ATSC 201 **Midterm Exam** Name: ______________________________
Prof. Stull (open books, notes, calculator)
Fall 2015 (50 points ≈ 1 minute/point) Student Number: ______________________

•••••••• (2 points)

1) List the 4 environmental pre-storm **favorable conditions** needed to form a thunderstorm:

a) ____

b) ____

c) ____

d) ____

••••••••

Use the following **sounding table** to answer all the remaining questions.

P (kPa)	T (°C)	Td (°C)	Wind Dir (°)	Wind Speed (m/s)	z (km) approximate
100	32	25	120	5	0
98	28				
92	23				
90	29		150	15	1
80	21		180	20	2
70	12		210	25	3
60	3		240	30	4
50	-8		270	35	5
40	-20		300	50	6
30	-31				
20	-31				

•••••••• (5 points)

2) Plot the whole temperature sounding on the attached full-size **skew-T diagram**, and also plot the bottom dew-point value.

Also attached is a zoomed **skew-T (ABL)** diagram, on which I already plotted the bottom portion of the temperature sounding, to save you time. You will use both the full size and zoomed diagrams below.

•••••••• (10 points)

3) Use the plot on the zoomed skew-T (ABL) to answer the following:

a) the top of the **mixed layer** (boundary layer, z_i) is at P = ____________________ kPa

b) the **LCL** is at P = ____________________ kPa

c) the **LFC** is at P = ____________________ kPa

d) and use your own plot from question (2): the **EL** is a P = ____________________ kPa

Name: ______________________________ SN: __________________

•••••••• (2 points)

4) Is there sufficient **humidity** in the boundary layer to support thunderstorms: Yes / No (circle one).

If yes, then what category of thunderstorm would be possible, and what would be its characteristics?

•••••••• (10 points)

5) CAPE is one measure of the nonlocal conditional instability. Use your plot from question (2) to estimate the **CAPE** (J/kg). Hint, to do this faster, break the whole CAPE area into one large triangle and one large rectangle, and use the altitude lines (labeled on the right side of the skew-T) to help you estimate the CAPE area and the associated CAPE value. A crude approximate answer is OK, if you show your work here and on your thermo diagram. (Note: $1 \text{ J/kg} = 1 \text{ m}^2/\text{s}^2$.)

•••••••• (3 points)

6) Assume that the CAPE you found in question (5) corresponds to the most unstable CAPE (MU CAPE). Is there sufficient **instability** to support thunderstorms: Yes / No (circle one).

If yes, then what category of thunderstorm would be possible, and what would be its characteristics?

•••••••• (2 points)

7) List 2 processes that could **trigger** the thunderstorm:

a) ______________________________ b) ______________________________

For the remainder of this exam, assume that a trigger mechanism does exist for this storm environment.

Name: ______________________________ SN: __________________

•••••••• (3 points)
8) Using data from the sounding table on page 1, plot the winds on the attached **hodograph**.

•••••••• (3 points)
9) On your hodograph from question (8), mark an "X" to indicate the **Normal Storm Motion**. You can use the approximate graphical method to estimate this. Your "X" approximately corresponds to a normal storm speed of ____________________ (m/s) and direction of ______________________ (°).

•••••••• (6 points)
10) For simplicity, assume that this storm moves at the normal storm speed. (Namely, it is NOT a right- or left-moving storm). Graphically estimate the value of the **0-3 km storm relative helicity (SRH)**, and show your work. Hint: To do it faster, use one big rectangle to approximate the area. Show your rectangle on the hodograph.

•••••••• (3 points)
11) Given the SRH from question (10), would there likely be a **tornado**? Yes / No (circle one).

