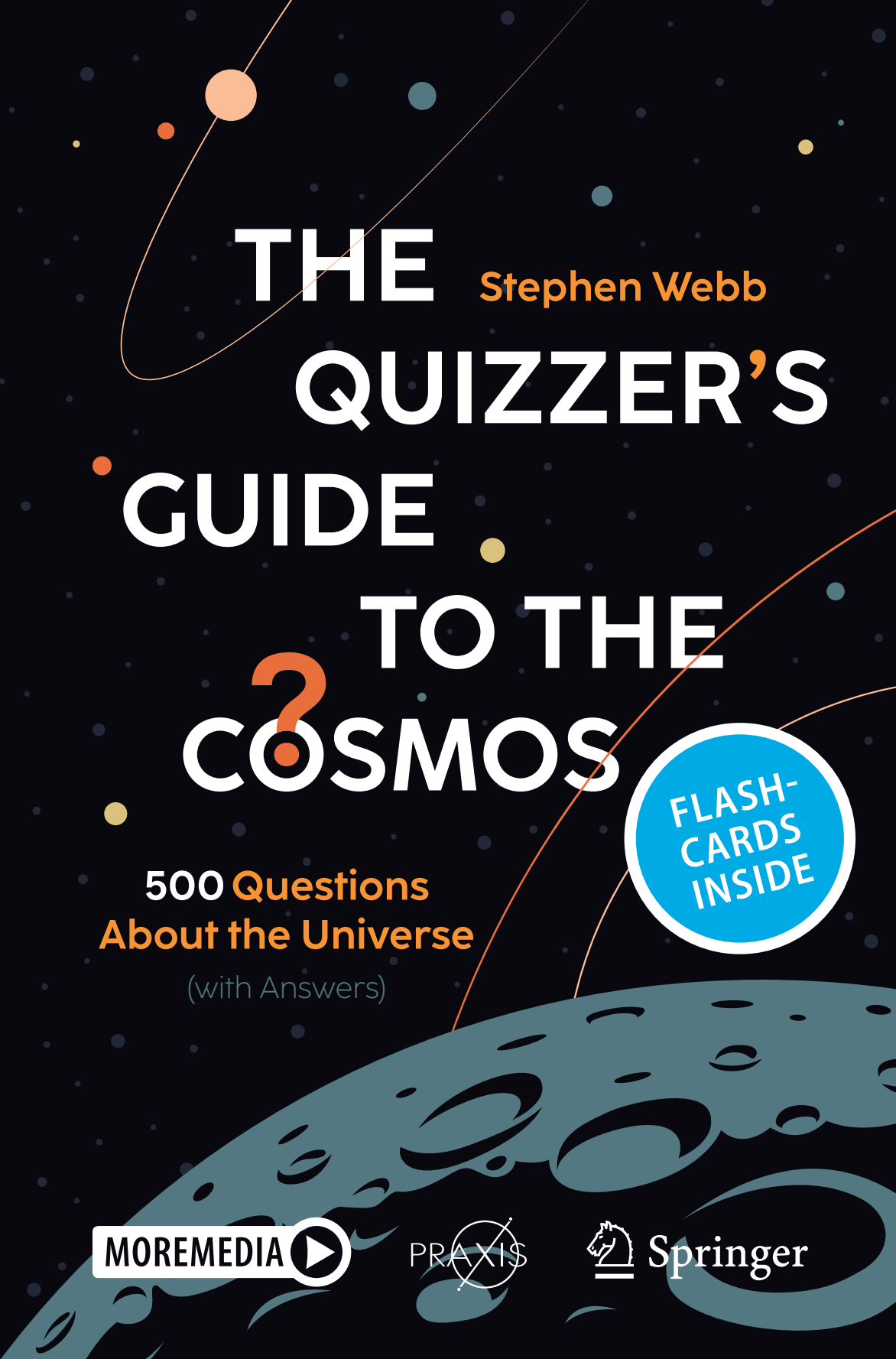
THE QUIZZER'S GUIDE TO THE COSMOS

Stephen Webb

500 Questions About the Universe (with Answers)

FLASH-CARDS INSIDE



MOREMEDIA PRAXIS Springer

Springer Praxis Books

Popular Astronomy

This book series presents the whole spectrum of Earth Sciences, Astronautics and Space Exploration. Practitioners will find exact science and complex engineering solutions explained scientifically correct but easy to understand. Various subseries help to differentiate between the scientific areas of Springer Praxis books and to make selected professional information accessible for you.

The Springer Praxis Popular Astronomy series welcomes anybody with a passion for the night sky. Requiring no formal background in the sciences and including very little to no mathematics, these enriching reads will appeal to general readers and seasoned astronomy enthusiasts alike.

Many of the books in this series are well illustrated, with lavish figures, photographs, and maps. They are written in a highly accessible and engaging style that readers of popular science magazines can easily grasp, breaking down denser aspects of astronomy and its related fields to a digestible level.

From ancient cosmology to the latest astronomical discoveries, these books will enlighten, educate, and expand your interests far beyond the telescope.

Stephen Webb

The Quizzer's Guide to the Cosmos

500 Questions About the Universe (with Answers)

PRAXIS

Springer

Stephen Webb
Lee-on-the-Solent, UK

Springer Praxis Books
ISSN 2626-8760 ISSN 2626-8779 (electronic)
Popular Astronomy
ISBN 978-3-031-52436-3 ISBN 978-3-031-52437-0 (eBook)
https://doi.org/10.1007/978-3-031-52437-0

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Paper in this product is recyclable.

To all the good people at the University of Portsmouth,
where I worked for so long

SN Flashcards Microlearning

Quick and efficient studying with digital flashcards – for work or school!

With SN Flashcards you can:

- **Learn** anytime and anywhere on your smartphone, tablet or computer
- **Master** the content of the book and test your knowledge
- **Get motivated** by using various question types enriched with multimedia components and choosing from three learning algorithms (long-term-memory mode, short-term-memory mode or exam mode)
