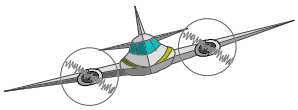
Problems class 3

A plane of mass 10 tonnes at 2000 m over Heathrow is flying in circles of radius 500 m, waiting for permission to land. It's effective cross-sectional area is 20 m^2 and drag coefficient 0.3. What is the power required to keep the plane flying at a speed of 300 km/h if the air density is 1.3 Kg/m^3? If the plane runs out of kerosene, what is the minimum angle at which it must descend in order to keep above it's stalling speed of 100 km/h? Note that at this speed, it's angle of attack changes, so the cross-sectional area becomes 40 m^2!



1

Problems class 3

A waterfall is 30 m high. The temperature of the gently flowing river water measured before the waterfall is 10 C, what is the temperature of the water flowing slowly away from the bottom of the waterfall? If the water is used to turn a turbine how will this result change? (qualitatively)

Specific heat capacity of water is 4190 J $kg^{-1}K^{-1}$.

2

Problems class 3

Robin Hood and Little John could reputedly shoot an arrow a distance of 1 mile. What force must they have been able to exert to draw their bows in performing this feat? Assume that the mass of their arrows was 300g and the distance they drew their bows 80 cm. What is:

The optimum angle to shoot the arrow?

The speed with which it would have to be launched to travel 1 mile (assume no air resistance!).

The work that would have to be done to accelerate the arrow to this speed.

The force necessary to draw a bow capable of doing this amount of work. Assume that a bow exerts a constant force as the bowstring is drawn back.