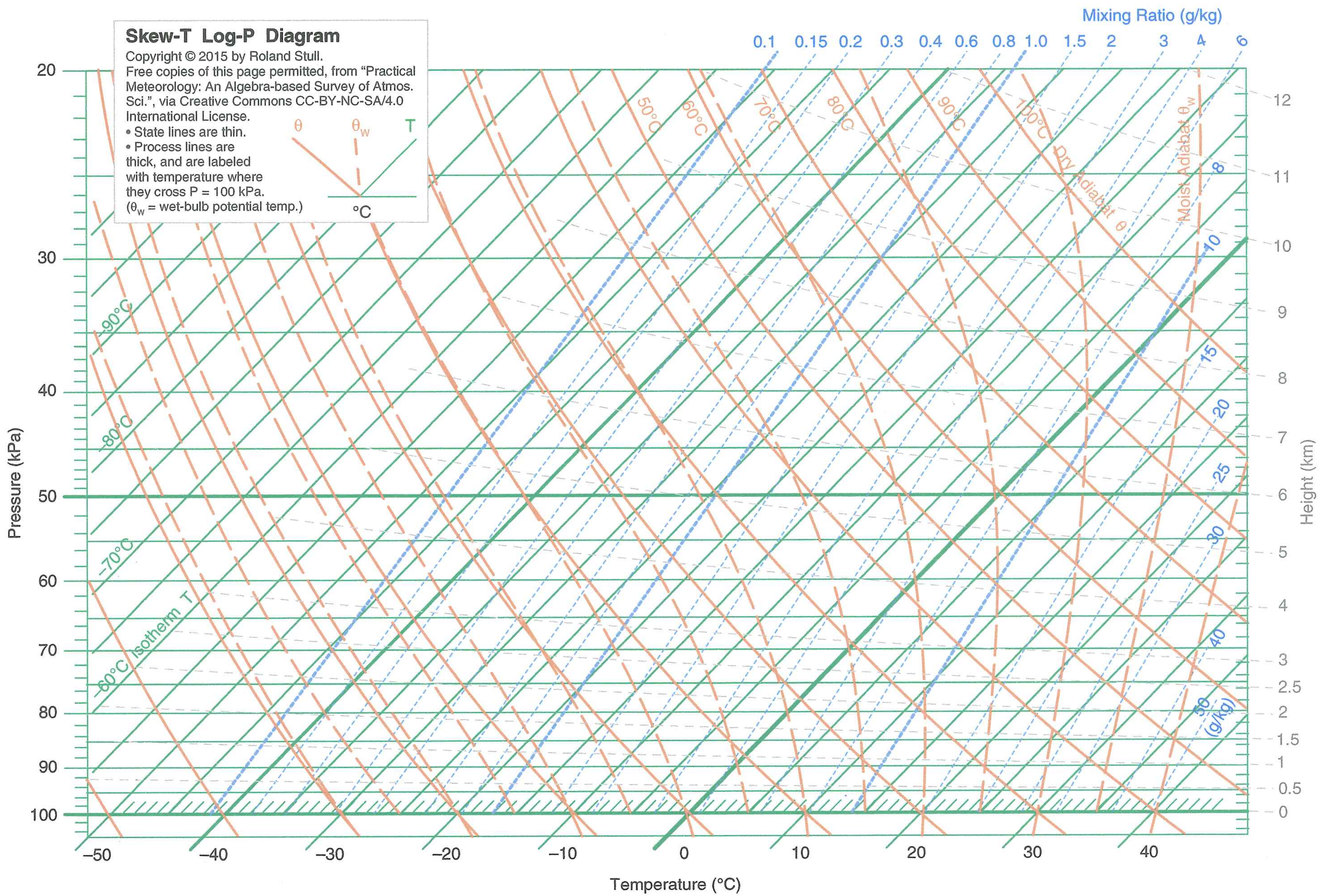
If yes, then what would be its likely **Enhanced Fujita** intensity?

Why?

