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Warning

CHARLES DARWIN UNIVERSITY

Family Name	
Given Names	
Student Number	
Teaching Period	Semester 1, 2016

FINAL EXAMINATION	**DURATION**
ENG247 – Fluid and Thermodynamics	Reading Time: **10** minutes Writing Time: **180** minutes

INSTRUCTIONS TO CANDIDATES

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is a RESTRICTED OPEN BOOK examination

Any calculator is permitted

No handwritten notes are permitted

Hard copy, unannotated English translation dictionary only

ADDITIONAL AUTHORISED MATERIALS	**EXAMINATION MATERIALS TO BE SUPPLIED**
No additional printed material is permitted	1 x 20 Page Book Formula Sheet/s

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1 (5 marks)

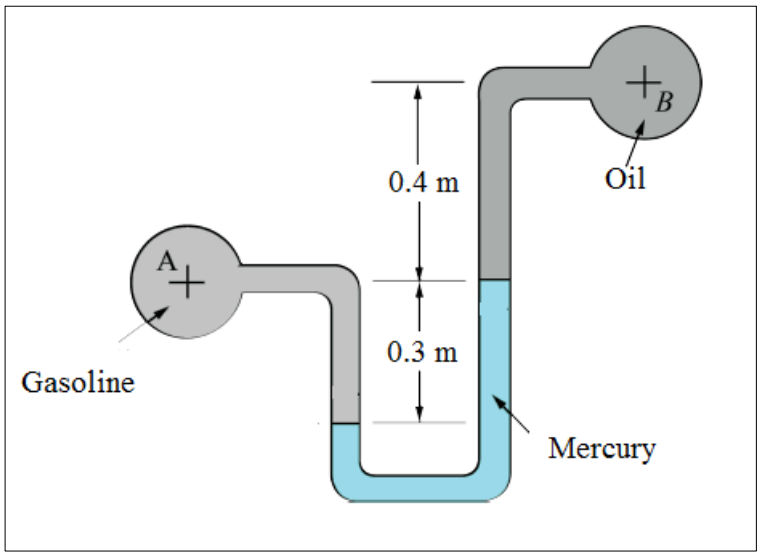
"The viscosity force in gases increases in magnitude with an increase in temperature.

The viscosity force in liquids decreases in magnitude with an increase in temperature."

Explain why this happens with aid of diagrams.

Question 2 (10 marks)

In the figure below, a pipe *A* contains gasoline (*SG* = 0.7), pipe *B* contains oil (*SG* = 0.9), and the manometer fluid is mercury. Determine the new differential reading if the pressure in pipe *A* is decreased 25 kPa, and the pressure in pipe *B* remains constant. The initial differential reading is 0.3 m as shown.



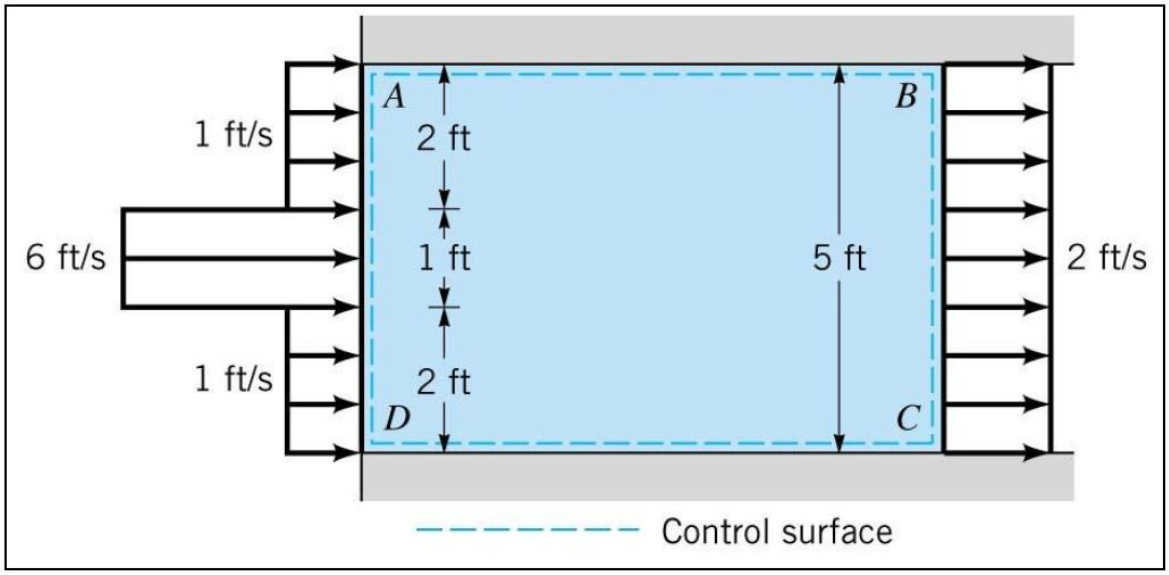
Question 3 (10 marks)

A fire hose nozzle has a diameter of 3 cm. According to the fire codes, the nozzle must be capable of delivering at least 16 L/s. If the nozzle is attached to an 8 cm diameter hose, what pressure must be maintained upstream of the nozzle to deliver this flowrate?

