B.SC. (V SEMESTER)
PHYSICAL CHEMISTRY
BLACK BODY RADIATION

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DEPARTMENT OF CHEMISTRY

CONTENTS

BLACK BODY

A perfectly black body is defined as one which absorbs all the heat radiations incident on it. This property is valid for radiation corresponding to all wavelengths and to all angles of incidence. Therefore, the black body is an ideal absorber of incident radiation.

LAWS OF BLACK BODY RADIATION

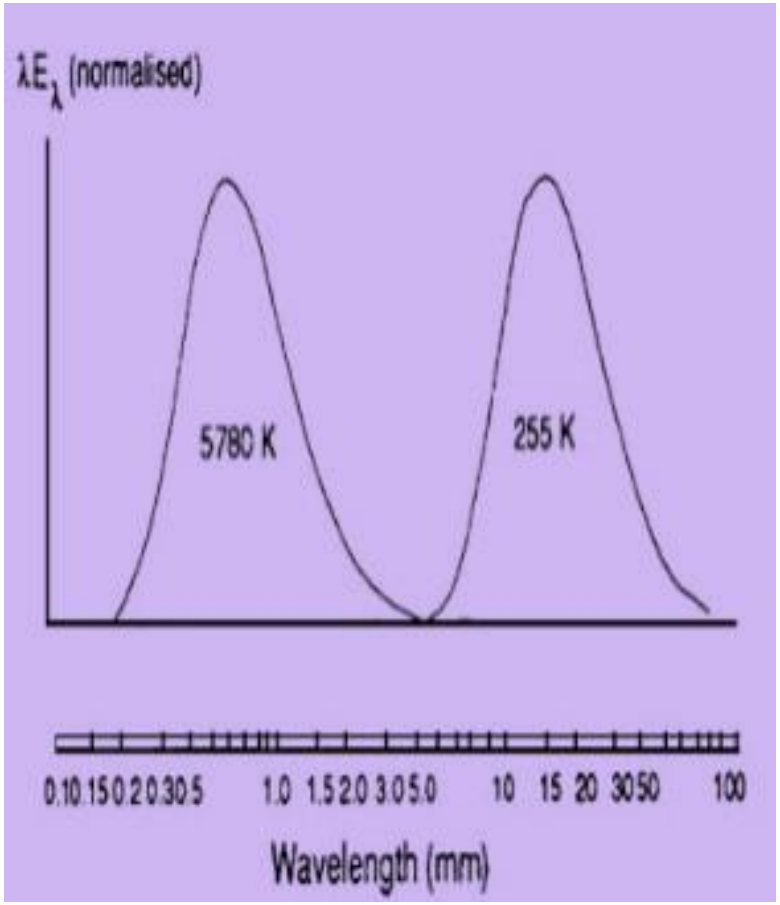
THE STEPHEN-BOLTZMANN LAW

The energy radiated by a black body radiator per second per unit area is directly proportional to the fourth power of the absolute temperature.

- Gives the total energy being emitted at all wavelengths by the black body.
- Explains the growth in the height of the curve as the temperature increases.

LAWS OF BLACK BODY RADIATION

THE STEPHEN-BOLTZMANN LAW



LAWS OF BLACK BODY RADIATION

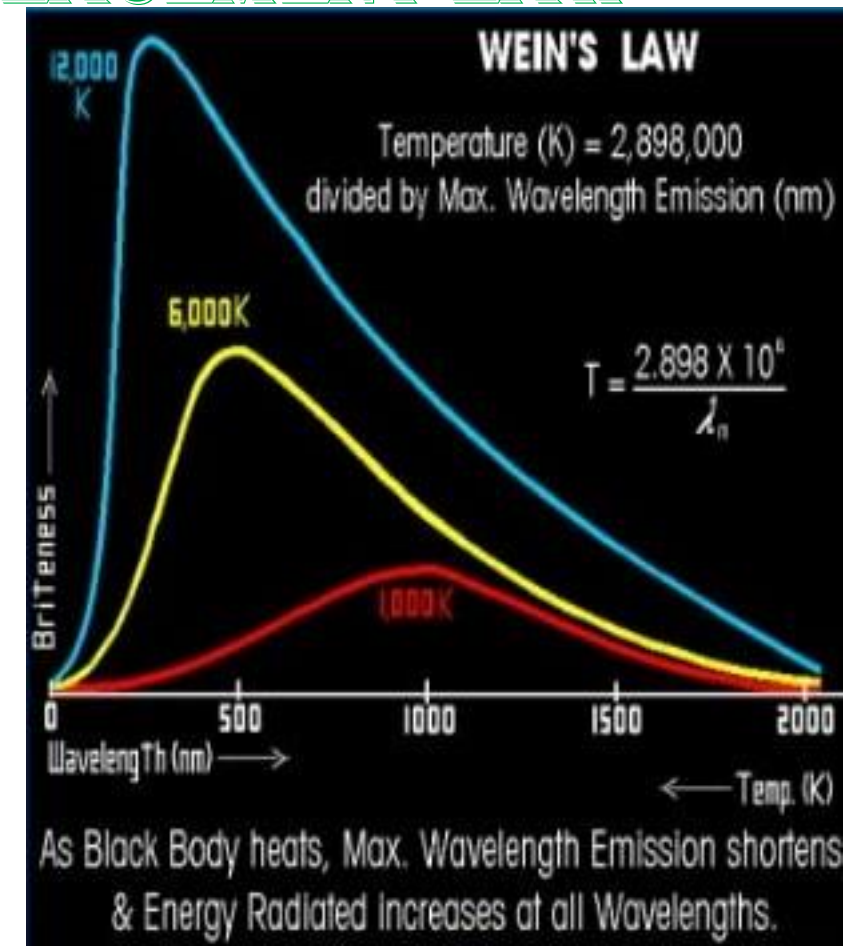
WIEN DISPLACEMENT LAW

The black body radiation curve for different temperature peaks at a wavelength inversely proportional to the temperature.

- It tells us as we heat an object up, its colour changes from red to orange to white hot.
- It can also used to calculate the temperature of stars. The surface temperature of the sun is 5778 K, this temperature corresponds to a peak emission=502nm=about 5000A.

LAWS OF BLACK BODY RADIATION

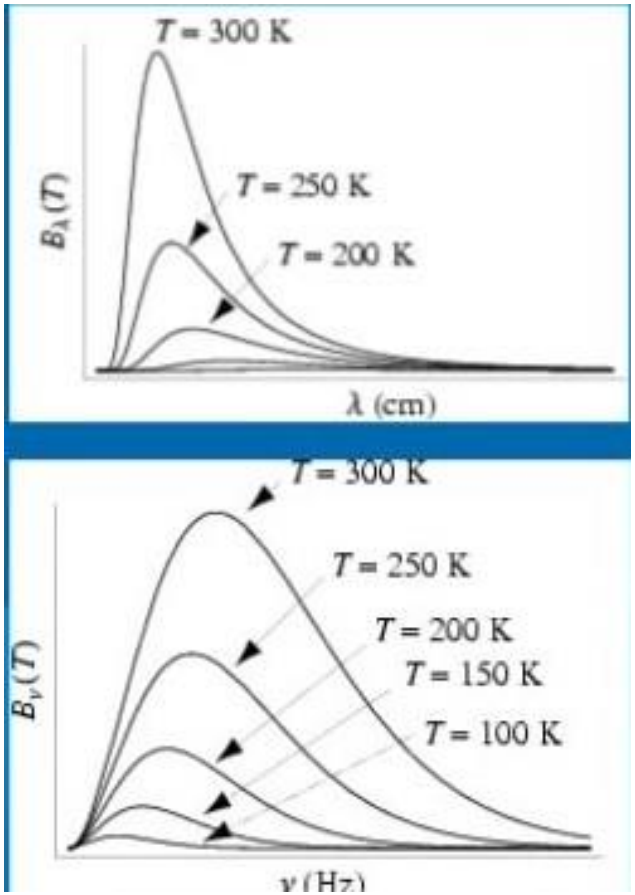
WIEN DISPLACEMENT LAW



LAWS OF BLACK BODY RADIATION

PLANCK'S RADIATION LAW

- There are two forms. As a Function of wavelength.
- And as a function of frequency.

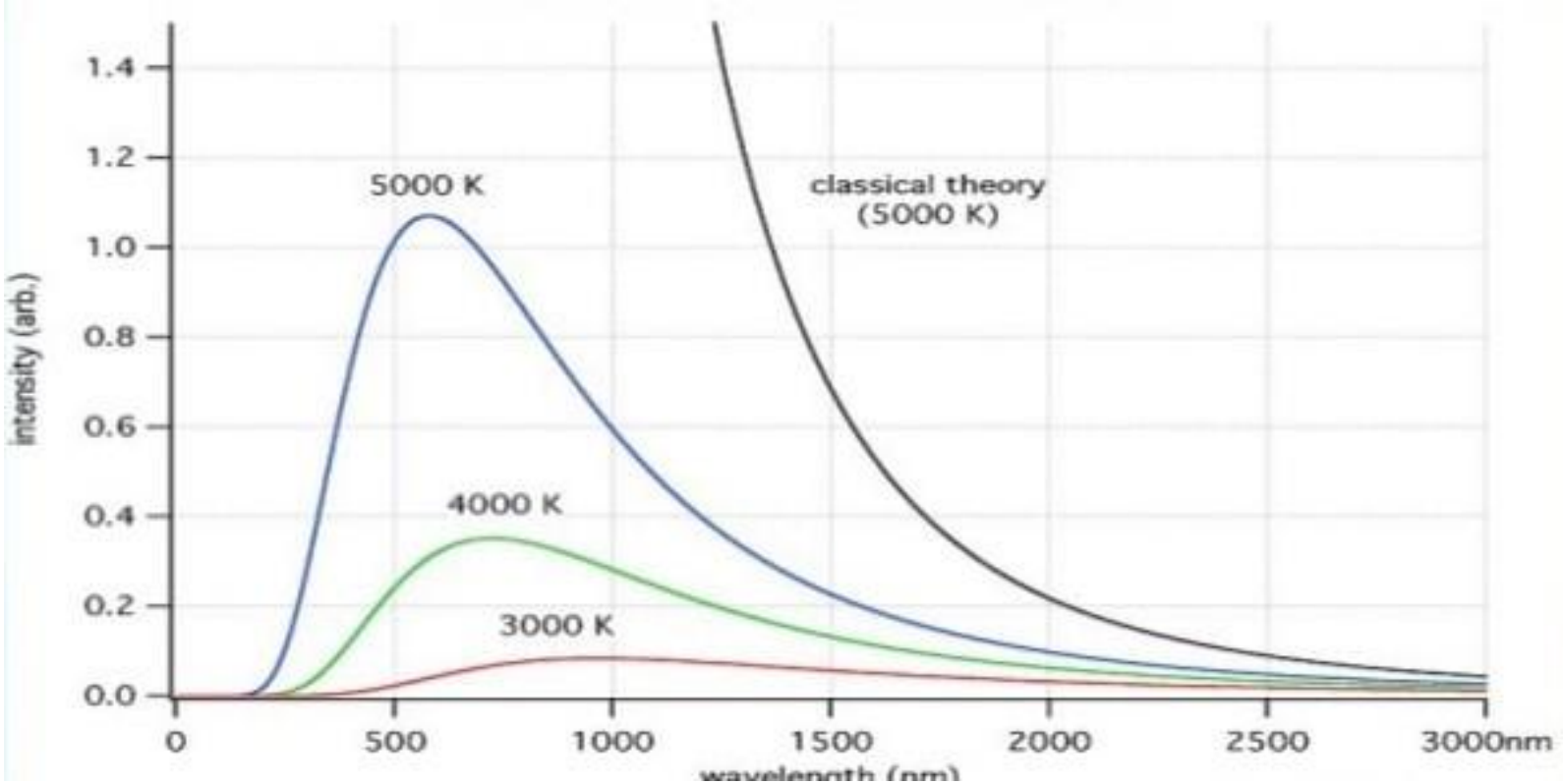


LAWS OF BLACK BODY RADIATION

PLANCK'S RADIATION LAW

The Planck law gives a distribution that peaks at a certain wavelength, peak shifts to shorter wavelengths for higher temperatures, and the area under the curve grows rapidly with increasing temperature.

Comparison between Classical and Quantum viewpoint



