

Open books, notes, calculator. No electronics that connect to the internet.

Student Number: _____

In all the questions below, if none of the answer-choices are perfectly accurate, then pick the answer that is the closest to accurate.

Given the following environmental sounding.

P (kPa)	100	95	90	80	40	30	20
T (°C)	39	30	25	25	-25	-34	-34
Td	20						

To answer the following 12 questions, **first plot the temperature data given above on the attached thermo diagram.**

- 1) (1 point) The mixing ratio, r (g/kg), of the environment at $P = 100$ kPa is: A) 50 B) 35 C) 30 D) 20 E) 15
- 2) (2 points) The relative humidity (RH%) of the environment at $P = 100$ kPa is: A) 50 B) 35 C) 30 D) 20 E) 15
- 3) (2 points) The wet-bulb temperature, T_w (°C), of the environment at $P = 100$ kPa is: A) 39 B) 30 C) 25 D) 20 E) 15
- 4) (1 point) The potential temperature, θ (°C), of the environmental air at $P = 95$ kPa is roughly
A) 50 B) 35 C) 30 D) 20 E) 15
- 5) (2 points) The pressure (kPa) at the top of the mixed layer (i.e., at z_i) is: A) 95 B) 90 C) 85 D) 80 E) 67
- 6) (2 points) If a cold front triggers a thunderstorm in this environment by forcing some air from the bottom of the atmosphere to rise, then the pressure (kPa) at cloud base (LCL) is: A) 95 B) 90 C) 85 D) 77 E) 67
- 7) (1 point) The pressure (kPa) at the tropopause is: A) 20 B) 26 C) 30 D) 34 E) 40
- 8) (2 points) The pressure (kPa) at the thunderstorm equilibrium level (EL, near the top of the thunderstorm) is:
A) 20 B) 26 C) 30 D) 34 E) 40
- 9) (1 point) The pressure (kPa) at the LFC (the bottom of the positive CAPE area) is roughly: A) 85 B) 80 C) 77 D) 67 E) 57
- 10) (1 point) How high must the trigger mechanism lift air to overcome the convective inhibition (CIN)?
A) 85 B) 80 C) 77 D) 67 E) 57
- 11) (2 points) The MU CAPE for this sounding is roughly 2850 J/kg. This indicates what type of thunderstorm threat?
A) ordinary CB B) marginal supercell C) supercell but not tornado
D) supercell with EF0-EF1 tornado E) supercell with EF2-EF5 tornado
- 12) (3 points) The static stability of the layer of air between pressure levels 90 and 84 kPa is approximately
A) stable B) neutral C) conditionally unstable D) unstable E) (not enough info to answer)

To answer the following 3 questions, **use the sounding plotted on the attached hodograph.**

- 13) (3 points) Using the graphical center-of-gravity method, estimate (by eye) the normal storm motion [direction(°) at speed (m/s)].
A) 210° at 40 m/s B) 200° at 10 m/s C) 180° at 15 m/s
D) 150° at 20 m/s E) 120° at 15 m/s
- 14) (1 point) If a thunderstorm forms in this environment and then splits into two storms, it is likely that
A) left-moving storm is favoured B) right-moving storm is favoured
C) both storms are nearly equally likely D) (not enough info to answer)
- 15) (1 point) At $z = 4$ km, the wind direction (°) is A) 330 B) 17.5 C) 20 D) 50 E) 150

- 16) (3 points) Suppose that a column of sinking air in a downburst is rotating clockwise in the N. hemisphere. As this air hits the ground, the air column shrinks in the vertical and expands in diameter as the downburst air spreads out. You would expect that the rotation will
- A) increase in the same direction due to the vertical convergence of air.
 - B) increase in the same direction due to the conservation of potential vorticity.
 - C) remain approximately constant due to the conservation of relative vorticity.
 - D) decrease in the same direction due to the conservation of potential vorticity.
 - E) change direction and decrease because of the presence of a mesocyclone.

