nermal-Fluid lab - Final Exam 26.05.2021 (Final Exam Thermal and fluid sciences laboratory)

Hi 0171305, when you submit this form, the owner will be able to see your name and email address.

* Required

1. The heat delivered to the cooling water was from both compressor and condenser. *
(1 Point)

- ○ True
- ● False

2. The unit has two evaporators, air evaporator and water evaporator *
(1 Point)

- ○ True
- ● False

3. The heat absorbed from condenser is less than that absorbed from compressor. *

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17. The flow rate in the reciprocating pump is almost constant. *
(1 Point)

- (•) True
- ( ) False

18. The flow rate in the reciprocating pump generally higher than that of the centrif
the same speed. *
(1 Point)

- ( ) True
- (•) False

19. The force on the plate is less than the force on the hemispherical cup. *
(1 Point)

- ( ) True
- ( ) False

Search

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e) None of the above

30. Air enters an adiabatic nozzle steadily at 127°C with a velocity of 100 m/s and le
at 77°C. The velocity at the nozzle exit is:
(2 Points)

- a) 561.30 m/s
- b) 648.46 m/s
- c) 461.11 m/s
- d) 333.14 m/s
- e) None of the above

Submit

Clos

a) For a positive displacement reciprocating pump, the amount of fluid flow rate is independent of pump rotational speed, ω.

b) Pumps extract energy from the fluid passing through.

c) Pressure of the fluid at the exit of the pump is lower than the pressure of the fluid at the inlet of the pump.

d) The performance of the pump is measured using coefficient of performance.

e) All of the above is not correct

25. In " Liquid-vapor saturation curve" experiment only one statement of the following is correct:
(2 Points)

a) Saturation pressure and temperature are independent from each other.

b) Saturation pressure is the pressure at which the liquid changes phase into super-heated phase.

c) Saturation temperature is the temperature at which the liquid becomes compressed liquid.

d) Saturation temperature varies as pressure varies.

e) None of the above is correct.

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8. The pressure ratio is the back pressure divided by the chest pressure. *
(1 Point)

- (•) True
- ( ) False

9. A honeycomb can be used to reduce turbulence intensity and to achieve a uniform low turbulence flow. *
(1 Point)

- (•) True
- ( ) False

10. Oil mist is formed by the atomization of a heated mineral water in an air stream. *
(1 Point)

- ( ) True
- (•) False

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11. The smoke generated by burning fuel. *
(1 Point)

- (selected) True
- False

12. Separation occurs at high angle of attack. *
(1 Point)

- (selected) True
- False

13. Centrifugal pumps are useful for irrigation purposes, water supply to towns and feedi
boilers. *
(1 Point)

- (selected) True
- False

14. Reynolds number is defined as the ratio between viscous force to inertia force. *
(1 Point)

- ○ True
- ◉ False

15. The flow rate in the positive displacement pump is almost constant. *
(1 Point)

- ○ True
- ◉ False

16. As the flow rate in the centrifugal pump increases the head increases. *
(1 Point)

- ○ True
- ◉ False

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22. The type of the nozzle used in the "flow through a nozzle" experiment is:
(2 Points)

- a) Convergent-Parallel
- b) Divergent-Parallel.
- c) Convergent-divergent.
- d) Divergent-divergent.
- e) None of the above.

23. Only one of the following statement is correct with regards to the Flow through a n
experiment:
(2 Points)

- a) As pressure increase in the direction of the flow in the nozzle velocity decreases.
- b) Both pressure and velocity decrease through the nozzle.
- c) Mass flow rate of the air increases as the area of the nozzle decreases.
- d) Cross section area of the nozzle increases in the direction of the flow.

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4. The heat absorbed by the evaporator was obtained from air flow drift by a fan *
(1 Point)

- (●) True
- ( ) False

5. The nozzle profile where the experiment conducted on was Convergent-divergent *
(1 Point)

- ( ) True
- (●) False

6. The back pressure is the pressure in the throat area of the pipe. *
(1 Point)

- (●) True
- ( ) False

28. For an insulated piston-cylinder system that have work done on it, one of the
increase:
(2 Points)

- a) It`s temperature
- b) It`s pressure
- c) It`s internal energy
- d) All of the above
- e) None of the above

29. For an insulated piston-cylinder system that have work done on it, one of the follo
increase:
(2 Points)

- a) It`s temperature
- b) It`s pressure
- c) It`s internal energy
- d) All of the above

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26. "Flow through a nozzle" experiment, one of the following statements is correct:
(2 Points)

- a) Throat pressure happens at the point where the spatial pressure change is maximum.
- b) Throat pressure is maximum pressure reading inside the nozzle.
- c) Throat pressure is minimum pressure reading inside the nozzle.
- d) Throat pressure is the gage pressure reading of the air supply tank.
- e) None of the above.

