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Review Sheet – Electrostatics

1. Read chapters 16, 17
2. **Terms to know**: neutral, positive ion, negative ion, grounding, leakage, polar, conduction, induction, electroscope, coulomb, point charge, inverse square law, Millikan's Oil Drop experiment, uniform electric field, two parallel plates, alpha particle, electric potential energy.

3. **Define:** *a) electric field* a region in space surrounding a charged object in which a second charged object experiences an electric force
   b) electric field strength Electric force per unit charge exerted on a small positive test charge
   d) electric potential amount of electric potential energy per unit charge

   e) electronvolt the amount of energy gained (or work done) moving an electron through a potential difference of one volt

   c) capacitance ratio of charge stored to potential difference

4. **State:** The Law of Conservation of Electric Charge The total electric charge of an isolated system remains constant.

5. **State:** Coulomb's Law The electrostatic force between two charged objects is directly proportional to the product of the two charges and inversely proportional to the square of the distance between their centers and acts along a line joining their centers.

$$F_e = \frac{kq_1q_2}{r^2}$$

6. What is an "elementary charge?" proton or electron - fundamental increment of charge
7. What is the only particle normally transferred when an object is charged? an electron

8. a) State the two units for electric charge. [Elementary charge] or [Coulomb]

   b) State the value of the charge on an electron using both units stated in part (a).
   $q = -1.60 \times 10^{-19}$ C or - 1 e.c.

   c) State the value of the charge on a proton using both units stated in part (a).
   $q = +1.60 \times 10^{-19}$ C or + 1 e.c.

   d) State the value of the mass of an electron and a proton.
   $m_p = 1.67 \times 10^{-27}$ kg $m_e = 9.11 \times 10^{-31}$ kg

9. When an object is charged by conduction, what charge does it acquire *compared to charging rod*??
   The same type of charge the 'charging' object has
10. When an object is charged by induction, what charge does it acquire *compared to charging rod*?
    The opposite type of charge the 'charging' object has

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11. How is a conductor different from an insulator?
    Charges (electrons) are relatively free to move around inside the material

12. a) A neg. charged rod repels a 2nd object. What can you conclude about the object?
    The object is negative

    b) A neg. charged rod attracts a 2nd object. What can you conclude about the 2nd object?*think! The object is positive OR neutral

13. Explain what is meant when an object is said to be "polar."
    the object may be neutral, but there is an internal charge separation, so one end is positive and one is negative

14. What is the general rule for determining the final charge on each object when two or more charged objects are touched together?
    The final type of charge is that of whichever had a larger charge to begin with

15. Explain the following statement: "Electric charge is quantized."
    Charge only comes in 'increments' equal to the charge of a proton or electron\

16. Predict what will happen to the leaves of an electroscope when a negatively charged rod is brought near a
    a) neutral electroscope - move apart

    b) positively charged electroscope - move together

    c) negatively charged electroscope - move apart

17. How many elementary charges are in one coulomb of charge?
    1 C = 6.25 x 10^{18} elementary charges

18. How can you determine if a particular value of charge is possible for an object?
    divide by elementary charge and see if a whole number

19. Compare and contrast the electric force with the gravitational force.
    Both $1/r^2$, both product of mass or charge
    Electric force attractive *or* repulsive (and very strong)
    Gravitational force only attractive (and weak)

20. How does the electrostatic force between two charges change if
    a) the distance between them is doubled? x1/4
    b) one charge is doubled? x2
    c) both charges are doubled? x4
    d) the distance between them is halved? x4

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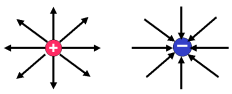
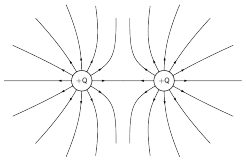
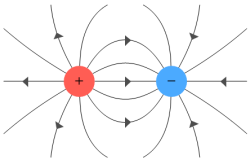
21. Draw the electric field lines around:
    a) a single positive charge
    b) a single negative charge



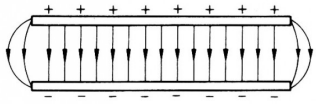
    c) two like charges



    d) two unlike charges



    e) two parallel plates



22. Be able to draw electric force vectors and electric field vectors.

23. State the conversion factor between joules and electronvolts.
    1.60×10^{-19} J = 1 eV

24. An electronvolt is a measure of: (choose one)
    force voltage **energy** power field strength potential differencee

25. Be able to determine the final speed of a charged particle moving between two parallel plates by a) the net force method and b) the energy method.

26. Be able to draw the electric field between two parallel plates. Why is it called a uniform electric field? The field is constant (except near the edges)

27. What physical properties does the capacitance of a capacitor depend on?
A - area of plates, d - distance between plates, ε - material between plates (permittivity)

28. What are the formulas for:

    a) the capacitance of a capacitor (2 formulas)?
    $C = Q/V$, $C = \varepsilon A/d$

    b) the energy stored in a capacitor (2 formulas)?
    Energy = $Q * V_{avg}$, Energy = $Q (1/2 V_{max})$

29. For two parallel plates, what is the formula for:
    a) the electric field? b) the potential difference?
    E = V/d V =

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For each quantity below, state symbol, unit, formula(s), and (vector/scalar)				
Quantity	**Symbol**	**Unit**	**Formula(s)**	**Type**
Electric field strength (intensity)	**E**	2 sets of units [N/C] [V/m]	**$E = F/q = kq/r^2$ (for point charge) $E=V/d$**	**vector**
Electric force	**F**	**[N]**	**$F=qE=kqq/r^2$**	**vector**
Electric potential energy	**E_p**	2 sets of units [J], [eV]	$E_p=qV$	**scalar**
Electric potential (potential difference, voltage)	V	2 sets of units [J/c] = [V]	$V=E_p/q$	**scalar**
Capacitance	C	2 sets of units [c/V] = [F]	C = Q/V	**scalar**

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Don't confuse the unit [c] coulomb (for electric charge) with the quantity C (capacitance)

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Don't confuse **E** (electric field) with E_p (electric potential energy)