

Will Legg

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**REFLECTION PROMPT: Reflecting on this week in class, were you able to improve on what you said last week? Why or why not?** This week in class I felt I was able to contribute a bit more than I had the previous week, in both our assessments of the problems and our problem solving process. Our group was able to identify items that we were solving for and were more clear in developing our plan and process this week.

**What went well this week? Be specific and include supporting examples from this week's class.** This week in class I was able to stay involved and clearly understand our process. I think our group is working pretty well together and it's easy for me to share my view of the problem. This week we stepped up our plan and made sure to develop our plan as we broke down the problem and brainstormed. We clearly broke down our process in solving and connected it with our plan by numbering the step we were working on and splitting up the step with drawn borders.

**What area(s) could you improve on for next week related to in class and how might you work to improve those next week? What strategies might you try to improve next week?** Next week I think we need to be more explicit and write down all of our assumptions that we need to make in order to solve our problem. I would like to stay involved and maybe as a group we could switch roles to make sure everyone can stay involved and make sure everyone is understanding our process and how we obtained our answers.

PASTE IMAGES OF YOUR TUESDAY WHITEBOARDS HERE:

<p><u>Facts</u></p> <ul style="list-style-type: none"> <li>- Spring constant: 15000 N/m</li> <li>- block mass: 400 kg</li> <li>- 3 kg harpoons @ 270 K</li> <li>- Each floor: 12 m</li> </ul>	<p><u>plan</u></p> <ol style="list-style-type: none"> <li>1 find coefficient of friction: steel</li> <li>2 find required spring compression</li> <li>3 calculate range of harpoons required <math>\rightarrow</math> 200 m/s at various heights</li> <li>find amount of ice needed to cool harpoons <math>\rightarrow</math> 270 K</li> </ol>	<p><u>Lacking</u></p> <p>- Angle of steel ramp</p> <ul style="list-style-type: none"> <li>- Force block exerts on the spring</li> <li>- The speed the harpoon leaves the spring <math>\rightarrow</math> to the speed when hitting zombie</li> </ul>
<p><u>Assumption</u></p> <ul style="list-style-type: none"> <li>- <math>\mu = 0.5</math> for cast concrete and steel</li> <li>- No Air Resistance</li> <li>- All energy is conserved</li> <li>- Room temp 295 K</li> <li>- Harpoon do not heat up during flight</li> </ul>	<p><u>Equation</u></p> $F_{fric} = \mu F_N \quad g = 9.81$ $U_{spring} = \frac{1}{2} K s^2$ $K \cdot E = \frac{1}{2} m v^2$ $KE_i + PE_i = KE_f + PE_f$ $Q = MC \Delta T$	<p><u>Representation</u></p> <p>Ramp</p> <p>KE + PE = E</p> <p>KE + PE = E</p>

<p>1. Solve for angle of steel ramp</p> $F_{fric} = \mu F_N$ $F_{fric} = mg \sin(\theta) \quad \mu = 0.5$ $F_N = mg \cos(\theta)$ $\frac{mg \sin(\theta)}{mg \cos(\theta)} = \frac{\mu mg \cos(\theta)}{\cos(\theta)}$ $\frac{\sin(\theta)}{\cos(\theta)} = \mu$ $\tan(\theta) = \mu$ $\tan^{-1}(\mu) = \theta$ $\tan^{-1}(0.5) = 26.6^\circ$ <p>(increased slightly to over come static friction)</p>	<p>2.1 Set up Energy</p> <p>Equation at max h</p> $\Delta E = 0 \quad E_i = E_f$ $KE_i + U_i = KE_f + U_f$ $U_i = mgh \quad KE_i = 0$ $mgh = KE_f - U_f$ $U_f = 0$ $mgh = KE_f$ $KE_f = 235440 \text{ J}$ <p>2.2 Use Final Kinetic in U<sub>spring</sub> Potential</p> $KE_f = \frac{1}{2} K s^2$ $s = \sqrt{\frac{2(KE_f)}{K}}$ $s = 5.6 \text{ m}$	<p>3. Solve for time in air</p> $h = g T^2$ $T = \sqrt{\frac{h}{g}}$ $T = 2.67 \text{ s}$ <p>4. Solve for V<sub>ini</sub></p> $U_{spring} = KE_f$ $KE_f = \frac{m v^2}{2}$ $v = \sqrt{\frac{2 K s^2}{m}}$ $v = 396 \text{ m/s}$ <p>5. Solve for d (max d)</p> $d = v \cdot T \quad d = 1057.3 \text{ m}$	<p>Test if harpoon will hit wall from 3rd floor</p> $d = v t$ $\frac{d}{v} = t \quad d = 70, v = 396$ $t = 1.769 \text{ s}$ $h = g t^2$ $h = 36 - 30 = 6$ $t_2 = \sqrt{\frac{h}{g}}$ $t_2 = \sqrt{\frac{6}{9.81}}$ $t_2 = 0.782 \text{ s}$ <p><math>\therefore</math> clear</p> <p>solve for d of harpoon</p> $d = v \cdot \sqrt{\frac{h}{g}} \quad v = 396 \text{ m/s}$ $g = 9.81 \rightarrow d = 857 \text{ m}$ $h = 46$ <p>3. <math>0.49 \cdot (295 - 270) = M \cdot 2.1 \cdot (270 - 250)</math></p> <p><math>= 0.875 \text{ kg of Ice per harpoon}</math></p>
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### facts

