On the incline shown, a block of mass 2 kg is launched upward with an initial velocity at point A of $v_0$. The block strikes a massless spring at B and compresses it. The relaxed length of the spring, $l_0$, is 0.5 m. The distance AB is 2.5 m. The coefficient of sliding friction is 0.3. The spring constant $k$ is 2500 N/m. If the spring is compressed to a length 0.3 m by the impact of the block (before the block stops), find the value of $v_0$. (Use energy methods.)

5 points

$$(U + K.E.)_{initial} =$$

5 points

$$(U + K.E.)_{final} + \text{Heat} + \text{Work done on Spring}$$

5 points

$$0 + \frac{1}{2} m v_0^2 = 0 + mgh + MNa + \frac{1}{2} Kx^2.$$ 

Spring initial length: $l_0 = 0.5$ m.

Compressed to 0.3 m

So $x = 0.5 - 0.3 = 0.2$ m.

AB = 2.5 m.

$$h = (2.5 + 0.2) \sin 30 = 1.35 \text{ m}.$$ 

$$d = 2.5 + 0.2 = 2.7 \text{ m}.$$ 

$Mg = 30$ 

$$\frac{1}{2} x^2 x v_0^2 = 2 \times 9.8 \times 1.35 + 0.3 \times 2 \times 9.8 \times \cos 30 + \frac{1}{2} \times 2500 \times (0.2)^2$$ 

$$v_0^2 = 26.45 + 13.75 + 50$$ 

$$v_0^2 = 94.9$$ 

$$v_0 = 9.74 \text{ m/s}$$