Dr. Rontgen at the Carle Foundation Hospital is an interventional radiologist. He recently prescribed CT imaging for a 80 years old male patient with a history of smoking, sedentary life style and habit of eating fatty food. CT scan of this patient's heart subsequently revealed several important factors. Being a student of bioengineering, Dr. Rontgen has asked you to help him with some calculations. The aorta is the principal blood vessel through which blood leaves the heart in order to circulate around the body. It has been found that the aorta has a radius of 10 mm.

(i) Calculate the average speed of the blood in the aorta if the flow rate is 5.0 L/min. (5 points)

(ii) Dr. Rontgen and your team also discovered from CT Angiogram that the patient’s artery is clogged by fatty deposits. The deposition of fatty material caused a significant change in the artery and a Hounsfield value drop by 50% and the blood flow velocity by 40%. Compare the mass flow rates in the coronary artery of a healthy person with the patient. If the blood has the same mass flow rate in both the persons, what velocity must the blood flow be when the diameter is reduced? The density of blood is 1.06 g/cm$^3$. (10 points)

(iii) An angioplasty is a common procedure where a balloon is passed into your artery on the end of a tube (catheter) and is inflated (blown up) to treat a narrowed or blocked artery. Dr. Rontgen performed angioplasty on this patient to open the clogged artery. Further follow-up CT angiogram revealed that the blood is flowing through the artery of radius 2 mm at a rate of 40 cm/s. Determine the flow rate and the blood volume that passes through the artery in a period of 30 s. (10 points)

Key 1. This is an open source/book problem.

Key 2. You are free to make any assumption to solve this problem