

Key for Midterm I

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

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

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

24. Open & Closed
25. Surplus, high, higher, & lower.
26. Solar noon, June, late afternoon, August, & Lag.
27. PGF
28. Three, & composition, function, & temperature.

III True or False Circle one (1 point each)

29. False
30. True
31. False
32. False

- 33. False
- 34. False
- 35. False
- 36. False

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

37.

- a. 1-Nitrogen (N)
- b. 2-Oxygen (O₂)
- c. 3-Argon (Ar)
- a. 4-Carbon dioxide (CO₂)

38.

- a. **Latitude-** This variable determines the amount of *Insolation*—which is the single most important influence on temperature variations. Latitude determines that the places closest to the equator receive more *Insolation* than those closest to the poles—due to the changes of both the angle of the sun and daylength.
- b. **Altitude-** Within the troposphere, temperatures decrease with increasing altitude above Earth's surface (5.5 F/1000 ft). Thus, at high elevations, average air temperatures are lower, nighttime cooling is greater, and temperature range between night and day, and summer and winter, is greater than at lower elevations.
- c. **Cloud cover-** In general, clouds moderate temperatures (lower daily and raise nighttime temperatures). Specifically, and depending on the type of cloud, altitude, and density, clouds control the temperatures on earth in two ways. A) High-altitude, ice-crystal clouds reflects less the insolation (albedo= ~50%) than thicker, low-altitude clouds (albedo= ~90%), and b) High-altitude clouds trap more the longwave radiation that comes from the earth than low-altitude clouds, which promote the warming due to the greenhouse forcing effect.
- d. **Land-Water heating differences (or Continentality)-** Each surface (land & water), absorbs and stores energy differently; given that water cools and warms slower than the surface of the earth, water moderates the temperatures and extreme temperatures occurs on land. There are five controlling factors for these land-water differences (evaporation, transparency, specific heat, movement and ocean currents, and sea-surface temperatures).

V Short Essays Choose only one (16 points)

39.

a. Explain continentality (6 pts)

Continental effect refers to areas less affected by the sea and therefore having a greater range between maximum and minimum temperatures, daily and yearly. Continents and oceans absorb and store energy differently; therefore, both contribute to the global pattern of temperature differently. Moderate temperature patterns are associated with water bodies. Following five phenomena control land-water heating differences.

- i. **Evaporation** (2 pts)- When water evaporates and thus changes to water vapor, heat energy is absorbed in the process and is stored in the water vapor as latent heat (higher latent heat), resulting in a lowering of temperatures. Temperature over land, with far less water, are not as moderated by evaporative cooling as are marine locations.
- ii. **Transparency** (2 pts)- Solid ground is opaque, and water is transparent. This characteristic of water results in the distribution of available heat energy over a much greater depth and volume, forming a larger energy reservoir than of the surface layers of the land.
- iii. **Specific heat** (2 pts)- Water can hold more heat than can soil or rock, and therefore water is said to have a higher specific heat. So, water warms and cools slowly. For this reason, day-to-day temperatures near a substantial body of water tend to be moderated.
- iv. **Mixing of currents** (2 pts)- Differing temperatures and currents result in a mixing of cooler and warmer waters, and that mixing spreads the available energy over an even greater volume than if the water were still. Surface water and deeper waters mix, redistributing energy.
- v. **Sea Surface Temperature** (2 pts)- Surface winds above ocean waters allow for further heat dissipation of latent heat. In addition, ocean temperature might result in a negative feedback. Higher ocean temperature -> higher evaporation rates -> water vapor content increase -> the overlying air mass becomes warmer (greenhouse effect) -> cloud formation (low clouds) -> lower temperature -> reduce evaporation rates

- b. Answers should address and explain the listed keywords (as well as give an example when appropriate).

When energy enters the earth's system, it can experience the following pathways and conversions: transmission, scattering, refraction, reflection, and absorption (1 pt).

- i. **Absorption** (3 pts) – energy is assimilated by molecules and converted to other types of energy. This can produce an increase in temperature as energy goes into heating the surface. (Example: absorption of energy by ground).
- ii. **Reflection** (3 pts)– energy is emitted back by the surface. This depends on **albedo** (the reflectivity or emissivity of the surface). Albedo depends on surface characteristics (color and roughness). (Example: snow and ice surfaces reflect most incoming radiation, i.e. we get sunburned when skiing because energy is reflected from the snow to our skin).
- iii. **Diffusion** (scattering) (3 pts)– energy is redirected by dust particles, pollutants, ice, water vapor etc. The light direction is changed, without altering the wavelength. Smaller molecules (eg. dust) in the air reflect shorter wavelengths (violet, blue); therefore, the blue color of sky; larger molecules (pollutants) reflect longer wavelengths (red) therefore the color of sunsets etc.
- iv. **Refraction** (3 pts)– change in the direction of energy (bending) as it passes from a medium to another due to a change in density, and therefore a change in speed. The result is that a beam of light is separated into its components (e.g. a rainbow).
- v. **Transmission** (3 pts)– passage of shortwave or long wave radiation through different mediums. Energy is transferred from molecule to molecule