

And The

**ANSWER IS...**

Atmospheric  
Structure and  
Composition

Radiation  
Laws

Matter &  
Thermo-  
dynamics

Time Series  
& Energy

Odds &  
Ends

100

100

100

100

100

200

200

200

200

200

300

300

300

300

300

400

400

400

400

400

500

500

500

500

500

# This gas is NOT a Greenhouse Gas.

What is...

1.  $O_2$




2.  $O_3$

3.  $CH_4$

4. Freon-11 (a CFC)

# The gases: H<sub>2</sub>O and CO<sub>2</sub>.

## What are...

1. The two most abundant gases.
2. The two most abundant Greenhouse gases. 
3. The two most abundant anthropogenically enhanced Greenhouse gases.
4. The two gases that comprise 99% of the atmosphere



The observation that “the atmosphere is heated from below” is most evident in this layer.

What is...

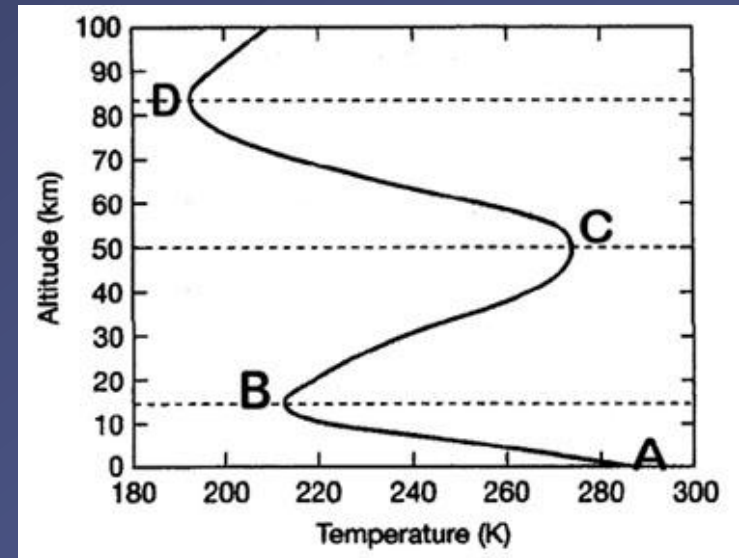
1. Layer A - B



2. Layer B - C

3. Layer C - D

4. Layer D and above



**The average temperature in this layer of the atmosphere gets cooler with increasing altitude.**

What is the...

1. TROPOSPHERE
2. TROPOPAUSE
3. STRATOSPHERE
4. THERMOSPHERE



# The residence time of CO<sub>2</sub> gas molecules, once they get into the atmosphere.

What is...

1. ~10-12 years

2. ~50 years

3. ~100 years



4. ~ 500 years



**N<sub>2</sub>, N, O and O<sub>2</sub> are effective absorbers of extremely harmful X-ray and UVC radiation in this layer.**

What is...

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere





# The Radiation Laws that best explains why absorption curves exist.

What is...

1. The hotter the body, the shorter the wavelength

$$\lambda_m = a / T$$

$$E = hc / \lambda$$

2. Shorter electromagnetic wavelengths have higher intensity radiation than longer wavelengths

3. The hotter the body, the (much) greater the amount of energy flux or radiation

$$E = \sigma T^4$$

4. Some substances emit and absorb radiation at certain wavelengths only.



The reason the relatively cooler Earth radiates its energy in longwave radiation, in contrast to the Sun which radiates most of its energy in short wave radiation: What is...

1. The hotter the body, the shorter the wavelength

$$\lambda_m = a / T$$



2. Shorter electromagnetic wavelengths have higher intensity radiation than longer wavelengths

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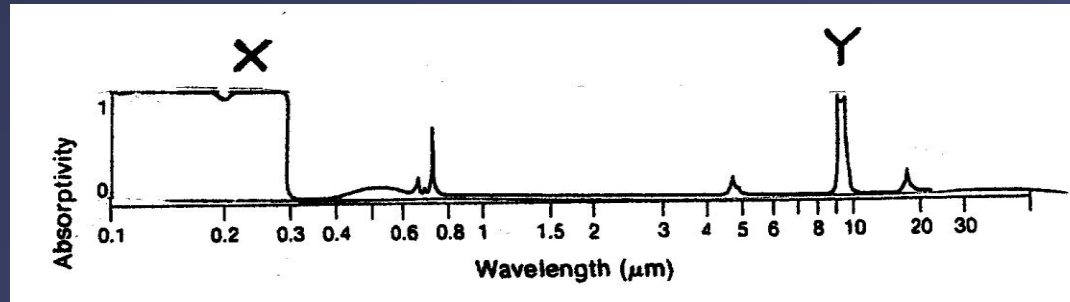
$$E = \sigma T^4$$

4. Some substances emit and absorb radiation at certain wavelengths only.



# The part of this O<sub>3</sub> absorption curve that is linked to OZONE'S absorption of harmful UV radiation in the stratosphere.

