Name: _____ ATSC 201 Midterm Student Number: _____

Fall 2021

Please use the bubble sheet to indicate your answers. Put your Name & ID on all papers.
Turn in all question sheets, thermo diagrams, hodographs, and bubble sheet.
Roughly 1 point per minute. **Open books, notes, laptop or epad, calculator.**

Q. (points)

1) 2 A tornado at Mytown translates due east toward Yourtown.
But the depth of the rotating mesocyclone doesn't change.
The tornado has a non-zero relative vorticity at Mytown.
When the tornado reaches Yourtown, the relative vorticity
will likely _____ relative to its value at Mytown.

| A | B | C | D | E |
|---|---|---|---|---|
| increase | remain the same | decrease | be zero | change sign |

2) 2 Which type of thunderstorm often produces lots of hail?

| A | B | C | D | E |
|---|---|---|---|---|
| low precipitation supercell | classic supercell | high precipitation supercell | hybrid sypercell | multi-cell |

3) 3 At latitude 55°N, the height gradient (Δz/Δd) of the
40 kPa isobaric surface is 60 m per 100 km.
The speed (m/s) of the geostrophic wind is approximately

| A | B | C | D | E |
|---|---|---|---|---|
| 40 | 50 | 55 | 60 | 65 |

4) 2 Given the Doppler radar display below (Fig 1), if the radar is
located at position E, then the weather at location E is

| A | B | C | D | E |
|---|---|---|---|---|
| gust front convergence zone | divergence zone under a downburst | cyclonically rotating tornado | anti-cyclonic rotating tornado | southeast wind |

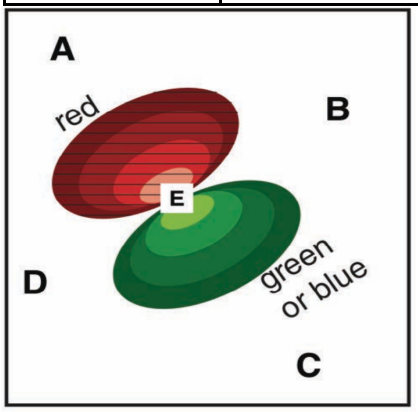


Fig. 1.

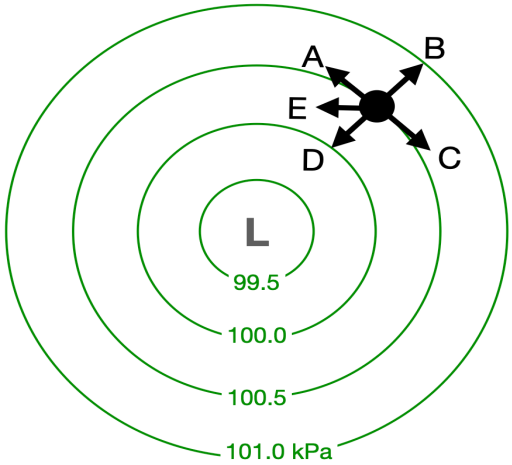


Fig. 2.

5) 2 In the Fig. 2 sketch of a
mid-latitude cyclone in the Northern Hemisphere, which vector represents the
likely boundary layer wind direction for the sketched air parcel (black dot)?

| A | B | C | D | E |
|---|---|---|---|---|

6) 2 For that same cyclone in Fig. 2, which vector represents the likely
direction of pressure-gradient force at the air parcel (black dot)?

| A | B | C | D | E |
|---|---|---|---|---|

7) 3 Given temperature T = 30°C and water vapor mixing ratio r = 20 g/kg.
What is the virtual temperature (°C)?

| A | B | C | D | E |
|---|---|---|---|---|
| 35.6 | 40.6 | 313.6 | 675.5 | 5671.4 |

8) 3 Given a MLCAPE **area** of 75 K·km.
What is the aproximate MLCAPE value (J/kg) ?
Hint, use |g/Te| = (9.8 m/s2) / (253 K) = 0.0387

| A | B | C | D | E |
|---|---|---|---|---|
| 2905 | 2475 | 1460 | 1205 | 950 |

9) 1 What thunderstorm and tornado severity
would you forecast,based on the CAPE from the previous exercise?

| | |
|---|---|
| A | No thunderstorm (CB) |
| B | Ordinary thunderstorm |
| C | Marginal supercell |
| D | Supercell, possibly with EF0 – EF1 tornado |
| E | Supercell, possibly with EF2 – EF5 tornado |

10) 7 Plot the following sounding (T, Td) on the attached Skew-T diagram.
Put your name on it, and turn it in with the rest of your exam.
(You will also use it to help answer the subsequent questions.)

