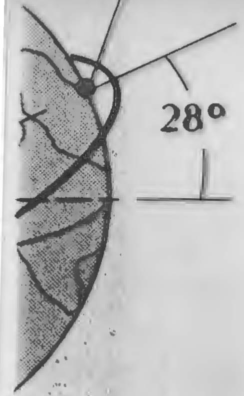


Section 9.4

19. Halley's comet (Figure 9.45) orbits the Sun in an elliptical orbit (the comet reached perihelion in 1986). When the comet is at perihelion, its distance from the Sun is 8.78×10^{10} m, and its speed is 5.45×10^4 m/s. When the comet is at aphelion, its distance is 5.28×10^{12} m. What is the speed at aphelion?

20. Explorer I, the first American artificial satellite, had an elliptical orbit around the Earth with a perigee distance of 6.74×10^6 m and an apogee distance of 8.91×10^6 m. The speed of this satellite was 6.21×10^3 m/s at apogee. Calculate the speed at perigee.

...tellite
Canaveral.

21. Vanguard I, the second American artificial satellite, moved in an elliptical orbit around the Earth with a perigee distance of 7.02×10^6 m and an apogee distance of 10.3×10^6 m. At perigee, the speed of this satellite was 8.22×10^3 m/s. What was the speed at apogee?

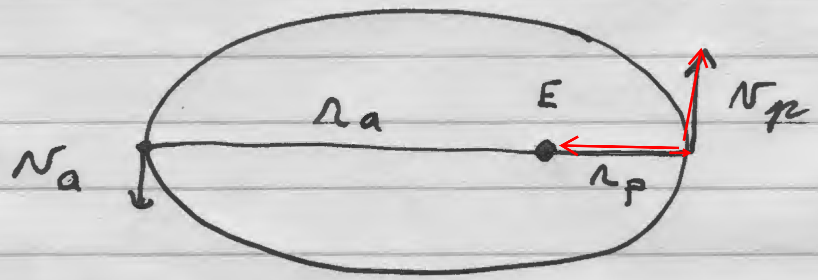
22. The Explorer X satellite had an orbit with perigee 175 km and apogee 181,200 km above the surface of the Earth. What was the period of this satellite?

23. Calculate the orbital periods of Sputnik I and Explorer I from their apogee and perigee distances given in Table 9.3.

Section 9.5

24. What is the kinetic energy and what is the gravitational potential energy for the orbital motion of the Earth around the Sun? What is the total energy

Eg. #21 Vanguard



$r_p = 7.02 \times 10^6\ m$ $\qquad v_p = 8.22 \times 10^3\ m/s$

$r_a = 10.3 \times 10^6\ m$ $\qquad v_a = ?$

Way #1 $\quad L_a = L_p$

$$m v_a r_a = m v_p r_p$$

$$v_a = v_p \frac{r_p}{r_a} = 8.22 \times 10^3 \frac{m}{s} \left(\frac{7.02}{10.3}\right)$$

$$v_a = 5.60 \times 10^3\ m/s.$$

Way #2 $\quad E_a = E_p$

$$\frac{1}{2} m v_a^2 - \frac{GMm}{r_a} = \frac{1}{2} m v_p^2 - \frac{GMm}{r_p}$$

$$\frac{1}{2} v_a^2 = \frac{1}{2} v_p^2 - GM\left(\frac{1}{r_p} - \frac{1}{r_a}\right)$$

$M = 5.98 \times 10^{24}\ kg$ $\qquad G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

$$v_a = 5.60 \times 10^3\ m/s$$

Note: $v_a < v_p$ (Farther ⇒ slower)