Innovators in Mathematics Education

Texas Instruments

MEI Conference 2013

Motivating learning in Mechanics with Geogebra

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Geogebra in mechanics

Creating a basic force diagram

Problem:
A block of mass m is resting on a rough horizontal plane. The block is pulled by a force P which is insufficient to move the block. Draw a force diagram of the forces acting on the block.

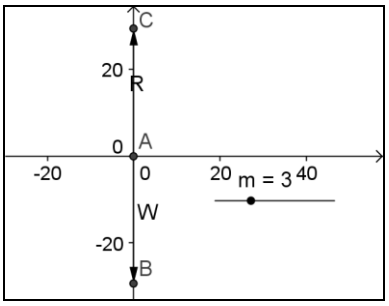
Creating the vectors for weight and normal reaction

1 Add a point (2nd menu) to represent the block modelled as a particle (for convenience place the point on the origin).

2 Add a slider for the mass (10th menu). Set the name to *m* and set the min to 0 and the max to 10.

3 Using the input bar at the bottom of the screen enter **(0,-9.8*m)**. You may need to zoom-out (11th menu) to see the point. Create a vector (3rd menu) joining the particle and the new point. Right-click on the vector, select properties then rename this vector as *W*.

4 Using the input bar enter **(0, 9.8*m)**. Create a vector joining the particle and the new point. Rename this vector as *R*.



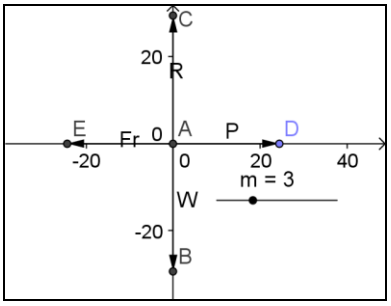
Creating the vectors for the pulling force and the friction

5 Add a new point on the *x*-axis.

6 Create a vector joining the particle and the new point. Rename this vector as *P*.

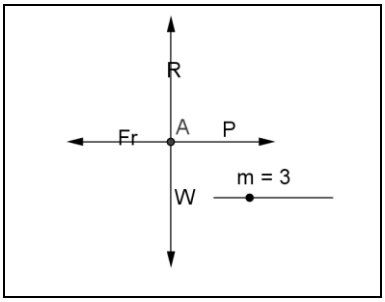
7 Using the input bar enter **(-x(D),0)**.

8 Create a vector joining the particle and the new point. Rename this vector as *Fr*.



Hiding construction objects for display purposes

9 For display purposes you can remove the axes (View > Axes) and hide all the points (right-click on the points and de-select Show object.



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Geogebra in mechanics

Creating a projectile

Problem:

A ball is kicked from the ground with velocity $\begin{pmatrix}15\\12\end{pmatrix}$ ms^{-1}.

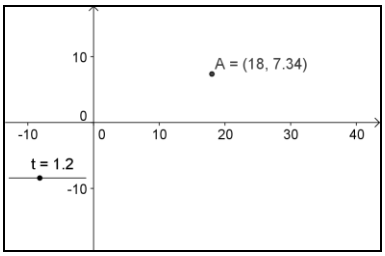
Find the velocity and the position of the object at time t.

Creating the projectile

1 Add a slider for the time (10th menu). Set the name to *t* and set the min to 0, the max to 3 and the increment to 0.05.

2 Generate a point representing the ball using the input bar at the bottom of the screen entering **(15*t,12*t-4.9*t^2)**.

3 Right-click on the point and select Properties. On the Show Label option select "Name and value".



Adding the velocity vector

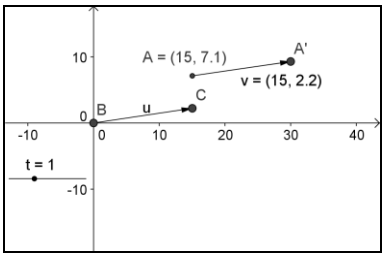
4 Add a point at the origin (2nd menu). Using the input bar at the bottom of the screen enter **(15,12-9.8*t)**.

