

## Learning Intentions

1. Apply problem-solving skills to a question about gravity.

## Question

In a faraway galaxy, there are 2 planets with equal radii,  $r$ . The distance between their centres is 6 times the radius of either planet. However, they are made of different materials, so one planet has 4 times more mass than the other.

An astronaut decides to park his spaceship between the two planets, such that the force of gravity on his spaceship from the denser planet exactly matches the force of gravity from the less dense planet. Where does he park?

Repeat the question if one planet has 25 times more mass than the other.

$$F_1 = \frac{G m_{\text{spaceship}} \cdot m_{P1}}{d_1^2}$$

$$F_2 = \frac{G m_{\text{spaceship}} \cdot m_{P2}}{d_2^2}$$

$$F_1 = F_2$$

$$\frac{G m_{\text{spaceship}} \cdot m_{P1}}{d_1^2} = \frac{G m_{\text{spaceship}} \cdot m_{P2}}{d_2^2}$$

$$\frac{d_2^2}{d_1^2} = \frac{m_{P2}}{m_{P1}}$$

$m_{P2} = 4m_{P1}$

$$\left(\frac{d_2}{d_1}\right)^2 = \frac{m_{P2}}{m_{P1}} = \frac{4m_{P1}}{m_{P1}} = 4$$

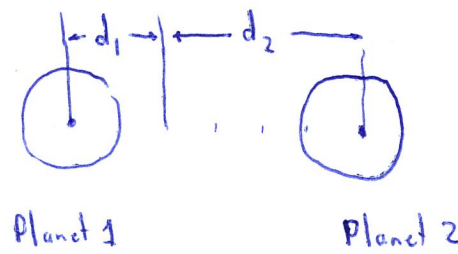
$$\frac{d_2}{d_1} = 2$$

$$\therefore d_2 = 2d_1$$

$$d_1 + d_2 = 6r$$

$$d_1 + 2d_1 = 6r$$

$$3d_1 = 6r$$

$$d_1 = 2r$$


Planet 1                      Planet 2

$$\left(\frac{d_2}{d_1}\right)^2 = 25$$

$$\frac{d_2}{d_1} = 5$$

$$d_2 = 5d_1$$

$$d_1 + d_2 = 6r$$

$$d_1 + 5d_1 = 6r$$

$$6d_1 = 6r$$

$$d_1 = r$$

