H.W. 6.

12.43 Let Energy emitted (Flux) be F_1. The cloud temperature for that flux = 107 k. = T_1
Find Temperature T_2 when $F_2 = 2F_1$.

$$\therefore \frac{F_2}{F_1} = \frac{\sigma T_1^4}{\sigma T_2^4} = \left(\frac{T_1}{T_2}\right)^4$$

$$\frac{2F_1}{F_1} = \left(\frac{107^4}{T_2^4}\right) \quad \therefore \quad T_2 = 127.24 \text{ k.}$$

When flux becomes twice temperature is 127k.

12.51) Radius of Saturns outer edge of A ring = 137×10^3 km
Radius of Saturns inner edge of B ring = 92×10^3 km

$$P_A^2 = \frac{4\pi^2}{GM} R^3 = \frac{4\pi^2 \times (1.37 \times 10^8)^3}{G \times 5.685 \times 10^{26}}$$

$P_A = 51739 \approx 14.37$ hrs

$$P_B^2 = \frac{4\pi^2}{GM} R^3 = \frac{4\pi^2 (92 \times 10^3)^3}{G \times 5.685 \times 10^{26}} \approx 7.9 \text{ hrs.}$$

b) As Saturn's Rotation period is 10.6 hrs
From equator you would see a retro motion for Ring A and a motion in same direction for ring B

13.44 Mass of Io is 8.932×10^{22} kg

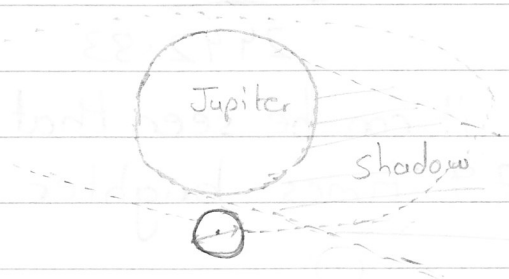
10% of mass is 8.932×10^{21} kg

The mass is ejected at 1000 kg/sec.

$\therefore$ Total seconds $= \frac{8.932 \times 10^{21}}{10^3} = 8.932 \times 10^{18}$ sec

Total time taken $\simeq 2.832 \times 10^{11}$ years.

13.46.



If Ganymede is just touching the shadow, it would require it to travel distance equal to its diameter to enter the shadow completely

$$\text{Orbital Speed} = \frac{2\pi (\text{Radius})}{\text{Orbital Period}}$$

$$= \frac{2 \times \pi \times 1.07 \times 10^9}{7.155 \times 24 \times 3600}$$

Orbital Speed $= 10,875$ m/sec

Time taken to travel diameter $= \frac{5268 \times 10^3}{10,875}$

Time $= 484.4$ sec

$\simeq 8.1$ mins.

14.35. a) Brightness of Pluto perihelion $= \frac{1}{(29.649)^2} \times$ Earth Brightness

Brightness at perihelion $= \frac{1}{879.1}$ Earth Brightness.

b) Brightness @ aphelion $= \frac{1}{(49.425)^2} \times$ Earth Brightness

$= \frac{1}{2442.83}$

c) From a) & b) it can be seen that at perihelion Pluto is 2.779 times brighter than on apehelion.

14.40 Let Period of object be P_θ and Period of Neptune be P_N. $\therefore P_\theta = \frac{3}{2} P_N$

$P_\theta^2 \propto R_\theta^3$ & $P_N^2 \propto R_N^{3/2}$

$\therefore \frac{P_\theta^2}{P_N^2} = \frac{R_\theta^3}{R_N^3}$ $\therefore \left(\frac{3}{2}\right)^2 = \frac{R_\theta^3}{R_N^3}$

$\therefore R_\theta = 1.31 R_N$