A. in conductors only

B. in insulators only

C. in bad conductors only

D. in both conductors and insulators

Answer: D

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10. Two charged spheres attract each other with a force. If they are touched with each other and thereafter brought back to their initial positions, the two spheres

A. attract each other with a smaller force

B. attract each other with a greater force

C. Repel each other with a smaller force

D. Repel each other with a greater force

Answer: C

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11. Charge of a conductor resides on the outer surface of it. This statement is correct

A. in all cases

B. in case of solid and hollow conductors

C. in case of only spherical conductors

D. in case of the conductors having no pointed ends

Answer: A

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12. With respect to a hollow sphere, a solid metallic sphere of the same radius will retain

A. more charge

B. less charge

C. equal amount of charge

D. none of the above

Answer: C

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13. The unit of surface density of charge in SI is

A. C

B. $C.M^{-1}$

C. $C.m^{-2}$

D. Cm^{-3}

Answer: C

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14. The diameter of a hollow conducting sphere is 2 cm. If the sphere has 12.56 unit charge, the surface density of charge in its inner surface in CGS unit is

A. 0

B. 1

C. 12.56

D. 6.28

Answer: A

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15. If a glass rod be rubbed with silk, what kind of charge is produced on the rod?

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16. If an ebonite rod be rubbed with flannel, what kind of charge is produced on the rod?

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17. A, B and C are three charged bodies. If A and B repel each other and A attracts C, what will be the nature of the force acting between B and C?

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18. Two point charges q_1 and q_2 are such that $q_1 q_2 < 0$. What is the nature of the force acting between the two charges?

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19. What is the number of electrons in 1C charge?

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20. _____ is the surmer test of electrification.

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21. In SI, the amount of charge of an electron is_____

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22. The charge on an electron is the_____ magnitude of charge in nature.

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23. If a body has 1.5×10^7 number of excess electrons, what is the charge on the body?

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24. If 10^{22} electrons are transferred from a metallic sphere, what will be the charge of the sphere?

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25. Write the name of a good conductor.

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26. Write the name of an insulator.

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27. Dry air is a good_____

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28. Diamond, ebonite, bakelite -these are _____ of electric ity.

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29. What kind of charges are produced at the near end and at the far end of a conductor due to induction?

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30. If complete induction takes place, the amount of the inducing charge and that of the induced charge become _____

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31. In case of electrostatic induction there should be a _____ between the charged body and the uncharged body.

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32. _____precedes attraction.

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33. Which is the appropriate season for performing experi ments on statical electricity?

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34. Where does the charge of a conductor reside?

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35. What should be the shape of a conductor to retain its charge?

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36. If a cubical conductor be charged, where will the surface density of charge be maximum?

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37. Is it safe or unsafe to remain inside a car at the time of lightning?

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38. Greater is the _____ of a region of a conductor, ____ is the accumulation of charge at that region.

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39. In case of a _____ conductor the surface density of charge is equal everywhere.

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40. Charge resides only on the_____ of a conductor.

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41. Why are two metal plates placed on the two inner sides of a gold-leaf electroscope?

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42. Charging of a gold-leaf electroscope by the process of _____ is not a good process.

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43. If the charge of an experimental body and that of a gold- leaf electroscope are of the same nature, the divergence of the leaves of the gold-leaf electroscope will _____

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44. To determine the nature of charge of a body it is brought _____ to a charged electroscope from a distance.

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45. Why should not a strongly charged body be brought very close to a gold-leaf electroscope?

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46. Why are gold leaves used in a gold-leaf electroscope?

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47. What makes a conductor different from an insulator?

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48. Why cannot the experiments on statical electricity be performed accurately in rainy

season?

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49. Why are electrical wires covered with non-conducting materials?

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50. Why does a spherical conductor retain its charge for a long time in comparison with the conductors of any other shape?

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51. Why is it not possible to charge a metal rod holding it in hand? What will you do to charge the rod?

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52. What is the utility of the drying agent inside a gold-leaf electroscope?

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53. Charging a gold-leaf electroscope by conduction is inferior to the method of charging by induction-explain.

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54. Can two similarly charged balls be attracted by each other? If yes, explain how.

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55. To charge a gold-leaf electroscope by induction, the inducting charge should be brought slowly near the electroscope from a large distance why?

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56. Bound charges can reside inside a hollow conductor. Explain.

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57. A charged glass rod is brought near a pin fixed with the disc of a gold-leaf electroscope and is then withdrawn. State and explain what may be observed.

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58. "There exists no sharp line separating conductors from insulators."-Explain.

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59. How it is possible to transfer whole of the charge on an insulated conductor to another insulated conductor.

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60. You are given a negatively charged pith ball, hanging from a string, and a non-conducting rod. As you bring the rod near the ball you find that the ball is attracted towards the rod. From this experiment it is not possible for you to determine whether the rod

is charged positively or neutral. Why not? What additional experiment would you propose to conduct to decide between these two possibilities?

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61. A body has $-80\mu C$ charge. What is the number of excess electrons in the body?

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62. A conductor is charged with 14.4×10^{-19} C. Determine the number of deficit of electrons in it. What will be the change in mass of the conductor?

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63. How much charge is to be given to a sphere of radius 30 cm so that its surface density of charge will be $\frac{2}{\pi}$ CGS unit?

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64. The surface area of a body is $25cm^2$ and its surface density of charge is 5 CGS unit. What is the total charge on it?

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65. What will be the surface density of charge of a sphere of radius 4 cm, if it is given 182 esu of charge?

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66. Two spheres of radii 4 cm and 8 cm have the same amount of charge. Determine the ratio of their surface densities of charge.

