

BAE 103
Energy in Biological Systems

Problem Set No. 5
Concepts of Power, Energy, and Thermal Efficiency
Due Date: Wednesday, February 7

- 5.1 A car is traveling along a highway at 65 miles per hour. The road is horizontal (0% slope). If the wind resistance and rolling resistance (at the wheels) creates a combined resistive force of 950 N, what is the power (kW) developed at the rear wheels?
- 5.2 How much power (kW) must the car engine in problem 5.1 develop if the overall mechanical efficiency of the transmission and drive train is 94%?
- 5.3 Assume the car engine in problem 5.1 is operated on gasoline with an energy content of 113,500 Btu's per gallon, and that the thermal efficiency of the spark ignition engine and drivetrain is 28.6%. What is the fuel efficiency of the car in miles per gallon?
- 5.4 The car in problem 5.1 approaches a mountain and begins ascending a grade of 6.0%. If the car maintains an uphill speed of 70 miles per hour, how much additional power (kW) must be developed by the engine to overcome the change in elevation? Assume the car has a mass of 1400 kg.
- 5.5 Assume the car above is operated on a blend of 85% ethanol and 15% gasoline (E85). If the energy content of ethanol is 80,460 Btu's per gallon, what is the energy content of the E85 fuel (Btu/gal)?
- 5.6 Assume the overall thermal efficiency of the engine and drivetrain of the car above drops to 26.1% when operated on E85 fuel. What is the estimated fuel economy (mi/gal) of the car above when subjected to the uphill operating conditions above (problem 5.4)? The car is fueled with E85.