

Xerographic Copiers

Turn off all electronic devices

Observations About Copiers

- Copiers consume colored powder or “toner”
- After jams, you can sometimes wipe off the powder images
- Copiers are often warm after being made
- Copiers are sometimes clingy with static electricity

3 Questions about Xerographic Copiers

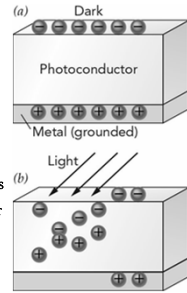
- How can light arrange colored powder on paper?
- How does a copier spray charge onto a surface?
- How does a copier make its copies permanent?

Question 1

Q: How can light arrange colored powder on paper?
 A: That light can control static electricity.

In a xerographic copier or printer,

- charge is sprayed onto an insulating layer
- opposite charge flows onto the layer's back
- the layer acts as a charged capacitor
- light selectively erases the separated charge
- the remaining charge attracts toner particles
- the toner particles are then bonded to paper



Question 2

Q: How does a copier spray charge onto a surface?

A: It uses a corona discharge to charge the air

A fine wire having a large voltage (either + or -)
 ♦ is covered with tightly packed “like” charges

The repulsive forces are so intense, they push charges into the air
 ♦ the charges are ferried by air particles (atoms, molecules, or even dust)
 ♦ this flow of charge into the air is a corona discharge

That discharge is caused by a strong electric field

Electric Field

Two views of electrostatic forces:

- Charge₁ pushes on Charge₂
- Charge₁ creates electric field that pushes Charge₂

Electric field isn't a fiction; it actually exists!

- a structure in space and time that pushes on charge
- a vector field: a vector at each point in space and time
- observed using a + test charge at each point

Voltage Gradient

A + test charge accelerates along

- ◊ electric field at the charge's position
- ◊ path that reduces the charge's total potential energy quickest

Voltage is electrostatic potential energy (EPE) per charge

- ◊ Voltage gradient is a spatial variation or "slope" in voltage
- ◊ A + test charge accelerates down a voltage gradient!

A voltage gradient is an electric field

- ◊ electric field points in the direction opposite the voltage gradient

Metals, Fields, & Corona Discharges

Inside a metal, charge can move

- ◊ At equilibrium: voltage is uniform, electric field is zero
- ◊ Charge resides only on the metal's surface

Outside a metal, charge cannot move

- ◊ At equilibrium: both voltage and electric field can vary

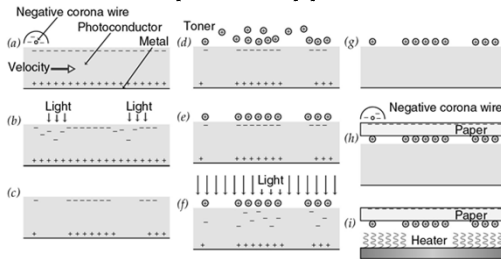
In the space near a thin wire or sharp point at large voltage,

- ◊ voltage varies rapidly with distance, so big electric field
- ◊ charge is pushed into the air: a corona discharge

Question 3

Q: How does a copier make its copies permanent?

A: It fuses or melts the powder onto the paper.



Summary about Xerographic Copiers

It sprays charge from a corona discharge

That charge precoats a special insulating surface

It projects a light onto surface

The charge escapes from illuminated regions

The remaining charge attracts toner particles

Those particles are fused to the paper as a copy