27. The specific volume of any fluid is:
(2 Points)

- a) An Extensive property
- b) An intensive property
- c) A Saturated liquid (vf)
- d) A Saturated vapor (vg)
- e) None of the above

05.2021 (Final Exam Thermal and fluid sciences laboratory)

24. In "comparison of pump characteristic" experiment one of the following statement is co
(2 Points)

- a) For a positive displacement reciprocating pump, the amount of fluid flow rate is independent of pu rotational speed, ω.
- b) Pumps extract energy from the fluid passing through.
- c) Pressure of the fluid at the exit of the pump is lower than the pressure of the fluid at the inlet of the
- d) The performance of the pump is measured using coefficient of performance.
- e) All of the above is not correct

25. In " Liquid-vapor saturation curve" experiment only one statement of the following is corr
(2 Points)

- a) Saturation pressure and temperature are independent from each other.
- b) Saturation pressure is the pressure at which the liquid changes phase into super-heated phase.
- c) Saturation temperature is the temperature at which the liquid becomes compressed liquid.
- d) Saturation temperature varies as pressure varies.
- e) None of the above is correct.

nal Exam 26.05.2021 (Final Exam Thermal and fluid sciences laboratory)

* Required

1. The heat delivered to the cooling water was from both compressor and condens
(1 Point)

- True
- False

2. The unit has two evaporators, air evaporator and water evaporator *
(1 Point)

- True
- False

3. The heat absorbed from condenser is less than that absorbed from compressor. *
(1 Point)

- True
- False

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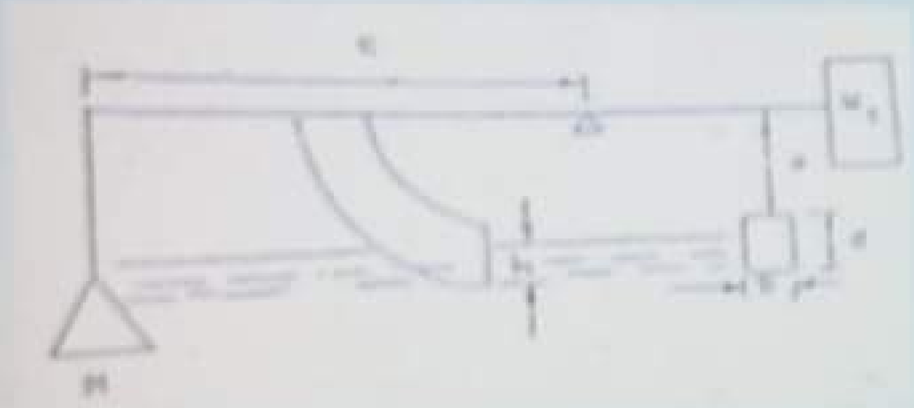
In center of pressure experiment, (ρ_{water} = 1000 kg/m3) With the following information: a = 0.1 m, b = 0.075m, c = 0.3 m, d = 0.1 m, h = 6 cm, and M = 78 g.



The Theoretical y_{cp} in (cm) is:

Answer:

Quiz navigation

1 2 3 4 5 6 7

In the Losses in Pipe Bends Experiment, The minor losses are due to friction and pipe fitting

- ( ) True
- (•) False

In the Thermal Conductivity Experiment, The thermal conductivity of the material is inversely proportional to its cross sectional area

- ( ) True
- (•) False

In the Losses in Pipe Bends Experiment, The friction factor is a function of Reynolds number

- (•) True
- ( ) False

6) In impact of water jet experiment, the water density is 1000 kg/m^3, the mass flow rate is 0.4 kg/s, the hei of vane above nozzle outlet is 0.04 m and the diameter of nozzle is 0.01 m. If a hemispherical cup is us the theoretical water jet force is:

a. 6.30 N
b. 4.01 N
c. 7.84 N
d. 5.10 N
a. None of the above

7) In "Flow through a nozzle" experiment, one of the following statements is correct:

a. Throat pressure is minimum pressure reading inside the nozzle
b. Throat pressure is maximum pressure reading inside the nozzle
c. Mass flow rate is minimum if the nozzle is choked
d. Throat pressure is the gage pressure reading of the air supply tank
e. None of the above

8) Only one of the following statement is correct with regards to the Flow through a nozzle experiment:

a. As pressure increases in the direction of the flow in the nozzle, velocity decreases
b. Both pressure and velocity decrease through the nozzle
c. Mass flow rate of the air increases as the area of the nozzle decreases
d. Cross section area of the nozzle increases in the direction of the flow
e. As the velocity increases in the direction of the flow, pressure decreases

9) *In flow through a nozzle experiment, the stagnation "chest" absolute pressure is 290 kPa, the stagna "chest" temperature is 18 °C, the air gas constant is 0.287 kJ/kg.K, the air specific heat ratio is 1.4, nozzle throat area is $9.16 \times 10^{-6}\ m^2$ and the throat absolute pressure is 265 kPa. The mass flow rate at nozzle throat is:*

a. 3.63×10^{-3} kg/s
b. 2.92×10^{-3} kg/s
c. 1.84×10^{-3} kg/s
d. 2.34×10^{-3} kg/s
e. None of the above

10) In losses in pipes experiment, pressure change in globe valve is measured using:

a. Pressurized piezometer tube	b. Piezoelectric gage pressure	c. U-tube manometer	d. Pitot-static tube	e. None of the above

11) The type of the nozzle used in the "flow through a nozzle" experiment is:

a. Divergent-Parallel	b. Convergent-Parallel	c. Convergent-divergent	d. Divergent-divergent	e. None of the above

(page 3 of 3) | (16) WhatsApp | Hadeel Al-Taji summary | nozzel thee pressure through

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Not yet answered

Marked out of 1.00

Flag question

Answer:

Time

Question 7

Not yet answered

Marked out of 2.00

Flag question

The P_{back} / P_{chest} ratio is:

Answer:

Previous page

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thermal-water-jet.pdf

13	1.5	220

The experimental $(P_t / P_o)_{exp}$ ratio is:

Answer:

Question 6

Not yet answered

Marked out of 1.00

Flag question

The theoretical $(P_t / P_o)_{theo}$ ratio for air is:

Answer: .866

Question 7

Not yet answered

Marked out of 2.00

The P_{back} / P_{chest} ratio is:

Answer: .2307

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False

In the Losses in Pipe Bends Experiment. The minor losses are due to friction and pipe fitting.

True

False

In the Flow Through a Nozzle Experiment. The pressure ratio is the ratio of the inlet pressure to the throat pressure

True

False

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More

Question 1
Not yet answered
Marked out of 2.00
Flag question

In center of pressure experiment: (ρ_{water} = 1000 kg/m3).With the following information: a = 0.1 m, b = 0.075m, c = 0.3 m, d = 0.1 m, h = 6 cm, and M = 79 g.

The Theoretical y_{cp} in (cm) is

Answer:

Time left 0:28:18

Question 2
Not yet answered
Marked out of 2.00
Flag question

The experimental y_{cp} in (cm) is:

Answer:

Results for the flat plate

Mass of water (kg)	Time (s)	Δx (mm)
7.5	14.27	75

The theoretical jet force in N is:

Answer: 3.51

Question 4

Not yet answered

Marked out of 1.00

Flag question

The experimental jet force in N is:

Answer:

In the Flow Through a Nozzle Experiment, The pressure ratio is the ratio of the .inlet pressure to the throat pressure

True

False

Pratio = Pback (outlet) / Pchest(inlet)

In the Hydrostatic Pressure Force on a Plane Surface Experiment, The pressure forces on the four surfaces other than the rectangular area were ignored .because they are too small

True

False

6) In impact of water jet experiment, the water density is 1000 kg/m³, the mass flow rate is 0.4 kg/s, the height of vane above nozzle outlet is 0.04 m and the diameter of nozzle is 0.01 m. If a hemispherical cup is used, the theoretical water jet force is:

a. 6.30 N
b. 4.01 N
c. 7.64 N
d. 5.10 N
e. None of the above

7) In "Flow through a nozzle" experiment, one of the following statements is correct

a. Throat pressure is minimum pressure reading inside the nozzle
b. Throat pressure is maximum pressure reading inside the nozzle
c. Mass flow rate is minimum if the nozzle is choked
d. Throat pressure is the gage pressure reading of the air supply tank
e. None of the above

8) Only one of the following statement is correct with regards to the Flow through a nozzle experiment

a. As pressure increases in the direction of the flow in the nozzle, velocity decreases
b. Both pressure and velocity decrease through the nozzle
c. Mass flow rate of the air increases as the area of the nozzle decreases
d. Cross section area of the nozzle increases in the direction of the flow
e. As the velocity increases in the direction of the flow, pressure decreases

9) In flow through a nozzle experiment, the stagnation "chest" absolute pressure is 290 kPa, the stagnation "chest" temperature is 18 °C, the air gas constant is 0.287 kJ/kg.K, the air specific heat ratio is 1.4, the nozzle throat area is $9.16 \times 10^{-6}\ m^2$ and the throat absolute pressure is 265 kPa. The mass flow rate at the nozzle throat is:

a. 3.63×10^{-3} kg/s
b. 2.92×10^{-3} kg/s
c. 1.84×10^{-3} kg/s
d. 2.34×10^{-3} kg/s
e. None of the above

10) In losses in pipes experiment, pressure change in globe valve is measured using:

a. Pressurized piezometer tube	b. Piezoelectric gage pressure	c. U-tube manometer	d. Pitot-static tube	e. None of the above

11) The type of the nozzle used in the "flow through a nozzle" experiment is:

a. Divergent-Parallel	b. Convergent-Parallel	c. Convergent-divergent	d. Divergent-divergent	e. None of the above

Pump characteristics

Centrifugal pump (13)

$P_s = 0$ bar, $P_d = 0.7$ bar, $\dot{Q} = 3.20 \times 10^{-3} \frac{m^3}{s}$, $\rho = 1000 \frac{kg}{m^3}$

$\Rightarrow F_n = 17.64\ N$, $\omega = 15$ rev/s, $R = 0.15\ m$

$$\eta_o = \frac{P_w}{P_B} = \frac{0.224}{0.249} = 0.899 \approx 0.901 \quad (c)$$

$$P_{water}(kW) = \rho g \dot{Q} h_p \times 10^{-3}$$

($\frac{kg}{m^3}$, $\frac{m}{s^2}$, $\frac{m^3}{s}$, m)

$$h_p = \frac{\Delta P}{\rho g} \times 10^5 = \frac{P_d - P_s}{\rho g} \times 10^5$$ (bar)

$$= \frac{0.7\ bar}{(1000)(9.81)} \times 10^5 = 7.135\ m$$

$$P(kW) = (1000)(9.81)(3.2 \times 10^{-3})(7.135) \times 10^{-3} = 0.224$$

$$P_B(kW) = 2\pi \omega_m F R \times 10^{-3} = 2\pi (15)(17.64)(0.15) \times 10^{-3} = 0.249$$

(14) (a)

---

(17) $P_s = 0$ bar, $P_d = 0.4$ bar, $\dot{Q} = 1 \times 10^{-3} \frac{m^3}{s}$, $\rho = 1000\ kg/m^3$, $F = 17.64\ N$

$\omega = 17.64 N$, $R = 0.15\ m$

$$\eta_v = \frac{\dot{Q}_m}{Q_c} = \frac{1 \times 10^{-3}}{2.04 \times 10^{-3}} = 0.49 \quad (d)$$

$$\dot{Q}_c = \left(\frac{0.75}{12.5}\right) \times 10^{-3} \times \omega_{Pump}$$

$\omega_p = 2\omega_m = 2(17) = 34 \frac{rev}{s}$

$$= \left(\frac{0.75}{12.5}\right) \times 10^{-3} \times 34 = 2.04 \times 10^{-3} \frac{m^3}{s}$$

For the following multiple choice questions, choose the *most correct answer*. **For computations, show the detailed solution for each question to guarantee the grade. (2 points each)**

[1-2]: In center of pressure experiment, if the plane surface is partially immersed, the water level h=4.0 cm, and the width of immersed surface b=7.5 cm. (γ_{water} = 9810 N/m³). Answer Problems (1-2):

1) The hydrostatic pressure force on the plane surface is:

b = 7.5 γ_{water} = 9810
h = 4 cm

a. 0.59 N
b. 0.33 N
c. 0.92 N
d. 0.15 N
e. None of the above

2) The theoretical center of pressure measured from the surface of the water is:

a. 3.33 cm
b. 1.33 cm
c. 2.67 cm
d. 2.00 cm
e. None of the above

3) Thermal conductivity of a material is

a. The resistance of a material to conduct heat through
b. The ability of a solid material to store heat
c. The ability of a material to conduct heat
d. A measure of liquids ability to convect heat
e. All of the above

[4-5] In the losses experiment, if the following data were measured: mass flow rate of 0.2 kg/s, density of w... is $\rho = 1000$ kg/m³, diameter of small pipe size 14 mm, dynamic viscosity of water is $\mu = 1 \times 10^{-3}$ N.s/m², roughness of the pipe surface is $\varepsilon = 0.0015$ mm. Answer Problems (4-5):

ρ = 1000 k

4) *The Reynolds number is:*

a. *2100.12*
b. *18189.14*
c. *57142.86*
d. *36378.27*
e. None of the above

5) *The friction factor is:*

a. *0.018*
b. *0.034*
c. *0.043*
d. *0.027*
e. None of the above

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Fw

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Results for the flat plate

Mass of water (kg)	Time (s)	Δx (mm)
7.5	14.27	75

The theoretical jet force in N is:

Answer:

The experimental jet force in N is:

Answer:

thermal-water-jet.pdf

(7) Flow through Nozzle

(a.)

(8) (c.)

(9) $P_0 = 290\ kPa$; $T = 18\ ^\circ C$; $R = 0.287\ \frac{kJ}{kg\,K}$, $\gamma = 1.4$

$A_t = 9.16 \times 10^{-6}\ m^2$, $P_t = 265\ kPa$

$$\dot{m} = A_t P_0 \left(\frac{P_t}{P_0}\right)^{\frac{1}{\gamma}} \sqrt{\frac{2\gamma}{(\gamma-1) R T_0} \left(1-\left(\frac{P_t}{P_0}\right)^{\frac{\gamma-1}{\gamma}}\right)}$$

$$= (9.16 \times 10^{-6}) * 290 \times 10^3 * \left(\frac{265}{290}\right)^{\frac{1}{1.4}} * \sqrt{\frac{2(1.4)}{(1.4-1)\ 287 * (18+273)} * \left(1-\left(\frac{265}{290}\right)^{\frac{1.4-1}{1.4}}\right)}$$

$$= 3.63 \times 10^{-3}\ kg/s$$ (a)

(11) b. Convergent – Parallel

In flow through a nozzle experiment, with the following information.

The throat diameter is as follows:

For the convergent nozzle	= 6.35 mm
For the convergent – divergent nozzle	= 6.36 mm
For the convergent – parallel nozzle	= 4.77 mm
Probe diameter	= 3.33 mm

Atmospheric pressure = 90 KPa, atmospheric temperature = 15 ˚C, R= 287 J/kg. K, γ=1.4

Table 1. The data collected in gage pressures

Position no.	X/L	P_o=300kPa
		Position pressure kPa
7	0.0	300
8	0.25	300
9	0.5	300
10	0.75	290

Atmospheric pressure = 90 KPa, atmospheric temperature = 15 °C, R= 287 J/kg Time left 0:02:01

Table 1. The data collected in gage pressures

Position no	X/L	P_o=300kPa Position pressure kPa
7	0.0	300
8	0.25	300
9	0.5	300
10	0.75	280
11	1	260
12	1.25	220
13	1.5	220

The experimental $(P_t / P_o)_{exp}$ ratio is:

Answer: 0.866

For the following multiple choice questions, choose the *most correct* answer. For **show the detailed solution for each question to guarantee the grade. (2 points**

[1-2]: In center of pressure experiment, if the plane surface is partially immersed, the water leve the width of immersed surface b=7.5 cm. ($\gamma_{water} = 9810\ N/m^3$). *Answer Problems (1-2):*

1) The hydrostatic pressure force on the plane surface is:
   a. 0.59 N
   b. 0.33 N
   c. 0.92 N
   d. 0.15 N
   e. None of the above

2) The theoretical center of pressure measured from the surface of the water is:
   a. 3.33 cm
   b. 1.33 cm
   c. 2.67 cm
   d. 2.00 cm
   e. None of the above

3) Thermal conductivity of a material is

a. The resistance of a material to conduct heat through
b. The ability of a solid material to store heat
c. The ability of a material to conduct heat
d. A measure of liquids ability to convect heat
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[4-5] In the losses experiment, if the following data were measured: mass flow rate of 0.2 kg/s, density of wate is $\rho = 1000\ kg/m^3$, diameter of small pipe size 14 mm, dynamic viscosity of water is $\mu = 1 \times 10^{-3} N.s/m^2$, roughness of the pipe surface is $\varepsilon = 0.0015$ mm. Answer Problems (4-5):

4) The Reynolds number is:
   a. 2100.12
   b. 18189.14
   c. 57142.86
   d. 36378.27
   e. None of the above

5) The friction factor is:
   a. 0.018
   b. 0.034
   c. 0.043
   d. 0.027
   e. None of the above

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Done

In the Losses in Pipe Bends Experiment. The minor loss coefficient K varies with the flow rate

- ○ True
- ◉ False

In the Hydrostatic Pressure Force on a Plane Surface Experiment. The rider weight balances the weight of the toroid in the dry situation only

- ◉ True
- ○ False

In the Impact of a Water Jet Experiment. For a constant mass flow rate, the force created by the jet is a function of the cross sectional area of the jet

- ◉ True
- ○ False

More

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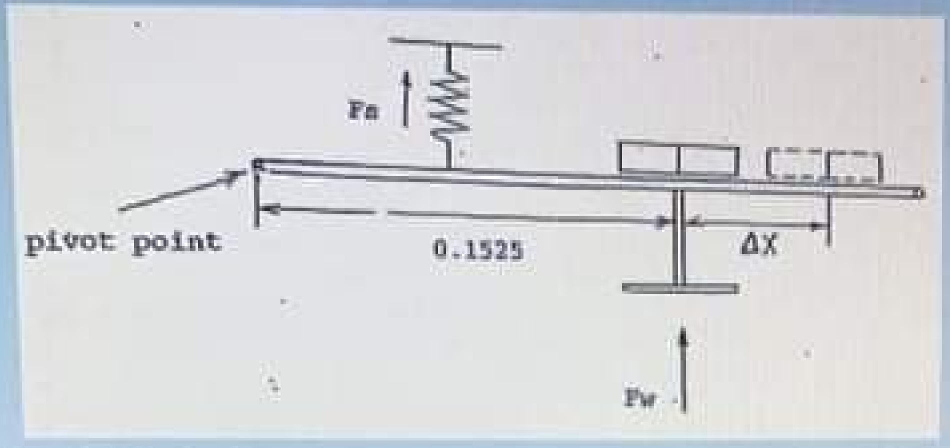
Time lef



