UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BNJ20203
PROGRAMME	:	BNG / BNH / BNK / BNL / BNM
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ONLY **FIVE (5)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Define surface tension and the capillary effect

(2 marks)

(b) Explain how the dynamic viscosity and kinematic viscosity of liquids and gases varies with the temperature

(2 marks)

(c) A very long plate is moved over the lower plate on layer of fluid as illustrated in **Figure Q1(c)** at constant velocity, u = 30 m/s and the distance between two plate, h = 0.3 mm. The viscosity is 0.65 g-s/m^2 and the specific gravity is 0.88. Determine:

(i) The kinematic viscosity of the liquid.

(2 marks)

(ii) The shear stress on the upper plate.

(3 marks)

(d) List the three primary purposes of dimensional analysis

(3 marks)

(e) The standard form of Bernoulli equation for incompressible fluid is as below:

$$P + \frac{1}{2}\rho V^2 + \rho g Z = C$$

(i) Prove that each additive term in the Bernoulli equation has the same dimensions

(3 marks)

(ii) Express the dimensions of constant, C

(1 mark)

(f) A cylinder of 0.2 m in diameter is to be mounted in a stream of water in order to estimate the force on a tall chimney of 1 m diameter which is subject to wind of 40 m/s. Calculate the speed of the stream necessary to give a dynamic similarity between the model and chimney

(4 marks)

Q2 (a) Define Pascal's law, and give a real-world example of it

(5 marks)

(b) Define what is barometer and how to get pressure value in barometer

(5 marks)

(c) A multifluid container is connected to a U-tube, as shown in **Figure Q2(c)**. For the given specific gravities and fluid column heights, determine the gage pressure at *A*. Also determine the height of a mercury column that would create the same pressure at *A*. Given $\rho_{water} = 1000\ kg/m^3$

(10 marks)

Q3 (a) Consider two 5 cm diameter spherical balls, one made of aluminum and the other of iron is submerged in water. Explain whether the buoyant forces acting on these two balls be the same or different.

(3 marks)

(b) Discuss the stability of

(i) a submerged

(2 marks)

(ii) a floating body whose center of gravity is above the center of buoyancy.

(2 marks)

(c) A 170 kg granite rock ($2700\ kg/m^3$) is dropped into a lake. A man dives in and tries to lift the rock. Determine how much force the man needs to apply to lift it from the bottom of the lake.

(6 marks)

(d) A crane is used to lower weights into the sea (density = $1025\ kg/m^3$) for an underwater construction project shown in **Figure Q3(d).** Determine the tension in the rope of the crane due to a rectangular 0.4 m x 0.4 m x 3 m concrete block (density = $2300\ kg/m^3$) when it is

(i) Suspended in the air

(4 marks)

(ii) Completely immersed in water.

(2 marks)

(iii) Then, calculate how many percent the weight decrease in the water.

(1 mark)

Q4 (a) Define static, dynamic, hydrostatic and stagnation pressure

(6 marks)

(b) A Pitot static probe connected to a water manometer is used to measure the velocity of air as depicted in **Figure Q4(b)**. If the vertical distance between the fluids level between two arms is 7.3cm, determine the air velocity. Take the density of air to be 1.25 kg/m^3.

(6 marks)

(c) Water flows at a rate of 0.035 m^3/s in a horizontal pipe whose diameter is reduced from 15 cm to 8 cm by a reducer. If the pressure at the centerline is measured to be 470 kPa and 440 kPa before and after the reducer, respectively, determine

(i) the irreversible head loss in the reducer. Take the kinetic energy correction factors to be 1.05

(6 marks)

(iii) power potential loss

(2 marks)

Q5 (a) Define the conservation of momentum principle.

(2 marks)

(b) Predict the effect to the momentum of a body if the net force acting on it is zero

(1 mark)

(c) Determine whether the momentum is a vector. If so, in what direction does it point

(2 marks)

(d) Write the momentum equation for steady one dimensional flow for the case of no external forces and explain the physical significance of its terms.

(5 marks)

(e) A reducing elbow shown in **Figure Q5 (c)** is used to deflect water flow at a rate of 30 kg/s in a horizontal pipe upward by an angle of u = 45° from the flow direction while accelerating it. The elbow discharges water into the atmosphere. The cross sectional area of the elbow is 150 cm^2 at the inlet and 25 cm^2 at the exit. The elevation difference between the centers of the exit and the inlet is 40 cm. The mass of the elbow and the water in it is 50 kg. Determine the anchoring force needed to hold the elbow in place. Take the momentum-flux correction factor to be 1.03.

