Q- A box of mass M placed on a table is connected to a hanging mass m by a string passing over a frictionless pulley as in the figure. If the box has mass of 1 kg, the coefficient of friction between the box and table surface is 0.3 and the box slides on the table at constant speed, what is the weight of the hanging mass m?

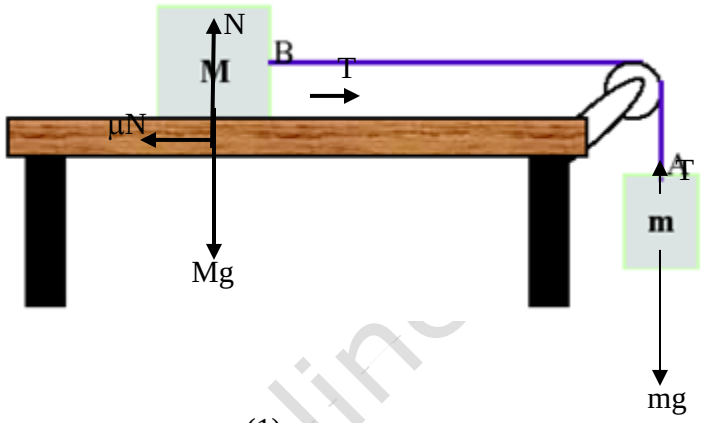
The forces acting on the box are:

The tension of the string T

The weight of the box Mg

The normal force of the table N and

The friction force μN



As the block is not moving in vertical direction, vertical forces are balanced and we have

$N - Mg = 0$

Or $N = Mg$ ---------- (1)

The friction force is given by the product of normal force and the coefficient of friction and is in direction opposite to the motion hence the friction will be towards left and as the box is moving with constant speed or with 0 acceleration, the net horizontal on the block must be zero and hence we have for horizontal direction

$T - \mu N = 0$

Or $T = \mu N = \mu Mg$ (using equation 1) ---------- (2)

Now the forces acting on the hanging mass m are

The weight of the hanging mass mg and

The tension in the string T

As the length of the string is constant and the string released due to motion of the box is coming to hanging part, the hanging mass will also move with the same constant speed in downward direction and thus the acceleration is zero. Hence writing equation of motion (F = ma) for the hanging mass we get

$T - mg = 0$ or $mg = T$

Substituting the value of the tension from equation (2) we get the weight of the hanging mass will be

$W = mg = T = \mu Mg = 0.3*1.0*10 = 3.0$ N

Answer: 3 N