

NE 602: RADIATION PROTECTION ENGG.
Final Examination

Open books and notes.

1. (a) What is the temperature change in a small parcel of dry air that is adiabatically displaced downward a distance of 50 meters? (b) Explain how this temperature change would be affected if the air being moved were humid vapor. DATA: c_p for dry air is $1.0035 \text{ kJ kg}^{-1} \text{ K}^{-1}$. *[15 points]*
2. ^{138}Xe (half life 14.2 min) is released at a constant rate of 10^6 Bq h^{-1} at an elevation of 75 m. What is the ground-level concentration $C \{\text{Bq m}^{-3}\}$ at a location directly downwind 2 km distant from the release point if the wind speed is 2 m s^{-1} on a day when the atmospheric stability is class B? Assume flat terrain and the Pasquill-Gifford diffusion parameters. *[25 points]*
3. The ground level concentration of molecular radioiodine (I_2) over a pasture under neutral atmospheric conditions is measured to be 1.5 MBq m^{-3} . Estimate the rate at which radioiodine is deposited on the pasture grass in Bq kg^{-1} . *[15 points]*
4. 15 TBq of a very long lived radionuclide is accidentally discharged into river which has an average width of 50 m, and average depth of 1.5 m, and a flow rate of 70000 m^3 per hour. The longitudinal dispersion coefficient D_x for this river is known to be about $20 \text{ m}^2 \text{ s}^{-1}$. What will be the maximum concentration of this radionuclide at a location 20 km downstream from the accident site? *[25 points]*
5. The average US adult human consumes about 26 g d^{-1} of poultry. (a) If this average human were to consume poultry which ingest 2 pCi d^{-1} of ^{137}Cs from contaminated feed, estimate the annual ^{137}Cs activity consumed by the human. (b) What would be the annual committed dose equivalent (Sv) received by the red marrow of such an individual? *[20 points]*