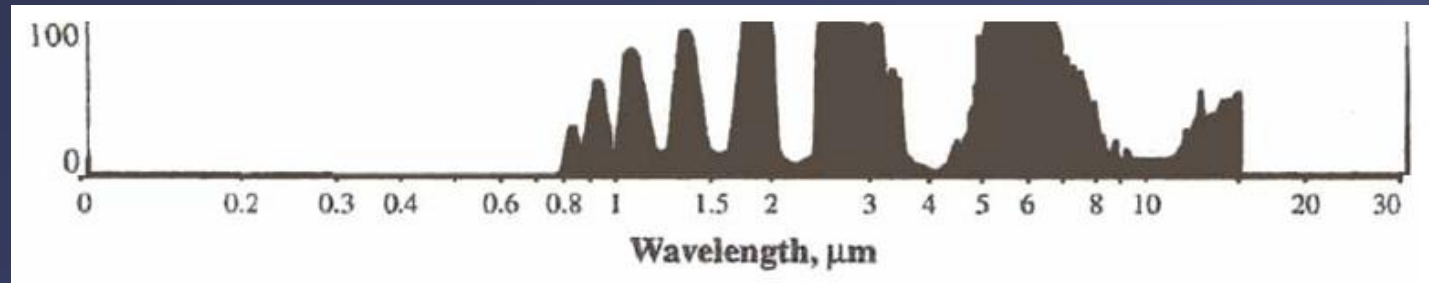
What is...



1. Part X of the absorption curve
2. Part Y of the absorption curve
3. Both Parts X & Y working together
4. Neither X or Y – this is NOT an absorption curve!



# This curve represents absorption by:



What is...

1. A blackbody
2. A gas that is NOT a Greenhouse Gas
3. All the gases in the atmosphere as a whole
4. A gas that absorbs ONLY infrared wavelengths of radiation



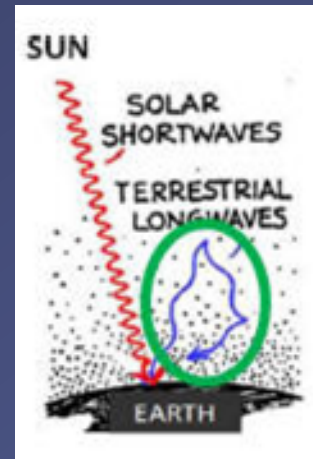
What is...

The Greenhouse Effect is best represented by the circled area in this sketch:

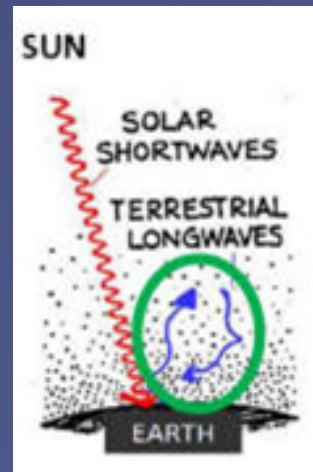
1. This one:



2. This one:




3. This one



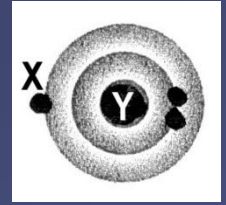
The reason why -- if Global Warming is occurring --we should be able to detect it FIRST in LAND SURFACE temperatures rather than OCEAN SURFACE temperatures.

### What is...

1. The **specific heat & heat capacity** of WATER is higher than that of SOIL, hence water heats up more slowly than soil. 
2. The **specific heat & heat capacity** of SOIL is higher than that of LAND, hence soil heats up more slowly than water.
3. The **reflectivity** of WATER is higher than that of SOIL, hence it will absorb more radiation



The number of positively charged protons the nucleus of this neutral lithium atom contains.



