Homework Set 1 Solutions

Prologue: Study Guide

1) B
2) E
3) A
4) D
5) D
6) B
7) E
8) A
9) D
10) Seven naked-eye objects: moon, planets, meteors, comets, stars, nebulae, galaxies
11) A star is celestial object which generates its own light.
12) The Milky Way is caused by the light from the stars in our galaxy as we look into the disk.
13) Sun as a basketball; Earth as a pin 107 feet away; Moon as a period 3 inches from the Earth; nearest star 5,400 miles from Sun.
14) A galaxy is group of gravitationally bound stars ranging from a billion to a thousand billion in number.
15) Nebulae are named so because they are indistinct and cloud-like glowing objects.
16) Meteors are caused by rocks from space, which heat up as they fall through the Earth's atmosphere and glow.

Prologue: Calculation

1) $(2\times10^{-2})\times(3\times10^{3})=(2\times3)\times(10^{-2}\times10^{3})=6\times10^{-2+3}=6\times10^{1}$

$= 60$

$\left(\frac{(4\times10^{-4})}{(2\times10^{-3})}\right)^{2}=\left(\left(\frac{4}{2}\right)\times\left(\frac{10^{-4}}{10^{-3}}\right)\right)^{2}=\left(2\times10^{-4+3}\right)^{2}=\left(2\times10^{-1}\right)^{2}=(0.2)^{2}$

$=0.04$

2) 1 lightyear = 9.6×10^{12} km

$9.6\times10^{12}\text{km}\times\left(\frac{(1\,\text{AU})}{(150\times10^{6}\text{km})}\right)=\left(\frac{9.6}{150}\right)\times\left(\frac{10^{12}}{10^{6}}\right)\left(\frac{\text{km}}{\text{km}}\right)\text{AU}=0.064\times10^{12-6}\,\text{AU}$

$= 0.064\times10^{6}\,\text{AU}=6.4\times10^{4}\,\text{AU}$

$=$ 64,000 AU

3) $d=v\times t$

$t=\frac{d}{v}=\frac{\left(150\times10^{6}\text{km}\right)}{\left(300{,}000\frac{\text{km}}{\text{s}}\right)}=\frac{\left(1.5\times10^{8}\text{km}\right)}{\left(3\times10^{5}\frac{\text{km}}{\text{s}}\right)}=\left(\frac{1.5}{3}\right)\times\left(\frac{10^{8}}{10^{5}}\right)\frac{\text{km}}{\left(\frac{\text{km}}{\text{s}}\right)}$

$= 0.5\times10^{8-5}\frac{1}{\left(\frac{1}{\text{s}}\right)}=0.5\times10^{3}\text{s}$

$= 5\times10^{2}\text{s}\simeq8.3\,\text{minutes}$

4)

a) $\frac{(\text{Sun diameter})}{(\text{Earth diameter})}=\frac{\left(1{,}392{,}000\,\text{km}\right)}{\left(12{,}756\,\text{km}\right)}=\frac{(1.392\times10^{6}\text{km})}{(1.2756\times10^{4}\text{km})}=\left(\frac{1.392}{1.2756}\right)\times10^{6-4}\frac{\text{km}}{\text{km}}$

$=1.091 \times 10^2$
$=109$ times larger

b) Distance to Rigel = 733 ly
Distance to Betelgeuse = 428 ly
This indicates that constellations are not groups of stars at the same distance.

c) If the star is 733 ly away. Light takes a year to travel the distance in a light year. The light reaching us right now was emitted by Rigel 733 years ago.

5) Similar to 4c, if the distance to nebula is 6,000 ly, then the light seen by the Chinese was emitted 6,000 years before 1054 AD. That means the supernova actually occurred 1054 AD – 6,000 yrs = 4946 BC.

Chapter 1: Study Guide

1) B	9) A	17) A
2) D	10) D	18) A
3) A	11) C	19) D
4) C	12) D	20) B
5) D	13) D	21) A
6) D	14) E	22) B
7) D	15) E	23) B
8) B	16) E	24) 150 AD

Chapter 1: Calculation

1) $15\,\text{arcseconds}\dfrac{(1\,\text{arcminute})}{(60\,\text{arcseconds})}\dfrac{(1\,\text{degree})}{(60\,\text{arcminutes})}=\dfrac{15}{(60\times60)}\,\text{degrees}$
$= 0.00417\,\text{degrees}$

2) $4\,\text{degrees}\dfrac{(60\,\text{arcminutes})}{(1\,\text{degree})}=4\times60\,\text{arcminutes}$
$= 240\,\text{arcminutes}$

3) $3\,\text{arcminutes}\dfrac{(1\,\text{degree})}{(60\,\text{arcminutes})}=\dfrac{3}{60}\,\text{degrees}$
$= 0.05\,\text{degrees}$

4) See page 18 Figure 1-9 (b) for help.

	Right Ascension	**Declination**
Vernal Equinox	0 h	0 degrees
Summer Solstice	6 h	23.5 degrees
Autumnal Equinox	12 h	0 degrees
Winter Solstice	18 h	-23.5 degrees

5) See **Measuring the Size of the Earth** starting on page 35 for help.

$$\frac{360}{10} \times 500\,\text{km}$$

= 18,000 km

6) The cosine of an angle in a right triangle equals the adjacent length over the hypotenuse length. In this case the adjacent length is the average distance between the Earth and the Moon, and the hypotenuse length is the average distance between the Earth and the Sun.

$$\cos\theta = \frac{d_{\text{Earth}-\text{Moon}}}{d_{\text{Earth}-\text{Sun}}}$$

$$\theta = \arccos\left(\frac{d_{\text{Earth}-\text{Moon}}}{d_{\text{Earth}-\text{Sun}}}\right) = \arccos\left(\frac{(3.844\times10^{8}\,\text{m})}{(1.49\times10^{11}\,\text{m})}\right)$$

= 89.85 degrees