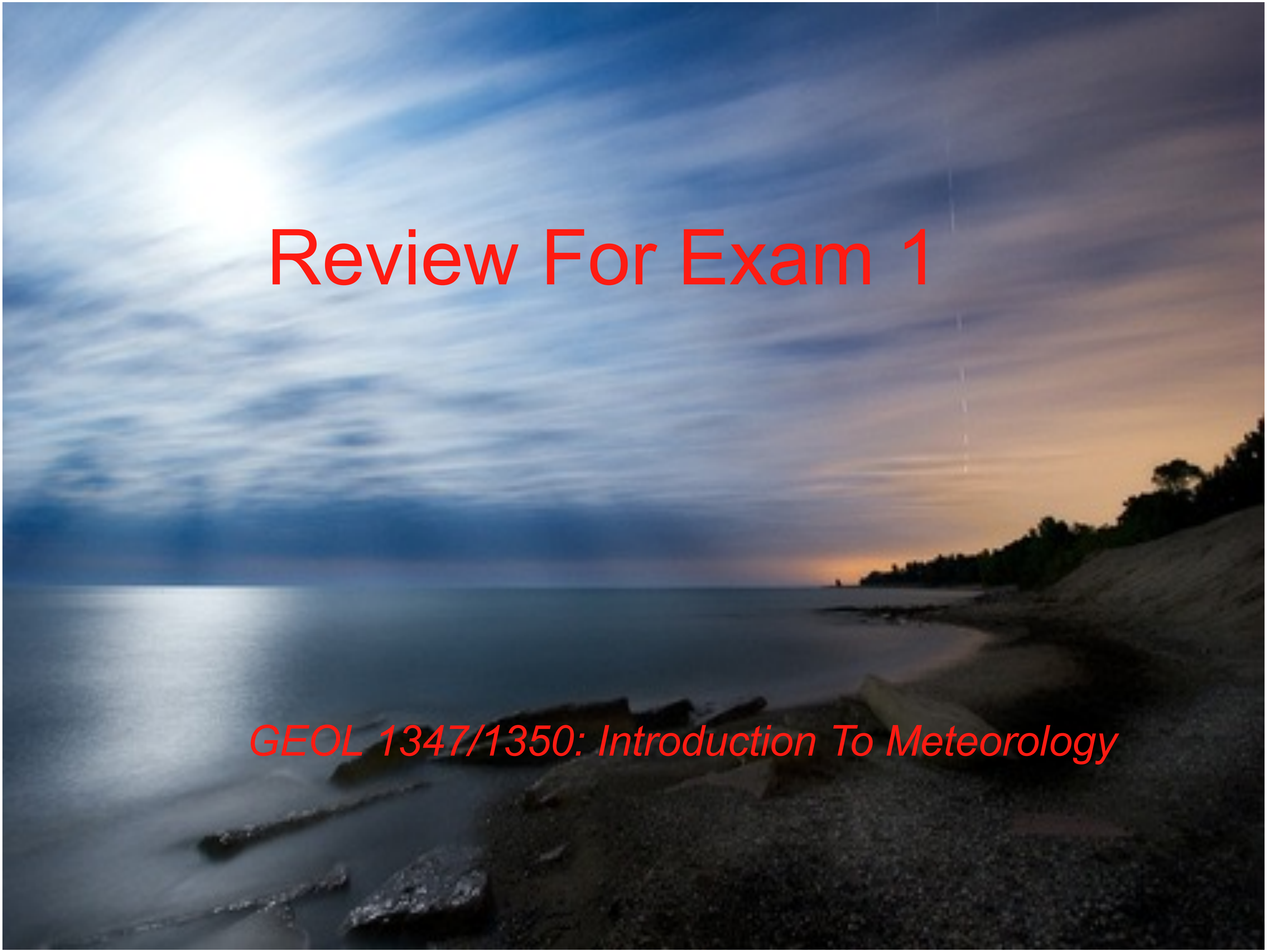


Review For Exam 1

GEOL 1347/1350: Introduction To Meteorology

Website

- Website for the Lecture Notes

http://easd.geosc.uh.edu/xjiang/course/GEOL1347.html

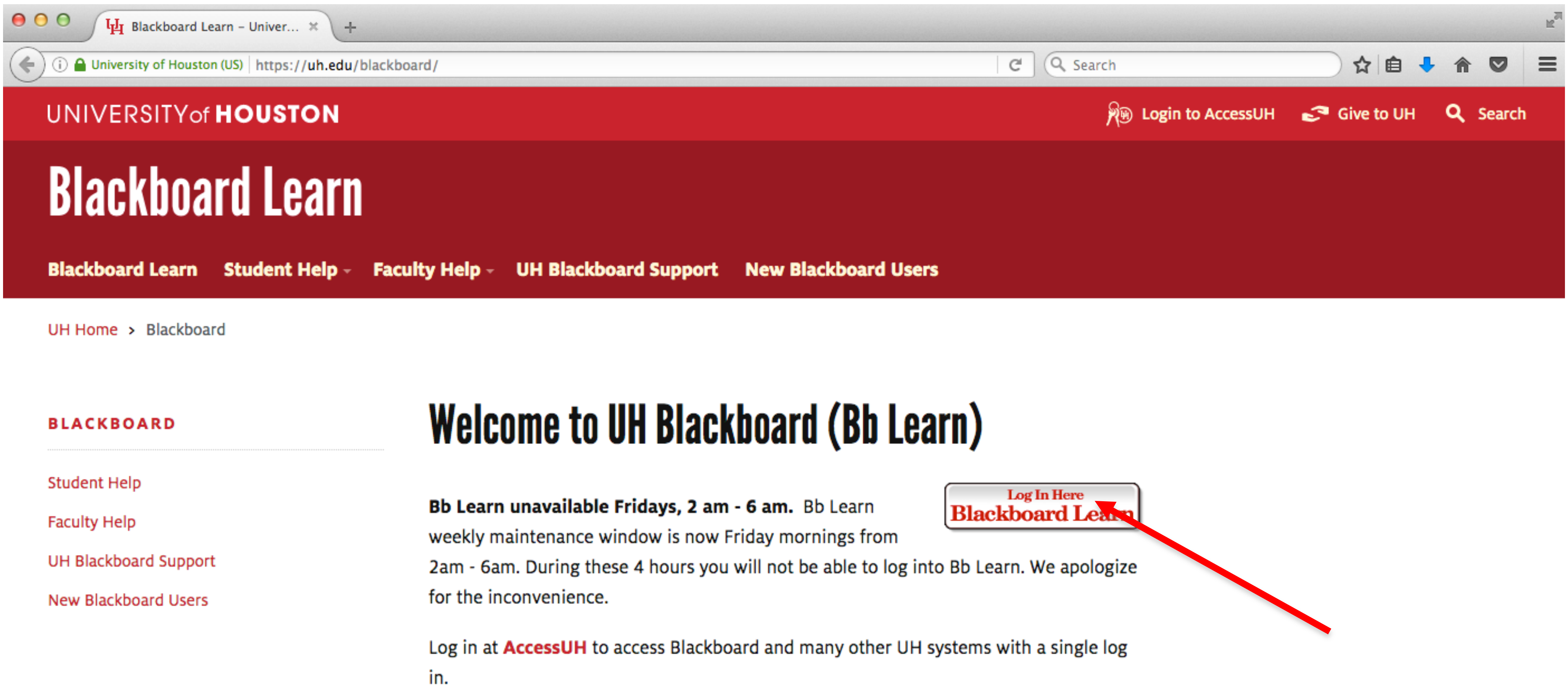
Username: class

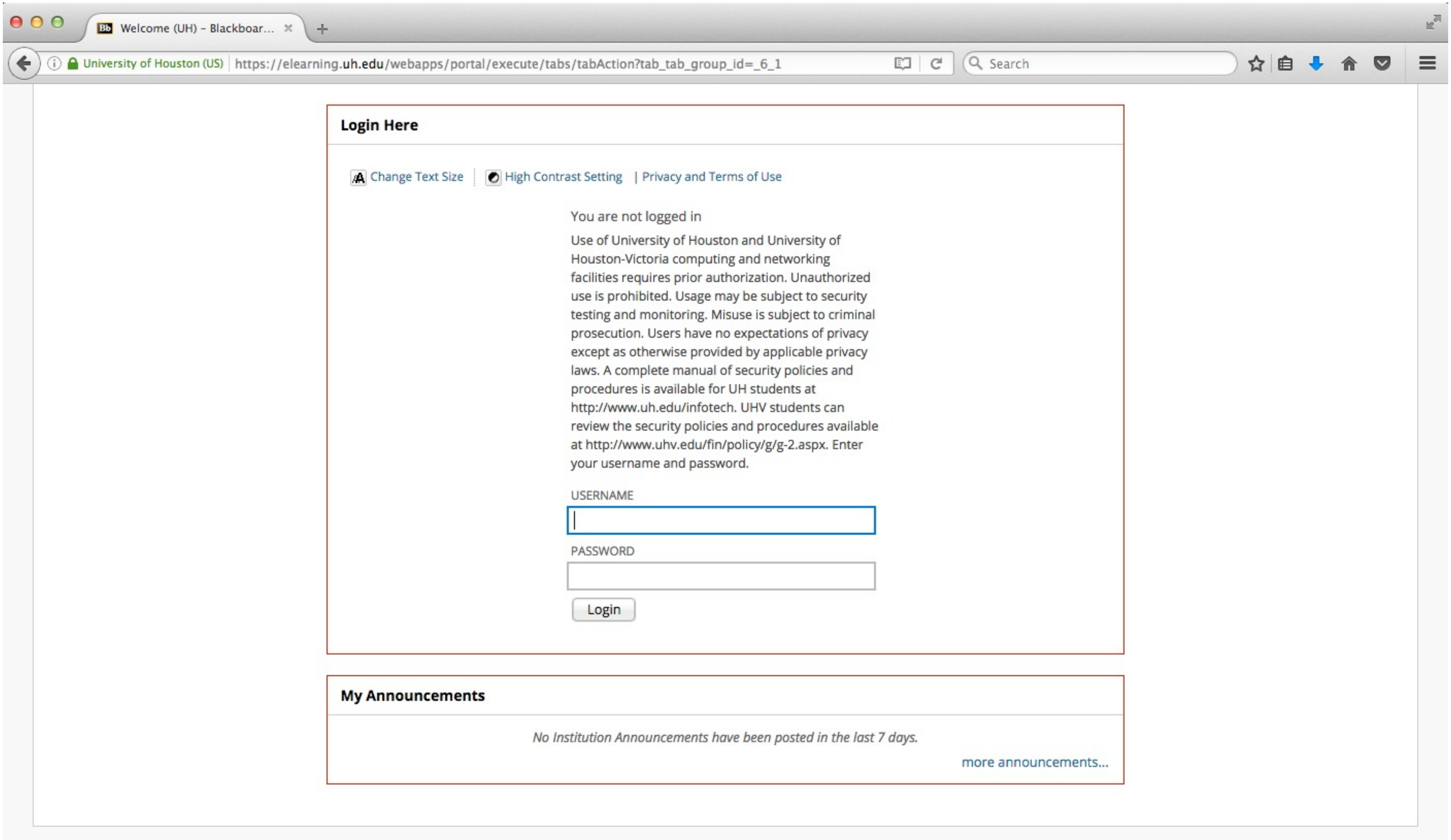
Password: #class#

Exam 1

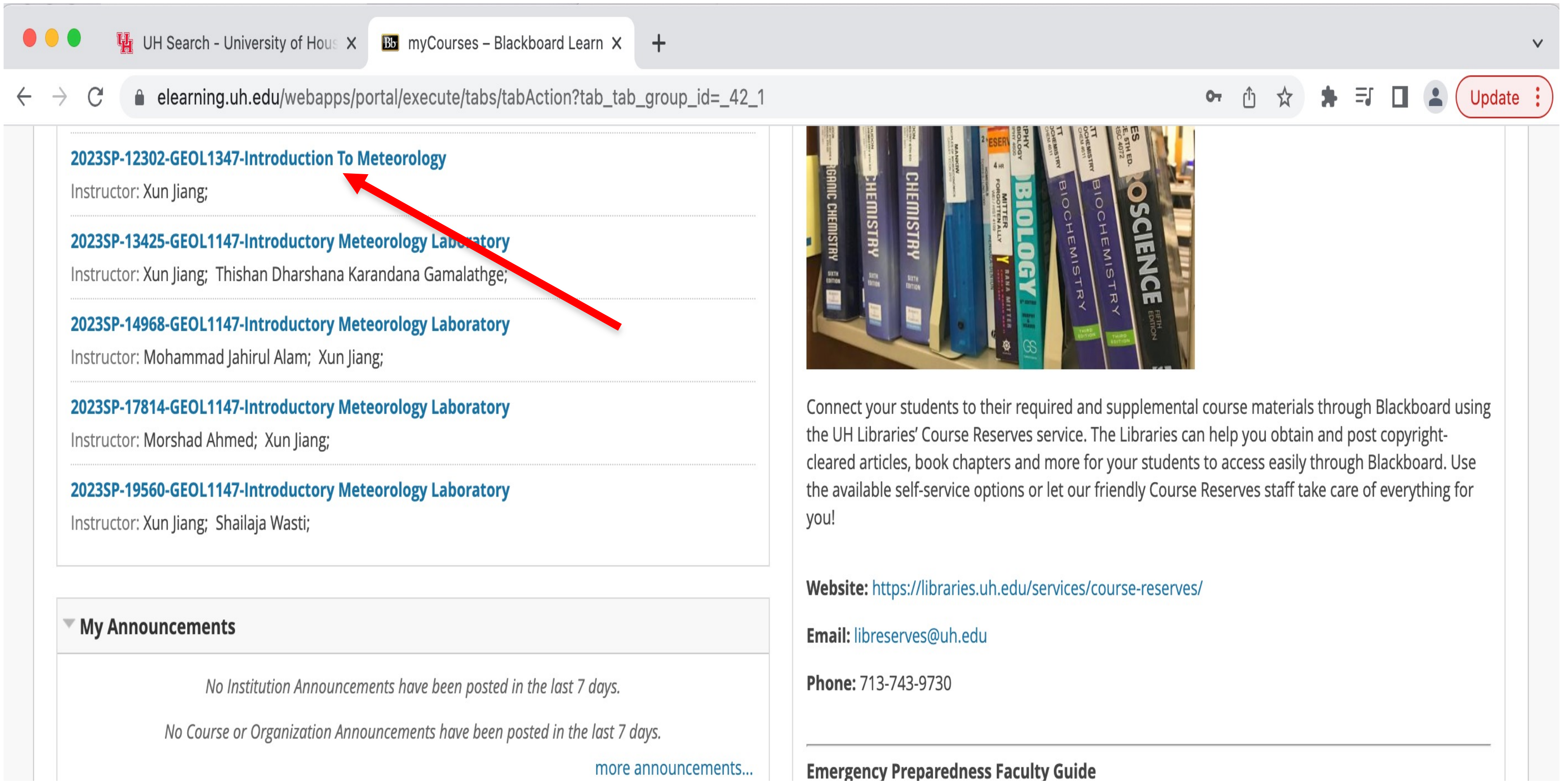
Online Test on Blackboard

Website: https://uh.edu/blackboard/





Username and password are your Cougarnet username and password.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Update
