ATSC 201
Assignment 2
Total mark out of 31

Chapter 1: **A7f, A10c, A11f, A12f**

A7f)
(4 marks)

Find the virtual temperature (degC) for air of
f) T(degC) = 0, r(g/kg) = 2.

Given:	T =	0	degC
	r =	2	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 =	273.15	K

Convert r to g/g:

	r(g/g) = r(g/kg) * (1kg/1000g)		
	r =	0.002	g/g

Tv =	**273.483243**	**K**
	0.333243	**degC**

Check: Units ok. Physics ok.
Discussion: The virtual temperature is only 0.33degC higher than the actual temperature. The moisture in the air is having a large effect.

A10c)
(4 marks)

What is the pressure (kPa) of air, given
T=90 degF and rho=1.2 kgm^-3 ?

Given:	T =	90	degF
	rho =	1.2	kg/m^3

Find:

P= ? kPa

Using: P = rho*R*T eq. 1.20
where R = 0.287053 kPa*m^3 / K * kg

Convert T to Kelvins:
T (K) = 5/9*(T (degF)-32) + 273.15
T = 305.3722222 K

P =	105.189615	kPa*m^3 / kg

Check: Units ok. Physics ok.
Discussion: A higher temperature and a higher density lead to a higher pressure, 105.2 kPa would be observed under a very strong anticyclone at sea level.

A11f)
(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 13km.

Given: rho = 1 kg/m^3
Δz = 13 km

Find: ΔP = ? kPa

2 valid solutions

1) 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 = 13000 m

ΔP =	**-127400**	**Pa**
	-127.4	**kPa**

2)

Using: rho= rho0*exp(-z/Hrho) eq. 1.13b
P=P0*exp(-z/Hp) eq. 1.9b

zi=	1.73514422	km	eq. 1.13b
zf=	14.7351442	km	
Pi=	79.8632769	kPa	
Pf=	13.4240972	kPa	

ΔP = 66.4391797 kPa

Check: Units ok. Physics ok.

Discussion: 1) If 1 atm = 101.325 kPa, an increase in altitude of 13km causes a loss of more than 1 atm of pressure.

2) If 1 atm= 101.325 kPa, an increase in altitude of 13km from a density of 1kg/m^3 causes a decrease of about 2/3 of standard pressure at the surface

A12f) (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): 50, 40.

Given:

P1 =	50	kPa
P2 =	40	kPa
avg Tv =	5	degC

Find: Δz = z2-z1 = ? km

Using: Δz = z2 - z1 = a * Tv * ln(P1/P2) 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 = 1818.57 m

1.82 km

Check: Units ok. Physics ok.

