

Physics 21 & 19

www.lehigh.edu/~physics/21

coursesite.lehigh.edu

PHY-019-021-FL11: Introductory Physics II (All Sections)

Home Help

[Home](#) PHY-019-021-FL11

Academic

Integrity

[Academic Integrity Vignettes](#)

[Provost's Academic Integrity Site](#)


Report a Problem

If you have any problems using this course, please complete this [form](#) immediately. Thank you for your cooperation.

Instructional Technology Team

Topic outline

 [Announcements](#)

 [Click here for the Physics 21 web site](#)

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Latest News

(No news has been posted yet)

Upcoming

Events

There are no upcoming events

[Go to calendar...](#)
[New Event...](#)

Recent Activity

Activity since Friday, 26 August 2011, 02:20 PM
[Full report of recent activity...](#)

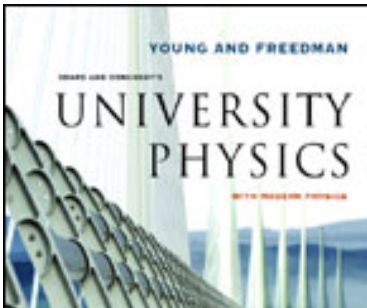


Course Materials (updated for 2011)

| | |
|--|---------------------------|
| General Information | (version August 16, 2011) |
| Schedule and Assignments | (version August 16, 2011) |
| Equation Sheet | (version August 16, 2011) |
| Handout on Optics | (version August 16, 2011) |
| Handout on Waves | (version August 16, 2011) |
| Line Integrals | (version August 16, 2011) |

The link above to "Line Integrals" shows how to do them rigorously. The information provided is not strictly part of the course materials, but may be helpful or even interesting to some students.

Textbook and Web-based Homework System (updated for 2011)



The text for Physics 21 and for Physics 19 is *University Physics*, by Hugh D. Young, Roger Freedman and Lewis Ford, 12th edition, and published by Pearson Addison Wesley. You will need only volume 2. For both 21 and 19, you also need access to the web-based homework system "Mastering Physics." If you took physics last year and had an access code for MasteringPhysics, you can use the same registration again this year. Your original registration is good for two years from the time of first use.



LEHIGH
UNIVERSITY



Dear Student:

In Physics 21, you will be using MasteringPhysics, an online tutorial and homework companion to your textbook. To use this system, you must first **register** and then **enroll** as explained below.

What You Will Need:

- ✓ A valid email address
- ✓ A student access code (packaged with your text or available for purchase at <http://www.masteringphysics.com/>).
- ✓ The zip code for your school: **18015**
- ✓ A “Course ID”: **PHYSICS21F2011** (make sure to use all caps)
- ✓ A “Student ID”: **your LIN** (nine digit Lehigh Identification Number: *nnn-nn-nnnn*)

Physics 21 Fall, 2011

General Information

Subject matter: Physics 21, Introductory Physics II, is a continuation of Physics 11. The general topics covered include electrostatics and magnetostatics, DC circuits, Maxwell's equations, waves, geometrical and physical optics.

General Plan: Classes meet four times per week, Tuesday and Thursday in a large lecture (for 50 minutes) and Wednesday and Friday in a small recitation class. Homework assignments, which are done online, will be due before most recitations and will be discussed in the recitation. There are two major exams during the semester, at 4:10 pm on Oct. 5 and Nov. 9. The final exam will be scheduled by the registrar.

Textbook and Homework: The text is *University Physics*, by Young and Freedman, volume 2, 12th edition. The homework will be handled by a web-based system called "Mastering Physics." Each student must obtain an access code (a 30 letter password) in order to register with the Mastering Physics website. The access code can be purchased separately or as part of a package with the textbook from the campus bookstore or from the publisher's web site. There is more information about "Mastering Physics" on the main class webpage and in other handouts.

