Arab Academy for Sciences & Technology & Maritime Transport
College of Engineering & Technology
Basic & Applied Sciences Department

Final Revision for BA114 - Physics II

Steam

1. 1 kg of steam at a pressure of 60 bar and a specific volume of 0.0277 m^3/kg is heated at a constant pressure. The steam is then cooled at constant volume to a pressure of 30 bar. The steam is finally compressed according to a law $pv^{1.1} = c$ to its initial conditions. Calculate the net work done, the net heat flow and the change in entropy in each process. Sketch the cycle on a p-v diagram. (27 – 5 – 1999)

2. 1 kg of steam at a pressure of 15 bar and dryness fraction 0.54 is heated at constant pressure until the temperature is 230^{o}C. The steam is then compressed isothermally till the pressure becomes 28 bar and the steam becomes dry saturated. Finally, the steam is cooled at constant volume back to its initial state. Calculate the change in entropy, the net work done and the heat flow in each process. Sketch the cycle on both p-v and T-s diagram. (17 – 5 – 2001)

3. 1 kg of steam at a pressure of 100 bar is contained in a cylinder of volume 0.012 m^3. The steam is allowed to expand isothermally till the pressure is 30 bar. The steam is then cooled at constant pressure and is finally compressed according to a law $pv^{1.3} = c$ to its initial state. Calculate the work done, the heat flow and the change in entropy in each process. Sketch the cycle on both p-v and T-s diagrams. (3 – 1 – 2002)

4. In a steam engine the steam is heated at constant volume from a pressure of 15 bar and specific volume 0.09957 m^3/kg till it becomes just dry saturated. The steam is then allowed to expand isothermally and is finally cooled at a constant pressure back to its initial conditions. Calculate the change in entropy, the work done and the heat flow in each process. Sketch the cycle on both p-v and T-s diagrams. (9 – 1 – 2003)

5. 1 kg of steam at a pressure of 100 bar and a specific volume of 0.01802 m^3/kg is allowed to expand isothermally until the pressure is 50 bar. The steam is then cooled at constant pressure. The steam is finally compressed according to a law $pv^{1.2} = c$ to its initial conditions. Calculate the work done, the heat flow and the change in entropy in each process. Sketch the cycle on both p-v and T-s diagrams. (5 – 6 – 2003)

6. 2.8 kg of steam occupies a volume of 0.05 m^3 is heated at constant pressure of 70 bar till it becomes just dry saturated. The steam is then cooled at constant volume to a pressure of 40 bar. Finally, the steam is compressed polytropically back to its initial conditions. Calculate the net work done, the net heat flow and the change in entropy in each process. Sketch the cycle on both p-v and T-s diagrams. (7 – 6 – 2004)

Perfect Gas

1. 1 kg of air is compressed adiabatically from a pressure of 80 bar and specific volume of 0.02 m^3/kg to a pressure of 140 bar. The air is then cooled at constant pressure. Finally, polytropic expansion according to a law $pv^{1.12} = c$ brings the air back to its initial conditions. Calculate the net work done and the net heat flow.(27 – 5 – 1999)

2. Oxygen (molar mass 32 kg/kmole, c_v=0.65 kJ/kg.K) at a pressure of 10 bar and temperature of 106 ^oC occupies a volume of 0.03 m^3 is allowed to expand isothermally until its pressure becomes 4.5 bar. Oxygen is then cooled at constant pressure. Finally, it is compressed adiabatically back to the initial state. Calculate the change in entropy, the net work done and the net heat flow. Sketch the cycle on the p-v and T-s diagrams. (17 – 5 – 2001)

3. 1 kg of Oxygen (molar mass 32 kg/kmole) at a pressure of 25 bar is cooled at constant volume until the pressure falls to 15 bar. It is then compressed isothermally and is finally heated at constant pressure to its initial state. If the initial specific volume is 0.06 m3/kg. Calculate the net work done, the net heat flow and the overall change of entropy. Sketch the cycle on both p-v and T-s diagram. (3 – 1 – 2002)

4. 1 kg of Oxygen (molar mass = 32 kg/kmole) of volume 0.08 m^3 at a pressure of 12 bar is allowed to expand adiabatically in a cylinder behind a piston until its pressure becomes 5 bar. The gas is then heated at constant pressure. Finally, it is compressed isothermally back to its initial state. Calculate the net work done, the net heat flow and the net change in entropy. Sketch the cycle on both the p-v and T-s diagram. Assume that Oxygen is a prefect gas and the specific heat at constant volume c_v = 0.65 kJ/kg. K.(9 – 1 – 2003)

5. 0.1 kg of Oxygen (molar mass 32 kg/kmole, γ= 1.4) at a pressure of 10 bar and volume of 0.01 m^3 is heated at constant pressure until the volume is doubled. It is then cooled at constant volume and is finally compressed adiabatically to its initial state. Calculate the work done, the neat flow and the change of entropy in each process. Sketch the cycle on both p-v and T-s diagrams. (5 – 6 – 2003).

