Computer Coaches For Introductory Physics Problem Solving:
Coaching Implementation

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Poster session: 2B17, Tu 9:20pm -10:50pm

3 types of computer coaches

- 1st: Computer coaches the student
  - Computer identifies decisions, student decides, computer assesses
- 2nd: Student coaches the computer
- 3rd: Student works more independently

Section One: Focus the Problem

- Focus the Problem
  - Picture
    - Important Objects
    - Kinematic Quantites
      - Position
      - Velocity
      - Acceleration
      - Time
    - Dynamic Quantites
      - Forces
    - Other Quantities
  - Questions
  - Approach
    - Physics Principle
    - System
    - Relevant Times
    - Relevant Info
- Describe the Physics
- Plan the Solution
- Execute the Plan
- Evaluate the Solution
- Summary

Important Objects

What objects should be included in a picture of the solution?

Choose the answer from the list below. Use the scroll bar if necessary.

- ○ Puck only.
- ○ Ramp only.
- ◉ Both puck and ramp.

From which point of view do you want to draw the picture?

Choose the answer from the list below.

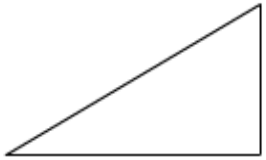
- ○ Top view.
- ◉ Side view.

Make Decisions about Drawing A Picture

Problem

At the State Fair you see people trying to win a prize at a game booth. They are sliding a metal disk shaped like a puck up a wooden ramp so that it gets near the top of the ramp before sliding back down. You estimate that you can slide the 'puck' at 8.0 ft/sec, but would that win the game? The two boundaries of the zone appear to be at 10 and 10.5 feet from the bottom of the ramp where you release the 'puck.' The ramp appears to be inclined at 37° from the horizontal. You happen to remember that between steel and wood, the coefficients of static and kinetic friction are 0.1 and 0.08,

Picture



Okay.

Problem

Continue

Section One: Focus the Problem

- Focus the Problem
  - Picture
    - Important Objects ✓
    - Kinematic Quantites ✓
    - 4 Kinematic Quantites
      - Position ✓
      - Velocity ✓
      - Acceleration ✓
      - Time ✓
    - Dynamic Quantites ✓
      - Forces ✓
      - Other Quantities ✓
  - Questions ✓
  - Approach ✓
    - Physics Principle
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Physics Principle

Which approach would you like to use? (You will be able to add another approach later if you want.)

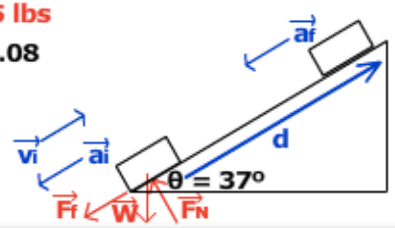
Choose the approach from the list below.

- Kinematics
- Dynamics
- Conservation of Energy

Make Decisions about which Physics Principle to use

Picture

$a_i = a$ $a_f = a$
$v_i = 8.0$ ft/s $v_f = 0$
$t_i = 0$ $t_f = ?$
W=2.5 lbs
$\mu_k = 0.08$



Question

How far up the ramp does the puck travel?

Approach

Dynamics

Okay.

Problem

Continue

Plan the Solution

- Focus the Problem
- Describe the Physics
- Plan the Solution
  - Arrange Equations
- Execute the Plan
- Evaluate the Solution
- Summary

Arrange Equations

Arrange the unknowns and equations to help you solve for the target quantity.

Click on an unknown you need to solve for and then an equation that can help you solve for it. Repeat until you have enough equations to solve for the target quantity. If you'd like to go back and add a different approach, click the 'Another Approach' button.

Algebra Help

Quantitative Relationships

Target Quantity: **d**

Other unknowns

a **t_f** **F_N**

Equations

$(W/2g)v_i^2 = \mu_k F_N d + W d \sin\theta$

$W\sin\theta + \mu_k F_N = (W/g)a$

$-W\cos\theta + F_N = 0$

$d = -1/2at_f^2 + v_i t_f$

$a = v_i / t_f$

Solution Plan

Find d

$(W/2g)v_i^2 = \mu_k F_N d + W d \sin\theta$

Find F_N

$-W\cos\theta + F_N = 0$

Clear Last

Clear All

Done

Another Approach

Knowns

$v_i = 8.0$ ft/s

$\mu_k = 0.08$

$W = 2.5$ lbs

$g = 9.8$ m/s^2

$\theta = 37°$

Okay.

Problem Focus Describe

3 types of computer coaches

- 1st: Computer coaches the student

- 2nd: Student coaches the computer
  - Student identifies decisions, computer decides, student gives feedback, Computer assesses

- 3rd: Student works more independently

Section One: Focus the Problem

Focus The Problem

I am having trouble deciding how to get started. What should I do first?

Choose the answer from the list below.

