1. Convert 1 day to s.

$$1 \text{ day } x \ \frac{24\ hrs}{1\ day} \ x \ \frac{60 \text{ min}}{1\ hr} \ x \ \frac{60\ s}{1 \text{ min}} = 86{,}400\text{s}$$

$= 8.64\ x\ 10^4$ s

Answer: 1 day = $8.64\ x\ 10^4$ s

2. The orbital period of Neptune is 164.793 yrs. Convert it to min.

$$164.793 \text{ yrs } x \ \frac{365.25\ days}{1\ yr} \ x \ \frac{24\ hrs}{1\ day} \ x \ \frac{60 \text{ min}}{1\ hr} = 86{,}674{,}526.28 \text{ min}$$

$= 8.667452628\ x\ 10^7$ min

Answer: 164.793 yrs = $8.667452628 \text{ x } 10^7$ min

3. The equatorial radius of Jupiter is 71,494 km. Convert it to cm.

$$71{,}494 \text{ km } x \ \frac{1{,}000\ m}{1\ km} \ x \ \frac{100\ cm}{1\ m} = 7{,}149{,}400{,}000 \text{ cm}$$

$= 7.1494\ x\ 10^9$ cm

Answer: 71,494 km = $7.1494\ x\ 10^9$ cm

4. Convert the orbital velocity of Mercury, 47.89 km/s, to m/hr.

$$\frac{47.89\ km}{1\ s} \ x \ \frac{1{,}000\ m}{1\ km} \ x \ \frac{60\ s}{1 \text{ min}} \ x \ \frac{60 \text{ min}}{1\ hr} = 172{,}404{,}000 \text{ m/hr}$$

$= 1.72404\ x\ 10^8$ m/hr

Answer: 47.89 km/s = $1.72404\ x\ 10^8$ m/hr

5. Convert the average density of Saturn, 0.69 g/cm^3, to kg/m^3.

$$\frac{0.69\ gm}{1\ cm^3} \ x\ \frac{1\ kg}{1{,}000\ g} \ x \left(\frac{100\ cm}{1\ m}\right)^3$$

$$= 690\ \text{kg/m}^3 = 6.90\ x\ 10^2\ \text{kg/m}^3$$

Answer: 0.69 gm/cm^3 = 6.90 x 10^2 kg/m^3

6. Convert the distance in ly, 4.24, to the closest star, Proxima Centauri to km.

$$4.24\ \text{ly}\ x\ \frac{9.46\ x\ 10^{12}\ km}{1\ ly} = 4.01104\ x\ 10^{13}\ \text{km}$$

Answer: 4.24 ly = 4.01104 x 10^{13} km

7. The speed of the space shuttle is about 17,600 miles/hr. How many years would it take the space shuttle to reach Proxima Centauri?

$$\frac{17{,}600\ miles}{1\ hr}\ x\ \frac{1.6\ km}{1\ mile} = \frac{28{,}160\ km}{1\ hr}$$

$$4.01104\ \text{x}\ 10^{13}\ \text{km}\ x\ \frac{1\ hr}{28{,}160\ km} = 1.424375\ x\ 10^9\ \text{hr}$$

$$1.424375\ x\ 10^9\ \text{hr}\ x\ \frac{1\ day}{24\ hrs}\ x\ \frac{1\ yr}{365.25\ days} = 162488\ \text{yrs} = 1.62488\ x\ 10^5\ \text{yrs}$$

Answer: It would take the space shuttle 1.62488 x 10^5 yrs to reach Proxima Centauri.

8. How long does light from the Sun take to reach the Earth in min?

distance = rate x time

$$\text{time} = \frac{distance}{rate}$$

rate = c = 3 x 10^5 km/s

distance = $d_{\text{Sun-Earth}}$ = 1.496 x 10^8 km

time = $\frac{d_{Sun\text{-}Earth}}{c}$ = 1.496 *x* 10^8 km *x* $\frac{1\ s}{3 \times 10^5\ km}$

498.667s *x* $\frac{1\ \text{min}}{60\ s}$ = 8.31 min

Answer: Light from the Sun takes 8.316 *x* 10^1 min to reach Earth.

