TI-nspire™

Grade level: 9-12
Subject: mathematics
Time required: 45 to 90 minutes

The Ball and All of Its Energy

by – Jacklyn Bonneau

Activity overview

Students will explore the conservation of energy of a ball which is tossed

Concepts

Concepts reinforced include

- *Potential energy*
- *Kinetic energy*
- *Conservation of Energy*

Teacher preparation

Download files and print off student worksheet. Have CBR-2s for each station and large playground balls. CBLs and motion sensors may be used instead of CBR-s.

Classroom management tips

Large slightly under-inflated playground balls which are slightly textured work best, nerf balls don't work. Be sure students have an unobstructed area to toss the balls up. It is best to slightly toss the balls; higher is not better and one good toss is all they need. They can keep the ball still until data collection stops after and before the toss.

TI-Nspire Applications

TI-Nspire and/or TI-Nspire CAS Data Collection, Lists and Spreadsheets, and Graphs and Geometry will be used.

Step-by-step directions

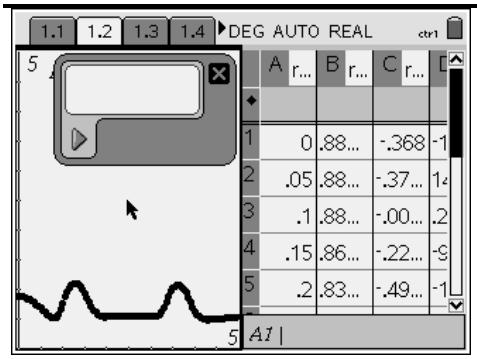
1. *Plug your CBR2 into the mini USB on the Nspire. Nspire will open with a split screen.*
2. *Use the mouse to move to the triangle on the screen and click it*
3. *Data Collection will begin, toss ball up and then click stop.*
4. *If needed repeat the last step.*
5. *Disconnect the CBR2.*
6. *Create your data table*
    a. *Insert a list and spead sheet page by pressing CONTROL I and choosing lists and spread sheets*
    b. *Move your curser to the column next to the A and type in run0. And a drop down will appear choose time.*
    c. *Repeat for B, C, and D columns choosing distance, velocity, and acceleration.*
7. *You can see these graphs of this data.*
    a. *Insert a graphs and geometry page.*
    b. *Choose a scatter plot by MENU>GRAPH TYPE> SCATTER PLOT.*
    c. *Use the pull down menu to choose time as the x then distance for the using TAB for going between.*
    d. *Down arrow when on the ^ to get to s2 and choose time and velocity*
    e. *For s3 choose time and acceleration.*
    f. *Get the window, MENU>WINDOW>ZOOMDATA. You want only one curve, if you have more set the window to include only one. MENU>WINDOW>WINDOW SETTINGS.*
    g.

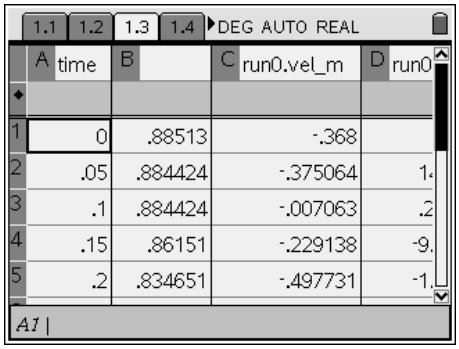
8. *Create a table of givens.*
    a. *Insert a calculator page by pressing CONTROL I and choosing calculator*
    b. *Define your variables by going to MENU>TOOLS>DEFINE and pressing enter and then typing in mass= _____. Fill in the mass of your ball. (students may type the word define instead of using the menu option.)*
    c. *Repeat above entering g=____. (Either instruct students to use 9.8 or the value obtained from the acceleration curve).*
9. *Create a Table of Calculations*
    a. *Insert a new table as in step 6.*
    b. *Column A should be time*
    c. *Column B will be Potential Energy (mass*g*run0.dist_m). (NOTE once you type in run0. You will get the options for the variables)*
    d. *Column C will be Kinectic Energy (.5*mass*run0.vel_m^2) (NOTE once you type in run0. You will get the options for the variables)*
    e. *Column D will be Total Energy (PE +_ KE)*
10. *Create a graph page.*
    a. *Insert a graphs and geometry page.*
    b. *Choose a scatter plot by MENU>GRAPH TYPE> SCATTER PLOT.*
    c. *Use the pull down menu to choose time as the x then Potential Energy for the using TAB for going between.*
    d. *Down arrow when on the ^ to get to s2 and choose time and Kinectic Energy*
    e. *For s3 choose time and Total Energy.*
    f. *Get the window, MENU>WINDOW>ZOOMDATA. You want only one curve, if you have more set the window to include only one. MENU>WINDOW>WINDOW SETTINGS.*

