



ADVANCED PHYSICS CLUB

APRIL 25, 2021

USEFUL RESOURCES

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:

https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2020

The practical information about the club and contacts can be found on the same web page.

TODAY'S MEETING

Today's homework is about the second law of thermodynamics. For some problems you may need the

following integral: $\int_a^b \frac{dx}{x} = \log\left(\frac{b}{a}\right)$.

You might find some additional information on the following site:

<http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/carnot.html#c2>

HOMEWORK

1. Could there exist a substance for which some state 1 and some state 2 lay on the same isotherm and on the same adiabat?
2. An ideal heat engine with energy conversion coefficient η is working in an inverse cycle. What maximal amount of heat could be taken from the cold reservoir by doing mechanical work A ?
3. What minimal amount of energy should be spent 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. A room is kept warm by using a burner with power 1 kW . When using this burner 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. Warm body 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 . Infinite environment with constant temperature $T_0 < T$ is used as a cold reservoir. What maximal work can be produced by cooling the warm body?
- *6. What maximal amount of work can be done using an iceberg of volume 1 km^3 as the cold reservoir and ocean of temperature 20°C as the hot reservoir? 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 3:00pm, via Zoom, on Sunday, **May 2**.