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67. The diameter of a sphere is 2 cm. The sphere is hollow and conducting and is given a charge of 6.16 units. Determine the surface density of charge of the sphere on its outer and inner surfaces in CGS unit.

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68. 64 equally charged water-droplets, each of radius 4 mm, are combined to form a large water-drop. Determine the ratio of the surface densities of charges in the two cases.

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69. The ratio of the radii of two spheres is 5:2 and that of their charges is 5:3. Determine the

ratio of the surface densities of charge of the two spheres.

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Entrance Corner

1. Statement I: If there exists attraction between two bodies, both of them may not be charged.

Statement II: A charged body can attract a neutral body.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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2. Statement I: Mass of a body decreases slightly when it is negatively charged.

Statement II: Charging is due to transfer of electrons.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation

for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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3. Statement I: Total charge on a body is the algebraic sum of charges located at different points of the body.

Statement II: Electric charge is additive in nature.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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4. Statement I: The tyres of an aircraft are slightly conducting.

Statement II: If a conductor is grounded, the extra charge induced on the conductor will flow to the ground.

A. Statement I is true, statement II is true, statement II is a correct explanation for

statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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5. Statement I: The top of a lightning conductor of a high building has sharp pointed ends.

Statement II: The surface density of charge at sharp points is very high, resulting in setting up of an electric wind.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true, statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: A

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6. Two identical metallic spheres are given charges +q and -q respectively. Now,

(A) Both spheres have equal masses

(B) The mass of the positively charged sphere is less than the negatively charged one.

(C) The mass of the negatively charged sphere is less than positively charged one.

(D) The change in the masses depends on the magnitude of charge transfer.

A. both spheres have equal masses

B. the positively charged sphere has a mass smaller than that of the negatively charged sphere

C. the negatively charged sphere has a mass smaller than that of the positively charged sphere

D. the change in the masses depends on the magnitude of charge transfer

Answer: B,D

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7. A spherical conductor A lies inside a hollow spherical conductor B. Charge Q_1 and Q_2 are given to A and B respectively.

A. charge Q_1 will appear on the outer surface of A

B. charge $-Q_1$ will appear on the inner surface of B

C. charge Q_2 will appear on the outer surface of B

D. charge $Q_1 + Q_2$ will appear on the outer surface of B

Answer: A,B,D

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8. Minimum quantity of charge available in nature is

A. 1 C

B. 4.8×10^{-13} C

C. 1.6×10^{-19} C

D. 4.8×10^{-10} esu

Answer: C,D

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9. A, B and C are three concentric metallic shells. Shell A is the innermost and shell C is the outermost. A is given some charge.

A. the inner surfaces of B and C will have the same charge

B. the inner surfaces of B and C will have the same surface density of charge

C. the outer surface of A,B and C will have the same charge

D. the outer surfaces of A , B and C will have the same surface density of charge

Answer: A,C

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10. Match column I with column II

Column I	Column II
(i) Conservation of electric charge is	Ⓐ electric charge
(ii) Quantisation is the property of	Ⓑ universal
(iii) Quantisation is not the property of	Ⓒ independent of the frame of reference
(iv) Amount of electric charge is	Ⓓ mass

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11. Match column I with column II

Column I	Column II
(i) Safe shelter during lightning	Ⓐ stray tall trees
(ii) Rubbing produces simultaneously	Ⓑ equal and opposite charges
(iii) Electrostatic induction takes place	Ⓒ building on metal frame
(iv) Unsafe place during lightning	Ⓓ unequal and opposite charges
	Ⓔ both in conductor and in insulator

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12. A glass rod when rubbed with silk acquires a charge of $+3.2 \times 10^{-7}$C.

Amount of charge on the silk is

A. 0

B. -3.2×10^{-7} C

C. $+1.6 \times 10^{-7}$ C

D. not possible to calculate

Answer: B

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13. A glass rod when rubbed with silk acquires a charge of $+3.2 \times 10^{-7}$C.

Transfer of mass from glass rod to silk is

A. 9×10^{-19} kg

B. 0

C. 18×10^{-19} kg

D. none of the above

Answer: C

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14. A hollow spherical conductor of radius 3 cm is charged with a charge of 36πC.

The surface density of charge on the inner surface of the hollow conductor is

A. 1C. cm^{-2}

B. 0

C. $10^4 C. cm^{-2}$

D. ∞

Answer: B

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15. A hollow spherical conductor of radius 3 cm is charged with a charge of 36πC.

The surface density of charge on the outer surface of the hollow conductor is

A. 0

B. $1C.m^{-2}$

C. $10^4C.m^{-2}$

D. ∞

Answer: C

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16. A hollow spherical conductor of radius 3 cm is charged with a charge of 36πC.

If the hollow sphere be a solid one , the surface density of charge on its outer surface is

A. 0

B. $1C.m^{-2}$

C. ∞

D. $10^4C.m^{-2}$

Answer: D

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17. An insulated spherical conductor of radius l m is charged with a positive charge of $8\pi C$. What is the surface density of charge on the surface of the conductor in C.m^{-2}?

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18. The surface area of a body is $10cm^2$ and its surface density of charge is 0.4 unit/cm^2. What is the total charge on it?

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19. A body has -0.8×10^{-18}C charge. What is the number of excess electrons in the body?

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20. A cube of side 2 cm has 72μ C charge. What is the average surface density of charge of the cube in $\mu C.\, cm^{-2}$?

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Examination Archive

1. Define surface density of electric charge

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2. The number of electrons in 2 C of charge is

A. 12.5×10^{-18}

B. $12.5 \times 10(-19)$

C. 12.5×10^{18}

D. 12.5×10^{19}

Answer: C

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