(10 marks)

Q6 (a) Explain whether the velocity profile will change in the flow direction or not, in the fully developed region of flow in a circular pipe.

(3 marks)

(b) Describe how head loss related can be related to pressure loss

(1 mark)

(c) For a given fluid, explain how you would convert head loss to pressure loss.

(2 marks)

(d) Water at 10°C ($\rho = 999.7$ kg/m^3 and $\mu = 1.307 \times 10^{-3}$ kg/m · s) is flowing steadily in a 0.20 cm diameter, 15 m long pipe at an average velocity of 1.2 m/s. Determine

(i) The pressure drop

(4 marks)

(iv) The head loss, and

(2 marks)

(iii) The pumping power requirement to overcome this pressure drop.

(2 marks)

(d) **Figure Q6(d)** shows a 16 L kerosene tank ($\rho = 820$ kg/m^3) is filled with a 2 cm diameter hose equipped with a 1.5 cm diameter nozzle meter. If it takes 20 s to fill the tank, determine the pressure difference indicated by the nozzle meter.

(6 marks)

- END OF QUESTION -

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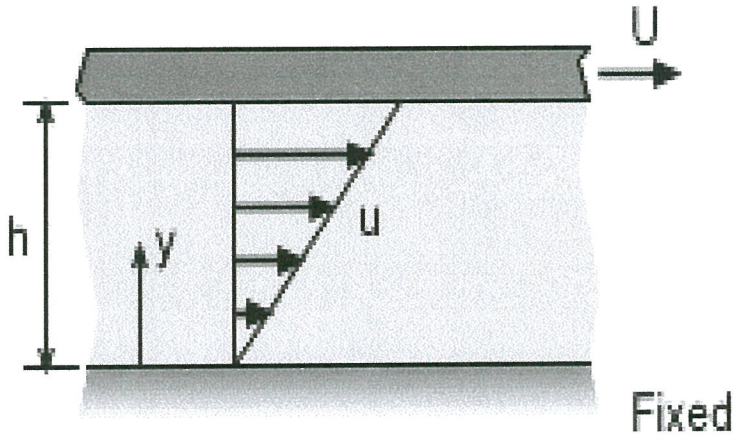

FIGURE Q1(c)

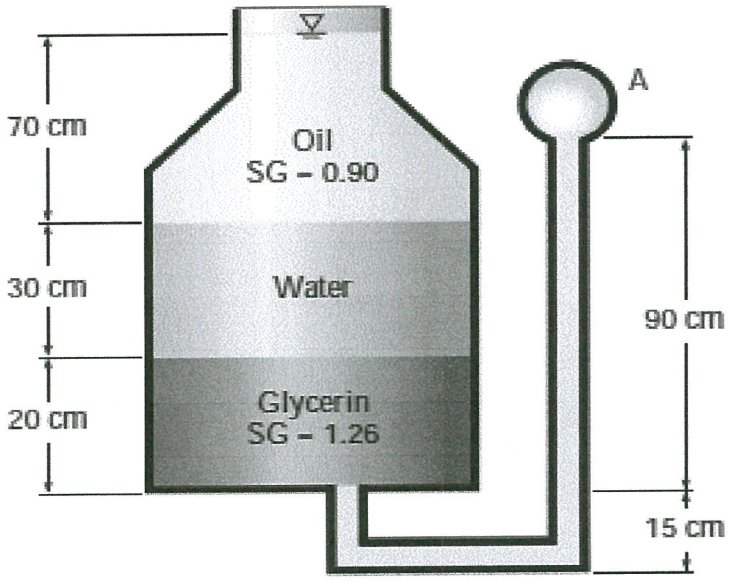

FIGURE Q2(c)

