Phys 1402 2017-08-02 Lec 18

Last Day! Final tomorrow.

Compare situations
- Object moves closer
- Object rays get more diverging

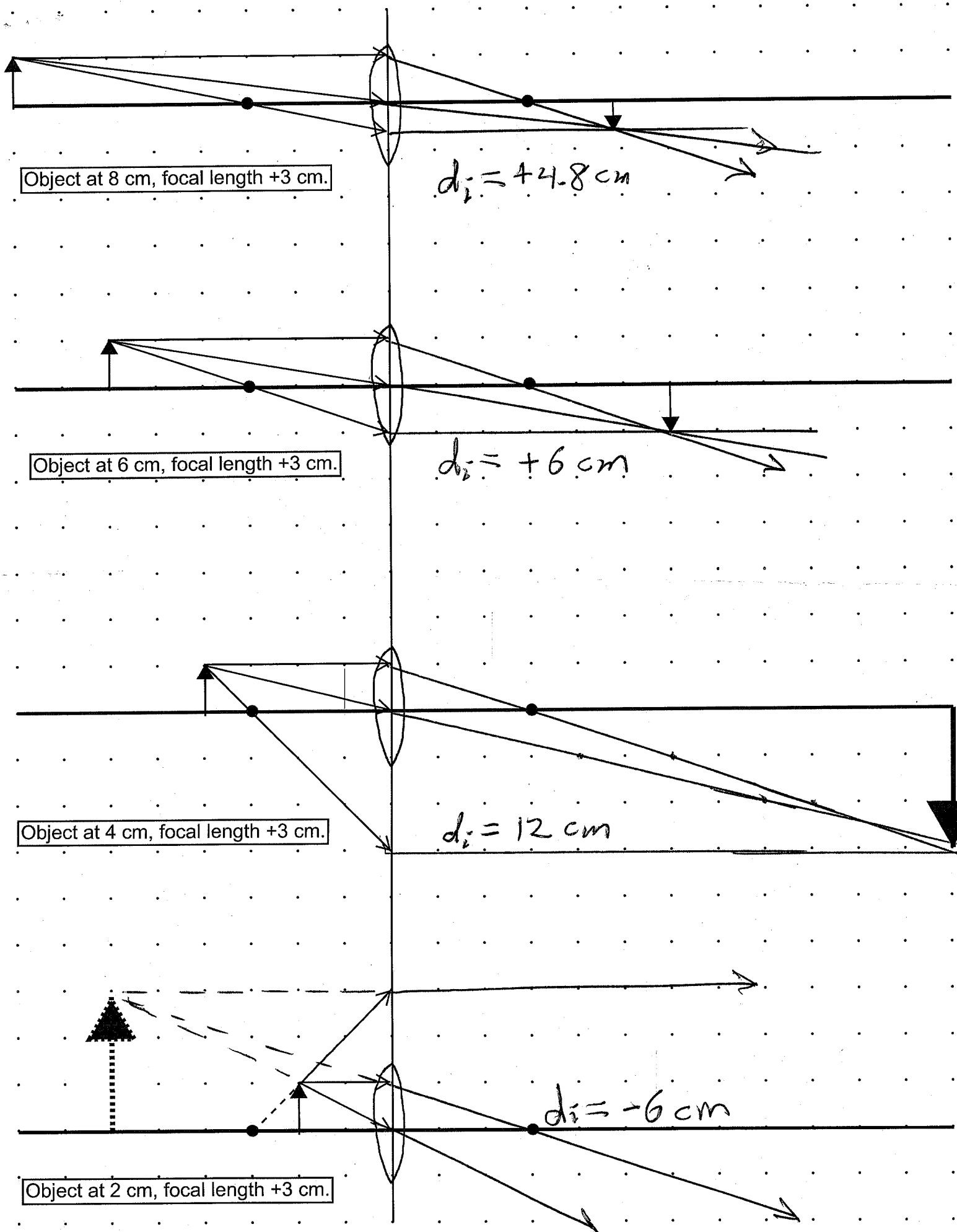
Principle Rays
- Parallel Ray - Bends thru f
- Central Ray - Goes straight
- Focal Ray - Object Ray hits "other f"
- Image Ray is horiz.

