



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>

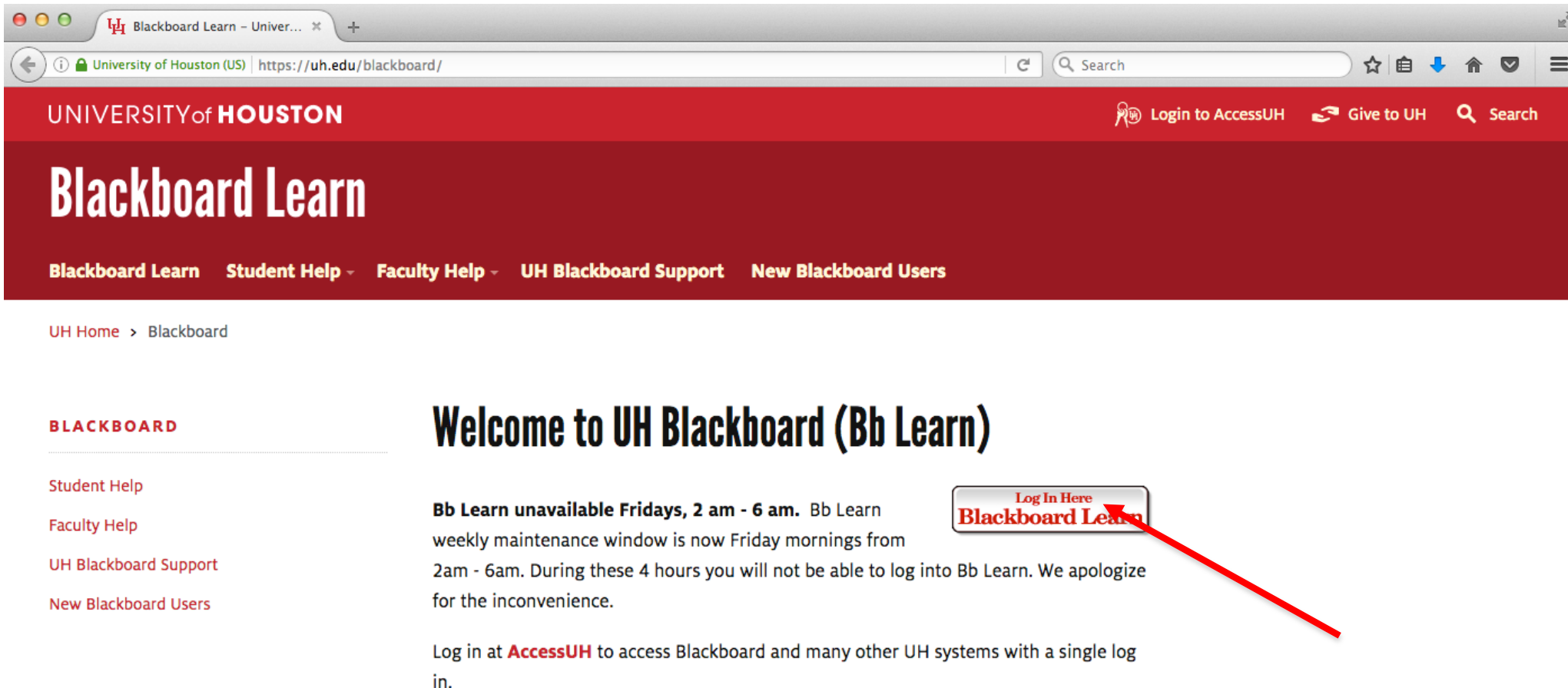
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Password: #class#

Exam 1

Online Test on Blackboard

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



UNIVERSITY of HOUSTON

Blackboard Learn

Blackboard Learn Student Help Faculty Help UH Blackboard Support New Blackboard Users

UH Home > Blackboard

BLACKBOARD

Student Help

Faculty Help

UH Blackboard Support

New Blackboard Users

Welcome to UH Blackboard (Bb Learn)

Bb Learn unavailable Fridays, 2 am - 6 am. Bb Learn weekly maintenance window is now Friday mornings from 2am - 6am. During these 4 hours you will not be able to log into Bb Learn. We apologize for the inconvenience.