| Approx. Height, z (km) | Pressure, P (kPa) | Temperature, T (°C) | Dew Point, Td (°C) | Wind Direction, α (°) | Wind Speed, M (m/s) |
|---|---|---|---|---|---|
| | 20 | −55 | | | |
| | 25 | −55 | | | |
| 6 | 44 | −25 | | 330 | 40 |
| 5 | 52 | −13 | | 300 | 30 |
| 4 | 60 | −2 | | 270 | 20 |
| 3 | 70 | 9 | | 240 | 15 |
| 2 | 80 | 11 | | 210 | 10 |
| 1 | 90 | 22 | | 180 | 5 |
| 0 | 100 | 33 | 14 | calm | 0 |

11) 3 For air at z = 0 in this sounding, what is the approximate relative humidity(%)?

| A | B | C | D | E |
|---|---|---|---|---|
| 10 | 14 | 25 | 30 | 50 |

12) 3 For air at z = 0 in this sounding, what is the approx. wet-bulb temperature(°C)?

| A | B | C | D | E |
|---|---|---|---|---|
| 33 | 44 | 39 | 25 | 21 |

13) 2 Based on the sounding above, at what pressure (kPa) is the tropopause?

| A | B | C | D | E |
|---|---|---|---|---|
| 20 | 25 | 30 | 35 | 40 |

14) 2 Based on the sounding above, at what pressure (kPa) is
the top of the convective boundary layer?

| A | B | C | D | E |
|---|---|---|---|---|
| 85 | 80 | 75 | 70 | 65 |

For the next several questions, use the sounding above, and consider an air parcel rising from the surface.

15) 1 The lifting condensation level (LCL) is near what pressure (kPa)?

| A | B | C | D | E |
|---|---|---|---|---|
| 85 | 80 | 75 | 70 | 65 |

16) 1 The level of free convection (LFC) is near what pressure (kPa)?

| A | B | C | D | E |
|---|---|---|---|---|
| 74 | 66 | 58 | 50 | 42 |

17) 1 The equilibrium level (EL) is near what pressure (kPa)?

| A | B | C | D | E |
|---|---|---|---|---|
| 52 | 44 | 39 | 25 | 21 |

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18) 7 Plot a hodograph using the winds given in the sounding from question 10.

19) 2 Using your hodograph from question 18,
What is the approximate "normal" storm motion direction and speed?

| A | B | C | D | E |
|---|---|---|---|---|
| 204° at 11 m/s | 215° at 15 m/s | 240° at 14 m/s | 290° at 13 m/s | 110° at 12 m/s |

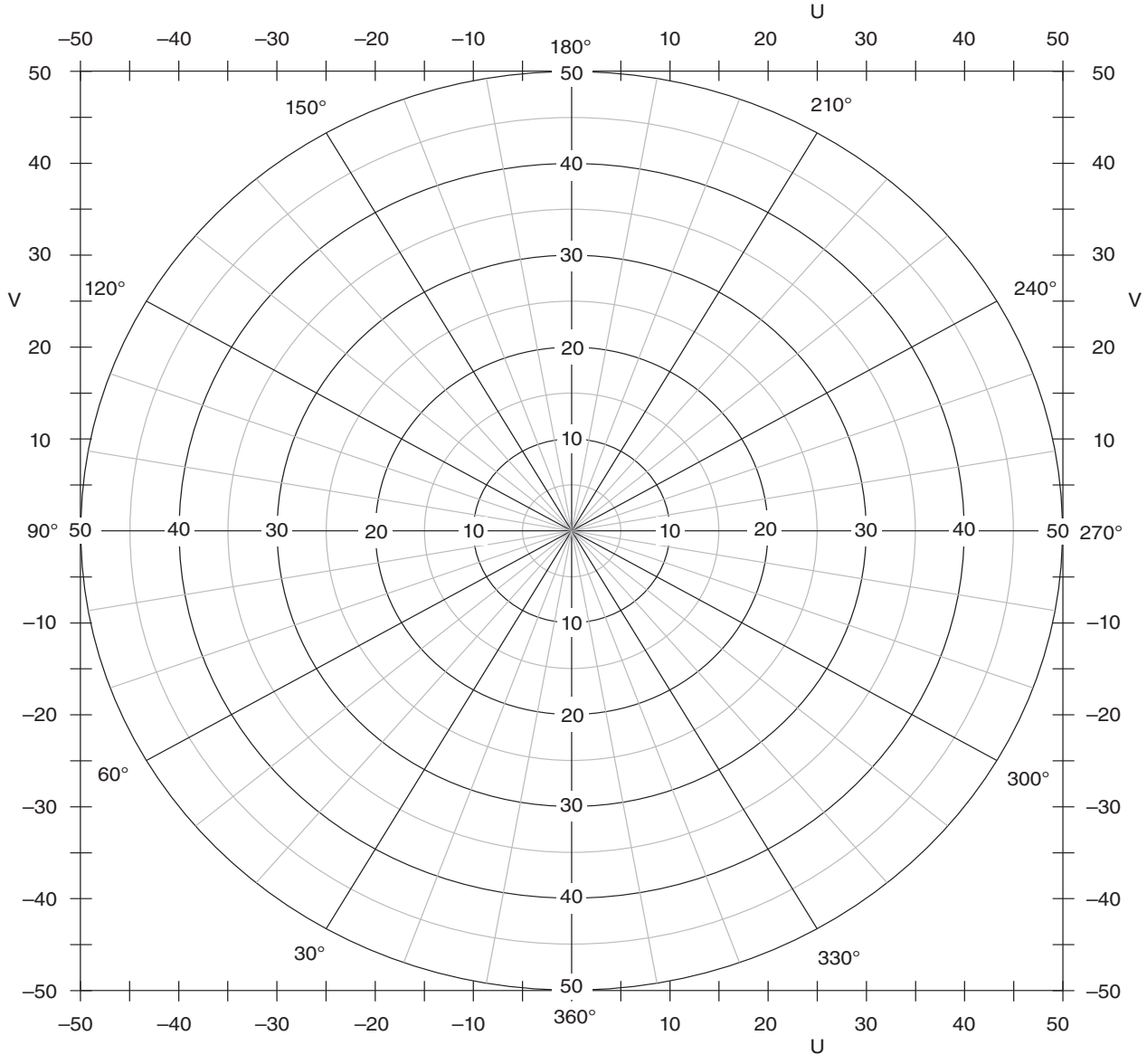
20) 1 Using your hodograph from question 18,
If a thunderstorm splits into two storms, which one will likely dominate?

