

Clicker Questions (chapters 1-5)

1. What is the diameter of the Earth?
 - a. 8000 km
 - b. 8000 miles
 - c. 25,000 km
 - d. 25,000 miles
2. Say we build a highway that stretches all the way around the Earth's equator. You get in a car and travel 500 miles per day long this road. How long will it take you to complete one lap around the planet?
 - a. 16 days
 - b. 32 days
 - c. 50 days
 - d. 100 days
3. If we took an opinion poll consisting of fair minded questions and we wanted the results to be good to ± 1 percent, how many people would we have to poll in our survey?
 - a. 100
 - b. 1000
 - c. 10,000
 - d. 100,000
4. There is a lot of modern evidence that the age of the universe is 13.7 billions years. If we mapped the entire history of the universe onto a calendar of 365 days, on what date of this compacted calendar did the dinosaurs become extinct? (They died off about 65 million years ago.)
 - a. April 2
 - b. September 2
 - c. December 30
 - d. at the end of December 31
5. A rough estimate of your latitude can be obtained by noting the elevation angle of
 - a. the Sun at noontime
 - b. Sirius as it transits the celestial meridian
 - c. Polaris
 - d the ecliptic
6. Say that where you lived the Sun is 70 degrees above the horizon at noontime on the first day of summer. How high above the horizon would the Sun be at this location at noon on the first day of winter?
 - a. 70 deg
 - b. 47 deg
 - c. 43 deg
 - d. 23 deg

7. Say you live in Hilo, Hawaii, at latitude $+19.7$ degrees. If it's a nice sunny June day at 12:30 PM (when the Sun is highest in the sky), through which windows of your house does the Sun shine most directly?
- north
 - east
 - south
 - west
8. The Sun rises in the east and sets in the west. Which direction does the Earth turn?
- towards the east
 - towards the west
 - towards the north
 - towards the south
9. The number of degrees that a celestial object is north or south of the celestial equator is called the
- latitude
 - declination
 - right ascension
 - elevation angle

The next four questions go together.

10. "We must protect our southern border!" Say President Trump and Congress allocate \$100 billion to hire guards to protect the US-Mexico border for the next 20 years. How much is the total budget, expressed in scientific notation?
- 1.0×10^8 dollars
 - 1.0×10^{10} dollars
 - 1.0×10^{11} dollars
 - 1.0×10^{14} dollars
11. Say it costs \$50,000 to hire a guard for one year. How much is a guard paid over 20 years?
- 1.0×10^4 dollars
 - 1.0×10^5 dollars
 - 1.0×10^6 dollars
 - 1.0×10^7 dollars
12. So, how many guards can be hired for that 20 year period?
- 1000
 - 10,000
 - 100,000
 - 1,000,000
13. If all your guards work 8 hour shifts and the US/Mexico border is 2000 miles long, what is the average spacing between guards along the border?
- 32 feet
 - 320 feet
 - 3200 feet
 - 32,000 feet

14. The Moon is visible

- a. only at night
- b. only between sunset and midnight
- c. only between midnight and dawn
- d. sometimes at night and sometimes during the day

15a. If it's 9 AM and we see the Moon in the sky and it is 50 percent illuminated, what is its phase?

- a. new Moon
- b. first quarter
- c. full Moon
- d. third quarter

15b. How often, on average, does the full Moon enter the Earth's umbral shadow, showing a partial or total lunar eclipse?

- a. every month
- b. every 6 months
- c. about once in 19 months
- d. every 223 full Moons

16. When we look at an object that is 1,000 light-years away we see it

- a. as it was 1,000 years ago
- b. as it was 1,000 light-years ago
- c. as it is right now, but it appears 1,000 times dimmer
- d. looking just the same as our ancestors would have seen it 1,000 years ago

17. Scientific thinking is

- a. based on everyday ideas of observation and trial-and-error experiments
- b. completely different from any other kind of thinking
- c. a difficult process that only a handful of people can do
- d. an ancient mode of thinking first invented in Egypt

18. The nuclear reactions in the Sun's core produce as a byproduct little neutral particles called electron neutrinos. Neutrino detectors on Earth only detect about 1/3 of the electron neutrinos that were expected. What is the *simplest* explanation for this (but not necessarily the right one)?

- a. something wrong with the neutrino detectors
- b. something wrong with nuclear theory
- c. a majority of electron neutrinos change into something else
- d. We have no idea.

19. One of the simplest astronomical instruments is called a

- a. staff of Asclepius
- b. staff of Ra
- c. Dowsing rod
- d. gnomon

20. Testing which hypothesis will lead most likely to scientific progress?
- “Step on a crack. Break your mother’s back.”
 - “Coke is bad for you, but Kool Aid is OK, since it has no carbonation.”
 - “We can deduce what the universe was like a millionth or a trillionth of a second after the Big Bang by carrying out particle physics experiments.”
 - “If you put milk and sugar in coffee, it negates the effect of the caffeine.”
21. When did we prove that Copernicus was right, that the Earth really does orbit the Sun?
- 1543, when his book was published
 - 1610, when Galileo first observed with a telescope
 - 1687, when Newton published the Law of Gravity
 - 1830’s, when astronomers measured the first trigonometric parallaxes
22. Why did Copernicus retain the notion of epicycles?
- to explain the phenomenon of retrograde motion
 - because the circle is the most perfect 2-D shape
 - He knew that a planet’s distance from the Sun varied, and he did not know that the planetary orbits were really ellipses.
 - The parameter or “latus rectum” of the conic section of the said path, was to the quantity and amplitude in a direct ratio, as the whole line to the sine of double the angle of incidence, formed by the bisection upon an horizontal line.
23. Jette is the name of the ferry that you take from Copenhagen to the Island of Hven. Who was Jette?
- one of Tycho’s assistants
 - Tycho’s wife
 - Tycho’s pet moose
 - Tycho’s court jester, who just happened to be a dwarf
24. In addition to the assertion that the Earth was the center of the cosmos, what other idea was a fundamental part of ancient and medieval astronomy?
- The orbit of a planet is an ellipse, with the Sun at one focus.
 - Celestial bodies (such as planets) move along perfect circles.
 - The force holding a planet in its orbit decreases proportional to the square of the distance.
 - Mass tells space how to curve, while space tells matter how to move.
25. Say an asteroid is discovered that is on average 4 AU from the Sun. How long does it take to orbit the Sun?
- 4 years
 - 8 years
 - 16 years
 - 64 years

