Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BNQ 10304
PROGRAMME CODE	:	BNN
DATE	:	JUNE/JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) (i) Define the term *buoyant force*.

(2 marks)

(ii) Describe the causes and the magnitude of buoyant force acting on a submerged body.

(3 marks)

(b) Explain if the buoyant force of two bodies that are submerged in water are same or different for the following conditions:

(i) Two identical spherical balls submerged at different depths.

(2 marks)

(ii) Two spherical balls (5 cm) made of aluminium and iron respectively.

(2 marks)

(iii) One 3 kg copper cube and 3 kg copper ball.

(1 mark)

(c) An irregular shaped body weighs 7200 N in the air and 4790 N in the water. Determine the volume and the average density of the body.

(8 marks)

(d) A multifluid container is connected to a U-tube, as shown in **Figure Q1 (d).** Determine:

(i) Gage pressure at "A".

(5 marks)

(ii) Height of a mercury column that would create the same pressure at "A".

(2 marks)

Q2 (a) Haziq is a recreational scuba diver. He decided to dive 15 m deep into the ocean. Calculate the absolute pressure when he is in that depth. The atmospheric pressure is 101 kPa and the density of the seawater is 1005 kg/m^3.

(3 marks)

(b) (i) Analyse the situation in **Q2(a)**

(3 marks)

(ii) Propose **THREE (3)** precautions to be taken for a safe diving and explain the reason of your proposal.

(3 marks)

(c) After diving, Haziq and his friend, Jeno decided to make a camp on the beach side. A few days later Jeno caught a fever and could not move at all. His body's temperature is very high and they could not reach out for help. Jeno was also losing water from his

constant diarrhoea. There are fluid bottles for intravenous infusion (IV) in the first aid bag.

(i) If it is observed that the fluid and the blood pressure balance each other when the bottle is 1.2 m above the arm level, determine the gage pressure of the blood. Take the density of the blood to be 1020 kg/m^3.

(3 marks)

(ii) If the gage pressure in the arm level need to be at least 20 kPa for sufficient flow rate, determine how high should Haziq placed the bottle.

(3 marks)

(d) A few days later Haziq and Jeno decided to climb up a mountain nearby. If the barometric reading of a barometer indicates 750 mmHg at the foot of the mountain and 580 mmHg at the top of the mountain. The densities of mercury and air are 13600 kg/m^3 and 1.225 kg/m^3, respectively. Calculate the height of their climb.

(6 marks)

(e) As they climb further up the mountain as in **Q1 (d)**,

(i) Determine **TWO (2)** possible health effects that could be affecting them

(2 marks)

(ii) Explain the reason behind its occurrence.

(2 marks)

Q3 (a) Describe conservation of *mass principle*.

(2 marks)

(b) Thermodynamically, energy can neither be destroyed nor created, as described by conservation of energy.

(i) Define the term of *Conversation of Energy*.
(ii) Relate *Conversation of Energy* with an *energy equation* with labels.

(4 marks)

(c) A 0.75 m^3 rigid tank initially contains air whose density is 1.18 kg/m^3. The tank is connected to a high-pressure supply line through a valve (refer to **Figure Q3 (b)**). The valve is opened, and air is allowed to enter the tank until the density in the tank rises to 4.95 kg/m^3. Calculate the mass of air that has entered the tank.

(4 marks)

(d) An oil pump is drawing 25 kW of electric power while pumping oil with ρ = 860 kg/m^3 at a rate of 0.1 m^3/s, as shown in **Figure Q3(d)**. The inlet and outlet diameters of the pipe are 8 cm and 12 cm, respectively. If the pressure rise of oil in the pump is measured to be 250 kPa and the motor efficiency is 90%, Calculate the mechanical efficiency of the pump. Take the kinetic energy correction to be 1.05.

