PHYS 102:General Physics I KOÇ UNIVERSITY Spring Semester 2016

College of Sciences

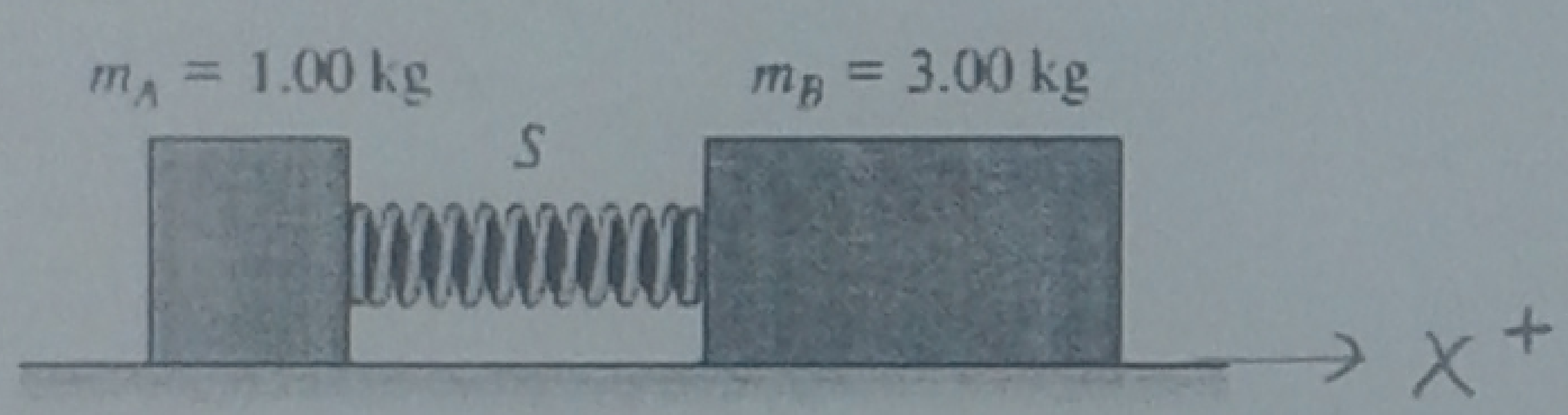
Section 1 Quiz 8 1 April 2016

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 10 minutes**

**Name:** **Student ID:** **Signature:**

Block A in the figure below has mass 1 kg, and block B has mass 3 kg. The blocks are forced together, compressing a spring S between them; then the system is released from rest on a level, frictionless surface. The spring, which has negligible mass, is not fastened to either block and drops to the surfaceafter it has expanded. Block B acquires a speed of 1.2 m/s.

a) What is the final speed of block A?
b) How much potential energy was stored in the compressed spring?




a) $v_B = 1.2\ m/s$ ⇒ From the conservation of momentum:

$P_i = P_f$ (no external force applied on the system)

$P_i = 0$ and $P_f = m_B v_B - m_A v_A \Rightarrow 0 = 3 \cdot 1.2 - 1 \cdot v_A$

↳ $v_A = 3.6\ m/s$

b) From the conservation of energy:

$K_i + U_i + W_{others} = K_f + U_f$ (with $K_i = 0$, $W_{others} = 0$, $U_f = 0$) $\Rightarrow U_i = K_f$

where $U_i = U_{spring} = \frac{1}{2} k x^2$ and $K_f = \frac{m_A v_A^2}{2} + \frac{m_B v_B^2}{2}$

↳ $U_{spring} = \frac{m_A v_A^2}{2} + \frac{m_B v_B^2}{2} = \frac{1 \cdot 3.6^2}{2} + \frac{3 \cdot 1.2^2}{2} =$

$= 7.2\ J$

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Section 2 Quiz 8 1 April 2016

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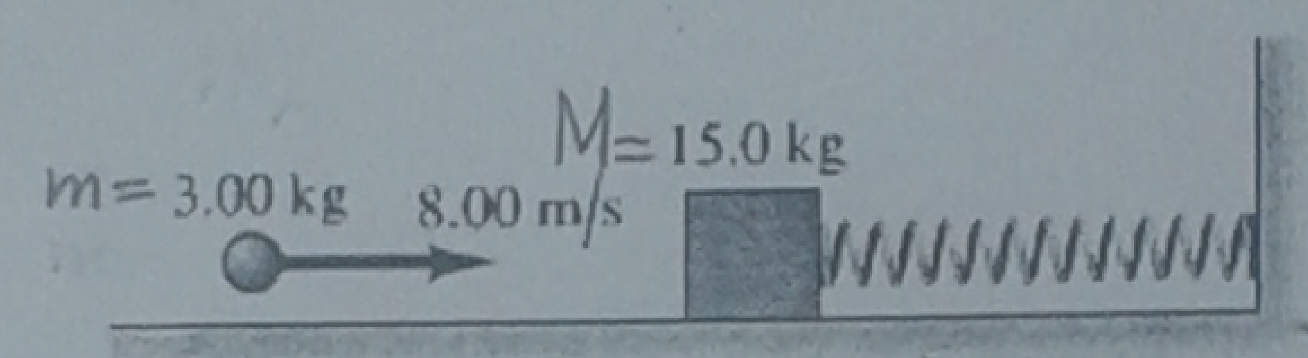
**Name:** **Student ID:** **Signature:**

