M1-SOAC TD5

Chapter 5: Tides

Question a:

Give brief explanations of the following phenomena:

1) Some regions have two tides per day
2) Some regions have one tide per day
3) The amplitude of the tide is greater at full moon or new moon compared to at half moon.
4) The principal period of the diurnal tide is 24h 50m and not 24h.
5) In the northern hemisphere, tidal maxima have a tendency to circulate anticlockwise around nodal points of the amphidromic system.
6) In the English Channel, the tide is higher on the French side.

Question b:

Imagine a spherical planet ($r = 4727km$, $M = 2{,}6792 \times 10^{24} kg$) entirely covered by ocean, rotating (1 revolution in 20 *hours*). A satellite ($m = 4{,}63 \times 10^{21} kg$) is in a permanent circular orbit, in the same direction as the planet's rotation. The orbital distance of this satellite is 500,000 *km* and its period of revolution is 200 *hours*.

1) Show that the gravity field (g) at the surface of this planet is 8 N/kg.
The universal gravitational constant is $G = 6{,}672 \times 10^{-11} N\, m^2\, kg^{-2}$.

2) What is the period (in *hours*) and wavelength of the tide at the equator (in *km*)?

3) The average depth of the ocean being $H = 3200\, m$, what is the maximum speed of the surface gravity wave?

4) At the equator, what is the speed needed to maintain the equilibrium tide?

5) What is the lowest latitude at which the tide can be in equilibrium?

6) If the satellite's orbit were elliptical, what characteristic(s) of the tide would be impacted? Why?

7) This planet orbits a large star ($M_E = 5 \times 10^{30} kg$) at an average distance of 300,000,000 *km*. Is the tide created by this star stronger than that created by the satellite?