

Test Information for Final Exam:

New formulas to memorize:

Images

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

Diffraction

$$\theta_{\min} \approx \lambda/a$$

$$\theta_{\min} \approx \lambda/D$$

Diffraction
Grating

$$\sin \theta = m\lambda/d$$

Relativity

$$L = L_p/\gamma$$

$$\Delta t = \gamma(\Delta t_p)$$

You must memorize that m is any integer, except it can't be zero for diffraction

New formulas to know how to use, but you need not memorize:

Focal Length

$$f = \frac{1}{2}R$$

$$\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

2-Slit Interference

$$\sin \theta_{\text{bright}} = \frac{m\lambda}{d}$$

$$I = I_{\max} \cos^2 \left(\frac{\pi d \sin \theta}{\lambda} \right)$$

Diffraction
Grating

Thin Film

$$2t_{\text{Weak}} = \lambda m$$

Position on a screen

$$x = L \tan \theta \approx L \sin \theta$$

Magnification

$$M \equiv h'/h = -q/p$$

$$m \equiv \theta/\theta_0$$

Diffraction

$$\sin \theta_{\text{dark}} = \frac{m\lambda}{d}$$

$$I = I_{\max} \left[\frac{\sin(\pi a \sin \theta/\lambda)}{\pi a \sin \theta/\lambda} \right]^2$$

X-Ray Scattering

$$2d \cos \theta = m\lambda$$

Brewster's Angle

$$\tan \theta_p = n_2/n_1$$

Telescope Magnification

$$m = f_o/f_e$$

Relativity

$$\gamma = \frac{1}{\sqrt{1-v^2/c^2}}$$

$$u' = \frac{u-v}{1-uv/c^2}$$

Relativistic Doppler Effect

$$f = f_0 \sqrt{\frac{1+v/c}{1-v/c}}$$

Old formulas to memorize:

E & M Force

$$\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B})$$

Flux
Definitions

$$\Phi_E = EA$$

$$\Phi_B = BA$$

Potential

$$U = qV$$

$$V = \frac{k_e q}{r}$$

$$E_x = -\frac{\partial V}{\partial x}$$

Current & Resistance

$$I = \frac{dQ}{dt}$$

$$\Delta V = IR$$

$$P = I(\Delta V)$$

Kirchoff's Laws

$$\sum I_{\text{in}} = \sum I_{\text{out}}$$

$$0 = \sum_{\text{loop}} \Delta V$$

Electric Field

$$\mathbf{E} = \frac{k_e q \hat{\mathbf{r}}}{r^2}$$

Gauss's Laws

$$\int \mathbf{E} \cdot \hat{\mathbf{n}} dA = \frac{q_{\text{in}}}{\epsilon_0}$$

$$\int \mathbf{B} \cdot \hat{\mathbf{n}} dA = 0$$

Capacitance

$$Q = C\Delta V$$

Inductors

$$\mathcal{E} = -L \frac{dI}{dt}$$

Units

$$A = C/s$$

$$N/C = V/m$$

$$F = C/V$$

$$\Omega = V/A$$

$$T = N/A/m$$

$$H = V \cdot s/A$$

Ampere's Law

$$\oint \mathbf{B} \cdot d\mathbf{s} = \mu_0 I_{\text{in}} + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$$

Faraday's Law

$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$

Frequency & wavelength

$$\omega = 2\pi f$$

$$f = 1/T$$

$$k\lambda = 2\pi$$

Reflection & Refraction

$$\theta_i = \theta_r$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

In a medium, $c, f,$ and ω stay constant, but $v, k,$ and λ can change.

$$\lambda = \lambda_0/n$$

Speed of Light

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

$$c = 3.00 \times 10^8 \text{ m/s}$$

Additional Information:

- **Test is Monday, May 5, 2:00 – 5:00, here in Olin 101**
 - **Bring a metric ruler, a pencil, and a calculator**
- You are responsible for using any formula that appeared on previous information sheets, both memorized and provided. However, if needed, they will be provided
 - Pay special attention to old memorized formulas; these are probably most important to me
- You are still expected to know the categories of EM radiation, in order, including at least six colors from the visible spectrum
- For optics, you should know how to do ray tracing, as well as direct calculations using formulas.
- This test is out of 200 points – it is twice as long as other tests
- There will be a review session in Olin 101 on Sunday, May 4, 7:00-8:00

New Material for Final Exam:

Chapter 36	Images
Chapter 37	Interference
Chapter 38	Diffraction and Polarization
Chapter 39	Special Relativity

Organization of the Test:

Part I: Multiple Choice (mixed old and new material) [40 points]

For each question, choose the best answer (2 points each)
[questions 1-20]

Part II: Short answer (new material) [20 points]

Choose **two** of the following questions and give a short answer (1-3 sentences) (10 points each).

[questions 21-23]

Part III: Short answer (old material) [20 points]

Choose **two** of the following questions and give a short answer (1-3 sentences) (10 points each)

[questions 24-26]

Part IV: Calculation (new material) [60 points]

Choose **three** of the following four questions and perform the indicated calculations (20 points each)

[questions 27-30]

Part V: Calculation (old material) [60 points]

Choose **three** of the following four questions and perform the indicated calculations (20 points each)

[questions 31-34]