**Habitable Planets**

For the following multi-planet systems (Kepler 47 and its planets 47b and 47c; Kepler 62 and its planets 62b, 62c, 62d, 62e, and 62f; and Kepler 69 and its planets 69b and 69c), determine the temperatures of the planets and which, if any, line in the habitable zone (HZ) where water on the surface of the planet can exist in a liquid form.

Use the Planet Temperature Calculator at <http://www.astro.indiana.edu/~gsimonel/temperature1.html>. In addition to the temperature of the host star and the planet’s distance from its star (its semi-major axis), the temperature of a planet depends on the fraction of starlight that is absorbed by or reflected from the planet (the albedo, a value from 1 to 100), and any planetary greenhouse.

For your calculations, assume that both the albedo and the greenhouse effect are similar to Earth’s (29 for the albedo and 1 for the greenhouse effect). For water to exist in liquid form the temperature must be between 0 C and 100 C.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Host Star Mass (MSun)** | **Planet Mass (MEarth)** | **Semi-Major Axis (AU)** | **Planet Temperature (C)** | **Is the planet in the HZ?** |
| **Kepler 47b** | 1.043 | > 860 MEarth | 0.295 |  |  |
| **Kepler 47c** | 1.043 | > 5400 MEarth | 0.989 |  |  |
| **Kepler 62b** | 0.69 | < 9 MEarth | 0.055 |  |  |
| **Kepler 62c** | 0.69 | < 9 MEarth | 0.093 |  |  |
| **Kepler 62d** | 0.69 | < 14 MEarth | 0.120 |  |  |
| **Kepler 62e** | 0.69 | < 36 MEarth | 0.427 |  |  |
| **Kepler 62f** | 0.69 | < 43 MEarth | 0.718 |  |  |
| **Kepler 69b** | 0.81 | Not meas. | 0.094 |  |  |
| **Kepler 69c** | 0.81 | Not meas. | 0.64 |  |  |

Pick ONE of the above planets not in the HZ, and determine values of the greenhouse effect and albedo that would permit liquid water to exist on the planet’s surface

Planet: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Albedo Value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Greenhouse Value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_