6. 1 kg of a perfect gas (M = 32 kg/ kmole, γ = 1.4) undergoes a four process cycle. The gas is initially at a pressure of 80 bar and a temperature of 327^oC. The gas is heated at a constant pressure until the volume is 0.025 m^3. The gas is then allowed to expand isothermally to a pressure of 30 bar. Then, the gas is cooled at constant pressure. Finally, the gas is compressed adiabatically back to its initial conditions. Calculate the net heat flow, the net work done and the change in entropy in each process. Sketch the cycle on both p-v and T-s diagrams.(7 – 6 – 2004)

7. A certain perfect gas at a pressure of 10 bar and a temperature of 97 ^oC occupies a volume of 0.04 m^3. The gas is allowed to expand adiabatically to a pressure of 4.5 bar then, it is heated at a constant pressure. Finally, it is compressed isothermally back to its initial conditions. Calculate the net change in entropy, the net work done and the net heat flow. Sketch the cycle on both p-v and T-s diagrams.(molar mass is 32 kg/kmole,c_v=0.65 kJ/kg.K). (13 – 8 – 2005)

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Steady Flow

1. Air flows steadily through an air compressor at the rate of 0.6 kg/s. The air enters at 8 m/s with a specific volume of 0.75 m^3/kg and a pressure of 2 bar. The air leaves at 5 m/s with a specific volume of 0.15 m^3/kg and a pressure of 7.5 bar. The specific internal energy of the air entering is 96 kJ/kg lower than that of the air leaving. Cooling water absorbs heat from the air at the rate of 64 kJ/s. Calculate the power required to drive the compressor. (27 – 5 – 1999)

2. A steady flow of 5.8 kg/s of steam enter a turbine at 60 m/s. The steam leaves the turbine at 150 m/s. The outlet pipe is 15 m lower than the inlet pipe and the enthalpy of the steam leaving is lower than that of the steam entering by 2450 kJ/kg. The power developed by the turbine is 14000 kW. Calculate the rate of heat flow. (17 – 5 – 2001)

3. A steady flow of steam of 0.8 kg/s enters a turbine at the following conditions: velocity 25 m/s, specific volume 0.19 m^3/kg and a pressure of 40 bar. The steam leaves at the following conditions: velocity 50 m/s, specific volume 3.5 m^3/kg and a pressure of 2 bar. The specific internal energy at exit is 500 kJ/kg lower than that at inlet. The exit pipe is 2 m lower than that at inlet. The power developed by the turbine is 500 kW. Calculate the rate of heat flow. (3 – 1 – 2002)

4. A steady flow of 1.4 kg/s of steam enter a turbine at the following conditions: velocity 65 m/s, specific volume of 0.122 m^3/kg and a pressure of 9.5 bar. The conditions at exit are: velocity 180 m/s, specific volume of 5.45 m^3/kg, pressure of 0.35 bar. If the specific internal energy at exit is 700 kJ/kg less than that at inlet. The power developed by the turbine is 800 kW. Find the rate of heat flow and the change in specific enthalpy. (9 – 1 – 2003)

5. Air flows steadily through an air compressor at the rate of 0.5 kg/s. The air enters the compressor at a speed of 5 m/s and a pressure of 1.5 bar and a specific volume of 0.9 m^3/kg. The steam leaves at 4 m/s with a pressure of 7.5 bar and a specific volume of 0.2 m^3/kg. The specific internal energy of the air entering is 80 kJ/ kg lower than that of the air leaving. Cooling water absorbs heat from the air at a rate of 60 kJ/s. Calculate the power required to drive the compressor. (5 – 6 – 2003)

6. Air flows steadily at the rate of 0.45 kg/s through an air compressor entering at 6.5 m/s with a pressure of 1.2 bar and a specific volume of 0.8 m^3/kg and leaving at 4.5 m/s with a pressure of 7 bar and a specific volume of 0.15 m^3/kg. The specific internal energy of the air entering is 90 kJ/kg lower than that of the air leaving and the inlet pipe is 5m higher than that at the exit pipe. Heat is rejected from the air at the rate of 60 kW. Calculate the power required to drive the compressor and determine the change in the specific enthalpy of the air. (7 – 6 – 2004)

7. A steady flow of steam enters a turbine at a rate of 4.6 kg/s, its initial velocity is 50 m/s. The velocity of the steam leaving the turbine increases to 120 m/s. The inlet pipe is 12 m higher than the exit pipe. If the specific internal energy of the steam entering is 2800 kJ/kg higher than that of the steam leaving and the power developed by the turbine is 12000 kW. Calculate the rate of heat flow given that the inlet and outlet pressures are 18 bar and 8 bar respectively. As well, the specific volumes are 0.5 m^3/kg and 1.4 m^3/kg respectively at the inlet and outlet. Also, calculate the change of specific enthalpy. (13 – 8 – 2005)

8. A steady flow of 1.32 kg/s of steam enters a turbine at 65 m/s with a specific volume 0.15 m^3/kg, a pressure of 9.5 bar and a specific internal energy of 2850 kJ/kg. The steam leaves at 180 m/s with a specific volume 5.5 m^3/kg, a pressure of 0.45 bar and specific internal energy of 2150 kJ/kg. The power developed by the turbine is 700 kW. Calculate the heat flow rate. (16 – 11 – 2005)

Good Luck