- **Create** your own question sets to personalise your learning experience

How to access your SN Flashcards content:

1. Go to the **1st page of the 1st chapter** of this book and follow the instructions in the box to sign up for an SN Flashcards account and to access the flashcards content for this book.
2. Download the SN Flashcards mobile app from the Apple App Store or Google Play Store, open the app and follow the instructions in the app.
3. Within the mobile app or web app, select the flashcards content for this book and start learning!

If you have difficulties accessing the SN Flashcards content, please write an email to **customerservice@springernature.com** mentioning "**SN Flashcards**" and the book title in the subject line.

Preface

Who doesn't like a quiz? The quiz format fills the schedules of UK television (*The Chase*; *Who Wants To Be A Millionaire?*; *Only Connect* … the list seems endless) and, from my limited experience, the same seems to be true in other countries. Social media is awash with quizzes (purporting to gauge your personality; measure your IQ; or identify your strengths and weaknesses). And if a pub landlord wants to pull in the punters on a wet Wednesday night, the go-to solution is to run a pub quiz. Quizzes are fun! So, for your astronomical pleasure, this book contains a quiz with 500 questions all involving space and the cosmos. Inside, you will discover how many people in recorded history have been hit by a meteorite; which bits of Galileo's body you can see in a museum; what foodstuff you should avoid if you visit a dark matter laboratory; and much more besides.

There is, though, a twist.

Every question has an associated answer, and the order of the questions is such that, if you read the answers in numerical order, you will be reading a history of astronomy. You will learn how astronomers developed our understanding of our solar system, then the stars, then our galaxy … all the way out to the farthest reaches of space and back to the start of the universe.

The book comes with one further addition. If you prefer to take the quiz on screen, then you can do so. Go to https://flashcards.springernature.com/login and create a user account by entering your email address and assigning a password. Then you will find the link at the beginning of the first chapter to access flashcards.