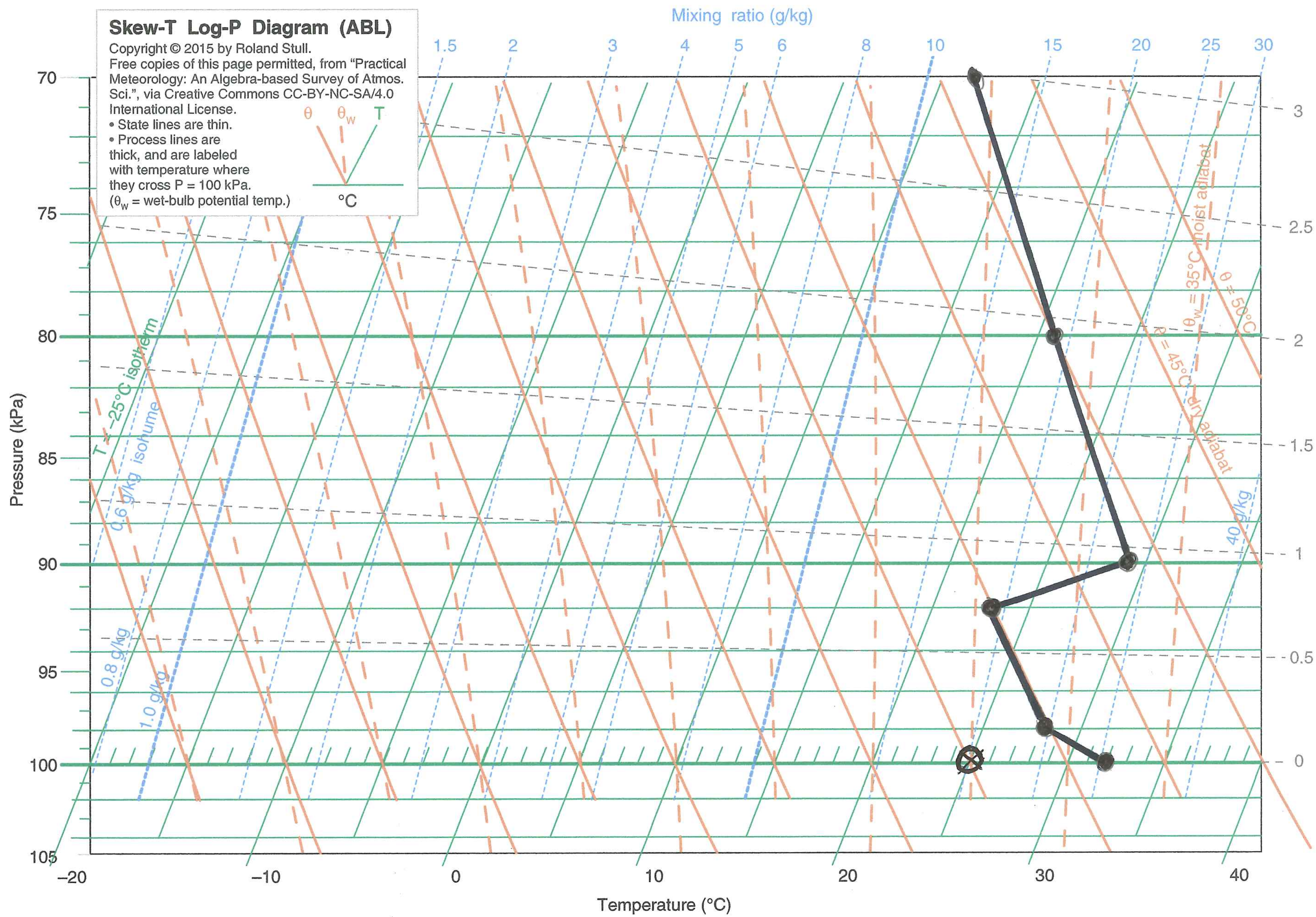
•••••••• (1 point)
12) For the environmental sounding that you used for all the questions above, are the 4 conditions from question (1) satisfied? Yes / No (circle one)

-end-

3 attachments



Skew-T Log-P Diagram
Copyright © 2015 by Roland Stull.
Free copies of this page permitted, from "Practical Meteorology: An Algebra-based Survey of Atmos. Sci.", via Creative Commons CC-BY-NC-SA/4.0 International License.
• State lines are thin.
• Process lines are thick, and are labeled with temperature where they cross P = 100 kPa.
(θ_w = wet-bulb potential temp.)
θ
θ_w
T
°C
Mixing Ratio (g/kg)
0.1 0.15 0.2 0.3 0.4 0.6 0.8 1.0 1.5 2 3 4 6 8 10 15 20 25 30 40 50 (g/kg)
50°C 60°C 70°C 80°C 90°C 100°C
Dry Adiabat θ
Moist Adiabat θ_w
–90°C –80°C –70°C –60°C Isotherm T
Pressure (kPa)
20 30 40 50 60 70 80 90 100
Height (km)
12 11 10 9 8 7 6 5 4 3 2.5 2 1.5 1 0.5 0
Temperature (°C)
–50 –40 –30 –20 –10 0 10 20 30 40


Skew-T Log-P Diagram (ABL)
Copyright © 2015 by Roland Stull.
Free copies of this page permitted, from "Practical Meteorology: An Algebra-based Survey of Atmos. Sci.", via Creative Commons CC-BY-NC-SA/4.0 International License.
• 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)
1.5 2 3 4 5 6 8 10 15 20 25 30
Pressure (kPa)
70 75 80 85 90 95 100 105
Height (km)
3 2.5 2 1.5 1 0.5 0
Temperature (°C)
−20 −10 0 10 20 30 40
T = −25°C isotherm
0.6 g/kg isohume
0.8 g/kg
1.0 g/kg
40 g/kg
θ = 50°C
θw = 35°C moist adiabat
θ = 45°C dry adiabat