What is...

1. One

2. Two

3. Three




4. None - the nucleus contains photons, not protons!



# Energy transfer by means of vibrational energy from one molecule to the next through a substance.

## What is...

1. Convection
2. Conduction 
3. Radiation
4. Latent Energy

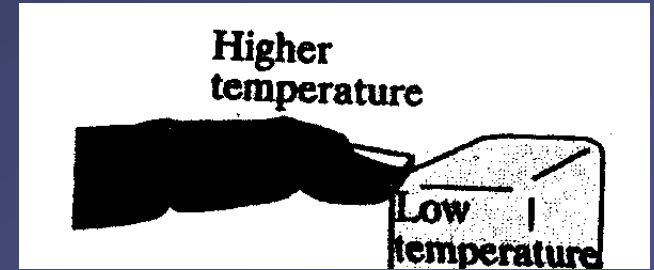




# How thermal energy will flow in this diagram, based on the 2nd Law of Thermodynamics

What is...

1. By means of CONVECTION



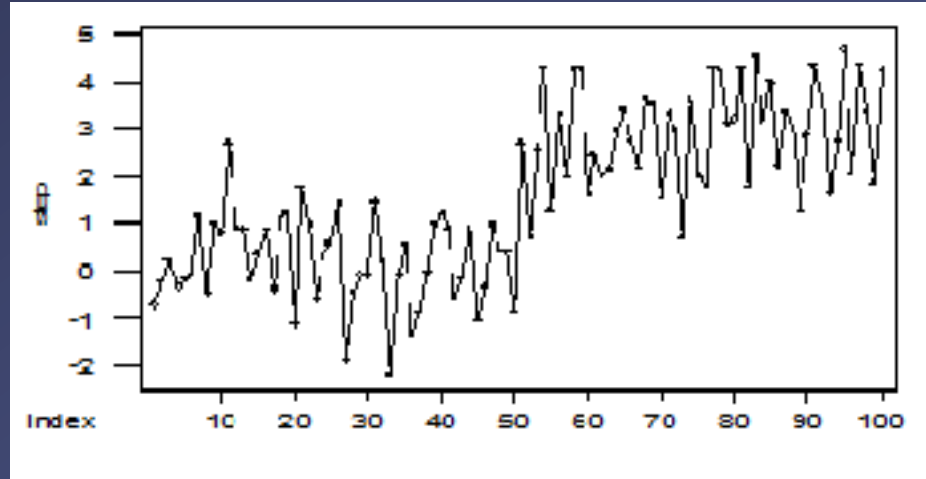
2. From the ICE CUBE to the FINGER


3. From the FINGER to the ICE CUBE



# What this TIME SERIES is illustrating:

## What is...



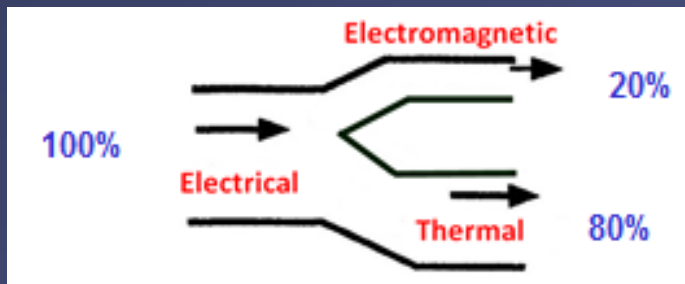
1. A constant mean
2. Quasi-periodicity
3. Abrupt change 
4. An increasing trend in the variance



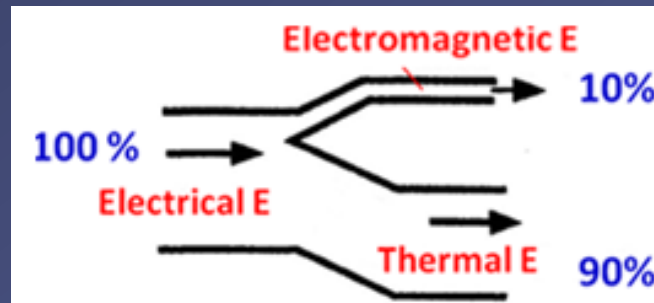
Of these choices, the energy flow diagram for an old-fashioned incandescent light bulb (the kind that should be replaced):

What is...