Obtaining Course Materials: Most "handouts" such as the reading assignments, schedule of lectures, and equation sheets must be downloaded from the course web page:

www.lehigh.edu/~physics/21

Paper copies of these documents will not normally be distributed in class or recitation. It is the responsibility of each student to visit the course web page and obtain the appropriate documents.

Quizzes: There will be nine quizzes during the semester. They will be at the beginning of the recitation section on most Wednesdays as announced in the schedule. The best eight quizzes will count, but no makeup quizzes will be given.

Makeup Exams: Makeups will be given for students who miss an hour exam for a legitimate reason.

Final Exam: The date and time of the final exam are set by the Registrar and cannot be changed.

Grading: Grades are based on the following scheme:

| | |
|--------------------------------|-----|
| First Exam (Oct. 5) | 100 |
| Second Exam (Nov. 9) | 100 |
| Quizzes (best eight of nine) | 60 |
| Homework (on the web) | 40 |
| Recitation leader's assessment | 50 |
| Final Exam | 200 |
| <hr/> | |
| Total | 550 |

Role of Recitation Leader: Each student's primary contact should be with his/her recitation leader. If you have questions or need help with an assignment, first ask your recitation leader. Each recitation leader will set his/her own office hours.

Equation Sheet: The exams are closed book, but an equation sheet will be provided. The equation sheet is posted on the web. Students should familiarize themselves with the equation sheet by using it for homework. The equation sheet is not intended to give every possible equation that might be needed to do a problem. Students are expected to be able to work specific problems starting from the general formulas given on the equation sheet.

Attendance Policy: Attendance at lecture and recitation is expected. Attendance in recitation will be taken into account by the recitation leader when assessing each student's performance.

Free Advice: Physics 21 is a fast paced course with a heavy workload. Assimilating the material presented each week is essential to understanding the following week's work. Come to class! Take notes! Keep up with the reading and homework assignments!

Physics 19: Physics 19 is a one credit course for students who have taken a three credit course similar to (but less comprehensive than) Physics 21. Students taking Physics 19 should attend the first lecture on Tuesday, Aug. 30 and then all the lectures and recitations beginning Thursday, Nov. 3, 2011. They will not take the second hour exam; they will take selected parts of the final exam.

Disability: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center C212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.



August 16, 2011

| Date | Class | Topic | Reading | Homework |
|------------|-------------|--|--------------------------------|-----------|
| 8-30 (Tu) | L-1 | Electric force and electric fields for point charges, using vectors | | |
| 8-31 (W) | R-1 | Demonstrate homework procedures; work ex. 21.9 using vector notation; | 21 §1-4 | HW-1 due |
| 9-1 (Th) | L-2 | Electric fields due to continuous charge distributions; work ex. 21-11 | 21 §5-7 | |
| 9-2 (F) | R-2 | Work exs. 21-10 and 21-12; calculate field of disk of charge; discuss HW-2 | | HW-2 due |
| 9-6 (Tu) | L-3 | Gauss's Law; work exs. 22-6, 7 | 22 §1-5 | |
| 9-7 (W) | R-3 | Quiz 1 ; work exs. 22-9; discuss HW-3 | | HW-3 due |
| 9-8 (Th) | L-4 | Electric potential and potential difference | 23 §1-4 | |
| 9-9 (F) | R-4 | Discuss HW-4; | | HW-4 due |
| 9-13 (Tu) | L-5 | Potential gradient; capacitance | 23 §5; 24 §1-2 | |
| 9-14 (W) | R-5 | Quiz 2 ; work ex. 24-3; discuss HW-5 | | HW-5 due |
| 9-15 (Th) | L-6 | Energy density in field; dielectrics | 24 §3-5, 25 §1 | |
| 9-16 (F) | R-6 | Discuss HW-6; work exs. 24,10-11 | | HW-6 due |
| 9-20 (Tu) | L-7 | Circuits; Kirchoff's rules | 25 §2-5; 26 §1-2 | |
| 9-21 (W) | R-7 | Quiz 3 ; discuss problem 24 (p 909); discuss HW-7 | | HW-7 due |
| 9-22 (Th) | L-8 | RC circuits | 26 §4-5 | |
| 9-23 (F) | R-8 | Discuss HW-8; work ex. 26-13 | | HW-8 due |
| 9-27 (Tu) | L-9 | Magnetic field and the force on moving charges | 27 §1-5 | |
| 9-28 (W) | R-9 | Quiz 4 ; work ex. 27-4; discuss HW-9 | | HW-9 due |
| 9-29 (Th) | L-10 | Magnetic force on currents | 27 §6-8 | |
| 9-30 (F) | R-10 | Discuss HW-10 | | HW-10 due |
| 10-4 (Tu) | L-11 | Catch up lecture Review session: 7:00 pm, LL270 | | |
| 10-5 (W) | R-11 E-1 | Review for exam <i>FIRST HOUR EXAM at 4:10 pm on October 5</i> | | no HW due |
| 10-6 (Th) | L-12 | Magnetic field of moving charges | 28 §1-7 | |
| 10-7 (F) | R-12 | Work ex. 28-4 ; discuss HW-12 <i>PACING BREAK: October 10-11</i> | | HW-12 due |
| 10-12 (W) | R-13 | Return and discuss exam; discuss HW-13 | | HW-13 due |
| 10-13 (Tu) | L-13 | Ampere's Law; magnetic materials | 28 §8 | |
| 10-14 (F) | R-14 | Discuss HW-14 | | HW-14 due |
| 10-18 (Th) | L-14 | Faraday's Law | 29 §1-4 | |
| 10-19 (W) | R-15 | Quiz 5 ; discuss HW-15 | | HW-15 due |
| 10-20 (Th) | L-15 | Inductance; Maxwell's Equations | 29 §5-7; 30 §1-3 | |
| 10-21 (F) | R-16 | Discuss HW-16 | | HW-16 due |

