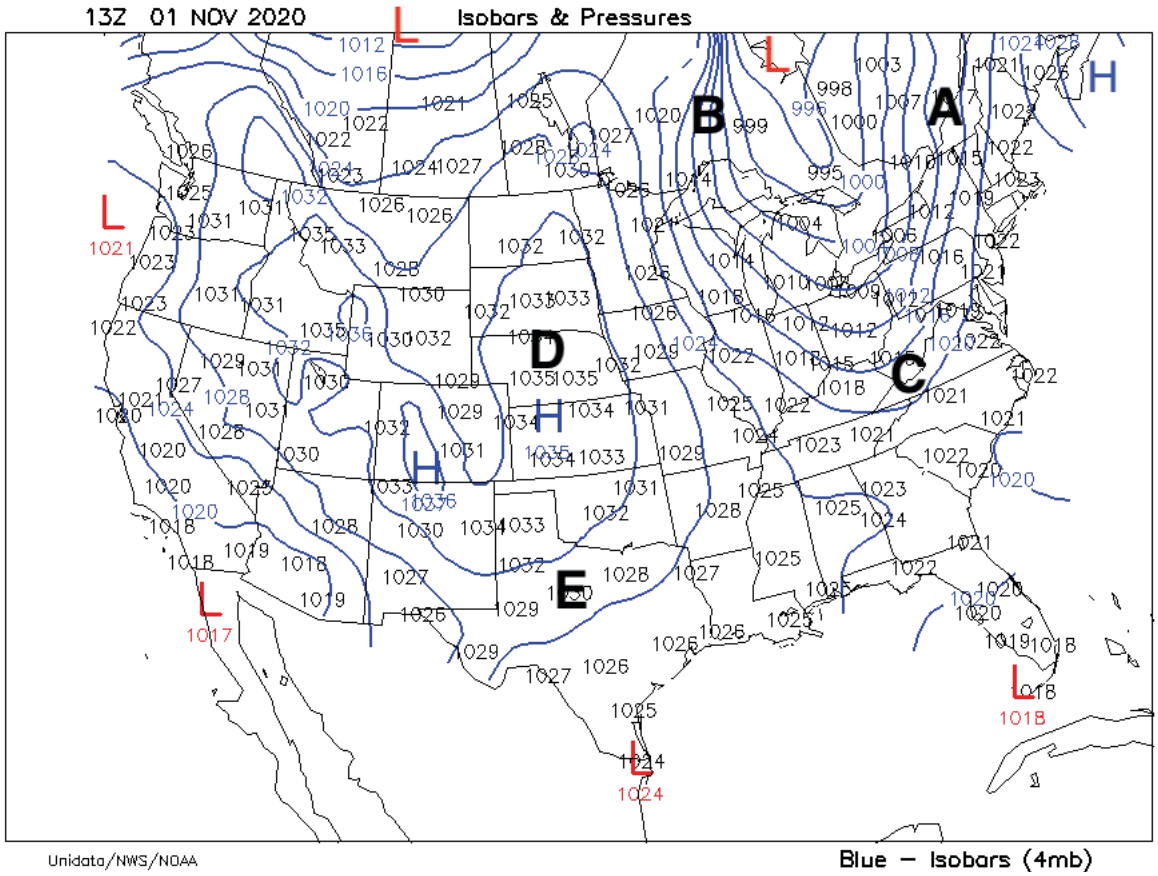
ATSC 201 Fall 2020 | Midterm Exam | a) questions for 2 pm
4 Nov 2020 | (open books, notes) | b) questions for 9 pm

Open books, notes, calculators, laptop. There are 15 questions total. Points are indicated for each question. Total points = 50. Time limit = 50 minutes. Thus, budget your time to spend roughly 1 minute per point, on average. Do NOT communicate with other students about this exam. Good luck.

Note: During COVID, two sections of this course were taught at two different times of day. Thus, I created two separate exams, one for each section. The 2 pm section (ATSC 201.101) saw and answered only questions (a), and the 9 pm section (ATSC 201.M01) saw and answered only questions (b).

