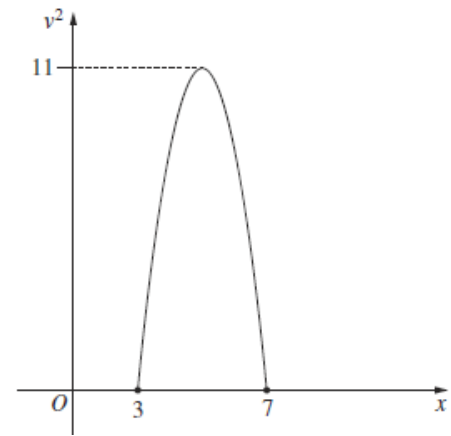


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- 2015 13 a** A particle is moving along the x -axis in simple harmonic motion. The displacement of the particle is x metres and its velocity is v ms^{-1} . The parabola shows v^2 as a function of x .
- For what value(s) of x is the particle at rest?
 - What is the maximum speed of the particle?
 - The velocity v of the particle is given by the equation $v^2 = n^2(a^2 - (x - c)^2)$ where a , c and n are positive constants. What are the values of a , c and n ?



- (i) At rest when $v^2 = 0$.
 $\therefore x = 3, 7$

State Mean:
0.86

- (ii) Maximum of 11.
 $\therefore v^2 = 11$
 $v = \sqrt{11}$

\therefore maximum speed is $\sqrt{11}$ ms^{-1} .

State Mean:
0.72

- (iii) Centre of motion c is middle of 3 and 7.
 $\therefore c = 5$
 \therefore amplitude $a = 2$

$$\begin{aligned} \text{Substitute in } v^2 &= n^2(a^2 - (x - c)^2) \\ 11 &= n^2(2^2 - (5 - 5)^2) \\ 4n^2 &= 11 \\ n &= \frac{\sqrt{11}}{2} \end{aligned}$$

State Mean:
1.22

* These solutions have been provided by [projectmaths](#) and are not supplied or endorsed by BOSTES.

Board of Studies: Notes from the Marking Centre

Question 13

- (a)(i) Most candidates stated the values of $x = 3$ and $x = 7$.

A common problem was:

- giving the answer as $x = 0, x = 5, x = \sqrt{3}$ or $x = \sqrt{7}$.

(ii)

Many candidates gave the correct value.

Common problems were:

- giving an answer of $v = 11$
- not recognising that speed is positive (ie giving answers of plus or minus a value).



(iii)

The most common method was to use simultaneous equations to first find c , then use this to find a and n . Some candidates used the data from the given parabola to manipulate the equation into the form given in the question. They were then able to read the required values easily from the equation.

Common problems were:

- not recognising the significance of the variables in relation to SHM
- trying to use data from the parabola in standard trig formula in SHM
- poor calculation and algebraic skills when solving simultaneous equations.