Nguyen Xuan Binh 887799 Exam Question 1

My last student number digit is 9 => Answer question 9, 10, 11, 12, 1, 2

Question 9: In model tests, we want to replicate the same conditions as the prototype. Building a prototype is often impossible or costly just for experiment, yet we want a model scale that is reliable => We need to control the conditions quickly and accurately. Unfortunately many conditions are hard to change or measure. Dimensional analysis can be used to construct functions that relate non-associated physical properties => In a model test, real dimensions do not matter, only dimensionless variables matter

Question 10: For Reynolds number

+ Low Reynolds number: viscosity has a strong effect and thus, the boundary layer is laminar and the streamwise velocity changes uniformly across the boundary layer's thickness

+ High Reynolds number: viscosity only affects very close to the object, the boundary layer is turbulent and its streamwise velocity are unsteady flows

Shape of object: Smooth, streamlined object will have the drag force increased by the boundary layer, while blunt object has streamline deformation and flow separation => flow separation in boundary layer results in losses

Question 11: Moody-diagram is a table that describes Darcy friction factor (f) as a function of Reynolds number and relative roughness of the surface (ε/D)

Question 12: A pump uses external energy and converts it to kinetic energy that gives to a fluid stream. A turbine on the other hand absorbs energy from the fluid stream and convert it to work => pump makes work to system and system makes work to turbine

Question 1: In Newtonian fluid, shear stress is the stress resulting from the flow field's viscosity against the pipe/material cross section. It is the product of the fluid's viscosity multiplied by its velocity gradient ($\tau = \mu \frac{du}{dy}$)

Question 2: ~~Yes~~ No, the hydrostatic force ~~can~~ can't be reduced to the centroid of the rectangle if the rectangle is vertically oriented

We have: $x_R = \frac{I_{xyc}}{Ay_c} + x_c$ and $y_R = \frac{I_{xc}}{Ay_c} + y_c$

=> $x_R = x_c$ and $y_R = \frac{1/12\, ba^3}{aby_c} + y_c \neq y_c$ => resultant force isn't the same point as the centroid