Electric Charges, Quantization of Charge, and Conservation of Charge

Theoretical Questions

1. **Which of the following is true about electric charge?**
   a) Charge is a scalar quantity.
   b) Charge is always conserved.
   c) Charge can exist without mass.
   d) Charge is quantized in nature.

2. **The quantization of charge implies:**
   a) Charge can take any continuous value.
   b) Charge is always an integral multiple of the elementary charge e.
   c) Charge is always positive.
   d) Charge is not conserved.

3. **Which of the following is NOT a property of electric charge?**
   a) Additivity
   b) Quantization
   c) Conservation
   d) Independence of inertial frame

4. **The law of conservation of charge states that:**
   a) Charge can be created but not destroyed.
   b) Charge can be destroyed but not created.
   c) The total charge in an isolated system remains constant.
   d) Charge is always neutral.

5. **Two identical metallic spheres carry charges of $+5\,\mu C$ and $-3\,\mu C$. If they are brought into contact and separated, what will be the charge on each sphere?**
   a) $+1\,\mu C$
   b) $+2\,\mu C$
   c) $-1\,\mu C$
   d) $+4\,\mu C$

6. **Which of the following is true about the elementary charge e?**
   a) $e = 1.6 \times 10^{-19}\,C$
   b) $e = 1.6 \times 10^{-19}\,J$
   c) $e = 1.6 \times 10^{-19}\,eV$
   d) $e = 1.6 \times 10^{-19}\,N$

7. **The charge on an electron is:**
   a) Positive
   b) Negative
   c) Neutral
   d) Variable

8. **Which of the following is NOT a method of charging?**
   a) Conduction
   b) Induction
   c) Friction
   d) Radiation

9. **When a glass rod is rubbed with silk, the rod becomes positively charged because:**
   a) Electrons are transferred from the rod to the silk.
   b) Protons are transferred from the silk to the rod.
   c) Electrons are transferred from the silk to the rod.
   d) Protons are transferred from the rod to the silk.

10. **The SI unit of charge is:**
    a) Coulomb
    b) Ampere
    c) Volt
    d) Ohm

Numerical Questions

11. **How many electrons are there in $1\,C$ of charge?**
    a) 6.25×10^{18}
    b) 1.6×10^{19}
    c) 6.25×10^{19}
    d) 1.6×10^{18}

12. **A charge of $3.2 \times 10^{-19}\,C$ is:**
    a) Equal to the charge of one electron.
    b) Equal to the charge of two electrons.
    c) Equal to the charge of one proton.
    d) Not possible as it violates quantization of charge.

13. **Two charges $+4\,\mu C$ and $-6\,\mu C$ are separated by a distance of $2\,m$. What is the net charge of the system?**
    a) $-2\,\mu C$
    b) $+2\,\mu C$
    c) $-10\,\mu C$
    d) $+10\,\mu C$

14. **A body has a charge of $-6.4 \times 10^{-19}\,C$. How many excess electrons does it have?**
    a) 2
    b) 4
    c) 6
    d) 8

15. **If 10^{10} electrons are removed from a neutral body, the charge on the body becomes:**
    a) $+1.6 \times 10^{-9}\,C$
    b) $-1.6 \times 10^{-9}\,C$
    c) $+1.6 \times 10^{-19}\,C$
    d) $-1.6 \times 10^{-19}\,C$

16. **A charge of $8\,\mu C$ is divided into two parts such that the force between them is maximum. What is the charge on each part?**
    a) $4\,\mu C$ and $4\,\mu C$
    b) $6\,\mu C$ and $2\,\mu C$
    c) $5\,\mu C$ and $3\,\mu C$
    d) $7\,\mu C$ and $1\,\mu C$

17. **A body has a charge of $4.8 \times 10^{-19}\,C$. Is this possible?**
    a) Yes, because it is an integral multiple of e.
    b) No, because it violates quantization of charge.
    c) Yes, because it is a fraction of e.
    d) No, because it is too small.

18. **Two identical conducting spheres carry charges of $+2\,\mu C$ and $-6\,\mu C$. When they are brought into contact and separated, what is the charge on each sphere?**
    a) $-2\,\mu C$
    b) $-4\,\mu C$
    c) $+2\,\mu C$
    d) $+4\,\mu C$

19. **A charge of $1\,C$ is equivalent to the charge of how many protons?**
    a) 6.25×10^{18}
    b) 1.6×10^{19}
    c) 6.25×10^{19}
    d) 1.6×10^{18}

20. **A body has a charge of $-3.2 \times 10^{-19}\,C$. How many excess electrons does it have?**
    a) 1
    b) 2
    c) 3
    d) 4

Answers and Explanations

1. **b) Charge is always conserved.**
   Explanation: Charge is conserved in all physical processes.

2. **b) Charge is always an integral multiple of the elementary charge e.**
   Explanation: Quantization means charge exists in discrete packets of e.

3. **d) Independence of inertial frame.**
   Explanation: Charge is frame-dependent in relativistic scenarios.

4. **c) The total charge in an isolated system remains constant.**
   Explanation: Conservation of charge is a fundamental law.

5. **a) $+1\,\mu C$**
   Explanation: Charges redistribute equally: $\frac{+5\,\mu C + (-3\,\mu C)}{2} = +1\,\mu C$.

6. **a) $e = 1.6 \times 10^{-19}\,C$**
   Explanation: Elementary charge is $1.6 \times 10^{-19}\,C$.

7. **b) Negative**
   Explanation: Electrons carry a negative charge.

8. **d) Radiation**
   Explanation: Radiation is not a method of charging.

9. **a) Electrons are transferred from the rod to the silk.**
   Explanation: Rubbing transfers electrons, leaving the rod positively charged.

10. **a) Coulomb**
    Explanation: SI unit of charge is Coulomb.

11. **a) 6.25×10^{18}**
    Explanation: $1\,C = 6.25 \times 10^{18}$ electrons.

12. **b) Equal to the charge of two electrons.**
    Explanation: $3.2 \times 10^{-19}\,C = 2e$.

13. **a) $-2\,\mu C$**
    Explanation: Net charge $= +4\,\mu C + (-6\,\mu C) = -2\,\mu C$.

14. **b) 4**
    Explanation: $n = \frac{6.4 \times 10^{-19}}{1.6 \times 10^{-19}} = 4$.

15. **a) $+1.6 \times 10^{-9}\,C$**
    Explanation: Removing electrons leaves a positive charge: $10^{10} \times 1.6 \times 10^{-19} = 1.6 \times 10^{-9}\,C$.

16. **a) $4\,\mu C$ and $4\,\mu C$**
    Explanation: Force is maximum when charges are equal.

17. **b) No, because it violates quantization of charge.**
    Explanation: $4.8 \times 10^{-19}\,C$ is not an integral multiple of e.

18. **a) $-2\,\mu C$**
    Explanation: Charges redistribute equally: $\frac{+2\,\mu C + (-6\,\mu C)}{2} = -2\,\mu C$.

19. **a) 6.25×10^{18}**
    Explanation: $1\,C = 6.25 \times 10^{18}$ protons.

20. **b) 2**
    Explanation: $n = \frac{3.2 \times 10^{-19}}{1.6 \times 10^{-19}} = 2$.