1. Left-click the red object and drag a velocity (red) vector out from it. If unsuccessful, press "Reset" and try again.

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2. Left-click the red object again and drag an acceleration (blue) vector out from it.



3. When the red object is not moving, the two vectors can be modified by left-dragging their heads.

4. Translate the whole system by right-dragging (or control-dragging) the red object.

5. After the velocity and acceleration are created, select the nature of force that acts on the red object.



6. When the "central force" is selected, a cross will appear. This is the centre at which the force is pointing. You can drag the cross to a new position.

7. To refresh the black dots on the locus, uncheck "Show locus" and check it again.

**Bertrand's theorem:**

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| **In central force motion, the orbits are closed only for inverse square law and Hooke's law.** |

Reference

H. Goldstein, Classical Mechanics (Addison-Wesley, Reading, MA, 1980), 2nd ed.

Lowell S. Brown Am. J. Phys. **46**, 930 (1978)

Y. Tikochinsky, Am. J. Phys. **56**, 1073 (1988)

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| http://ngsir.netfirms.com/images/motion.png | http://ngsir.netfirms.com/images/aeroplane.png |
| The horizontal component of the tension in the rope provides the centripetal force. | The horizontal component of the lifting force acting on the wings of an aeroplane provides the centripetal force for its turn. |