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
= 4.17×10^{-2} A
R = V/I
= $240/4.17 \times 10^{-2}$
= 576 Ohms

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

[b] P = IV
= 2 x 12
= 24 W

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

10.5 [a] The globe could be for either a car or a household lamp. A small reading lamp globe has a low wattage and current draw while the dashboard light in car is also a low power and current bulb.

[b] $I = 1.70 \times 10^{-2}$ A
$P = 4$ W
$R = P/I^2$
$= 4 / (1.70 \times 10^{-2})^2$
$= 1.38 \times 10^4$ Ohms

10.6 [a] $P = 2.3$ W $\quad I = 3.80 \times 10^{-1}$ A
$V = P/I$
$= 2.3/(3.80 \times 10^{-1})$
$= 6$ V

[b] $R = P/I^2$
$= 2.3 / (3.80 \times 10^{-1})^2$
$= 15.9$ Ohms

10.7 [a] $V = 12$ V
$P = 55$ W
$I = P/V$
$= 55/12$
$= 4.58$ A

[b] $R = P/I^2$
$= 55 / (4.58)^2$
$= 2.62$ Ohms

10.8 [a] $P = 60$ W
$t = 4.86 \times 10^5$s
$W = Pt$
$= 60 \times 4.86 \times 10^5$
$= 2.92 \times 10^7$j
kW h $= (2.92 \times 10^7)/(3.60 \times 10^6)$
$= 8.1$ kW h
Cost $= 8.1 \times 0.25$
$= \$2.03$

[b] $P = 11$ W
$t = 4.86 \times 10^5$s
$W = Pt$
$= 11 \times 4.86 \times 10^5$
$= 5.35 \times 10^6$j
kW h $= (5.35 \times 10^6)/(3.60 \times 10^6)$
$= 1.49$ kW h
Cost $= 1.49 \times 0.25$
$= \$0.37$

[c] $P = 2400$ W
$t = 1.44 \times 10^4$s
$W = Pt$
$= 2400 \times 1.44 \times 10^4$
$= 3.46 \times 10^7$j

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 x 15 = 525 W
V = 240 V
t = 12 x 60 x 60 = 4.32×10^4 s
W = P x t
= 525 x 4.32 x 10^4
= 2.27×10^7 J
kW h = $(2.27 \times 10^7)/(3.60 \times 10^6)$
= 6.3 kW h
Cost = 6.3 x 0.25
= $1.58

10.11 [a] P = 150 W
V = 240 V
I = P/V = 150/240
= 0.625A

[b] R = $P/I^2 = 150/(0.625)^2$
= 384 Ohms

[c] t = 3.60×10^3
W_{Total} = P x t
= 150 x 3.60 x 10^3
= 5.40×10^5 J
W_{light} = 5.40×10^5 x 0.95
= 5.13×10^5 J

[d] t = 1.80×10^4s
W = Pt = 150 x 1.80 x 10^4s
= 2.70×10^6 J
kW h = $(2.70 \times 10^6)/(3.60 \times 10^6)$
= 0.75 kW h
Cost = 0.75 x 0.25
= $0.19

10.12 [a] P = 1.08×10^4 W
t = 4.00×10^3 x t_{days}
cost = $800
kW h = 800/0.25
= 3200 kW h
W = kW h x 3.60×10^6
= 3200 x 3.60 x 10^6
= 1.152 x10^{10} J
W = P x t
1.152 x10^{10} = 4.00×10^3 x t_{days} x 1.08×10^4
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 $V = 1.4v$
$I = 2.3\ A$
$T = 3.60 \times 10^3$
$P_{light} =$
$P_{Battery} = I \times V = 1.4 \times 2.3 = 3.22\ W$
$W_1 = P_{Battery} \times t = 3.22 \times 3.60 \times 10^3$
$= 1.16 \times 10^4\ J$
$W_2 = P_{light} \times t$
$= 3t$
$W_1 = W_2$
$3t = 1.16 \times 10^4$
$t = 3.86 \times 10^3\ s$
$= 64.4\ min$