Log in at **AccessUH** to access Blackboard and many other UH systems with a single log in.

Log In Here
Blackboard Learn

The screenshot shows a web browser window with the title "Welcome (UH) - Blackboard...". The address bar displays the URL "https://elearning.uh.edu/webapps/portal/execute/tabs/tabAction?tab_tab_group_id=_6_1". The page content is divided into two main sections. The top section, titled "Login Here", contains links for "Change Text Size", "High Contrast Setting", and "Privacy and Terms of Use". Below these links, a message states "You are not logged in" and provides information about the University of Houston's computing and networking facilities, including a warning about unauthorized use and links to security policies. The login form consists of two input fields: "USERNAME" and "PASSWORD", followed by a "Login" button. The bottom section, titled "My Announcements", displays a message: "No Institution Announcements have been posted in the last 7 days." and a link for "more announcements...".

Login Here

[Change Text Size](#) | [High Contrast Setting](#) | [Privacy and Terms of Use](#)

You are not logged in

Use of University of Houston and University of Houston-Victoria computing and networking facilities requires prior authorization. Unauthorized use is prohibited. Usage may be subject to security testing and monitoring. Misuse is subject to criminal prosecution. Users have no expectations of privacy except as otherwise provided by applicable privacy laws. A complete manual of security policies and procedures is available for UH students at <http://www.uh.edu/infotech>. UHV students can review the security policies and procedures available at <http://www.uhv.edu/fin/policy/g/g-2.aspx>. Enter your username and password.

USERNAME

PASSWORD

Login

My Announcements

No Institution Announcements have been posted in the last 7 days.

[more announcements...](#)

Username and password are your Cougarnet username and password.

UH Search - University of Hou X

myCourses - Blackboard Learn X

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elearning.uh.edu/webapps/portal/execute/tabs/tabAction?tab_tab_group_id=_42_1

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...



Connect your students to their required and supplemental course materials through Blackboard using the UH Libraries' Course Reserves service. The Libraries can help you obtain and post copyright-cleared articles, book chapters and more for your students to access easily through Blackboard. Use the available self-service options or let our friendly Course Reserves staff take care of everything for you!

Website: <https://libraries.uh.edu/services/course-reserves/>

Email: libreserves@uh.edu

Phone: 713-743-9730

Emergency Preparedness Faculty Guide

5

UH Search - University of Houston x Content - 2023SP-12302-GEO x +

elearning.uh.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_10103288_1&course_id=_173623_1&mode=reset

2023SP-12302-GEO1347-Introduction To Meteorology Content

Content

Build Content Assessments Tools Partner Content

Test1 Spr23

Availability: Item is hidden from students.

Course Management

- Control Panel
 - Content Collection
 - Course Tools
 - Evaluation
 - Grade Center
 - Users and Groups
 - Customization
 - Help

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?

