Infrared Radiation (IR) and Temperature

Absorption and Emission of IR by an object

- No matter the temperature, all objects absorb and emit infrared radiation.

    1. When an object absorbs infrared radiation, it will get warmer
    2. When an object emits infrared radiation, it gets cooler

- When the object reaches equilibrium. It maintains a constant temperature, absorbing radiation at the same rate it emits radiation.

Black Bodies

- A black body is an object that absorbs all incident radiation, regardless of frequency. There are no known perfectly black bodies on Earth or anywhere in the universe.

- A perfect black body is a theoretical object, but if it existed, it would have these properties:

    - It absorbs all light and electromagnetic radiation that falls on it
    - It is unable to reflect or transmit any radiation

- A good absorber of radiation is also a good emitter of radiation, so a perfect black body is the best emitter of radiation. An object that perfectly absorbs infrared radiation must be black because a black surface absorbs all wavelengths of visible light.

- Thermal radiation emitted by hot objects is called **black body radiation**. Objects emit black body radiation in the form of electromagnetic waves. These electromagnetic waves typically lie in the infrared region of the electromagnetic spectrum.

- The hotter an object, the more thermal radiation it emits, and the wavelength of that thermal radiation decreases.

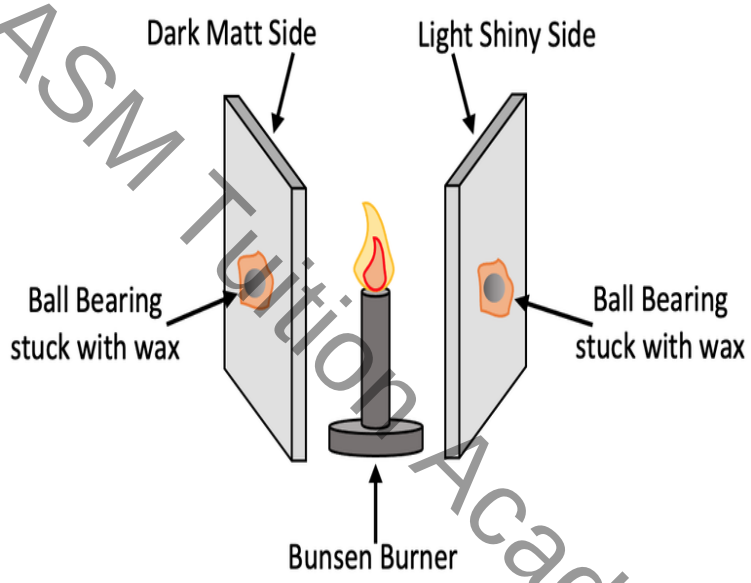
- However, the intensity of the shorter wavelengths increases more than the longer wavelengths. Therefore, each curve skews more to the left.

- **Example :** This explains why Bunsen burner flame colours change with increasing temperature. A blue flame is hotter than a red one and emits light with a shorter wavelength.

Absorbing radiation

- When an object absorbs radiation, it heats up and its temperature will rise.For example you feel the heat of the sun when you absorb the infrared radiation from it.
- If a cloud passes in front of the sun, you absorb less infrared, and it feels cooler.

Investigate Absorption with the melting Wax Trick



1. Two squares of aluminium are arranged as shown above.
2. One is painted dull black, the other is polished and shiny.
3. To ensure a fair test they are the same area and thickness and are placed the same distance from the Bunsen flame.
4. Two identical corks are stuck to the back of the plates using equal amounts of Vaseline or candle wax (control variables).
5. The Bunsen is lit.
6. Quite quickly the cork attached to the black plate falls off.
7. The cork behind the polished plate takes much longer to fall off.

Conclusion

Both plates receive the same quantity of radiation, but the black plate heated up more quickly.

This tells us that a dull, black surface is a better absorber of radiation than a shiny, polished surface.

Investigating Emission of Infrared Radiation by Leslie Cube

- A Leslie cube is a hollow metal cube with the following different surfaces on each of its four vertical faces:

1. Matt black paint
2. Matt white paint
3. Shiny metal
4. Dull metal

- You can investigate infrared (IR) emission and absorption with a Leslie cube using the following process:

Experiment:

1. Set up the Leslie cube on a heat-proof mat with an infrared detector placed 5 cm5 cm from the surface.
2. Fill the Leslie cube with boiling water and place the lid on. Leave for 1 minute1 minute to allow the surfaces to warm up.
3. Use the infrared detector to measure the amount of radiation emitted from the surface.
4. Repeat the infrared measurement for each of the surfaces. Make sure the distance between the surface and the detector is the same for each measurement.