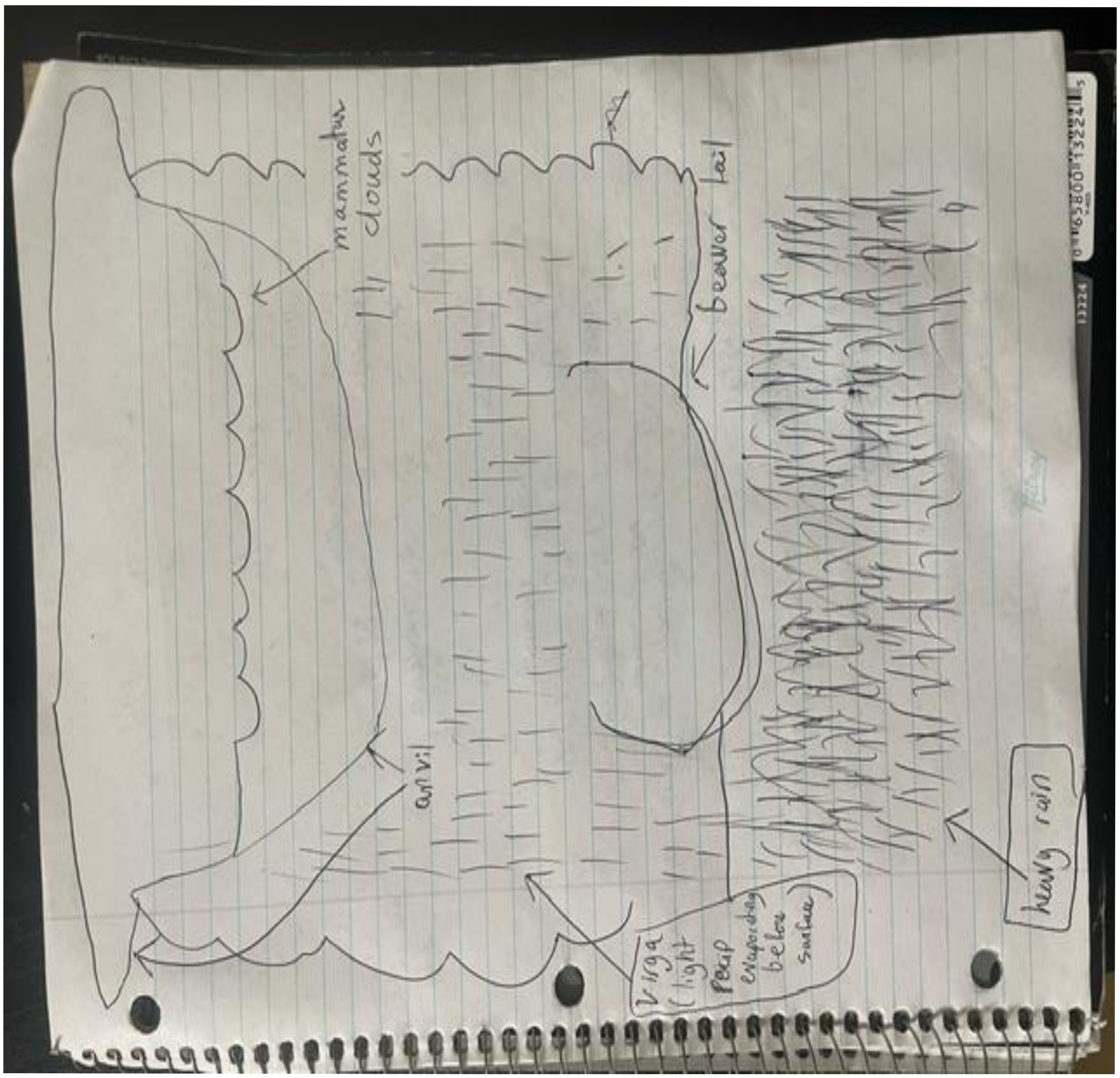
Discussion: Because of the log profile, the thickness between pressure levels expands higher in the atmos.

Chapter 14: E4a, E7, E10

E4a

(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: NE



The view of the thunderstorm from the northeast is under a precipitation of no rain, but looking towards the thunderstorms, you can see the anvil cloud at the highest altitude, but closest horizontally to the observer. Some mammatus clouds can be observed under the anvil cloud due to the cooling air aloft. Further horizontally some virga is visible aloft above the beaver tail. The beaver tail is visible at lower altitudes and below the beaver tail altitude, but further away

E7

E7. Can a thunderstorm exist without one or more cells? Explain.

(5 marks)

No, a thunderstorm is defined by a region of clouds with a large vertical extent produced by an updraft leading to the towering/convection of clouds that can produce heavy precipitation and lightning. By definition this region is defined as a thunderstorm cell and if the thunderstorm is part of a larger that observes little convective activity, then the region experiencing thunderstorms are still classified as thunderstorm cells within the larger systems. So, thunderstorms are either observed in a single cell, in a multi-cell complex or as an isolated cell in a larger synoptic system.

E10

(6 marks)

What is a derecho, and what causes it? Also, if strong straight-line winds can cause damage similar to that from a weak tornado, what are all the ways that you could use to determine (after the fact) if a damaged building was caused by a tornado or derecho?

A derecho is a strong mesoscale convective system (MCS) that produces widespread downdraft winds of at least 26 m/s over a distance of at least 400 km with a lifetime of at least 3 hours.

The derecho forms in a mesoscale convective complex that has a pool of cool descending air and rising air at the top creating a region of low relative pressure at mid-altitude. This causes the formation of the rear-inflow jet that contributes to the movement of the convective line in a particular direction. With the descending pool of cool air a large downdraft is observed creating a region of high pressure under the precipitation leading to an outflow boundary layer producing particularly strong winds at the leading edge of the storm. The cool advancing air also induces the rise of the warm surface boundary layer air aloft prolonging the lifetime of the storm.

The damages from a derecho are differentiable from a tornado by the extent

The damages from a derecho are differentiable from a tornado by the extent of area damage spreading hundreds of kilometer and following the horizontal movement of a long band and all fallen trees or debris should be pushed in the same direction unlike a tornado that has a narrow damage path with varying wind directions.