Classes are Lectures (L), Recitations (R), or Exams (E). Reading should be completed before the associated class. **22** §4 means chapter 22, section 4 of text. The deadline for completing each homework assignment HW-*n* (using the web-based system) is 7:00 am on the day of the corresponding recitation.

| Date | Class | Topic | Reading | Homework |
|--|-------|--|--------------------------------|-----------|
| 10-25 (Tu) | L-16 | AC circuits: transients and steady state | 30 §4-6 | |
| 10-26 (W) | R-17 | Quiz 6 ; discuss HW-17 | | HW-17 due |
| 10-27 (Th) | L-17 | Steady state AC circuits; phasor diagrams | 31 §1-3 | |
| 10-28 (F) | R-18 | Discuss HW-18; work exs. 31-4,5 | | HW-18 due |
| 11-1 (Tu) | L-18 | Resonance in ac circuits; transformers | 31 §4-6 | |
| 11-2 (W) | R-19 | Quiz 7 ; discuss HW-19 | | HW-19 due |
| 11-3 (Th) | L-19 | Start waves (download text from web) | Handout, part I | |
| 11-4 (F) | R-20 | Discuss HW-20 | | HW-20 due |
| 11-8 (Tu) | L-20 | Catch up lecture Review Session: 7:00 pm, LL270 | | |
| 11-9 (W) | R-21 | Review for exam | | no HW due |
| | E-2 | <i>SECOND HOUR EXAM at 4:10 pm on November 9</i> | | |
| 11-10 (Th) | L-21 | Superposition of waves | Handout, part II | |
| 11-11 (F) | R-22 | Discuss HW-22 | | HW-22 due |
| 11-15 (Tu) | L-22 | Light as an E&M wave | 32 §1-5 | |
| 11-16 (W) | R-23 | Quiz 8 ; discuss HW-23 | | HW-23 due |
| 11-17 (Th) | L-23 | Ray optics: mirrors | 33 §1-2; 34 §1-2 | |
| 11-18 (F) | R-24 | Discuss HW-24 | | HW-24 due |
| 11-22 (Tu) | L-24 | Ray optics: lenses | 33 §3, 34 §3-4 | |
| <i>THANKSGIVING BREAK: November 23-25</i> | | | | |
| 11-29 (Tu) | L-25 | Ray optics: optical instruments | 33 §4; 34 §5-8 | |
| 11-30 (W) | R-25 | Quiz 9 ; discuss HW-25 | | HW-25 due |
| 12-1 (Th) | L-26 | Physical optics: interference | 33 §7; 35 §1-5 | |
| 12-2 (F) | R-26 | Discuss HW-26 | | HW-26 due |
| 12-6 (Tu) | L-27 | Physical optics: diffraction, polarization | 33 §5; 36 §1-5 | |
| 12-7 (W) | R-27 | discuss HW-27 | | HW-27 due |
| 12-8 (Th) | L-28 | Resolution of optical instruments | 36 §7 | |
| 12-9 (F) | R-28 | Discuss HW-28 | | HW-28 due |
| | E-3 | <i>FINAL EXAM (scheduled by the Registrar during the period Dec. 13-21)</i> | | |

