34) Phobos $\qquad\qquad$ Deimos

$r_P = 9.4 \times 10^6\, m \qquad r_D = 2.35 \times 10^7\, m$

$T_P = 0.32$ days $\qquad T_D =$

$$\frac{T_P^2}{r_P^3} = \frac{T_D^2}{r_D^3}$$

$$T_D = \sqrt{\left(\frac{T_P^2}{r_P^3}\right) \times r_D^3}$$

$$T_D = \sqrt{\left(\frac{(0.32\text{day})^2}{(9.4\times10^6 m)^3}\right) \times (2.35\times10^7 m)^3}$$

$\boxed{T_D = 1.20 \text{ days}}$ (Key says 1.6 days, but they failed to take square root).

b) $\cancel{T^2 = a^3}$

$\cancel{a = \sqrt[3]{T^2} =}$

$$\frac{T_P^2}{r_P^3} = \frac{T_M^2}{r_M^3}, \text{ so } r_M^3 = \frac{T_M^2 \cdot r_P^3}{T_P^2} \quad r = \sqrt[3]{\frac{T_M^2 \cdot r_P^3}{T_P^2}}$$

$$r_M = \sqrt[3]{\frac{(1.02\text{ days})^2 \cdot (9.4\times10^6 m)^3}{(0.32\text{ days})^2}} = \boxed{2.04\times10^7 m}$$

D

(37) Earth orbits sun in $T_E =$ 365.25 days with orbital radius of 1.5×10^{11} m. r_E

a) How many days for Mercury to orbit the sun?

$r_M = 5.8 \times 10^{10}$ m solve for r_M

$$\frac{T_E^2}{r_E^3} = \frac{T_M^2}{r_M^3} \qquad \cancel{r_M^3 = \frac{T_M^2 \cdot r_E^3}{T_E^2}} \qquad \cancel{r = \sqrt[3]{\frac{T_M^2 \cdot r_E^3}{T_E^2}}}$$

$$\cancel{r = \sqrt[3]{}}$$

SORRY

$$T_M^2 = \frac{T_E^2 \cdot r_M^3}{r_E^3} = T_M = \sqrt{\frac{T_E^2 \cdot r_M^3}{r_E^3}} =$$

$$T_{Merc} = \sqrt{\frac{(365.25\text{ days})^2 \cdot (5.8 \times 10^{10}\text{ m})^3}{(1.5 \times 10^{11}\text{ m})^3}}$$

$T_M = 87.8$ days $= 88$ days

b) $$T_{Mars} = \sqrt{\frac{T_E^2 \cdot r_M^3}{r_E^3}} = \sqrt{\frac{(365.25\text{ days})^2 (2.3 \times 10^{11}\text{ m})^3}{(1.5 \times 10^{11}\text{ m})^3}}$$

$T_{Mars} = 693.5$ days

c)

37 c) $T_{Jupiter} = 4333$ days.

what is $r_{Jupiter}$?

$$\frac{T_E^2}{r_E^3} = \frac{T_J^2}{R_J^3} \quad r_J^3 = \frac{T_J^2 \cdot r_E^3}{T_E^2}$$

$$r_J = \sqrt[3]{\frac{T_J^2 \cdot r_E^3}{T_E^2}} = \sqrt[3]{\frac{(4333\text{ days})^2 \cdot (1.5\times10^{11}\text{ m})^3}{(365.25\text{ days})^2}}$$

$$r_J = 7.5\times10^{11}\text{ m}$$

40 a) $$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

$$T^2 = \frac{4\pi^2 \cdot r^3}{G \cdot M}, \text{ so } T = \sqrt{\frac{4\pi^2 \cdot r^3}{GM}} =$$

$$T = \sqrt{\frac{4\pi^2 \cdot (1.5\times10^{11}\text{ m})^3}{(6.67\times10^{-11}\frac{\text{N m}^2}{\text{Kg}^2} \cdot 1.989\times10^{30}\text{ Kg})}} = 3.17\times10^7\text{ s}$$

$$3.17\times10^7\text{ s} \left|\frac{1\text{ min}}{60\text{ s}}\right|\frac{1\text{ hr}}{60\text{ min}}\left|\frac{1\text{ day}}{24\text{ hr}}\right. = 367\text{ days}$$

b) $$v = \frac{2\pi r}{T} = \frac{(2\pi \cdot 1.5\times10^{11}\text{ m})}{3.17\times10^7\text{ s}} = 3.0\times10^4\ \frac{\text{m}}{\text{s}}$$

3

41) $r_{IO} = 4.2 \times 10^8 \, m$

$T_{IO} = 1.77 \, days$

$1.77 \, days \left(\frac{\cancel{24} \, hr}{1 \, day} \middle| \frac{60 \, min}{1 \, hr} \middle| \frac{60 \, sec}{1 \, min} \right)$

a) what is $M_{Jupiter}$?

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM} \therefore \cancel{M} \; T^2 GM = 4\pi^2 r^3$$

$$M_J = \frac{4\pi^2 r^3}{T^2 G}$$

$$M_J = \frac{4\pi^2 \cdot (4.2 \times 10^8 m)^3}{\left(\cancel{1.77 \, days}\right)^2 (152928 \, s)^2 \cdot 6.67 \times 10^{-11} \frac{N \cdot m^2}{Kg^2}} = \cancel{7.41 \times 10^{27} m^3} = 1.9 \times 10^{27} \, Kg$$

b) $r_{europa} = 6.7 \times 10^8 \, m$ $\quad T_{europa} = ?$

$$\frac{T_{IO}^2}{r_{IO}^3} = \frac{T_{europa}^2}{r_{Europa}^3} \text{, so } T_{Europa} = \sqrt{\frac{T_{IO}^2 \cdot r_{europa}^3}{r_{IO}^3}}$$

$$T_{Europa} = \sqrt{\frac{(1.77 \, days)^2 \cdot (\cancel{4.2 \times 10^8} \; 6.7 \times 10^8 m)^3}{(4.2 \times 10^8 m)^3}} = \cancel{1.77 \, days}$$

$= 3.57 \, days$

41

c) $T_{Ganymede} = 7.2$ days

$$\frac{T_{io}^2}{r_{io}^3} = \frac{T_{Gan}^2}{r_{Gan}^3} \quad \text{so} \quad r_{Gan} = \sqrt[3]{\frac{T_{Gan}^2 \cdot r_{io}^3}{T_{io}^2}}$$

$$r_{Gan} = \sqrt[3]{\frac{(7.2 \text{ days})^2 \cdot (4.2 \times 10^8 \text{ m})^3}{(1.77 \text{ days})^2}}$$

$$r_{Gan} = 1.07 \times 10^9 \text{ m}$$

d) $T_{Jup} = 0.41$ days

$$\frac{T_{io}^2}{r_{io}^3} = \frac{T_J^2}{r_J^3} \qquad r_{Jup\ sat} = \sqrt[3]{\frac{T_J^2 \cdot r_{io}^3}{T_{io}^2}}$$

$$r_{Jup\ sat} = \sqrt[3]{\frac{(0.41 \text{ days})^2 \cdot (4.2 \times 10^8 \text{ m})^3}{(1.77 \text{ days})^2}}$$

$r_{Jup\ sat} = 1.6 \times 10^8$ m (Key says 2.55×10^7 m) might be wrong?