Ex3.2 A gas is compressed from an initial volume of 0.42 m^3 to a final volume 0.12 m^3 . During the quasi-equilibrium process, the pressure changes with volume according to the relation $P = aV+b$, where a = -1,200 kPa / m^3 and b = 600 kPa. Calculate the work done during this process (a) by plotting the process on a *P-v* diagram and finding the area under the process curve and (b) by performing the necessary integrations

Ex3.3 A piston-cylinder device initially contains 0.4 m^3 of air at 100 kPa and 80°C. The air is now compressed to 0.1 m^3 in such a way that the temperature inside the cylinder remains constant. Determine the work done during this process.

Ex3.4 A mass of 1.2 kg of air at 150 kPa and 12°C is contained in a gastight, frictionless piston-cylinder device. The air is now compressed to a final pressure of 600 kPa. During the process heat is transferred from the air such that the temperature inside the cylinder remains constant. Calculate the work done during this process.

Ex3.5 Nitrogen at an initial state of 300 K, 150 kPa, and 0.2 m^3 is compressed slowly in an isothermal process to a final pressure of 800 kPa. Determine the work done during this process.

Ex3.6 A mass of 5 kg of saturated water vapor at 300 kPa is heated at constant pressure until the temperature reaches 200°C. Calculate the work done by the steam during this process.

Ex3.7 A frictionless piston cylinder devic initially contains 200 L of saturated liquid refrigerant-12. The piston is free to move, and its mass is such that it maintains a pressure of 800 kPa on the refrigerant. The refrigerant is now heated until its temperature rises to 50°C. Calculate the work done during this process.

Ex3.8 A piston-cylinder device initially contains 100 kg of air at 100 kPa and 300 K. The air is now compressed slowly according to the relation $PV^{1.3}$ = constant until it reaches a final pressure of 1500 kPa. Determine the work done during this process. (R = 0.287 kJ/kg.K)

Ex3.9 A frictionless piston device contains 2 kg of nitrogen at 100 kPa and 300 K. Nitrogen is now compressed slowly according to the relation $PV^{1.4}$ = constant until it reaches a final temperature of 360 K. Calculate the work done during this process.

Ex3.10 Determine the power required to acceleration a 9 kg car shown in figure from rest to a velocity of 80 km/h in 20 s on a level road.

Ex3.11 A piston-cylinder device contains 0.05 m^3 of a gas initially at 200 kPa. At this state a linear spring which has a spring constant of 150 kN/m is touching the piston but exerting no force on it. Now heat is transferred to the gas, causing the piston to rise and to compress the spring until the volume inside the cylinder doubles. If the cross-sectional area of the piston is 0.25 m^2, determine (a) the final pressure inside the cylinder, (b) the total work done by the gas, and (c) the fraction of this work done against the spring to compress it.

Ex3.12 A piston cylinder device contains 50 kg of water at 150 kPa and 25°C. The cross-sectional are of the piston is 0.1 m^2. Heat is now transferred to the water, causing part of it to evaporate and expand. When the volume reaches 0.2 m^3, the piston reaches a linear spring whose spring constant is 100 kN/m. More heat is transferred to the water until the piston rises 20 cm more. Determine (a) the final pressure and temperature and (b) the the work done during this process. Also show the process on a *P-V* diagram.