Kwame Nkrumah University of Science and Technology
Faculty of Physical and Computational Sciences
College of Science
Department of Meteorology and Climate Science
Met 253: Fortran for Scientific Computing

NB: Submit you answers to **met253.2023@gmail.com**
Deadline for submission **25th April, 2023 11:59 GMT.** Late submissions will not be tolerated.

Question 1
The magus formula is used to calculate the saturation vapour pressure of water at a given temperature. This is important because it tells us how much water vapour the air can hold at a particular temperature before it becomes saturated and starts to condense into clouds. By calculating the vapour pressure we determine if the air is likely to form clouds or not. Using a simplified version of the Magnus formula below, write a fortran code to estimate the saturation vapour pressure at different temperatures using the temperature provided in the file "*data.txt*". For each row, print out the temperature and its corresponding saturation vapour pressure. Format the output appropriately using the format descriptors.

$$e_s = 6.107\, x\, 10^{\left(\frac{7.5T}{273+T}\right)} \ [hpa]$$

where e_s is saturation vapour pressure in hpa and T is the temperature in Degree celcius.

Question 2
Potential temperature is the temperature an air parcel will assume, when it is brought adiabatically to the reference pressure. It is a useful tool because it helps understand the vertical structure of the atmosphere, determine the stability of the atmosphere and the potential of severe weather like intense thunderstorms. Using the formula below, calculate the potential temperature of an air parcel using the data provided in the file "data.txt", given that P_0 is 1000hpa. For each row, print out the pressure , temperature and its corresponding potential temperature. Format your output appropriately using the format descriptors

$$T = T_o \left(\frac{p_o}{p}\right)^{\frac{R}{C_p}}; \frac{R}{C_p} \approx 0.286$$

where T is temperature in degree Kevin, P is pressure in hpa.

Question 3
Radiation is one of the primary three ways that heat is transferred in the atmosphere along with conduction and convection. The study if radiation is important because it helps us understand the how energy is exchanged between the atmosphere and the earths surface. Using a simplified Stephan Boltzmann's formula below calculate the energy emitted by a black body using the data provided in the file "*data.txt*". Relating the energy to its wavelength, estimate the corresponding wavelength of the energy. For each row, print out the temperature (T) and the corresponding Energy (E) and Wavelength. Format your output appropriately using the format descriptors.

$$E = \sigma T^4$$
$$E = hc/\lambda ,$$
where λ = waveleght
c = $3 \times 10^8 ms^{-1}$
$\sigma = 5.67 \times 10^{-8}$ and h = plancks constant = $6.626 \times 10^{-34} Js^{-1}$.

Note: Temperature T is in Kelvin

Data in file “data.txt”:

Temperature (degree celcius)	Pressure (hpa)
40	975
38	950
36	925
34	900
32	875
30	850
28	825
26	800
24	700
22	600