2023SP-12302-GEOL1347-Introduction To Meteorology
Instructor: Xun Jiang;
2023SP-13425-GEOL1147-Introductory Meteorology Laboratory
Instructor: Xun Jiang; Thishan Dharshana Karandana Gamalathge;
2023SP-14968-GEOL1147-Introductory Meteorology Laboratory
Instructor: Mohammad Jahirul Alam; Xun Jiang;
2023SP-17814-GEOL1147-Introductory Meteorology Laboratory
Instructor: Morshad Ahmed; Xun Jiang;
2023SP-19560-GEOL1147-Introductory Meteorology Laboratory
Instructor: Xun Jiang; Shailaja Wasti;
My Announcements
No Institution Announcements have been posted in the last 7 days.
No Course or Organization Announcements have been posted in the last 7 days.
more announcements...
CHEMISTRY
CHEMISTRY
BIOLOGY
BIOCHEMISTRY
BIOCHEMISTRY
SCIENCE
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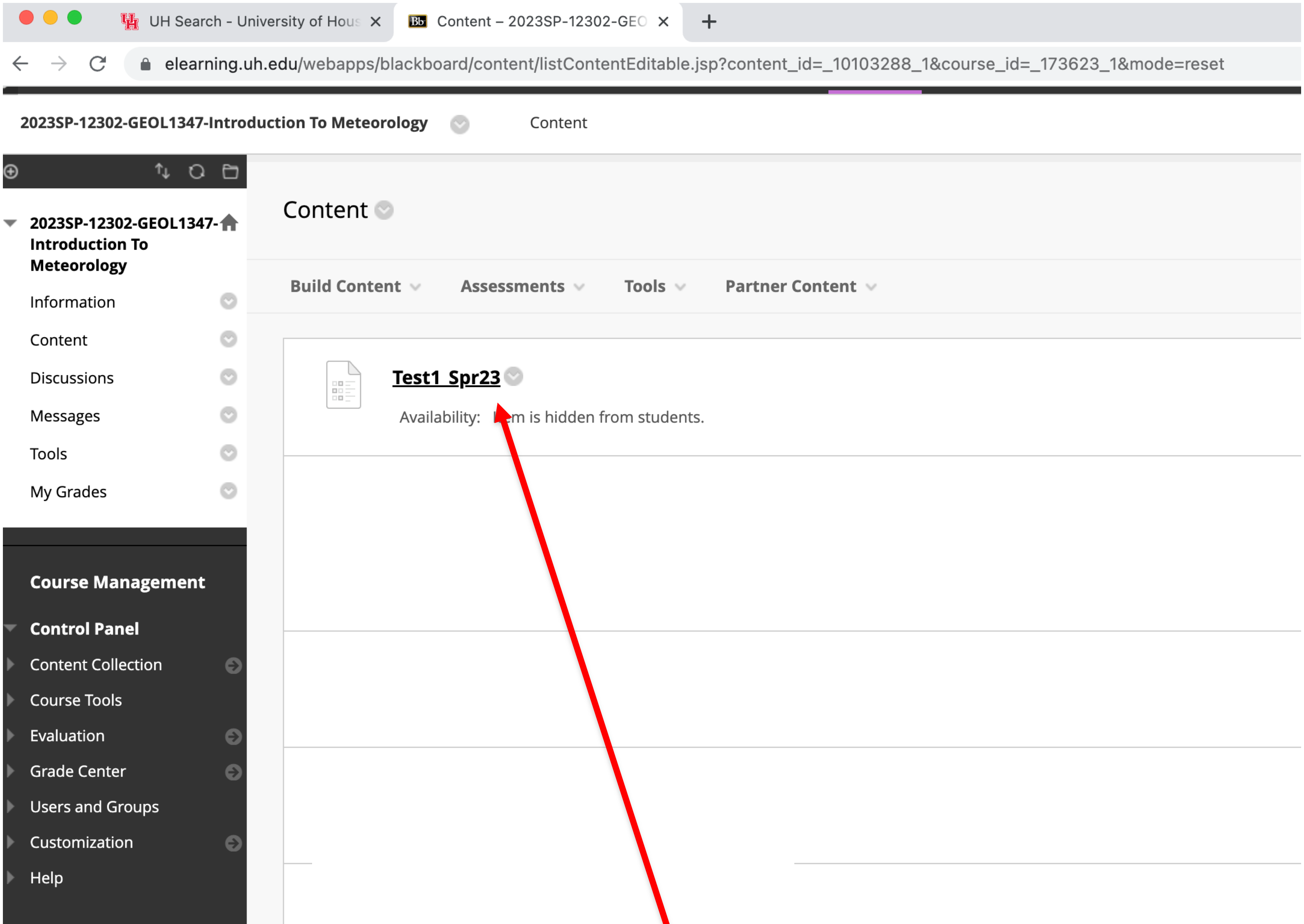


You should be able to see Test 1 after 1pm on Feb 7. Please finish the test during 1pm-2:30pm.

- The test is close book and close notes.
- There are 25 multiple choice questions.
- Time limit is 80 mins.
- Once started, the test must be completed in one sitting. Do not leave test before clicking save and submit.
- The test will save and submit automatically when the time expires.
- Please take the test during 1pm-2:30pm on Feb 7.
- You can use a scientific calculator.

Exam 1

Cover: L1 (The Earth's Atmosphere I); L2 (The Earth's Atmosphere II); L3 (Warming the Earth and Atmosphere I); L4 (Warming the Earth and Atmosphere II)

Close-book Exam

Exam counts 25% of the total grade.

