Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) diagram to show:
both focal points coinciding and labelled, with $f_o > f_e$ **(1)**
centre ray straight through objective, rays crossing at focal plane and proceeding to eyepiece **(1)**
rays refracted at eyepiece and emerge parallel to construction line **(1)**

3

(b) (i) ($f_o + f_e = 3.5$, and $f_o / f_e = 100$) estimate $f_o \approx 3.5$ m and $f_e \approx 0.035$ m **(1)**

(ii) (use of $M = \frac{\alpha}{\alpha}$ gives) $\alpha = \frac{4.0 \times 10^{-3}}{100} = 4.0 \times 10^{-5}$ (rad) **(1)**

(use of $\alpha = \frac{D}{r}$ gives) $D = 4.0 \times 10^{-5} \times 1.3 \times 10^{9} = 5.2 \times 10^{4}$ km **(1)**

(allow C.E. for value of α)

3

(c) no chromatic aberration - mirrors do not refract light **(1)**
no spherical aberration - use of parabolic mirror **(1)**
no distortion - mirror can be supported more strongly **(1)**
better resolving power or greater brightness - mirrors can be larger **(1)**
more light gets through (image brighter) - lens absorbs more light **(1)**
(any two)

2

[8]

Q2.

(a) ratio of the number of photons falling on a device that produce a signal to the total number of photons falling on the device **(1)**
> 70% (for CCD) **(1)**

2

(b) silicon chip **(1)**
divided into picture elements (pixels) **(1)**
(light) photons incident **(1)**
electrons released **(1)**
charge or number released proportional / related to beam intensity / brightness **(1)**
image produced identical to electron pattern **(1)**

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when exposure complete, charge processed to give image **(1)**

max 5

[7]

Q3.

(a) (i) (use of $\lambda_{max}T$ = 0.0029 gives) $\lambda = \frac{0.0029}{6000}$ **(1)**

$= 4.8 \times 10^{-7}$ m **(1)**

(ii) values on axis : 0.5 1.0 1.5 2.0 **(1)**

(iii) similar shaped curve with peak shifted to right **(1)**

max 4

(b) (i) <u>difference</u> in absolute magnitude = 5 **(1)**
corresponds to × 100 difference in brightness,
some reference to absolute scale **(1)**
Arcturus lower absolute magnitude, therefore brighter **(1)**

(ii) (use of $P = \sigma AT^4$ gives) $\frac{P_A}{P_S} = 100 = \frac{A_A T_A^4}{A_A T_S^4}$ **(1)**

$\frac{A_A}{A_S} = 100 \times \left(\frac{6000}{5000}\right)^4$ **(1)** (= 200)

max 4

[8]

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