13	12e	A particle moves along a straight line. The displacement of the particle from the origin is x, and its velocity is v. The particle is moving so that $v^2 + 9x^2 = k$, where k is a constant. Show that the particle moves in simple harmonic motion with period $\frac{2\pi}{3}$.	2

State Mean: **1.08/2**

$v^2 + 9x^2 = k$

$v^2 = k - 9x^2$

$\ddot{x} = \frac{d}{dx}\left[\frac{1}{2}v^2\right]$

$= \frac{d}{dx}\left[\frac{1}{2}(k - 9x^2)\right]$

$= -9x$

As $\ddot{x} = -9x$, then in SHM with $n = 3$. Also period $= \frac{2\pi}{n}$, then period is $\frac{2\pi}{3}$.

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by the Board of Studies

Board of Studies: Notes from the Marking Centre

For 2 marks, candidates needed to show that the particle was moving in simple harmonic motion by proving the differential equation $\ddot{x} = -n^2x$, or correctly using $\frac{d}{dx}\left(\frac{1}{2}v^2\right)$, in the context of this question.

Common problems were:

- differentiating poorly, which limited the accuracy of some responses
- simply using a common identity such as $v^2 = n^2\left(a^2 - x^2\right)$ and stating that $n = 3$.

Source: http://www.boardofstudies.nsw.edu.au/hsc_exams/