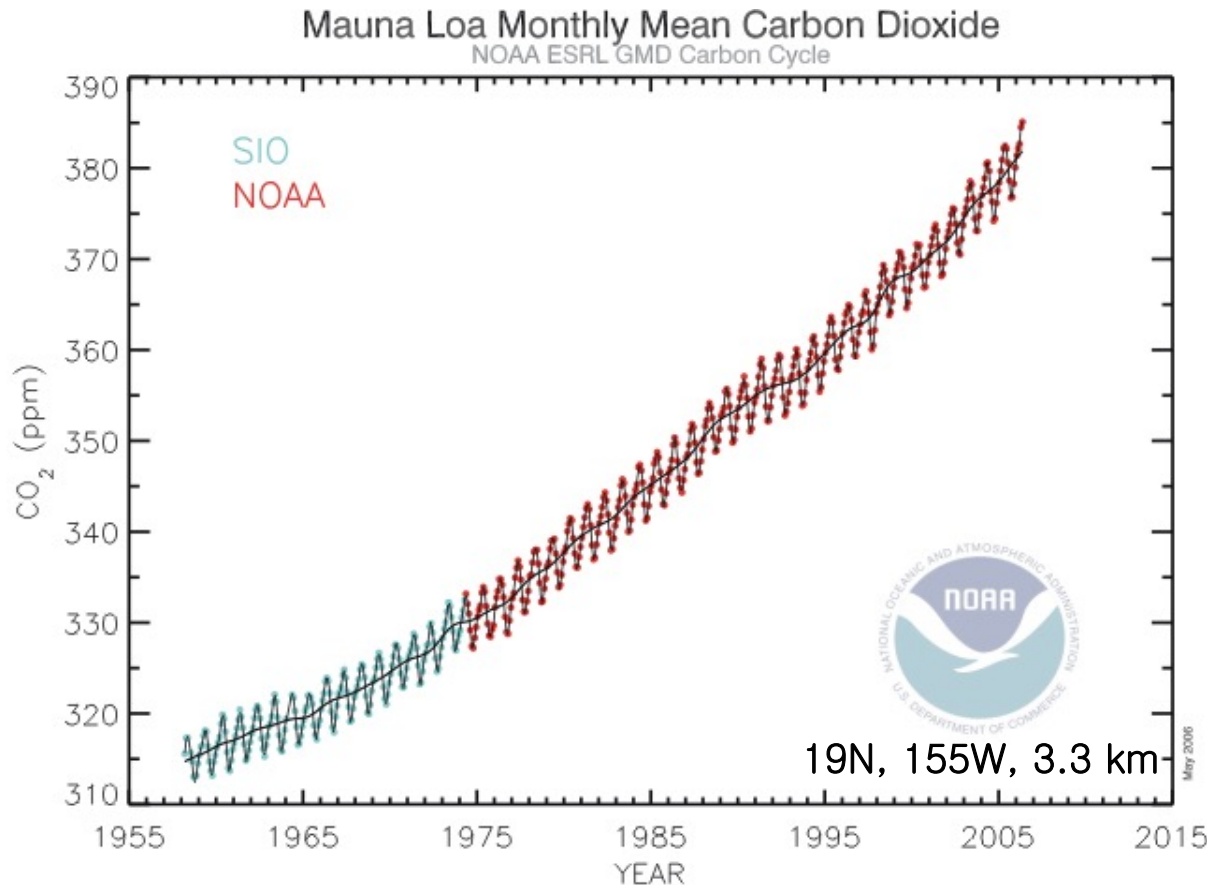
Permanent Gases

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 ₂ O	18.02	< 4.%
• Carbon dioxide	CO ₂	44.01	0.038%
• Methane	CH ₄	16.04	0.00017%
• Nitrous oxide	N ₂ O	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.

Increase in atmospheric CO₂ from 1959 – 2004:
 $\Delta(\text{CO}_2) \approx 377 \text{ ppmv} - 315 \text{ ppmv} = 62 \text{ ppmv}$