26. Why was Galileo put on trial by the Roman Inquisition in 1633?
- because he advocated the separation of Church and State
 - because he believed that intelligent beings lived on other planets
 - because an edict issued in 1616 said that good Catholics could not discuss the motion of the Earth *in any way whatsoever* (and in his Dialogue on the Two Chief Systems of the World he clearly discussed that possibility)
 - because he was an atheist
27. We have talked about a number of astronomers of the Renaissance. Who spent the greatest number of nights actually observing the heavens with some kind of instrument?
- Nicholas Copernicus (1473-1543)
 - Tycho Brahe (1546-1601)
 - Johannes Kepler (1571-1630)
 - Galileo Galilei (1564-1642)
28. Kepler's First Law states that the orbit of a planet is a(n) [] with the Sun at one focus.
- circle
 - ellipse
 - parabola
 - hyperbola
29. Kepler's Third Law may be written: $p^2 = a^3$. What is "a".
- awesomeness
 - acceleration
 - orbital semi-major axis size
 - azimuth
 - aphelion distance
30. An object that orbits the Sun is found to have a mean distance of 20 AU. What is the orbital period of this object?
- 31.6 years
 - 63.2 years
 - 89.4 years
 - 164 years
31. Say two cars are driving down a dock and drive off the end. One is going 60 mph, the other 90 mph. Which car hits the water first?
- the car going 60 mph
 - the car going 90 mph
 - they both hit the water at the same time
- 32a. When a pole vaulter runs down the runway, plants the pole and springs into the air, the vaulter is converting
- speed to velocity
 - momentum to angular momentum
 - mass into energy
 - kinetic energy to gravitational potential energy

- 32b. How many high tides are there each day at an ocean location?
- 1
 - 2
 - 3
 - 4
33. If we moved the Moon twice as far away as it is presently, how would that affect the gravitational force between the two?
- it would remain the same
 - it would be 2 times weaker
 - it would be 4 times weaker
 - it would be 8 times weaker
34. If we moved the Moon twice as far away as it is presently, how would that affect the height of the tides?
- they would remain the same height
 - they would be half as high
 - they would be $1/4$ as high
 - they would be $1/8$ as high
35. Say the highest high tide was 10 feet at a particular location on the Earth. If we moved the Moon to *half* its present distance, how high would the highest high tide be at that location?
- 10 feet
 - 20 feet
 - 40 feet
 - 80 feet
36. Consider two optical telescopes, one of diameter 10 inches, the other of diameter 40 inches. How much more “light gathering power” does the larger one have?
- it depends on the magnification
 - 4 times as much
 - 16 times as much
 - 64 times as much
37. Which of the following is a kind of light that has the shortest wavelengths and the highest energies?
- ultraviolet light
 - radio waves
 - visual light
 - gamma rays
 - cosmic rays
38. Which of the following light waves moves most rapidly?
- ultraviolet light
 - visible light
 - infrared light
 - radio waves
 - they all move at the same speed

39. An 8-inch diameter reflecting telescope of focal length 48 inches is used with a 1/2 inch focal length eyepiece. What is the magnification?
- 16 power
 - 24 power
 - 96 power
 - 192 power
40. What do we mean by the term “quantum efficiency?”
- the effectiveness of the evil organization Quantum in the James Bond movie Quantum of Solace
 - the ability of light to move through air
 - the ability of light to move through water
 - the percentage of photons hitting a light sensitive element that is converted by chemical action (film) or converted into electrons which we can count
41. A cooled Charge Coupled Device can achieve what peak quantum efficiency?
- 0.8 percent
 - 8 percent
 - 80 percent
 - 180 percent
42. Which of the following is NOT an example of a *paradigm*?
- the Sun is the center of the solar system
 - the Earth is the center of the solar system
 - George Washington was born in 1732
 - the continents move around on tectonic plates
 - species come into existence and die as a result of natural selection
43. Why are there no green stars?
- it's not possible for a black body curve to peak in the green
 - the black body curve is wide enough that the blend of photons you get doesn't produce a green hue
 - stars have no chlorophyll
44. A rock heated to 2500 deg K will produce which kind of spectrum?
- emission line
 - absorption line
 - continuous spectrum
45. The hydrogen- β line has a wavelength in the lab of 4861 Å. Say we take the spectrum of a star and we observe that this line has a wavelength of 4859 Å. With respect to us the velocity of the star along the line of sight is
- 4859 km/sec towards us
 - 4859 km/sec away from us
 - 123 km/sec towards us
 - 123 km/sec away from us

46. All the planets revolve around the Sun in a counterclockwise direction (as you look down on the solar system and can see the Earth's North Pole). As observed from the Earth, which statement is correct?
- a. Planets move towards the east against the background of stars.
 - b. Planets move towards the west against the background of stars.
 - c. Planets move towards the east, then stop and back up for several weeks or months, then resume their eastward motion.