Problem Set 10: Energy and Power

10.1 [a] $P = 1200W$
$V = 240v$
$I = P/V$
$= 1200/240$
$= 5$ Amps

[b] $R = V/I$
$= 240/5$
$= 48$ Ohms

10.2 [a] $P = 6W$
$I = 0.5A$
$V = P/I$
$= 6/0.5$
$= 12V$

[b] $R = V/I$
$R = 12/0.5$
$= 24$ Ohms

10.3 $P = 100W$
$V = 240v$
$I = P/V$
$= 100/2400$
$= 4.17 \times 10^{-2}$ A
$R = V/I$
$= 240/4.17 \times 10^{-2}$
$= 576$ Ohms

10.4 [a] $I = 2A$
$V = 12v$
$t = 1.20 \times 10^{3}$ s
$P = IV$
$= 2 \times 12$
$= 24$ W
$W = Pt$
$= 24 \times 1.20 \times 10^{3}$
$= 2.88 \times 10^{4}$ joules

[b] $P = IV$
$= 2 \times 12$
$= 24$ W

[c] $q = It$
$= 2 \times 1.22 \times 10^{3}$
$= 2.44 \times 10^{3}$ C

kW h = $(3.46 \times 10^7)/(3.60 \times 10^6)$
= 9.6 kW h
Cost = 9.6 x 0.25
= \$2.40

[d] P = 1700 W
t = 300s
W = Pt
= 1700 x 300
= 5.10×10^5J
kW h = $(5.10 \times 10^5)/(3.60 \times 10^6)$
= 1.42×10^{-1} kW h
Cost = 1.42×10^{-1} x 0.25
= \$$3.54 \times 10^{-2}$ or 3.5c

10.9 [a] P = 2000w
t = 1.08×10^4s
W = Pt
= 2000 x 1.08×10^4
= 2.16×10^7J
kW h = $(2.16 \times 10^7)/(3.60 \times 10^6)$
= 6 kW h
Cost = 6 x 0.25
= \$1.50

[b] V = 240v
R = 26 ohms
t = 1.44×10^4s
I = V/R = 240/26 = 9.23A
P = IV = 9.23 x 240
= 2215 W
W = 2215 x 1.44×10^4
= 3.19×10^7 J
kW h = $(3.19 \times 10^7)/(3.60 \times 10^6)$
= 8.86 kW h
Cost = 8.86 x 0.25
= \$2.22

[c] V = 240 V
I = 8 A
t = 1.80×10^3 s
P = IV = 8 x 240
= 1920 W
W = Pt
= 1920 x 1.80 x 10^3
= 3.46×10^6 J
kW h = $(3.46 \times 10^6)/(3.60 \times 10^6)$
= 0.96 kW h
Cost = 0.96 x 0.25
= \$0.24

10.10 *Assuming 15 globes rated at 35 watts are all the lights in the house running for approximately twelve hours a day at a cost of 25c per KwH*

$P = 35 \times 15 = 525$ W

$V = 240$ V

$t = 12 \times 60 \times 60 = 4.32 \times 10^4$ s

$W = P \times t$

$= 525 \times 4.32 \times 10^4$

$= 2.27 \times 10^7$ J

kW h $= (2.27 \times 10^7)/(3.60 \times 10^6)$

$= 6.3$ kW h

Cost $= 6.3 \times 0.25$

$= \$1.58$

10.11 [a] $P = 150$ W

$V = 240$ V

$I = P/V = 150/240$

$= 0.625$A

[b] $R = P/I^2 = 150/(0.625)^2$

$= 384$ Ohms

[c] $t = 3.60 \times 10^3$

$W_{Total} = P \times t$

$= 150 \times 3.60 \times 10^3$

$= 5.40 \times 10^5$ J

$W_{light} = 5.40 \times 10^5 \times 0.95$

$= 5.13 \times 10^5$ J

[d] $t = 1.80 \times 10^4$s

$W = Pt = 150 \times 1.80 \times 10^4$s

$= 2.70 \times 10^6$ J

kW h $= (2.70 \times 10^6)/(3.60 \times 10^6)$

$= 0.75$ kW h

Cost $= 0.75 \times 0.25$

$= \$0.19$

10.12 [a] $P = 1.08 \times 10^4$ W

$t = 4.00 \times 10^3 \times t_{days}$

cost $= \$800$

kW h $= 800/0.25$

$= 3200$ kW h

$W = $ kW h $\times 3.60 \times 10^6$

$= 3200 \times 3.60 \times 10^6$

$= 1.152 \times 10^{10}$ J

$W = P \times t$

$1.152 \times 10^{10} = 4.00 \times 10^3 \times t_{days} \times 1.08 \times 10^4$

$t_{days} = 267$ days

10.13 [a] $V = 12$ V
$T = 3.60 \times 10^3$s
$I = 40$ A
$P = IV = 12 \times 40 = 480$ W
$W = P \times t = 480 \times 3.60 \times 10^3$
$= 1.73 \times 10^6$ J

[b] $V = 12$ V
$I = 75$ A
$t = 3.60 \times 10^3$
$P_{Globes} = 110$ W
$P_{Battery} = IV = 75 \times 12 = 900$ W
$W_1 = P \times t = 900 \times 3.60 \times 10^3$
$= 3.24 \times 10^6$ J
$W_2 = 110 \times t$
$W_1 = W_2$
$110t = 3.24 \times 10^6$
$t = 2.95 \times 10^4$s
$= 491$min
$= 8.18$ hrs

10.14 $V = 1.4$v
$I = 2.3$ A
$T = 3.60 \times 10^3$
$P_{light} =$
$P_{Battery} = I \times V = 1.4 \times 2.3 = 3.22$ W
$W_1 = P_{Battery} \times t = 3.22 \times 3.60 \times 10^3$
$= 1.16 \times 10^4$ J
$W_2 = P_{light} \times t$
$= 3t$
$W_1 = W_2$
$3t = 1.16 \times 10^4$
$t = 3.86 \times 10^3$ s
$= 64.4$ min