Answers Week 13

13-1 3m

13-3 NO! For a divergent lens focal length (f) is negative, therefore image distance (q) is negative. All the images are virtual, upright and reduced.

13-5 q = -10 cm
The image is virtual, upright and twice the size of the object [m = 2].

13-7 $\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$

$x=(p-f)$ $\qquad x'=(q-f)$

Hence $\frac{1}{x+f}+\frac{1}{x'+f}=\frac{1}{f}$

and therefore $xx'=f^2$

13-9 In an ordinary source of light, there are an enormous number of electrons each of which makes a "jump" within its atom and produces a light wave of a given frequency. The typical jump time is about 10^{-8} sec, so a single jump produces a "wave train" about 3m long. However, the jumps are all independent of one another so each has its own phase. Therefore, in the entire light beam the phase varies randomly in time.

13-11 Superpose the two waves each of amplitude E_m.
The total E field will have the amplitude

$$E_A = 2E_m\, Cos\left(\frac{\phi_1-\phi_2}{2}\right)$$

where $(\phi_1-\phi_2)$ is a random function of time.
The total Average intensity

$$<I>=\frac{1}{2}\epsilon_0 C E_A{}^2=\frac{1}{2}\epsilon_0 C\left(2E_m{}^2\right)$$

which is twice the intensity from a single source of amplitude E_m.

13-13 15π radians