Results for the flat plate

Mass of water (kg)	Time (s)	Δx (mm)
7.5	14.27	75

The theoretical jet force in N is:

Answer:

thermal-water-jet.pdf

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Done

.Inlet pressure to the throat pressure

True

False

In the Hydrostatic Pressure Force on a Plane Surface Experiment, The pressure forces on the four surfaces other than the rectangular area were ignored .because they are too small

True

False

In the Thermal Conductivity Experiment, The temperature gradient with the steel .specimen is higher than that within the copper specimen

True

False

More

Zain JO 3:21 PM 41%

Done

State whether each of the following statements is True (T) or False (F)

In the Thermal Conductivity Experiment. The specimens were heated up using hot water

- (•) True
- ( ) False

In the Impact of a Water Jet Experiment. The force on the plate would be the same if the plate in vertical or inclined

- (•) True
- ( ) False

In the Losses in Pipe Bends Experiment. The minor losses are due to friction and pipe fitting

More

1. [illegible] density of water is ρ = 1000 kg/m³, dynamic viscosity of water is μ = 1.8 × 10⁻³ N.s/m². [illegible]

[illegible]

Straight Pipe

Length = 914.4 mm

Small diameter = 13.6 mm

Large diameter = 26.2 mm

Pipe material is copper [illegible]

turbulent

0.0286

m (kg)	Time (s)	ṁ (kg/s)	V (m/s)	Re	Flow Type	h₁ (mm)	h₂ (mm)	Δh (m)	[illegible]	[illegible]	[illegible]
7.5	29.08					610	340				

$\dot{m} = \frac{m}{T} = \frac{7.5}{29.08} = 0.2579 \text{ kg/s}$

$\dot{m} = \rho V A \Rightarrow A = \frac{\pi}{4}(13.6 \times 10^{-3})^2 = 1.452 \times 10^{-4}$

$V = \frac{\dot{m}}{\rho A} = \frac{0.2579}{1000 \times 1.452 \times 10^{-4}} \Rightarrow 1.775 \text{ m/s}$

$Re = \frac{\rho V D}{\mu} = \frac{1000 \times 1.775 \times 13.6 \times 10^{-3}}{1.8 \times 10^{-3}}$

$= 13413.74$

$h_f = f\frac{LV^2}{2Dg} \Rightarrow f = \frac{2Dg\,h_f}{LV^2}$

$610 - 340 = 270 \text{ mm}^{-3}$ (m)

$= \frac{2 \times 13.6 \times 10^{-3} \times 9.81 \times 270 \times 10^{-3}}{914.4 \times 10^{-3} \times 1.775^2} = 0.025$

④ & ⑤ : Losses in Pipes

$\dot{m} = 0.2\ kg/s$, $\rho = 1000\ kg/m^3$, $D_{small} = 14\ mm$, $\mu = 1\times10^{-3}\ \frac{N.s}{m^2}$

$\epsilon = 0.0015\ mm$

④ → $Re = \frac{\rho V D_{small}}{\mu} = \frac{(1000)\left(\frac{\dot{m}}{\rho A}\right) D_{small}}{\mu}$

$A = \frac{\pi}{4} D_{small}^2$, $D_{small} \rightarrow 14\times10^{-3}$, $\mu \rightarrow 1\times10^{-3}$

$Re = 18189.14$, Turbulent flow

⑤ $\frac{1}{\sqrt{f}} = -2.0 \log\left(\frac{0.0015\times10^{-3}}{3.7\times14\times10^{-3}} + \frac{2.51}{Re\sqrt{f}}\right)$

$f = 0.027$ ⓓ

---

⑩ c

18

$\dot{m} = 0.25\ kg/s$, $\rho = 1000\ kg/m^3$, $D_{small} = 14\ mm$, $\mu = 1\times10^{-3}\ \frac{N.s}{m^2}$, $h_m = 0.1\ m$

$h_m = K\frac{V^2}{2g}$

$0.1 = K\frac{(1.624)^2}{2(9.81)}$

$K = 0.744$ ⓐ

$\dot{m} = \rho V A$

$0.25 = (1000)\ V \times \frac{\pi}{4}(14\times10^{-3})^2$

$\therefore V = 1.624\ m/s$

7.5	14.27	75

The theoretical jet force in N is:

Answer: 3.51 N

You must enter a valid number. Do not include a unit in your response.