The clever people at Springer Nature have designed the flashcard app around evidence-based learning techniques, so the app not only keeps track of your score, but it can also help you remember the material. The main

difference between the app and the physical book is that the app presents the questions and the options in random order. Perhaps a sensible approach would be to read the physical book first, and then use the app to see what you have retained.

I should, though, issue a warning. This book has not been designed to teach you astronomy. To learn astronomy, you need to learn mathematics; you need to answer the questions in a good textbook; and you need to get feedback on your work from a teacher. The learning of facts and trivia will not inculcate an understanding of astronomy. Nevertheless, I hope this book, in addition to being fun, might help with your journey towards understanding the science. If you want to take a deeper dive into the subject by yourself, the resources in the references section will assist.

How might this book of facts and trivia help you understand astronomy? Well, in *Remember, Remember*, Ed Cooke, a Grand Master of Memory and the co-founder of the online educational platform Memrise, tells of how he began a series of educative 'memory walks' in London. The idea was that, using a mnemonic technique first developed by the Greeks, the walks would enable attendees to learn a set of facts—for example, the names of the monarchs of England and Britain. It worked. At the end of a walk, participants were able to recite the 60 or so kings and queens, effortlessly, forwards and backwards, along with relevant biographical details. News of the walks spread. Cooke found, after a while, that professional historians were tagging along. It seemed that the professionals did not know this stuff! Cooke did some research and discovered that Oxford history undergraduates could name an average of only 9 of 52 British prime ministers. (The book was published back in 2008. We have had a churn of politicians since then, and we are now on our 57th prime minister.) The Oxford professors were not much better than their students.

Clearly, it was—and is—possible to be a historian without knowing a fact such as Aethelwulf's wife Osburga was mother to four kings: Aethelbald, Aethelbert, Aethelred, and Alfred the Great. If a historian needed that detail, he or she could simply look it up. But equally clearly there must be something comforting for people about *knowing* the fact, and having it as part of one's 'mental furniture'—else why go on those walks? I believe the same holds true with astronomy. You can appreciate astronomy as an amateur, and you can be a successful professional astronomer, without knowing which movie inspired Bondi, Gold, and Hoyle to develop the steady state model of the universe, say; or which famous author first stated the modern resolution to Olber's paradox; or what the previous pole star was before Polaris moved into place. You really don't need to know these things to *do* astronomy. But there *is*

something comforting about *knowing* those facts, in context, without having to look them up—just as it helps an historian to know that Stephen reigned between Henry I and Henry II, without having to visit the library to check. It's even better than that: I believe knowing stuff, even seemingly trivial stuff, can help the brain to make new, creative connections between concepts that truly are essential. That ability for humans to make new, meaningful connections is particularly important in an age in which generative AI can spew out material by the screenful.

Here, then, are 500 questions about the universe. You might disagree with some of the answers. (One question generated much discussion when I tested it on people. The answer hinges on how you interpret the word 'success'!) And, depending upon when you read this book, a 'record holder' type of question might be out of date: the brightest supernova, the hottest star, the fastest-spinning pulsar … all these records, which stand as of January 2024, are liable to change as astronomers learn more about the universe. Well, the reference section at the back of the book contains the sources for the questions, and so should be able to settle disputes. More importantly, these sources—a mix of popular and technical books, podcasts, and professional research papers—can help you with your studies in astronomy. They cannot provide information on developments that take place after January 2024, but they will provide a solid foundation to assist you with your own research into new developments in astronomy and cosmology.

So don't take the quiz too seriously. But do please have fun!

