Name: [redacted] Lab section/instructor: [redacted]

Student ID#: [redacted] Exam 2: Physics 50, Sec. 1 4 November 2014.

Please keep this exam closed until given the signal to start. The exam will end promptly at 1:10, at which time you will send your papers to the end of the row to be collected. If you finish early, please wait until 1:10.

There are 5 pages with problems; each page is worth 10 points, for a total of 50 points on this exam. (Don't forget the back of the past page.)

You may use a calculator, but no other materials are allowed during this exam. Also, show all of your work because unsupported work will not receive credit.

$$x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2 \qquad v_x = v_{0x} + a_x t \qquad v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

$$x - x_0 = \left(\frac{v_{0x} + v_x}{2}\right)t \qquad a_{\text{rad}} = \frac{v^2}{r} \qquad C = 2\pi r \qquad \sum \vec{F} = m\vec{a}$$

$$w = mg \qquad f_s \le \mu_s N \qquad f_k = \mu_k N \qquad W = \vec{F} \cdot \vec{s} \qquad W_{\text{total}} = \Delta K$$

$$K = \frac{1}{2}mv^2 \qquad \vec{p} = m\vec{v} \qquad \left|\vec{F}_{\text{el}}\right| = kx \qquad U = mgh \qquad U_{\text{el}} = \frac{1}{2}kx^2$$

For grading use only:

NL 15

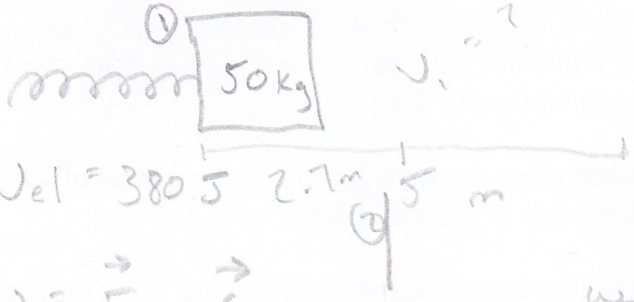
CE 10

CP 10

EP 10

WF 10

A wooden block whose mass is 50.0 kg is pressed against a spring that stores 380.0 J of energy. The system is released from rest and the block slides across a horizontal floor a distance of 5.00 m before coming to a stop. What is the speed of the block when it is 2.70 m from where it started?



$W = \vec{F} \cdot \vec{s}$

$\frac{1}{2}kx^2 = 380\,J$

$K_{e2} = 0 \quad U_{e1} = 380$

$U_{e1} + K_{e_1} + W_T = K_{e2}$

$380 + W_T = 0$

$W_T = -380\,J$

$W_T = f_k(s)(\cos\theta)$

$W_T = 490(\mu_k)(-5)$

$\frac{-380}{2450} = \mu_k$ ✓

$\mu_k = .155$

$K_{e_1} = 0 \qquad f_k = -75.95$

$W_{T_2} = 205.65 \leftarrow W_{T_2} = f_k \cdot \vec{s}$

$U_{e1} + K_{e_1} + W_{T_2} = K_{e_2}$

$380 - (205.65) = \frac{50}{2}(v^2)$

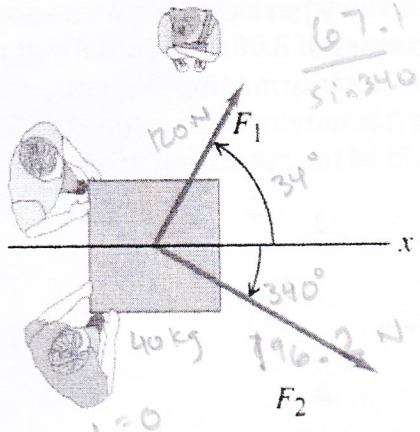
$\sqrt{6.974} = v$ ✓

$v = 2.64\ m/s$

very nice!

10

Two people push on a box with a mass of 40.0 kg, shown here as viewed from above. Force F_1 has a magnitude of 120.0 N and a direction of 34.0° as measured from the x axis. Force F_2 has a magnitude that is unknown, and is directed an angle of -20.0° from the x axis. The box starts from rest and moves a distance of 50.0 meters along the x axis in 8.00 seconds. Find the magnitude of force F_2 and also find the coefficient of kinetic friction between the box and the floor.