Earth's Atmosphere

- Gravity ---- Reason for "Orange skin" atmosphere

Gravitational attraction has compressed the atmosphere into a shallow layer.

What is the composition of the Earth's atmosphere?

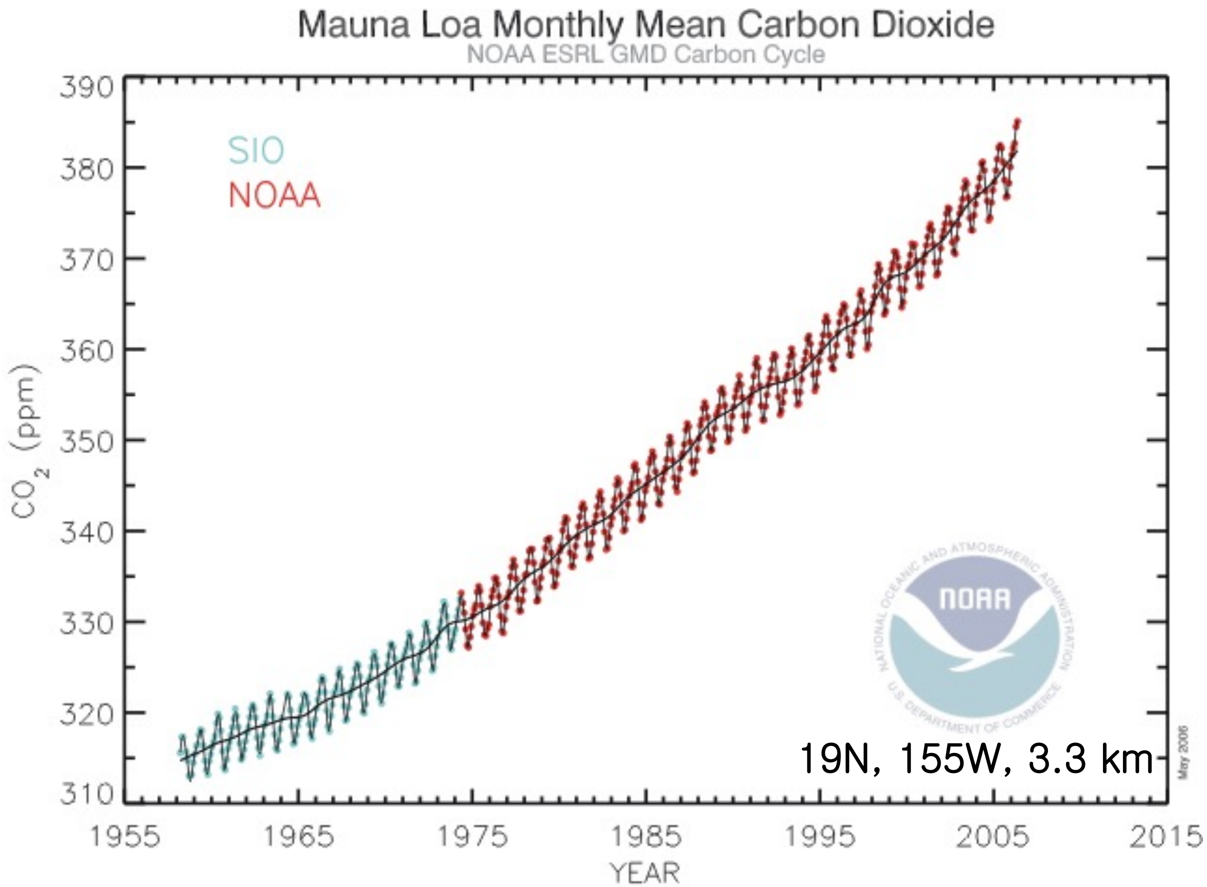
Permanent Gases

Name of the gas		Molecular weight (g/mol)	Percentage
Nitrogen	N_2	28.01	78.08%
Oxygen	O_2	32.00	20.95%
Argon	Ar	39.95	0.93%
Neon	Ne	20.18	0.0018%
Helium	He	4.00	0.0005%
Hydrogen	H_2	2.02	0.00006%
Xenon	Xe	131.30	0.000009%

Variable Gases

Name of the gas		Molecular weight	Percentage
Water vapor	H_2O	18.02	< 4.%
Carbon dioxide	CO_2	44.01	0.038%
Methane	CH_4	16.04	0.00017%
Nitrous oxide	N_2O	44.01	0.00003%
Ozone	O_3	48.00	0.000004%
Particles (dust, soot, etc.)			0.000001%
Chloroflourocarbons	CFCs		0.00000002%

Trace Constituents



Atmospheric carbon dioxide monthly mean mixing ratios. Data prior to May 1974 are from the Scripps Institution of Oceanography (SIO, blue), data since May 1974 are from the National Oceanic and Atmospheric Administration (NOAA, red). A long-term trend curve is fitted to the monthly mean values. Contact: Dr. Pieter Tans, NOAA ESRL GMD Carbon Cycle, Boulder, Colorado, (303) 497-6678, pieter.tans@noaa.gov, and Dr. Ralph Keeling, SIO GRD, La Jolla, California, (858) 534-7582, rkeeling@ucsd.edu.