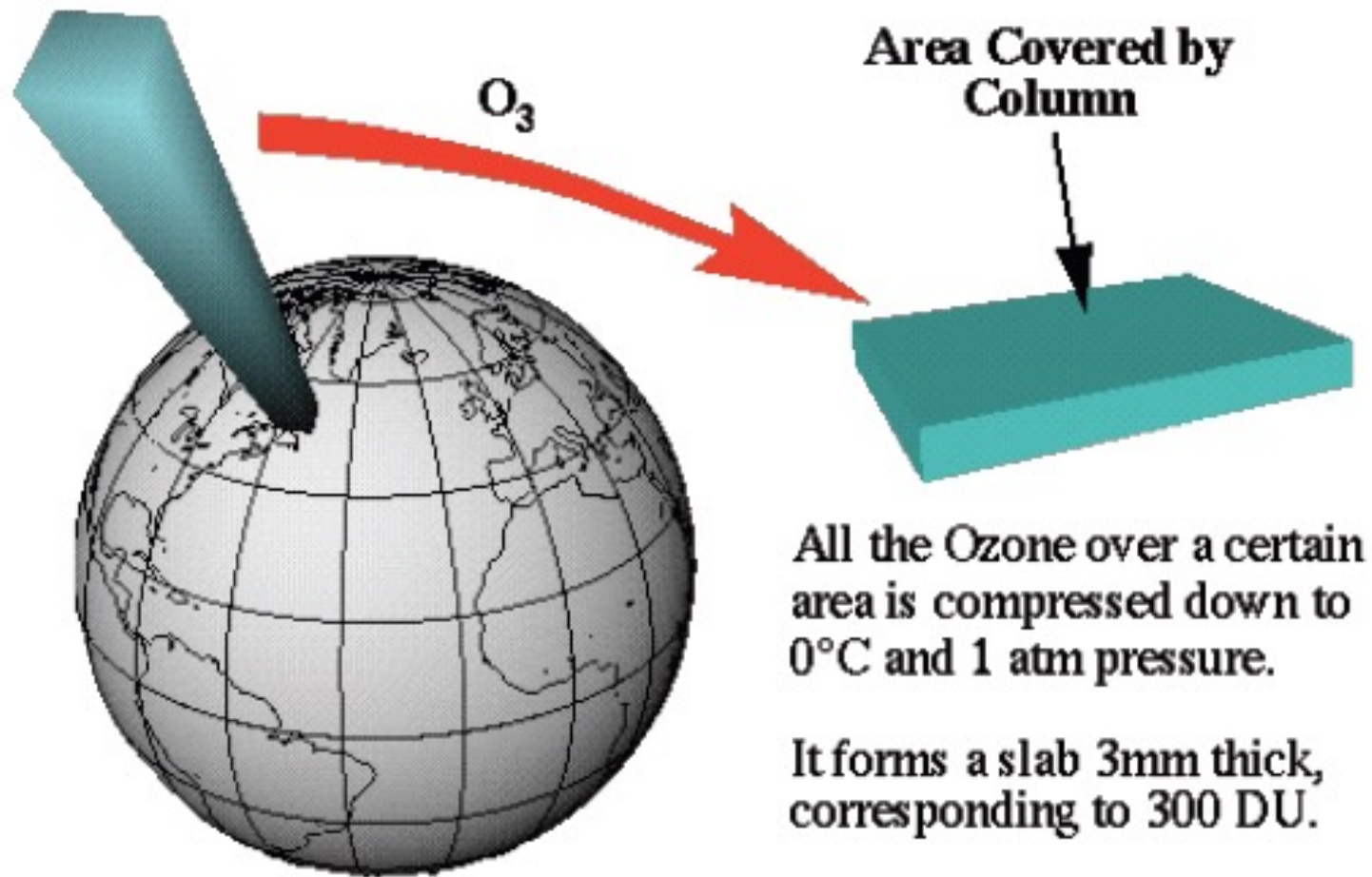
Charles David Keeling

- **Longest continuous record**
- **Regional CO₂ trend**
- **CO₂ seasonal Cycle**
High in winter (respiration)
Low in summer (photosynthesis)

Keeling Atmospheric CO₂ 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, H₂. Most scientists feel that this early atmosphere escaped into space from the earth's hot surface.
- *Outgassing* (volcanic eruption) releases CO₂, N₂, H₂O, 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/m²

