List of Formula & Constant

Speed of light in vacuum, $c = 299\ 792\ 458$ m s^{-1}

Constant of gravitation, $G = 6.674 \times 10^{-11}$N m^2 kg^{-2}

Solar constant, $A = 1367$ W m^{-2}

Mean value, Hubble parameter $= 68$

Diapason of values, $H_O = 50 - 100$ km s^{-1} Mpc^{-1}

Planck constant, $h = 6.626 \times 10^{-34}$ J s

Charge of electron, $e = 1.602 \times 10^{-19}$ C

Mass of electron, $m_e = 9.109 \times 10^{-31}$ kg

Proton-to-electron mass ratio $= 1836.15$

Faraday constant, $F = 96\ 485$ C mol^{-1}

Magnetic constant, $\mu_0 = 1.257 \times 10^{-6}$ H m^{-1}

Universal gas constant, $R = 8.314$ J mol^{-1} K^{-1}

Boltzmann constant, $k_B = 1.381 \times 10^{-23}$ J K^{-1}

Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}

Wien's Displacement constant, $b = 2.898 \times 10^{-3}$ m K

Laboratory wavelength of H$\alpha = 6562.81$ Å

Tropical year length, $T = 365.242199$ days

Sidereal year length, $T = 365.25636$ days

Anomalistic year length, $T = 365.259636$ days

Nodal period of lunar orbit $= -18.6$ years

Standard atmosphere $= 101\ 325$ Pa

Visible light extinction by the terrestrial atmosphere in zenith (minimum)$= 19\%$, 0.23 m

Height of homogeneous atmosphere $= 7991$ m

Refractive index of water at 20°C, n $= 1.334$

Moment of inertia of a solid ball, $I = \dfrac{2}{5}MR^2$

Moment of inertia of sphere, $I = \dfrac{2}{3}MR^2$

Volume of a ball, $V = \dfrac{4}{3}\pi R^3$

Area of sphere, $A = 4\ \pi R^2$

$\pi = 3.14159265$

e $= 2.71828183$

Golden ratio, $\phi = 1.61803399$
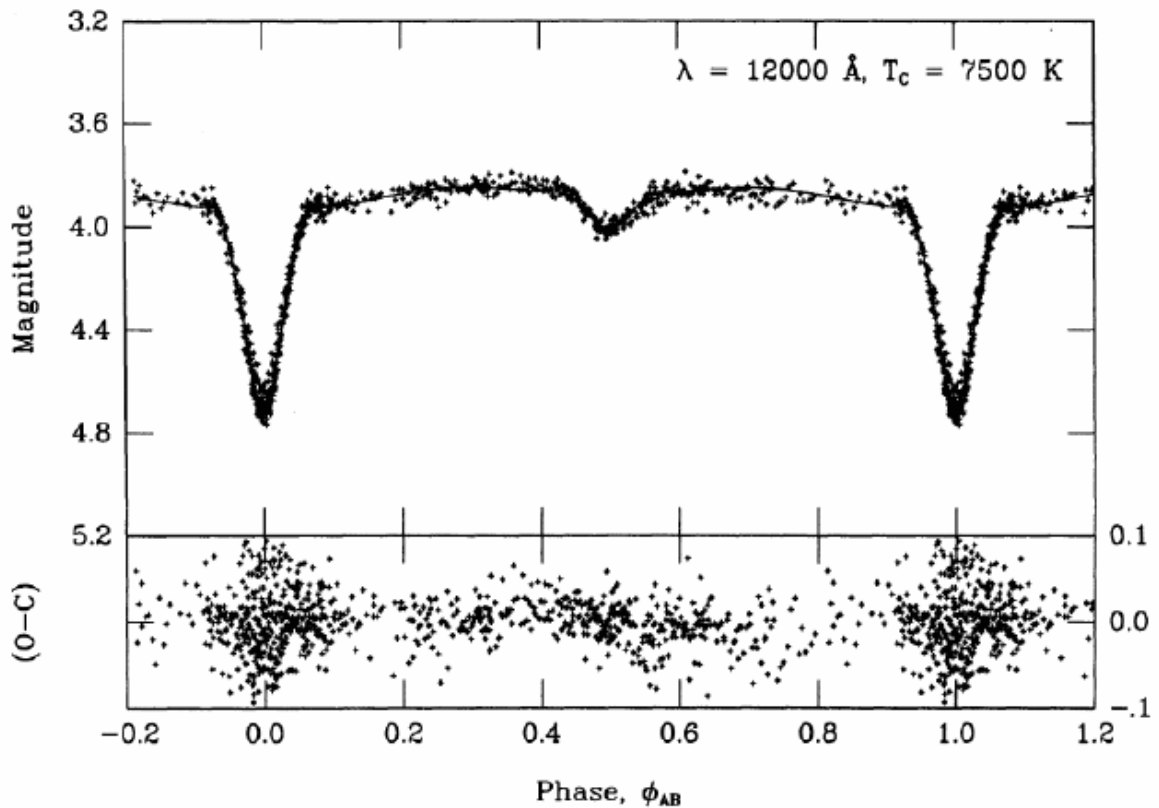
PRACTICAL AND DATA ANALYSIS QUESTION

1. The light curve of an eclipsing binary star system is shown in the figure below. Estimate from this light curve the ratio R/r:

   where

          R is the radius of the larger star

          r is the radius of the smaller star

   Assume that the eclipse is central, and the smaller star is a fainter star.

