# How many trips to the moon?

Students investigate the relationships between very large measurements to examine the usefulness of expressing large numbers in scientific notation for operations.

## Visible learning

### Learning intention

* To be able to operate with large numbers expressed in scientific notation.

### Success criteria

* I can multiply large numbers expressed in scientific notation.
* I can divide large numbers expressed in scientific notation.
* I can round the decimal part of numbers in scientific notation to simplify approximate calculations.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* solves measurement problems by using scientific notation to represent numbers and rounding to a given number of significant figures **MA5-MAG-C-01**

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## Activity structure

### Launch

1. Lead a discussion with students asking them to share the furthest destination they have travelled to.
2. Use Google Maps ([bit.ly/GoogleMapsSyd](https://bit.ly/GoogleMapsSyd)) to find the distance in kilometres of the trips suggested by students.
3. Explain to students that the furthest destination any human has travelled is to the moon, a distance of 384 400 km from Earth.
4. Have students engage in a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)) to answer the following questions.
5. The distance from Sydney to Brisbane is 733 kilometres. How many trips from Sydney to Brisbane does it take to get to the moon?
6. The longest flight in the world is currently 15 426 kilometres, from Singapore to New York. How many trips from Singapore to New York does it take to get to the moon?
7. The distance from Earth to Venus is 295 times the distance to the moon. How far is it to Venus?

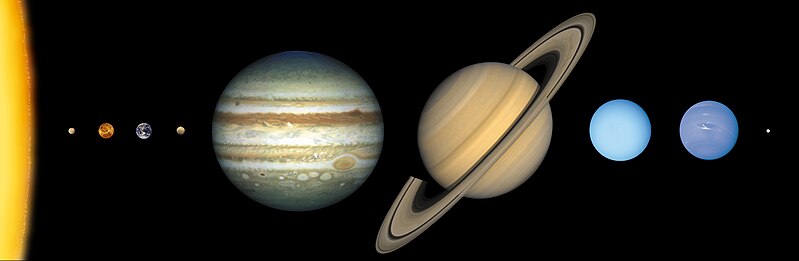
The purpose of these problems is to have students identify that such questions lead to division and multiplication. Teachers can modify these questions for their context and should consider extending the narrative with articles such as ‘The new longest flight in the world’([bit.ly/LongestFlightArticle](https://bit.ly/LongestFlightArticle)).

### Explore

#### How big is each planet?

1. Display Figure 1.

Figure 1 – the solar system



[This Illustration](https://commons.wikimedia.org/wiki/File:Solar_system_scale.jpg) by Unknown Author is licensed under [CC BY-SA](https://creativecommons.org/licenses/by-sa/3.0/).

1. Explain that this image shows all the planets in our solar system and the edge of the sun. The moon cannot be seen in this image because it is too small.
2. Hand students Appendix A ‘How big is that many moons?’ and have them read the example in the table.
3. Have students use a calculator to complete the table, leaving their final answers in scientific notation.
4. Have students engage in a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)) to discuss the question under the table and look for a trend.

Prompt students to consider the index laws to help explain the trend in powers of 10 in the answers.

#### How many moons away is each planet?

1. Explain to students that while 12 human beings have walked on the moon between 1969 and 1972, no person has ever walked on another planet.
2. Hand students Appendix B ‘How many moon trips away?’and explain that we are going to find how many trips to the moon it will take to get to the other planets.
3. Have students again use a calculator to follow the first example and complete the table in Appendix B.
4. Students are to engage in a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)) focusing on the questions below the table, looking for trends.

Prompt students to again consider the index laws to help explain the trends in the table.

### Summarise

1. Conclude that when multiplying and dividing numbers in scientific notation, we can use the multiplication and division index laws to compute powers of 10 and separately address the decimal part of these numbers.
2. Get students to write notes to their future forgetful self ([bit.ly/notesstrategy](https://bit.ly/notesstrategy)) to help them remember how to multiply and divide large numbers expressed in scientific notation.
3. Lead a discussion with students to suggest reasons why humans have not travelled further than the moon or walked on other planets.

A discussion around the implications of their findings is an opportunity for the teacher to assess students’ abilities to interpret large measurements expressed in scientific notation.

### Apply

1. Give students access to the website ‘Exploratorium’ ([bit.ly/AgeOtherWorlds](https://bit.ly/AgeOtherWorlds)) and have them enter their birthday.
2. Have students create a notice/wonder list ([bit.ly/noticewonderstrategy](https://bit.ly/noticewonderstrategy)) about what they see.
3. Using their age in days, demonstrate how to calculate your age in minutes (on Earth) and write this number in scientific notation, rounded to one significant figure.

A student who turned 15 years old today would be 5 475 days old and would therefore be minutes old, or minutes old.