9. Convert the mass of Pluto, 0.0022 M_{Earth}, to kg:

M_{Earth} = 5.976 *x* 10^{24} kg

0.0022 M_{Earth} = 0.0022 *x* 5.976 *x* 10^{24} kg = 1.31472 *x* 10^{22} kg

Answer: 0.0022 M_{Earth} = 1.31472 *x* 10^{22} kg

10. Sirius has a radius of 2.1 R_{Sun}. Convert it to m.

R_{Sun} = 695,000 km

2.1 R_{Sun} = 2.1 *x* 695,000 km = 1,459,500 km

1,459,500 km *x* $\frac{1{,}000\ m}{1\ km}$ = 1,459,500,000 m = 1.4595 *x* 10^9 m

Answer: 2.1 R_{Sun} = 1.4595 *x* 10^9 m

11. The star Betelgeuse is 420 ly away. This means that the light we see from that star left it 420 years ago. Convert 420 yrs to Cosmic Calendar time in s.

Cosmic Calendar time = $\frac{real\ time}{1.2 \times 10^{10}}$ = $\frac{420\ yrs}{1.2 \times 10^{10}}$ = 3.5 *x* 10^{-8} yrs

= 3.5 *x* 10^{-8} yrs *x* $\frac{365.25\ days}{1\ yr}$ *x* $\frac{24\ hrs}{1\ day}$ *x* $\frac{60\ \text{min}}{1\ hr}$ *x* $\frac{60\ s}{1\ \text{min}}$ = 1.104516s

Answer: 420 yrs = 1.104516 s on the Cosmic Calendar

12. Convert the tilt of the Earth's axis of rotation, 23.5^{o}, from the ecliptic plane to degrees and arcminutes.

Subtract the integer part: 23.5 d - 23 d = 0.5 d

$$0.5\text{d}\ x\ \frac{60'}{1\,d} = 30'$$

23d + 0.5d = 23.5d

Answer: 23.5 d = 23d 30'

13. The declination, *d*, of the star Procyon is 05d 13' 30" . Convert it to arcseconds.

$$\left(5d\ x\ \frac{3{,}600''}{1\,d}\right) + \left(13'\ x\ \frac{60''}{1'}\right) + 30''$$

= 18,000" + 780" + 30" = 18,810"

Answer: 05d 13' 30" = 18,810"

14. Convert the right ascension of the star Pollux, 07h 45m 14.5s, to h.

$$7\text{h} + \left(45m\ x\ \frac{1h}{60m}\right) + \left(14.5s\ x\ \frac{1h}{3{,}600s}\right)$$

= 7h + 0.75h + 0.00403h = 7.75403h

Answer: 07h 45m 14.5s = 7.75403h

15. The angular distance between Antares and Shaula, 17d 16' 49". Convert it to degrees.

$$17\text{d} + \left(16'\ x\ \frac{1d}{60'}\right) + \left(49''\ x\ \frac{1d}{3{,}600''}\right)$$

=17d + 0.267d + 0.0136d = 17.2806d

Answer: 17d 16' 49" = 17.2806d

16. The angular distance between the stars Caph and Schedar is 4.91472^o. Convert it to degrees, arcminutes, and arcseconds.

Subtract the integer part: 4.91472d - 4d = 0.91472d

$$0.91472d \; x \; \frac{60'}{1\,d} = 54.8832'$$

Subtract the integer part: 54.8832' - 54' = 0.8832'

$$0.8832' \; x \; \frac{60''}{1'} = 53''$$

Answer: 4.91472^o = 4d 54' 53"

17. The synodic period of the Moon is 29 days 12h 44m 2.82s. Convert it to days.

$$12 \text{ hr} \; x \; \frac{1\,day}{24\,hr} = 0.5 \text{ days}$$

$$44 \text{ min} \; x \; \frac{1\,hr}{60 \text{ min}} \; x \; \frac{1\,day}{24\,hr} = 0.0306 \text{ days}$$

$$2.82s \; x \; \frac{1 \text{ min}}{60\,s} \; x \; \frac{1\,hr}{60 \text{ min}} \; x \; \frac{1\,day}{24\,hr} = 0.000033 \text{ days}$$

