ATSC 201 Fall 2025
Chapter 1: A7g, A10h, A11g, A12g
Chapter 14: E4c, E11
Total mark out of 26

Chapter 1:

A7g) (4 marks)

Find the virtual temperature (degC) for air of g) T(degC) = -10, r(g/kg) = 1.

Given:	T =	-10	degC
	r =	1	g/kg
Find:	Tv =	?	degC
Using:	Tv = T * (1 + (a*r))		eq. 1.21
where	a =	0.61	g/g dryair/watervapor

Convert T to Kelvins:
T(K) = T(degC) + 273.15
T = 263.15 K

Convert r to g/g:
r(g/g) = r(g/kg) * (1kg/1000g)
r = 0.001 g/g

Tv =	**263.3105**	**K**
	-9.83948	**degC**

Check: Units ok. Physics ok.
Discussion Because the air is relatively dry, there is little difference between the actual and virtual temperatures.

A10h) (4 marks)

What is the density (kg/m3) of air, given h) P = 50 kPa and T = -30 degC?

Given:	P =	50	kPa
	T =	-30	degC

Convert T to Kelvin:
T(K) = T(degC) + 273.15
T = 243.15 K

Find:	ρ =	?	kg/m^3
Using:	ρ=P/(Rd*T)		
where	Rd =	0.286053	kPa*K^-1 * m^3 * kg^-1

ρ =	**0.718868**	**kg/m^3**

Check: Units ok. Physics ok.
Discussion This air is much less dense than air at
sea level

A11g)
(4 marks)

At a location in the atmosphere where the air density is 1 kg/m^3 find the change of pressure (kPa) you would feel if your altitude increases by 16km.

Given: rho = 1 kg/m^3
Δz = 16 km

Find: ΔP = ? kPa

Using: ΔP = rho * g * Δz eq. 1.25a
where g = -9.8 m/s^2

Convert Δz to m:
Δz (m) = Δz (km) * 1000
Δz = 16000 m

ΔP = -156800 Pa
-156.8 kPa

Check: Units ok. Physics ok.
Discussion If 1 atm = 101.325 kPa, an increase in altitude of 16km causes a loss of approximately 1.5 atm of pressure.

A12g)
(4 marks)

At a location in the atmosphere where the average virtual temperature is 5 degC, find the height difference (ie. The thickness in km) between the following two pressure levels (kPa): 40, 30.

Given: P1 = 40 kPa
P2 = 30 kPa
avg Tv = 5 degC

Find: Δz = z2-z1 ? km

Using: Δz = z2 - z1 = a * Tv * eq. 1.26a
where a = 29.3 m/K

Convert Tv into Kelvins:
Tv (K) = Tv (degC) + 273.15
Tv = 278.15 K

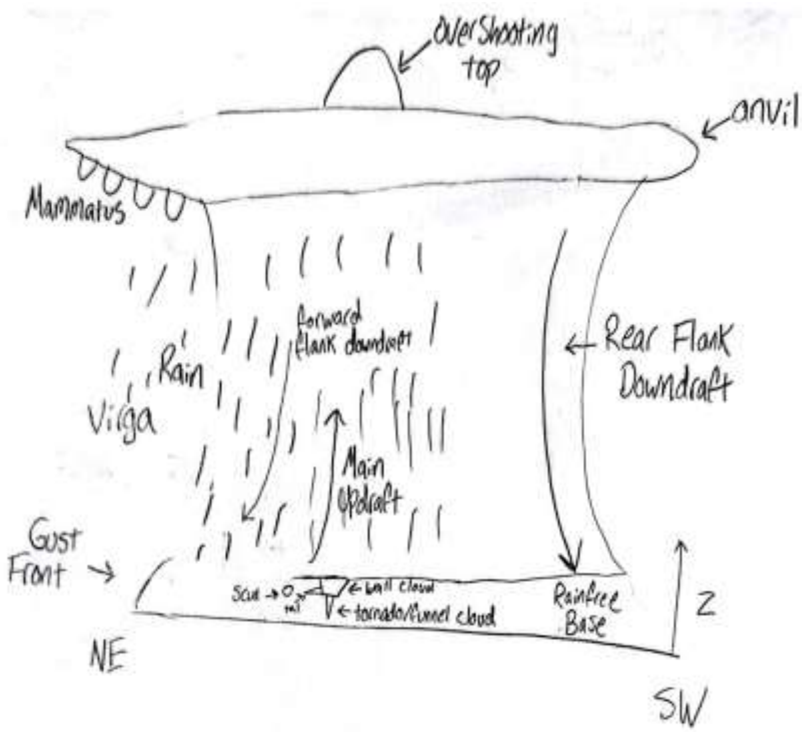
Δz = z2-z1 2344.55 m
2.34 km

Check: Units ok. Physics ok.

Discussion Because of the log profile, the thickness between pressure levels expands higher in the atmos.

Chapter 14:
E4c)
(4 marks)

Consider Figs. 14.4a & b. If you were a storm chaser, and were off to the side of the storm as indicated below, sketch which components of the storm and associated clouds would be visible (i.e., could be seen if you had taken a photo). Label the key cloud features in your sketch. Assume you are in the following direction from the storm: c) Northwest



E11)
(6 marks)

Summarize the different types of supercells, and list their characteristics and differences. Explain what factors cause a supercell to be of a specific type, and where you would most likely find it.

3 Types of Supercells:

1. Classic/Medium Precipitation Supercell

- Summary: moderate precipitation, distrinct up/downdraft regions, curved precipitation region
- Location: anywhere (you can consider this implied if the student does not explicitly state it)
- Important Factors: warm, humid air and strong winds. In short, this air is blown to the top of the troposphere by a strong updraft and transported elsewhere by upper tropospheric winds. The cooling of this air leads to the formation of hydrometeors which eventually become precipitation

2. High Precipitation Supercell

- Summary: Precipitation falls from most cloud bases, much of the surrounding sky is filled with mid/low clouds, heavy rain region can wrap around updraft region, very low visibility
- Location: warm humid locations (e.g. southeastern US)
- Important Factors: even more warm, humid air

3. Low Precipitation Supercell

- Summary: high visibility, can produce large diameter hail
- Location: dry/mountainous regions (e.g. US east of the Rockies)
- Important Factors: same as classic but tilted updraft (wind shear) blows precipitation particles away from updraft, making accumulation difficult