1a. (2 points). In the attached surface weather map of sea-level pressure in North America, the strongest surface winds are at: A, B, C, D, E
1b. (2 points). In the attached surface weather map of sea-level pressure in North America, the weakest surface winds are at: A, B, C, D, E

2a. (3 points). In the attached surface weather map of sea-level pressure in North America, southwest surface winds are most likely at: A, B, C, D, E
2b. (3 points). In the attached surface weather map of sea-level pressure in North America, northeast surface winds are most likely at: A, B, C, D, E



=== end of questions that use the weather map ===

3a. (3 points). At latitude 45°N, the magnitude of the Coriolis parameter is approximately_ s^{-1} .
A) 0.515×10^{-4} B) 1.03×10^{-4} C) 1.16×10^{-4} D) 1.30×10^{-4} E) 2.06×10^{-4}
3b. (3 points). At latitude 63°N, the magnitude of the Coriolis parameter is approximately_ s^{-1} .
A) 0.515×10^{-4} B) 1.03×10^{-4} C) 1.16×10^{-4} D) 1.30×10^{-4} E) 2.60×10^{-4}

4a. (5 points). Suppose you are at an altitude where the air density is 1 kg/m^3 and at a location where the Coriolis parameter is 1×10^{-4} s^{-1}. If the horizontal pressure gradient is 0.5 kPa/(100 km), then the magnitude of the geostrophic wind is approximately ____ m/s.
A) 5,000 B) 1,000 C) 500 D) 100 E) 50
4b. (5 points). Suppose you are at an altitude where the air density is 1 kg/m^3 and at a location where the Coriolis parameter is 1×10^{-4} s^{-1}. If the horizontal pressure gradient is 1.0 kPa/(100 km), then the magnitude of the geostrophic wind is approximately ____ m/s.
A) 10,000 B) 1,000 C) 500 D) 100 E) 50

5a. (3 points). Suppose a 10 km thick column of air at 50°N has relative vorticity of 1×10^{-4} s^{-1}. If the column stretches to become 12 km thick, then the potential vorticity will:
A) increase B) stay the same C) decrease but remain positive D) decrease and become negative E) not enough info to answer
5b. (3 points). Suppose a 10 km thick column of air at 50°N has relative vorticity of 1×10^{-4} s^{-1}. If the column stretches to become 12 km thick, then the relative vorticity will:
A) increase B) stay the same C) decrease but remain positive D) decrease but remain negative E) not enough info to answer

