METEOROLOGY 110 01 Fall, 2014

Exam #1 Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This exam consists of 42 multiple choice questions worth 2% each and extended questions worth a total of 16%. Answer all questions on the answer sheet by blackening in the correct space. Choose the one BEST answer to each question. READ EACH QUESTION CAREFULLY AND COMPLETELY! Answer the extended questions at the end in the blank space provided. You have 50 minutes. Check your answers

1. What is an air parcel?

a) a package delivered by Federal Express

b) the air which descends the mountain in a Chinook

c) only air in which condensation is taking place

d) a small representative sample of air about 1 cubic meter in volume.

e) a device to record temperature and pressure above the ground.

2. Mean sea level pressure is approximately

a) 1000 mb b) 1000 inches of Mercury c) 100 mb d) 29.96 mb e) 1000 pounds per square inch

3. Insolation is a combination word that means

a) The stuff you put in the attic to keep the heat in.

b) Interior solutions at ionization

c) Incoming solar radiation

d) the opposite of outsolation

e) Intense snowfall oscillation

4. The atmosphere is more than ¾ Nitrogen. How did that come about?

a) All the Nitrogen in the atmosphere was created when the Earth formed.

b) Nitrogen has been emitted by bacteria for the last 2 billion years.

c) Gases such as carbon dioxide and water vapor didn’t stay in the atmosphere, leaving Nitrogen.

d) Nitrogen is formed by Solar Radiation (Insolation) and we have a lot of that.

e) There is a chemical reaction between water and oxygen that produces Nitrogen

5. Oxygen didn’t exist in the Earth’s first atmosphere. How did our atmosphere first acquire it?

a) 200 million years ago the trees began emitting oxygen.

b) Cyano bacteria began emitting oxygen about 2 billion years ago.

c) Primordial dinosaurs breathed in carbon dioxide and breathed out oxygen.

d) Pure oxygen comes from outgassing, starting 4.5 billion years ago.

e) When the moon collided with Earth, oxygen was created in the explosion.

6. Outgassing happens on Earth from which geological formations?

a) Volcanoes, geysers, and fumaroles

b) helium deposits

c) Big mountain chains like the Rockies and the Himalayas.

d) deep ocean trenches and caves

e) lightning, clouds, and fog

7. When air temperature increases with height in the troposphere, it is called

a) a maximal b) an incremental c) an inversion d) normal e) unstable

8. When you read a thermometer, the number you are reading is

a) the temperature of the air

b) the humidity of the air

c) the pressure of the air

d) the temperature of the liquid in the bulb.

e) the temperature of your hand.

9. As you go up in the troposphere and stratosphere, what happens to the density of air?

a) It increases with height

b) It decreases with height

c) It stays the same

d) Air density varies randomly as you go up

e) Air density is constant until the tropopause, but increases above that

10. As you go up in the troposphere and stratosphere, what happens to the air pressure?

a) It increases with height b) It decreases with height c) It stays the same

11. The boundary between the troposphere and the stratosphere is called

a) the lapse level b) the cloud base c) the tropopause d) the heating level e) the storm level

12. A thermometer has a large lag coefficient. That means

a) it will be inaccurate

b) the thermometer will respond to large temperature changes.

c) the thermometer will respond to small temperature changes.

d) it will respond slowly but it could be very accurate

e) it will be much more accurate than a small lag thermometer

13. The basic cause for seasons for the Northern Hemisphere on Earth in its current orbit and axis tilt is

a) being close to the sun in July and far from the sun in January

b) the angle of insolation is more direct in July and less direct in January.

c) Insolation is zero in January everywhere in the Northern Hemisphere

d) Earth’s axis tilt changes from month to month. In summer we tilt away from the North Star.

e) The atmosphere filters out all sunlight, starting on September 21, lasting until March 21.

14. What was wrong with Galileo’s thermometer?

a) it had no temperature marks.

b) it was very inaccurate since he built it himself.

c) he had to turn it upside-down to get it to work.

d) it was 30 feet high and couldn’t fit in a normal room.

e) nothing was wrong and we still use thermometers exactly like Galileo built.

