HW 5.

9.29) Power Reaching atmosphere = 1.75×10^{17} W

a) Power Reflected Back = albedo x Power

$= 0.31 \times 1.75 \times 10^{17}$

$= 5.425 \times 10^{16}$

b) Solar Power Not Reflected = $(1 - \text{albedo}) \times 1.75 \times 10^{17}$

$= 1.21 \times 10^{17}$ W

As a black body earth would Radiate as much power as it gets.

c) Power per one square meter = $\frac{\text{Power Radiated}}{4\pi R^2}$

$$\text{Power} = \frac{1.21 \times 10^{17}}{4 \times \pi \times (6.378 \times 10^6)^2}$$

$$\text{Power} = 236.7 \text{ W/m}^2$$

d) Average Temperature of Surface can be found by:-

$$F = \sigma T^4$$

$$236.7 = 5.67 \times 10^{-8} \times T^4$$

$$T = 254.18 \text{ K} = -18.8 \text{ C}$$

The actual Average Temperature of earth is much more than the calculated temperature due to the presence of atmosphere & Green house gases.

9.35) The plates have moved 60 km in 3.3 million years. ∴ Rate per year

$$= \frac{60 \times 10^3 \times 10^3}{3.3 \times 10^6} \text{ mm years.}$$

Rate of drift = 18.18 mm/year

11.51) Period of Rotation = 58.646 days.

∴ Period = $58.646 \times 24 \times 3600 = 5067014.4$ second

Now diameter of Mercury = 4880 km

a) ∴ The linear distance travelled by a point on equator = $\pi \times D$

$$= \pi \times 4880 \times 10^3 \text{ m}$$

$$= 15330972 \text{ m}$$

∴ Speed = $\frac{\text{Linear distance}}{\text{Period}} = 3.02$ m/sec

b) Difference in wavelength $\Delta\lambda$ can be found by Doppler equation.

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$$

$$\therefore \Delta\lambda = \frac{v}{c} \times \lambda = \frac{3.02}{3 \times 10^8} \times 12.5 \times 10^{-2}$$

$$\Delta\lambda = 12.58 \times 10^{-10} \text{ m}$$

∴ Different in wavelength = 12.58 Å

or 1.258 nm

64. Note:- If we assume the numbers from 11.62 i.e. Distance between Hellas & Olympus mons as 30 km, we get the answer at the back of book. But if we refer to figure 11.20 the distance comes out to be 16. This gives half the answer at the back of book. For now I am using the map as reference.

→ Distance between Olympus & Hellas = 16.
The beam of light would travel (2×16) km more than Olympus.
∴ The difference in Round Trip Time = $\frac{32 \times 10^3}{3 \times 10^8}$

$= 10.6 \times 10^{-5}$ seconds

Difference in R.T.T. = 106 μ secs.

* We dont need to know the height of MOLA

11.7.3 For Angular size of Phobos & Diemos we use the appendix data.

Phobos largest Diameter = 28×10^3 meter.
Average Distance from center 9378×10^3 meters.
Deimos largest Diameter = 16×10^3 meters.
Average Distance from center = 23460×10^3 meters

* Phobos :-

For a man on surface

$$D = \frac{\alpha d}{206265}$$

$$28 \times 10^3 = \frac{\alpha \times (9378 - 3397) \times 10^3}{206265}$$

$$\alpha = 965.62 \text{ arc secs.}$$

$$\alpha = 16.09 \text{ arc mins.}$$

Moon is ≈ 30 arc mins. So Phobos would look smaller than moon.

* Deimos :-

For man on surface

$$16 \times 10^3 = \frac{\alpha (23460 - 3397) \times 10^3}{206265}$$

$$\alpha = 164 \text{ arc secs}$$

$$\alpha = 2 \text{ arc min.}$$

Deimos would look much smaller than moon.