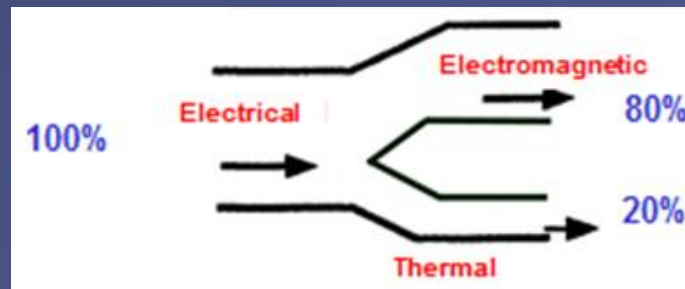
1.



2.



3.



# The term used to describe motion-related energy.

What is...

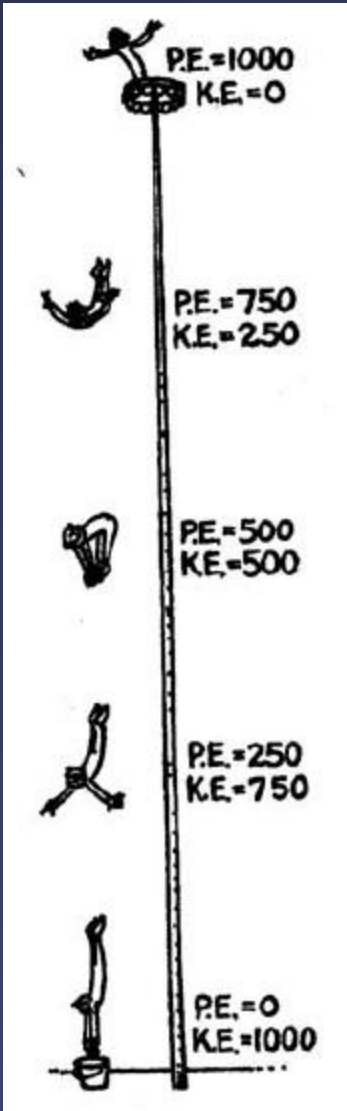
1. Potential energy
2. Electromagnetism
3. Kinetic energy
4. Gravitational energy



# The Law illustrated by this diagram of the diver's plunge to the ground is:

What is...

1. Stefan-Boltzmann
2. Sustainability
3. Conservation of Energy
4. Inverse square



The word that best completes this sentence:  
“Energy may not be destroyed,  
but it can become \_\_\_\_\_.”

What is...

1. Matter
2. Mass
3. Inefficient



# The wavelength range of infrared radiation.

What is...

1.  $< 0.4$  micrometers

2.  $> 0.7$  micrometers



3. 400 – 700 nanometers

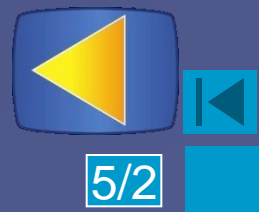
4. Longer wavelengths than microwaves



# The key factor that makes certain gases act as greenhouse gases!

What is...

1. They are diatomic
2. They absorb shortwave radiation and emit longwave radiation
3. They easily reflect IR radiation back to the Earth's surface
4. They absorb and emit infrared radiation





# The tree ring core that represents a tree that is highly SENSITIVE to climate & good for crossdating:

What is...

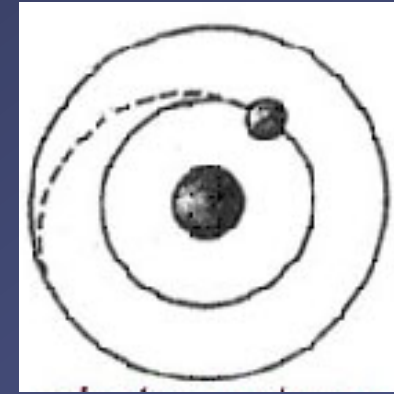
1. This one:




2. This one:



What occurs in an atom when an electron takes a quantum leap from a higher to a lower energy level.



What is...

1. A photon is emitted 
2. A photon is absorbed
3. There is no change because energy is conserved.



# Quantum behavior of certain molecules (bending, rotation, vibrations)

## What is...

1. Why photons leap to higher energy states
2. Behavior explained by Newton's Laws
3. The reason LE is not sensed as heat
4. The reason some gases are greenhouse gases and others are not.





**THE END!**