

Key for Midterm II

I Multiple choice (Choose the most correct answer; only one) (1 point each)

1. C
2. A
3. E
4. B
5. C
6. B
7. C
8. D
9. B
10. C
11. A
12. C
13. E
14. E
15. B & F
16. B (DELETED)
17. E
18. D
19. C
20. C
21. E
22. C
23. C

II Fill in the blanks Choose the correct answer (circle one when appropriate or fill in the blanks) (0.5 point each)

24. Polarity; surface tension; capillarity
25. Gravity or air pressure; density; temperature; compression; expansion; gravitational; buoyancy.
26. Decrease; warm; decrease; increase.

III True or False Circle one (1 point each)

27. False
28. False
29. Increase & True or Decrease & False
30. True
31. True

- 32. True
- 33. False
- 34. False

IV **(Super) Short-answers** (8 points each)

35.

- a. Convective (0.5 point); e.g. mountain storms, heat island effect, etc.(0.5 point)
- b. Convergence (0.5 point): e.g. ITZC (0.5 point).
- c. Orographic (0.5 point); e.g. lifting due to mountains as barriers (0.5 point).
- d. Frontal (0.5 point); e.g. cold and warm fronts (0.5 point).

36.

Location of the cities: Buffalo is located on the leeward side (east-side) of lake Erie, and Toronto is located on the windward side (west side) of lake Ontario. (1 point)

The predominant winds are the *westerlies*, which blow from west to east. (1 point)

The cold and dry wind that comes from the west absorbs the moisture and heat from the evaporated water of the lake, so that the air mass becomes warmer and wetter than it was before it reaches the lake. (3 point)

Once the air mass reaches the end of the lake and blows over Buffalo, it confronts a much colder air (the land is colder than the water during winter), resulting in that the air mass reaches dew point easily, it condenses, and even freezes, so that high amount of snow falls over the city. (3 point)

V **Short Essays** Choose only one (10 points)

37.

- a. **Explain** the Köppen Climate classification. **Focus** on 1) the criterion and 2) hierarchy of the classification, its 3) benefits and 4) drawbacks, 5) its main climate exceptions (if any), and 6) its most recent limitation.
- Criteria & hierarchy (3 points)
 - Average monthly temperatures

- Average monthly precipitation
 - Total annual precipitation
- Benefits **(2 points)**
 - It correlates reasonably with actual world
 - Standard worldwide and readily available data
- Drawbacks **(2 points)**
 - Winds, temps extremes, precipitation intensity, amount of sunshine, cloud cover, or net radiation
 - The causes of precipitation or temperatures patterns are not included.
- Exceptions **(2 points)**
 - Dry Arid and Semiarid Climates (B) [primarily based on moisture]
- Most recent limitation **(1 point)**
 - Current climatic changes are challenging the validity of the traditional climate classification.

b. Describe the formation of precipitation that occurs in a rising parcel of dry air **(3 points for describing the process)**. In your answer, please define and address each of the following keywords: dry adiabatic rate, condensation, dewpoint, moist adiabatic rate, clouds **(0.5 pts. for defining and another 0.5 for addressing each concept)**. Remember to draw and label a diagram to illustrate your answer **(1 point)**.

- A parcel of dry air is being warmed → lower density than its surroundings → warm air rises
- As air rises vertically, it reaches areas of lower pressure (pressure decreases with altitude) → expansion → cooling at **DAR (dry adiabatic rate)** – (6 deg. C/ 1000 m), the rate by which unsaturated air cools/warms by expansion/contraction.
- Further cooling → air reaches its **dewpoint** - temperature at which a parcel of air becomes saturated (holds the maximum amount of water vapor it can hold, RH = 100%)—cooling at **MAR (moist adiabatic lapse rate)**— 6 deg C/1000m, the rate at which saturated air cools/warms by expansion/contraction.
- When the air parcel reaches its dewpoint, **condensation** occurs (change of phase from water vapor to liquid water with release of latent heat) → **cloud** formation (masses of moisture droplets)→ condensation around cloud-condensation nuclei → release of water in liquid form as rain (or solid as hail, ice, snow).
- Finally, when condensation takes place, **latent heat** from evaporation (i.e. when energy was used to evaporate liquid water and, therefore, stored in the water vapor molecules) is released. Thus, the temperature from latent heat increases the temperature of the air parcel, explaining the slower cooling rate of the MAR as the air parcel expands.