COLLAGE 2023

HW-8

(Submit by Mar 17)

RLMSIS 2.0 models the global average density profile for the major constituents in Figure 1(a) and global average temperature profile in Figure 1(b). Table 4.6 below provides the electron-neutron collision frequencies. Use this information to answer the question on Page 2.
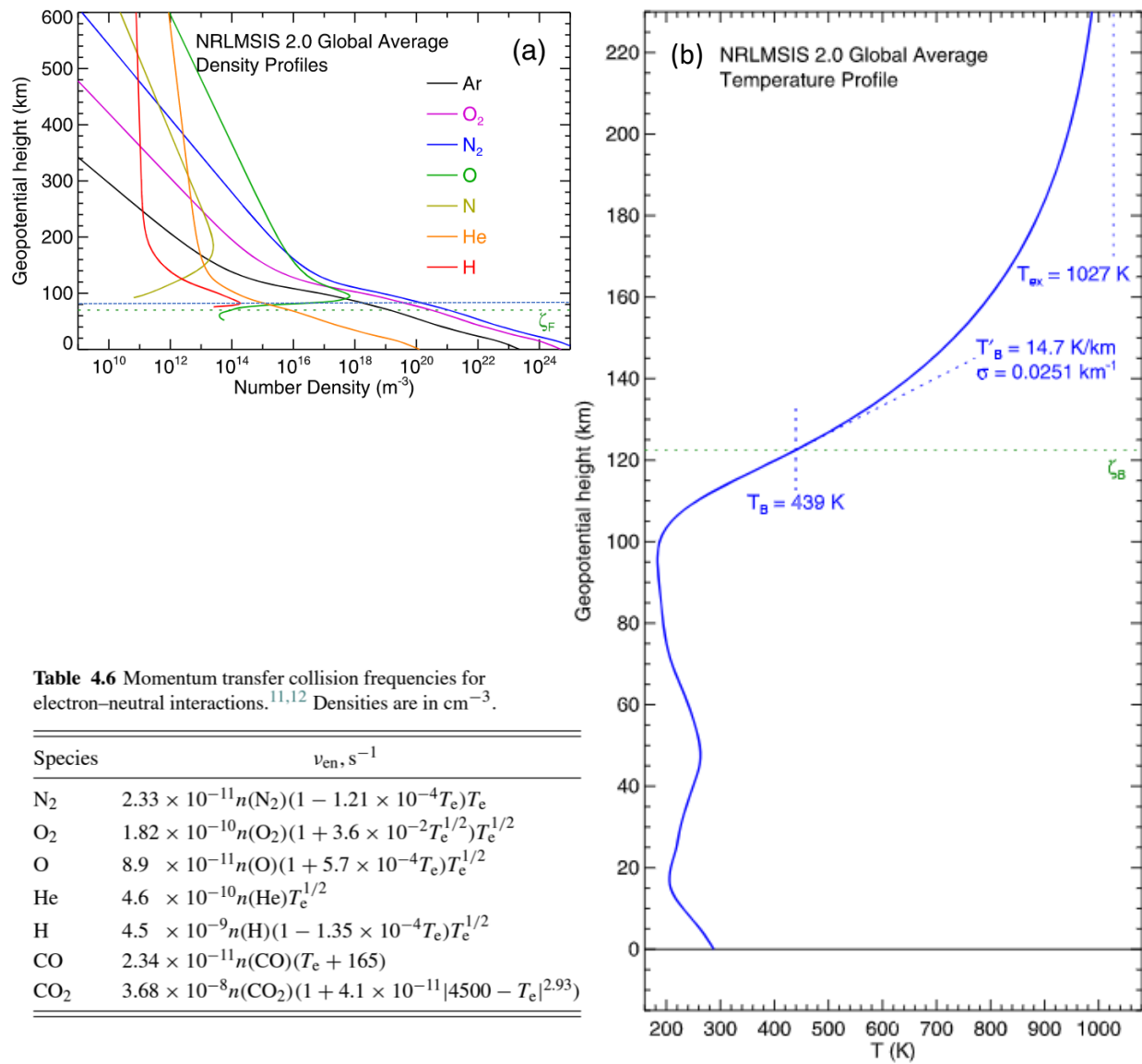

Table 4.6 Momentum transfer collision frequencies for electron–neutral interactions.[11,12] Densities are in cm^{-3}.