Classes are Lectures (L), Recitations (R), or Exams (E). Reading should be completed before the associated class. **22** §4 means chapter 22, section 4 of text. The deadline for completing each homework assignment HW-*n* (using the web-based system) is 7:00 am on the day of the corresponding recitation.

Physics 21
Fall, 2011

Equation Sheet

| | | | | | |
|--------------------------------|--------------|--|------------------------|------------------|---|
| speed of light <i>in vacuo</i> | c | 3.00×10^8 m/s | Planck's constant | h | 6.626×10^{-34} J s |
| Gravitational constant | G | 6.67×10^{-11} N m ² /kg ² | Planck's constant/(2π) | $\hbar = h/2\pi$ | 1.055×10^{-34} J s |
| Avogadro's Number | N_A | 6.02×10^{23} mol ⁻¹ | electron rest mass | m_e | 9.11×10^{-31} kg |
| Boltzmann's constant | k_B | 1.38×10^{-23} J/K | proton rest mass | m_p | 1.6726×10^{-27} kg |
| charge on electron | e | 1.60×10^{-19} C | neutron rest mass | m_n | 1.6749×10^{-27} kg |
| free space permittivity | ϵ_0 | 8.85×10^{-12} C ² /(N m ²) | atomic mass unit | u | 1.6605×10^{-27} kg |
| free space permeability | μ_0 | $4\pi \times 10^{-7}$ T m/A | $1/(4\pi\epsilon_0)$ | k | 8.99×10^9 N m ² /C ² |
| gravitational acceleration | g | 9.807 m/s ² | | | |

$$\mathbf{F}_{2 \text{ on } 1} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2 (\mathbf{r}_1 - \mathbf{r}_2)}{|\mathbf{r}_1 - \mathbf{r}_2|^3}$$

$$\mathbf{F} = q\mathbf{E}$$

$$d\mathbf{E}(\text{at } \mathbf{r}) = \frac{1}{4\pi\epsilon_0} \frac{dQ(\mathbf{r} - \mathbf{r}')}{|\mathbf{r} - \mathbf{r}'|^3}$$

$$\mathbf{E} = -\nabla V = -\left(\hat{i} \frac{\partial V}{\partial x} + \hat{j} \frac{\partial V}{\partial y} + \hat{k} \frac{\partial V}{\partial z}\right)$$

$$V_f - V_i = -\int_i^f \mathbf{E} \cdot d\mathbf{l}$$

$$V = \frac{1}{4\pi\epsilon_0} \frac{Q}{r}; dV = \frac{1}{4\pi\epsilon_0} \frac{dQ}{|\mathbf{r} - \mathbf{r}'|}$$

$$u_{\text{elec}} = \frac{1}{2}\epsilon_0 E^2, u_{\text{mag}} = \frac{1}{2\mu_0} B^2$$

$$\text{Work} = \int \mathbf{F} \cdot d\mathbf{l}$$

$$E_{\text{line}} = \frac{1}{2\pi\epsilon_0} \frac{\lambda}{r}; E_{\text{plane}} = \frac{\sigma}{2\epsilon_0}$$

