Absolute magnitude, apparent magnitude and distance

Let L be the amount of energy which would be received from the star per m^2 per second were it at a distance of 10 pc, and M its absolute magnitude. Let l and m be the corresponding values at its actual distance (say) of d (pc).

Then, since radiant energy obeys the inverse-square law,

$$\frac{L}{l} = \frac{d^2}{(10)^2}$$

Brightness ratio

We also know that a difference of five magnitudes corresponds to a factor of one hundred in brightness. Therefore, a difference of x magnitudes corresponds to a factor of $100^{\frac{x}{5}}$. That is, 100 to the power $\frac{x}{5}$

$\Rightarrow \frac{L}{l}$ is also equal to $100^{\frac{(m-M)}{5}}$

Thus, $$\frac{d^2}{100} = 100^{\frac{(m-M)}{5}}$$

Taking logarithms to base 10: