



ADVANCED PHYSICS CLUB

APRIL 23, 2023

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
http://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2022
The practical information about the club and contacts can be found on the same web page.

TODAY'S MEETING

Today we solved some more problems on the first law of thermodynamics. Our next topic is the second law of thermodynamics.

USEFUL INFORMATION

You might find some theoretical background on the following website:
<http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/carnot.html#c2>

For some problems you may need the following integral: $\int_a^b \frac{dx}{x} = \log\left(\frac{b}{a}\right)$.

HOMEWORK

1. IS it possible for any substance to have two states, 1 and 2, that lay on the same isotherm and on the same adiabat?
2. An ideal heat engine has efficiency η . It is used in a reverse cycle. What maximal amount of heat could be taken from the cold reservoir by using mechanical work W ?
3. What is the minimal amount of energy one should spend on turning water taken at 0°C to ice at 0°C ? Temperature of the environment is 20°C , latent heat of melting for water is 338 kJ/kg .
4. During the winter a room is kept warm by using a burner with power 1 kW . With the burner turned on the temperature in the room is 17°C while the outside temperature is -23°C . What power would be required for keeping the same inside temperature if an ideal heat pump was used instead of a burner?
5. A warm object with initial temperature T is used as a hot reservoir for a heat engine. Its' heat capacity does not depend on temperature and is equal to C . As a cold reservoir one uses an infinitely big environment with constant temperature $T_0 < T$. What maximal work can be produced by cooling down the warm object?
- *6. What maximal work can be produced using an iceberg of volume 1 km^3 as the cold reservoir and ocean of temperature 20°C as the hot reservoir for a heat engine? How much time is needed for the Grand Coulee hydroelectric power station (which has power output of about 7000 MW) to produce the same amount of energy?
- *7. Find an expression for the entropy of ideal gas. Derive equation of an adiabat of ideal gas using this expression for entropy.

FOR THE NEXT MEETING

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **April 30**.