Tutorial Sheet 3 *Energy, Fluids*

Discussion/Conceptual questions *Last updated: 14/08/2014*

1. In the game "Angry Birds", a spring (rubber band) is used to launch small birds at their enemies, the pigs, thus transforming spring energy into kinetic energy. As the height of the bird is increasing, it

   (a) gains more kinetic energy
   (b) gains gravitational potential energy
   (c) loses kinetic energy.
   (d) loses gravitational potential energy.

2. Suppose you want to ride your mountain bike up a steep hill. Two paths lead from the base to the top, one twice as long as the other. Compared to the average force you would exert if you took the short path, the average force you exert along the longer path is

   (a) four times as small
   (b) three times as small
   (c) half as small
   (d) the same
   (e) undetermined – it depends on the time taken.

3. In level flight, the air flowing over an aeroplane's wings causes a force called *lift* which always acts in a direction perpendicular to the surface of the wing. This is the force which keeps the plane in the air. With reference to the lift force and the other forces acting on the plane, explain why the pilot of a plane *banks* the plane when she wants to change its direction of flight. Why not simply point the nose in the direction she wants the plane to fly? What is the advantage in also tilting (banking) the plane?

4. Why is it hard to move a rotary floor-polisher when it is switched off, but easy when it is switched on and the brush is rotating?

Problem-solving questions

5. A 110 g ice hockey puck slides on the ice for a distance of 15 m before stopping. If its initial speed was 6 m/s, find

   (a) the frictional force on the puck.

   (b) the coefficient of kinetic friction between the puck and the ice.

6. During a storm, a yacht is anchored in a 10 m deep harbour. The wind pushes against the boat with a steady horizontal force of 7000 N. The anchor rope is 50 m long and stretched straight between the anchor and the boat. What is the minimum amount of work that the crew of the boat must do to pull in 30 m of the anchor rope and move the boat nearer to the anchor?

7. Consider three books (of equal size and mass), stacked on top of each other on the edge of a table. How far over the edge of the table can the top book be, without toppling over?

   (Extension: hard!) If you use more books, how far can you get?

8. Andy (90 kg) and Julian (30 kg) are on a see saw which has total length 10m, with the pivot in the centre, and Julian is at one end, Andy is 2m from the other end. What is the net torque on the seesaw? Rachel (20 kg) joins Julian on his end, where should she sit to balance the torque to zero? Where is the centre of mass of the system in each case?