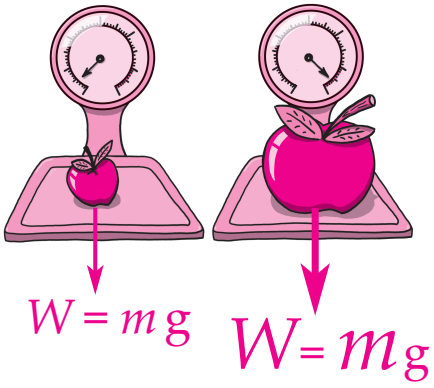
Weight

Weight is the non-contact force of gravity.

As weight is a force, it is measured in units called newtons (usually shortened to N).
A medium apple has a weight of about 1 N.

An object's weight depends on how much stuff it contains. This is called its mass (measured in kilograms or grams).

The weight also depends on the strength of the local gravitational field.



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1 Are these describing weight or mass? Decide each one separately.

(a) It is measured in kilograms.

(b) It makes things hard to support.

(c) It measures the amount of stuff.

(d) It is measured in newtons.

(e) It makes moving things hard to stop.

(f) It would be larger in stronger gravity.

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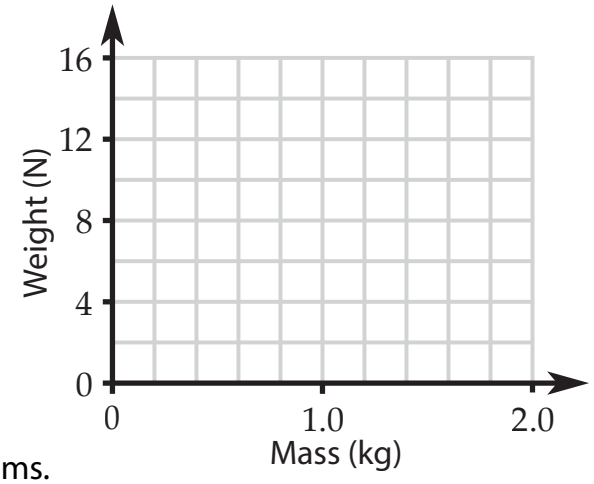
2 The weights of some objects (on Earth) are given in the table. $1\text{ kg} = 1000\text{ g}$

Object	**Mass** (g)	**Mass** (kg)	**Weight** (N)
Apple	100		1.0
Full bottle	1200		12
Rat	400		4.0
Kitten	1600		16



(a) Fill in the column with masses in kilograms.

(b) Plot a graph of weight against mass. Add a straight line of best fit.

(c) What is the weight of a 0.6 kg bag of flour? Use the graph.

(d) What is the weight of a 3 kg melon? (Look for a pattern in the numbers.)

(e) Complete the equation: weight (in newtons) $=$ mass (in kilograms) $\times$ ☐

3 At a port in Brazil, $15\,000$ kg of sugar is loaded onto a ship. The sugar weighs $146\,820$ N. The ship travels to the UK. The Earth's gravity field is stronger in the UK than in Brazil.

(a) Is the sugar's mass in the UK smaller than, equal to, or larger than $15\,000$ kg? Why?

(b) Is the sugar's weight in the UK smaller than, equal to, or larger than $146\,820$ N? Why?

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4 Work out the numbers which need to go in the boxes to make the equations true.

(a) $\square = 60 \times 10$ (b) $\square = 24 \times 10$ (c) $\square = 20 \times 3$

5 Work out the numbers which need to go in the boxes to make the equations true.

(a) $120 = \square \times 10$ (b) $75 = \square \times 10$ (c) $12 = \square \times 3$

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weight (N) on Earth = mass (kg) $\times 10$ weight (N) on Mars = mass (kg) $\times 3$

6 Will a 1 kg bag of flour weigh more on Earth or Mars?

7 Is the gravity stronger on Earth or Mars? How do the equations tell you this?

8 Work out these weights using the equations:

(a) 5 kg cat on Earth

weight (N)	=	mass (kg)	×	10
	=	5	×	10

(b) 4000 kg elephant on Mars

weight (N)	=	mass (kg)	×	3
	=	4000	×	3

9 Work out these masses using the equations:

(a) 650 N teacher on Earth

weight (N)	=	mass (kg)	×	10
650	=		×	10

(b) 9 N hen on Mars

weight (N)	=	mass (kg)	×	3
9	=		×	3

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10 Calculate the weight of each mass. Remember that 1 kg = 1000 g.

(a) 2.0 kg on Earth (b) 3.0 kg on Mars (c) 540 g on Earth

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11 Calculate the mass (in kg) of each weight.

(a) 20 N on Earth (b) 60 N on Mars (c) 0.7 N on Earth

12 Calculate the mass (in g) of each weight on Earth.
(a) 8.0 N (b) 0.5 N (c) 0.02 N

The weight of a kilogram depends on the strength of gravity.

On Earth, one kilogram weighs 10 N.
On the Moon, one kilogram weighs 1.7 N.
On Mars, each kilogram weighs 3 N.
On Venus, one kilogram weighs 7 N.

13 What is the weight of...
(a) 5 kg on Mars?
(b) 2 kg on Venus?
(c) 50 kg on the Moon?
(d) 60 kg on Mars?

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14 How many kilograms of mass would you need to weigh...
(a) 15 N on Mars?
(b) 28 N on Venus?
(c) 34 N on the Moon?
(d) 300 N on Mars?

The weight of each kilogram is called the gravitational field strength.
Its symbol is g and it is measured in N/kg.

The gravitational field strength on Earth is 10 N/kg.

15 Write down the gravitational field strength (giving the units) on
(a) the Moon (b) Mars (c) Venus

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16 Complete the word equations using **weight**, **mass** and g.
(a) weight $=$ (b) mass $=$ (c) $g =$

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17 Rewrite your word equations using symbols. W is weight and m is mass.
(a) $W =$ (b) $m =$ (c) $g =$

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18 Calculate the gravitational field strength (g) on
(a) Neptune if a 300 kg rocket weighs 3300 N.
(b) Jupiter if a 3 kg rabbit weighs 69 N.