29 days + 0.5 days + 0.0306 days + 0.0000326 days = 29.531 days

Answer: 29 days 12h 44m 2.82s = 29.531 days

18. The surface temperature of Venus is 882^oF. Convert it to both ^oC and K.

$$^oC = \frac{5}{9}(882^oF - 32^oF) = 472.2^oC$$

$$K = 472.2^oC + 273^oC = 745.2K$$

Answer: $882^oF = 472.2^oC = 745.2K$

19. The temperature of the star Sirius is 9,150 K. Convert it to both ^{o}C and ^{o}F.

$^{o}C = K - 273^{o}C = 9{,}150\ K - 273^{o}C = 8{,}877^{o}C$

$^{o}F = \frac{9}{5}(^{o}C) + 32^{o}F = \frac{9}{5}(8{,}877^{o}C) + 32^{o}F = 16{,}010.6^{o}F$

Answer: 9,150 K = 8,877^{o}C = 16,010.6^{o}F

20. Pluto is 39.44 AU from the Sun. Calculate the approximate area of the solar system in km^2. Assume that Pluto marks the edge of our solar system and its distance from the Sun is the radius of our solar system. Remember that the formula for area is $A = \pi r^2$.

$A_{solar\ system} = 3.14\ x\ (39.44\ AU)^2 = 3.14\ x\ 1{,}555.51\ AU^2 = 4{,}884.313\ AU^2$

$$= 4{,}884.313\ AU^2\ x\ \left(\frac{1.496\ x\ 10^8\ km}{1\ AU}\right)^2 = 1.0931\ x\ 10^{20}\ km^2$$

Answer: The area of the solar system is $1.0931\ x\ 10^{20}\ km^2$

21. The radius of the Sun is 695,000 km. The radius of the Earth is 6,378 km. Calculate how many Earths would fit inside the Sun. Remember that the formula for volume is $V = \frac{4}{3}\pi r^3$.

$V_{Sun} = \frac{4}{3}\pi\ x\ (695{,}000\ km)^3$

$V_{Earth} = \frac{4}{3}\pi\ x\ (6{,}378\ km)^3$

$$\frac{V_{Sun}}{V_{Earth}} = \frac{\frac{4}{3}\pi\ x\ (695{,}000\ km)^3}{\frac{4}{3}\pi\ x\ (6{,}378\ km)^3} = \frac{(695{,}000\ km)^3}{(6{,}378\ km)^3}$$

$$= \frac{3.36\ x\ 10^{17}\ km^3}{2.59\ x\ 10^{11}\ km^3} = 1{,}293{,}900\ \text{Earths} = 1.2939\ x\ 10^6\ \text{Earths}$$

Answer: $1.2939\ x\ 10^6$ Earths would fit inside the Sun.

22. The amount of mass contained in stars in our neighborhood is about 0.039 $M_{Sun}/parsec^3$ (Sky & Telescope, p. 44, June, 1999). Convert it to kg/m^3.

$M_{Sun} = 1.989 \text{ x } 10^{30}$ kg

$0.039\ M_{Sun} = 0.039\ x\ 1.989\ x\ 10^{30}\ \text{kg} = 7.7571\ x\ 10^{28}\ \text{kg}$

$1\ \text{parsec}^3 = 1\ \text{parsec}\ x\ \text{parsec}\ x\ \text{parsec}$

$$1\ \text{parsec}^3\ x \left(\frac{3.26\ ly}{1\ parsec}\right)^3 = 34.646\ \text{ly}^3$$

$34.646\ \text{ly}^3 = 34.646\ \text{ly}\ x\ \text{ly}\ x\ \text{ly}$

$$34.646\ \text{ly}^3\ x \left(\frac{9.46\ x\ 10^{15}\ m}{1\ ly}\right)^3 = 2.933\ x\ 10^{49}\ \text{m}^3$$

$$0.039\ M_{Sun}/\text{parsec}^3 = \frac{7.7571\ x\ 10^{28}\ kg}{2.933\ x\ 10^{49}\ m^3} = 2.6448\ x\ 10^{-21}\ \text{kg/m}^3$$

Answer: $0.039\ M_{Sun}/\text{parsec}^3 = 2.6448\ x\ 10^{-21}\ \text{kg/m}^3$