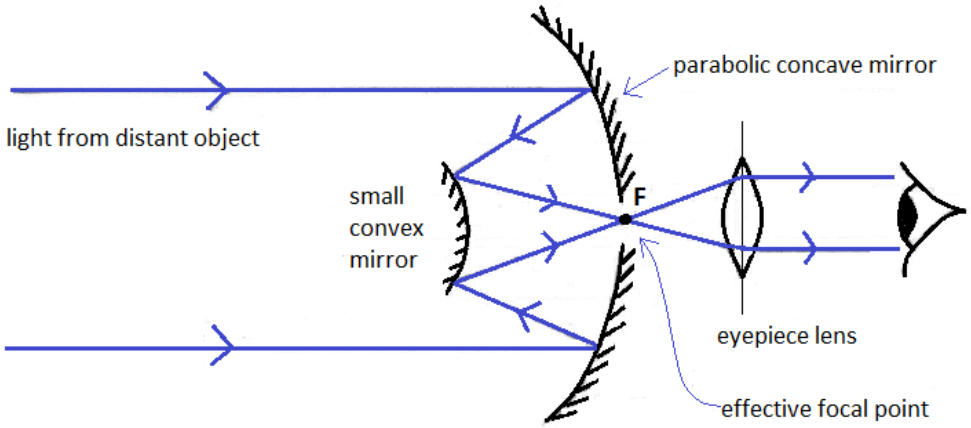
ASTROPHYSICS

1-3 Reflecting telescopes

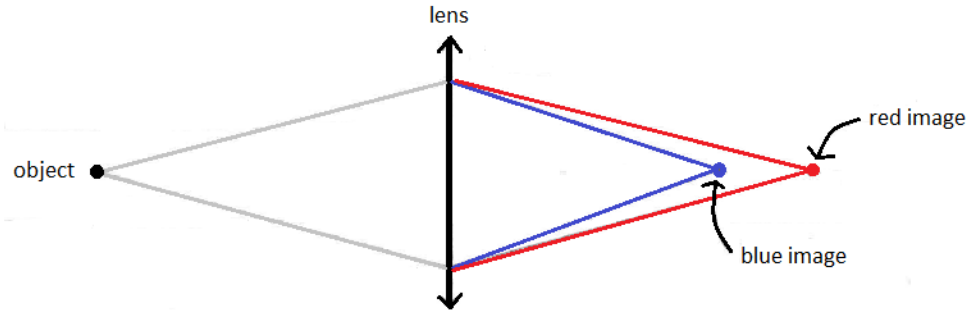
1. Passage of light from distant object through Cassegrain telescope:



N.B. when drawing this in an exam the concave mirror's two halves must form part of a complete arc and the small convex mirror must be clearly convex and not plane

This is easier to draw if you draw the rays in first and then put the concave mirror in where they cross.

2. (a) Chromatic aberration is when the different colours of light are brought to a focus at different points.



(This is a result of the different speeds of the different colours in the glass resulting in them being refracted differently)

(b) The objective of a refracting telescope is a lens and can thus produce chromatic aberration by refraction of the incoming light. The objective of a Cassegrain reflector telescope is a mirror and no refraction, hence not chromatic aberration, can occur.

3. Disadvantages of a Cassegrain telescope:

   - some of the light is blocked by the secondary mirrors and supporting frames unlike in a simple refractor telescope where there is nothing to block the light

   - has a more restricted field of view than a simple refractor because the angular magnification is greater which makes it more difficult to locate an object (for the same length of telescope)

   Any 1 disadvantage and reason

   Advantages of a Cassegrain telescope:

   - fainter stars can be seen as it can be as it can be much wider and collect more light than a simple refractor. This is because it is possible to manufacture much wider high-quality concave mirrors than the convex lenses used in refractors.
   - there is reduced image distortion due to spherical aberration by using a parabolic mirror compared to a refractor
   - can be shorter and easier to handle than the corresponding refracting telescope for the same angular magnification
   - has a greater angular magnification for the same length of telescope as the effective objective focal length is greater and angular magnification = $\frac{\text{focal length of the objective}}{\text{focal length of the eyepiece}}$

   Any 1 advantage and reason

4. (a) primary mirror diameter = 80 mm, eye pupil diameter = 8 mm

   Ratio = $\frac{80^2}{8^2}$ = 100 times more collected (ratio of areas ($\pi d^2/4$, π and 4 cancel)

   (b) f_0 = 2.8 m, f_e = 0.07 m

   angular magnification $= \frac{f_0}{f_e}$ $= \frac{2.8}{0.07}$ = 40