A 15 kg block is attached to a very light horizontal spring of force constant 500 N/m and is resting on a frictionless horizontal table as shown in the figure. Suddenly it is struck by a 3 kg stone traveling horizontally at 8 m/s to the right, whereupon the stone rebounds at 2 m/s horizontally to the left. Find the maximum distance that the block will compress the spring after the collision.

$v_{m,i} = 8\ m/s$

$v_{m,f} = 2\ m/s$




$\rightarrow x+$

From the C.o.m : $P_i = P_f \Rightarrow m \cdot v_{m,i} = M \cdot v_M - m\, v_{m,f}$

$\Rightarrow 3 \cdot 8 = 15 \cdot v_M - 3 \cdot 2 \Rightarrow v_M = \frac{3 \cdot 10}{15} = 2\ m/s$

From the C.o.e : $K_i + U_i + W_{others} = K_f + U_f$ ($U_i = 0$, $W_{others} = 0$, $K_f = 0$)

(no dissipation)

$\Rightarrow K_i = U_f \Rightarrow \frac{M \cdot v_M^2}{2} = \frac{k\, x_{max}^2}{2}$

$\Rightarrow x_{max} = v_M \cdot \sqrt{\frac{M}{k}} = 2 \cdot \sqrt{\frac{15}{500}} = 2 \cdot \sqrt{\frac{3}{100}} = \frac{2\sqrt{3}}{10} = \frac{\sqrt{3}}{5}\ m$

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Section 3 | Quiz 8 | 1 April 2016

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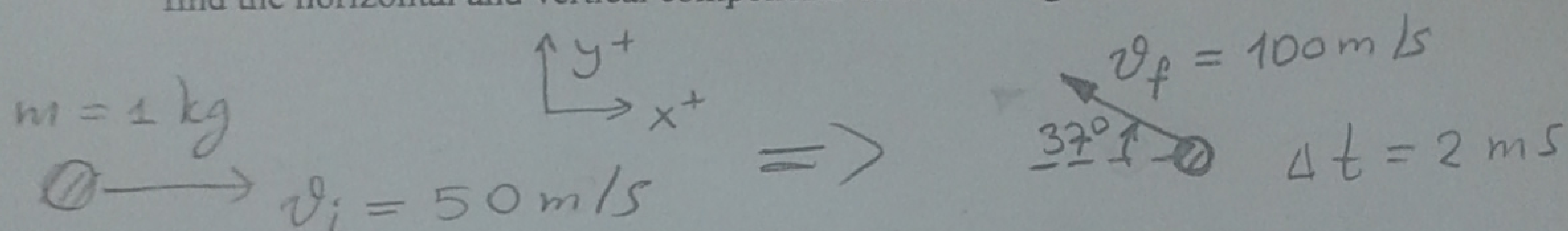
Quiz duration: 10 minutes

Name: | Student ID: | Signature:

A bat strikes a 1 kg baseball. Just before impact, the ball is traveling horizontally to the right at 50 m/s, and it leaves the bat traveling to the left at an angle 37 degrees above horizontal with a speed of 100 m/s. If the ball and bat are in contact for 2 ms (1 millisecond = 1/1000 s), find the horizontal and vertical components of the average force on the ball.




Change of momentum: $\vec{P} = \vec{F}_{avg} \cdot \Delta t$

x: $\Delta p_x = F_{avg,x} \cdot \Delta t \Rightarrow (-m v_f) - m v_i = F_{avg,x} \cdot \Delta t$

$\Rightarrow -1 \cdot 100 - 1 \cdot 50 = F_{avg,x} \cdot 2 \cdot 10^{-3}$

$\Rightarrow F_{avg,x} = -\dfrac{150}{2 \cdot 10^{-3}} = -75 \cdot 10^{3}\,N = -75\,kN$ //

y: $\Delta p_y = F_{avg,y} \cdot \Delta t \Rightarrow m v_f \cdot \sin 37° - 0 = F_{avg,y} \cdot \Delta t$

$\Rightarrow 1 \cdot 100 \cdot \sin 37° = F_{avg,y} \cdot 2 \cdot 10^{-3}$

$\Rightarrow F_{avg,y} = \dfrac{100 \cdot \sin 37°}{2 \cdot 10^{-3}} \cong 30.1\,kN$ //

$\Rightarrow \vec{F} = F_x \hat{i} + F_y \hat{j} = -75 \hat{i} + 30.1 \hat{j}$ (kN) //