Exploring Space

S3 Physics

Lesson Title: Gravity on Other Planets

Learning Intention:

Today we are learning about gravity throughout our solar system.

Success Criteria:

✓I can explain why the force of gravity is not uniform throughout the solar system.

✓I can calculate unknown values for weight, mass or gravitational field strength for different planets in our solar system.

Employability skill(s):

Numeracy

Simulating Gravity on Other Planets

Watch the following video about gravity on other planets.

Gravity on Other Planets

The gravitational field strength on Earth is 9.8 N kg^{-1}.

This means that every kilogram of mass on Earth has a force of 9.8 N pulling it towards the Earth's surface. This force is called its weight.

We calculate the weight of an object using the relationship:

$$W = mg$$

Where:

W = weight (N)

m = mass (kg)

g = gravitational field strength (N kg^{-1})

Gravity on Other Planets

The gravitational field strength on each of the planets in our Solar System, on the Moon and at the surface of the Sun are provided in the table shown.

In an assessment you would be given these values on the data sheet.

Can you work out why the gravitational field strength on the moon is weaker than on Earth? Why is it stronger on the Sun than on Earth?

Gravitational field strengths

	Gravitational field strength on the surface in $N\,kg^{-1}$
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Example 1

Calculate the weight of a Moon rock which has a mass of 540 g.

$$W = ?$$
$$m = 0.54\ kg$$
$$g = 1.6\ N\ kg^{-1}$$

$$W = mg$$
$$W = 0.54 \times 1.6$$
$$W = 0.86\ N$$

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Example 2

Calculate the mass of the Curiosity Rover. It has a weight of 3300 N on Mars.

$$W = 3300\ N$$
$$m = ?$$
$$g = 3.7\ N\ kg^{-1}$$

$$W = mg$$
$$3300 = m \times 3.7$$
$$m = \frac{3300}{3.7}$$
$$m = 890\ kg$$

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Example 3

An astronaut with a mass of 78.6 kg travels to another planet in our solar system where his weight is 684 N. Determine by calculation what planet he visits.

$$W = 684\ N$$
$$m = 78.6\ kg$$
$$g = ?$$

$$W = mg$$
$$684 = 78.6 \times g$$
$$g = 8.7\ N\ kg^{-1}$$

The planet is Uranus.

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
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Task: Answer the following questions

1. A rocket of mass 2 000 000 kg travels from Saturn to Earth.
   a) Calculate the weight of the rocket on Saturn.
   b) Calculate the weight of the rocket on Earth.
2. A small tin of oil has a mass of 300 g.
   a) Calculate the weight of the tin of oil on Saturn.
   b) Determine the mass of the tin of oil on Jupiter.
3. A man has a weight of 700 N on Earth. Calculate his weight on Neptune.
4. A snail has a weight of 0.5 N on Earth. Calculate its mass on the Moon.
5. A rock has a weight of 10.4 N on Mars. Determine the planet on which the weight of the rock would be 25.2 N.