Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BNQ 10304
PROGRAMME CODE	:	BNN
DATE	:	JULY 2022
DURATION	:	3 HOURS

INSTRUCTION

1. ANSWER ALL QUESTIONS
2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK.**

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Determine the atmospheric pressure at a location where the barometric reading is 840 mm Hg and the gravitational acceleration is g = 9.805 m/s^2. Assume the temperature of mercury to be 10°C, at which its density is 13,550 kg/m^3.

(3 marks)

(b) Intravenous (IV) infusions usually are driven by gravity by hanging the fluid bottle at sufficient height to counteract the blood pressure in the vein and to force the fluid into the body (**Fig. Q1 (b)**). The higher the bottle is raised, the higher the flow rate of the fluid will be.

(i) If it is observed that the fluid and the blood pressures balance each other when the bottle is 1.5 m above the patient's arm level, determine the gage pressure of the blood with assumptions made. Take the density of the fluid to be 1020 kg/m^3.

(6 marks)

(ii) If the gage pressure of the fluid at the arm level needs to be 20 kPa for sufficient flow rate, determine how high the bottle must be placed.

(4 marks)

(iii) Describe what will happened to the patient if the bottle is placed below the minimum height for sufficient flow rate.

(4 marks)

(c) Shakir and Aminuddin decided to go for a drive to Mount X. Describe what are expected at the high altitude and give your reasonings;

(i) to both of them.

(4 marks)

(ii) to the vehicle's performance.

(4 marks)

Q2 (a) The water in a tank is pressurized by air. The pressure is measured by multi-fluid manometer as shown in **Fig. Q2(a)**. If h_1 = 0.2 m, h_2 = 0.3 m and h_3 = 0.46 m, and densities of water, oil and mercury to be 1000 kg/m^3, 850 kg/m^3 and 13600 kg/m^3, respectively, determine the gage pressure of air in the tank.

(7 marks)

(b) A thin plate moves between two parallel, horizontal, stationary flat surfaces at a constant velocity of 5 m/s, as shown in **Fig. Q2(b)**. The two stationary surfaces are spaced 4 cm apart, and the medium between them is filled with oil whose viscosity is 0.9 N.s/m^2. The part of the plate immersed in oil at any given time is 2 m long and 0.5 m wide.

(i) If the plate moves through the mid-plane between the surfaces, determine the force required to maintain this motion.

(10 marks)

(ii) Calculate the force if the plate is 1 cm from the bottom surface and 3 cm from the top surface.

(8 marks)

Q3 (a) Milk with a density of 1020 kg/m^3 is transported on a level road in a 9 m long, 3 m diameter cylindrical tanker (**Fig. Q3 (a)**). The tanker is completely filled with milk (no air space), and it accelerates at 4 m/s^2. If the minimum pressure in the tanker is 100 kPa, determine;
(i) the maximum pressure difference.

(6 marks)

(ii) the location of the maximum pressure.

(3 marks)

(b) A fish tank that contains 60 cm high water is moved in the cabin of an elevator. Determine the pressure at the bottom of the tank when the elevator is;
(i) stationary.

(7 marks)

(ii) moving up with an upward acceleration of 3 m/s^2.

(5 marks)

(iii) moving down with a downward acceleration of 3 m/s^2.

(4 marks)

Q4 (a) Balloons are often filled with helium gas because it weighs only about one-seventh of what air weighs under identical conditions.
The buoyancy force, which can be expressed as $F_b = \rho_{air} g V_{balloon}$, will push the balloon upward. If the balloon has a diameter of 12 m and carries two people, 70 kg each (**Fig. Q4 (a)**), determine the acceleration of the balloon when it is first released. Assume the density of air is $\rho_{air} = 51.16$ kg/m^3, and neglect the weight of the ropes and the cage.

(8 marks)

(b) Express the Bernoulli equation in **THREE (3)** different ways using (a) energies, (b) pressures, and (c) heads.

