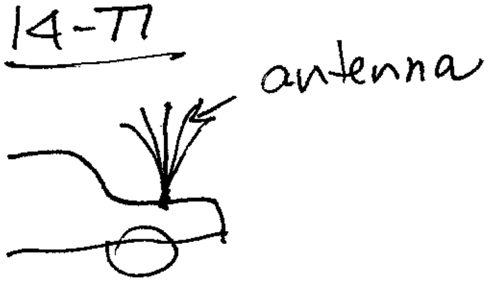
Chapter 14

- Wave functions $y = Y \sin 2\pi \left(\frac{t}{T} - \frac{x}{\lambda}\right)$
- standing waves.

14-77



length = 0.9m = L

12 oscillations in 5.0 s.

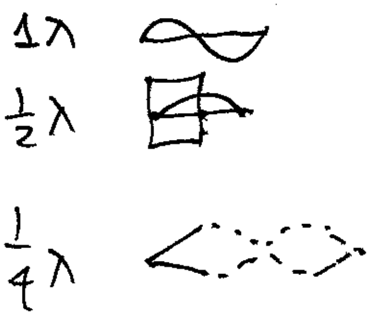
Get speed from $v = \lambda f$

Use $f = \frac{\#\text{oscillations}}{\text{time}} = \frac{12}{5.0s} = 2.4\text{ Hz}$

Use

$L = \frac{1}{4}\lambda$

$\lambda = 4L = 3.6\text{ m}$

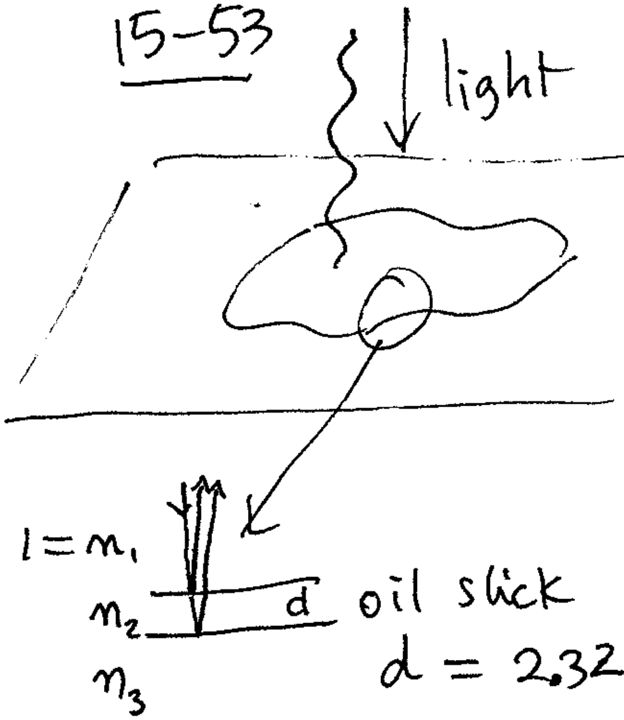


$v = (3.6)(2.4) = 8.6\text{ m/s}$

Chapter 15

- 2-slit interference
- Thin films

15-53



$d = 2.32 \times 10^{-7}$ m

$v_{oil} = 0.80c$
$v_{air} = c$
$v_{water} = \frac{c}{1.33} = 0.75c$; $n_{water} = 1.33 = \frac{c}{v_{water}}$

when do you get constructive interference from the two surfaces?

$p.d. = 2d = n\lambda \leftarrow$ wavelength in oil
(no added half-λ's)

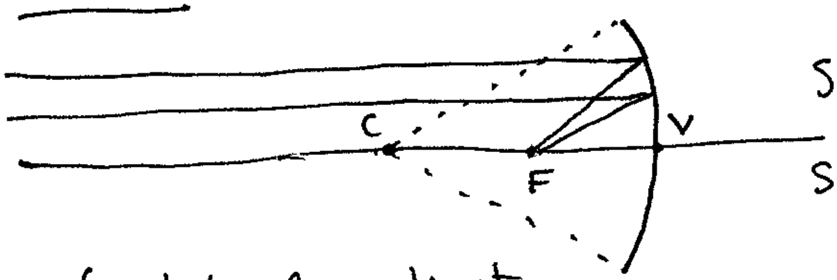
$n\lambda = 2d = (2.32 \times 10^{-7}) \times 2$
$= 4.64 \times 10^{-7}$ m $= 464$ nm

- 1st possibility $n=1$
  $\lambda = 464$ nm ✓ visible
- 2nd possibility $n=2$
  $\lambda = 232$ nm ✗ not visible
- ... no other visible λ's.