Charles David Keeling

Increase in atmospheric CO2 from 1959 – 2004:

$\Delta(CO_2) \approx$ 377 ppmv - 315 ppmv = 62 ppmv

- **Longest continuous record**
- **Regional CO_2 trend**
- **CO_2 seasonal Cycle**

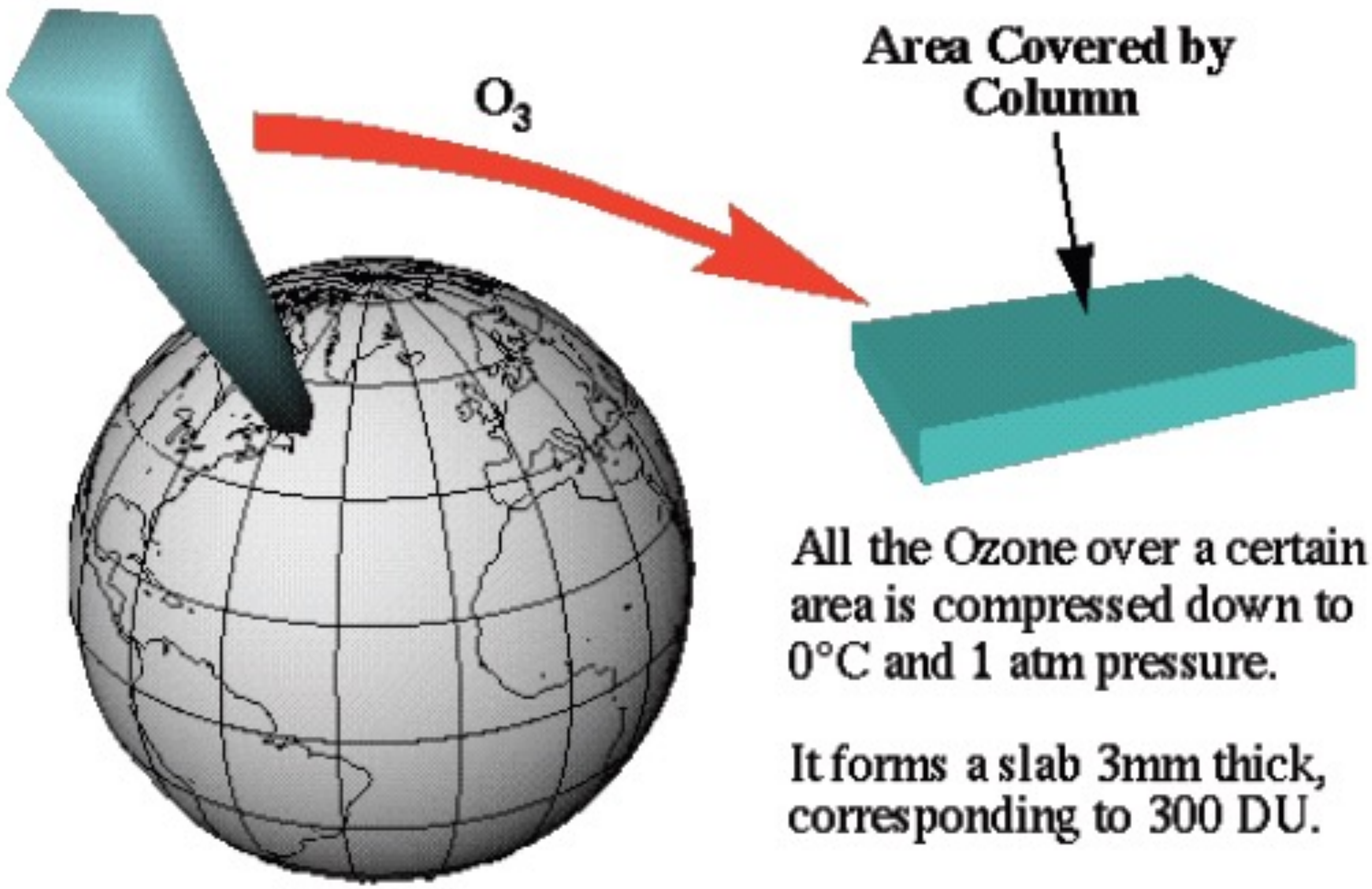
  High in winter (respiration)

  Low in summer (photosynthesis)

Keeling Atmospheric CO_2 Record

Column Ozone (Dobson Unit)

- Dobson Unit (DU) is the most common unit for measuring O3 concentration.



How did the atmosphere arrived at its currents state?

• The earth's first atmosphere (4.6 billion years ago) consisted mostly of He, $H_{2;}$ Most scientists feel that this early atmosphere escaped into space from the earth's hot surface.

• *Outgassing* (volcanic eruption) releases CO_2, N_2, H_2O, forming the earth's second atmosphere

Vorticity

Vorticity is a concept used in fluid dynamics.

It is the tendency for elements of the fluid to "spin".

If a parcel has a counterclockwise spin, it has a positive vorticity.

