Power and Efficiency

1. When a 1100 kg car is in neutral, it slows from 60 mi h^{-1} to 40 mi h^{-1} in 7.0 seconds due to air resistance.
    a. Calculate the amount of energy dissipated due to the air resistance during the seven seconds.
    b. Deduce the power output needed to maintain 50 mi/h in watts.
    c. Convert the power to horsepower.
    d. The engine is 20% efficient. Determine the rate of energy input to the engine to maintain 50 mi h^{-1} .

2. A 1400 kg sports car speeds up from rest to 95 km/h in 7.5 s. Determine the average power output

3. A pump lifts 21.0 kg of water per minute through a height of 3.5 m. Calculate the minimum output rating for the pump motor.

4. A 2000 kg truck is pulled out of a snowy ditch by the use of an electric motor. The ditch is 2.0 meters deep and the motor is ⅔ efficient.
    a. Calculate the work done by the motor.
    b. Calculate the amount of energy wasted by the motor.

5. A 20.0 kg crate is lifted directly up by a cable that has a constant vertical tension of 220 N.
    a. Calculate the speed of the crate after it has been raised 1.0 m.
    b. Calculate the instantaneous power output of the motor pulling the cable after the block has been raised by 1.0 m.
    c. Calculate the speed of the crate after it has been raised 2.0 m.
    d. Calculate the instantaneous power output of the motor pulling the cable after the block has been raised by 2.0 m.

6. A given superball is 80% efficient dropped on pavement. The ball is dropped from a height of 2.5 meters
    a. Calculate the speed of the ball just before it hits the ground.
    b. Calculate the speed of the ball when it leaves the ground the first time.
    c. Determine the maximum height after the first bounce.
    d. Calculate the maximum height after the second bounce.
    e. Explain why the efficiency of the superball will change with time.