

Problem Venus

An observer located in Deh-Namak has observed Venus for seven months, started from September 2008 and continued until March 2009. During the observation, a research grade CCD camera and image processing software was used to grab high resolution images and to extract high precision data. Table (1) shows the collected data during the observation.

Table (1) description:

Column 1	Date of observation.
Column 2	Julian date for date of observation – 2454000.
Column 3	Earth-Sun distance in astronomical unit (AU) for observation date and time. This value is taken from high precision tables.
Column 4	Phase of Venus, Percent of Venus disk illuminated by the Sun as observed from the Earth.
Column 5	Angular diameter of Venus disk in arc-second.
Column 6	Elongation of Venus, the angular distance between center of the Sun and center of Venus in degrees as observed from the Earth.

- Using given data in table (1), calculate the Sun-Venus-Earth angle ($\angle SVE$). This is angular separation between the Sun and the Earth as seen from Venus. Write $\angle SVE$ angle in column 2 of Table (2) in your answer sheet for all observation dates.
- Calculate Sun – Venus distance r_v in AU and write it down in column 3 of table (2) for all observation dates.
- Plot Sun – Venus distance versus Julian dates.
- Find perihelion (r_v^{min}) and aphelion (r_v^{max}) distances of Venus from the Sun.
Max is: 0.728, Min is: 0.718
- Calculate semi-major axis (a) of Venus orbit.
a is: 0.364, b is: 0.359
- Calculate eccentricity (e) of Venus orbit.
e is: 0.4537

- g) Calculate Venus-Sun-Earth angle($\angle VSE$). This is angular separation between the Earth and Venus as seen from the Sun. Write ($\angle VSE$) in column 4 of table (2) for all observation dates.
- h) Calculate Earth-Venus distance Δ in AU and write it down in column 5 of table (2).
- i) Calculate radius of Venus (R_v) and write it down in column 6 of table (2).
- j) Calculate average value of (R_v) . **The avg is: 0.1589**
- k) Estimate error of (R_v).

The error is: 0.01365

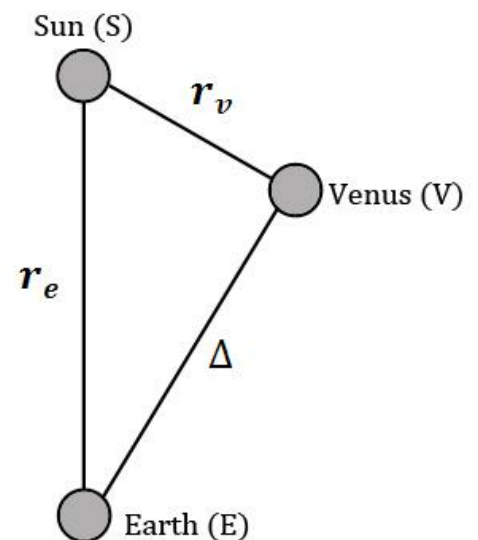
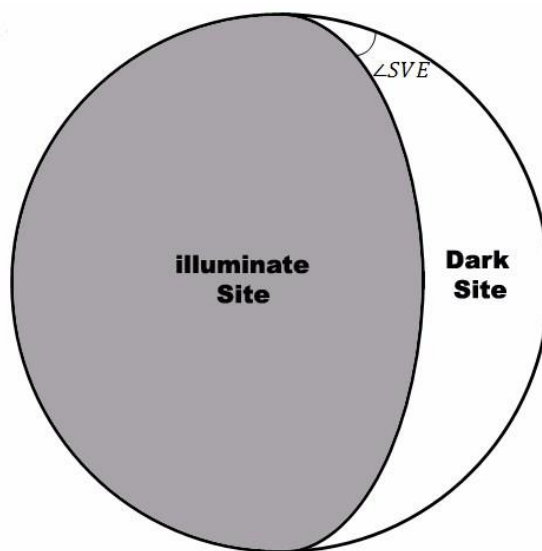


table (1)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Date	Julian Date - 2454000	Earth - Sun Distance (AU)	Phase (%)	Angular Diameter (")	Elongation (SEV) (°)
2008-Sep-20	729.5	1.0043	88.4	12	27.56
2008-Oct-10	749.5	0.9986	84.0	12	32.29
2008-Oct-20	759.5	0.9957	81.6	13	34.53
2008-Oct-30	769.5	0.9931	79.0	14	36.69
2008-Nov-09	779.5	0.9905	76.3	14	38.71
2008-Nov-19	789.5	0.9883	73.4	15	40.62
2008-Nov-29	799.5	0.9864	70.2	16	42.38
2008-Dec-19	819.5	0.9839	63.1	19	45.29
2008-Dec-29	829.5	0.9834	59.0	21	46.32
2009-Jan-18	849.5	0.9838	49.5	25	47.09
2009-Feb-07	869.5	0.9863	37.2	32	44.79
2009-Feb-17	879.5	0.9881	29.6	37	41.59
2009-Feb-27	889.5	0.9904	20.9	44	36.16
2009-Mar-19	909.5	0.9956	3.8	57	16.08

table(2)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Date	$\angle SVE$	r_v	$\angle VSE$	Δ	R_v
2008-Sep-20	39.825	0.726	112.62	0.2783	0.029
2008-Oct-10	47.156	0.728	100.55	0.2706	0.028
2008-Oct-20	50.802	0.728	94.67	0.2651	0.030
2008-Oct-30	54.549	0.728	88.76	0.2625	0.0323
2008-Nov-09	58.264	0.728	83.03	0.2613	0.0320
2008-Nov-19	62.095	0.727	77.28	0.2614	0.034
2008-Nov-29	66.171	0.725	71.45	0.2609	0.036
2008-Dec-19	74.811	0.723	59.90	0.2624	0.043
2008-Dec-29	79.630	0.721	54.05	0.2648	0.048
2009-Jan-18	90.572	0.719	42.34	0.2683	0.057
2009-Feb-07	104.83	0.718	30.38	0.2691	0.074
2009-Feb-17	114.079	0.719	24.34	0.2694	0.086
2009-Feb-27	125.591	0.721	18.25		0.103
2009-Mar-19					