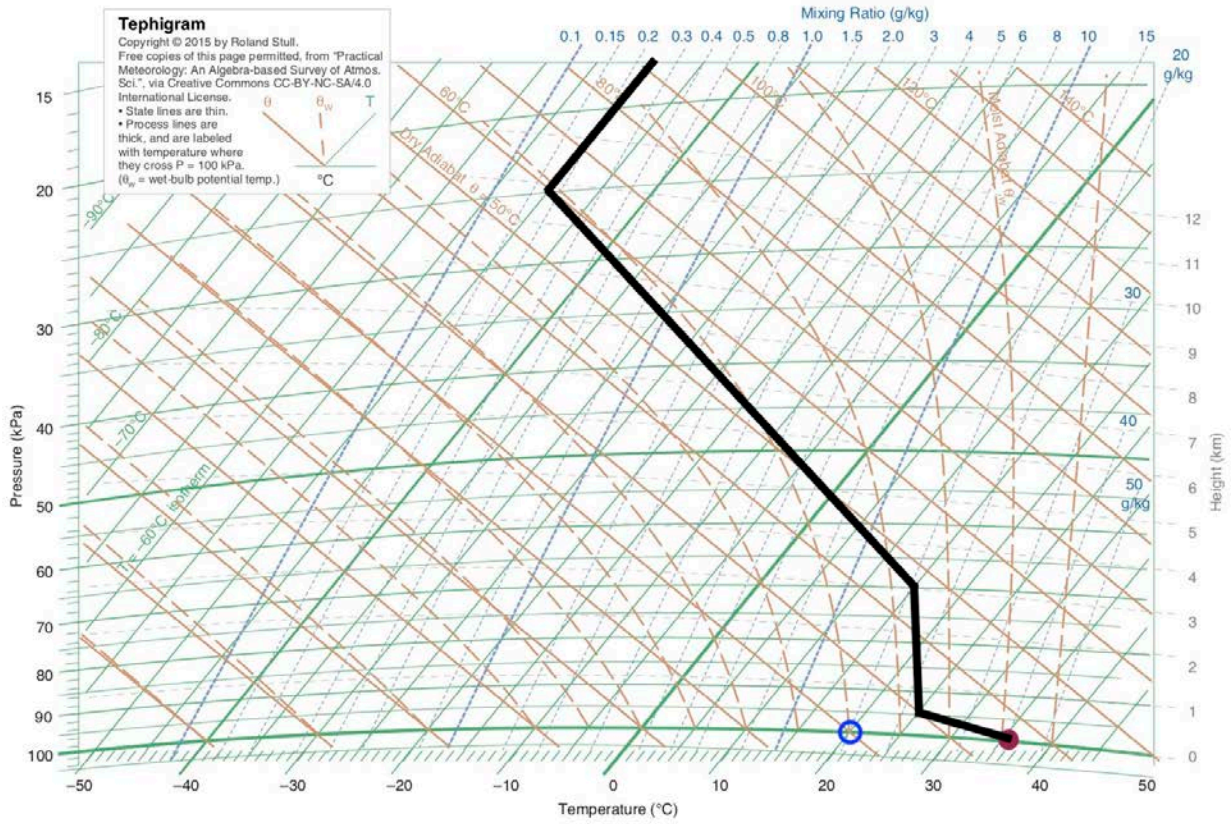
=== start of questions that use the following sounding ===

The following environmental sounding info is already plotted for you on the attached thermo diagram. Use it to answer the following questions. If it is hard to see the details of this thermo diagram, you might want to plot this sounding on your own printed copy of the tephigram from Chapter 5, page 155, of the textbook. For an air parcel that might rise from the surface, assume it has the same initial temperature and dew point as the environment at 100 kPa.

P (kPa)	T (°C)	Td (°C)
100	36	20
95	25	
70	15	
25	–50	
18	–50	

6a. (2 points). The top of the mixed layer, z_i, is at approximately _____ kPa.
A) 95 B) 85 C) 65 D) 45 E) 25
6b. (2 points). The tropopause is at approximately ___ kPa.
A) 95 B) 85 C) 65 D) 45 E) 25

7a. (5 points). For the environmental air at P = 100 kPa, its relative humidity is approximately
A) 15% B) 20% C) 37% D) 53% E) 100%
7b. (5 points). The lifting condensation level (LCL)is at approximately ___ kPa.
A) 95 B) 90 C) 85 D) 80 E) 70



8a. (3 points). The level of free convection (LFC) is at approximately ___ kPa.
A) 21 B) 25 C) 62 D) 80 E) 84
8b. (3 points). The equilibrium level (EL) is at approximately ___ kPa.
A) 21 B) 25 C) 62 D) 80 E) 84

9a. (3 points). The convective inhibition (CIN) region is between what two key altitudes?
A) earth's surface and LCL B) z_i and LFC C) LCL and LFC
D) LCL and EL E) LFC and EL
9b. (3 points). The convective available potential energy (CAPE) region is between what two altitudes?
A) earth's surface and LCL B) z_i and LFC C) LCL and LFC
D) LCL and EL E) LFC and EL

10a. (5 points). The most unstable convective available potential energy (MU_CAPE) for this sounding is approximately 2850 J/kg. The type of thunderstorm expected is:

A) non-supercell B) supercell but no tornado C) supercell with weak tornado
D) supercell with significant tornado E) (thunderstorms are not expected)

10b. (5 points). The most unstable convective available potential energy (MU_CAPE) for this sounding is approximately 2850 J/kg. The max likely updraft speed (m/s) expected is approximately:

A) 26.7 B) 37.8 C) 53.4 D) 75.5 E) 106.8

11a. (3 points). The static stability (parcel method) of the layer of air between 95 and 90 kPa is

A) stable B) neutral C) unstable D) (not enough info to determine)

11b. (3 points). The static stability (parcel method) of the layer of air between 20 and 18 kPa is

A) stable B) neutral C) unstable D) (not enough info to determine)

=== end of questions that use the sounding ===

12a. (4 points). Suppose a column of air between pressure levels 100 kPa and 50 kPa has an average temperature of 10°C, and has initial vertical thickness of that layer of approximately 5.75 km. If that layer warms to 30°C, the final vertical thickness will ___.