Lee on the Solent, UK
January 2024

Stephen Webb

Contents

1

A Journey Around Our Cosmic Neighbourhood: The Solar System and Its Secrets

You can use the "SN Flashcards" app to access the questions digitally and free of charge.To use the app, please follow the instructions below:

1. Go to https://flashcards.springernature.com/login
2. Create a user account by entering your e-mail address and assigning a password.
3. Use the following link to access your SN Flashcards set: ▶ sn.pub/W0yrye

If the link is missing or does not work, please send an e-mail with the subject "SN Flashcards" and the book title to customerservice@springernature.com.

1.1 Quiz

1. What is the Kármán line?

   □ The orbital path taken by Apollo 11 to reach the Moon
   □ A generally agreed boundary between Earth and space
   □ The curve adopted under gravity by the material of a (hypothetical) space elevator
   □ A straight line which, when orbits align, can be drawn through any four bodies in the solar system

2. The Sun accounts for how much of the mass of the solar system?

   □ More than 99.8%
   □ Approximately 95%

S. Webb, *The Quizzer's Guide to the Cosmos*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-52437-0_1

□ Between 92–94%
□ Less than 89.9%

3. The Sun has a mean diameter of 1,391,400 km, but its polar diameter is smaller than its equatorial diameter. How much smaller?

□ 10 km
□ 1000 km
□ 5000 km
□ 10,000 km

4. After hydrogen and helium, which is the most abundant element in the Sun?

□ Carbon
□ Iron
□ Neon
□ Oxygen

5. How does the average density of the Sun compare with that of Earth?

□ It is about 75% as dense as Earth
□ It is about 50% as dense as Earth
□ It is about 25% as dense as Earth
□ It is about 10% as dense as Earth

6. What is the surface temperature of the Sun?

□ 10,000,000 K
□ 148,500 K
□ 12,286 K
□ 5778 K

7. When was the first known observation of a sunspot made?

□ 4th century BCE
□ 1st century BCE
□ 2nd century CE
□ 12th century CE

8. During a span of 30 years one might expect roughly 50,000 sunspots to be visible. In the period 1672–1699, how many sunspots did astronomers observe?

□ 100,000
□ 45,000
□ 5000
□ 50

9. The Moon shines because it reflects light from the Sun. Who was the first to propose this idea?

□ Anaxagoras
□ Anaximander
□ Arhytas
□ Aristarchus

10. From Earth we can see only 50% of the Moon's surface at any one time. *Overall*, what percentage of the Moon's surface is visible from Earth?

□ 50%
□ 54%
□ 59%
□ 63%

11. Today, we can measure the distance to the Moon to what level of precision?

□ Kilometer-level precision
□ Meter-level precision
□ Millimeter-level precision
□ Nanometer-level precision

12. At arm's length, roughly what angle does the width of your index finger span?

□ 10°
□ 5°
□ 2°
□ 1°

13. What is the name for a straight-line configuration of three celestial bodies in a gravitational system?

□ Crwth
□ Syzygy
□ Trochilus
□ Tsktsk

14. On 16 July 2186, observers in northern Guyana will experience a total solar eclipse. This eclipse will have the longest duration in recorded history. How long will totality endure for those observers?

□ 2 minutes 32 seconds
□ 4 minutes 59 seconds
□ 7 minutes 29 seconds
□ 9 minutes 46 seconds

15. A solar eclipse once interrupted a battle. Since we know when the eclipse happened, this is the earliest historical event we can date to a particular day. When was the battle?

□ 2 December 776 BCE
□ 28 May 585 BCE
□ 14 March 444 BCE
□ 25 February 257 BCE

16. Our word 'planet' comes from the Greek word planētes. What does planētes mean?

□ Large star
□ Sky god
□ Unwavering light
□ Wanderer

17. What characteristic of the Sun, Moon and planets gave rise to the ordering of the days of the week?

□ Their apparent size
□ Their colour
□ Their distance from Earth
□ The strength of the god associated with them

18. Who was the first person to argue that Earth orbits the Sun?

□ Aristarchus of Samos
□ Hipparchus of Nicaea
□ Nicolaus Copernicus
□ Pythagoras of Samos

19. How are the words 'eclipse' and 'ecliptic' related etymologically?

□ The two words are etymologically unrelated
□ They both come from Latin and Greek root words meaning 'to be hidden'
□ They both come from Latin and Greek root words meaning 'a flat plane'
□ They both come from Latin and Greek root words meaning 'circular'

20. The French astronomer Delambre wrote several books about astronomical history. Which scientist did Delambre call the 'father of astronomy'?

