THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF MINING ENGINEERING

FIRST SEMESTER EXAMINATION – 2020

2ND YEAR MINING ENGINEERING & 2ND YEAR MINERAL PROCESSING ENGINEERING

MN212 – THERMO-FLUIDS

DATE: WEDNESDAY 24TH JUNE 2020

TIME: 12:50 PM

TIME ALLOWED: 3 HOURS

INSTRUCTION TO CANDIDATES:

1. YOU HAVE **10 MINUTES** TO READ THE PAPER. **DO NOT** WRITE DURING THIS PERIOD

2. THERE ARE FIVE QUESTIONS. **ATTEMPT ALL**. WRITE ANSWERS IN THE ANSWER BOOKLET PROVIDED.

3. WRITE YOUR **NAME** AND **NUMBER** CLEARLY ON THE **ANSWER BOOK**. DO THIS **NOW.**

MARKING SCHEME:

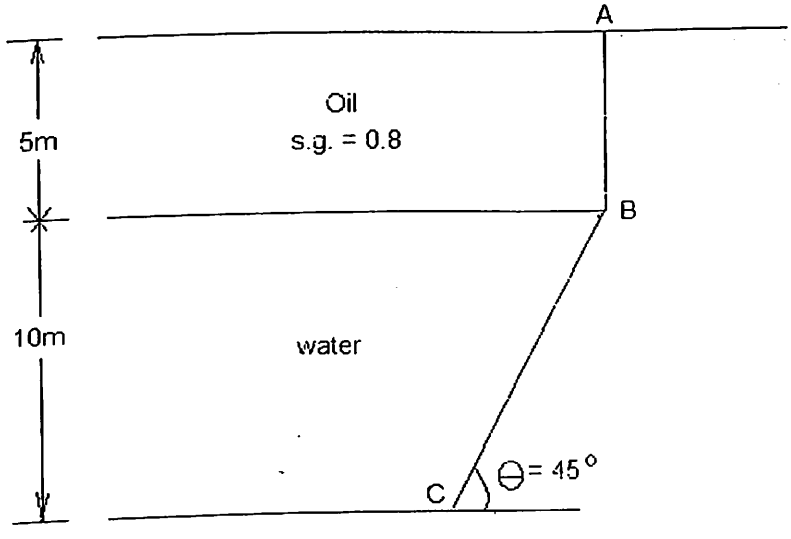
THE QUESTIONS CARRY EQUAL MARKS. TOTAL MARK IS 100

QUESTION ONE

(a) Define the following terminologies with aid of diagram or equations where necessary (**2 marks each**)

(i) Absolute and gauge pressure
(ii) Stagnation pressure
(iii) Viscosity
(iv) Newtonian and Non-Newtonian fluids
(v) Surface tension

(b) Shown is a reservoir for two immiscible liquids, oil and water. Oil has a depth of 5m and water depth of 10m.



Breath = 1m

Calculate;

(i) The pressure head at the bottom of the tank in terms of water head (**2 marks**)
(ii) The resultant force at BC (**4 marks**) and
(iii) The line of action of the resultant force (**4 marks**)

QUESTION TWO

(a) Define the following terminologies with examples and/or equations where applicable (**1 mark each**)

(i) Steady and unsteady flow
(ii) Stream tube
(iii) Conservation of mass
(iv) Uniform & Non-uniform flow

(b) What is meant by continuity of flow and under what conditions does it occur? **(3 marks)**

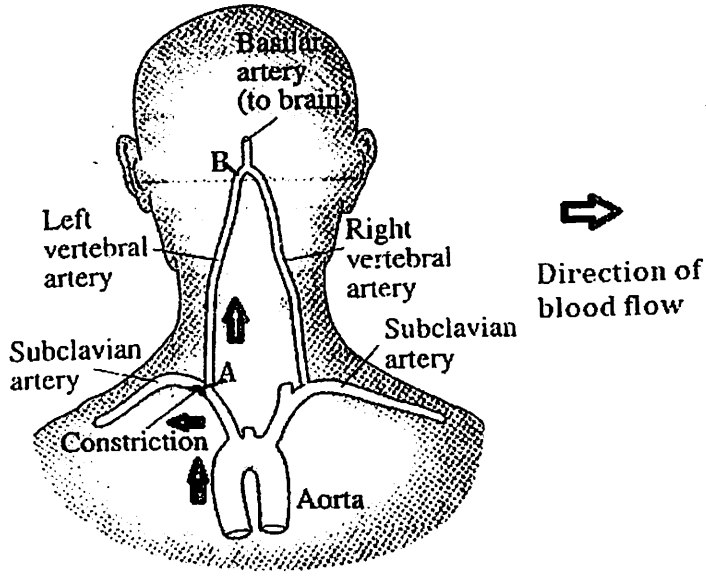
(c) Oil flows through a pipe line which contracts from 450mm dia. at A to 300mm dia. at B and then forks, one branch being 150mm dia. discharging at C and the other branch 225mm dia. discharging at D.

If the velocity at A is 1.8m/s and the velocity at D is 3.6m/s, calculate **(13 marks)**;

(i) Discharges at C & D and
(ii) Velocities at B & C

QUESTION THREE

(a) Below is an illustration of blood flow system from the heart to the brain and back.



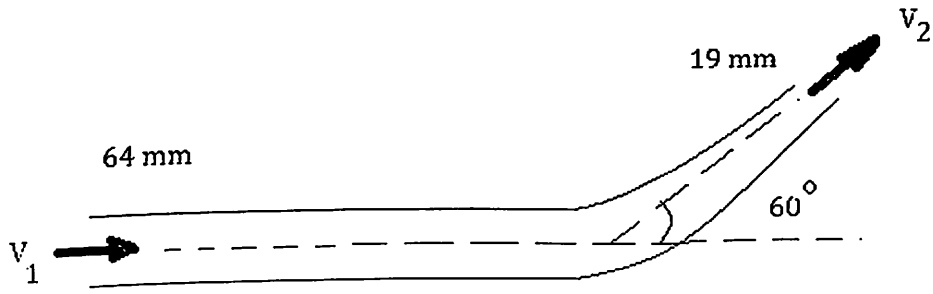
Normal flow of blood to the brain must be maintained to avoid serious health consequences such as attack of the brain. At point A in the diagram, there is a *constriction that is narrowing the effective cross-sectional area of the subclavian artery.*

(i) Will the pressure at point A high or low compared with the pressure at point B. Explain the reason for your answer **(4 marks)**

(ii) Will normal blood flow to the brain occur through the left vertebral artery with the constriction of subclavian artery? Provide explanation for your answer (**4 marks**)

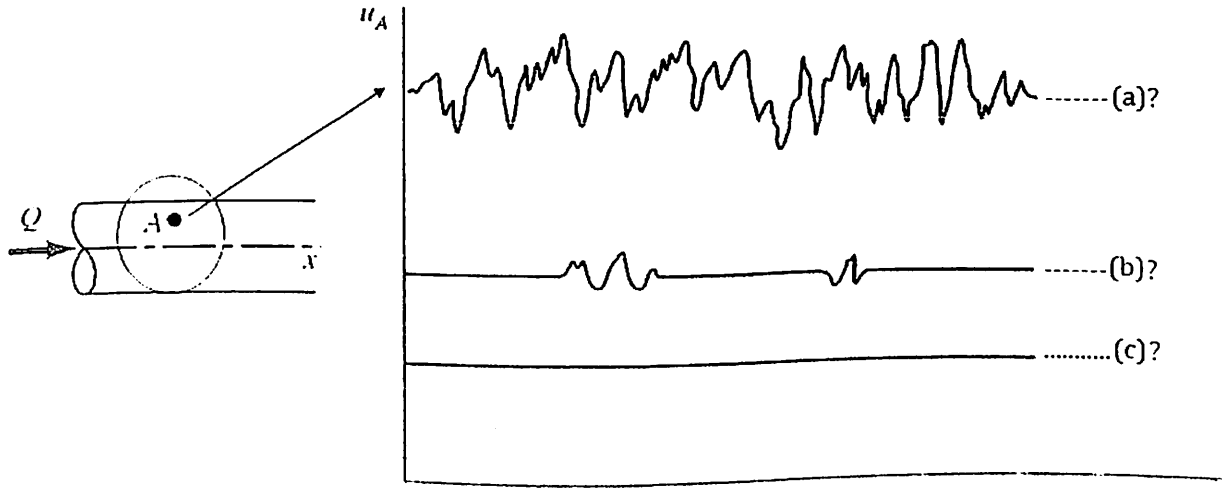
(b) A nozzle attached to a pipeline of dia. 64 mm discharges water to the atmosphere at a jet velocity of 30m/s. the nozzle dia. is 19 mm and is bent upwards to the horizontal.

Determine the tension force on the flanged connection between the pipe and the nozzle (**12 marks**)



QUESTION FOUR

(a) Below is a time dependent velocity graph of a fluid particle for 3 different flow regime: Identify them (**4 marks**).



(b) Water of density 1000kg/m^3 and viscosity of 0.001 N.s/m^2 is flowing steadily in a 0.051m diameter horizontal pipe made of stainless steel of

roughness, $\varepsilon = 2.13 \times 10^{-6}$ m at a rate of 0.0057 m^3/s. Determine (**16 marks**);

(i) The pressure drop, Δp
(ii) Head loss and
(iii) Required power input, $\dot{W}$ for flow over 61 meter long section of the pipe

QUESTION FIVE

(a) A fluid at 4.15 bar is expanded reversibly according to the law PV = constant to a pressure of 1.15 bar until it has a specific volume of 0.12 m3/kg. It is then cooled reversibly at a constant pressure, then is cooled to constant volume until the pressure is 0.62 bar; and is the allowed to compress reversibly according to a law PV^n = constant back to the initial conditions. The work done in the constant pressure is 0.525kJ and the mass of the fluid present is 0.22kg.

Calculate the value of n in the 4^{th} process and the net work, W_{net} of the cycle and sketch the cycle on a P-V diagram (**12 marks**)

(b) A Carnot engine receives 500kJ of heat per cycle from a high-temperature heat reservoir at 652 °C and rejects heat to a low-temperature heat reservoir at 30°C. Determine,

(i) The thermal efficiency of this Carnot engine, η_{th} (**4 marks**)
(ii) The amount of heat rejected to the low-temperature heat reservoir, Q_L (**4 marks**)

.....GOOD LUCK...END OF EXAM.....