A) become negative B) decrease C) not change D) increase
E) (not enough info to answer)

12b. (4 points). Suppose a column of air between pressure levels 100 kPa and 50 kPa has an average temperature of 10°C, and has initial vertical thickness of that layer of approximately 5.75 km. If that layer cools to –10°C, the final vertical thickness will ___.

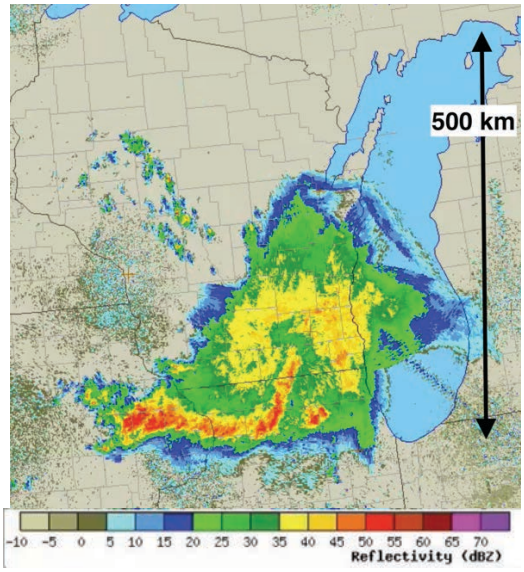
A) become negative B) decrease C) not change D) increase
E) (not enough info to answer)

13a. (3 points). The phenomenon observed in this radar reflectivity image is a/an ____ .

A) typhoon B) supercell thunderstorm C) cold front
D) weakly-forced (airmass) thunderstorm E) mesoscale convective system

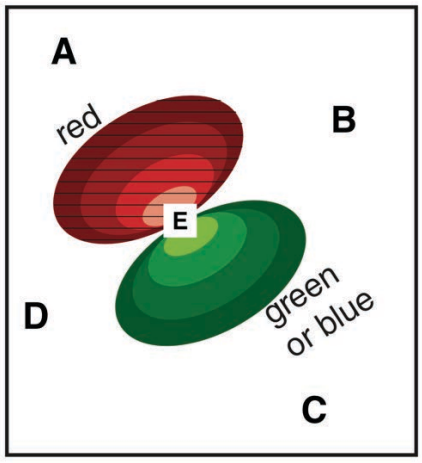
13b. (3 points). The phenomenon observed in this radar reflectivity image is a/an ____ .

A) bow echo B) supercell thunderstorm C) cold front
D) weakly-forced (airmass) thunderstorm E) typhoon



14a. (3 points). Given the Doppler velocity display in the image below. At which location (A, B, C, D, E) would the weather radar be if this display is showing clockwise-rotating tornado at location E?

14b. (3 points). Given the Doppler velocity display in the image below. At which location (A, B, C, D, E) would the weather radar be if this display is showing a convergence zone (such as at a gust front) at location E?



15a. (3 points). Suppose that you had used your hodograph and measured the 0 to 3 km Storm Relative Helicity (SRH) to be 275 $m^2 s^{-2}$. What strength tornado is most likely?

A) no tornado B) EF0 to EF1 C) EF2 to EF3 D) EF4 E) EF5

15b. (3 points). Suppose that you had used your hodograph and measured the 0 to 3 km Storm Relative Helicity (SRH) to be 125 $m^2 s^{-2}$. What strength tornado is most likely?

A) no tornado B) EF0 to EF1 C) EF2 to EF3 D) EF4 E) EF5

== end of exam ==