ATSC 201 Fall 2025
Homework 1 Answer Key
Total mark out of 25
Chapter 1: A1g, A3g, A5g, A6g, A9g, A14g, A15g

Chapter 1

A1g) (4 marks)

Find the wind direction (degrees) and speed (m/s), given the (U,V) components: g) (-2,-10) mi/h

Given: U = -2 mi/h
V = -10 mi/h

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 = 0 deg
M = 10.198039 mi/h
= 4.55893137 m/s

M =	**4.56**	**m/s**
alpha =	**11.31**	**deg**

Checks: Units ok. Physics ok.
Discussion: The wind is coming from the NNE with a magnitude of 4.56 m/s.

A3g) (3 marks)

Convert the following UTC time to local time in your own time zone: g) 18:00

Given: 18:00 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 =	**11:00**	**PDT**
for partial marks: ST =	**10:00**	**PST**

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

A5g)
(2.5 marks)

Find the pressure in kPa at the following heights above sea level, assuming an average T = 250K: g) 2 km

Given:	z (m) =	2	km	"="	2000
	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 =	**77.1**	**kPa**

Checks: Units ok. Physics ok.
Discussion:

At 2 km above sea level, pressure is about 76% of what it is at sea level. There are fewer air molecules above 2 km above sea level, than at sea level.

A6g)
(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: g) Between pressure levels 100 and 50 kPa

Given: Pbottom = 100 kPa
Ptop = 50 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 = 100000 Pa
Ptop = 50000 Pa

Δm = 5096.84 kg

Checks: Units ok. Physics ok.
Discussion: This is a calculation of the air mass between 100 and 50 kPa pressure that exists over 1 square meter of area.

A9g)
(2.5 marks)

Convert the following temperatures: g) 2000°C = ?K

Given: $T_{°C}$ = 2000 °C

Find: T_K = ? K

Using equation 1.7b:

$T_K = T°C + 273.15$

$T_{°F}$ =	2273.15	K

Checks: Units ok.

Discussion: 2273.15K is hot enough to instantly melt pure iron

A14g)
(4.5 marks)

What is the geopotential height and geopotential, given the geometric height? g) 5 km

Given:	z =		5	km	"=" 5000
Find:	H =	?		m	
	Φ =	?		m^2/s^2	

Using eq. 1.14a or b:

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 =	**4996.07**	**m**
Φ =	**49011.45**	**m^2/s^2**

Checks: Units ok. Physics ok.

Discussion: The difference between the geometric height and the geopotential height is relatively small at 5 km.

A15g) (5.5 marks)

What is the standard atmospheric temperature, pressure, and density at the following geopotential height: g) 40 km ?

Given:	H =	40	km
Find:	T =	?	degC
	P =	?	kPa
	ρ =	?	kg/m^3

Using eqs. 1.16 for 32km ≤ H ≤ 47km:

T = 228.65+2.8*(H-32)

T =	**251.05**	**K**
	-22.10	**degC**

Using eq. 1.17 for 32km ≤ H ≤ 47km:

P = 0.868*(228.65/T)^[12.2011]

P =	**0.28**	**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 =	**0.00385094**	**kg/m^3**

Checks: Units ok. Physics ok.

Discussion:

At 40 km, the pressure and density of the air is much less than at the surface