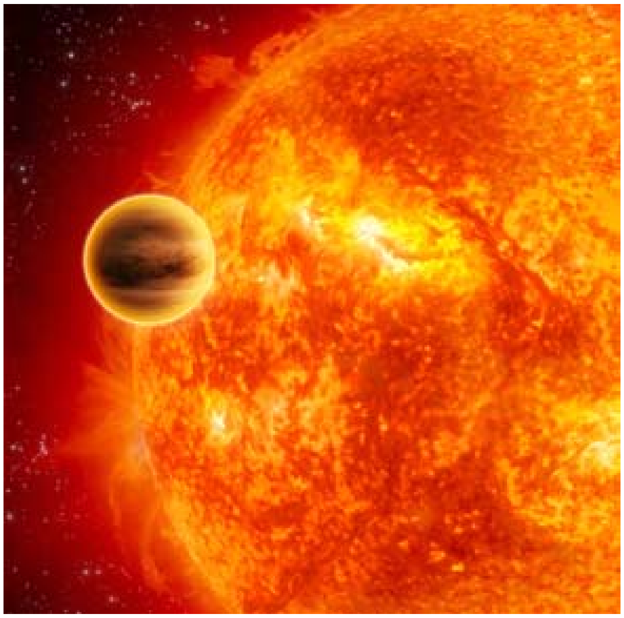

Over 430 planets have been discovered orbiting nearby stars since 1995. Called 'exoplanets' to distinguish them from the familiar 8 planets in our own solar system, they are planets similar to Jupiter in size, but orbiting their stars in mostly elliptical paths. In many cases, the planets come so close to their star that conditions for life to exist would be impossible.

Astronomers are continuing to search for smaller planets to find those that are more like our own Earth.

(Artist rendition: courtesy NASA)

Use the basic properties and formulae for ellipses to analyze the following approximate exoplanet orbits by first converting the indicated equations into standard form. Then determine for each planet the:

A) a= semi-major axis

B) b=semi-minor axis;

C) ellipticity $e = \frac{\sqrt{(a^2 - b^2)}}{a}$

D) 'perihelion' closest distance to star, defined as P=a(1-e);

E) 'aphelion' farthest distance from star, defined as A = a(1+e).

Problem 1: Planet: 61 Virginis-d Period=4 days $1 = 4x^2 + 5y^2$

Problem 2: Planet: HD100777-b Period=383 days $98 = 92x^2 + 106y^2$

Problem 3: Planet: HD 106252-b Period=1500 days $35 = 5x^2 + 7y^2$

Problem 4: Planet: 47 UMa-c Period= 2190 days $132 = 11x^2 + 12y^2$

Problem 1: 61 Virginis -d Period=4 days $1 = 4x^2 + 5y^2$

$$1 = \frac{x^2}{0.25} + \frac{y^2}{0.20}$$

a=0.5 b=0.45 $e = \frac{\sqrt{(a^2 - b^2)}}{a}$ = **0.43** P = (0.5)(1-0.43) = **0.28**, A=(0.5)(1+0.43) = **0.71**

Problem 2: Planet: HD100777-b Period=383 days $98 = 92x^2 + 106y^2$

$$1 = \frac{x^2}{1.06} + \frac{y^2}{0.92}$$

a=1.03 b=0.96 $e = \frac{\sqrt{(a^2 - b^2)}}{a}$ = **0.36** P = (1.03)(1-0.36) = **0.66,** A=(1.03)(1+0.36) = **1.40**

Problem 3: Planet: HD 106252-b Period=1500 days $35 = 5x^2 + 7y^2$

$$1 = \frac{x^2}{7.0} + \frac{y^2}{5.0}$$

a=2.6 b=2.2 $e = \frac{\sqrt{(a^2 - b^2)}}{a}$ = **0.53** P = (2.6)(1-0.53) = **1.22**, A=(2.6)(1+0.53) = **4.0**

Problem 4: Planet: 47 UMa-c Period= 2190 days $132 = 11x^2 + 12y^2$

$$1 = \frac{x^2}{12.0} + \frac{y^2}{11.0}$$

a=3.5 b=3.3 $e = \frac{\sqrt{(a^2 - b^2)}}{a}$ = **0.33** P = (3.5)(1-0.33) = **2.35,** A=(3.5)(1+0.33) = **4.65**