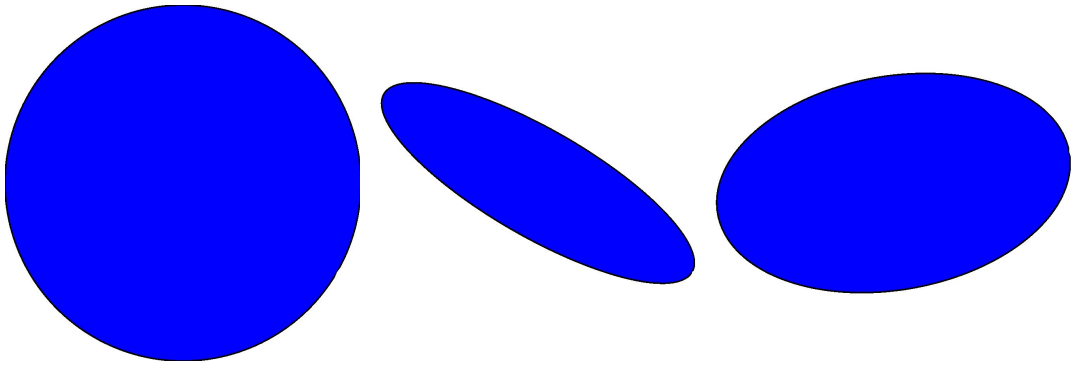
Physics of Galaxies HW: Set 1

Issue Date: 5/10/17 Hand-In Date: 12/10/17

Students should hand in their exercises by **4.00pm** on the date given above; exercises will not be accepted for marking later than this. The **Course Title**, the exercise **Set Number** and the **Student's Name** should be stated clearly.

1. Explain meaning of all symbols in Hubble's galaxy classification scheme for elliptical galaxies, i.e. $n = [10x(1 - b/a)]$ for En **[2 marks].**



Use ruler to measure *a* and *b* in the above three elliptical galactic shapes to determine *n* in each case. Show your calculations of *n* explicitly in each case **[3 marks].**

In Hubble's galaxy classification scheme, state what happens to the size of the bulge/bar and winding of the spiral arms as one goes from Sa→Sc or SBa→SBc **[3 marks].**

2. Hubble's constant is expressed as

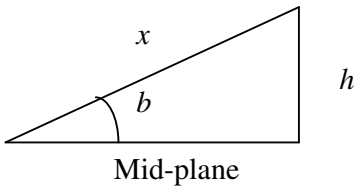
$$H_o = h \times 100 \text{ km s}^{-1} \text{ Mpc}^{-1} \qquad (1.1)$$

Show, by direct calculation, that

$$\frac{1}{H_o} \approx \frac{10^{10}}{h} yr \quad \textbf{[2 marks]} \qquad (1.2)$$

Hubble's value of *h* was about 5. What was the problem with this value? **[2 marks]**

3. If *k* is the extinction per unit length due to Galactic dust and one can model the Galaxy as a cylinder of height 2*h* and very large radius,



derive the formula

$$m - m_o = 1.09\, kh \text{ cosec } b$$

for the number of magnitudes by which an extragalactic source at Galactic latitude *b* (which is an angle) is dimmed for an observer in the mid-plane. You should justify the factor 1.09. (Note that the flux decreases (due to the light extinction) by a factor $\exp(-kx)$ over a distance *x* i.e. $F = F_o \exp(-kx)$ and that apparent magnitude is related to flux by $m - m_o = -2.5 \log (F/F_o)$, where symbols with subscript "o" refer to values without the extinction. **[4 marks]**

16 marks in total