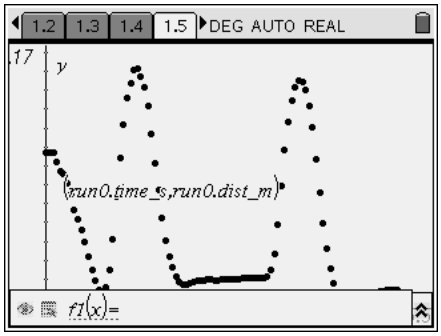
Assessment and evaluation *Optional: Answers to student questions in the Student TI-Nspire document and/or student worksheet*

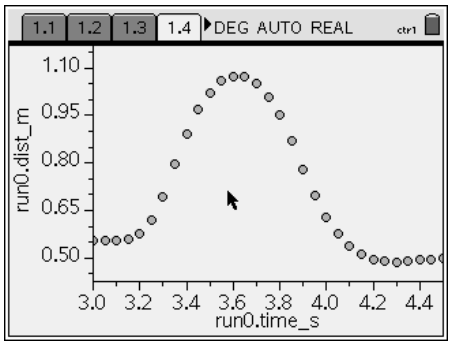
Activity extensions

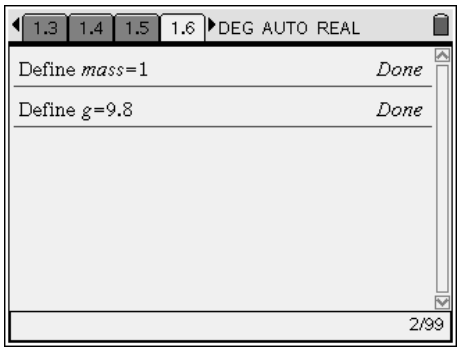
- *Have students discuss the graphs of distance, velocity and acceleration.*
- *Have students find g from the acceleration graph, supply a variety of balls for this.*
- *Students can determine the elasticity for the collision if they do the bounce of the ball.*

