3. A sonometer wire is stretched between two points A and B, 1.0 m apart as shown in the diagram. This wire is made to vibrate transversely with a single loop, by plucking the middle of the wire at O.
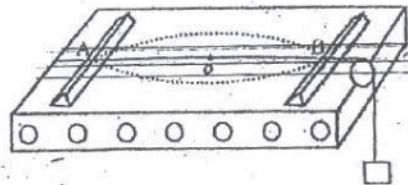
The wire vibrates in simple harmonic motion in a vertical plane and the motion is given by

$a = -16\pi^2 \times 10^4 y$, where a (ms^{-2}) is the acceleration and y is the vertical displacement.

(a) (i) Draw a rough sketch to show the variation of y with time t.

(ii) Calculate the periodic time of the vibration of the wire. *(2 lines)*

(iii) Find also the frequency of the vibration. ....Hz

(b) (i) What is the wavelength of the wave produced. *(one line)*

(ii) Hence calculate the velocity of the transverse wave in the wire. *(one line)*

(C) (i) Write down an expression relating the transverse wave velocity (V), tension (T) and the mass per unit length (m) of the wire. *(one line)*

(ii) If $m = 1.0 \times 10^{-4}$ kg m^{-1}, what is the tension in the wire? *(2 lines)*

(d) (i) When students were asked to resonate to sonometer wire using a vibrating tuning fork they used the following methods.

(1) Holding the tuning fork just above the middle of the wire.

(2) Keeping the tuning fork on the middle of the wire.

(3) Placing the tuning fork on the sonometer box.

Which one of the above method is correct. Explain your answer. *(2 lines)*

(ii) What should be the lowest frequency of the tuning fork which would resonate with the wire. *(one line)*

(e) If a paper rider is placed at the middle of the wire, at O, for what minimum displacement of the wire the rider will begin to fly off from the wire. (Hint: This will happen when the reaction on the paper rider by the wire becomes zero) *(3 lines)*