(15 marks)

Q4 (a) The flow can be laminar or turbulent. In either case, the region from pipe inlet to the point at which the velocity profile is fully developed is called hydrodynamic entrance

region. The length of this region is called the hydrodynamic entry length, L_h, where L_h/D is a function of R_e. Draw diagram with completed labels showing both hydrodynamic entrance and fully developed region.

(8 marks)

(b) Describe **THREE (3)** characteristics of turbulent flow in pipes.

(3 marks)

(c) Water flows in a reducing pipe section, as shown in **Figure Q4 (c)**. The flow upstream is laminar and the flow downstream is turbulent. Identify the ratio of centerline velocities at 1 and 2. (14 marks)

- END OF QUESTIONS -

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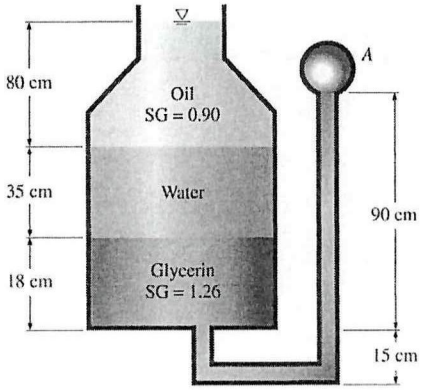

Figure Q1 (d): A multifluid container connecting to U-tube

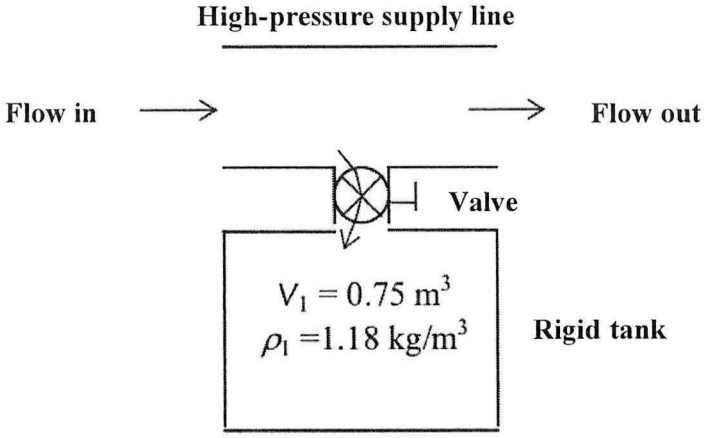

Figure Q3 (b): A tank which is connected to a high-pressure supply line via a valve

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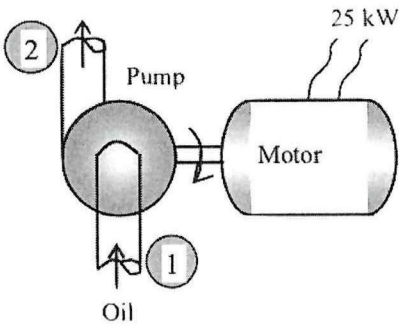
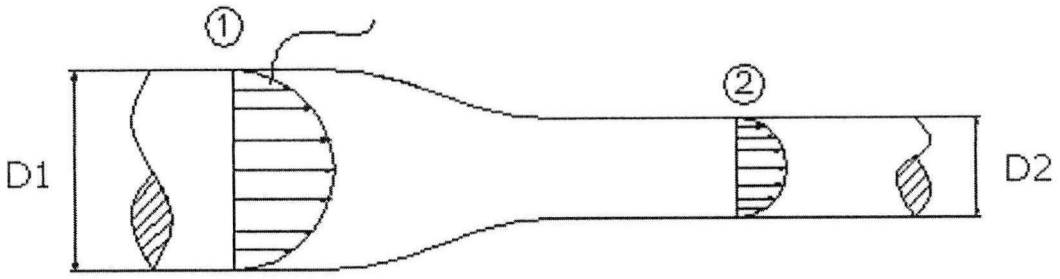


Figure Q3(d): An oil pump with power of 25 kW



Note: D1 and D2 are diameter at centerline 1 and 2, respectively.

Figure Q4 (c): Reducing pipe section