AK

Percent Efficiency Problems

1) $\frac{V}{R} = \frac{IR}{R}$ $\quad \frac{12.0\,V}{2.0\,\Omega} = I = 6.0\,A$

$E = VIt$
$= (12.0\,V)(6.0\,A)\left(30.0\,min \times \frac{60\,s}{1\,min}\right)$

$E_{in} = 129600\,J$

$Q = mc\Delta T$
$= (2.50 \times 10^2\,g)\left(4.18\,\frac{J}{g \cdot C}\right)(100.0°C - 85.0°C)$
$= 15675\,J$

$\% \, eff = \frac{E_{out}}{E_{in}} \times 100 = \frac{15675\,J}{129600\,J} \times 100 = 12.1\%$

2) $Q = mc\Delta T$
$= (150.0\,g)\left(4.19\,\frac{J}{g \cdot °C}\right)(70.0°C - 23.0°C)$
$= 29539.5\,J$

$E = Pt = 600.0\,W \times 1\,min \times \frac{60\,s}{1\,min} = 36000\,J$

$\% \, eff = \frac{E_{out}}{E_{in}} \times 100 = \frac{29539.5\,J}{36000\,J} \times 100 = 82.1\%$

3) $Q = mc\Delta T = (152.0\,g)\left(4.19\,\frac{J}{g \cdot C}\right)(10.0°C) = 6368.8\,J$

$E = VIt = (6.0\,V)(1.75\,A)\left(10.0\,min \times \frac{60\,s}{1\,min}\right) = 6300\,J$

a) not possible as $E_{in} = E_{out}$
OR b) an error was made

4) $Q = ?$ $Q = mc\Delta T$

$= 250$

$= (120.0g)\left(\frac{4.19J}{g°C}\right)(27.0°C - 22.0°C)$

$Q = 2514J = 2500J$ 2sf

5) $E = Q$ if 100% $\frac{\cancel{VIt}}{\cancel{Vt}} = \frac{mc\Delta T}{Vt}$

$$I = \frac{(250.00g)\left(\frac{4.19J}{g°C}\right)(43.0°C - 18.0°C)}{(12.0V)\left(10.0min \times \frac{60s}{1min}\right)}$$

$I = 3.64A$

I did this in 1 step!
You can (i) E=V Calculate HE first $Q = mc\Delta T$
then ii) say Q=E bec 100% eff
then iii) E=VIt & rearrange for I

6) $Q = 14700J$ $\frac{Q}{mc} = \frac{\cancel{mc}\Delta T}{\cancel{mc}}$

i) solve for ΔT $\frac{14700J}{(250.0g)\left(4.19\frac{J}{g°C}\right)} = \Delta T = 14.0°C$

then
ii) $\Delta T = T_f - T_i$
$+T_i \quad +T_i$

$14.0°C + 24.0°C = T_f = 38.0°C$

7) $200.0\,\cancel{kg} \times \frac{1000\,g}{1\,\cancel{kg}} = 200\,000\,g = m$

$Q = mc\Delta T = (200\,000\,g)\left(4.19\,\frac{J}{g\cdot C}\right)(60.0°C - 15.0°C)$

$= 37710000\,J = 3.77 \times 10^{7}\,J$ sf $= Q$

8) $\frac{Q}{mc} = \frac{m\cancel{c}\Delta T}{\cancel{mc}}$

i) $\frac{935\,000\,J}{(5000\,g)\left(2.2\,\frac{J}{g\cdot C}\right)} = \Delta T = 85.0\,°C$

ii) $\Delta T = T_f - T_i$
$+T_i \qquad +T_i$

$85.0°C + 5.0°C = T_f = 90.0°C$

9) $R = 5.0\,\Omega$ $T_i = 20.0°C$ $T_f = 26.0°C$
vol = ? $I = 2.0\,A$
$t = 5.0\,min$
$m = ?$

$V = IR$
$= (2.0\,A)(5.0\,\Omega)$
$= 10.\,V$

$E = VIt$
$= (10.\,V)(2.0\,A)\left(5.0\,min \times \frac{60\,s}{1\,min}\right)$
$E = 6\bar{0}00\,J$

if E is conserved = 100% eff then:

$E_{in} = Q_{out}$

$\therefore Q = 6\bar{0}00\,J = mc\Delta T$

$\frac{6\bar{0}00\,J}{c\Delta T} = \frac{mc\Delta T}{c\Delta T}$

$\frac{6\bar{0}00\,J}{\left(\frac{4.19\,J}{g\cdot C}\right)(6.0°C)} = m = 238 \rightarrow 240.\,g$

which doesn't make sense for a water heater!

10) "increase in T" = ΔT = ?

$$\frac{Q}{mc} = \frac{mc\Delta T}{mc} \qquad E = VIt$$

$$= (20.0V)(1.0A)\left(30.0min \times \frac{60s}{min}\right)$$

$$\frac{36000J}{(100g)\left(\frac{4.19J}{g°C}\right)} = \Delta T \qquad = 36000J = Q$$

$\Delta T = 86°C$

11) $Q = E$

$$\frac{mc\Delta T}{VI} = \frac{VIt}{VI}$$

$$t = \frac{\left(180.L \times \frac{1000mL}{1L} \times \frac{1g}{1mL}\right)\left(\frac{4.19J}{g°C}\right)(60.0°C - 40.0°C)}{(220.V)(20.0A)}$$

$$= 3428s \rightarrow 3430s \ (3sf) \times \frac{1min}{60s} = 57.2min = t$$

12) $E = Q$

$$\frac{Pt}{P} = \frac{mc\Delta T}{P}$$

$-10.00°C \rightarrow 48.00°C$

$T_f - T_i = \Delta T$

$48.00°C - (-10.00°C) = 58.00°C$

$$= \frac{\left(1.50L \times \frac{1000mL}{1L}\right) \times \frac{1.11g}{1mL} \times \frac{2.21J}{g°C} \times 58.00°C}{1000W}$$

$$= \frac{J}{\frac{J}{s}} \cdot \frac{s}{J} = s \qquad t = 213s$$