$$E = \frac{Q}{\epsilon_0 A} = \frac{\sigma}{\epsilon_0} \text{ for } \parallel \text{ plate capacitor}$$

$$Q = CV; C = \epsilon_0 K \frac{A}{d} = \epsilon \frac{A}{d}$$

$$U_{\text{cap}} = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C}$$

$$U_{\text{ind}} = \frac{1}{2} LI^2$$

$$V = IR \quad R = \frac{\rho L}{A}$$

$$P = IV \quad P = I^2 R$$

$$R = mv_{\perp}/(qB) \text{ circ. orbit}$$

$$\mathbf{A} \times \mathbf{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$$\xi_i = C_i \text{ (series) or } R_i \text{ (parallel):}$$

$$\frac{1}{\xi_{\text{effective}}} = \frac{1}{\xi_1} + \frac{1}{\xi_2}$$

$$\xi_i = C_i \text{ (parallel) or } R_i \text{ (series):}$$

$$\xi_{\text{effective}} = \xi_1 + \xi_2$$

$$X_R = R, X_L = \omega L, X_C = \frac{1}{\omega C}$$

$$RC \text{ time constant} = RC$$

$$LR \text{ time constant} = L/R$$

$$Q(t) \text{ for } RLC \text{ circuit}$$

$$Q_0 \exp(-Rt/2L) \cos \omega t$$

$$\omega^2 = \frac{1}{LC} - \frac{R^2}{4L^2}$$

$$\mathbf{F} = q\mathbf{v} \times \mathbf{B}; d\mathbf{F} = Id\mathbf{l} \times \mathbf{B}$$

$$d\mathbf{B} = \frac{\mu_0}{4\pi} \frac{Id\mathbf{l} \times (\mathbf{r} - \mathbf{r}')}{|\mathbf{r} - \mathbf{r}'|^3}$$

$$\text{long wire: } B = \frac{\mu_0 I}{2\pi R}$$

$$\text{center loop: } B = \mu_0 I/2R$$

$$I = \frac{dQ}{dt} \quad I = -neAv_d$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}, \quad \frac{I_s}{I_p} = \frac{N_p}{N_s}$$

$$\chi_m = \frac{\mu}{\mu_0} - 1$$

$$\boldsymbol{\tau} = \boldsymbol{\mu} \times \mathbf{B} \quad \boldsymbol{\mu} = I\mathbf{A}$$

$$\text{solenoid } B = \mu_0 nI$$

$$\text{solenoid } L = \mu_0 N^2 A/l$$

$$\oint \mathbf{E} \cdot d\mathbf{A} = \frac{Q}{\epsilon_0}$$

$$\oint \mathbf{B} \cdot d\mathbf{A} = 0$$

$$\oint \mathbf{E} \cdot d\mathbf{l} = -\frac{d}{dt} \int \mathbf{B} \cdot d\mathbf{A}$$

$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I + \mu_0 \epsilon_0 \frac{d}{dt} \int \mathbf{E} \cdot d\mathbf{A}$$

$$\sin(a \pm b) = \sin a \cos b \pm \cos a \sin b$$

$$\sin(\theta \pm \frac{\pi}{2}) = \sin \theta \cos \frac{\pi}{2} \pm \cos \theta \sin \frac{\pi}{2} = \pm \cos \theta$$

$$\cos(a \pm b) = \cos a \cos b \mp \sin a \sin b$$

$$\sin a + \sin b = 2 \cos \left(\frac{a-b}{2}\right) \sin \left(\frac{a+b}{2}\right)$$

| | |
|--------------------------|-------------------------|
| $C = 2\pi r$ | circumference of circle |
| $C = \pi d$ | circumference of circle |
| $A = \pi r^2$ | area of circle |
| $A = 4\pi r^2$ | surface area of sphere |
| $V = \frac{4}{3}\pi r^3$ | volume of sphere |