Species	ν_{en}, s^{-1}
N_2	$2.33 \times 10^{-11} n(N_2)(1 - 1.21 \times 10^{-4} T_e) T_e$
O_2	$1.82 \times 10^{-10} n(O_2)(1 + 3.6 \times 10^{-2} T_e^{1/2}) T_e^{1/2}$
O	$8.9 \times 10^{-11} n(O)(1 + 5.7 \times 10^{-4} T_e) T_e^{1/2}$
He	$4.6 \times 10^{-10} n(He) T_e^{1/2}$
H	$4.5 \times 10^{-9} n(H)(1 - 1.35 \times 10^{-4} T_e) T_e^{1/2}$
CO	$2.34 \times 10^{-11} n(CO)(T_e + 165)$
CO_2	$3.68 \times 10^{-8} n(CO_2)(1 + 4.1 \times 10^{-11}|4500 - T_e|^{2.93})$

Figure 1

A solar fare event occurred at around 14:00 UT on 22 October 2014. A group of researchers from the Czech Republic have modeled the ionospheric effects from this event, as shown in Figure 2 (collision frequency on the left and electron density profile on the right). Solid lines represent modeled values before 14:00 and dashed lines the values during solar fare event.

Question 1: Use the quiet-condition electron density (solid blue line in Figure 1(a)) at 80 km and the neutral density information on Page 2 to estimate the electron collision frequency and compare it to Figure 2(b). Assume $\nu_{en} = \nu_{e,N2} + \nu_{e,O2}$. Explain why your estimation is larger or smaller than Figure 2(b).
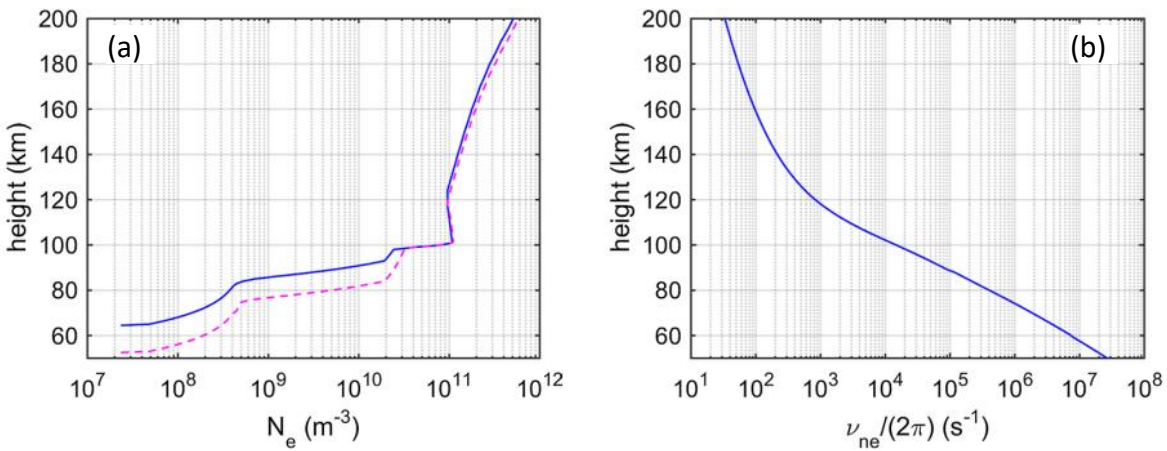

Figure 2

Question 2: Based on Figure 2, for an over-the-horizon radio system operating at 3 MHz, at what altitude will the radio wave be reflected by the ionosphere during the solar flare?