**Introduction to Meteorology**

**Homework #1**

**Answers**

**1. What is meteorology?**

The study of the atmosphere and its phenomena.

**2. What is a meteorologist?**

A scientist that uses scientific principles to explain or forecast

atmospheric phenomena

**3. What percentage of meteorologists do forecasts for radio and television**

**stations (broadcast meteorologists)?**

About 5%

**4. Earth’s atmosphere is**  a life providing thin gaseous envelope .

**5. a) 99% of dry air is composed of what two gases? b) Are these gases active**

**ingredients for weather and climate?**

a) Oxygen and nitrogen; b) No

**6. What are three reasons that water vapor is such a critical component of the**

**atmosphere in regard to weather and climate?**

1) Source of precipitation

2) Can exist in all three phases (solid, liquid and gas) at temperatures found

on earth; releases latent heat during condensation (gas to liquid), an important source of energy that powers storms

3) Important “greenhouse gas”

**7. How have humans upset the balance in the atmosphere created by the**

**carbon dioxide cycle?**

By putting carbon dioxide into the air in minutes, through burning of fossil fuels, what took millions of years to create (fossil fuels form over millions of years by pressure of overlying earth on buried decaying plant matter).

**8. a) Where is most of the ozone in our atmosphere located?**

**b) Why is it critical to maintaining life on earth?**

a) The stratosphere

b) Absorbs harmful, high-energy ultraviolet raysfrom the sun so that they do

not reach earth’s surface

**9. a) What atmospheric gas is responsible for the “ozone hole”?**

**b) Where did this gas come from?**

**c) Did this gas really create a “hole” in the ozone layer”?**

a) Chlorofluorocarbons (CFCs)

b) Manmade chemical in propellants, refrigerants and solvents

c) No; reduction of ozone (NOT absence) in polar regions

**10. What is the definition of atmospheric (air) pressure?**

The amount of force exerted by the air molecules on earth’s surface due to gravity **or** ***the weight******of a column of air above any given point***

**11. Air density and pressure *always***  decrease with height above earth’s surface .

**12. The atmosphere is divided into different “layers” based upon**  changing

vertical temperature profiles .

**13. a) What is the lowest layer of the atmosphere, where all weather occurs?**

**b) What is the vertical temperature profile of this layer?**

a) Thetroposphere

b) Temperature ***decreases*** with height

**14. a) What is the layer above the “weather” layer?**

**b) What is its temperature profile?**

**c) Why does it have this temperature profile?**

a) The stratosphere

b) Temperature ***increases*** with height

c)Ozone absorbs UV light from the sun and heats the surrounding air

**15. What is the transition zone between these two layers called?**

The tropopause

**16. a) What is the definition of weather?**

**b) What is the definition of climate?**

a) The state of the atmosphere at any given time and place

b) Weather “averaged” over a long period of time ***or*** the weather that is

typicalof a particular region

**17. What is the definition of temperature?**

A measure of the average speed (kinetic energy) of the molecules of a substance

**18. Which is heavier (more dense) warm air or cold air?**

Cold air

**19. Energy from the sun is utilized to evaporate water from earth’s surface.**

**This solar energy is then transferred to the atmosphere when this water vapor condenses to form clouds as**  latent heat  **a form of energy which is responsible for generating thunderstorms and hurricanes.**

**20. a) What are the other three methods of heat transfer in the atmosphere**

**and what is their definition?**

**b) Which method is utilized to transfer heat from the sun to the earth?**

a) 1. ***Conduction*** is the direct transfer of heat between adjacent molecules

2. ***Convection*** is the transfer of heat by the mass movement of air

3. ***Radiation*** is energy traveling through space in the form of waves

b) Radiation

**21. In regard to the temperature of vertically moving air parcels (convection),**

**rising air**  cools  **and sinking air**  warms **.**

**22. What are the three important rules regarding radiation?**

1) All objects emit radiation

2) The higher an object’s temperature, the shorter are the wavelengths of

emitted radiation

3) The greater the temperature of an object, the greater amount (intensity) of

radiation it emits

**23. The sun emits a maximum of radiation as**  visible light  **and the**

**earth, which is much cooler, emits almost all of its radiation as**  infrared

radiation .

**24. The temperature of a substance**  increases **when it absorbs radiation?**

**25. The “greenhouse effect” occurs because certain gases in the atmosphere**

**are**  selective absorbers **, transmitting**  visible light from the sun **so**

**that it can heat the earth but then absorbing**  infrared radiation **,**

**emitted by the earth, as it tries to escape into outer space.**

**26. The “greenhouse effect” is a**  good  **thing because, without it, the**

**temperature of earth’s surface would average**  0°F **instead of 59°F.**

**27. What are the two most important greenhouse gases (strongest selective**

**absorbers) in the atmosphere?**

Water vapor ***and*** Carbon dioxide

**28. The troposphere is heated**  indirectly  **by the sun as it is**  warmed from

below by earth’s surface **(which was directly heated by the sun), by the mechanisms of heat transfer previously discussed.**

**29. What is scattering?**

When visible light is deflected by air molecules in all directions.

**30. a) What is albedo?**

**b) What type of earth surface has the highest albedo?**

a) A measure of the percent of radiation which is reflected by a given surface

b) Snow

**31. Low latitudes (tropics) tend to gain more energy than they lose (heat**

**surplus) since they receive more direct sunlight and high latitudes lose more energy to space than they gain (deficit). So that the temperature imbalance does not become extreme (unstable),**  atmospheric **and**

oceanic **circulations and**  storms **redistribute heat by moving warm air and water**  poleward  **and cold air and water**  equatorward**.**

**32. Why do we have seasons?**

Because the earth is not oriented straight up and down but is tilted on its axis 23½°

**33. Our seasons are regulated by how much solar energy is received at earth’s**

**surface. This is determined by what two things?**

1) The angle at which sunlight strikes the surface

2) How long the sun shines (daylight hours)

**34. Why is direct sunlight (sun directly overhead) more intense than sunlight**

**striking the surface at an angle (sun lower, toward the horizon)?**

1) The amount of heat energy provided has to be spread over a much larger

area when striking at an angle and therefore any given point will receive less heat

2) The lower the angle of the sun, the more atmosphere it must pass

through providing more opportunity for scattering and absorption so less solar radiation reaches the surface and is available to be absorbed

**35. The Summer Solstice in the Northern Hemisphere (June 21) is the**

**“astronomical”**  first day of summer **. On this day, the northern half of**

**earth is tilted directly**  toward  **the sun so that places in the Northern**

**Hemisphere receive more**  solar energy **than any other time of the year**

**(sun most directly overhead, longest day of the year).**

**36. If the last question is correct why does it tend to be warmer in July and**

**August than on June 21?**

Although solar radiation is greatest in June, incoming energy continues to exceed outgoing energy for several weeks after the solstices

**37. Why is the Arctic (above 66½°N) called the “land of the midnight sun”?**

During summer, the sun is above the horizon for most of the night.

**38. On the Autumnal (Fall) and Vernal (Spring) Equinoxes the sun is directly**

**above**  the equator  **and**  day and night  **are of equal length everywhere in the world.**

**39. The “meteorological” summer season is defined as the three months with**

the warmest temperatures **;**  June **,**  July  **and**  August **.**

**40. Seasons in the Southern Hemisphere are**  exactly opposite **to those in**

**the Northern Hemisphere.**