The experimental jet force in N is:

Answer: 2.943

In the Hydrostatic Pressure Force on a Plane Surface Experiment, The leve
.water in the tank was measured using a regular sca

True
False

In the Losses in Pipe Bends Experiment, Losses in gate values are affected by the
.degree of their opening

True
False

n the Hydrostatic Pressure Force on a Plane Surface Experiment, The location of
the center of pressure is not the same if different fluids are used

True
False

(18) Heat Pump

$\dot{Q}_H = 1.9\ kW,\ \dot{Q}_L = 1.4\ kW,\ T_H = 60°C,\ T_L = 7°C$

$$COP_{(HP)} = \frac{Q_H}{Q_H - Q} = \frac{1.9}{1.9 - 1.4} = \underline{3.8} \quad \underline{(b)}$$

---

(15) Liquid – Vapor

(d)

---

(20)
$$\left(\frac{dT}{dp}\right)_{sat} = T\frac{v_{fg}}{h_{fg}} \quad [k/kPa]$$

$$= (133.5 + 273)k \cdot \frac{(0.6057)\ m^3}{kg * 2164\ \frac{kJ}{kg}}$$

$$* \left(\frac{dT}{dp}\right)_{sat} = 0.114\ \frac{k}{kPa} \quad (a)$$

In the Flow Through a Nozzle Experiment, The chest pressure has to be constant .for a given mass flow rate of working fluid

True

False

(6) Imapct of water jet

$\rho = 1000\ kg/m^3$; $\dot{m} = 0.4\ \frac{kg}{s}$; $S = 0.04\ m$; $D_{Nozzle} = 0.01\ m$

→ hemospherical cup

$F_{th} = 2\dot{m}u_0$

$= 2(0.4)(5.0153)$

$= 4.01224\ N$

≈ 4.01 (b)

$\dot{m} = \rho u A_{nozzle}$

$0.4 = (1000)\, u * \frac{\pi}{4}(0.01)^2$

$u = 5.093\ m/s$

$u_0^2 = u^2 - 2gS \Rightarrow u_0 = \sqrt{5.093^2 - 2(9.81)(0.04)}$

$* u_0 = 5.0153\ m/s$

16) In the losses experiment, if the following data were measured for the Expansion section: mass flow rate of 0.25 kg/s, the density of water is $\rho = 1000\ kg/m^3$, diameter of small pipe size 14 mm, dynamic viscosity of water is $\mu = 1 \times 10^{-3} N.s/m^2$, the minor head loss is 0.1 m. The loss coefficient K is:

a. 0.744
b. 4.464
c. 0.595
d. 1.116
e. None of the above

17) In pump characteristics experiment, for the centrifugal pump the following data were recorded: the suction pressure is 0 bar, the delivery pressure is 0.4 bar, the volume flow rate is $1 \times 10^{-3}\ m^3/s$, the water density is $1000\ kg/m^3$, the spring load is 17.64 N, the motor speed is $17\ rev/s$ and the torque arm radius is 0.15 m. The volumetric efficiency of the pump is:

a. 0.83
b. 0.55
c. 0.69
d. 0.49
e. None of the above

18) In heat pump experiment, the high-temperature heat rate was 1.9 kW and the Low-temperature heat rate was 1.4 kW. The high-temperature was 60 °C and the low-temperature was 7 °C. The actual coefficient of performance of the heat pump is:

a. 2.71
b. 3.80
c. 3.16
d. 2.38
e. None of the above

19) In "thermal conductivity" experiment

a. Thermal conductivity of the specimen is dependent on temperature difference across specimen
b. Higher temperature difference across the specimen and smaller cross-section area yields more heat conducted through the specimen
c. Temperature of circulating water is measured using thermocouple
d. Thermal conductivity is independent from heat path length (x) and cross section area (A) of the specimen
e. All of the above

20) In the liquid-vapor saturation curve experiment, calculate the theoretical T-P saturation slope [i.e. $\left(\frac{dT}{dP}\right)_{sat}$] at absolute pressure of 3 bar. (1 bar = 100 kPa)

a. 0.114 K/kPa
b. 0.090 K/kPa
c. 0.158 K/kPa
d. 0.075 K/kPa
e. None of the above

For the following multiple choice questions, choose the *most correct answer*. **For computations, show the detailed solution for each question to guarantee the grade. (2 points each)**

[1-2]: In center of pressure experiment, if the plane surface is partially immersed, the water level h=4.0 cm, and the width of immersed surface b=7.5 cm. ($\gamma_{water} = 9810\ N/m^3$). Answer Problems (1-2):

