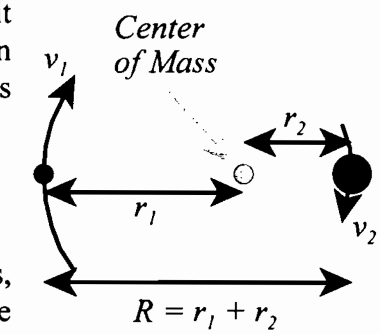
stars using this value. Finally, calculate the mass of each star using equation (2). Enter your results in the appropriate boxes and click on the *Check Your Answers* button at the bottom of the window. Correct results will be indicated with a check mark.

UNIT 22 - APPENDIX

Because of their mutual gravitational attraction, binary stars orbit around each other; or more exactly they orbit around a point between them known as the center of mass. The definition of center of mass requires that:



$$m_1 r_1 = m_2 r_2$$

where r_1 and r_2 are the distances of the stars from the center of mass, and $R = r_1 + r_2$. Since the stars must complete one full circle in the same time, T, it also follows that:

$$m_1 v_1 = m_1 2\pi r_1/T = m_2 2\pi r_2/T = m_2 v_2$$

The gravitational force of attraction is given by Newton's Universal Law of Gravity:

$$F_g = \frac{G m_1 m_2}{R^2}$$

and provides the centripetal acceleration required for each of the planets in its own orbit:

$$F_g = \frac{G m_1 m_2}{R^2} = m_1 \frac{v_1^{\,2}}{r_1} = m_2 \frac{v_2^{\,2}}{r_2}$$

Eliminating r_1 and r_2 from the above equations gives the result:

$$m_1 = \frac{(v_1 + v_2)\, v_2\, R}{G} \qquad and \qquad m_2 = \frac{(v_1 + v_2)\, v_1\, R}{G}$$

ECLIPSING BINARIES

In the case of eclipsing binaries, the distance R is not known. If we eliminate it from the equations using the relationship $2\pi R = 2\pi(r_1+r_2) = (v_1+v_2)T$ for the circumferences of the orbits of the stars, then we get the result:

$$m_1 = \frac{(v_1 + v_2)^2\, v_2\, T}{2\,\pi\, G} \qquad and \qquad m_2 = \frac{(v_1 + v_2)^2\, v_1\, T}{2\,\pi\, G}$$