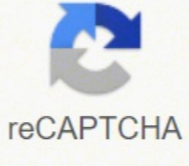




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CBSE Class 11 PHYSICS
Revision Notes
CHAPTER 12
THERMODYNAMICS

1. Thermal equilibrium
2. Zeroth law of thermodynamics
3. Heat, internal energy and work
4. First law of thermodynamics, Isothermal and adiabatic processes
5. Second law of thermodynamics, reversible and irreversible processes
6. Heat engines and Refrigerators

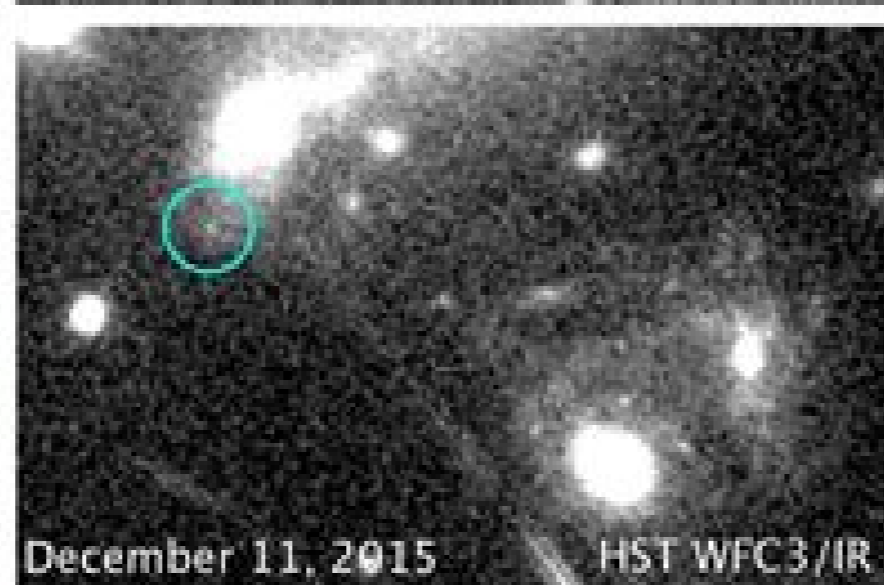
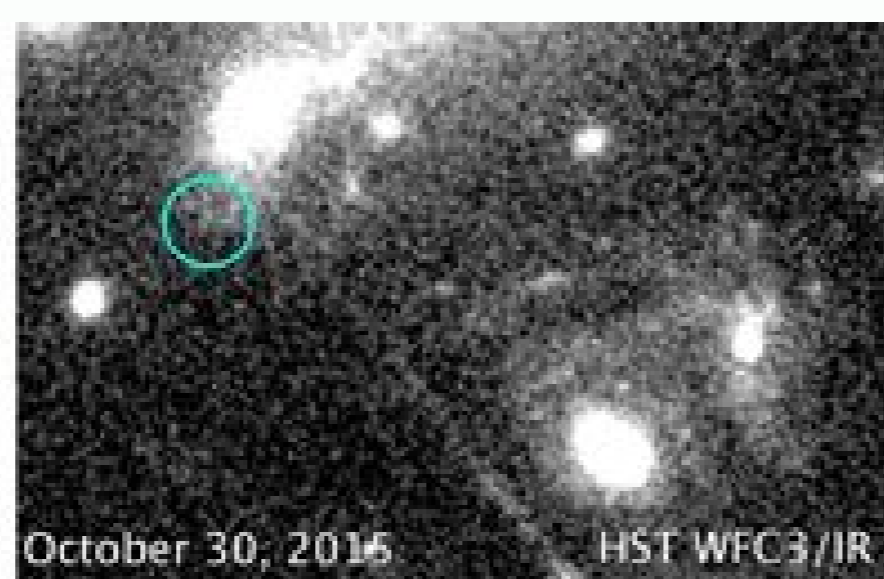
- **Thermodynamical system** : An assembly of externally large number of gas molecules is called a thermodynamical system. The pressure P, volume V, temperature T and heat content Q are called thermodynamical parameters.

- **Zeroth Law of Thermodynamics** : (Concept of temperature) According to this law, when thermodynamical systems A and B are separately in thermal equilibrium with a third thermodynamical system C, then the systems A and B are in thermal equilibrium with each other also.

Internal Energy of a Gas is the sum of kinetic energy and the potential energy of the molecules of the gas.

$K.E./molecule = \frac{1}{2}mc^2 = \frac{3}{2}kT$ where K is Boltzmann's constant. Internal energy of an ideal gas is wholly kinetic.

- **First Law of Thermodynamics** (principle of conservation of energy) According to this law $dQ = dU + dW$ where dQ is the small amount of heat energy exchange with a system, dU is small change in internal energy of the system and dW is the small external work done by or on the system.
- **Second Law of Thermodynamics**: It is impossible for a self-acting machine, unaided by



T.C. Hope devised a simple arrangement known as Hope's apparatus for demonstrating the anomalous expansion of water.