Question 4 (10 marks)

Water enters a 5 ft wide, 1 ft deep channel as shown below. Across the inlet the water velocity is 6 ft/s in the centre portion of the channel and 1 ft/s in the remainder of it. Further downstream, the water flows at a uniform velocity of 2 ft/s across the entire channel. The fixed control volume *ABCD* coincides with the system at time $t = 0$. Make a sketch to indicate:

a. the distance covered by water after 0.5 s. (7 marks)
b. the fluid that has entered and exited the control volume in that time period. (3 marks)



Question 5 (15 marks)

Provide short answers for the following:

a. Inside a glass of cold water with ice cubes, explain why the ice cubes float on water; what is the temperature of the water for the ice and water to co-exist and what happens to the water level when all the ice melts into water.

(5 marks)

b. A fan is used to circulate the air inside an enclosed room. If the room is fully insulated, will the temperature in the room increase or decrease after the fan has operated for some time?

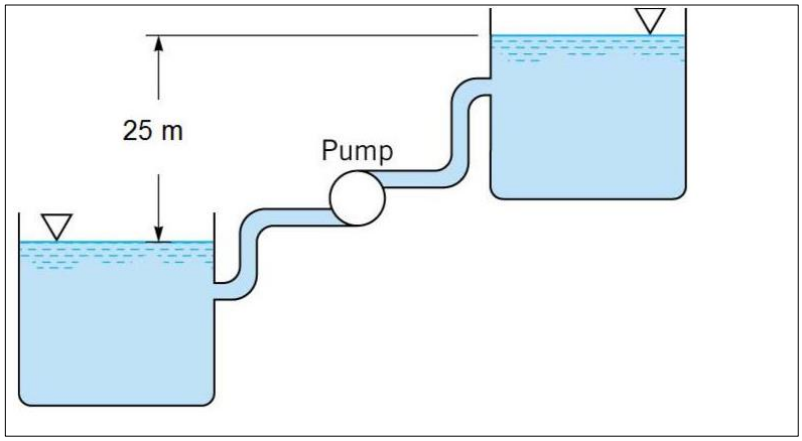
(5 marks)

c. The length of a spring can be changed by (a) applying a force to it or (b) changing its temperature (i.e. thermal expansion). What type of energy interaction between the system and its surroundings is required to change the length of the spring in these two ways?

(5 marks)

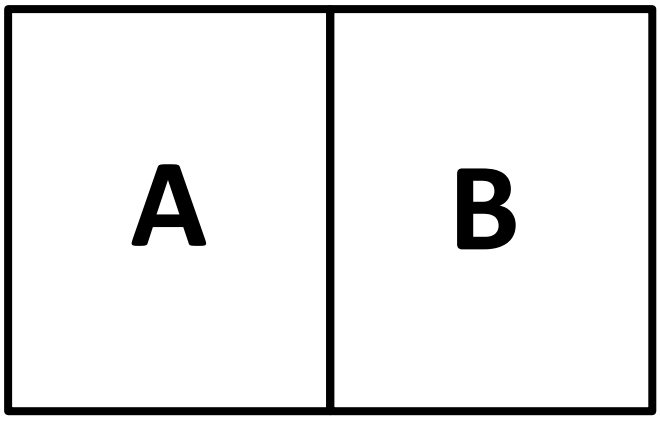
Question 6 (15 marks)

Water is pumped from one tank to another through a smooth plastic tube of radius 0.1 m. The flow rate is 0.75 m^3/s. The total length of the plastic tubing is 180 m. Taking into account the major friction losses, and the minor losses associated with the four 0.5 m bends, determine the pump head and the shaft work of the pump. You may assume the temperature of the water is 20 ^oC.



Question 7 (15 marks)

An insulated container of volume 0.20 m^3 is divided into two equal chambers of volume 0.10 m^3. Chamber A is completely filled with water at a temperature of 20 °C and a pressure of 100 kPa. Chamber B contains a bronze block at a temperature of 95 °C.



The partition between A and B is then removed and the water and bronze block interchange heat until a thermal equilibrium is reached.

a) What is the final temperature of the water? (5 marks)

b) What is the resulting change in the entropy after the partition is removed? (5 marks)

c) Explain if the entropy principle is satisfied. (5 marks)

The specific heat of bronze is 0.4 kJ/kg·K and the specific heat of water is 4.181 kJ/kg·K. Density of bronze is 8280 kg/m^3 and density of water at 27°C is 996.5 kg/m^3.

Question 8 (20 marks)

A piston cylinder device containing argon gas undergoes an isothermal compression at 100 °C from 150 kPa to 50 kPa. The gas constant for argon is 0.2081 kJ/kg·K and specific heat for argon is 0.3122 kJ/kg·K.

a) Determine the amount of work done (per kg) on the gas. (5 marks)

b) Determine the net heat transfer (per kg) during the process. (5 marks)

The piston is then fixed in place while 80 kJ/kg of heat is added to the system.

c) What are the final temperatures and pressures of the system? (5 marks)

d) Sketch the evolution of the system from its initial to final state on a T-v diagram and a p-V diagram. (5 marks)

THE END