

Astronomy 102A

Homework 1: Scientific Notation, Units, Math, Angles, Plots, Motion, Orbits Not to be handed in. Homework solutions are posted already.

- The quantity 2.9979×10^{10} cm/s is the same as:
 - 29979000 cm/s.
 - 29979000000 cm/s.
 - 2.9979×10^{10} km/s.
 - the speed of sound.
 - 2.9979 cm/s.
- “Let’s play *Jeopardy!* For \$100, the answer is: The international standard units for science and probably the most common subset of these units.”

What are the _____ units and _____ units, Alex?

 - British Imperial; Btu
 - SI; HMS
 - SI; MKS
 - British Imperial; MKS
 - ancient Babylonian; HMS
- A light-year is:
 - the opposite of a leap year.
 - less filling.
 - the cause of eclipses.
 - the distance light travels in one year.
 - the time it takes the Earth to return to the same point relative to the fixed stars.
- A parsec (pc) is:
 - about 3 light-years.
 - the same as a light-year.
 - about the same as a light-year.
 - the distance light travels in a year.
 - about 2 light-years.
- “Let’s play *Jeopardy!* For \$100, the answer is: The approximate length of a standard university lecture as pointed out by Nobel-prize-winning physicist Enrico Fermi.”

What _____, Alex?

 - is a century
 - seems like a century
 - is a centi-century
 - is a micro-century
 - is a milli-century
- About how many kilometers are there in a light-minute? Recall the speed of light is 2.9979×10^{10} cm/s.
 - 2.9979×10^{10} km.
 - 3×10^{10} km.
 - 1.8×10^{12} km.
 - 1.8×10^7 km.
 - 3×10^7 km.
- “Let’s play *Jeopardy!* For \$100, the answer is: 86400.”

What is the length of _____ in seconds, Alex?

 - a minute
 - an hour
 - a day
 - a year
 - four score and seven years
- The mean distance from the Earth to the Sun in astronomical units (AU) is:
 - 1 AU.
 - 40 AU.
 - 1.496×10^{13} cm.
 - 1.5 AU.
 - 8 arcminutes.
- Name three astronomically relevant physical scales.
 - The Earth-Moon distance, the Earth-Sun distance, and the radius of the Galactic disk.
 - The Earth-Moon distance, the Earth-Sun distance, and the length of a snail’s trail.

- c) The Earth-Moon distance, the Earth-Paris distance, and the length of a snail's trail.
d) The Earth-Moon distance, the Earth-Sun distance, and the Las Vegas-Reno distance.
e) The Earth-Moon distance and the Earth-Sun distance.
10. Name a physical scale that is **NONE** too relevant to astronomy.
- a) The Earth-Moon distance.
b) The Earth-Sun distance.
c) The radius of the Galactic disk.
d) The Las Vegas-Reno distance.
e) The radius of the Galactic halo. The Galactic halo is a spherical mass distribution surrounding the Galactic disk. It has relatively little luminous matter, but apparently a lot of dark matter.
11. The Earth rotates once a day and has an equatorial radius of 6378 km. What is the speed of a point on the equator relative to a system orbiting with the Earth, but not rotating?
- a) 1 km/s. b) 0.46 km/s. c) 3×10^5 km/s. d) 1 km. e) 0.46 km.
12. The acceleration due to gravity of a free-falling object on the surface of the Earth is $g = 9.8 \text{ m/s}^2$. If an object falls from rest and one can neglect air resistance, what is its speed after 3 seconds?
- a) 9.8 m/s^2 . b) 9.8 m/s. c) 0.1 m/s. d) about 30 m/s. e) 98 m/s.
13. Proxima Centauri is 4.2 light-years from the Earth. How many years does it take for light to travel from Proxima to Earth?
- a) 4.2 light-years. b) 4.2 years. c) 4.2 seconds. d) 8 minutes. e) Millions of years.
14. Pluto's mean distance from the Sun is about:
- a) 1 AU. b) 0.1 AU. c) 40 AU. d) 1 light-year. e) 1.2 AU.
15. The mean distance from the Moon to the Earth is 3.844×10^{10} cm and the speed of light is 2.998×10^{10} cm/s. How long does it take light to travel from the Moon to the Earth?
- a) 8 minutes. b) 1.28 seconds. c) No time at all. d) 30 seconds. e) 30 arcminutes.
16. Which is the outermost planet in our solar system from the Sun? Why is the outermost planet not always the same planet? **HINT:** You may have to look some information up.
- a) Pluto is always the outermost planet of the solar system.
b) Uranus is always the outermost planet of the solar system.
c) The outermost planet is either **PLUTO** or **URANUS**. Most of the time Pluto is the outermost planet, but because of its very elliptical orbit Pluto is sometimes within the orbit of Uranus and then Uranus is the outermost planet. In the period 1979 February 7 to 1999 February 11 Uranus was the outermost planet.
d) The outermost planet is either **PLUTO** or **NEPTUNE**. Most of the time Pluto is the outermost planet, but because of its very elliptical orbit Pluto is sometimes within the orbit of Neptune and then Neptune is the outermost planet. In the period 1979 February 7 to 1999 February 11 Neptune was the outermost planet.
e) The outermost planet is either **MERCURY** or **NEPTUNE**. Most of the time Mercury is the outermost planet, but because of its very elliptical orbit Mercury is sometimes within the orbit

of Neptune and then Neptune is the outermost planet. In the period 1979 February 7 to 1999 February 11 Neptune was the outermost planet.

