Course 141: MECHANICS

Problem Set 16

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1. A uniform solid cube of edge length $2a$ is suspended from a horizontal axis along one edge. Find the length of the equivalent simple pendulum. Given that the cube is released from rest with its centre of mass level wth the axis, find the angular velocity when it reaches the lowest point.

2. For the cube un Problem 1, find the horizontal and vertical components of the reaction on the axis as a function of its angular position. Compare your result with the corresponding expressions for the equivalent simple pendulum.

3. A uniform solid cube of edge length $2a$ is sliding with velocity v on a smooth horizontal table when its leading edge is suddenly brought to rest by a small ridge on the table.

   (a) Which dynamical variables are conserved (i) before impact, (ii) during impact, (iii) after impact?

   (b) Find the angular velocity immediately after impact and the fractional loss of the kinetic energy.

   (c) Determine the minimum value of v for which the cube topples over rather than falling back.

4. Find the principal moments of inertia of a uniform solid cube of mass m and edge length $2a$ with respect to

   (a) The mid-point of an adge

   (b) A vertex.

5. A pendulum consists of a light rigid rod of length 250 mm, with two identical uniform spheres of radius 50 mm attached one on either side of its lower end, so that in equilibrium their centres are level with it. Find the period of small oscillations perpendicular to the line of centres and along it.