

**UNIVERSITY OF GHANA**

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**SCHOOL OF ENGINEERING SCIENCES**

**B.Sc. (ENGINEERING) SECOND SEMESTER EXAMINATIONS 2014/2015**

**FAEN 204: Fluid Mechanics (3 CREDITS)**

**INSTRUCTION: ANSWER ALL QUESTIONS. ANSWER SECTION 'A' ON THE QUESTION PAPER AND ATTACH IT TO THE ANSWER BOOKLET GIVEN**

**TIME ALLOWED: TWO (2) HOURS**

**CANDIDATE ID No..... Signature.....**

**SECTION A**

1. Choose the correct answer

a. Newton's Law of viscosity relates

- (i) Pressure, velocity and viscosity
- (ii) Shear stress and velocity gradient of a fluid
- (iii) Shear stress, temperature, velocity and viscosity
- (iv) Pressure, viscosity and velocity gradient

b. The pressure in METERS of Oil (sp.gr = 0.8) which is equivalent to 80 m of water is

- (i) 64                      (ii) 80                      (iii) 100                      (iv) 88

c. The continuity Equation

- (i) Expresses the relation between energy and work
- (ii) Relates mass rate of flow for two points in a fluid flow system
- (iii) Relates the momentum per unit volume for two points in a fluid flow system
- (iv) Expresses a constant discharge through a long straight pipe

d. Uniform flow in a prismatic channel occurs

- (i) Whenever the flow is steady
- (ii) When  $\frac{dv}{dt}$  is zero everywhere
- (iii) Only when the velocity vector at any point remains constant
- (iv) When  $\frac{dv}{ds} = 0$

e. In open channel flow

- (i) The energy grade line coincides with the free surface

- (ii) The hydraulic grade line coincide
  - (iii) The hydraulic grade line can never rise
  - (iv) The hydraulic grade line and the free surface coincide
- f. Reynolds number for a rectangular pipe may be defined as  $\frac{VL}{\mu}$  where L is
- (i) The hydraulic radius
  - (ii) 2 times the hydraulic radius
  - (iii) 3 times the hydraulic radius
  - (iv) 4 times the hydraulic radius
- g. For laminar flow in a pipe, if the velocity at the centre of the pipe is 0.1m/sec, then the average velocity is
- (i) 5cm/sec      (ii) 10cm/sec      (iii) 15cm/sec      (iv) 20cm/sec
- h. In turbulent flow, the friction factor (f) for a rough pipe depends on
- (i) The relative roughness only
  - (ii) The Reynolds Number only
  - (iii) The size of the pipe and discharge
  - (iv) The Reynolds Number and the relative roughness.
- i. In a laminar flow of a viscous liquid, if the velocity is V, m/sec pipe diameter, d(m) pipe length L(m) and Re is the Reynolds Number, then the Friction head loss,  $h_L$  is given by
- (i)  $h_L = Re \frac{LV^2}{2gd}$       (ii)  $h_L = \frac{Re}{16} \cdot \frac{L}{4d} \cdot \frac{V^2}{2g}$
  - (iii)  $h_L = \frac{16}{Re} \cdot \frac{4L}{d} \cdot \frac{V^2}{2g}$       (iv)  $h_L = \frac{16}{Re} \cdot \frac{L}{4d} \cdot \frac{V^2}{2g}$
- j. A news broadcaster reports that the barometric pressure is 772mm of mercury (sp.gr. = 13.6). The atmospheric pressure in KPa (abs.) is
- (i) 103.0
  - (ii) 100.0
  - (iii) 130.0
  - (iv) 124.0

(30 Marks)

**SECTION 'B'**

2. A tank containing lubricating oil with a specific gravity of 0.80 has a rectangular gate 8m long and 6m deep located on a side such that the top of the gate is level with the surface of the oil.

