

### Answer on Question #73340 - Physics / Electric Circuits

A wire of resistance  $R = 3.0 \Omega$  is connected to a battery whose emf is  $\mathcal{E} = 5.0 \text{ V}$  and whose internal resistance is  $= 1.0 \Omega$ .

(a) How much energy is transferred from chemical to electrical form in  $t = 4.0 \text{ min}$ ?  
(b) How much energy appears in the wire as thermal energy in that time?

**Solution:**

(a) Total energy that is transferred from chemical to electrical form in  $t = 4 \text{ min}$

$$U_{total} = \mathcal{E}It$$

where  $I = \frac{\mathcal{E}}{R+r}$  is the current through the circuit.

So

$$U_{total} = \frac{\mathcal{E}^2}{R+r} t = \frac{5.0^2}{3.0 + 1.0} \times 4 \times 60 = 1500 \text{ J}.$$

(b)

$$U_{wire} = I^2Rt = \frac{\mathcal{E}^2}{(R+r)^2} Rt = \frac{5.0^2}{(3.0 + 1.0)^2} \times 3.0 \times 4 \times 60 = 1125 \text{ J}.$$

**Answers:**

(a) 1500 J  
(b) 1125 J

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