2. (a) Fig. 1 shows a schematic diagram of a sonometer which is an instrument for studying the properties of transverse stationary waves in a stretched string.

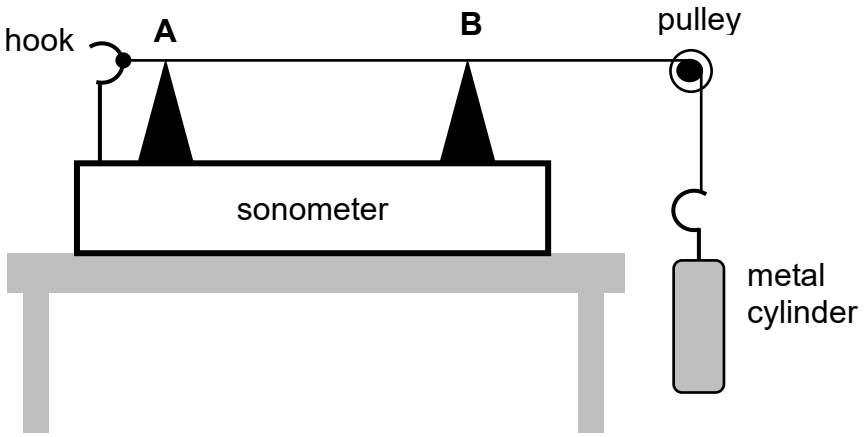

Fig. 1.

The string can be vibrated using an electrical vibrator. Stationary waves can be formed in the portion of the string between the two wedges (labelled A and B in Fig. 1). The tension in the string is provided by a metal cylinder hanging from one end of the string as in Fig. 1. In a particular experiment, the mass of the cylinder is 2.0 kg. The string has a circular cross-section with uniform diameter of 1.5 mm and the density of the material of the string is 8830 kg m^{-3}. The string is vibrating in its fundamental mode with a frequency of 22.0 Hz. What is the distance between the two wedges?

[2 marks]

2. (b) The metal cylinder has a density 8400 kg m^{-3} and a diameter of 5.0 cm. While still hanging from the end of sonometer wire, the cylinder is completely immersed in water. What **changes** must be made to the distance between the two wedges so that the frequency of fundamental mode still remains at 22.0 Hz?

[Density of water = 1000 kg m^{-3}]

[4 marks]

2. (c) The distance between the two wedges is now adjusted back to the value as calculated in part 2(a). The metal cylinder is now immersed in brine which has a density of 1220 kg m^{-3}. The string is now allowed to vibrate in the second overtone mode. The sound waves produced by the string and the sound waves from a piano note of frequency 64 Hz are sounded together. What is the frequency of the beat produced?

[4 marks]