Thermodynamics list 6

1. Calculate the dynamic pressure of a gas with density of $\rho = 0{,}6\,{}^{kg}/_{m^3}$, which flows through the pipeline with diameter of d= 300mm. The volumetric flow rate is $\dot{V} = 0{,}5\,{}^{m^3}/_{s}$.
2. Calculate the velocity of the air flow within a pipeline with diameter of d=200mm when the static pressure is *p=700 Pa*, the total pressure is $p_t = 1200\,Pa$. The density of the air is $\rho = 1{,}195\,{}^{kg}/_{m^3}$.
3. Calculate the velocity of air with $\dot{V}_0 = 2000\,{}^{um^3}/_{h}$. Calculate the dynamic pressure if the temperature is *t=400*℃*,* pressure is *p=3 bar*. The density of air in standard conditions is $\rho = 1{,}29\,{}^{kg}/_{m^3}$.
4. A tank with volume of $V = 0{,}6\,m^3$ is inflated with compressed air with the pressure of $p_m = 0{,}4\,MPa$ and the temperature of 27℃. Calculate the amount of air within the tank using *kg, kmol*, and um^3 units. The ambient pressure is $p_0 = 1\,bar$.
5. The weight of a container filled with nitrogen decreased for *3 kg* as a consequence of releasing some amount of gas into the ambient with temperature of *T=300K.* The pressure drop detected on the manometer after the temperature equalized with ambient temperature is $\Delta p = 0{,}4\,MPa$. Calculate the volume of the tank.
6. The water brake was used for determining the power of an engine. The water flux flowing through the brake is $\dot{m} = 6\,{}^{kg}/_{s}$. The water temperature at the brakes inlet is $t_1 = 20$℃, the temperature at the brake outlet is $t_2 = 50$℃. Assuming that heat loss in the brake is 10% of the engine power calculate the effective power of the engine.
7. Calculate the absolute, technical and effective power of a process performed by a gas within a cylinder when the relationship $pV = 4 \cdot 10^4$ is valid. Known are: the initial pressure $p_1 = 1{,}0\,MPa$, the final pressure is $p_2 = 0{,}1\,MPa$, the ambient pressure is $p_0 = 950\,hPa$.
8. Calculate the power of ideal piston engine with swept volume of $V_s = 0{,}04m^3$ in which the gas decompresses from $p_1 = 0{,}9\,MPa$ to $p_2 = 0{,}1\,MPa$. The cylinder is filled when the piston travels l=20% of swept distance. The process of a gas within the engine can be expressed with rectilinear relationship of p(V). The frequency of engine rotation is $\omega = 20s^{-1}$.

9. The helium has undergone an isobaric, reversible process from $p = 7bar, t_1 = 20℃, V_1 = 15\ dm^3$ to the stage where $t_2 827℃$. Considering the gas as perfect calculate:
    - The absolute work of the process,
    - The amount of heat delivered into the medium,
    - The change of the internal energy.

10. The oxygen has undergone an isobaric, process from $p = 3bar, T_1 = 300K$, $V_1 = 50\ dm^3$ to the stage where $V_2 = 180\ dm^3$. Considering the gas as perfect calculate:
    - The gas temperature after the process,
    - The amount of heat delivered into the medium.