$J = \Delta P \rightarrow P_2 - P_1$

$J = m(v_2) - m(v_1)$

$\Sigma F_y = 0$

$\sin 34(120) - x(\sin 340) = 0$

$\frac{67.1}{\sin 340} = -196$

$F_{total} = \sqrt{(F_{xT})^2 + (F_{yT})^2}$

$F_{xT} = 99.5 + 184.4 \rightarrow 283.9$

$F_{yT} = 67.1 - 67.1 = 0$

$F_{total} = \sqrt{80599.21} \rightarrow 283.9$

50m

$t = 8$ sec

$J = \Delta P$

$J = \text{Force}(\text{time})$

$J_x = 795.84 + 7.52$

$J_y = 536.82$

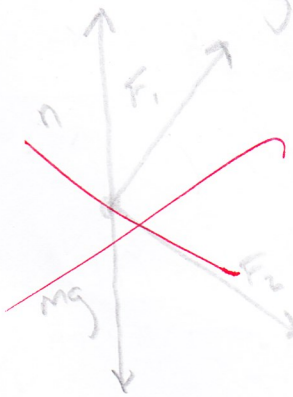
J = impulse

$W_{other} = \vec{F} \cdot \vec{S}$

$\vec{J} = \vec{F}(\text{time})$

$J = 283.9(8)$

$J = 2271.2$ kg·m/s



$n = mg$

$2271.2 = P_2 - P_1$

$P_2 = 2271.2$ 56.775

$P_1 = 0$

$v_2 = 56.78$ m/s

$\cos 34(120) + \cos 20(x) =$

$120(\sin 34) - x(\sin 340) = 0$

$K_{E_1} + W_{other} = K_{E_2}$

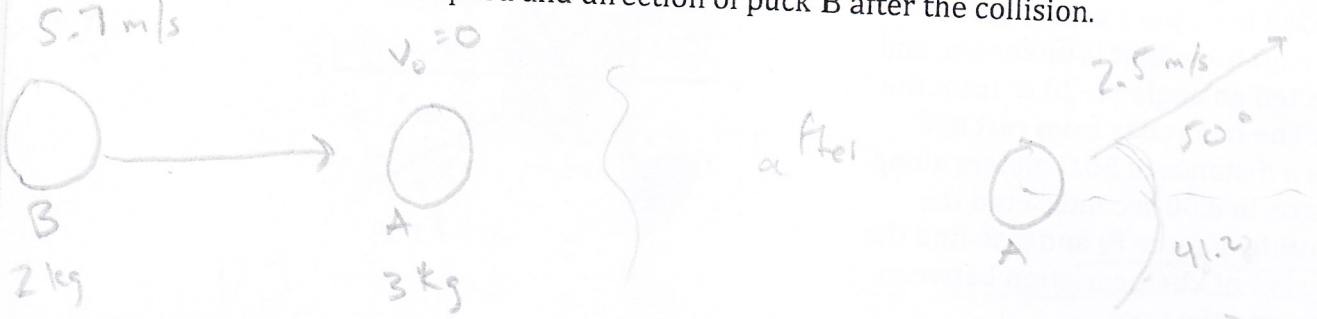
$W_{other} = 2271.2$

$392(\mu_K)(50) = \frac{2271.2}{19600}$

$\mu_K = .116$

$F_2 = 196.2$ N

One hockey puck collides with another on a frictionless, horizontal air table. Puck A has a mass of 3.00 kg is initially at rest at the origin. Puck B has a mass of 2.00 kg and is initially moving along the +x axis at a speed of 5.70 m/s. After the collision, puck A is moving with a speed of 2.50 m/s at an angle of 50.0° with respect to the x-axis. Find the speed and direction of puck B after the collision.



$$m_B\vec{v}_{B_1} + m_A\vec{v}_{A_1} = m_B\vec{v}_{B_2} + m_A\vec{v}_{A_2}$$

x comp

$$2(5.7) = 2(v_{B_2})(\cos\theta) + 3(2.5)(\cos 50^\circ)$$

$$11.4 = 2\left(\frac{-2.873}{\sin\theta}\right)(\cos\theta) + 4.82$$

$$6.58 = -5.746(\cot\theta)$$

$$\cot\theta = -1.145 \rightarrow 41.2$$

y comp

$$0 = 2(v_{B_2})\sin\theta + 3(2.5)\sin 50^\circ$$

$$\frac{-5.74}{2} = v_{B_2}\sin\theta \qquad v_{B_2} = \frac{-2.873}{\sin\theta}$$

speed / x

$$11.4 = 2(v_{B_2})\cos 318.8 + 7.5(\cos 50)$$

$$v_{B_2} = -4.37 \text{ m/s}$$

$$3.29 = v_{B_2}(\cos 318.8) \text{ or}$$

32.49

9.37 + 19.09

not elastic

$KE_1 = KE_2$?

