Problem 3.1

a)

$$V_{load} = \varepsilon \frac{R_{load}}{R_{load} + r}$$
$$P_{load} = \frac{V_{load}^2}{R_{load}} = \varepsilon^2 \frac{R_{load}}{(R_{load} + r)^2}$$

b)

$$\frac{d}{dR}\left(\frac{R}{(R+r)^2}\right) = \frac{r-R}{(R+r)^3} = 0$$
$$R = r$$

Therefore the power will be largest when $R_{load} = r$

c)

$$P_{total} = I^2 r + I^2 R = 2I^2 r$$

Therefore 50% of the power is dissipated by the battery