This print-out should have 6 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points
The efficiency of a 464 MW nuclear power plant is 28.6%. If a river of flow rate $4.83 \times 10^6$ kg/s were used to transport the excess thermal energy away, what would be the average temperature increase of the river? Answer in units of $^\circ$C.

002 (part 1 of 2) 10.0 points
A Carnot engine has a power output of 179 kW. The engine operates between two reservoirs at 21$^\circ$C and 575$^\circ$C. How much thermal energy is absorbed per hour? Answer in units of J.

003 (part 2 of 2) 10.0 points
How much thermal energy is lost per hour? Answer in units of J.

004 10.0 points
A Carnot engine has an efficiency of 17.7 percent when the hot reservoir temperature is 311$^\circ$C. If we want to improve the efficiency to 38.7 percent, what should be the temperature of the hot reservoir, assuming everything else remains unchanged? Answer in units of $^\circ$C.

005 (part 1 of 2) 10.0 points
A refrigerator has a coefficient of performance equal to 4.48. If the refrigerator absorbs 123.3 J of thermal energy from a cold reservoir in each cycle, find the work done in each cycle. Answer in units of J.

006 (part 2 of 2) 10.0 points
Find the thermal energy expelled to the hot reservoir. Answer in units of J.