Calculation $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$ $M = -\frac{d_i}{d_o}$

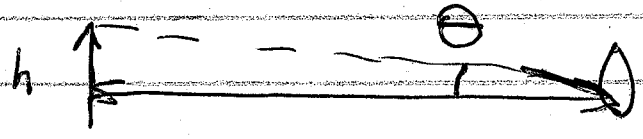
Ex: $d_o = 8\,cm$ $d_i = \left(\frac{1}{3} - \frac{1}{8}\right)^{-1}$ $M = \frac{-4.8}{8} = -0.6$
$f = +3\,cm$ $= +4.8\,cm$

$d_o = 6\,cm$ $d_i = +6\,cm$ $M = -1.0$
$f = +3\,cm$

- Closer object → Further Image
- If $d_o = f$ → $d_i = \infty$
- Even closer, virtual image formed



Subtended Angle



$$\text{Mag} = \frac{\theta_{\text{with}}}{\theta_{\text{without}}} = \frac{h/f}{(h/25\text{cm})} = \frac{25\text{cm}}{f}$$

Actually, obj can be a little closer.

$$m = \frac{25\text{cm}}{f} + 1$$

Ex 10× Lens

$$10 = \frac{25\text{cm}}{f} + 1$$

$$f = \frac{25\text{cm}}{9} = 2.78\text{ cm}$$

(I) Amount = Rate Time

(II) Cost = Rate Amount
↑ $ per item

Goal: $3 savings
$0.12/kWh energy rate

(II) $3 = ($0.12/kWh)(Amount of energy)

$\frac{3}{0.12} = 25$ kWh

(I) (25 kWh) = (50 W) Δt

$\frac{25000 \text{ Wh}}{50 \text{ W}} = \Delta t = 500$ hours

Quiz 4, AC

Given $\Delta V_R = 14 \sin(377t)$

Compare to $V_{max} \sin(2\pi f t)$ or cosine

Resistor $V_{max} = 14\ V$ (#10)

$377 = 2\pi f \rightarrow f = 60\ Hz$

Resistor $V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{14}{\sqrt{2}} = 10\ V$ (#11)

$V = IR$ $\quad I = \frac{V}{R} = \frac{10\ V}{500\ \Omega} = 0.020\ A$

$= 20\ mA$ (#12)

$C = 3.54\ \mu F$

Capacitor: $X_C = \frac{1}{2\pi f C} = \frac{1}{377(3.54 \times 10^{-6})}$

$= 750\ \Omega$ (#13)

$L = 663\ mH$

Inductor: $X_L = 2\pi f L = (377)(0.663\ H)$

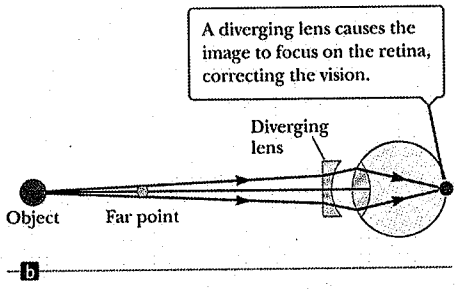
$= 250\ \Omega$ (#14 almost)

Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$= \sqrt{500^2 + 500^2} = 707\ \Omega$ (#14)

$P = I_{rms}^2 R = (0.02)^2(500) = 0.2\ W$ (#15)

Correcting Nearsightedness



- A diverging lens can be used to correct the condition.
- The eye looks at a virtual image (not shown) at the far point.

Section 25.2

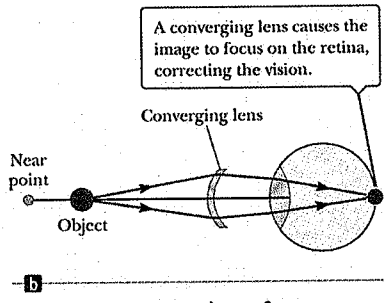
Ex: $d_o = \infty$

$d_i = -(\text{far point}) = -0.5\ m$

$\left(\frac{1}{\infty} + \frac{1}{-0.5}\right)^{-1} = -0.5\ m = f$

$\text{Power} = \frac{1}{f} = -2$

Correcting Farsightedness



- Image Rays don't converge enough to focus, so make them converge more with a converging lens.
- The eye looks at a virtual image (not shown) at the near point.

