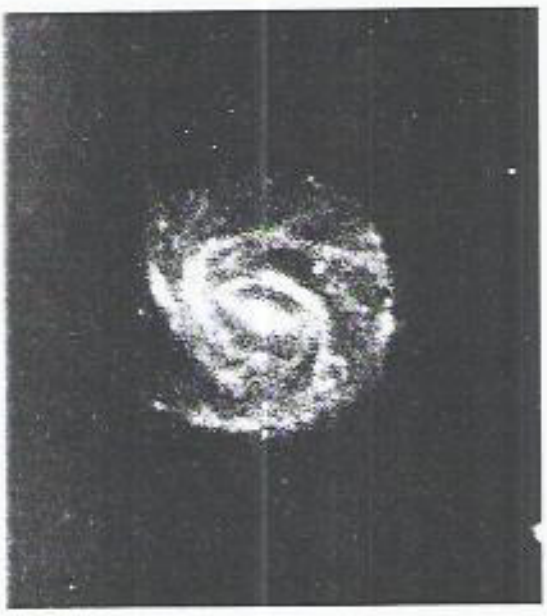
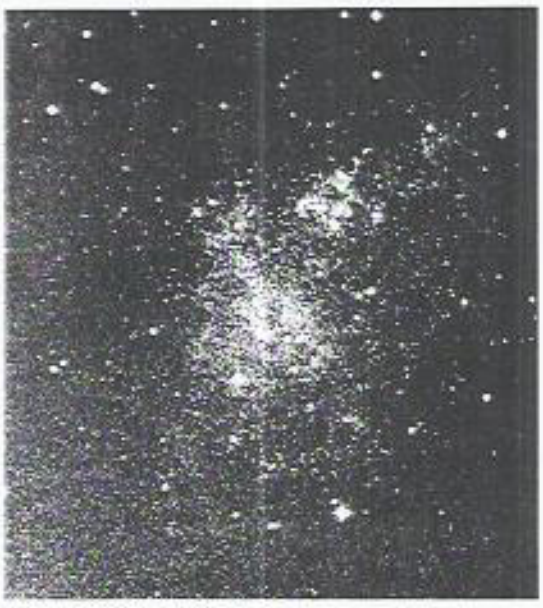
(a)



(b)



(c)

Figure 1 Three galaxies (a, b, c) of different Hubble classes.

Question 3

This question relates to Book 3 Chapter 3, and carries 25% of the marks for this assignment.

An E4 galaxy is observed using a new X-ray satellite, and as a result is classified as an active galaxy.

(a) (*5 marks*) (i) In a sentence, state why the X-rays from the galaxy are not observable at the Earth's surface.

(ii) In a few sentences, describe the two features of the galaxy's X-ray spectrum that could have led to it being classified as active.

(b) (*6 marks*) Optical astronomers prepare to take the first optical spectrum of the galaxy. With the aid of a sketch (with labelled axes), describe in a few sentences the likely features of the optical spectrum that would distinguish it from that of a normal galaxy.

(c) (*8 marks*) (i) On a sketch of a model of an active galactic nucleus, show where the optical emission that characterizes an active galaxy comes from. On the same sketch, show where the X-ray emitting region is located.

(ii) Account for the spectral line-widths in the optical spectrum.

(iii) The X-rays are found to vary on a time-scale of about 3 days. Estimate the size of the X-ray emitting region. Express your answer in metres, and as a multiple of the diameter of Pluto's orbit. *Show details of your working.*

(d) (*6 marks*) (i) In a few sentences, describe how the X-rays are thought to be produced.

(ii) In a couple of further sentences, state how the X-rays provide the power for the optical spectrum.