15. With a wind from the east, temperatures in southern California can reach into the upper 90’s. That situation is called

a) a heat wave b) California chinchilla c) the desert fox d) being ankle-deep e) a Santa Ana

16. A lapse rate is

a) a change of pressure over a period of time.

b) a change of dew point with time.

c) a change of temperature with height.

d) a change in carbon dioxide concentration.

17. Why do meteorologists use the Celsius temperature scale instead of the Fahrenheit scale?

a) Celsius invented his scale first.

b) The Fahrenheit scale is inaccurate.

c) Celsius used more natural events to define 0ºC and 100ºC.

d) Water boils at 0ºC.

e) Air can be at 0°F or 0°C and you can't divide by 0.

18. If the surface temperature is 50°F and the temperature at 6000 feet elevation is -10°F, what is the average lapse rate from the surface to 6000 feet in the proper units? Remember Lapse rate = -(T2 – T1)/(Alt2 – Alt1)

a) -60°F/6000 feet b) -0.01°F/foot c) 40°F/6000 feet d) 10°F/foot e) 10°F/1000 feet

19. In question 18, the lapse rate you found is called

a) normal b) inversion c) steady d) perverse e) stratospheric

20. Suppose the lapse rate from the surface (0 km) to 1 km is 5°C/km but the lapse rate from 1 km to 2 km is

-5°C/km. If a parcel starts from the surface what will happen? Note: km = kilometer, about 5/8 of a mile.

a) The parcel is unstable and will rise from 0 to 2 km.

b) The parcel is unstable and will rise from 0 to 1 km but stable above 1 km so it stops rising.

c) The parcel is stable and will not rise from the surface to 1 km.

d) The parcel is stable and rises well beyond 2 km.

e) The behavior of the parcel is entirely unpredictable.

21. I take a barometer in a hot air balloon. As the balloon rises, what happens to the air temperature?

a) it increases b) it decreases c) it stays the same d) it fluctuates randomly

22. On that same hot air balloon ride when my barometer reads 600 mb I pass out. Why?

a) I am only getting 60% of the oxygen I get at sea level

b) I am totally overwhelmed by my view of cirrus clouds from above them.

c) The pressure is so low that my ears explode.

d) The visibility is so great at 600 mb that I can see Poughkeepsie.

e) Gravity is less that high up so the blood isn’t getting to my brain.

23. 55ºC is equivalent to

a) 131ºF b) 99ºF c) 41.4ºF d) 112.6ºF e) 156.6ºF

24. -4ºF is equivalent to

a) 15.556ºC b) 29.778ºC c) -64.8ºC d) 20ºC e) -20ºC

25. 100ºK is equivalent to

a) 212ºF b) -279.4ºF c) 37.778ºF d) -173ºF e) 0ºF

26. The temperature to which air must be cooled to produce a fog is called

a) the Fog Point b) the Freezing Point c) an Obscuration d) Room Temperature e) The Dew Point

27. Sometimes at night, under clear skies, cold air pools in the Susquehanna River valley. If the air cools enough to produce condensation in the air of the valley what do we see?

a) dew on the grass b) radiation fog c) insolation drops d) Nitrogen particles e) water vapor

28. When water is boiling you see steam coming from the teapot. What are you seeing?

a) water vapor b) ice crystals c) water droplets d) smoke e) raindrops

29. Warm air (80°F) can hold \_\_\_\_\_\_\_\_ water vapor than cool air (30°F).

a) less b) much less c) much more d) a little more e) exactly the same amount of

30. The highest clouds in the troposphere consist entirely of \_\_\_\_\_\_\_\_\_.

a) hail b) ice crystals c) raindrops d) liquid cloud droplets e) smog

31. A example of a man-made cloud is

a) Cirrocumulus

b) Mare’s tails

c) Popcorn cumulus

d) Condensation Trails, also known as contrails

e) fog

32. If the mixing ratio of the air is 5.5 g/kg and the capacity of the air is 10 g/kg, what is the relative humidity?

a) 10% b) 15.5% c) 5.5% d) 55% e) 182% Reminder: RH = (w/ws)x 100%

33. At 15°C, the air has a capacity of holding, at most, 20 grams of water vapor for each kilogram of dry air. If measurements show 8 grams of water vapor to be present, the relative humidity is

a) 80% b) 40% c) 30% d) 12% e) 0%

34. If the saturation mixing ratio is 25 g/kg and the relative humidity is 40%, how much water vapor is actually present in 1 kg of dry air?

