# Written Homework – Module 5 Name:

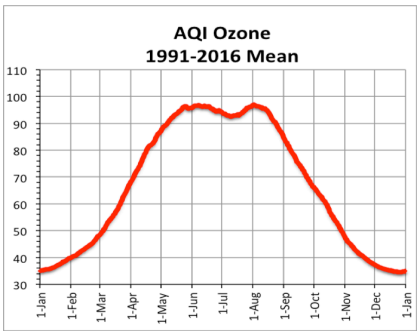
1) Give two reasons why periods of glacial advance in the higher latitudes of the Northern Hemisphere tend to occur with colder summers, but not necessarily with colder winters? (Hint: consider the impact of temperature on glacial melt during the summer and on saturation vapor pressure during the winter.) There is a 600 character limit to all questions.

2) Paleoclimate data show that recent ice ages in the Northern Hemisphere tend to occur with colder summers. Which orbital extremes would be conductive to colder summers. Explain your answers.
   a) When the tilt (obliquity) of the Earth's axis is at a maximum or minimum?
   b) When the sun is closer to or farther from Earth during summer in the Northern Hemisphere?
   c) When the eccentricity of the Earth's orbit is at its least or at its most elliptical phase?

3) Describe four meteorological factors that frequently occur together during the summer and early fall over the Los Angeles Basin that set the stage for a major buildup of photochemical smog, being certain to detail how each factor would contribute to a buildup. You can neglect seasonal differences in the input of primary pollutants that leads to the creation of photochemical smog.

Skyline of downtown Los Angeles, shrouded by smog.
Photo: Robert S. Donovan

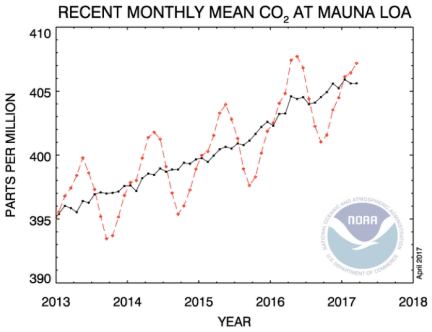
4) The graph to the right shows the daily average value of the AQI (Air Quality Index) in Phoenix, Arizona for ozone, which is the primary irritant of photochemical smog. Describe the two primary meteorological reasons why the values for ozone are higher during the four warmest calendar months (May-June-July-August) than during the four coolest months (Nov-Dec-Jan-Feb), being certain to explain how each factor contributes to the buildup. You can neglect seasonal differences in the input of primary pollutants that leads to the creation of ozone.




AQI for ozone at Phoenix Arizona.
Data source: https://www.epa.gov/

5) The figure shows monthly mean CO2 levels (ppm) at the NOAA Mauna Loa laboratory for the period Jan 2013 to Mar 2017. The red line gives monthly values that include seasonal variations; the black line gives the long-term trend with the seasonal cycle removed. Dots are the mean for the middle of the month. (First dot is Jan 2013; last dot is Mar 2017.) Use the graph to answer the following questions.

a) What is the average annual rate of increase of CO2 in ppm per year for the period Jan 2013 to Jan 2017?
b) In which month is the average CO2 concentration the lowest? In which month is it the highest?
c) How large are seasonal increases in CO2 concentrations from their lowest to highest value?
d) What is the primary cause for the seasonal cycle of CO2? Explain. (Hint: Review Fig. 1.4 of Ahrens.)




CO2 levels at Mauna Loa, Hawaii.
Units: parts per million (ppm).
Data Source: https://www.esrl.noaa.gov/