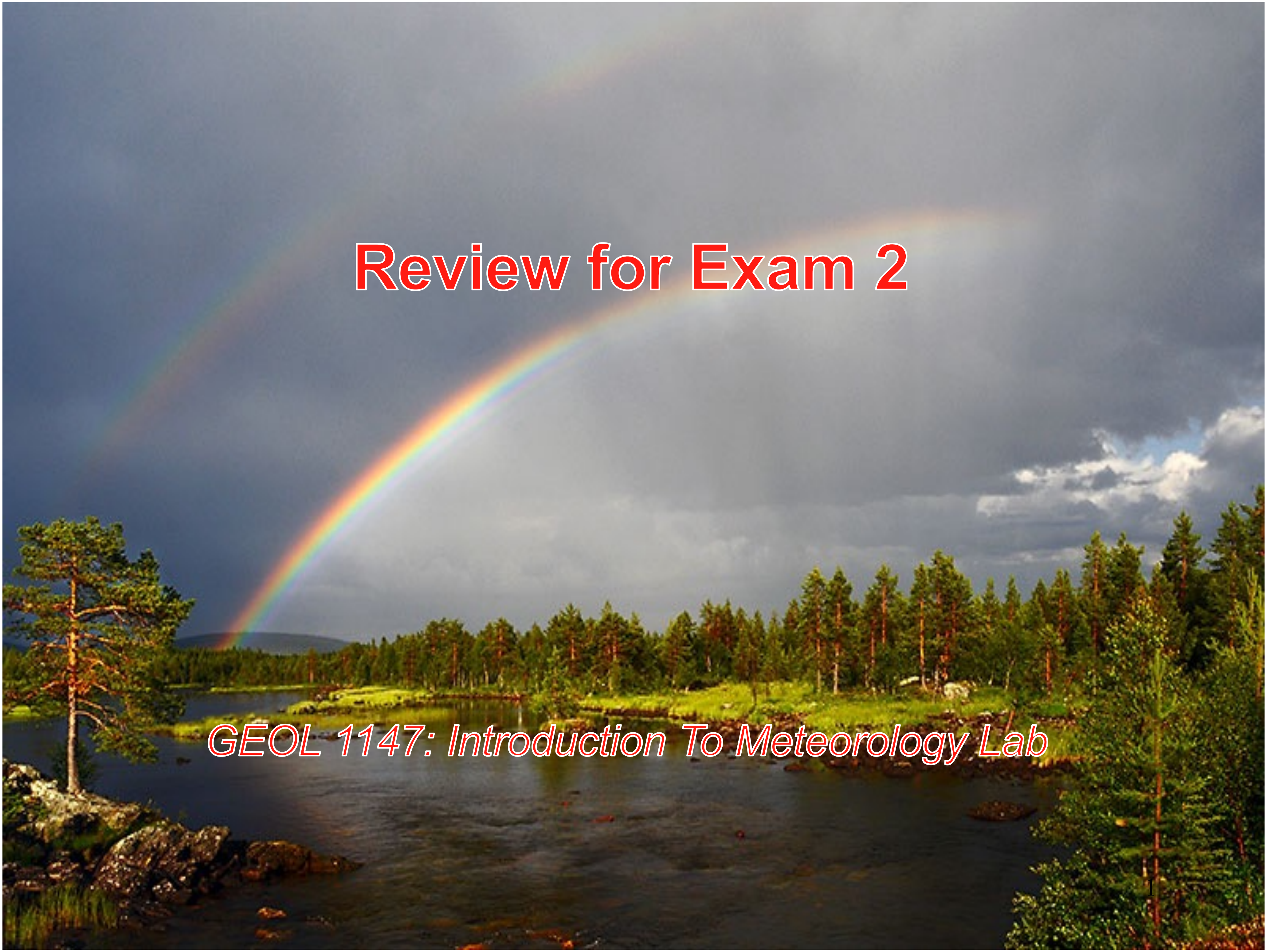

Review for Exam 2
GEOL 1147: Introduction To Meteorology Lab

Exam 2

Cover: Labs 3-5

Close-book Exam

You can bring a calculator with you.

Exam counts 22.5% of the total grade.

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*

As T increases, E increases by a power of 4. If T doubles, E increases by 16 times!