LAWS OF BLACK BODY RADIATION

RAYLEIGH- JEANS LAW

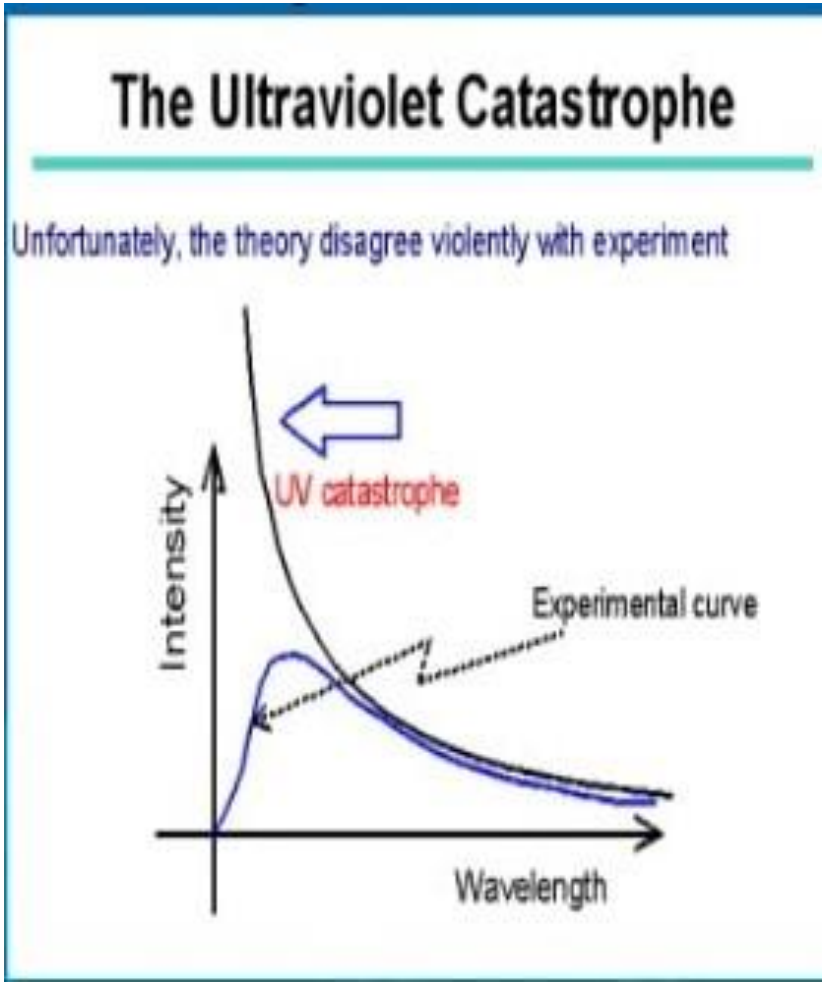
- It agrees with experimental measurements for wavelengths.
- It predicts an energy output that diverges towards infinity as wavelength grow smaller.

LAWS OF BLACK BODY RADIATION

RAYLEIGH- JEANS LAW

- The failure has become

Known as the ultraviolet catastrophe.



