H.W 2. Astro 1.

4.41. Mass of Moon = 7.35×10^{22} kg
Mass of earth = 5.98×10^{24} kg.
Distance R = 384 400 km = 3.844×10^{8} meters ~~km~~

$\therefore$ Force Exerted by Earth on Moon =

$$F = \frac{G M_E M_M}{R^2} = \frac{(6.67\times10^{-11})(5.98\times7.35\times10^{46})}{(3.844\times10^{8})^2}$$

$$= \frac{(6.67\times43.953\times10^{35})}{14.77\times10^{16}}$$

$$\boxed{F = 19.85\times10^{19} \text{ Newtons}}$$

→ The Force exerted by Moon on Earth would be equal & opposite.

4.47 The space craft orbited 111 km above the moon's Surface.
$\therefore$ We use $P^2 = \frac{4\pi^2}{G(m_{moon}+M_{sattellite})} r^3$

here mass of Sattelite << Mass of moon.
hence we can say

$$P^2 = \frac{4\pi^2}{G M_{moon}} r^3 = \frac{4\times\pi^2\times\left[(3476/2)+111\right]^3}{G M_{moon}}$$

CTD →

$$P^2 = \left(\frac{4\pi^2}{4.9 \times 10^{12}}\right)(1.749 \times 10^6)^3$$

$P^2 = 45916770$

$P = 6776$ seconds.

$$\boxed{\therefore P = 1.88 \text{ hrs or} \approx 113 \text{ minutes}}$$

5.30 Temperature of IO's volcano is 320°C

a) $T = (320+273)^\circ k. = 593 k.$

$\therefore$ Using Wein's law.

$$\lambda_{max} = \frac{0.0029}{593} = 4.890 \times 10^{-6} \text{ meters.}$$

$= 4890$ nanometers.

This wavelength is in Infra Red Region.

b) Using Boltzman's law, we can find the Ratio of energy Radiated (Energy flux)

$$\frac{F_{IO}}{F_{pele}} = \frac{\sigma (T_{IO})^4}{\sigma (T_{pele})^4} = \frac{(123)^4}{(593)^4} = \frac{1}{540}$$

$\therefore$ Pele radiates 540 times more energy than IO.

5.33. The energy of photon detected $= 511\ keV$.

$\therefore$ Using Planck's law.

$$E = h\nu \quad \text{where } \nu = \text{~~feq~~ frequency.}$$

$$\therefore E = h\frac{c}{\lambda}$$

$$511 \times 10^{3} = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}$$

$\therefore$ ~~$\lambda = 0.0389$~~

Now the Quantity on Left is in Electron Volts. We need to convert it into Joules for an answer.

$\therefore 511 \times 10^{3}\ eV = 511 \times 10^{3} \times e$ where e is charge on eletron.

$$e = 1.602 \times 10^{-19}\ C.$$

$$\therefore 8.187 \times 10^{-14} = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}$$

$$\lambda = 2.427 \times 10^{-12}\ m.$$

$\boxed{\lambda = 2427\ nm}$:- This is Infra Red.

5.40. λ observed $= 486.112\ nm$ $\quad \lambda_{actual} = 486.133\ nm$.

Wave length Shift $\Delta\lambda = \lambda_{actual} - \lambda_{observed}$

$$= 486.133 - 486.112$$

$$\Delta\lambda = 0.021\ nm.$$

$\therefore$

CTD →

Using Doppler's law.

$$\frac{\Delta\lambda}{\lambda_{actual}} = \frac{V}{C} \therefore \frac{0.021\times10^{-9}}{486.133\times10^{-9}} = \frac{V}{3\times10^{8}}$$

$\therefore V = 1.296\times10^{\cancel{5}4}$ m/s.

$\boxed{V = 1296 \text{ m/s}}$ → This is a blueshift as the observed wavelength is decreasing. The star is comming towards us.

5.41 $\lambda_{actual} = 700$nm $\quad \lambda_{observed} = 500$nm

$\Delta\lambda = \lambda_{actual} - \lambda_{observed}$

$\Delta\lambda = 200$nm.

$$\therefore V = \frac{\Delta\lambda}{\lambda_{actual}} \times C = \frac{200}{700} \times 3\times10^{8}$$

$\boxed{V = 8.57\times10^{7} \text{ m/s}}$

Offcourse you deserve a ticket ☺.