OIQ Exam 04-AGRIC-A4 Fluid Flow. November 2012

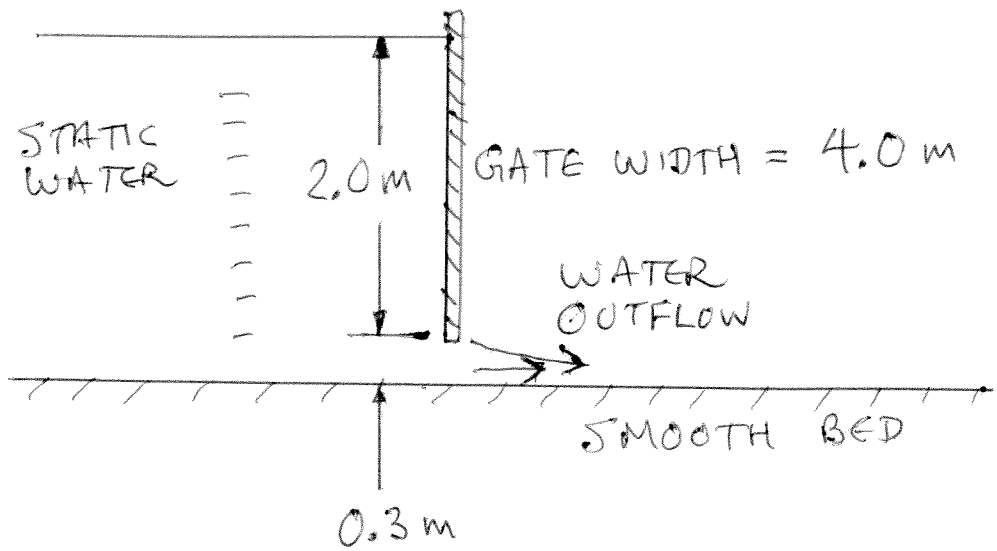
NOTE : All questions are worth 20 marks each, and all should be answered.

1. A brewery uses its water supply from a nearby fresh water reservoir. To meet this need a new piping system was designed which connects the fresh water basin to a water treatment reservoir at a lower elevation. These two reservoirs are connected by three clean cast iron pipes in series. The length of the first pipe, L1 = 250 m, its inside diameter D1 = 200 mm; L2 = 400 m, D2 = 300 mm; L3 = 1100 m, D3 = 450 mm. If the flow is 360 cubic meters per hour of water at 20°C, determine the difference in elevation between the fresh water and the treatment reservoirs.

2. A large centrifugal pump receives water at zero pressure (above atmospheric) and delivers it at a pressure of 400 kPa and a volume rate of 6 m^3/minute. If the internal pumping efficiency is 80%, what power is required to operate the pump?

3. The viscosity of blood is to be determined from measurements of the shear strain rate, **du/dy**, obtained from a small blood sample tested in a suitable viscometer, where **u** is the fluid velocity and **y** is the distance perpendicular to the velocity. Based on the data given below of shear stress **T** versus shear strain rate, determine if the blood is a Newtonian or a non-Newtonian fluid. Explain how you arrived at your answer.

T (N/m^2)	0.04	0.06	0.12	0.18	0.3	0.52	1.12	2.10
du/dy (s^{-1})	2.25	4.50	11.25	22.5	45.0	90.0	225	450

4. A concrete lined water transfer canal has a rectangular cross section of width 3.0 m and the water is flowing at a depth of 1.0 m. If the longitudinal slope of the canal is 0.5% and the Manning roughness coefficient of the concrete liner is 0.014, calculate the volume flow of the canal in cubic meters per second.

5. A vertical gate controls the outflow of water from a canal as shown in the diagram below. The gate width is 4.0 m, and its opening height is 30 cm. If the coefficient of orifice discharge flow for this gate is 0.70, and the downstream head is essentially zero, calculate the discharge rate of the gate in cubic meters per second.