5 Create a vector between the point at the origin and the new point (3rd menu). *This creates the velocity vector which then needs to be transposed to the projectile.*

6 Select Vector from point (3rd menu) and select the point representing the ball and the vector.

7 Right-click on the point and select Properties. On the Show Label option select "Name and value".

8 You may wish to hide the vector at the origin and all the points except the ball. You can do this quickly by clicking the blue circle next to the object in the algebra window.

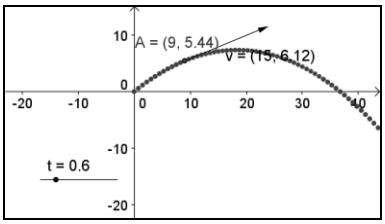


Adding the path and animating

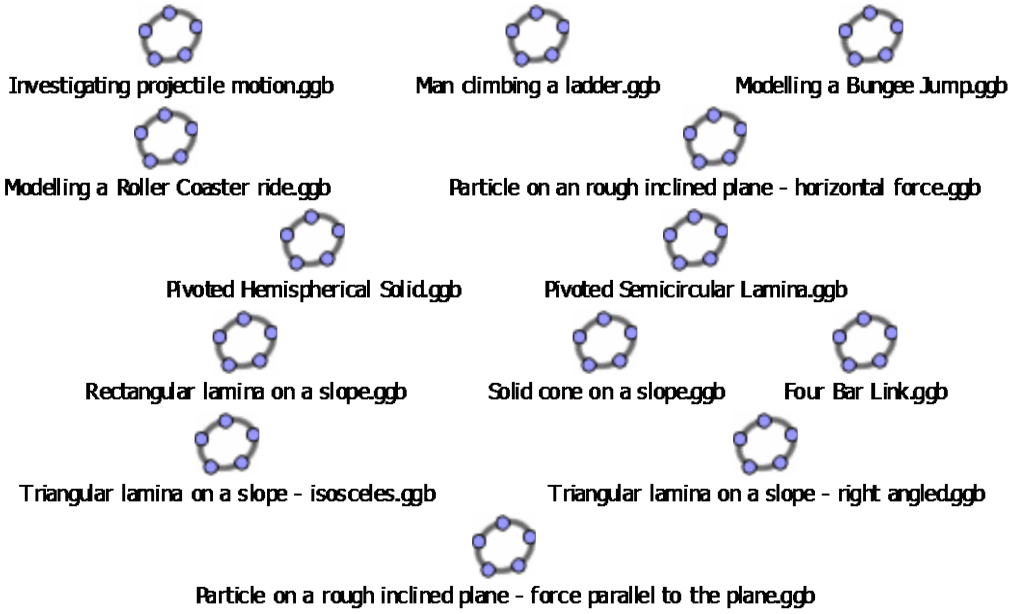
9 To display the path of the projectile right-click on the point and select Trace On.

10 To animate the path of the projectile right-click on the slider. On the Slider tab set the Animation Repeat to Increasing. On the Basic tab select Animation On.

11 A play/pause button should appear at the bottom of the screen.



The following examples of the use of Geogebra in mechanics can be found (in no particular order) in the folder 'Mechanics_Geogebra_files_DC'. (available from http://www.mei.org.uk/files/Mechanics_Geogebra_files_DC.zip)



These were created by Derek Couzens (a former FMSP manager). They were developed for his teaching, but he has kindly made them freely available for others to use.

The key point about them is that they provide a mechanism to allow students to investigate specific ideas and concepts. Many would require guidance from the teacher, but it is also the case that worksheets could be constructed to tease out the key points from the simulations.

Demonstrations for every question on the January 2007 Mechanics 1 paper have been produced and are available to be downloaded.
(http://www.mei.org.uk/files/ict/m1ja07_geogebra.zip)

Using Geogebra in this way highlights how mechanics is an application of both geometry and algebra.

Please do explore all these files that have been produced and consider how you could use and adapt them to suit your need.