Physics of Galaxies

ANSWERS: Exercise NUMBER 2

1. At E=13.6 eV (ionization energy of hydrogen), plasma recombines = kT. Thus

$T = 13.6 \times 1.6 \times 10^{-19} / 1.38 \times 10^{-23} = 1.6 \times 10^{5}$K [3 marks]

Based on Saha equation and using T=2.7(1+z) we have z=4000/2.7-1=1481≈1500K [1 mark]

"Now" means z=0, thus T=2.7(1+0)=2.7K [1 mark]

[3+1+1 = **5 marks**]

2. In spiral galaxies

1. Stars form gradually within a protogalaxy; [1 mark]

2. Gas not involved in star-formation collapses to form a disk; [1 mark]

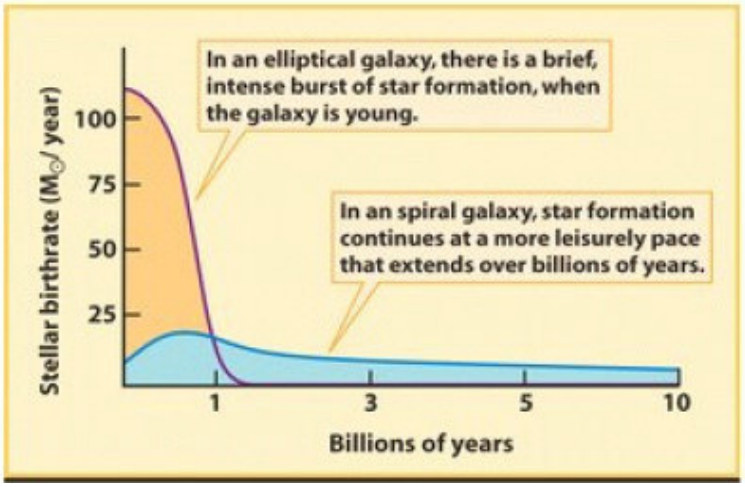
3. A spiral galaxy results [1 mark].

In elliptical galaxies

1. Stars form rapidly within a protogalaxy; [1 mark]

2. Gas is quickly consumed to make stars; [1 mark]

3. An elliptical galaxy results [1 mark]. [1+1+1+1+1+1=**6 marks**]



[**4 marks**]

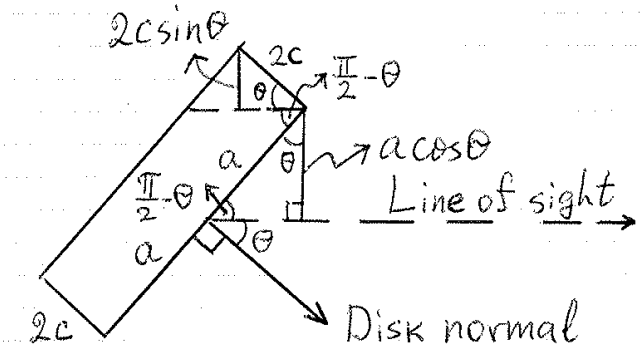
3. Ellipticity is defined as:

$e = 1 - thickness/width =$

$$1 - \frac{2a\cos\theta + 2c\sin\theta}{2a} =$$

$$1 - \cos\theta - (c/a)\sin\theta$$

[6 marks (which include 3 marks for sketch)**]**



Simplest argument against the idea that the flattest ellipticals, E7, are disks at an inclination is the value of *c/a* obtained: For E7, *n*=7=10*e*.

Thus, $e = 0.7 = 1 - \cos\theta - (c/a)\sin\theta$. Putting in $\theta = \pi/2$ yields *c/a*=0.3 >> than what is observed for spiral galaxies, i.e. 0.01—0.001, typically **[4 marks]**.

[Total Set 2 marks available 25]