If a parcel has a clockwise spin, it has a negative vorticity

Standard Sea-Level Pressure

- 101.325 kPa
- 1013.25 hPa
- 101,325 Pa
- 101,325 N/m^2

Atmospheric Pressure at altitude z

$$P = P_o e^{-(a/T)z}$$

Pressure decreases approximately exponential with height

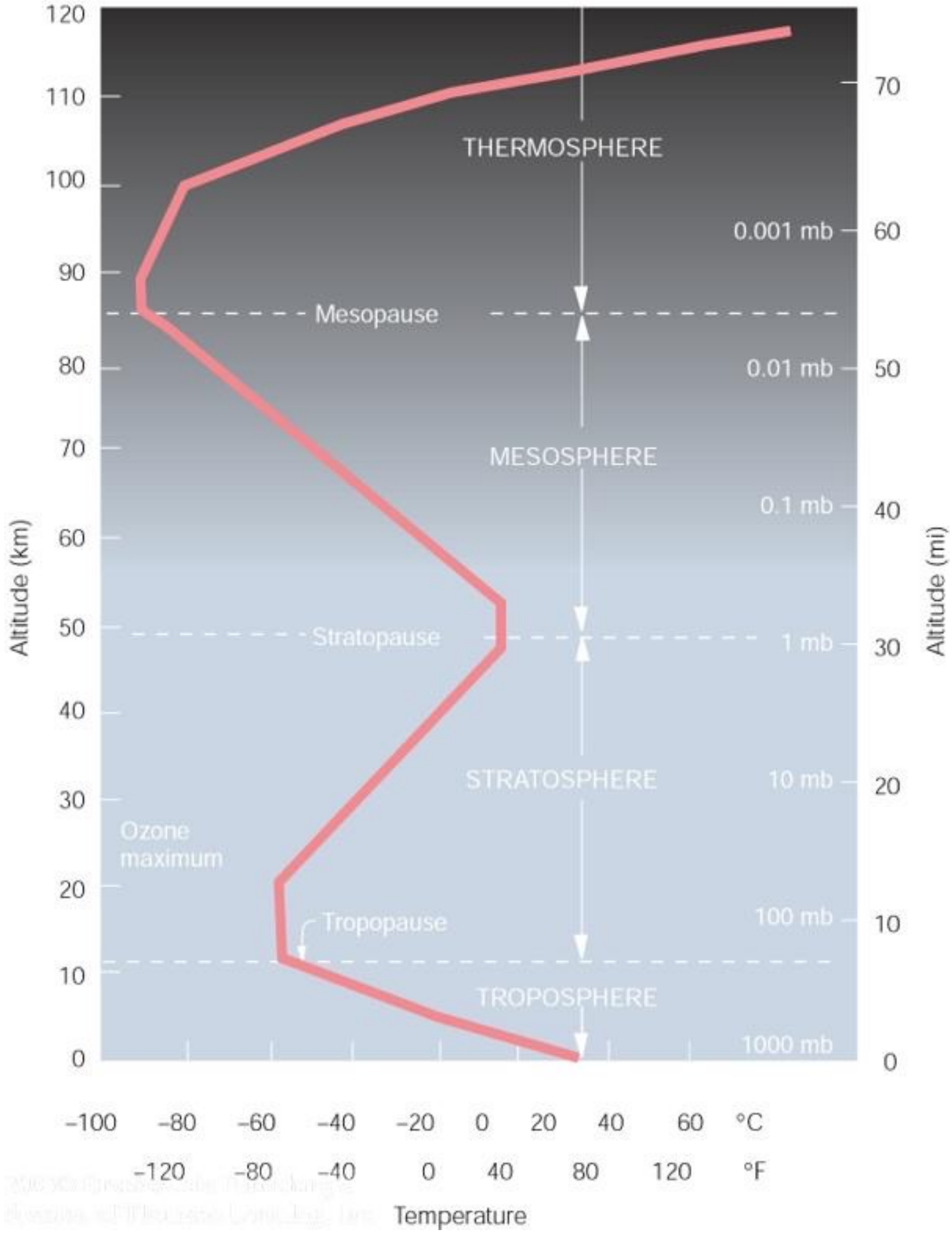
a = 0.0342 K/m
e = 2.71828

T = in Kelvin
z in m

$$P = P_o e^{-z/H_p}$$

$$H_p = 7.29\,km = 7290\,m$$

Scale height, or
e-folding distance of pressure



Thermosphere (85-500km): T increases with height. Absorption of highly energetic solar radiation by the small amount of residual oxygen.

Mesosphere (50-85 km): T decreases with height. No O_3 heating.

Stratosphere (11-50km); T increases with height as results of absorption of solar UV by stratospheric ozone.

Troposphere (0-11 km): T decreases with height at a rate of 6.5 K/km. Driven by surface heating.

Temperature **is a measure of average kinetic energy of a substance; simply, is a measure of average speed of air molecules**

High **temperatures corresponds to** ***faster*** **average molecule speeds**

Temperature scales - three commonly used scales:

- **Fahrenheit (°F)**
- **Celsius (°C)**
- **Kelvin (K)**

Forms of energy

kinetic energy **is the work that a body can do by virtue of its motion** $KE = \frac{1}{2} m v^2$

Potential energy **is the work an object can do as a result of relative position, or the *potential* to do work, or stored energy that can be converted to other forms of energy.**

$PE = m \times g \times h$ m - mass, g - acceleration of gravity, h – object's height above ground