Chapter 16

- Images produced by mirrors
- Snell's law

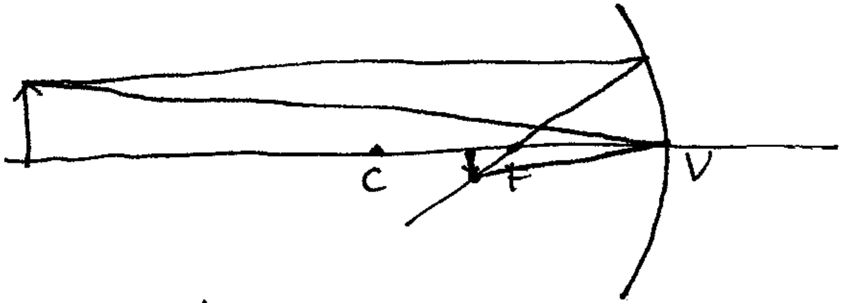
16-33



$S_o = \infty$

$S_i = f$

infinitely far object



distant object

suppose $s_o = 100f$
what is s_i, in terms of focal length?

$$\frac{1}{s_o} + \frac{1}{s_i} = \frac{1}{f}$$

$\nearrow$ 100f

$$\frac{1}{s_i} = \frac{1}{f} - \frac{1}{s_o} = \frac{1}{f} - \frac{1}{100f}$$

$$= \frac{99}{100f}$$

$$s_i = \frac{100}{99} f = 1.01 f$$

Chapta 17

- Images produced by lenses

17-27

$$m = \frac{h_i}{h_o} = -\frac{s_i}{s_o}$$

$f = 0.50\,m$

(a) want $m = -0.5$.
Whee do you place
The object?

From $m = -0.5 = -\frac{s_i}{s_o} \rightarrow s_i = 0.5\,s_o$

↙

From $\frac{1}{s_i} + \frac{1}{s_o} = \frac{1}{f} \rightarrow \frac{2}{s_o} + \frac{1}{s_o} = \frac{1}{f}$

$\frac{3}{s_o} = \frac{1}{f} \rightarrow \frac{s_o}{3} = f \rightarrow s_o = \cancel{\frac{f}{3}}\, 3f = 1.5\,m$

$\underline{\underline{\cancel{0.17\,m}}}$

(b) want $m = +1.2$

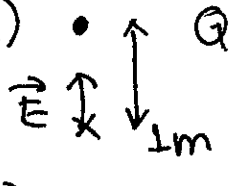
...

Chapter 18 Mostly conceptual

Chapter 19

- Electric forces & fields
- Electric potential energy & potential

19-19 (a)

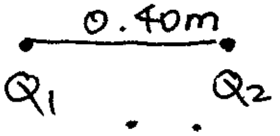


$Q = -2\times10^{-18}C$

$$E = k\frac{|Q|}{r^2} = 9.0\times10^9 \cdot \frac{2\times10^{-18}}{1^2} = 1.8\times10^{-8}\ N/C$$

(b) There is an electron at $r = 1.0$ m from Q. Same answer.

(c)

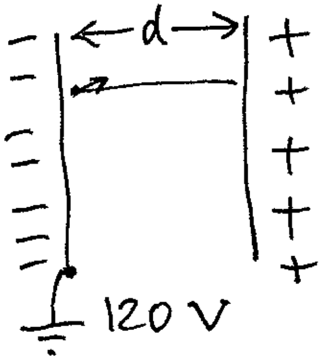


$Q_1 = Q_2 = 0.003$ C

E changes — need to know at what point.

Could calculate: $F_{\text{between } Q_1 \& Q_2} = k\frac{Q_1Q_2}{r^2}$; $PE = k\frac{Q_1Q_2}{r}$

19-75



(a) An e^- is emitted at negligible speed

With what speed does it reach the + plate?

Energy is conserved $\cancel{KE_1} + \cancel{PE_1} = KE_2 + PE_2$

$\underset{\frac{1}{2}mv^2}{\downarrow}$ $\hookrightarrow qV$

$\frac{1}{2}mv^2 = eV$ can find v ✓

(b) How long does it take?