□ Aristarchus of Samos
□ Eratosthenes of Cyrene
□ Hipparchus of Nicaea
□ Thales of Miletus

21. The Greek scientist Eratosthenes had a nickname. What was it?

□ Alpha
□ Beta
□ Gamma
□ Delta

22. We know little about the life of the Greek (or Egyptian) astronomer Claudius Ptolemy, except that he flourished between the years 127–141 CE. How do we know this?

□ The dates are mentioned in passing in a biography of the Greek physician Galen, Ptolemy's near-contemporary
□ These are the earliest and latest dates of observations made by Ptolemy
□ Ptolemy is cited in a surviving letter from the Roman emperor Marcus Aurelius
□ The years are carved into stone column at an observatory in Alexandria

23. The poet Omar Khayyam measured the length of the year. What value did arrive at?

□ 400 days
□ 365.24219858156 days
□ 364.99 days
□ 116π days

24. Brahmagupta, an Indian scientist, made several important contributions to mathematics. Which of the following developments did he pioneer?

□ Elliptic functions
□ Probability
□ Rules to compute with zero
□ Transcendental numbers

25. Copernicus is best known for the formulation of a heliocentric model of the universe, but he was active in other fields too. In 1519, he formulated an important economic principle. What is that principle now called?

□ Gibrat's law
□ Goodhard's law
□ Gresham's law
□ Parkinson's law

26. The Danish astronomer Tycho Brahe had an artificial brass what?

□ Left big toe
□ Nose
□ Right ear
□ Right index finger

27. In 1620, how was Johannes Kepler able to help his mother?

□ He defended her against a charge of witchcraft
□ He helped her produce a horoscope for the Holy Roman Emperor
□ He gave her the royalties from his science fiction novel *Somnium* (*The Dream*)
□ He offered her a place in his household, after she fell into destitution

28. In science, which year is sometimes called 'The Year of Wonders'?

□ 1114
□ 1412
□ 1573
□ 1666

29. Edmond Halley's most important contribution to science was in helping to fund the publication of Newton's *Principia*, the most influential book in science. The Royal Society was unable to publish *Principia* because it had blown its publishing budget. On what?

□ Publication of the book *De History Piscium* (Of the History of Fish)
□ Investment in the tulip craze
□ Late entry into a seventeenth century version of what would come to be known as a pyramid scheme
□ A refurbishment of Robert Hooke's laboratory in London

30. In 2012, the International Astronomical Union defined what distance to be precisely 149,597,870.7 km?

□ Astronomical unit
□ Average Earth–Venus distance
□ Light-second
□ Radius of the solar system

31. Knowledge of the Earth–Sun distance is crucial for the definition of which distance unit commonly used in astronomy?

□ Light-second
□ Light-year
□ Parsec
□ Redshift

32. Who coined the term 'parsec' for the distance unit commonly used in astronomy?

□ George Ellery Hale
□ Edwin Powell Hubble
□ Harlow Shapley
□ Herbert Hall Turner

33. Which planet has the greatest orbital eccentricity (in other words, which planetary orbit is most elliptical)?

□ Saturn
□ Jupiter
□ Venus
□ Mercury

34. For which planet did Egyptian astronomers have two names, Set and Horus?

□ Mercury
□ Venus
□ Earth
□ Mars

35. Which planet has the longest day?

□ Mercury
□ Venus
□ Mars
□ Jupiter

36. Which planet is hottest?

□ Mercury
□ Venus
□ Earth
□ Mars

37. In 1639, who made the first recorded observation of a transit of Venus?

□ Bonaventura Francesco Cavalieri
□ Galileo Galilei
□ Jeremiah Horrocks
□ Martin van den Hove

