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
Copies are often warm after being made
Copies are sometimes clingy with static electricity

3 Questions about Xerographic Copiers

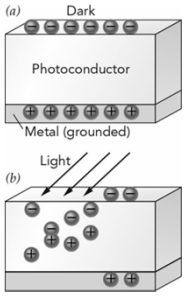
1. How can light arrange colored powder on paper?
2. How does a copier spray charge onto a surface?
3. How does a copier make its copies permanent?

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:

- $Charge_1$ pushes on $Charge_2$
- $Charge_1$ creates electric field that pushes $Charge_2$

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

Voltage is electrostatic potential energy per charge
- decreasing voltage is decreasing electrostatic potential energy
- the path of quickest electrostatic potential decrease is (–) voltage gradient
- voltage gradient is essentially the (rising) slope of voltage

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

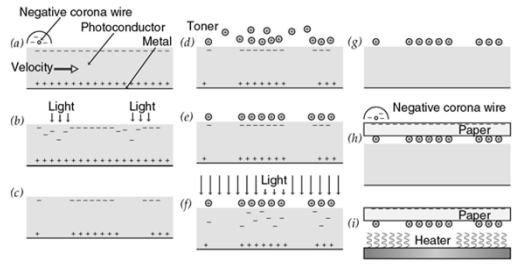
Outside a metal, charge cannot move
- At equilibrium: both voltage and electric field can vary

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