1. Have students use their ages and the index laws, without a calculator, to complete the table in Appendix C ‘My lifetimes’.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* **It could be beneficial to start with simpler examples such as comparing a 15-minute trip with a 60-minute trip and examining the language differences that make the situation require multiplication or division to be resolved.**

**Summarise**

* Challenge students to use algebra to generalise the result of operations with scientific notation, such as

**Apply**

* Students can be given the opportunity to use a calculator and asked to examine and reflect upon the trends in their results when completing Appendix C.

### Suggested opportunities for assessment

**Launch**

* **When students are sharing, evaluate students’ ability to interpret situations as requiring either multiplication or division.**

**Apply**

* Appendix C can be collected to assess students’ ability to operate with large measurements in scientific notation without a calculator.

## Appendix A

### How big is that many moons?

The mass of the moon is , or . The table below tells us how many moons it takes to make up the volume of the planets in our solar system.

Use this information to find the volume of each planet. The first one is done for .

|  |  |  |
| --- | --- | --- |
| Planets | How many moons makes up the planet | Volume of the planet |
| Mercury | moons |  |
| Venus | moons |  |
| Earth | moons |  |
| Mars | moons |  |
| Jupiter | moons |  |
| Saturn | moons |  |
| Uranus | moons |  |
| Neptune | moons |  |

What do you notice about the powers of 10 in each of the last 4 answers?

## **Appendix B**

### How many moon trips away?

The distance from the Earth to the moon is , or .

The table below shows the distance from Earth to each of the planets in our solar system. Use your calculator to determine how many times each planet is from Earth, using the distance to the moon as a measurement. The first one is done for you.

|  |  |  |
| --- | --- | --- |
| Planets | Distance from the Earth (km) | How many moons away? |
| Mercury |  | moons |
| Venus |  |  |
| Mars |  |  |
| Jupiter |  |  |
| Saturn |  |  |
| Uranus |  |  |
| Neptune |  |  |

What do you notice about the powers of 10 in each question?

What do you notice about the decimal in your answers?

## Appendix C

### My lifetimes

The table below shows how many of your lifetimes certain landmarks and cultures have been known to exist for. (Note, in some cases we have reason to believe they have existed for much longer).

Without a calculator, use the index laws to multiply and divide the numbers by your age in minutes to fill in the blank cells.

|  |  |  |
| --- | --- | --- |
|  | My lifetimes | How long do we know it has existed |
| Sphinx, Egypt | lifetimes |  |
| Stonehenge, England | lifetimes |  |
| Shahr-e Sukhteh, Iran | lifetimes |  |
| Monte d’Accoddi, Italy |  | minutes |
| Göbekli Tepe, Turkey |  | minutes |
| Aboriginal cultures |  | minutes |

## Sample solutions

### Appendix A – How big is that many moons?

|  |  |  |
| --- | --- | --- |
| Planets | How many moons makes up the planet | Volume of the planet |
| Mercury | moons |  |
| Venus | moons |  |
| Earth | moons |  |
| Mars | moons |  |
| Jupiter | moons |  |
| Saturn | moons |  |
| Uranus | moons |  |
| Neptune | moons |  |

What do you notice about the powers of 10 in each of the last 4 answers?

The power of 10 in the number of moons goes up by 10 or 11 when multiplying by the volume of the moon, which has 10 to the power of 10 in it.

### **Appendix B –** How many moon trips away?

|  |  |  |
| --- | --- | --- |
|  | Distance from the Earth (km) | How many moons away? |
| Mercury |  | moons |
| Venus |  | moons |
| Mars |  | moons |
| Jupiter |  | moons |
| Saturn |  | moons |
| Uranus |  | moons |
| Neptune |  | moons |

What do you notice about the powers of 10 in each question?

From the distance from the Earth in kilometres to the number of moons, the power of 10 goes down by either 5 or 6, with 5 being the power of 10 in the distance to the moon.

What do you notice about the decimal in your answers?

If I round the distance from the Earth to 2 significant figures, the decimals in the number of moons in scientific notation is approximately this number divided by 4, which is the first digit if I round the distance to the moon to one significant figure, 400 000 km.

### Appendix C – my lifetimes

The solutions in the table below are based on a student who has turned 15 years old today.

|  |  |  |
| --- | --- | --- |
|  | My lifetimes | How long do we know it has existed |
| Sphinx, Egypt | lifetimes | minutes |
| Stonehenge, England | lifetimes | minutes |
| Shahr-e Sukhteh, Iran | lifetimes | minutes |
| Monte d’Accoddi | lifetimes | minutes |
| Göbekli Tepe, Turkey | lifetimes | minutes |
| Aboriginal cultures | lifetimes | minutes |

## References

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