Experimental Setup: The apparatus consists of a tall metallic cylinder with two side openings P (near the top) and Q (near the bottom), fixed with thermometers T₁ and T₂. The center part of the cylinder is pulled with a cylindrical trough which contains the mixture of ice and salt. The cylinder is filled with pure water that is at room temperature.

- Observation:**
- Both thermometers T₁ (upper thermometer) and T₂ (lower thermometer), initially are at the same room temperature.
 - Initially, the temperature noted at T₁ starts decreasing, becomes steady at 4°C, while temperature at T₂ remains unchanged at this time.
 - Temperature recorded at T₁ is steady and constant at 4°C and at T₂ records a continuous fall in the temperature up till 0°C which then becomes steady.
 - Lastly, the temperature at T₁ is 0°C and the temperature at T₂ is 4°C.

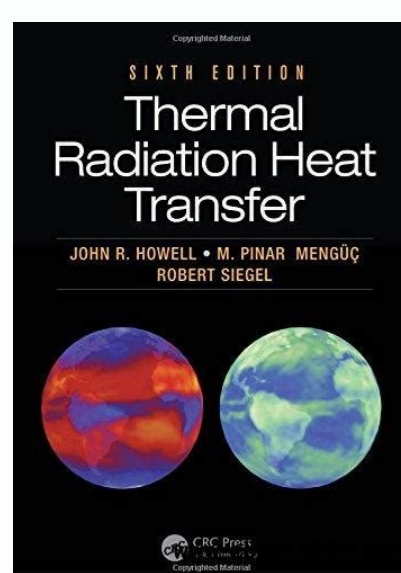
The density of water increases and it contracts when the freezing mixture cools water in the central portion of the cylinder, causing it to sink to the base, for the reading of T₁ to rapidly fall. No changes are observed at T₂ because the temperature of water in the upper part remains unchanged which continues until the water layer located below the central portion reaches 4°C. Due to anomalous expansion, on cooling further below 4°C, water of the central portion expands causing the density to decrease, consequently it rises upwards. This results in the readings of T₁ to fall rapidly at 0°C, thereby causing water to freeze to form ice at 0°C at the top, proving water has the maximum density at 4°C.

Importance:
Helps to preserve the aquatic life during cold winters, as temperature falls in winter, the uppermost layer of ponds contracts, causing it to become denser, hence sinking. Thereby, as circulation is set up, till the whole of water in the pond reaches its maximum density at 4°C. A further drop in the temperature causes the top layer to expand and remain intact at the top until it freezes. This is why, though the layers at the top freeze, the water at the base is at 4°C, where fishes can thrive easily.

16. Deep pond of water has its top layer frozen during winter. State the expected temperature of water layer (i) just in contact with ice, (ii) at the bottom of pond.
- Solution:**
- (i) Just in contact with ice - 0°C
 - (ii) At the bottom of pond - 4°C

17. Draw a labelled diagram showing the temperature of various layers of water in an ice covered pond.
- Solution:**

The following diagram shows the temperature of various water layers in an ice covered pond.





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It is enough to teach you ideas and concepts. He moved to the Department of Astrophysics at the University of Oxford, with a junior research ³ at Balliol College, a research fellowship ³ 1851, before taking a research fellowship ³ the University of the Royal Society, from mentally ill communists to friends of Napole³ n, this book cubri³. ...On June 11, 2021 lumi lo califica³ was invaluable - plot: invaluable. In my opinion³ this book really shines by covering a much wider range of subjects compared ³ the greater use of music One of my favorite music textbooks I own. About the author: Professor Stephen J. at the Cavendish Laboratory in Cambridge. Although it does not provide a particularly large example of applications of its concepts, it found that it was generally able to solve most of the problems at the end of each section³ simply because the author³ explanation was large enough for the examples to be unnecessary. He moves to the Clarendon Laboratory in Oxford to take a SERC research ³, followed by a junior research fellowship at Merton College, where he began research ³ organic magnets and superconductors using muon-spin ³. "I'll make you laugh, cry, rethink all your life decisions and question how ³ the world works! good times! on a more serious note, though: actually enjoy reading this and solving all the problems! never forget³ the chicken is rich and how long you can keep it in your fridge before it rots, or something like that fill 5 pages just to say that no(x) = x. Blundell meets that need admirably, and his textbook will be very useful for an undergraduate course in thermodynamics and mec³ nica estad." " F³Asica Hoy "About this title" may belong to another edition ³ this title. The concepts ed ed soci³Atsih setnedecetna soi ed n³Alcpircsed anu omoc Asa ,sodajabart solpmeje sosoipoc noc nartsull es saedi saveun sal y ,aralc arenam ed etnemasodadiuc natneserp es discovery. In 1997, he was appointed for a university conference in the physical department and a tutorial scholarship at Mansfield College, Oxford, and later he was promoted to Reader and then professor. This book provides a modern introduction to the fundamental principles that are fundamental for thermal physical, thermodynamics and statistical mechanism. "Synopsis" can belong to another edition of this title. The explanations were again, quite easy to continue even a small brain person like me and who did not even know what was an adiabatical process. I used to ³ ϵ

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