Need to use Newton's 2nd law

or know the acceleration

If you know d

$E = \Delta V/d \ldots$

$F = eE \ldots$

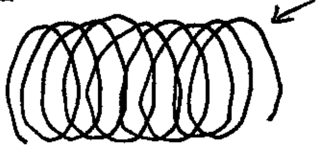
$a = F/m \ldots$

Chapter 20

Current; Capacitance; Resistance (including r), Power

20-39

Coil



← #18 nichrome wire

100 complete turns

core diameter 3 cm = D = 0.03 m

(a) Resistance of coil

wire diameter 1.024 mm = 2r; $R = \rho L / A$ ($A \leftarrow \pi r^2$)

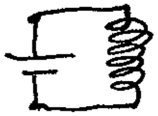
$\rho = 1.00 \times 10^{-6}\ \Omega \cdot m$

Example 20-5: $R_{1/2\,m\ of\ wire} = 0.61\Omega$ For our coil,

$L = 100 \times \text{circumference} = 100 \times \pi D = 9.42\ m$

$R = R_{1/2\,m\ of\ wire} \times 18.84 = 11.5\ \Omega$

(b)



$V_{term} = 1.48\,V$ $\quad I = \frac{V_{term}}{R} = \frac{1.48}{11.5} = 0.13\,A$ $\quad \boxed{I = 0.1A}$

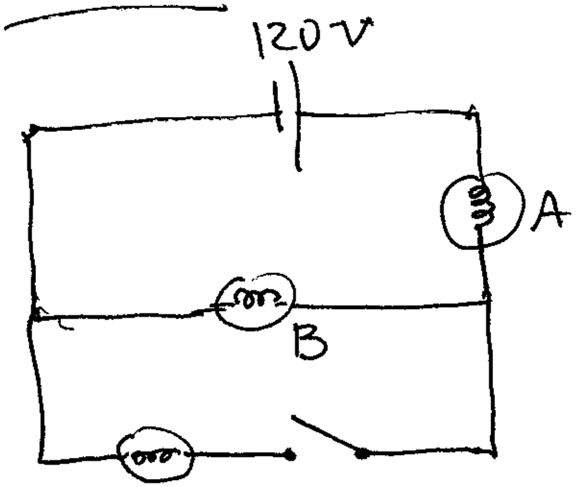
(c) Internal resistance $r = 0.40\,\Omega$. What is $\mathcal{E}$?

$V_{term} = \mathcal{E} - Ir$; $\mathcal{E} = V_{term} + Ir = 1.48 + \underbrace{(0.13)(0.40)}_{0.05\cancel{2}} = 1.53\cancel{2}V$

Chapter 21

Resistors } in series & parallel, RC circuits
Capacitors }

21-55



before you close the switch, what is the power dissipated in each bulb?

With 2 bulbs, $I = \frac{1}{2} I_{\text{single bulb}}$
$= 0.25 A$

and $P = VI = I^2R = V^2/R$
$= \frac{1}{4}$ normal power $= 15W$

3 identical bulbs, 60-W, 120-V.

power if connected directly to 120V.

Then $I = \frac{P}{V} = \frac{60}{120} = 0.50 A$

Close the switch

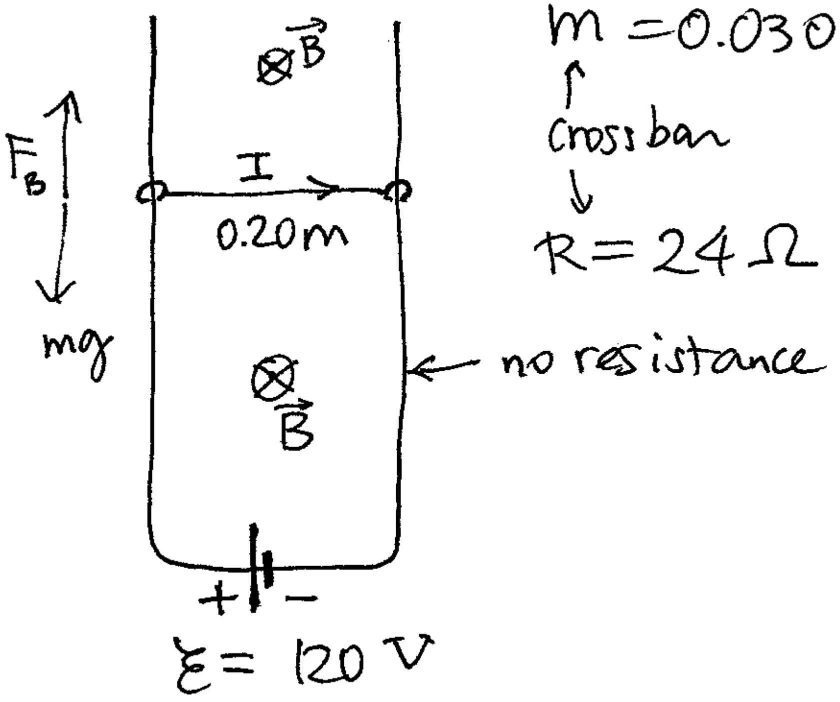
- Bulb A shines more brightly, because there is less overall resistance
- Bulb B: Before switch closed
  $R_{total} = 2R$, $I_{total} = \frac{V}{2R}$
  After switch closed
  $R_{total} = \frac{3}{2}R$, $I_{total} = \frac{V}{\frac{3}{2}R}$
  $= \frac{2V}{3R}$

So $I_{\text{bulb B}} = \frac{V}{3R}$.