To answer the following 2 questions, **use the RHI radar reflectivity image at right.**

- 17) (1 point) What is the dominant feature in the radar image? (The location is the central prairies of the USA.)
- A) squall line
 - B) basic thunderstorm
 - C) supercell thunderstorm
 - D) hurricane or typhoon
 - E) bow echo

- 18) (2 points) What is the approximate heaviest rainfall rate (mm/h) estimated from the radar image at right? A) 50 B) 55 C) 200 D) 560 E) 3250

To answer the following 4 questions, **use the attached weather map** of the weather over the northeast Pacific Ocean. On this map the thin lines are isobars, with abbreviated labels. E.g.: label "16" means 101.6 kPa, and label "96" means 99.6 kPa. Namely, the preceding "9" or "10" is omitted from the pressure label.

- 19) (1 point) Which location has the fastest winds? A) A B) B C) C D) D E) E
- 20) (1 point) Which location has the slowest winds? A) A B) B C) C D) D E) E
- 21) (2 points) Which locations are likely to have northeast winds?
- A) A & E
 - B) A & C
 - C) A & D
 - D) C & D
 - E) A & D
- 22) (2 points) At location A on the map, Coriolis force is pointing to the
- A) right of the wind
 - B) left of the wind
 - C) opposite to the wind
 - D) directly toward the low-pressure center
 - E) northeast

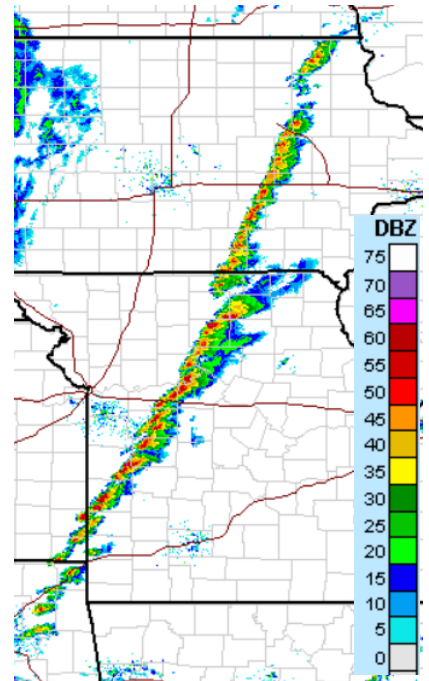
- 23) (1 point) Most of the storms and clouds happen in the
- A) tropopause
 - B) stratopause
 - C) mesopause
 - D) exopause
 - E) troposphere

- 24) (4 points) What is the thickness of the layer of air between pressure-levels 100 and 50 kPa, if that layer has average virtual temperature of 10°C? A) 203 m B) 575 m C) 2.03 km D) 5.75 km E) 20.3 km