Internal Energy **– total energy stored in an object (potential + kinetic)**

Wavelength & Frequency Specification

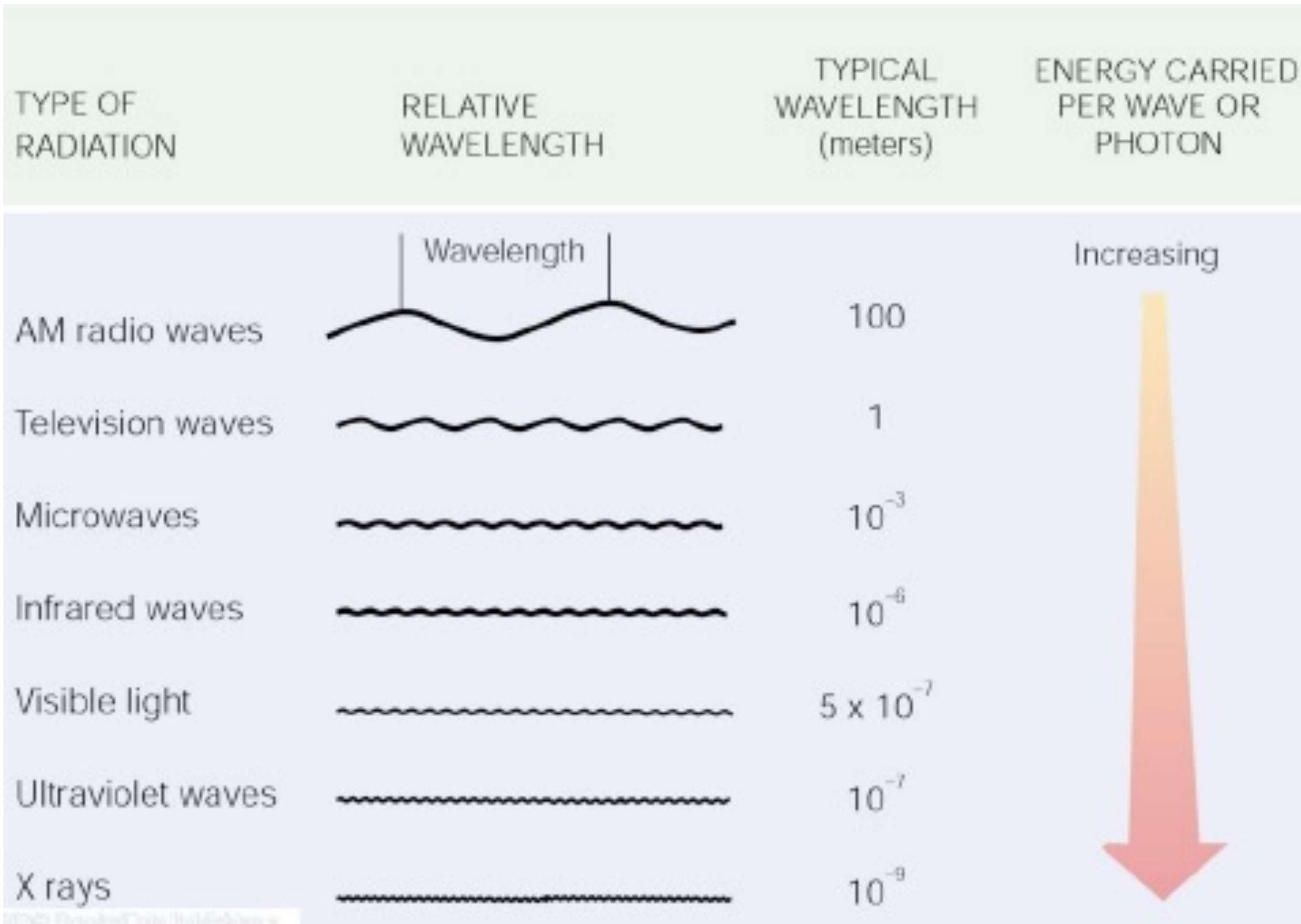
- Relation between wavelength and frequency
- $\lambda\nu = c$
- λ is wavelength, ν is frequency, and c is speed of light.
- Since c is a constant, shorter (longer) wavelength corresponds to a high (low) frequency.

Particulate Nature of Radiation

- The energy of a photon is
- $E = h\nu$
- Where h = Planck's constant = 6.6261×10^{-34} Js^{-1}, ν = frequency (hz).

- Each photon's energy is related to the electromagnetic wave frequency (ν).

Radiation Characterized by Wavelength



Longer waves carry less energy than the shorter waves.

Basic laws for radiation

Stefan-Boltzman law: **The amount of energy per square meter per second that is emitted by an blackbody is related to the 4th power of its Kelvin temperature**

$$E = \sigma T^4$$

where E is in $J\ s^{-1}\ m^{-2}$ or Watts m^{-2}

$\sigma = 5.67 \times 10^{-8}\ W\ m^{-2}\ K^{-4}$ ***Stefan-Boltzman constant***

A warmer object emits much more radiation than a cooler object

Wien's law:

Wavelength of peak radiation emitted by an object is inversely related to temperature

λ_{max} = 2897 / T ~ 3000/T

(λ_{max} is in μm and T is in Kelvin)

Solar radiation : $\lambda_{max\ sun}$ ~ 3000/6000 K ~ 0.5 μm,

Earth radiation: $\lambda_{max\ earth}$ ~ 3000/300 K ~ 10 μm,

Solar radiation is shortwave radiation

Earth radiation is longwave radiation