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Date: Thursday, July 13th, 2006

Time: 3 – 5 pm (Maximum time allotted – 1 hour, 50 minutes)

Preamble: The exam consists of 6 parts.

- The first section, ‘who’s who’ is worth 5 marks.
- The second section, acronyms, is worth 5 marks.
- The third section, true or false, is worth 5 marks.
- The fourth section consists of five definitions for a total of 10 marks.
- The fifth section consists of four short answer questions worth five marks each for 20 marks.
- In final section there is one concept map worth 5 marks.

There are a total of 50 marks. Gauge your time accordingly.
Part 1. “Who’s Who”. Join the names on the left with associated concepts on the right. 1 mark each.

Fujita       Tornadoes       Mt. Vesuvius
W. Gray      Hurricanes      Stratospheric ozone
R. Hosseinián Stratospheric ozone Smog
Edward I     Smog           Tornadoes
Pliny        Mt. Vesuvius    Hurricanes

Part 2. Acronyms. Write out the full meaning of the following five acronyms. 1 mark each.

1. CFC    Chlorofluorocarbons
2. VOC    Volatile Organic Compounds
3. IPCC   Intergovernmental Panel on Climate Change (Lecture 8)
4. ppb    parts per billion
5. UV     ultraviolet
Part 3. True or False. Indicate ‘T’ or ‘F’ in the spaces provided. 1 mark each.

1. The urban heat island is partly due to air conditioners.  ___ T _____

2. Low pH values imply a higher level of acidity.  ___ T _____

3. Urban ozone levels are often lowest on the weekend.  ___ F _____

4. Cirrocumulus is a high-level tropospheric cloud.  ___ T _____

5. A land breeze blows out to sea.  ___ T _____

Part 4. Definitions. 2 marks each. Total of ten marks.

1. Polar cell

A circulation involving sinking air at the poles and rising air at around 60° N/S

2. Nimbostratus

Layered clouds that produce rain

3. Monsoon

A seasonal shift (1 mark) in wind direction and precipitation (1 mark)
4. Latent heat

Heat that is absorbed or released when a substance changes phase

5. Critical load analysis

A method to target emission reductions to areas that are most sensitive

Part 5. Short Answers. Answer the following four questions. Each is worth five marks for a total of 20 marks. Point form responses are acceptable, but make sure that your answer is clear.

1. What is the main difference between the ‘plume’ and ‘pool’ models for acid deposition? Why would a location that behaved like a ‘plume’ look more like a ‘pool’ during a year of anomalously high rainfall?

Plume (2 marks): Acid is replenished as fast as precipitation washes it out; increased precipitation means increased deposition, while concentration remains constant.

Pool (2 marks): Acid is not replenished as fast as precipitation washes it out; increased precipitation means reduced concentration, while deposition increases only a little.

High rainfall (1 mark): The depletion rate becomes faster than the rate of replenishment.
2. The diurnal temperature range (the difference between $T_{max}$ and $T_{min}$) has decreased in Toronto by around 1.2°C over the past 160 years. Give two possible explanations for this phenomenon. According to Gough and Rozanov (2004), how much is each factor expected to have contributed to the total.

I accepted a number of answers for the possible explanations, but Gough and Rozanov (2004) broke it down only as follows:

Urban heat island (1 mark): most effective at night, so $T_{min}$ increases more than $T_{max}$ (1 mark)

Atmospheric aerosol pollution (1 mark): cooling effect during daylight hours, reducing $T_{max}$ but not $T_{min}$ (1 mark)

G & R estimated that each had contributed 0.6°C to the total (1 mark).

3. Describe three components of atmospheric dynamics that affect ozone distribution through the stratosphere. What geographical feature contributes to there being a ‘hole’ over the Antarctic but not (yet) the Arctic?

Note that “dynamics” refers to movement; in this case, the movement of the atmosphere.

The Dobson-Brewer circulation carries ozone from the tropics to the poles in the stratosphere (1 mark).

The El Niño / Southern Oscillation amplifies DB during the El Niño phase (1 mark).

The Quasi-Biennial Oscillation amplifies DB during its westerly phase (1 mark).

The circumpolar winds in the stratosphere are more regular (circular) in the Antarctic than in the Arctic due to the continentality (alternating lands and ocean) of the Arctic region (1 mark). This zonal (east-west) wind presents a barrier to the meridional transport of ozone by DB (1 mark), so the concentration of ozone is lower in the South Pole than the North.
4. Where do tropical cyclones form? What is the threshold temperature for their formation? Describe three factors that affect the length and strength of tropical cyclones?

Tropical cyclones form between 5° and 20° N/S (not at the equator) (1 mark).

The threshold temperature for their formation is 26.5°C (1 mark).

Sea Surface Temperature: warmer temperatures mean longer, more powerful tropical cyclones (1 mark).

Landfall: this cuts off the hurricane from its energy supply, causing it to weaken and dissipate (1 mark). Greater friction also slows down the surface winds.

Upper level winds: strong winds aloft can disrupt the convective cells of a hurricane and shorten their lifespan (1 mark). Their effects on upper level winds are the mechanisms through which ENSO and QBO affect hurricanes.
Part 6. One concept map, worth a total of five marks. Choose one of the following papers, covered in class, and create a concept map in the space below that describes the study. Circle the study you have chosen.


There is no single right answer for a concept map; however, there are several possible answers that are not worth full marks. This is the general approach that I took to marking these:

3 marks for the main thrust of the research. This includes one mark for identifying the researchers and their research question, one mark for describing the data they used, when and where they got it, and how they analyzed it, and one mark for their conclusions.

1 mark for noting background topics at various stages of the research. These should not be very long, but also more than a one-word generality. For a full mark I expected more than one ‘bubble’.

1 mark for noting the relevance of the research. This means including 1-3 ‘bubbles’ after the conclusions, indicating issues that are affected by the conclusions or where future work could be done on this issue.

Finally, I took off up to one mark for the appearance of the concept map. I want each ‘bubble’ or ‘box’ to be clearly defined and separate, with neither too many nor too few words in each, and an easy-to-follow flow. Few people lost marks here.