ATSC 201 Fall 2024
Homework 1 Answer Key
Total mark out of 25
Chapter 1: A1f, A3f, A5f, A6f, A9f, A14f, A15f

Chapter 1

A1f)
(4 marks)

Find the wind direction (degrees) and speed (m/s), given the (U,V) components: f) (5,20) m/s

Given:	U =	5	m/s
	V =	20	m/s

Find: alpha (wind direction) M (wind speed)

Using eq. 1.1:

M = (U^2 + V^2)^0.5

Using eq. 1.2a:

alpha = 90deg - (360deg/C)*arctan(V/U) + alpha0

	C =	360	deg
if U > 0	alpha0 =	180	deg
	M =	20.6155281	m/s

M =	**20.62**	**m/s**
alpha =	**194.04**	**deg**

Checks: Units ok. Physics ok.
Discussion: The wind is coming from the SSW with a magnitude of 20.62 m/s.

A3f)
(3 marks)

to local time in your own time zone: f) 15:15

Given: 15:15 UTC

Find: local time

Using eqs. from Table 1-1

DT = UTC - beta

ST = UTC - alpha

Vancouver's time zone is "U" (Pacific)

beta =	7:00	PDT
alpha =	8:00	PST

Currently, local time is PDT.

DT =	**8:15**	**PDT**
for partial marks: ST =	**7:15**	**PST**

Checks: Units ok.

Discussion: Vancouver is currently in Pacific Daylight Time, so it is presently 7 hours behind UTC time.

A5f) (2.5 marks)

Find the pressure in kPa at the following heights above sea level, assuming an average T = 250K: f) 5km.

Given:	z (m) =	5	km	"="	5000	m
	avg T =	250	K			

Find: P ? kPa

Using eq. 1.9a:

P = Po * e^(-(a/T)*z)

where:	Po =	101.3250	kPa
	a =	0.0342	K/m

P =	**51.1**	**kPa**

Checks: Units ok. Physics ok.

Discussion: At 5000m

A6f)
(3 marks)

Use the definition of pressure as a force per unit area, and consider a column of air that is above a horizontal area of 1 square meter. What is the mass of air in that column: f) above height where the pressure is 30 kPa

Given:	Pbottom =	30	kPa
	Ptop =	0	kPa
	A =	1	m^2

Find: Δm = ? kg
mass of air between Pbottom and Ptop

Using eq. 1.11:
Δm = (A/g)*(Pbottom - Ptop) where g = 9.81 m/s^2

Convert Pbottom(kPa) and Ptop(kPa) to Pbottom(Pa) and Ptop(Pa):

Pbottom =	30000	Pa
Ptop =	0	Pa

Δm = 3058.10 kg

Checks: Units ok. Physics ok.
Discussion: This is a calculation of the air mass above 30 kPa pressure level that exists over 1 square meter of area.

A9f)
(2.5 marks)

Convert the following temperatures: f) 250 K = ?°F

Given: $T_{°K}$ = 250 K

Find: $T_{°c}$ = ? °F

Using equation 1.6a and 1.7b:
$T°F = 9/5*(T_K - 273.15)+32$

$T_{°F}$ =	-9.67 °F

Checks: Units ok.

Discussion: -9.67°F is colder than the coldest temperature ever recorded at the Vancouver Intl airport

A14f) (4.5 marks)

What is the geopotential height and geopotential, given the geometric height? f) 2km

Given: z = 2 km = 2000 m

Find: H = ? m

Φ = ? m^2/s^2

Using eq. 1.14a:

H = Ro*z /(Ro + z)

where the radius of the Earth, Ro = 6356.766km = 6,356,766m.

Ro = 6356766 m

And using eq. 1.15:

Φ= g*H where g = 9.81 m/s^2

H = 1999.37095 m

H =	**1999.37 m**
Φ =	**19613.83 m^2/s^2**

Checks: Units ok. Physics ok.

Discussion: The difference between the geometric height and the geopotential height is negligible at 2000m.

A15f) (5.5 marks)

What is the standard atmospheric temperature, pressure, and density at the following geopotential height: e) 5km ?

Given: H = 5 km

Find: T = ? degC

P =	?	kPa
ρ =	?	kg/m^3

Using eqs. 1.16 for H < 11km:

T = 288.15-6.5*H

T =	**255.65**	**K**
	-17.50	**degC**

Using eq. 1.17 for H < 11km:

P = 101.325*(288.15/T)^[-5.255877]

P =	**54.02**	**kPa**

Using and rearranging eq. 1.18:

ρ = P / Rd*T where Rd = 0.287053 kPa*m^3 / K*kg
gas constant for dry air

ρ =	**0.73611546**	**kg/m^3**

Checks: Units ok. Physics ok.

Discussion:

At 5km, the air is noticeably colder and lower pressure and density