| A | B | C |
|---|---|---|
| left-moving | both will remain roughly equal strength | right-moving |

50 minutes total

Optional Bonus worth 5 points — Use the sounding from question (10). What is the approximate surface-based CAPE **area** (K· km) ? (Hint, break the total area into a few simple triangles andrectangles or trapezoids, instead of counting small slices.)

| A | B | C | D | E |
|---|---|---|---|---|
| 25 | 35 | 45 | 55 | 65 |



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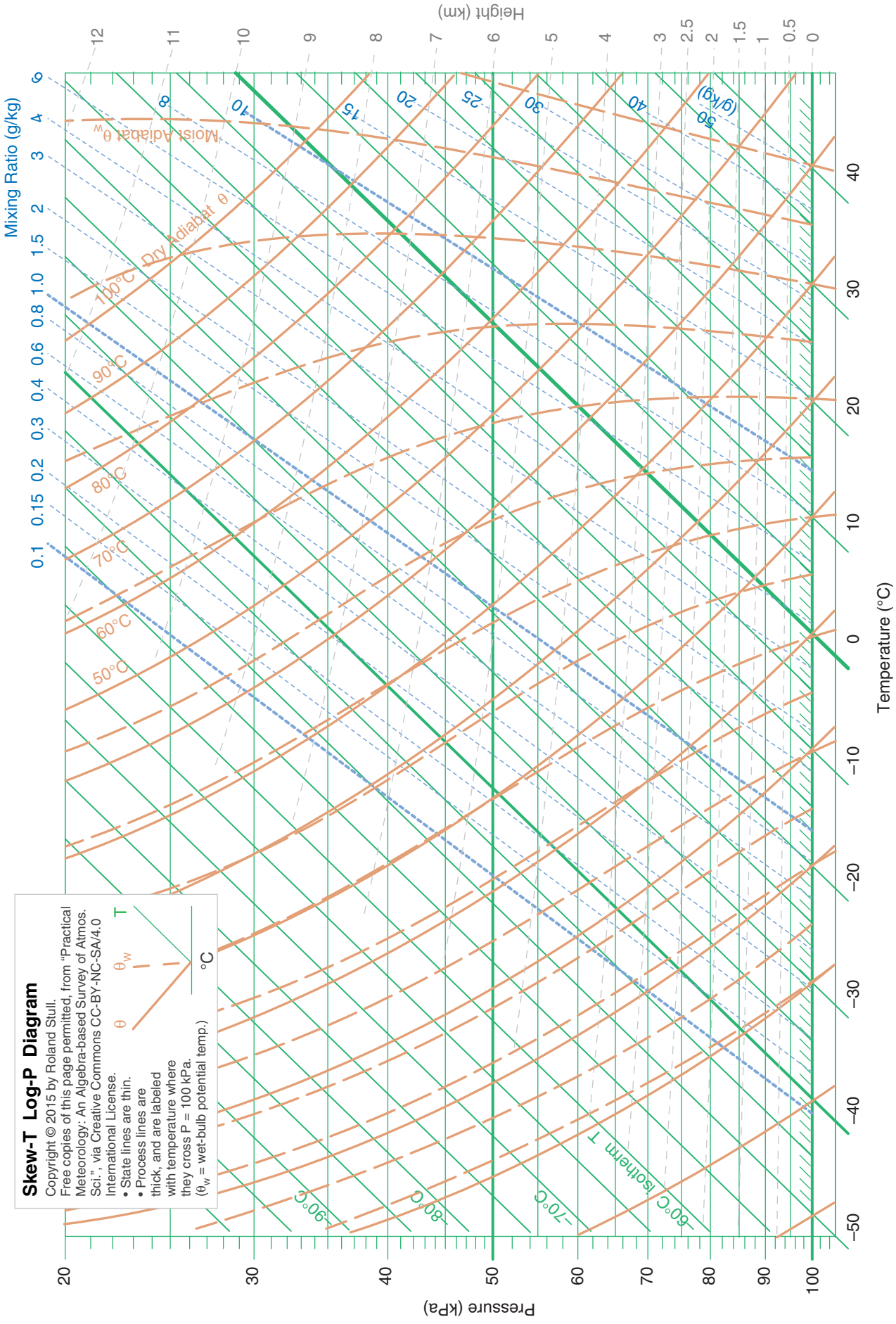
Skew-T Log-P Diagram