38. Which is the densest planet in the solar system?

□ Mercury
□ Venus
□ Earth
□ Mars

39. Polaris is the current pole star. What was the previous pole star?

□ Antares
□ Kochab
□ Pherkad
□ Thuban

40. Who or what is Lilith?

□ The first monkey to complete one orbit of Earth
□ A hypothetical second moon of Earth
□ The name given to the lens of the largest ever refracting telescope
□ A small moon of Mars

41. Contemplation of what is reputed to have caused Isaac Newton's head to ache?

□ An apple falling on his head
□ Binomial theory generalisation to non-integer exponents
□ Curve of fastest descent
□ The motion of the Moon

42. What are Kordylewski clouds?

□ Patches of black pixels that appear on CCD images
□ Blurring of images of nearby astronomical objects that appear on pre-1945 photographic plates
□ Clouds that inhibit infrared observations from ground-based telescopes
□ Concentrations of dust at the L4 and L5 Lagrangian points of the Earth–Moon system

43. The highest mountain in the solar system is on which planet?

□ Mars
□ Earth
□ Venus
□ Mercury

44. What causes Mars to appear red?

□ Crustal rocks on Mars contain large amounts of red jasper
□ Dust scattering in the Martian atmosphere
□ Iron oxide (rust) on the Martian surface
□ Optical effects in Earth's atmosphere

45. Which planet has the largest magnetosphere?

□ Earth
□ Mercury
□ Neptune
□ Jupiter

46. The biggest mean *ocean* tidal range on Earth is 11.7 m. By how much does Io's *crust* rise and fall through the action of tides?

□ 0.1 m
□ 1 m
□ 10 m
□ 100 m

47. Who first demonstrated that light travels at a finite speed?

□ Bernard Le Bovier de Fontenelle
□ Christiaan Huygens
□ Jean Picard
□ Ole Rømer

48. How long is a light-year?

□ 9,461,000,000 km
□ 365,250,000,000 seconds
□ 9,461,000,000,000 km
□ 299,792,458,000,000 seconds

49. Which is the least dense planet?

□ Jupiter
□ Saturn
□ Uranus
□ Neptune

50. What part of Galileo's body can you see if you visit the eponymous museum in Florence?

□ Heart
□ Brain
□ Big toe
□ Middle finger

51. Which Greek myth did Galileo invoke after observing Saturn through a telescope?

□ Cronus eating his own children
□ Hephaestus being banned from Olympus
□ Hermes moving between world and underworld
□ Niobe being transformed into a rock

52. The Roche limit is the distance from an object at which an orbiting body, held together only by gravitational self-attraction, is pulled apart by tidal forces. Where is the Roche limit for the Sun for a rigid body with the density of Earth? (In other words, in theory, how close would Earth have to be to the Sun for it to be tidally disrupted.)

□ The Roche limit is inside the Sun
□ The Roche limit lies at the surface of the Sun
□ The Roche limit is twice the Sun's radius
□ The Roche limit is at 0.2 AU

53. Which object was initially called George?

□ Saturn
□ Uranus
□ Neptune
□ Pluto

54. Which of the following did William Herschel NOT do?

□ Composed Allegro in G Minor (keyboard work)
□ Discovered Mimas and Enceladus, moons of Saturn
□ Established that coral is not a plant but a marine invertebrate
□ First observation of Martian ice caps

55. Who was the first paid female astronomer?

□ Mary Somerville
□ Caroline Lucretia Herschel
□ Henrietta Swan Leavitt
□ Jill Cornell Tartar

56. Which planet is invisible to the naked eye?

□ Mercury
□ Saturn
□ Uranus
□ Neptune

57. The 'Happy face' crater on Mars is officially named after an astronomer involved in the discovery of Neptune. Which astronomer?