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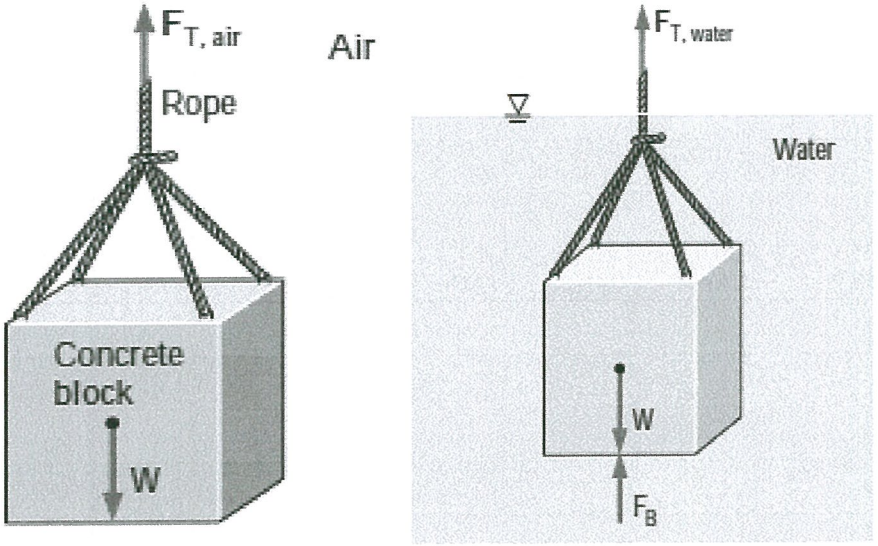

FIGURE Q3(d)

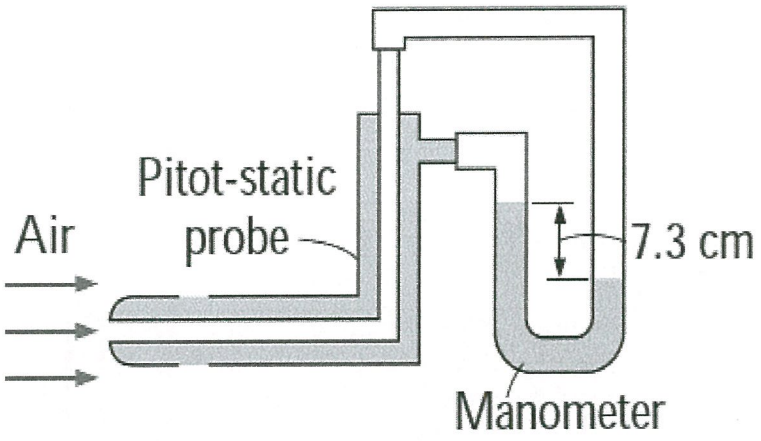

FIGURE Q4(b)

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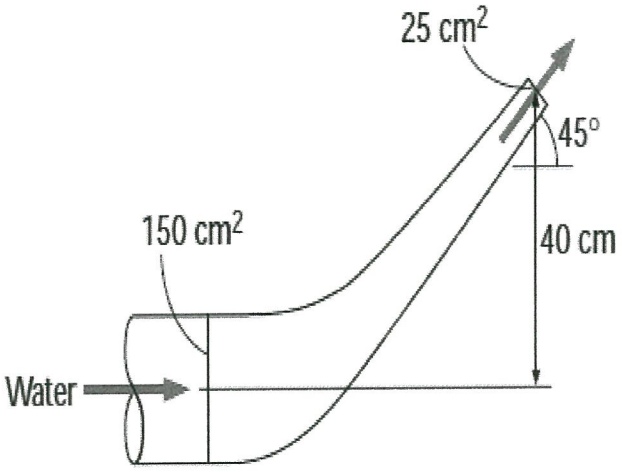

FIGURE Q5(c)

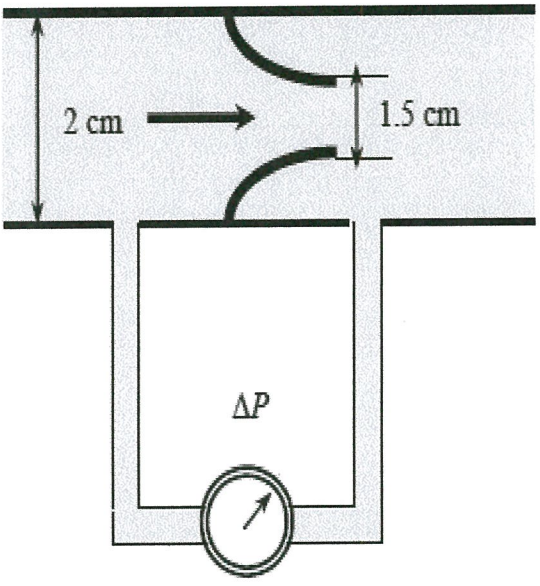

FIGURE Q6(d)