Physics 30 - Lesson 18B
Electric Power

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1) /3

The power company for Calgary is Enmax. ✓

Cost of power is $\approx \$0.079/kWh$ ✓ ✓

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2) /3

$t = 1.5\,\text{min} \times 60s = 90s$

$I = 4.0A$

$V = 60V$

$P = ?$

$E = ?$

$P = IV = 4.0A(60V) = 240W$ ✓

$E = Pt = 240W \times 90s$ ✓

$\boxed{E = 2.16 \times 10^4 J}$

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3) /3

a) $P = IV = 12.5A(240V)$ ✓

$\boxed{P = 3.0kW}$

b) $P = I^2R = (12.5A)^2(8.3\Omega)$ ✓

$\boxed{P = 1.2kW}$

c) $P = \dfrac{V^2}{R} = \dfrac{(120V)^2}{240\Omega} = \boxed{60W}$ ✓

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4) /4

a) $P = IV = 15A(240V)$ ✓

$\boxed{P = 3.6kW}$

b) toaster

$I = \dfrac{P}{V} = \dfrac{800}{120} = 6.67A$ ✓

kettle

$I = \dfrac{P}{V} = \dfrac{1180}{120} = 9.83A$ ✓

$I = 20A - 6.67A - 9.83A = \boxed{3.5A}$ ✓

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5) /4

a) $I = \dfrac{P}{V} = \dfrac{1000}{120} = \boxed{8.3A}$ ✓

b) $R = \dfrac{V}{I} = \dfrac{120}{8.3} = \boxed{14.4\Omega}$ ✓ $\qquad I = \dfrac{V}{R} = \dfrac{240}{14.4} = \boxed{16.7A}$ ✓

c) $P = I^2R = 16.7^2(14.4)$ ✓

$P = 4.0kW \rightarrow$ something will melt

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6) $t = \frac{1}{4}h \times 1year \times \frac{356days}{year} \times \frac{24h}{day}$

$t = 2190h$ ✓

/3 $P = IV = (2.5A)(120V)$

$P = 0.300kW$ ✓

$\text{cost} = Pt \times rate = 0.300kW \times 2190h \times \frac{\$0.042}{kWh}$ ✓

$\boxed{\text{cost} = \$27.59}$

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7) $R = 16\Omega$

$V = 120V$

$t = 30\,\text{min} \times \frac{60s}{\text{min}}$ ✓

$t = 1800s$

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$E = Pt = VIt = \frac{V^2t}{R}$ ✓

$E = \frac{(120V)^2(1800s)}{(16\Omega)} = 1.62MJ$ ✓ ✓

$\text{cost} = 1.62MJ \times \frac{\$0.030}{MJ}$ ✓

$\text{cost} = \boxed{\$0.049}$ ✓

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8) $R = 160\Omega$ ✓

$I = 15A$

$t = 30\,\text{min} = 0.50h$

$rate = \$0.12/kWh$

/6

$E = Pt = VIt = I^2Rt$ ✓ ✓

$E = (15A)^2(160\Omega)(0.50h) = 18.0kWh$ ✓

$\text{cost} = 18.0kWh \times \frac{\$0.12}{kWh}$ ✓

$\text{cost} = \$2.16$ ✓

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9) Electric cost

$P = 100W$

$t = 2000h$ ✓

$E = Pt = 100W(2000h)$

$E = 200kWh$ ✓

$\text{cost} = 200kWh \times \frac{\$0.040}{kWh}$ ✓

$\text{cost} = \$8.00$ ✓

Kerosene cost

$\text{cost} = \frac{0.0328L}{h} \times 2000h \times \frac{\$0.22}{L}$ ✓ ✓

$\text{cost} = \$14.43$ ✓

savings = \$14.43-\$8.00= $\boxed{\$6.43}$ ✓

/9

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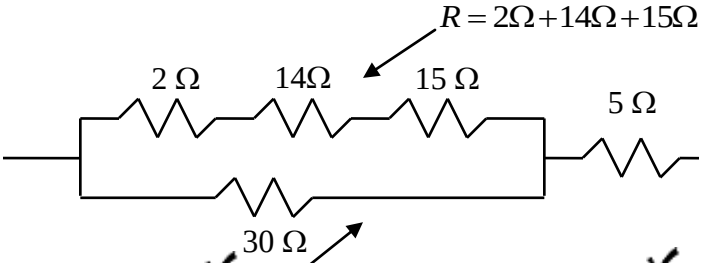
10) Find R_{Total}



$R = 2\Omega + 14\Omega + 15\Omega = 31\Omega$

$\frac{1}{R_A} = \frac{1}{31\Omega} + \frac{1}{30\Omega}$ ✓

$R_A = 15.2\Omega$

$R_T = 15.2\Omega + 5\Omega$ ✓

$\boxed{R_T = 20.2\Omega}$ ✓

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Find energy

$V = 120V$

$R = 20.2\Omega$

$t = 36 \times 24 \times 3600$

$t = 3.11 \times 10^6 s$

$E = PT = VIt = \frac{V^2}{R}t = \frac{(120V)^2}{20.2\Omega}(3.11 \times 10^6)s$ ✓ ✓

$E = 2.21 \times 10^9 J = 2212.3MJ$ ✓

$\cos t = 2212.3MJ \times \frac{\$0.13}{MJ} = \boxed{\$287.60}$ ✓ ✓

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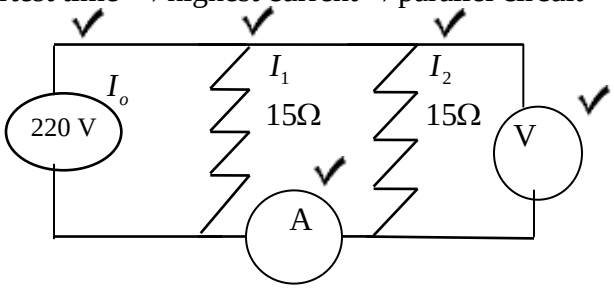
11) a) Shortest time $\rightarrow$ highest current $\rightarrow$ parallel circuit



✓ ✓ ✓ ✓ ✓

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b) $I_o = ?$

$I_1 = \frac{V_1}{R_1} = \frac{220V}{15\Omega} = 14.67A$ ✓ ✓ ✓

$I_2 = I_1 = 14.67A$

$I_o = I_1 + I_2 = 14.67A + 14.67A$ ✓

$\boxed{I_o = 29.3A}$ ✓

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c) $P = ?$

$P = VI = 220V(14.67A)$ ✓ ✓

$\boxed{P = 3.226kW \text{ per coil}}$ ✓

/3

d) See diagram

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e) $E = mc\Delta t = (160kg)(4.19\frac{kJ}{kg°C})(1.0°C) = 670.4kJ$ ✓

$P_{Total} = \overset{\text{2 coils}}{2} \times \overset{\text{per coil}}{3.226kW} = 6.45kW$ ✓

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$P = \frac{E}{t}$ ✓

$t = \frac{E}{p} = \frac{670.4kJ}{6.45kW} = 103.9s$ ✓

$\boxed{t = 1.73\text{min}}$ ✓
