In order to determine the density of the material which is used to make the 25 cents coin, a student measures the diameter (d), thickness (t) and the mass (m) of a coin. His measurements were $t = 1.77$ mm, $d = 18.01$ mm and $m = 3.12$ g.

(a) (i) What is the least count of the instrument used to measure d in mm?

  (ii) Give a list of measuring instruments in the laboratory to measure the thickness (t) and the diameter (d) with the given accuracy.

   (1) Thickness (t)   (a) ------------------   (b) ----------------------   (c) ----------------------

   (2) Diameter (d)   (a) ------------------   (b) ----------------------

(b) Write an expression for the density ρ of the material of coin in terms of t, d and m.

(c) (i) If you have been provided with lots of coins and a meter ruler as the measuring instrument, explain how you would obtain an average value for t with a 1/100 mm accuracy stated above.

  (ii) How many coins would you need to obtain the measurement with above accuracy?

(d)(i) One of these coins were tied on to one end of a sensitive vertical spring, and the extension of the spring was measured with a meter ruler. Extension of the spring when the coin was in air is X_a while the extension of the spring when the coin is completely under water is X_w. Find the relative density of the material of the coin.

(ii) When the shape of the coin was considered, it more accurate to obtain the volume of the coin by immersing it in water, rather than the method described in part (b) above. Explain why immersing the coin in water is more suitable.

(e) The coin is made up of an alloy containing metal A and metal B. Relative density of the alloy is 8 and the relative densities of metal A and metal B are 3 and 9 respectively. Find the ratio between the masses of metal A and metal B found in the alloy.