Problem 1.

1 - The damascene process, by filling a hole or trench and etching back, provides for planarization, such as in the W plug process. In the normal masked plasma etch process, a non-planar topography often results.

2 - The damascene process might be used when a good plasma etch process can not be developed for a film, such is for Cu (due to the low volatility of the etch products primarily.) In a damascene process, CMP can be utilized for the etchback, which can etch back almost anything, and a masked plasma etch of that material is not required.

Problem 2.

The relevant equations are simply

$$\therefore R = k_1 \frac{\lambda}{NA} = 0.6 \frac{\lambda}{0.85} \quad \text{and} \quad \text{DOF} = \pm k_2 \frac{\lambda}{(NA)^2} = \pm 0.5 \frac{\lambda}{(0.85)^2}$$

If we use immersion lithography, the NA would be increased by 1.6 given the refractive index.