Atmospheric Pressure at altitude z

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

Pressure decreases approximately exponential with height

$a = 0.0342 \text{ K/m}$

$T = \text{in Kelvin}$

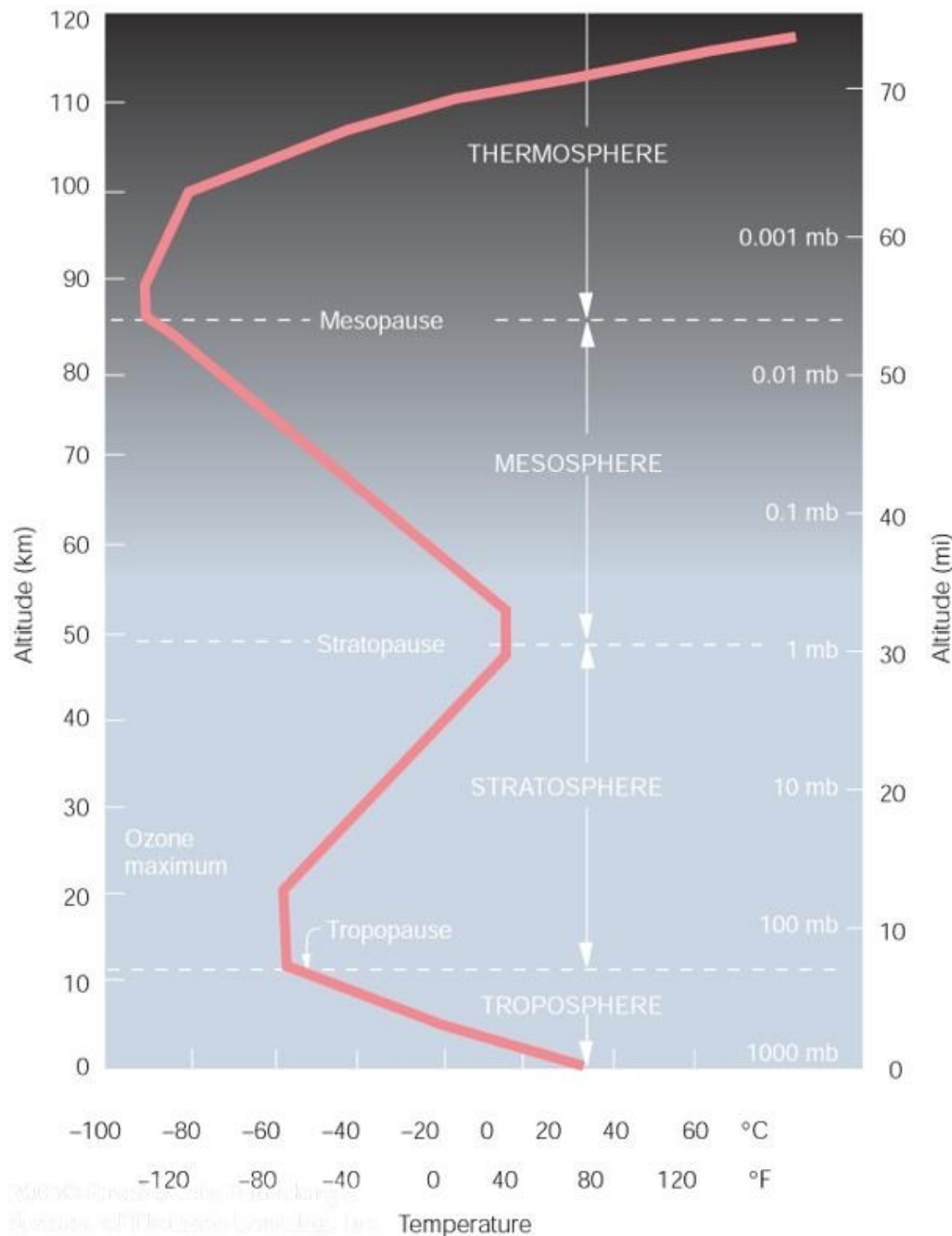
$e = 2.71828$

$z \text{ in m}$

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

$$H_p = 7.29 \text{ km} = 7290 \text{ m}$$

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 O₃ 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 = $6.6261 \times 10^{-34} \text{Js}^{-1}$, ν = frequency (hz).
- Each photon's energy is related to the electromagnetic wave frequency (ν).

Radiation Characterized by Wavelength

TYPE OF RADIATION	RELATIVE WAVELENGTH	TYPICAL WAVELENGTH (meters)	ENERGY CARRIED PER WAVE OR PHOTON
AM radio waves		100	 Increasing
Television waves		1	
Microwaves		10^{-3}	
Infrared waves		10^{-6}	
Visible light		5×10^{-7}	
Ultraviolet waves		10^{-7}	
X rays		10^{-9}	

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 $\text{J s}^{-1} \text{m}^{-2}$ or Watts m^{-2}

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

$$\lambda_{\max} = 2897 / T \sim 3000/T$$

(λ_{\max} is in μm and T is in Kelvin)

Solar radiation : $\lambda_{\max \text{ sun}} \sim 3000/6000 \text{ K} \sim 0.5 \mu\text{m}$,

Earth radiation: $\lambda_{\max \text{ earth}} \sim 3000/300 \text{ K} \sim 10 \mu\text{m}$,

Solar radiation is **shortwave radiation**

Earth radiation is **longwave radiation**