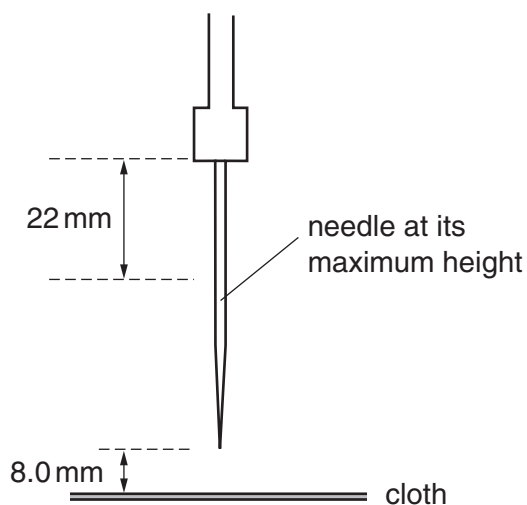


- 3 The needle of a sewing machine is made to oscillate vertically through a total distance of 22 mm, as shown in Fig. 3.1.

For  
Examiner's  
Use



**Fig. 3.1**

The oscillations are simple harmonic with a frequency of 4.5 Hz.

The cloth that is being sewn is positioned 8.0 mm below the point of the needle when the needle is at its maximum height.

- (a) State what is meant by *simple harmonic motion*.

.....  
 .....  
 ..... [2]

- (b) The displacement  $y$  of the point of the needle may be represented by the equation

$$y = a \cos \omega t.$$

- (i) Suggest the position of the point of the needle at time  $t = 0$ .

..... [1]

- (ii) Determine the values of

1.  $a$ ,

$a =$  ..... mm [1]

2.  $\omega$ .

$\omega =$  .....  $\text{rad s}^{-1}$  [2]

(c) Calculate, for the point of the needle,

(i) its maximum speed,

speed = .....  $\text{ms}^{-1}$  [2]

(ii) its speed as it moves downwards through the cloth.

speed = .....  $\text{ms}^{-1}$  [3]