Phys 1B
Solutions
Summer 2010

CH 21

1a) $V_{rms} = V_{max}/\sqrt{2}$

$V_{max} = 141V$

b) $I_{rms} = V_{rms}/R$, $V_{rms} = 100V$, $R = 5\Omega$ } $I_{rms} = 20A$

c) $I_{max} = \sqrt{2} \cdot I_{rms}$, $I_{rms} = 20A$ } $I_{max} = 28A$

d) $P = I_{rms} \cdot V_{rms} = 2000W$.

4) $P = V_{rms} \cdot I_{rms}$

$I_{rms} = P/V_{rms}$, $P = 100W$, $V_{rms} = 120V$ } $I_{rms} = 0.833A$ for the 100W bulb

$I_{rms} = P/V_{rms}$, $P = 150W$, $V_{rms} = 120V$ } $I_{rms} = 1.25A$ for the 150W bulb.

$R = V_{rms}/I_{rms}$

$R = 120V/0.833A = 144\Omega$

for the 100W bulb

$R = V_{rms}/I_{rms}$

$R = 120V/1.25A = 96\Omega$

for the 150W bulb.

29a) $\Delta V = I Z$

$Z = \Delta V / I \Rightarrow$
$\Delta V = 104 V$
$I = 0.5 A$
} $Z = 208 \Omega$

b) $P = I_{rms}^2 \cdot R$
$P = 100 W$
$I = 0.5 A$
} $R = 40.0 \Omega$

c) $Z = \sqrt{R^2 + X_L^2}$

$X_L = 2\pi f L$
$Z = 208 \Omega$
$R = 40 \Omega$
$f = 60 Hz$
} $L = \frac{\sqrt{Z^2 - R^2}}{2\pi f} = 0.541 H$

39) $I_1 \Delta V_1 = I_2 \Delta V_2$

$I_1 = 50 A$
$\Delta V_1 = 3600 V$
$I_2 = ?$
$\Delta V_2 = 100\,000 V$
} $I_2 = 1.8 A$

$P = I^2 R$
$R = 100 \Omega$
$I = 1.8 A$
} $P = 324 W$ dissipated

$P = I \Delta V = 180.000 W$ is generated. Hence,

$\frac{324}{180.000} \times 100 = 0.18 \%$

40a) It should have fewer turns, because the voltage is stepped down, it is a step-down transformer

b) $I_1 \Delta V_1 = I_2 \Delta V_2$

$$\left.\begin{aligned} I_1 &= 500mA \\ \Delta V_1 &= 6V \\ \Delta V_2 &= 120V \end{aligned}\right\} I_2 = 25mA$$ is the current in the primary.

c) $\Delta V_2 = N_2/N_1 \, \Delta V_1$

$$\left.\begin{aligned} \Delta V_2 &= 6V \\ \Delta V_1 &= 120V \\ N_1 &= 400 \end{aligned}\right\} N_2 = \frac{N_1 \Delta V_2}{\Delta V_1} = 20$$ turns is the # of turns in the secondary.

43) $$\left.\begin{aligned} c &= f\lambda \\ c &= 3 \cdot 10^8 \, m/s \\ f &= 75 Hz \end{aligned}\right\} \lambda = 4 \cdot 10^6 m$$

A quarter wave length antenna would be $1 \cdot 10^6 m = 1000 km$ or about 1/3 the distance from here to NY.

45a) $$\left.\begin{aligned} c &= f\lambda \\ \lambda &= 660 \cdot 10^{-9} m \end{aligned}\right\} f = 4.55 \cdot 10^{14} Hz$$ for 660 nm light

$$\left.\begin{aligned} c &= f\lambda \\ \lambda &= 940 \cdot 10^{-9} m \end{aligned}\right\} f = 3.19 \cdot 10^{14} Hz$$ for 940 nm light

b) If 67% will get absorbed, 33% gets transmitted because of the E^2 factor in intensity $E \propto \sqrt{I}$ Hence if I transmits by 33% then $E \propto$ amplitude will be $\sqrt{0.33} = 0.57 \Rightarrow 57\%$

50) $C = f\lambda$

$f = 27.3 \cdot 10^6$ Hz

$C = 3 \cdot 10^8$ m/s

} $\lambda = 10.98 \simeq 11$ m.

52) ~~d~~ $t = d/v$

$d = 3$ m

$V = 343$ m/s

} $t = 0.00875$ sec for the message to reach the person in the room

$t = d/v$

$d = 100 \cdot 10^3$ m

$C = 3 \cdot 10^8$ m/s

} $t = 0.00033$ sec for the message to go 100km

So the message travels faster and sooner through the radiowaves, of course this ignores any conversion times, etc.

58) first assume that you cover about $1 m^2$ of body space. then at the surface the power/~~m~~m^2 is 0.60×1340 W/m^2 = 804 W.

Only 50% of this gets aborbed Hence,

$0.5 \times 804 = 402$ W is the powe absorbed in 60 min/3600sec/1 hr

this is $402 W \times 3600 sec \approx 1.5 \cdot 10^6$ J of energy.