(6 marks)

(c) State **THREE (3)** major assumptions used in the derivation of the Bernoulli equation.

(3 marks)

(d) A pressurized tank of water has a 10 cm diameter orifice at the bottom, where water discharges to the atmosphere (**Fig. Q4 (d)**). The water level is 2.5 m above the outlet. The tank air pressure above the water level is 250 kPa (absolute) while the atmospheric pressure is 100 kPa. Neglecting frictional effects, determine the initial discharge rate of water from the
tank.

(8 marks)

- END OF QUESTIONS -

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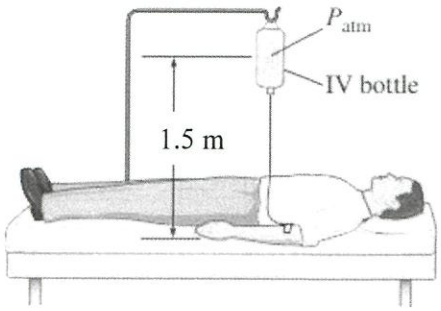

Fig. Q1 (b)

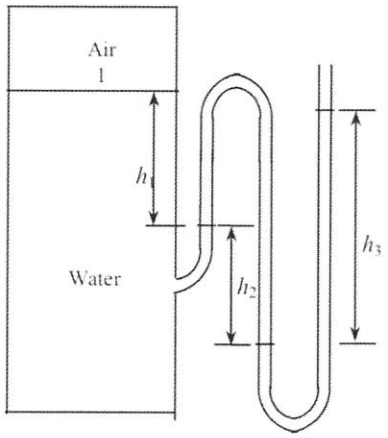

Fig. Q2 (a)

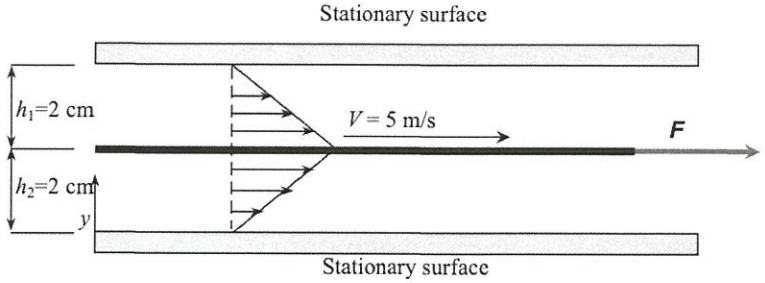

Fig. Q2 (b)

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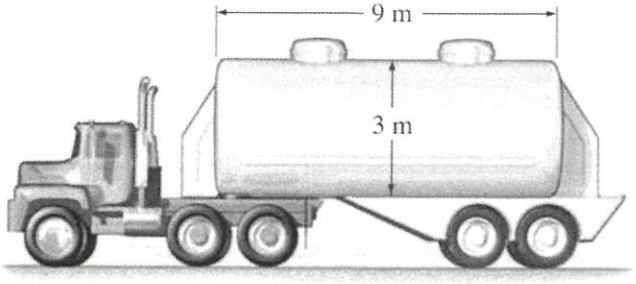

Fig. Q3 (a)

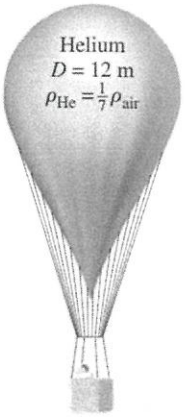

Fig. Q4 (a)

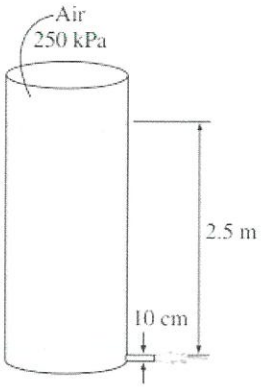

Fig. Q4 (d)