$$ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\int \frac{du}{\sqrt{a^2 + u^2}} = \ln(u + \sqrt{a^2 + u^2})$$

$$\int \frac{u du}{\sqrt{a^2 + u^2}} = \sqrt{a^2 + u^2}$$

$$\int \frac{du}{a^2 + u^2} = \frac{1}{a} \tan^{-1} \left(\frac{u}{a}\right)$$

$$\int \frac{u du}{a^2 + u^2} = \frac{1}{2} \ln(a^2 + u^2)$$

$$\int \frac{du}{(a^2 + u^2)^{3/2}} = \frac{u}{a^2 \sqrt{a^2 + u^2}}$$

$$\int \frac{u du}{(a^2 + u^2)^{3/2}} = -\frac{1}{\sqrt{a^2 + u^2}}$$

$$\int e^{au} du = \frac{1}{a} e^{au}$$

$$\int \ln u du = u \ln u - u$$

$$\int u^n du = \frac{1}{n+1} u^{n+1}$$

$$\int \frac{du}{a+bu} = \frac{1}{b} \ln(a+bu)$$

$$\int \frac{du}{u} = \ln u$$

$$\int_0^{2\pi} \cos^2 \theta d\theta = \int_0^{2\pi} \sin^2 \theta d\theta = \pi$$

$$v = \sqrt{T/\rho} \quad (T=\text{tension})$$

$$v = (347.4 \text{ m/s}) \sqrt{T/300}$$

$$v = \lambda f = \omega/k$$

$$\omega = 2\pi f \quad k = 2\pi/\lambda$$

$$T = 1/f \quad (T=\text{period})$$

$$\langle P \rangle = \frac{1}{2} \rho A^2 \omega^2 v$$

$$\frac{\partial^2 D}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 D}{\partial t^2}$$

$$\mathbf{S} = \frac{1}{\mu_0} (\mathbf{E} \times \mathbf{B})$$

$$\bar{S} = \frac{1}{2} \epsilon_0 c E_0^2 = \frac{1}{2} \frac{c}{\mu_0} B_0^2$$

$$= \frac{E_0 B_0}{2\mu_0} = \frac{E_{\text{rms}} B_{\text{rms}}}{\mu_0}$$

$$c = 1/\sqrt{\epsilon_0 \mu_0}$$

$$\mathbf{E} \times \mathbf{B} \propto \mathbf{v} \quad (\text{plane wave})$$

$$\Delta x \Delta p \gtrsim \hbar \quad (\hbar = h/2\pi)$$

$$\lambda = h/p \quad (\text{de Broglie})$$

$$-\frac{\hbar^2}{2M} \frac{\partial^2 \psi}{\partial x^2} = i\hbar \frac{\partial \psi}{\partial t}$$

$$\text{KE} = p^2/(2M)$$

$$p = \hbar k \quad E = \hbar \omega = hf$$

$$e^{i\theta} = \cos \theta + i \sin \theta$$



Recitation Leaders

- Marten Beels
LL307, 8-5410
- Carl Faust
LL302, 8-3963
- Dr. Jon Glueckstein (lead RL)
LL401, 8-3910
- Ruthie Malenda
LL302, 8-3963
- Dr. Peter Tupa
LL401, 8-3910

General Pattern

General Pattern

- Read assignment before lecture

General Pattern

- Read assignment before lecture
- Hear the lecture

General Pattern

- Read assignment before lecture
- Hear the lecture
- See example in recitation

General Pattern

- Read assignment before lecture
- Hear the lecture
- See example in recitation
- Do the homework problems on the web

General Pattern

- Read assignment before lecture
- Hear the lecture
- See example in recitation
- Do the homework problems on the web
- Discuss in recitation

The Pace is Fast

The material presented each week is essential for understanding the following week's work.

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The material presented each week is essential for understanding the following week's work.

- Come to class

The Pace is Fast

The material presented each week is essential for understanding the following week's work.