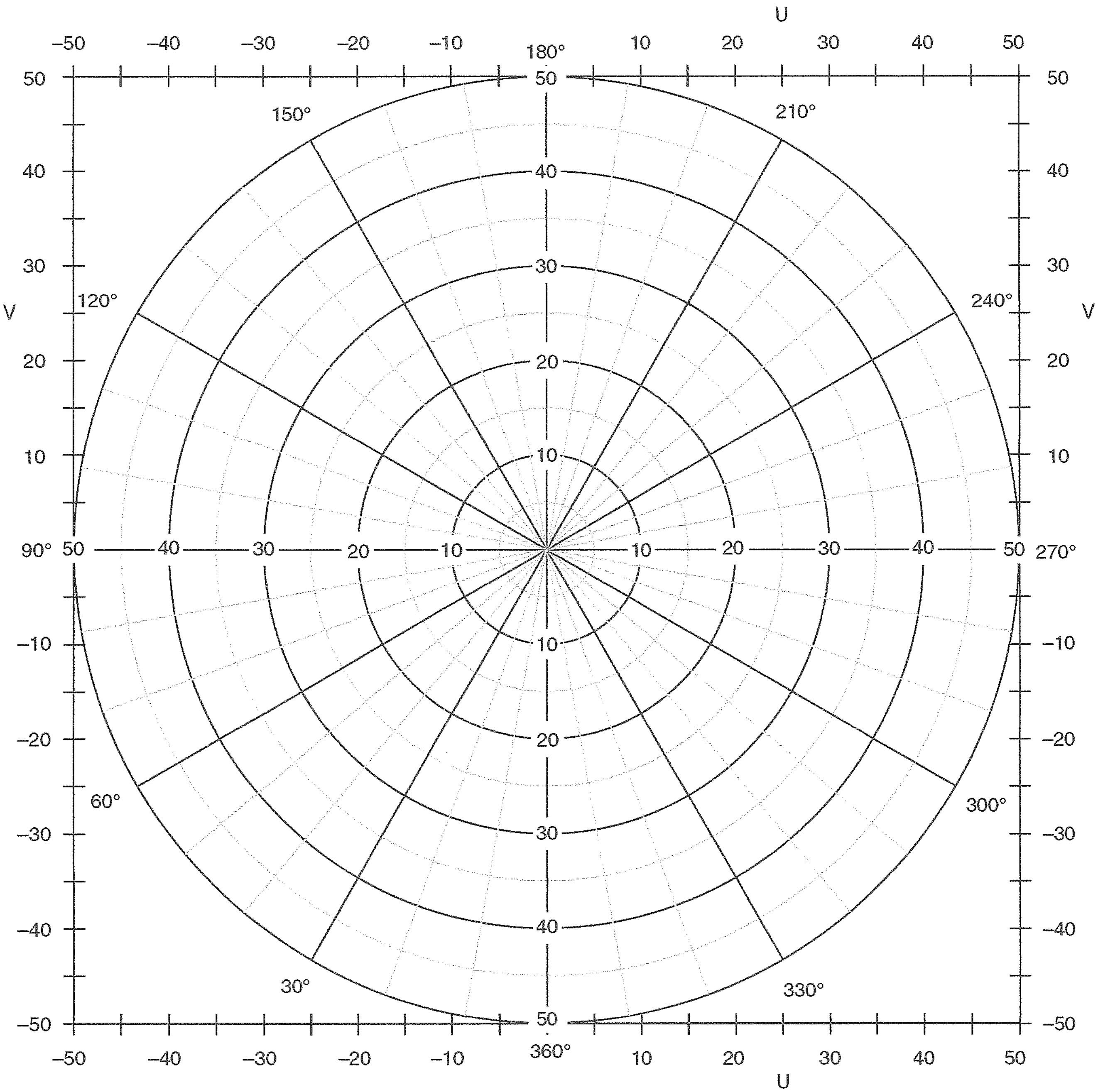


Figure 14.51
Blank hodograph for you to copy and use. Compass angles are direction winds are from. Speed-circle labels can be changed for different units or larger values, if needed.