Chapter 22

Magnetic forces on charges/currents
Torques on loops ; Magnetic fields produced by currents

22-69



(a) When can the crossbar remain stationary?

$\vec{B}$ into the page
(& right strength).

(b) What must the magnitude of B be?

$\Sigma F = 0$ no net force

$F_B = mg$

$IL B \overset{1}{\cancel{\sin\theta}} = mg$

$$B = \frac{mg}{IL} = \frac{(0.030)(9.8)}{(\underbrace{120/24}_{5})0.20}$$

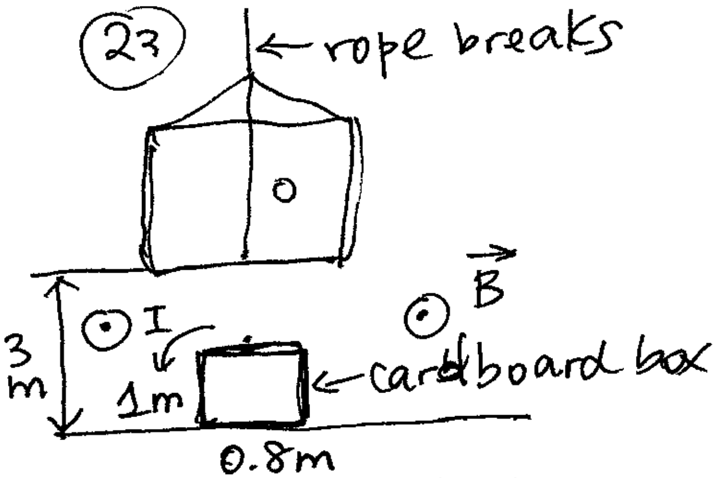
$$= 0.29\text{ T}$$

Chapter 23

Faraday's Law; Generators, transformers

23-23&49

(23)



counterclockwise

$\Phi_{before} = BA\cos\theta = (4.0\times10^{-5})(1\times0.8)1$

$= 3.2\times10^{-5}$ Wb $\Big\}$ $\Delta\Phi = -3.2\times10^{-5}$ Wb

$\Phi_{after} = 0$

time for safe to fall 2m $y=\frac{1}{2}gt^2$, $t=\sqrt{\frac{2y}{g}}=\sqrt{\frac{2\times2}{9.8}}$

$=0.6389$ s

time to fall 3m

$t=\sqrt{2y/g}=\sqrt{2\times3/98}=0.7825$ s

$\Delta t = 0.1436$ s

(49) $N=100$

$B=4.0\times10^{-5}$T

calculate $\mathcal{E}$

$\mathcal{E}=-N\frac{\Delta\Phi}{\Delta t}$

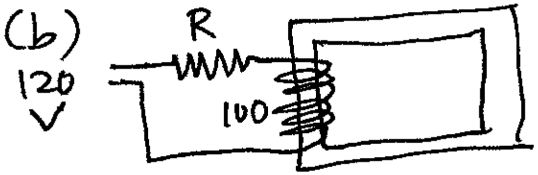
$\mathcal{E} = 100\,\frac{3.2\times10^{-5}}{0.1436} = 0.02$ V

23-59

(a) If 60-W, 120-V bulb is connected to 120 V, use $P=IV$

$I = P/V = \frac{60}{120} = 0.50$ A

(b)

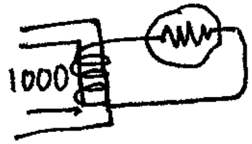


$R=60\,\Omega$

use $V=IR$

$I_1 = V/R = \frac{120}{60} = 2.0$ A

(c)



$P_{primary}=P_{secondary}$

$I_2=\frac{100}{1000}I_1=0.20$ A

less brightly.

(d) Need $I_2=0.50$A

Need ~~=~~ $I_1=5.0$ A

Need $R=\frac{V}{I_1}=\frac{120}{5.0}$

$=24\,\Omega$