

- 1 Explain the difference between QE and DQE. Produce additional entries in Table 9.1 for CCDs with 5 and 15 electrons of readout noise.

QE: determined in the laboratory with a stable well-designed calibration system

Influence of other optics are removed

DQE: efficiency of an idealized imaging system

$$\eta' = \eta \frac{1}{\left(1 + \frac{R^2}{\eta N_p}\right)}$$

Table 9.1. Detective quantum efficiency (DQE) as a function of readout noise R (electrons rms) and number of incident photons N_p for two values of the true QE (30% and 60%).

Read noise $R(e^-)$	Incident number of photons (N_p)					
	1	10	100	1,000	10,000	100,000
1	6.9 (22.5)	22.5 (51.4)	29.0 (59.0)	29.9 (59.9)	30.0 (60.0)	30.0 (60.0)
10	0.1 (0.4)	0.9 (3.4)	6.9 (22.5)	22.5 (51.4)	29.0 (59.0)	29.9 (59.9)
100	0.001 (0.004)	0.009 (0.215)	0.1 (0.4)	0.9 (3.4)	6.9 (22.5)	22.5 (51.4)
5	0.36 (1.41)	3.21 (11.61)	16.36 (42.35)	27.69 (57.6)	29.75 (59.75)	29.98 (59.98)
15	0.04 (0.16)	0.39 (1.56)	3.53 (12.63)	17.14 (43.64)	27.91 (57.83)	29.78 (59.78)

7 What is meant by the “zeropoint” of a magnitude scale?

$$m = m_0 - 2.5 \log F + 2.5 \log F_0 \quad (9.16)$$

Zeropoint of magnitude

“magnitude” is relative variable=need **reference point**

Vega system: Vega is assigned 0 magnitudes in every bandpass