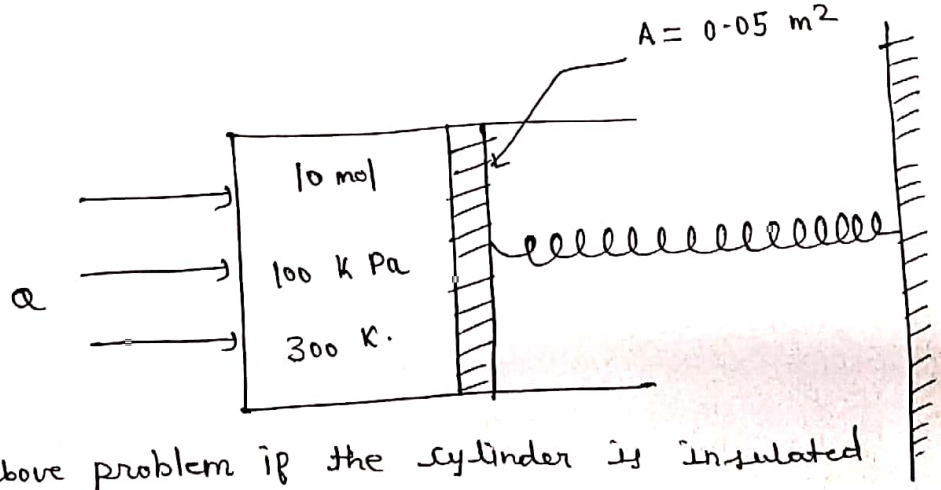
Assignment - I

1) A simple engine uses an ideal gas with ($\gamma = 1.4$) as the working fluid in a piston cylinder assembly. The gas is first heated at constant volume from 1 bar and 300 K to 5 bar, then it is allowed to expand isothermally to a pressure of 1 bar. Finally the gas is cooled at constant pressure until its temperature is reduced to 300 K. Calculate the efficiency (defined as the Ratio of the net work done to the energy absorbed as heat) of the cycle.

2) A cylinder contains 10 moles of an ideal gas ($\gamma = 1.4$) at 100 KPa and 300K as shown in fig below. At this stage the spring just touches the piston but exerts no force on it. Energy is transferred as heat to the gas causing the piston to move. During this process the force exerted by the spring is proportional to the displacement, with a spring constant of 50 $\left(\frac{KN}{m}\right)$. The cross sectional area of the piston is 0.05 m^2

Determine a) the temperature of the gas when the pressure reaches 500 K Pa

and b) the energy transferred as heat.



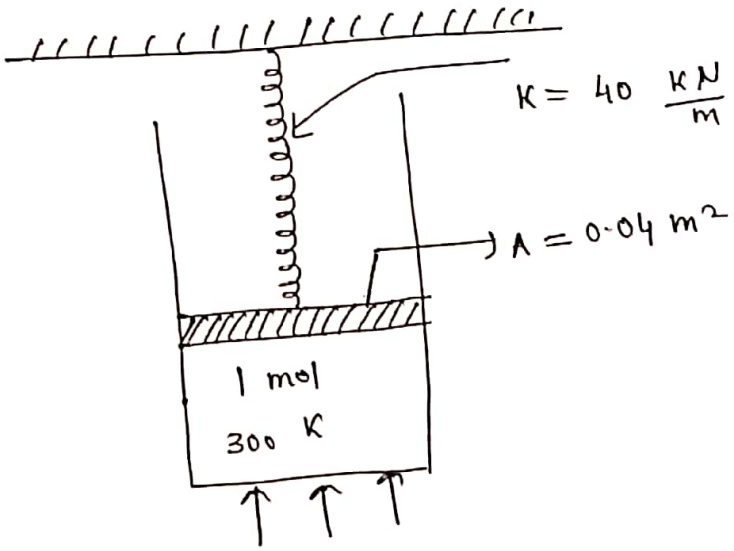
3) Repeat the above problem if the cylinder is insulated and the energy is added as work by rotating a paddle wheel inside the gas space instead of the energy transfer as heat. Determine the work done by the gas, the work done by the paddle wheel and, the final temperature of the gas.

4) A cylinder contains one mole of an ideal gas. ($\gamma = 1.4$) at 300 K and 100 K Pa as shown in the figure below. At this stage the spring is at its natural length and exerts no force on the piston. The cylinder is heated causing the piston to move. The spring force is proportional to the distance moved from the normal position with a spring constant of 40 $\left(\frac{KN}{m}\right)$. The cross sectional area of the piston is 0.04 m^2.

Determine a) The temperature of the gas when its pressure is 400 K Pa

b) The work done by the gas.

c) The Energy transfer as heat



Answer Key

1) 0.2243

2) (a) 1620.16 K (b) 280.395 KJ

3) 6 KJ , 280.395 KJ , 1620.16 K

4) (a) 1775.3 K (b) 3 KJ (c) 33.664 KJ