2. Suppose tonight you are on a beach in Batu Ferringhi, Penang, and the sky is very clear and there is no moon and you can see many stars in the night sky. By using the star-chart that is provided and by observing the stars and constellations, describe one method on how you can determine the four directions North, South, East and West while standing on the beach.

3. Describe in detail one method used by astronomers to detect the presence of exoplanets orbiting around nearby stars to the Sun. Sketch and label diagram to describe the method.
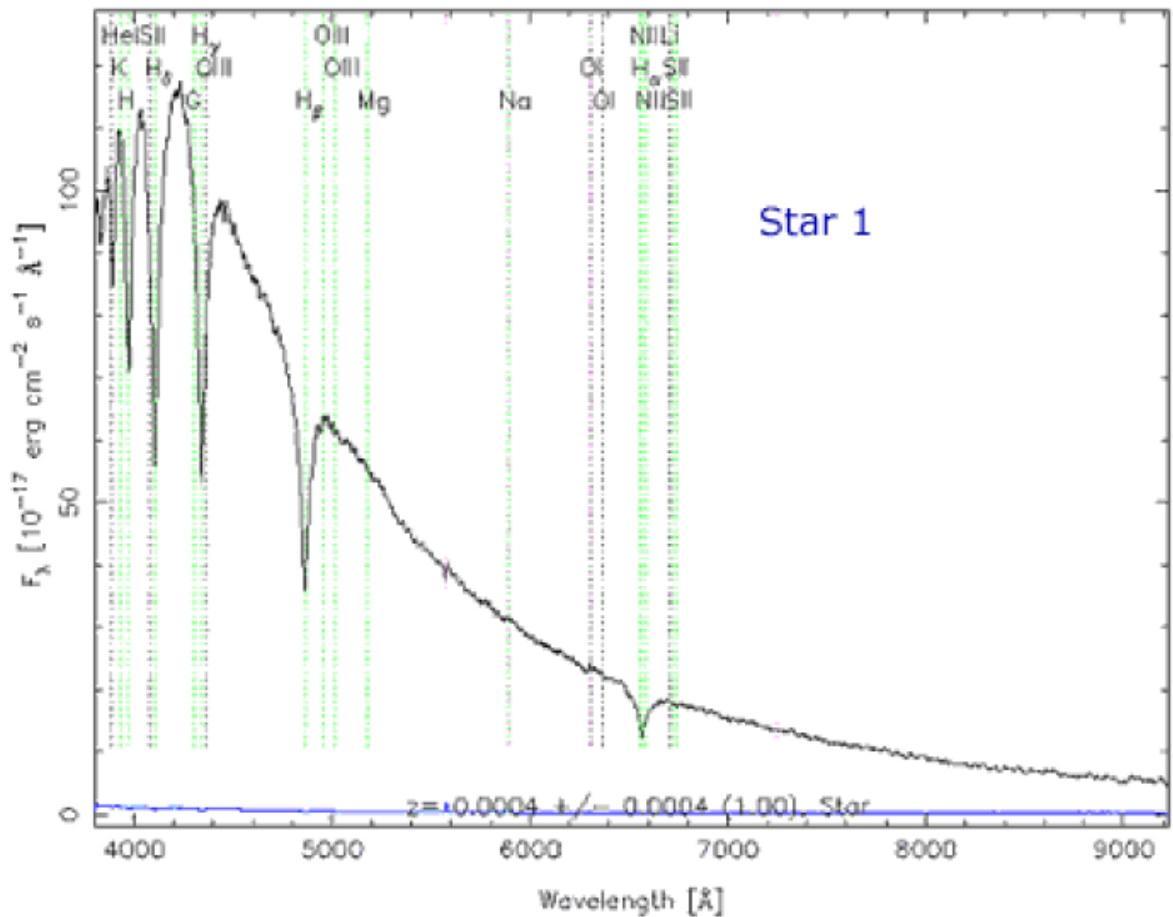
4. Afiqah was observing the sky from a location on the Earth's equator on the night of 20th to 21st March and she made the following observations in her diary:

— Today is 11 days before the Full Moon

— Saturn is seen in the constellation of SAGITTARIUS

— Jupiter is seen rising at the time of the Moon set

— Mars' position was coinciding with the centre of the Milky Way

— Mercury set about 2 hours before Moon set

— Venus was seen in the evening sky for about 2 hours after sun set

Using the information given above, mark on the given star-chart the positions of the Sun, the Moon and the five planets at 11.00 a.m. on the Vernal Equinox day (21st March).

5. The figure below shows the spectrum of a star with many absorption lines. Referring to this spectrum, list down five properties of the stellar atmosphere of this star.

END OF QUESTION