① Read the pages outlined and/or follow the instructions given.
② Unless space has been given, answer the questions on a separate sheet and then staple it to this sheet.
③ Use complete sentences when necessary (i.e. explain, describe, why, ...). Also, watch your spelling and grammar and be sure to write neatly!

A. Definitions/Check & Reflect on Your Reading (P.278-288)

{2} 1. Define the following terms:
(a) big bang theory (b) spectral lines (c) spectral shifting (d) spectroscope

{4} 2. The electromagnetic (em) spectrum diagram (P.281) consists of seven components: radio waves, microwaves, ... Use the diagram and the fact "the shorter the wavelength the more energy the wave has," to answer the following:
(a) Which component of the em spectrum has the longest wavelength? The most energy?
(b) Which colour of visible light has the longest wavelength? The most energy?

{4} 3. Refer to the "Doppler effect" diagrams (P.283) to help answer the following:
(a) What is the Doppler effect?
(b) Explain whether the duck (Q.6/P.288) is swimming away from you or toward you in each case.

{6} 4. (a) What does (i) "red shift" and (ii) "blue shift" mean?
(b) What do each indicate about a star or galaxy's motion with respect to the observer? (i.e. is it moving toward the observer or away from the observer?)

{2} 5. Which theory, to date, continues to be the only theory for the universe's formation that is supported by the entire body of scientific information gathered so far?

B. Activity #1 (Modelling the Distances to Galaxies P.276)

{2} 1. Using a scale of 1m = 2.5 million ly, calculate the model distance for each galaxy (see note). Record these distances to the nearest whole number in the chart below.

{2} 2. Using a scale of 1 cm = 10 m, calculate the length of the line needed to represent these model distances. Record these lengths to one decimal place. (The first one is done for you.)

{1} 3. The ✗ on the line represents Earth (or the Milky Way Galaxy). Label it Milky Way galaxy.

{1} 4. Measure 0.1 cm along the line to the right of the ✗. Plot this second point. Label it Andromeda.

{6} 5. Continue plotting and labelling all the galaxies except the Hubble Deep Field galaxies. The direction to each galaxy is not important for this activity, just the distance.

Galaxy	Distance (ly)	Model Distance (m)	Line Length (cm)
Andromeda galaxy	2.5 million	1	0.1
Magellanic galaxy NGC 2366	12.5 million		
Sombrero galaxy	38 million		
Antennae galaxies	90 million		
Seyfert's Sextet	190 million		
Cartwheel galaxy	620 million		
Hubble Deep Field galaxies	10 000 million		

NOTE: model distance = distance ÷ 2.5 million line length = model distance ÷ 10

C. Activity #2 (Comparing Light Spectra P.304)

1. The spectral pattern for an element is like a "fingerprint." Study the spectral patterns for the five elements (hydrogen, helium, ...) shown (P.304).

{5} 2. Answer the following questions:
(a) Which three elements are visible in mystery star A?
(b) Which three elements are visible in mystery star B?
(c) Which single element, listed in the spectral chart, is not present in either mystery star?