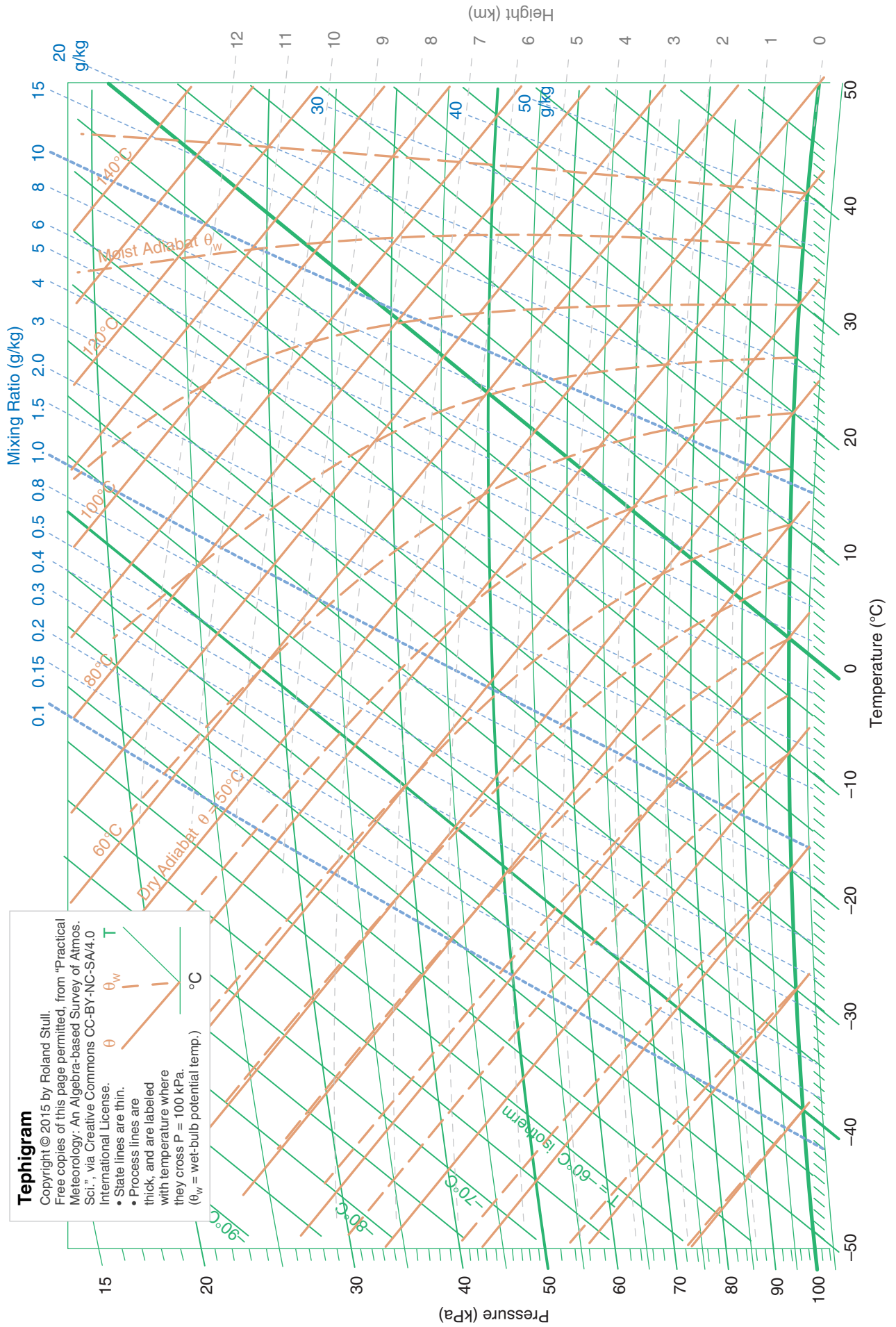
- 25) (5 points) Suppose the pressure decreases 0.4 kPa towards the south, across a distance of 100 km at 50°N latitude. The geostrophic wind is roughly
- A) 270° at 30 m/s
 - B) 300° at 25 m/s
 - C) 0° at 50 m/s
 - D) 60° at 25 m/s
 - E) 90° at 30 m/s

- 26) (2 points) If a tornado blew over a mobile/trailer home without destroying it, then its Enhance-Fujita-scale rating is
- A) 0
 - B) 1
 - C) 2
 - D) 3
 - E) 4

- 27) (1 point) Of the various thunderstorm hazards, ___ is/are the greatest hazard(s) to crops and ___ is/are the greatest hazard(s) to people.
- A) lightning ; hail
 - B) hail ; tornadoes
 - C) lightning ; tornadoes
 - D) tornadoes ; lightning
 - E) hail ; lightning



-end-



Tephigram
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 • State lines are thin.
 • Process lines are thick, and are labeled with temperature where they cross $P = 100 \text{ kPa}$. ($\theta_w =$ wet-bulb potential temp.)