- Come to class
- Take notes

The Pace is Fast

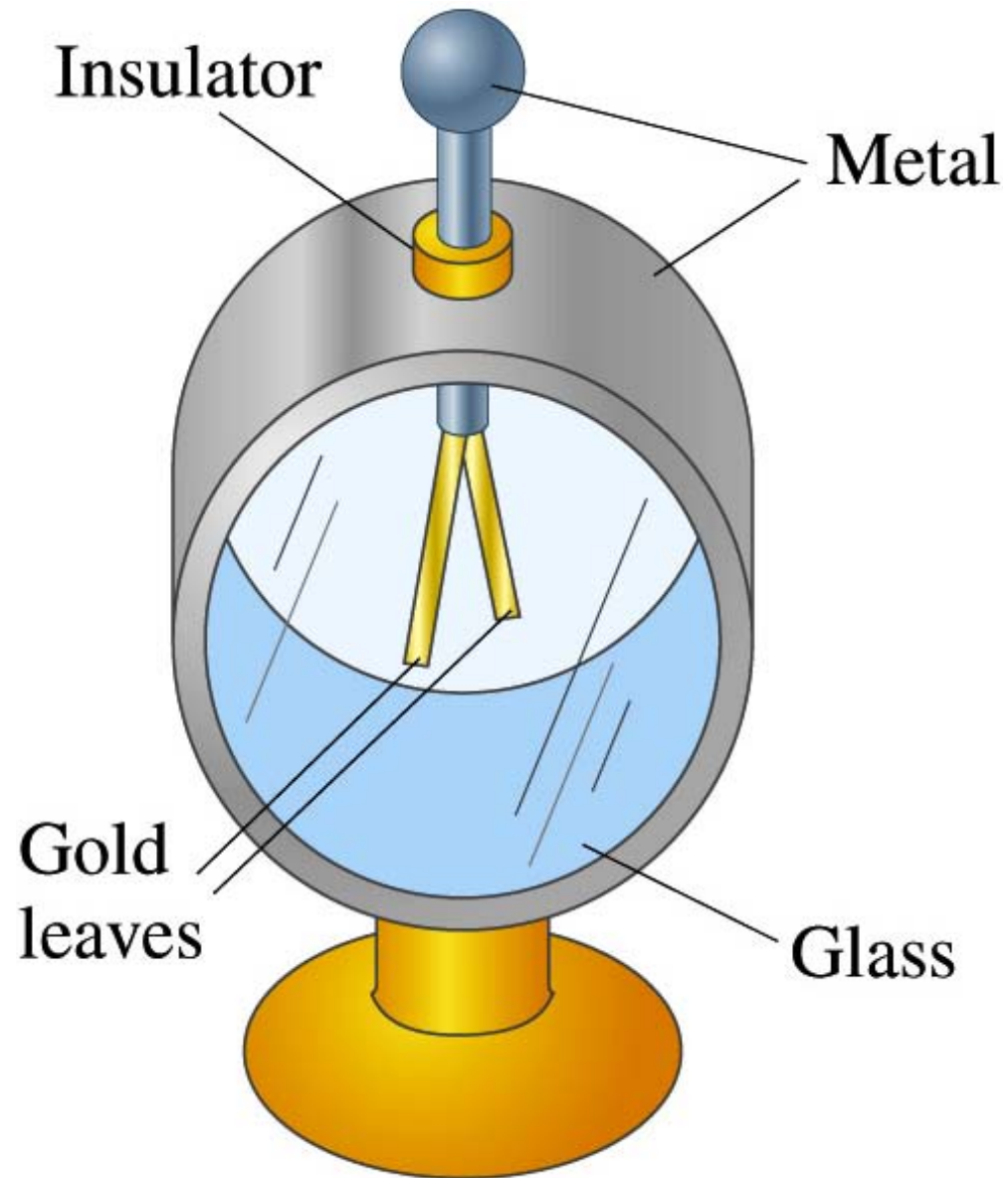
The material presented each week is essential for understanding the following week's work.