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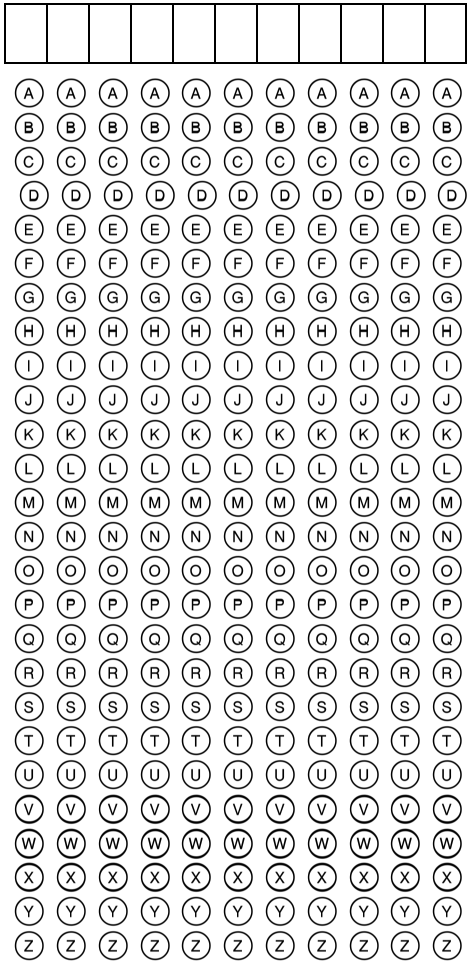
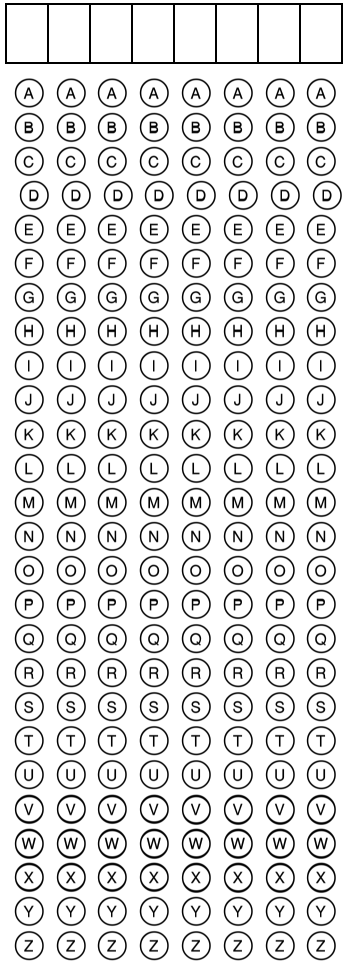
• State lines are thin.
• Process lines are thick, and are labeled with temperature where they cross P = 100 kPa.
(θw = wet-bulb potential temp.)
θ
θw
T
°C
Mixing Ratio (g/kg)
Pressure (kPa)
Temperature (°C)
Height (km)
Dry Adiabat θ
Moist Adiabat θw
100°C
90°C
80°C
70°C
60°C
50°C
-90°C
-80°C
-70°C
-60°C Isotherm T
(g/kg)

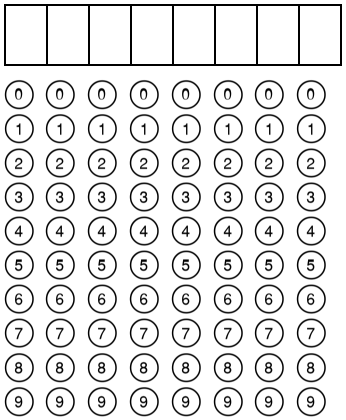
LAST NAME



FIRST NAME



ID NUMBER



TEST FORM

| | | |