Electric Charges and Fields: Chapter Introduction

A rubbed comb lifts paper bits without touching them. Rubbing moves electrons, a charged body attracts even neutral paper by induction, and every charge reaches out through its electric field.

Name: Date: Score: ____ / 21

A. Fill in the blanks

1. Rubbing a plastic comb with dry hair transfers ____ to the comb.

2. Like charges ____ each other.

3. A charged body attracting a neutral body is explained by ____.

4. In Coulomb's law, the force varies inversely as the ____ of the distance.

5. Electric field lines start on ____ charges and end on negative charges.

B. True or False

6. A neutral piece of paper cannot be attracted by a charged comb. True / False

7. Unlike charges attract each other. True / False

8. Two electric field lines can cross each other. True / False

9. Doubling the distance between two charges halves the force. True / False

C. Assertion and reason

10. Assertion (A): A charged comb attracts small bits of paper.
Reason (R): Charges in the paper shift, so the nearer side is oppositely charged.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

11. Assertion (A): Field lines from a positive charge point outward.
Reason (R): Field lines start on positive charges.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

D. Choose the correct option

12. A comb rubbed with dry hair becomes negative because it:

(a) loses protons
(b) gains electrons
(c) loses electrons
(d) gains protons

Answer: _____

13. If both charges are doubled and the distance is unchanged, the force becomes:

(a) 2F (b) 4F

(c) F/2 (d) F/4

Answer: _____

14. The SI unit of electric charge is the:

(a) ampere (b) coulomb

(c) volt (d) newton

Answer: _____

15. The force on a charge q_0 in an electric field E is:

(a) E/q_0 (b) q_0E

(c) q_0/E (d) q_0^2E

Answer: _____

E. Numerical problems

16. Two charges exert a force of 36 N on each other. Find the force when the distance between them is tripled.

17. Find the force between two charges of 1 μC each placed 0.3 m apart in air ($k = 9 \times 10^9$ N m² C^{-2}).

18. A charge of 2 μC is placed in a field of 5×10^3 N/C. Find the force on it.

F. Short answer questions

19. Explain why a rubbed comb lifts bits of paper.

20. What is an electric field? How does it explain force without contact?

G. Match the columns

21. Match each item in Column A with the correct item in Column B.

Column A	Column B	Your answer
1. Like charges	(a) Electric field lines	1 → ____
2. Unlike charges	(b) Attract	2 → ____
3. $F \propto 1/r^2$	(c) Repel	3 → ____
4. Lines from + to −	(d) Coulomb's law	4 → ____

Detailed solutions

1. electrons

2. repel

3. induction

4. square

5. positive

6. False. Induction makes the nearer side oppositely charged, so it is attracted.

7. True. One of the basic properties of charge.

8. False. At a crossing the field would have two directions, which is impossible.

9. False. $F \propto 1/r^2$, so the force becomes one-fourth.

10. (a) R is the induction that explains A.

11. (a) R explains the direction in A.

12. (b) gains electrons. Only electrons move when bodies are rubbed.

13. (b) 4F. $F \propto q_1 q_2$, so it becomes $2 \times 2 = 4$ times.

14. (b) coulomb. Charge is measured in coulombs.

15. (b) q_0E. $F = q_0E$.

16. $F \propto 1/r^2$; $F' = 36 \div 3^2 = 36 \div 9$. **Answer: 4 N**

17. $F = k\, q_1 q_2 / r^2 = 9 \times 10^9 \times (1 \times 10^{-6})^2 / (0.3)^2$; $= 9 \times 10^{-3} / 0.09$. **Answer: 0.1 N**

18. $F = qE = 2 \times 10^{-6} \times 5 \times 10^3$. **Answer: 1×10^{-2} N = 0.01 N**

19. Rubbing transfers electrons from the hair to the comb, so the comb is negative. Near it, charges in the neutral paper shift: positive charge nearer, negative farther. The nearer attraction is stronger than the farther repulsion, so the paper is pulled up (induction).

20. The region around a charge where another charge experiences a force; $E = F/q_0$. The charge does not need to touch: its field exists in the space around it and acts on any charge placed there.

21. 1 → (c), 2 → (b), 3 → (d), 4 → (a). Each idea matches its rule from the chapter introduction.