QUESTION 1. **(30 points for 15 short questions, 2 points for each short question)**
Show, in a few steps in the writing sheets, your method of solution. Write your final
answers in the answer sheets provided. Partial credits will be given for answers without
showing method of solution.

1.1   For an observer at latitude 42.5^o N and longitude 71° W, estimate the time of sun
        rise on 21 December if the observer's civil time is - 5 hours from GMT. Ignore
        refraction of the atmosphere and the size of the solar disc.

1.2   The largest angular separation between Venus and the Sun, when viewed from the
        Earth, is 46°. Calculate the radius of Venus's circular orbit in A.U.

1.3   The time interval between noon on 1 July and noon on 31 December is 183 solar
        days. What is this interval in sidereal days?

1.4   One night during a full Moon, the Moon subtends an angle of 0.46 degree to an
        observer. What is the observer's distance to the Moon on that night?

1.5   An observer was able to measure the difference in the directions, due to the
        Earth's motion around the Sun, to a star as distant as 100 parsecs away. What
        was the minimum angular difference in arc seconds this observer could measure?

1.6   A Sun-orbiting periodic comet is the farthest at 31.5 A.U. and the closest at 0.5
        A.U.. What is the orbital period of this comet?

1.7   For the comet in question 1.6, what is the area (in square A.U. per year) swept by
        the line joining the comet and the Sun?

1.8   At what wavelength does a star with the surface temperature of 4000 K emit most
        intensely?

1.9   Calculate the total luminosity of a star whose surface temperature is 7500 K, and
        whose radius is 2.5 times that of our Sun. Give your answer in units of the solar
        luminosity, assuming the surface temperature of the Sun to be 5800 K.

1.10   A K star on the Main Sequence has a luminosity of $0.4L_\odot$. This star is observed
        to have a flux of 6.23×10^{-14} $W.m^{-2}$. What is the distance to this star? You
        may neglect the atmospheric effect.

1.11   A supernova shines with a luminosity 10^{10} times that of the Sun. If such a
        supernova appears in our sky as bright as the Sun, how far away from us must it
        be located?

1.12   The (spin-flip) transition of atomic hydrogen at rest generates the electromagnetic wave of the frequency $n_0 = 1420.406$ MHz. Such an emission from a gas cloud near the galactic center is observed to have a frequency $n = 1421.65$ MHz.

Calculate the velocity of the gas cloud. Is it moving towards or away from the Earth?

1.13   A crater on the surface of the Moon has a diameter of 80 km. Is it possible to resolve this crater with naked eyes, assuming the eye pupil aperture is 5 mm ?

1.14   If the Sun were to collapse gravitationally to form a non-rotating black hole, what would be its event horizon (its Schwarzschild radius)?

1.15   The magnitude of the faintest star you can see with naked eyes is $m = 6$, whereas that of the brightest star in the sky is $m = -1.5$. What is the energy-flux ratio of the faintest to that of the brightest?