□ Johann Gottfried Galle
□ Urbain Jean Joseph LeVerrier
□ John Couch Adams
□ James Challis

58. Regarding the colours of Uranus and Neptune, which of the following claims is correct?

□ Both are shades of blue, but Uranus is a dark blue and Neptune is a lighter blue
□ Both are shades of blue, but Uranus is a light blue and Neptune is a darker blue
□ Both are the same shade of blue
□ Both are a shade of ivory

59. On average, which is the closest planet to every other planet?

□ Earth
□ Mars
□ Mercury
□ No single planet is the closest to every other planet

60. On which celestial body would you find Sputnik Planitia?

□ Moon
□ Mars
□ Venus
□ Pluto

61. How many natural satellites does Pluto possess?

□ 2
□ 3
□ 4
□ 5

62. After the dwarf planet Pluto, and its satellite Charon, which was the first trans-Neptunian object to be discovered?

□ 15760 Albion
□ 15810 Arwan
□ 19521 Chaos
□ 20000 Varuna

63. Which is the ninth most massive object in orbit around the Sun?

□ Ceres
□ Eris
□ Pluto
□ Sedna

64. In 2019, NASA's New Horizon spacecraft flew past a Kuiper Belt object that looked rather like a snowman. What is the official name of the object?

□ Arrokoth
□ Frosty
□ Thorin
□ Ultima Thule

65. The Titius–Bode law successfully predicted the orbits of which two objects in the solar system, before its predictions started to fail?

□ Ceres and Neptune
□ Ceres and Uranus
□ Neptune and Pluto
□ Uranus and Neptune

66. The word 'asteroid' means 'star-like'. Who coined the word 'asteroid'?

□ William Herschel
□ Caroline Herschel
□ Giuseppe Piazzi
□ Johann Bode

67. After whom is minor planet 8749 (discovered in 1998) named?

□ The Beatles
□ Brian May
□ Queen
□ Patrick Moore

68. The three main types of asteroid, based upon composition, are C (chondrite), S (stony), and M (metallic). Which is the commonest type of asteroid?

□ C
□ S
□ M
□ C, S, and M are equally common

69. One way of classifying asteroids is to use their location. What class of asteroid is to be found in specific parts of Jupiter's orbit?

□ Achaeans
□ Hellenes
□ Spartans
□ Trojans

70. A few asteroids orbit entirely within Earth's orbit. (At aphelion they are closer to the Sun than Earth is at perihelion.). Following the convention that an asteroid class should be named after the first confirmed member of the class, what is this type of asteroid called?

□ Amor asteroid
□ Apollo asteroid
□ Aten asteroid
□ Atira asteroid

71. In 2022, astronomers confirmed the discovery of an asteroid whose orbit lies entirely interior to Venus. Following the convention that an asteroid class should be named after the first confirmed member of the class, what will this type of asteroid be called?

□ 'Aló'chaxnim asteroid
□ Amor asteroid
□ Apollo asteroid
□ Aten asteroid

72. Analysis of material samples taken from the asteroid 162173 Ryugu confirmed the presence of what?

□ Amino acids
□ Diamonds
□ Highly magnetic particles
□ The past presence of water ice

73. More than 10,000 Apollo asteroids—Earth-crossing objects—are known. How many of them are classified as potentially hazardous objects?

□ More than 8000
□ 5500–6500
□ 1500–2500
□ Fewer than 500

74. In all of history, how many confirmed cases have there been of a meteorite striking someone?

□ 0
□ 1
□ 17
□ 32

75. Which event is regarded as the greatest meteor shower recorded in modern times?

□ The Capricornids shower of 1647
□ The Geminids shower of 1792
□ The Leonids shower of 1833
□ The Perseids shower of 1993

76. How did Fred Whipple describe comets?

□ Cruddy pellets
□ Dirty snowballs
□ Icy spillikins
□ Watery wisps