- ○ Choose an approach to use
- ○ Decide on the question to be answered
- ○ Draw a physics diagram
- ○ Draw a picture of the situation
- ○ Write down quantitative relationships

Student decides what to do

Problem

Your company is designing an apparatus for an ice skating show. An ice skater will start from rest and slide down an ice-covered ramp. At the bottom of the ramp, the skater will glide around an ice-covered loop which is the inside of a vertical circle before emerging out onto the skating rink floor. For a spectacular effect, the circular loop will have a diameter of 30 feet. Your task is to determine the minimum height from the rink floor to the top of the ramp for the skater to make it around the loop. When barely making it around, the skater briefly loses contact with the ice at the top of the loop and at that point the skater is in free fall.

Section One: Focus the Problem

Focus The Problem

Draw a Picture

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Draw a Picture

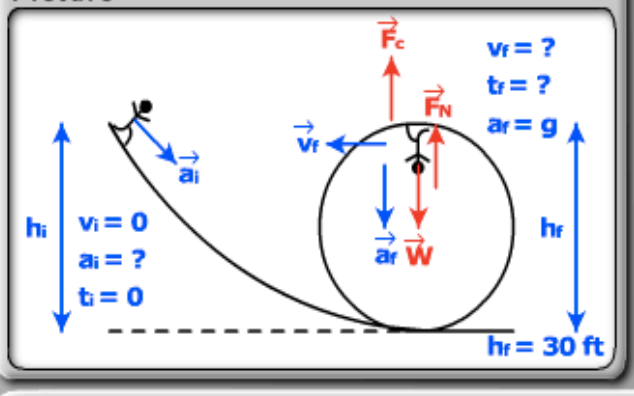
I've added more information to the picture below. Are these forces correct?

Choose the answer from the list below.

- Yes
- No

Student checks computer's work (picture)

Picture



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Execute the Plan

- Focus the Problem
- Describe the Physics
- Plan the Solution
- Execute the Plan

Solve For Target Quantity

My algebra for solving for h_i is shown at right. Have I done it correctly?

Choose the answer from the list below.

- (•) Yes
- ( ) No

Student checks computer's work (algebra)

Solution Plan

Find h_i:

$1/2v_f^2+gh_f - gh_i = 0$

Find v_f:

$g = 2v_f^2/h_f$

$v_f = \sqrt{(2g/h_f)}$

$h_i = 2h_f$

Knowns

$g = 9.8\ m/s^2$

$h_f = 30ft$

No. The algebra is incorrect.

3 types of computer coaches

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- 3rd: Student works more independently
  - Computer provides help as necessary

Section One: Enter the Answer

Enter & Evaluate the Answer

Enter & Evaluate the Answer

Enter your expression for the unstretched length of the bungee cord L in terms of the mass m of the jumper and the height h of the jump. Click Done when finished.

Use the interface to build an expression that yields the correct answer.

Solve it on your own

m	4	+	)	
g	5	-		
h	6	*		
1	7	/		+/-
2	8	^	C	CA
3	9	(	Done	

I got stuck and couldn't get an answer.

Problem

Because of your knowledge of physics, you have a summer job working for a company that arranges bungee jumps. The cords used in the jump are sorted by their unstretched length and their spring constant (when the cords stretch, they exert a force that has the same properties as the force exerted by a spring). Your first task is to develop equations for the company employees to use when picking out a cord for a jump. Given the mass of the jumper and the height of the jump, your equations should allow an employee to calculate the correct unstretched length and spring constant for the bungee cord to be used and you decide to first develop an equation for the correct unstretched length. For the most exciting jump, the person should stop just short of the ground. In order to keep the jumper safe, the company doctor recommends that the maximum acceleration

Answer

Section One: Enter the Answer

- Enter & Evaluate the Answer

Enter & Evaluate the Answer

Enter your expression for the unstretched length of the bungee cord L in terms of the mass m of the jumper and the height h of the jump. Click Done when finished.

Use the interface to build an expression that yields the correct answer.

h / (3 * m)

m	4	+	)	
g	5	-		
h	6	*		
1	7	/		+/-
2	8	^	C	CA
3	9	(	Done	

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Answer

L = h / (3 * m)

Click continue and we will check your answer.

Continue

Section One: Enter the Answer

- Enter & Evaluate the Answer

Enter & Evaluate the Answer

Does your expression for L have the correct units?

Choose the answer from the list below.

- (•) Yes
- ( ) No

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Answer

L = h / (3 * m)

No. Your answer does not have the correct units. Click Continue to go back and fix your answer.
Remember to check your units.

Continue

Section One: Enter the Answer

Enter & Evaluate the Answer

Enter & Evaluate the Answer

With which part of the framework would you like to get help?

Choose the answer from the list below.

- Focus the Problem: Picture and question
- Focus the Problem: Choose approach(es)
- Focus the Problem: Elaborate the approach(es)
- Describe the Physics: Draw a diagram and choose a target quantity
- Describe the Physics: Find quantitative relations
- Plan the Solution
- Execute the Plan

Problem

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Answer

Thanks!

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Minnesota Physics Education Research group:
http://groups.physics.umn.edu/physed