Midterm Questions_Spring 2022

Professor Andreas Züttel

Assistant: Yasemen Kuddusi

Question 1 (CHAPTER 1: BASICS)

A child of a family wants his room (10×4×4 m^3) to be heated to 25 °C from the air that is originally at 15 °C. The room is heated by a thermal energy storage with a heating rate of 80 kJ/h, the heat loss from the room is 2 kJ/h. Estimate the time when the child's room will reach to the desired temperature? ($c_{v,av}$= 0.72 kJ/kg°C, MW= 29 g/mol)

Question 2 (CHAPTER 1: BASICS, CHAPTER 2: ENERGY DEMAND)

How much money would you save yearly if you decrease your daily showering time from 10 minutes to 5 minutes. Volumetric flowrate of the shower is 12 liters/min. and the heating used per liter of water is 120 Btu per liter and energy cost of the heating is 0.15 CHF per kWh.

Question 3 (CHAPTER 3: RESOURCES)

A university computer lab consisting of 15 computers is always open for users except on the weekends. In the weekdays, it is open from 08:00 A.M. until 08:00 P.M. Each computer needs 240W. (Coal: 0.37 kg CO_2/ kWh, 1 tonne coal=30 GJ)

a) *Calculate how much CO_2 will be released from a coal power plant to keep this computer lab operating?*
b) *Calculate coal mass consumed for this coal power plant to keep this computer lab operating?*

Question 4 (CHAPTER 4: CARNOT CYCLE-STEAM ENGINE and CHAPTER 5: PISTON ENGINE)

Calculate the work when 2 m^3 of CO_2 at 120 kPa and 25°C is compressed isothermally to 800 kPa.

Question 5 (CHAPTER 7: NUCLEAR ENERGY and CHAPTER 3: RESOURCES)

A car consumes approximately 25 liters of gasoline per day. ($density_{gasoline}$=0.75 kg/L). Heating value of gasoline is around 44000 kJ/kg. If this car was able to run with 0.4 kg of ^{235}U, estimate the time when it would need refueling. (Complete fission energy from ^{235}U= 6.73 10^{10} kJ/kg)