Working with Magnitude and Brightness

Name Key

Purpose:
- To provide you with necessary skills to understand the relationship between the concepts of stellar magnitude and brightness
- To give you practice performing simple mathematical calculations using magnitude difference and brightness

Estimated Completion Time: 30 minutes

Each question is worth 2 marks (part marks where warranted)

Resources needed:
- Calculator (preferably scientific)
- Textbook
- Web access is highly desirable

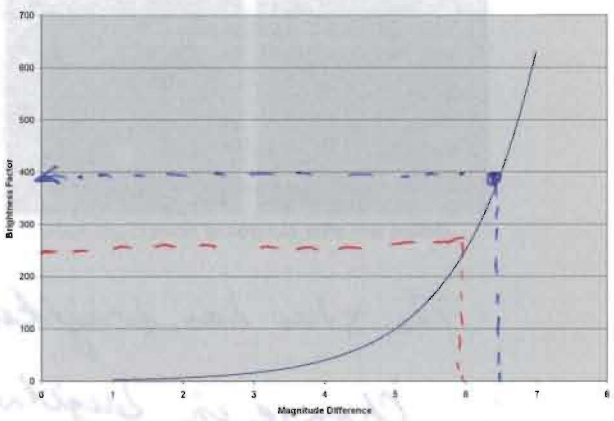
Questions

1. What is the general "rule of thumb" to use when converting differences in magnitude to brightness factors? (2 marks)

1 mag diff = 2.51 x the brightness

5 mag diff = 100 x

2. Use the graph shown below to answer the following questions. Be sure to draw on the graph to show how you did it.



   a. A magnitude difference of 6.5 is equivalent to a brightness factor of 400? (1 mark)

$(2.51)^{6.5} = 396 \approx 400$

   b. If a star suddenly "dimmed" by a factor of 250 explain clearly how that star's magnitude will have changed.(1 mark)

use the graph or

$$\Delta mag = \frac{\log(250)}{\log(2.51)} = 6$$

3. The farther away a star is the fainter it appears. If you move 50 times farther away from a star it will appear 2500 times fainter. How will the magnitude of the star have changed? (2 marks)

use $\Delta mag = \frac{\log(2500)}{\log(2.51)} = 8.5$ Since the star is 2500× dimmer, its magnitude will have increased by 8.5 magnitudes.

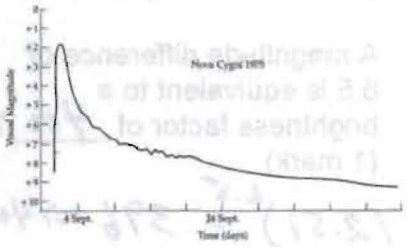
4. The bright star Algol (which literally means "Demon Star") actually consists of two stars orbiting each other every 2.867 days. During this time Algol is eclipsed by a fainter companion and dims from magnitude 2.1 to magnitude 3.4 in a little over 2 hours and then brightens again just as quickly. At its faintest, how much less light do we receive from Algol? Express this as a brightness factor. (2 marks)

The brightness factor is $(2.51)^{\Delta m} = (2.51)^{(3.4-2.1)}$

$= (2.51)^{1.3} = 3.3 \times$ less light

5. During a nova outburst a star suddenly brightens dramatically. One of the most spectacular in recent years was the appearance of Nova Cygni 1975. On the night of August 29, 1975 a new star (hence the name "nova") appeared in the constellation Cygnus. It brightened from magnitude 18 to a very bright magnitude 1.8 in a matter of several days. By what factor did this star increase its energy output? (2 marks)

Before and after pictures of Nova Cygni 1975



Graph showing change in magnitude of Nova Cygni 1975

The star has brightened by $18 - 1.8 = 16.2$ magnitudes!

$\therefore$ Change in brightness $= (2.51)^{16.2} = 2.98 \times 10^6$

or we are now getting about 3 million times as much energy from the star!