Friction - Exercises (2 pages; 8/2/26)

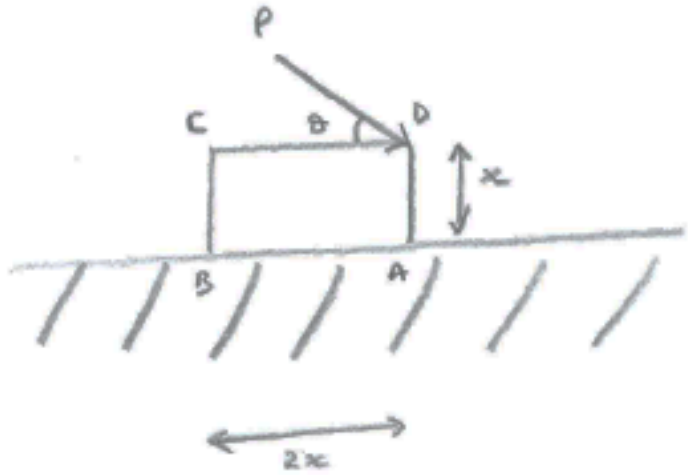
(1) A sledge with a child onboard is being pulled along on level ground, at a constant speed, by means of a rope inclined at 30° to the horizontal. The sledge and child together have a mass of $100kg$. The coefficient of friction between the sledge and the ground is $\frac{1}{10}$. Assuming that $g = 10$, find the tension in the rope.

(2) A block rests on a slope which is angled at $\theta°$ to the horizontal. The coefficient of friction between the surface of the slope and the block is $tan\ \alpha$. P_1 is the horizontal force that needs to be applied to the block to stop it from slipping down the slope, whilst P_2 is the greatest horizontal force that can be applied without the block slipping up the slope.

(i) Show that $\frac{P_2}{P_1} = \frac{\tan(\theta+\alpha)}{\tan(\theta-\alpha)}$

(ii) Explain what happens when $\theta < \alpha$

(3) A uniform block of mass m rests on a table, and a force P is applied at D, as shown in the diagram. The block has length $2x$ and height x. The coefficient of friction between the block and the table is μ.



(i) If the block is on the point of sliding, find an expression for P.

(ii) If instead the block is on the point of toppling, find an expression for P.

(iii) If the block is to topple before it slides, find a condition on μ.

(4) Referring to the diagram, A is a smooth pulley of mass 2 kg, which can move up and down; B is a smooth, fixed pulley, and C is a block of mass 1kg, which is initially held at rest on a table. A light inextensible rope is fixed at D, and leads to C, via the two pulleys.

C is now released and accelerates at 2 ms^{-1}. Find the coefficient of friction, μ between C and the table.