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

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

Solar radiation is shortwave radiation

Earth radiation is longwave radiation

Greenhouse 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%

Albedo

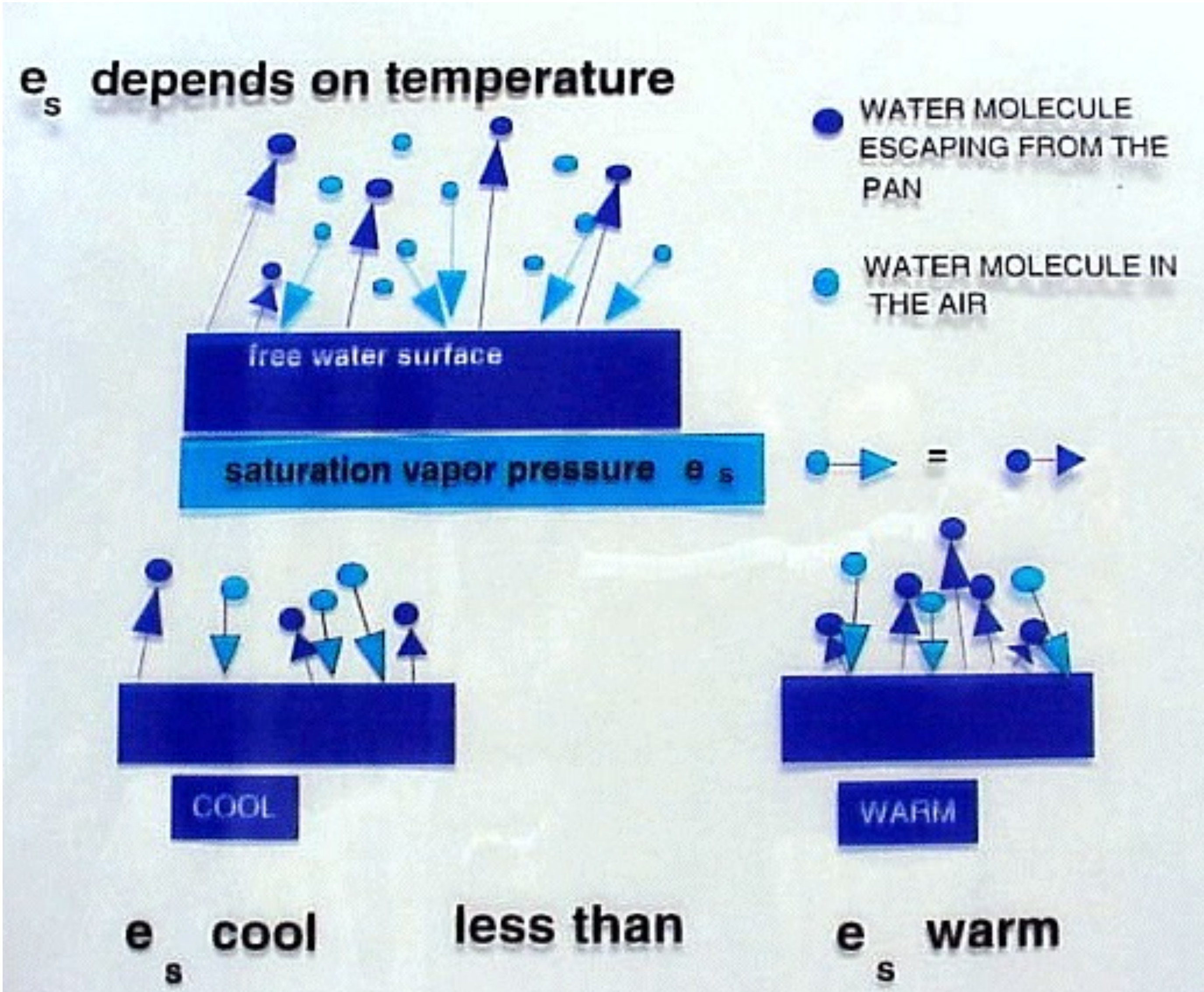
SURFACE	ALBEDO (PERCENT)
Fresh snow	75 to 95
Clouds (thick)	60 to 90
Clouds (thin)	30 to 50
Venus	78
Ice	30 to 40
Sand	15 to 45
Earth and atmosphere	30
Mars	17
Grassy field	10 to 30
Dry, plowed field	5 to 20
Water	10*
Forest	3 to 10
Moon	7

*Daily average.

Vapor pressure - e

- Air molecules all contribute to pressure p
- Each subset of molecules (e.g., N_2, O_2, H_2O) exerts a partial pressure
- The vapor pressure, e, is the pressure exerted by water vapor molecules in the air
  - similar to atmospheric pressure, but due only to the water vapor molecules
  - 2-30 mb common at surface
  - the larger the vapor pressure is, the more water vapor molecules in the atmosphere

Saturation vapor pressure e_s depends upon temperature
higher temperature, higher e_s,
more water vapor that the air can hold



Mixing Ratio - r

- Ratio of mass of water to mass of <u>dry</u> air in a unit volume
- Invariant to change in volume

$$r = \frac{m_v}{m_d}$$

Relative Humidity – R.H.

The ratio of the amount of water vapor in the air compared to the amount required for saturation.

R.H. = water vapor content / water vapor capacity

$$\text{R.H.} = \frac{e}{e_s(T)} = \frac{\tilde{n}_v}{\tilde{n}_{vs}(T)} = \frac{q}{q_s(T)} = \frac{r}{r_s(T)}$$

Higher relative humidity does not necessarily mean more water vapor in the air

Dew Point Temperature - T_d

- Temperature to which air must be cooled (at constant pressure and constant water vapor content) to become saturated.
- When $T=T_d$, $e_s(T_d) = e$, $q_s(T_d) = q$, $r_s(T_d) = r$
- $T_d \leq T$
- Unlike relative humidity which is a measure of how near the air is to being saturated, dew point temperature is a measure of its actual moisture content. *The higher the dew point, the more water vapor in the air.*

- Dew point depression: $T- T_d$
- The larger the dew point depression is, the drier the air is, or the air is farther away from saturation

Moist adiabatic lapse rate

Decrease of temperature with height for saturated air

Γ_s always < Γ_d