- Come to class
- Take notes
- Keep up with the homework

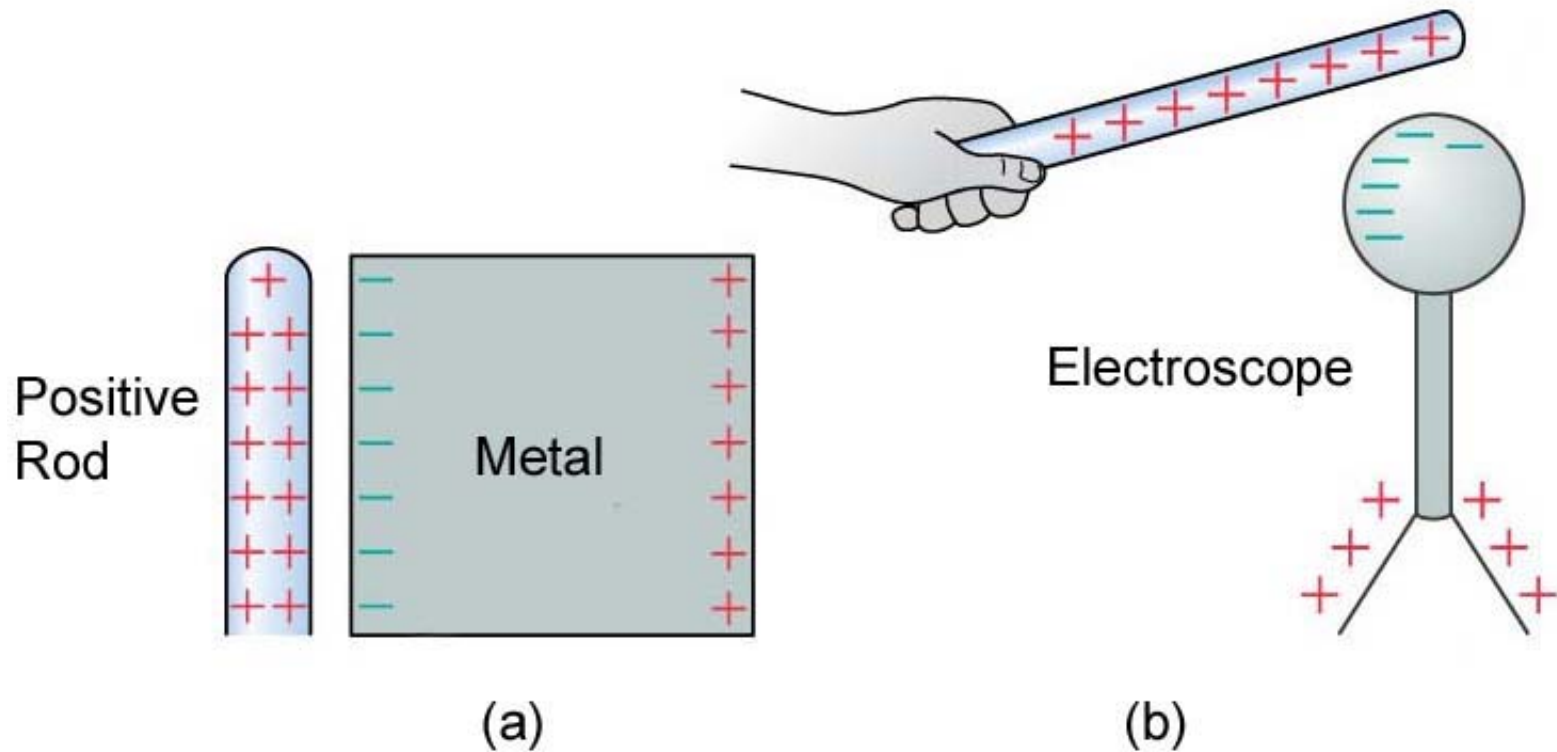
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| <hr/> | |
| Total | 550 |

Electroscope I



Electroscope II



Polarization of charge inside an electroscope.

Summary

- Coulomb's Law with vectors
- Superposition
- Electric Field