17. How many degrees in a circle, arcminutes in a degree, and arcseconds in an arcminute?
- a) 100, 10, 10. b) 360, 10, 10. c) 360, 100, 100. d) 360, 60, 60. e) 360, 24, 60.
18. A fist at arm's length spans about how many degrees?
- a) About 1° . b) About 18° . c) About 10° . d) 360° . e) 180° .
19. A human-made, Earth-orbiting satellite is passing by Polaris. At closest approach it is about a fist at arm's length away in angular separation.
- a) The closest approach is about 10° in angle and about 10 light years in space.
 b) The closest approach is about 100° in angle and about 100 light years in space.
 c) The closest approach is about 360° in angle and you **CANNOT** tell the spatial separation with the information given.
 d) The closest approach is about 10° in angle and the spatial separation is virtually the same as the Earth-Polaris spatial separation since the Earth-satellite spatial separation is negligible for most purposes compared to the Earth-Polaris spatial separation.
 e) The closest approach is about 10° in angle and also about 10° in spatial separation.
20. A straight line on a plot represents a/an _____ function.
- a) linear b) inverse-square c) quadratic d) logarithmic e) perpendicular
21. A curve on a plot that decreases as 1 over the square of the horizontal axis coordinate represents a/an _____ function.
- a) linear b) inverse-square c) quadratic d) logarithmic e) perpendicular
22. On a standard logarithmic or log plot an axis unit is:
- a) one. b) a power of ten. c) one or two. d) one, two, or three. e) a power of one.
23. Say you have a set of masses $m_1, m_2, \text{etc.}$ at positions $x_1, x_2, \text{etc.}$ Their center of mass position x_{cm} along the x -axis is given in general by
- $$x_{\text{cm}} = \frac{m_1 x_1 + m_2 x_2 + \dots}{m_1 + m_2 + \dots},$$
- where “...” just means “and so on.” This formula follows from the definition of center of mass as the mass-weighted average position of a body. Now I give you a special case of $m_1 = 9 \text{ kg}$ at $x_1 = 0 \text{ m}$ and $m_2 = 1 \text{ kg}$ at $x_2 = 10 \text{ m}$. What is the center of mass position of the masses in the special case?
- a) 0 m. b) 1 m. c) 5 m. d) 9 m. e) 10 m.
24. Most comets that are gravitationally bound to the Sun have very elliptical orbits. This means that the eccentricity of their orbits is:
- a) exactly zero. b) almost zero. c) exactly 1. d) much bigger than zero in some sense.
 e) bigger than 1.
25. There are two gravitationally-bound bodies isolated in space. Describe their motion.

- a) The **LARGER** mass body orbits the **SMALLER** mass body in a circle.
 - b) The **SMALLER** mass body orbits the **LARGER** mass body in a circle.
 - c) The two bodies orbit their joint center of mass in ovals.
 - d) The two bodies orbit their joint center of mass in circles always.
 - e) The two bodies orbit their joint center of mass in ellipses.
26. To very good approximation the planets move in:
- a) elliptical orbits with the Sun at one focus of the ellipse.
 - b) circular orbits with the Sun at circle center.
 - c) elliptical orbits with the Sun at the center of ellipse. (The center of the ellipse is where the major and minor axes cross.)
 - d) planar orbits with the Sun at plane center.
 - e) spherical orbits with the Sun at sphere center.
27. A planet is orbiting the Sun in an **ELLIPTICAL** orbit.
- a) It moves fastest at **APHELION** and slowest at **PERIHELION**.
 - b) It moves fastest at **PERIHELION** and slowest at **APHELION**.
 - c) It moves fastest at **HELLION** and slowest at **ANTIHELLION**.
 - d) It moves at a constant speed.
 - e) It doesn't move at all.
28. The eccentricity of a body in orbit about the Sun is 0.20. How does its distance from the Sun vary?
- a) At **APHELION** the body is **20 %** farther from the Sun than the standard mean distance. At **PERIHELION** it is **20 %** closer to the Sun than the standard mean distance.
 - b) At **APHELION** the body is **10 %** farther from the Sun than the standard mean distance. At **PERIHELION** it is **20 %** closer to the Sun than the standard mean distance.
 - c) At **APHELION** the body is **20 %** farther from the Sun than the standard mean distance. At **PERIHELION** it is **10 %** closer to the Sun than the standard mean distance.
 - d) The distance does not vary. The orbit is circular.
 - e) The orbit is extremely elliptical. At **APHELION** the planet is well beyond the orbit of **PLUTO**. At **PERIHELION** the planet is well within the orbit of **VULCAN**. Vulcan is an asteroid (sometimes called a planet in the past) that is within the orbit of Mercury. The body is clearly a comet.