(9 marks)

(a)   The radius of the orbit of Venus around the Sun is 1.08 × 10¹¹ m.

   (i)   Derive an expression that relates the orbital period of Venus to the orbital radius of Venus and the mass of the Sun.

   (3 marks)

   (ii)   Calculate the time in Earth days for Venus to orbit the Sun.   **(3 marks)**

The passage of the planet Venus between the Earth and the Sun is a predictable regular occurrence. It is known as the 'transit of Venus'. Captain Cook sailed to Tahiti to measure the time Venus took to cross the Sun's surface.

A is the point at which Venus appears to intersect with the surface of the Sun. This occurs at different times for observers at different positions on the Earth's surface.
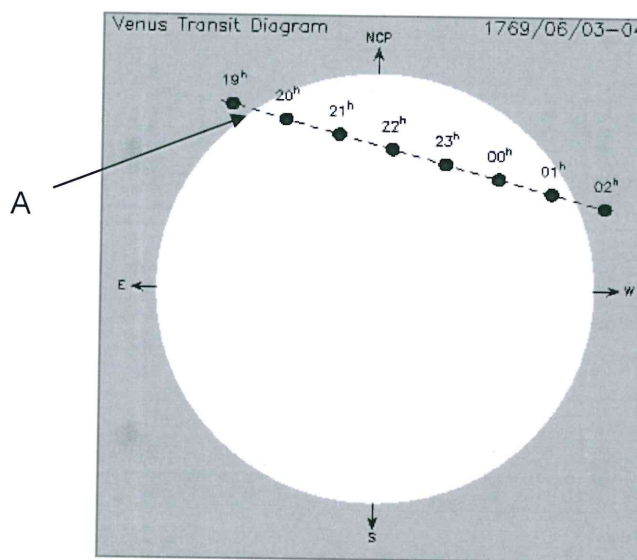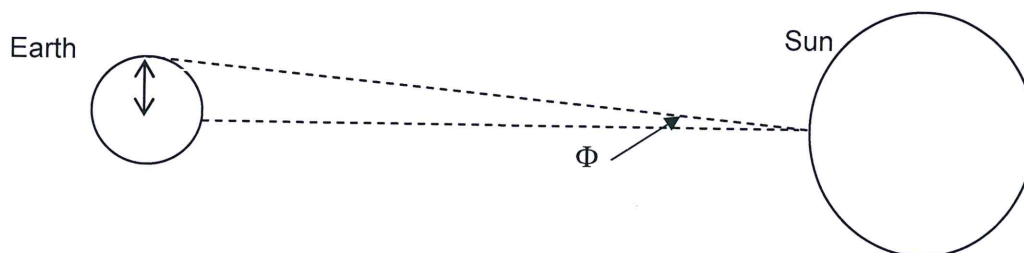

Diagram is **not** to scale

(b)   By measuring the time difference between the occurrence of A at different locations on Earth (Tahiti and California) astronomers were able to measure the solar parallax angle Φ as shown in the diagram below, which is not to scale. In this way the distance from the Earth to the Sun was calculated in 1769 with amazing accuracy.

Calculate the Earth – Sun distance in kilometres if the solar parallax angle Φ = 0.00250°.

(3 marks)

Question 2   2011:2:17

(12 marks)

The planet Jupiter has a mass of 1.90×10^{27} kg, a radius of 71 500 km and many moons.

The closest moon, Metis, has a mass of 9.56×10^{16} kg and a mean orbital radius of 1.28×10^5 km. Metis has an average planetary radius of 21.5 km.

(a)   Calculate the gravitational force of attraction between Jupiter and Metis.   (3 marks)

(b)   Calculate the time it takes in hours for Metis to orbit around Jupiter.   (4 marks)

(c)   Calculate the magnitude and direction of the net gravitational force acting on a 1.00 kg mass resting on the surface of Metis that faces Jupiter.   (5 marks)

Question 3   2014:1:9

(5 marks)

Use the information given in the Formulae and Data Booklet to calculate the orbital period, in seconds, of the Moon around the Earth.