4.37 m/s @ 318.8°

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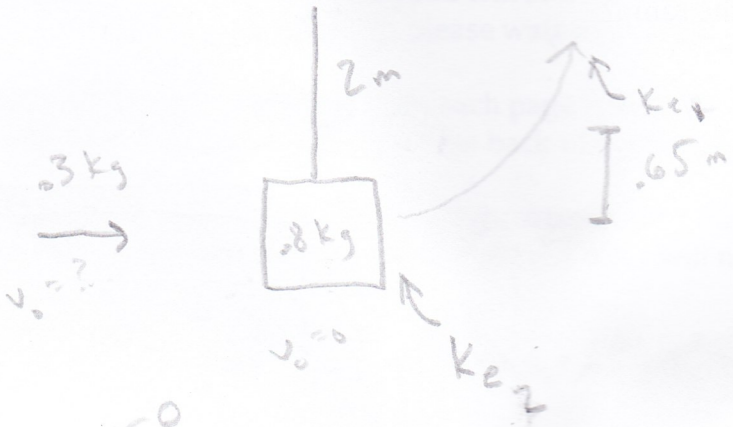
A block of cheese with a mass of 0.800 kg is suspended from the ceiling by a long thin cable. The cable is 2.00 m long, and the cheese is initially at rest. A dart with a mass of 0.300 kg is moving horizontally, and it strikes the cheese at an unknown speed. The dart is then embedded in the cheese, and the cheese+dart swings, tracing out the arc of a circle. It reaches a maximum height of 0.650 m. What was the dart's speed just before it struck the cheese?



find v_0 dart

$U + K_{e_1} = K_{e_2}$

$.8(9.8).65 = \frac{1}{2}.8(v^2)$

$\sqrt{12.74} = v$ $\quad v = 3.57$ @ bottom

$m_D \vec{v}_{D_1} + m_B \vec{v}_{B_1} = (m_{DTB})\vec{v}_F$

$.3(v_D) = 1.1(3.57)$

$v_D = 13.09$ m/s

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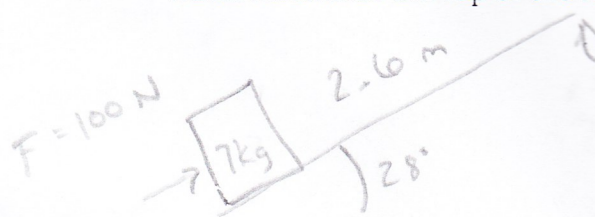
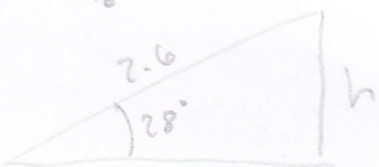
A ramp has an incline of 28.0° above horizontal and is 2.60 meters long. A robotic arm pushes a 7.00-kg block up the ramp, exerting a 100.0-N force parallel to the ramp. This force is exerted on the block by the robotic arm all the way up the ramp.

If this block has been sprayed with silicone oil (to eliminate friction) and it has an initial velocity of 1.80 m/s at the bottom of a ramp, what is the speed of the block when it reaches the top of the ramp?



$v_0 = 1.8$ m/s



$\sin 28 = \frac{h}{2.6}$

Conservation of energy

$U_1 + K_{e_1} + W_{other} = U_2 + K_{e_2}$

$0 \quad \frac{1}{2}\vec{F}\cdot\vec{s} = 260\ J$

$\frac{7}{2}(1.8)^2 + 260 = \frac{7}{2}(v)^2 + m(g)(1.22$

$11.34 + 260 = \frac{7}{2}v^2 + 83.73$

$187.61 = \frac{7}{2}v^2$

$v = 7.32$ m/s

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