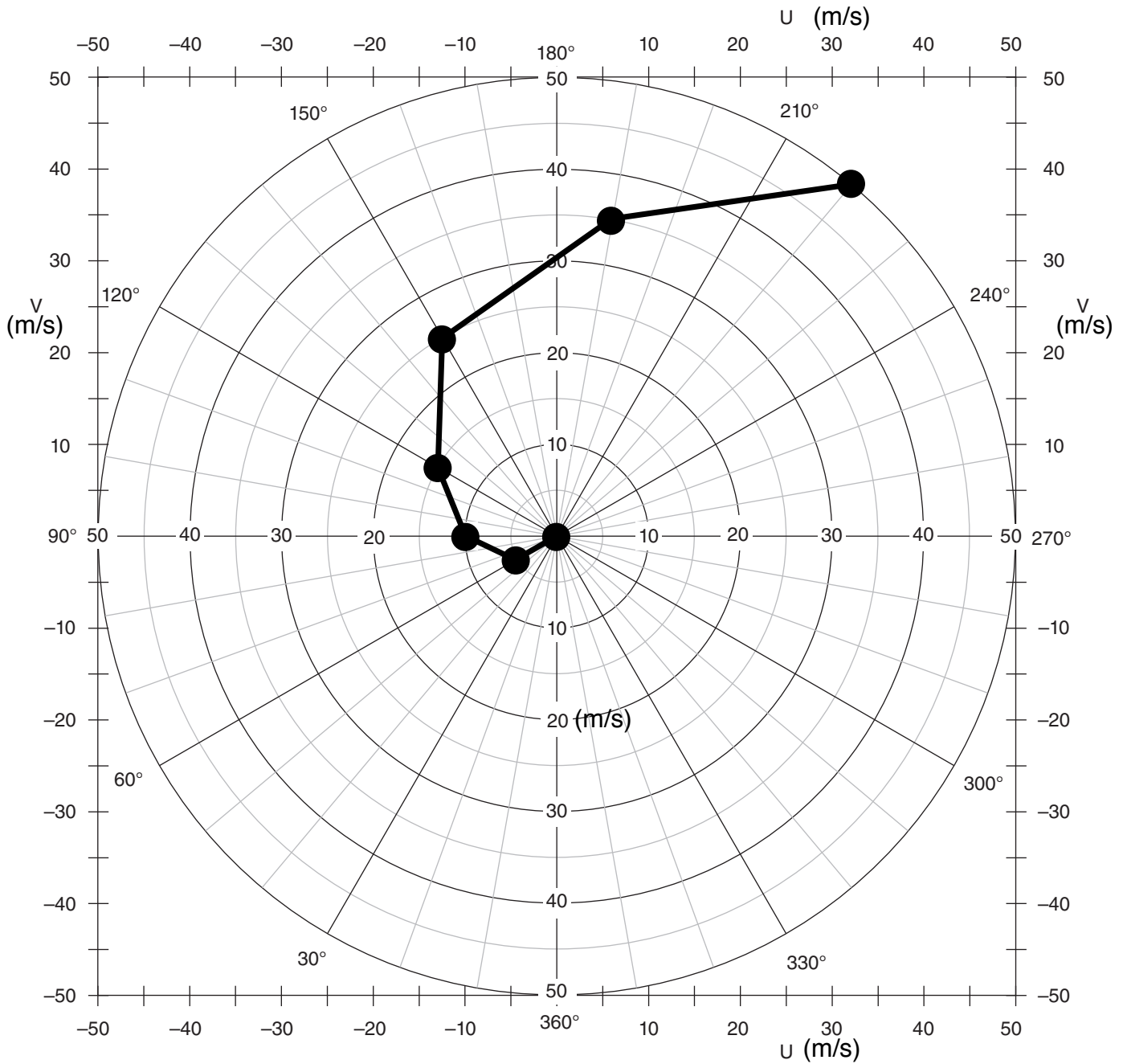


Figure 14.51
 Blank hodograph for you to copy and use. Compass angles are direction winds are from. Speed-circle labels can be changed for different units or larger values, if needed.

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