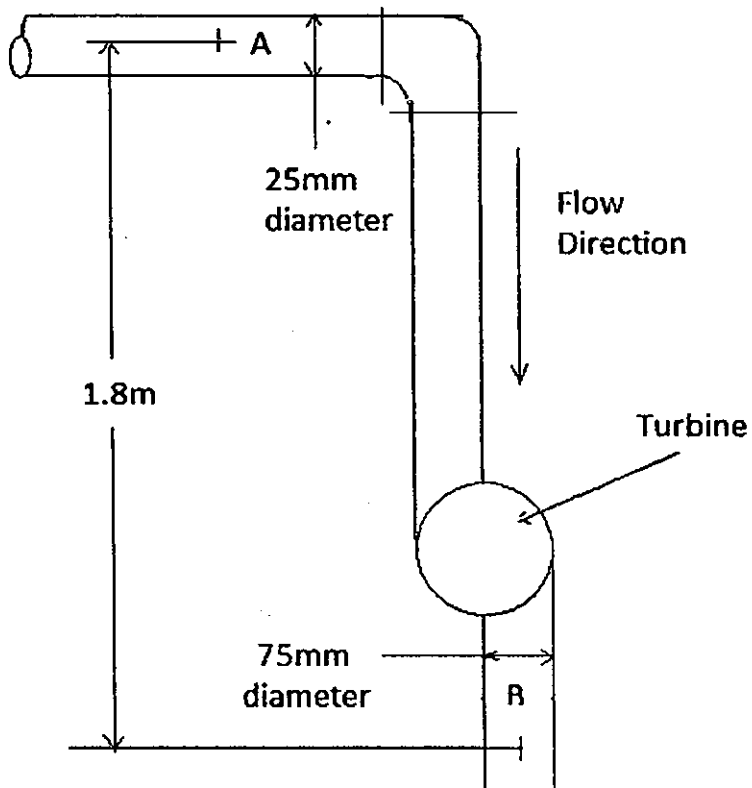
Calculate

- (i) The magnitude of the resultant force on the gate.
- (ii) The centre of pressure of this force from the top of the gate.

**(20 Marks)**

3. (a) State two restrictions placed on the use of Bernoulli's Equation and indicate how these restrictions are eliminated by the use of the General Energy Equation

- (b) Water is flowing at a rate of 250 L/min through the turbine shown in the figure below.



The pressure at A is 700KPa and the pressure at B is 125KPa. It is estimated that friction head loss in the piping amounts to 4.0N.m/N of water flowing in the system.

(a) Calculate the power delivered to the turbine by the water

(b) If the mechanical efficiency of the turbine is 85%, calculate the power output.

(25Marks)

4. (a) Define

(i) Hydraulic Radius

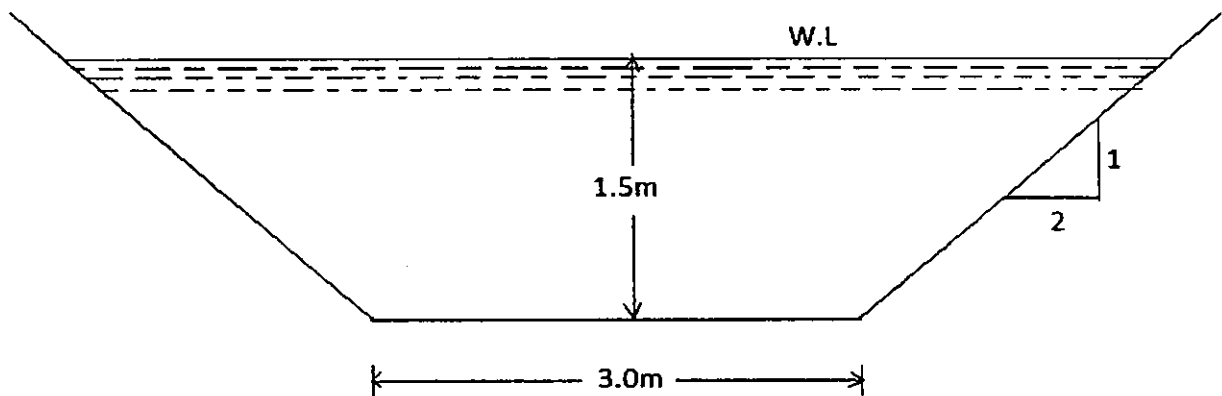
(ii) Hydraulic Depth of a fluid conveyance system

(b) A cross-section of an irrigation canal shown below has a surface of float finished concrete and is laid on a slope which falls 0.1m per 100m of length. Calculate

(i) The normal discharge

(ii) The Froude Number

Given:  $n = 0.015$



(25 Marks)