Section 25.2

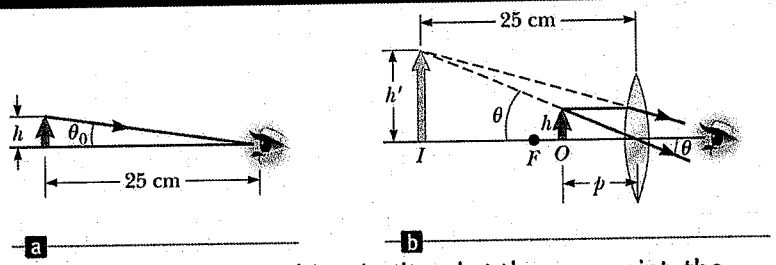
$d_o = 25$ cm

$d_i = -(\text{near point}) = -8$ m

$\left(\frac{1}{0.25} + \frac{1}{-8}\right)^{-1} = f = 0.258$ m

$\text{Power} = \frac{1}{f} = +3.9$

The Size of a Magnified Image



- Without the lens, an object is placed at the near point, the angle subtended is a maximum.
  - The near point is about 25 cm
- With the lens, the object is placed near the focal point of a converging lens, the lens forms a virtual, upright, and enlarged image.

Section 25.3

w/o $\tan\theta_0 = \frac{h}{25\,cm} \approx \theta_0$ in rad

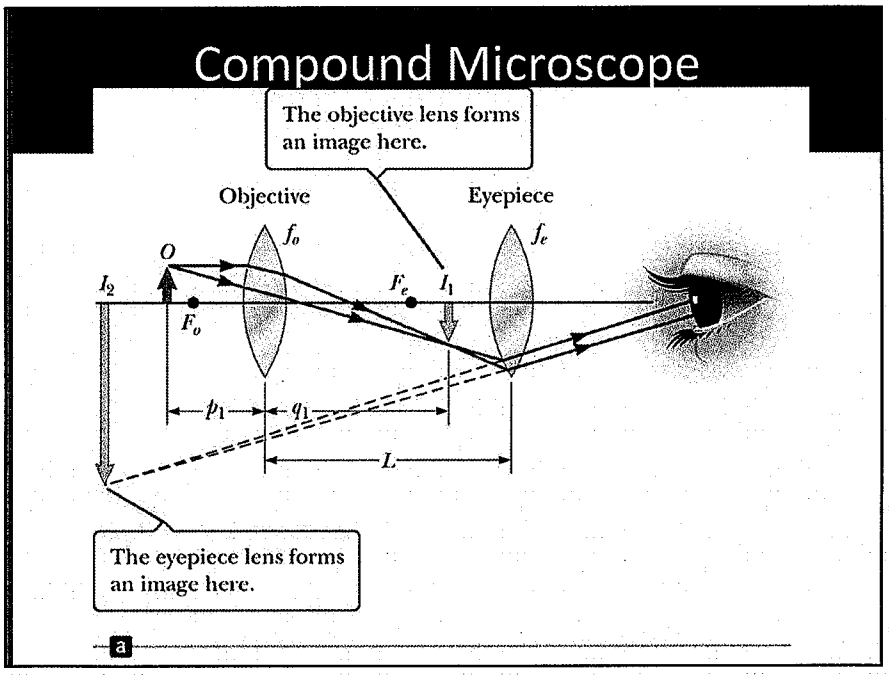
w/ $\tan\theta = \frac{h}{f} \approx \theta$

$$mag = \frac{\theta}{\theta_0} = \frac{h/f}{h/25\,cm} = \frac{25\,cm}{f}$$

Can get obj a little closer for more mag.

$$\text{max mag} = \frac{25\,cm}{f} + 1$$

Compound Microscope



- Object at approx focal point of objective
- Projects real image inside microscope
- Eyepiece acts as magnifying glass
- Creates virtual image to look at.

Objective: $M = \frac{-d_i}{d_o} = \frac{-L}{F_o}$

Eyepiece: $m = \frac{25\,cm}{f_e}$

Overall: $m = \frac{-L(25\,cm)}{f_o f_e}$