1. A processor has 10,000 lb of raw milk which contains 3.7% fat and 8.7% dissolved non-fat solid. This milk is separated into cream containing 40% fat and skim milk containing 0.5% fat by centrifugation. Please calculate:

   (a) Weight of cream and skim milk obtained from the centrifugation process

   (b) % non-fat solid in the skim milk

   (c) % non-fat solid in the cream

   (註：non-fat solid 為可溶性物質，無法被離心分離，因此於離心後會均勻的分佈於 cream 以及 skim milk 中之非脂肪部分) (25 分)

2. For a imcompressible fluid flowing through a circular pipe of radius R, the velocity profile is parabolic for laminar flow as shown below:

$$v = v_{max} \left[1-(r/R)^2\right]$$

   Where v_{max} is the maximum velocity at the center (where $r = 0$) and v is the velocity at a radial distance r from the center. Derive an expression for the average velocity v_{av} (25 分)

3. Soybean oil is being pumped through a pipe at a steady mass-flow rate. A pump supplies 200 J/kg mass of fluid flow. The entrance absolute pressure in the inlet pipe to the pump is 100 kN/m^2. The exit section of the pipe downstream from the pump is 5 meter above the entrance and the exit pressure is 180 kN/m^2 (absolute pressure). If the exit and entrance pipes are the same diameter, density of soybean oil is 919 kg/m^3, and the fluid is in turbulent flow, calculate the friction loss in the system. (25 分)

4. Saturated steam at 267°F is flowing inside a pipe having an inside diameter of 0.824 inch and outside diameter 1.05 inch. The pipe is insulated with 1.5 inch of insulation on the outside. The convective coefficient for the inside steam surface of the pipe is estimated as h_i = 1000 btu/h. ft^2.°F, and the convective coefficient on the outside of the insulation is estimated as h_o = 2 btu/h. ft^2.°F. The mean thermal conductivity of the metal is 26 btu/h. ft.°F and 0.037 btu/h. ft.°F for the insulation. Please calculate the heat loss for 1 ft of the pipe when the surrounding air is at 80°F. (25 分)

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