- mass satellite: 4500 kg
- mass probe: 400 kg
- dist from Earth:  $1.7 \times 10^9$  m
- satellite speed: 340 m/s
- asteroid mass: 9300 kg
- asteroid speed: 950 m/s
- dist sat to asteroid:  $5 \times 10^6$  m
- probe spring stiffness:  $5.3 \times 10^9$  N/m

### Assumptions

- Speed of light:  $3 \times 10^8$  m/s
- Signal travels @ speed of light
- collisions are maximally inelastic: momentum conserved but energy is not

### Plan

1. Calculate time for signal to reach satellite
2. Calculate if Asteroid will hit satellite before signal
3. Calculate the speed the spring must launch the probe to have satellite reach Earth
4. Time you can wait to send signal

### Equation

$$KE = \frac{1}{2} m v^2$$

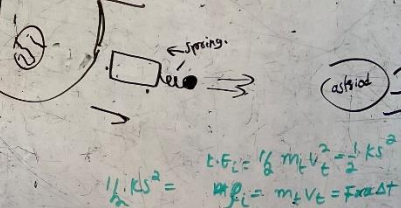
$$U_{spr} = \frac{1}{2} k s^2$$

### Lacking

#### Spring compression

- Time for signal to reach satellite
- Force the spring must exert

### Representation



$$U_{spr} = \frac{1}{2} k s^2 = \frac{1}{2} m_p v_p^2$$

$$m_p v_p = m_s v_s + m_a v_a$$

1. Solve for time it takes signal to reach Satellite

$$v_s = \frac{d}{t} \quad t = \frac{d}{v_s}$$

$$t = \frac{1.7 \times 10^9}{3 \times 10^8} = 6.3 \text{ seconds}$$

2. How far will satellite and asteroid travel

$$d_s = v_s \cdot t \quad d_a = v_a \cdot t$$

$$d_s = 2152.2 \text{ m} \quad d_a = 6015.5 \text{ m}$$

(they won't collide before signal)

3.1 Solve for speed of probe to stop asteroid  $v_a = 0$

$$(m_a \cdot v_a) + (m_p \cdot v_p) = (m_a + m_p) v_f$$

$$(m_a \cdot v_a) + (m_p \cdot v_p) = 0$$

$$v_p = \frac{-(m_a \cdot v_a)}{m_p} \quad v_p = -22,087.5 \text{ m/s}$$

3.2 Solve for speed of satellite

$$v_f (m_p + m_s) = v_s m_s + v_p m_p$$

$$v_f (m_p + m_s) - v_p m_p = v_s m_s$$

$$v_s = \frac{v_f (m_p + m_s) - v_p m_p}{m_s}$$

$$v_s = \frac{340(400 + 4500) - (-22,087.5) \cdot 400}{4500}$$

$$v_s = 2,333.56 \text{ m/s}$$

3.3 Solve for compression of spring

$$KE_p + KE_s = PE_{spring} + KE_{fs}$$

$$KE = \frac{1}{2} m v^2 \quad U_{spr} = \frac{1}{2} k s^2$$

$$\frac{1}{2} m_p v_p^2 + \frac{1}{2} m_s v_s^2 = \frac{1}{2} k s^2 + \frac{1}{2} m_f v_f^2$$

$$\frac{m_p v_p^2 + m_s v_s^2 - m_f v_f^2}{k} = s^2$$

$$s = \sqrt{\frac{400 \times 22,087.5^2 + 4500 \times 2,333.56^2 - 400 \times 340^2}{5.3 \times 10^9}}$$

$$s = 6.43 \text{ m}$$

4.  $|v_a| + |v_s| = d$

$$950t + 340t = 500,000$$

$$819.672 - t_{collision}$$

Time you can wait is 813.37 seconds