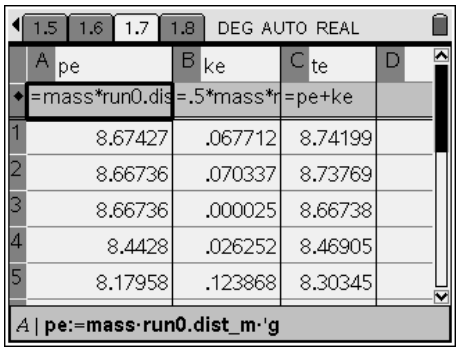


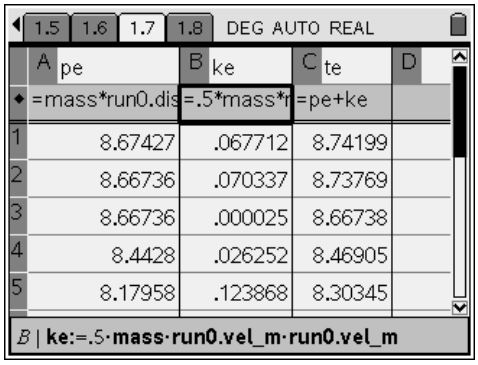


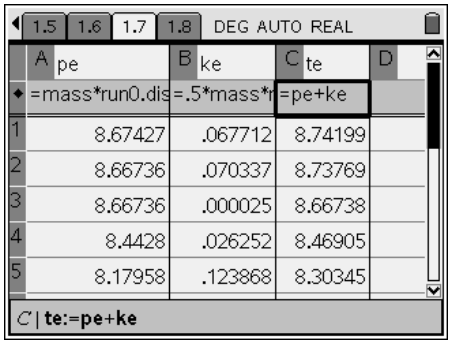


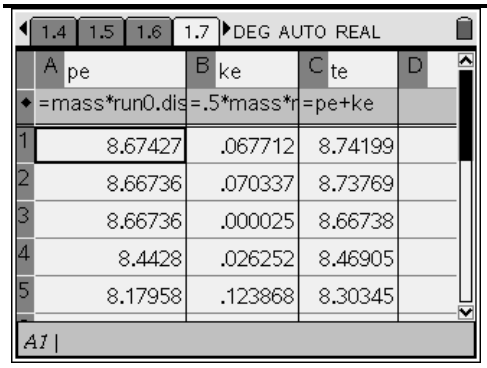











1.4 1.5 1.6 1.7 DEG AUTO REAL
A pe
B ke
C te
D
=mass*run0.dis
=.5*mass*r
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1 8.67427 .067712 8.74199
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5 8.17958 .123868 8.30345
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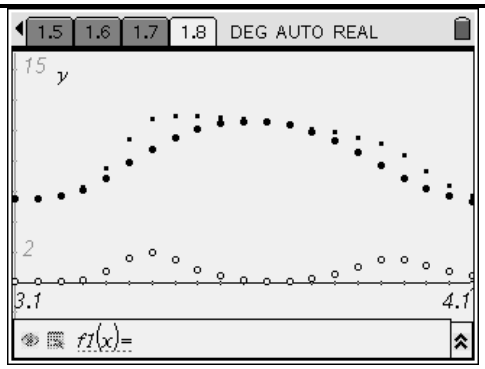
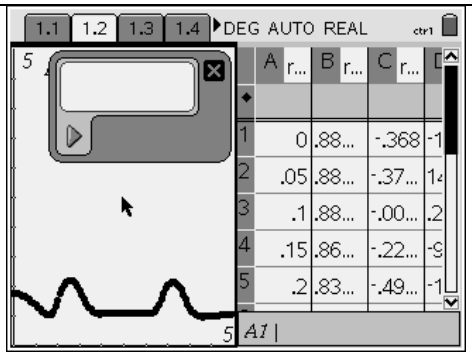
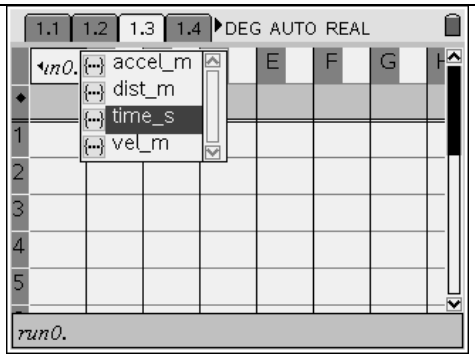
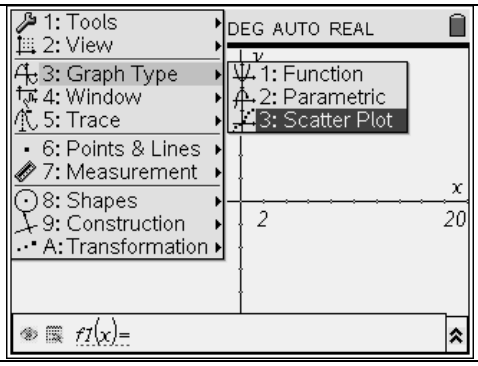

1.5 1.6 1.7 1.8 DEG AUTO REAL
15
y
2
3.1
4.1
f1(x)=

Student Worksheet

1. *Plug your CBR2 into the mini USB on the Nspire. Nspire will open with a split screen.* 2. *Use the mouse to move to the triangle on the screen and click it* 3. *Data Collection will begin, toss ball up and then click stop.* 4. *If needed repeat the last step.* 5. *Disconnect the CBR2.*	
6. *Create your data table* a. *Insert a list and spead sheet page by pressing CONTROL I and choosing lists and spread sheets* b. *Move your curser to the column next to the A and type in run0. And a drop down will appear choose time.* c. *Repeat for B, C, and D columns choosing distance, velocity, and acceleration*	
7. *You can see these graphs of this data.* a. *Insert a graphs and geometry page.* b. *Choose a scatter plot by MENU>GRAPH TYPE> SCATTER PLOT.*	

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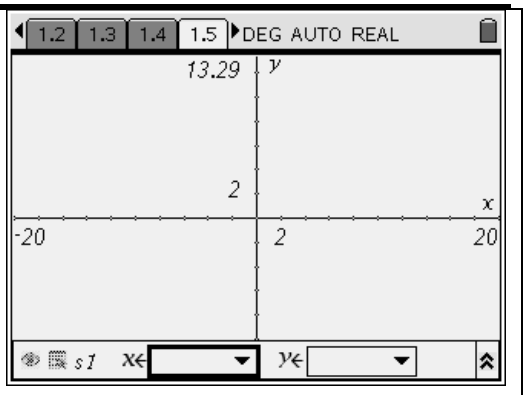