a) 10 g b) 62.5 g c) 1000 g d) 0.625 g e) 25 g

35. Suppose the air inside the lab with a RH = 56% has a temperature of 21°C and a dew point of 11°C. If the outside temperature is 15°C, is the air outside saturated? Assume the water vapor content is the same inside as it is outside.

a) yes, the inside air is drier

b) yes, the outside air is evaporating more so it is more humid than inside

c) no, the outside RH would be 11/15 x 100% = 73%

d) no, the dew point outside is also 11°C so it’s not saturated with 15°C temperature

e) it could be but you can’t tell from this information what’s going on outside

36. On a morning satellite image you see no clouds over New York State except for very thin “vein-like” white clouds around Oneonta and Binghamton. What are those?

a) Overnight thunderstorms.

b) Cirrus clouds due to contrails.

c) fog in the river valleys.

d) Stratocumulus clouds

e) Altostratus varicosus clouds.

37. There are four basic types of clouds. What are those four categories?

a) Tall, medium, short, and tiny.

b) Saturated, almost saturated, medium saturation, and too dry for condensation.

c) High, middle, low, and vertically growing.

d) Tropical, subtropical, extra-tropical, and non-tropical.

e) White, green, yellow, and red.

38. Two kinds of pictures which satellites take of clouds are

a) cumulus and nimbus b) orbit-up and orbit-down c) rough and finished

d) invisible and intuitive e) infrared and visible

39. Infrared satellite pictures are useful because they show clouds at night. How do they do that?

a) The night side of the Earth is illuminated by the moon’s reflected light.

b) The satellite senses the heat from the top of the clouds.

c) Cloud motions are sensed by the satellites special filters.

d) The Earth looks lighter below the clouds. A computer reverses the images so the clouds look white.

e) Actually all satellite images are a government hoax. They make it up as they go along.

40. The most unstable lapse rate you can find in a layer of the atmosphere has what kind of temperatures?

a) very warm air at the bottom with very cold air at the top

b) very cold air at the bottom with very warm air at the top

c) steadily increasing temperature from bottom to top

d) negative lapse rates everywhere

e) all temperatures in unstable layers are measured in Kelvin degrees.

41. It’s 5 p.m. and a thundershower has just finished and is still visible to your east but the sun is out behind you to the west. The sunlight is shining through the raindrops and reflecting within some of them twice before coming out. What are you looking at?

a) A very wet meteorology professor who has been standing out in the rain.

b) A double rainbow.

c) Mare’s tails

d) Thunder, so you need to get inside quick!

e) thick grey fog

42. The sky fills with cirrostratus clouds at 5 p.m., about two hours before sunset. Looking west, you see the a large bright halo around the sun. What causes that?

a) Sunlight gets absorbed by the liquid cloud droplets.

b) Radar beams are being scattered by the cloud.

c) This is a mirage caused by water in the atmosphere.

d) In that direction, you are actually looking at the moon.

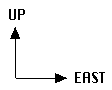
  e) Sunlight is being diffracted through ice crystals.

Extended Questions: Answer on the question page. Your answers must be readable.

This question refers to the cross sectional diagram below. The time of year is July. The cross section is of southern California. It’s the black line on this map:



Here is your cross section. The ocean is on the left and the desert is on the right:



I. ( 5%) If an air parcel travels from point A to point B, then to point C, describe what happens to its temperature during that journey. Don’t worry about why (that’s part II), just describe the temperature changes. Be sure you do say whether the temperature at A is warmer or cooler than at C. Stop at point C.

II. ( 6%) What is happening to the air parcel to cause the temperature change as it moves from Point B to Point C in Los Angeles? Point B is in the San Bernardino mountains which are about 6,000 feet high.

III. (5%) Point D is well out into the Pacific Ocean. If it continues to travel out to point D, the air parcel will be cooler than it is when it’s over Los Angeles. What causes that to happen? (hint: this is NOT adiabatic)