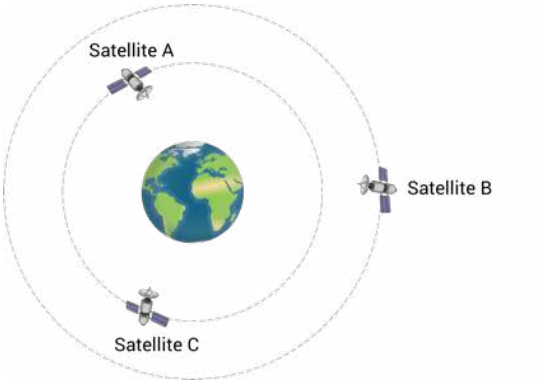
0 1

There are thousands of artificial satellites in orbit around the Earth at any given time. The below diagram shows potential orbits of three such satellites about the Earth.



Information of each of these satellites is given in the below table.

Satellite	A	B	C
Mass (kg)	350	350	280
Height above surface (km)	11,400	35,900	11,400

0 1 . 1

John believes that the force of gravitational attraction between satellite A and the Earth will be greater than that between satellite C and the Earth. Is he correct? Explain you answer.

Yes [1]. Satellite A has a larger mass than satellite C [1] and so will weigh more [1].

Satellites A and C are the same height above the surface of the Earth, so the only other thing that can affect the gravitational force of attraction between them and the Earth is their mass. As the mass of A is greater, the gravitational force acting between it and the Earth (its weight) will be greater. (You could have also used W = m g in answering this question.)

0 1 . 2

He then asks you to explain why the weight of satellite A will be greater than that of satellite B. What will you tell him?

Both satellites have the same mass [1] but satellite A is closer to the Earth than satellite B [1] and the force of gravitational attraction between two objects (bodies) increases as they get closer together [1].

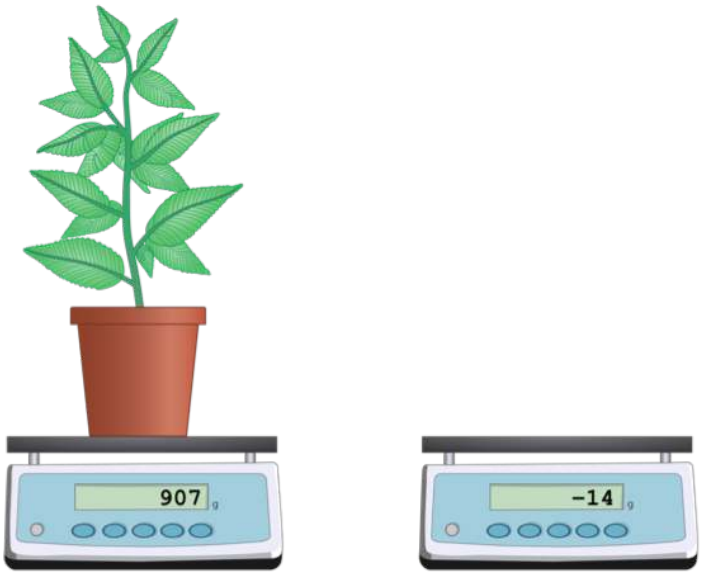
0 1 . 3

Satellite B weighs 78.6 N. Calculate the gravitational field strength at its orbital height.

For satellite B, W = 78.6 N and m = 350 kg
W = m g
g = W ÷ m = 78.6 ÷ 350 = **0.22 N/kg** (2 d.p.)

0 2

When a potted plant is placed onto an electronic balance, the reading on the digital readout is 907 g. As shown below, when the plant is removed from the balance, the reading changes to –14 g.



0 2 . 1

Calculate the mass of the plant.

Mass = 907 – (–14) = **921 g**

0 2 . 2

Hence calculate its weight at the surface of the Earth.
Take the value of g at the surface of the Earth to be 9.8 N/kg.

m = 0.921 kg
W = m g
W = 0.921 × 9.8 = **9.03 N** (2 d.p.)

Remember to convert masses to kilograms before using W = m g

0 2 . 3

The gravitational field strength at the top of Mount Everest is roughly 0.4% lower than its value at the surface of the Earth. Calculate what the weight of the plant would be at the top of Mount Everest.

At top of Mount Everest, g = 9.8 × 0.996 = 9.76 N/kg
(Or decrease in g = 9.8 × 0.004 = 0.04, g = 9.8 – 0.04 = 9.76 N/kg)
W = m g = 0.921 × 9.76 = **8.99 N** (2 d.p.)

To find 99.6% of 9.8, multiply it by $\frac{99.6}{100}$ = 0.996; to find 0.4% of 9.8, multiply it by $\frac{0.4}{100}$ = 0.004.

0 2 . 4

The electronic scales were not properly calibrated for this measurement. State the name given to the type of error which this could have introduced into the mass reading (and weight calculation) above.

Systematic error (accept zero error) [1].