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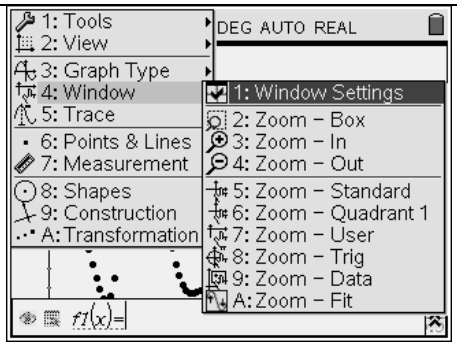

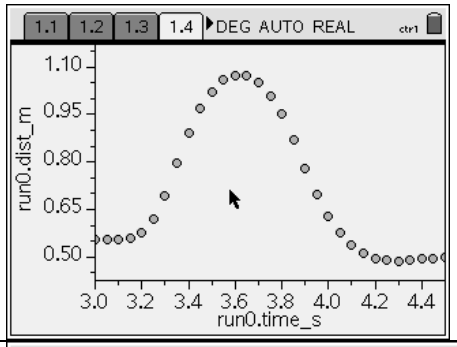

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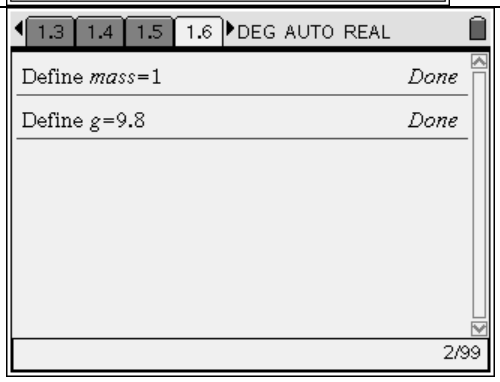
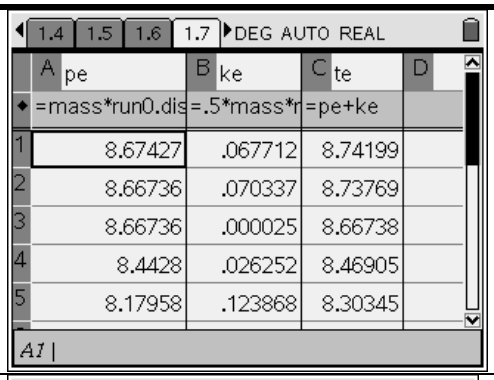
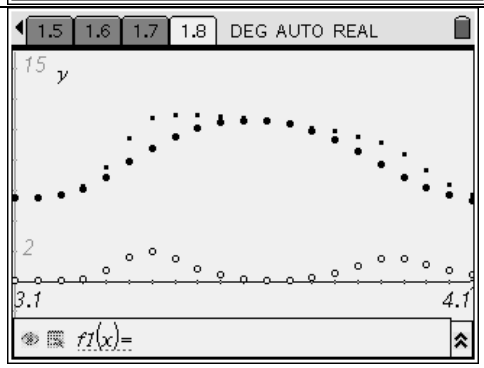


9. *Create a Table of Calculations* a. *Insert a new table as in step 6.* b. *Column A should be time* c. *Column B will be Potential Energy. (NOTE once you type in run0. You will get the options for the variables)* d. *Column C will be Kinectic Energy (NOTE once you type in run0. You will get the options for the variables)* e. *Column D will be Total Energy.*	
10. *Create a graph page.* a. *Insert a graphs and geometry page.* b. *Choose a scatter plot by MENU>GRAPH TYPE> SCATTER PLOT.* c. *Use the pull down menu to choose time as the x then Potential Energy for the using TAB for going between.* d. *Down arrow when on the ^ to get to s2 and choose time and Kinetic Energy* e. *For s3 choose time and Total Energy.* f. *Get the window, MENU>WINDOW>ZOOMDATA. You want only one curve, if you have more set the window to include only one. MENU>WINDOW>WINDOW SETTINGS.* g. *For s3 choose time and Total Energy.*	

Questions

1. *Where is the Potential Energy the greatest? The least? Why?*

2. *Where is Kinetic Energy the greatest? The least? Why?*

3. *What can we conclude about total energy?*

4. *How would the graphs change if it were a bounce? Why?*

5. *How would the graphs change if the ball were or a different mass? Why?*