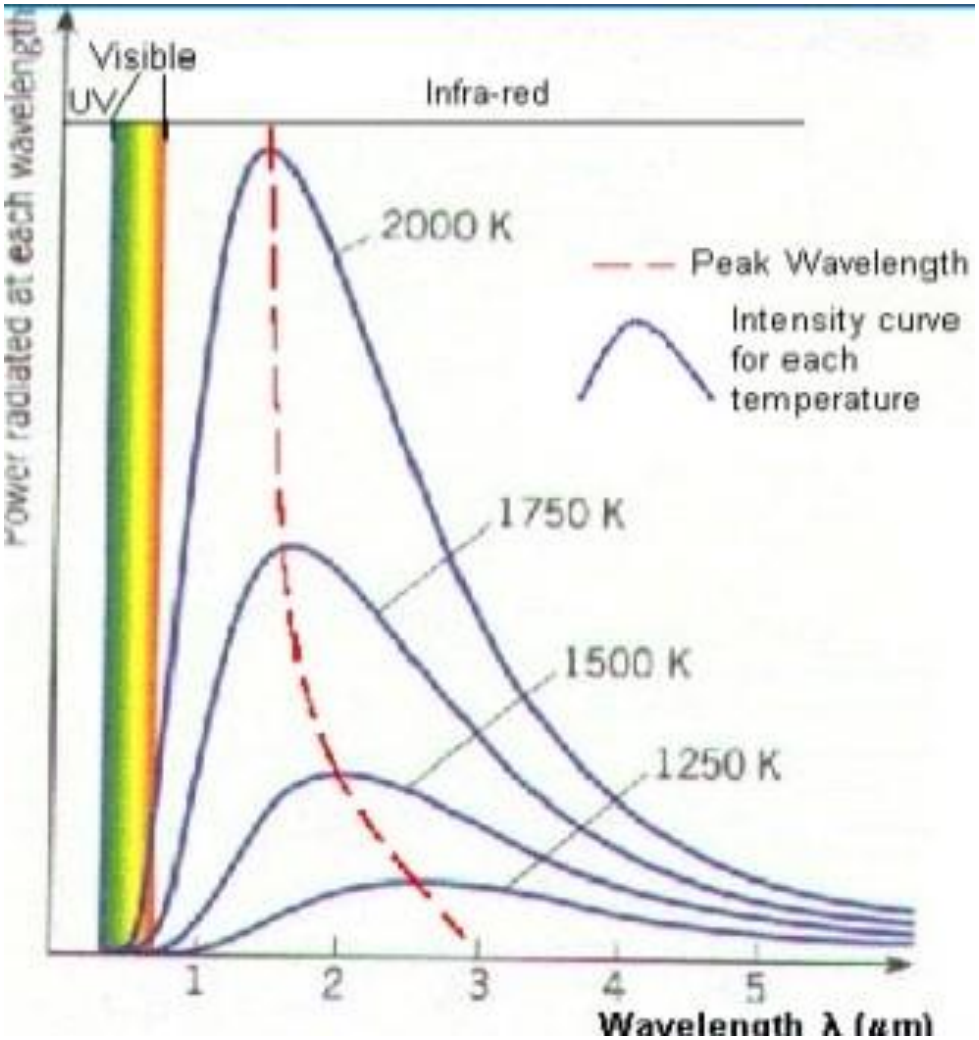
Applications of Black Body Radiation

- The blackbodies are used for lighting, heating, security, thermal imaging, as well as testing and measurement applications. Since the intensity of the energy at any temperature and wavelength and can be determined using the Planck Law of radiation.

CONCLUSION

- As the temperature increases, the peak wavelength emitted by black body decreases.
- The curve gets infinitely close to the axis but never touches it.
- As the temperature increases, the total energy emitted increases, because the total area under the curve increases.

CONCLUSION


Power radiated at each wavelength
Visible
UV
Infra-red
2000 K
Peak Wavelength
Intensity curve for each temperature
1750 K
1500 K
1250 K
1
2
3
4
5
Wavelength λ (μm)

THANKS