

## Universal law of gravity worksheet.

For the questions in this worksheet take:

$$g \text{ (on the Earth's surface)} = 9.8 \text{ m s}^{-2}$$

$$G \text{ (the Universal Constant of Gravitation)} = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$$

$$M_E \text{ (the mass of the Earth)} = 6.0 \times 10^{24} \text{ kg}$$

$$M_M \text{ (the mass of the Moon)} = 7.34 \times 10^{22} \text{ kg}$$

$$R_M \text{ (the radius of the Moon's orbit around the Earth)} = 3.84 \times 10^8 \text{ m}$$

$$R_E \text{ (the radius of the Earth)} = 6.38 \times 10^6 \text{ m}$$

$$r_M \text{ (the radius of the Moon)} = 1.74 \times 10^6 \text{ m}$$

$$M_S \text{ (the mass of the Sun)} = 2.0 \times 10^{30} \text{ kg}$$

$$R_{SE} \text{ (the radius of the Earth's orbit around the Sun)} = 1.5 \times 10^{11} \text{ m}$$

1. What is the gravitational force of attraction between:

**a** two oranges of mass 0.12 kg placed 0.20 m apart on a table?

**b** the Earth and the Sun?

2. How far apart would you theoretically need to place two masses each of  $4.0 \times 10^5$  kg, in order for the force between them to be 0.10 N?

3. The magnitude of the gravitational force of attraction between two objects is  $F$  when they are placed a distance  $r$  apart. What is the magnitude of the gravitational force of attraction between the two masses if:

**a** the mass of one object is halved?

**b** the mass of both objects is halved?

**c** the distance between the centres of the two masses is halved?

**d** the distance between the two masses is increased by a factor of three?

4. What is the gravitational force of attraction between the Earth and the Moon?

**5. a** What is the weight of a 1.0 kg mass on the surface of the Earth?

**b** How far from the centre of the Earth is the mass when its weight is 5.0 N?

**6.** What is the gravitational field strength at a point whose distance from the Earth's surface is equal to the radius of the Earth?

**7.** What is the gravitational field strength on the surface of the Moon due to the Moon?

**8.** At what distance from the Earth would a spacecraft experience zero net gravitational force due to the opposing pulls of the Earth and the Moon?