1) The hydrostatic pressure force on the plane surface is:

b = 7.5 γ_{water} = 9810 N/m³
h = 4 cm

a. 0.59 N
b. 0.33 N
c. 0.92 N
d. 0.15 N
e. None of the above

2) The theoretical center of pressure measured from the surface of the water is:

a. 3.33 cm
b. 1.33 cm
c. 2.67 cm
d. 2.00 cm
e. None of the above

3) Thermal conductivity of a material is

a. The resistance of a material to conduct heat through
b. The ability of a solid material to store heat
c. The ability of a material to conduct heat
d. A measure of liquids ability to convect heat
e. All of the above

[4-5] In the losses experiment, if the following data were measured: mass flow rate of 0.2 kg/s, density of water *is $\rho = 1000\ kg/m^3$, diameter of small pipe* size 14 mm, dynamic viscosity of water is $\mu = 1 \times 10^{-3} N.s/m^2$, *roughness of the pipe surface is* $\varepsilon = 0.0015$ mm. Answer Problems (4-5):

ρ = 1000 k

4) The Reynolds number is:

a. 2100.12
b. 18189.14
c. 57142.86
d. 36378.27
e. None of the above

5) The friction factor is:

a. 0.018
b. 0.034
c. 0.043
d. 0.027
e. None of the above

(3) c Thermal Conductivity

(12) X

(19) (a)

9	0.5	300
10	0.75	290
11	1	260
12	1.25	220
13	1.5	220

Time left

The experimental $(P_t / P_o)_{exp.}$ ratio is:

Answer:

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The theoretical $(P_t / P_o)_{theo.}$ ratio for air is:

Answer:

Done

In the Flow Through a Nozzle Experiment. The pressure through the nozzle is measured using the small pressure gage.

- (●) True
- ( ) False

In the Thermal Conductivity Experiment. The experiment was considered a one dimensional heat transfer problem because of the small cross sectional area of the specimens.

- (●) True
- ( ) False

In the Impact of a Water Jet Experiment. The force generated by the jet is calculated by taking moment about the center of the jet.

- (●) True
- ( ) False

More

[illegible] flow through a nozzle experiment, with the following information. Fill the table below, [illegible]

The throat diameter is as follows:
For the convergent nozzle = [illegible] mm
For the convergent - divergent nozzle = 6.[illegible] mm
For the convergent - parallel nozzle = 4.77 mm
Probe diameter = 3.33 mm

Atmospheric pressure = 90 KPa, atmospheric temperature = 15 C, R = 287 J/kg. K, γ = 1.4

Table 1. The data collected in gage pressures

Position no.	X/L	P_o=500kPa Position pressure kPa
7	0.0	500
8	0.25	490
9	0.5	490
10	0.75	480
11	1	420
12	1.25	380
13	1.5	365

P_o (gage)	$(P_t/P_o)_{exp}$	$\dot{m}_t$ (kg/s)	P_{back}/P_{chest}
500 kPa			

P_T gauge

$$\frac{P_t}{P_o} = \frac{420+90}{500+90} = 0.8644$$

$$\dot{m}_t = A_t P_o \left(\frac{P_t}{P_o}\right)^{\frac{1}{\gamma}} \sqrt{\frac{2\gamma}{(\gamma-1)RT_o}\left(1-\left(\frac{P_t}{P_o}\right)^{\frac{\gamma-1}{\gamma}}\right)}$$

$$A_t = \frac{\pi}{4}(4.77^2 - 3.33^2)\times10^{-6} = 9.16\times10^{-6}$$

$= 9.0512\times10^{-3}$ kg/m

$$\frac{P_{back}}{P_{chest}} = \frac{P_{atm}}{P_o + P_{atm}} = \frac{90}{500+90} = 0.1525$$

water (kg)		
7.5	14.27	75

The theoretical jet force in N is:

Answer: 3.51

Question 4

Not yet answered

Marked out of 1.00

Flag question

The experimental jet force in N is:

Answer: 2.943

In the Thermal Conductivity Experiment, The input heat was measured by a wattmeter

- (●) True
- ( ) False

In the Flow Through a Nozzle Experiment. The pressure at the throat was always higher than the critical pressure.

- ( ) True
- (●) False

In the Flow Through a Nozzle Experiment. The nozzle's purpose is to create a higher pressure fluid flow at the expense of the velocity

- ( ) True
- (●) False

Zain JO 3:21 PM 41%

Done

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State whether each of the following statements is True (T) or False (F)

In the Losses in Pipe Bends Experiment. The friction factor is a function of .Reynolds number

- True
- False

In the Losses in Pipe Bends Experiment. The head loss due to fittings is .proportional to the kinetic energy

- True
- False

In the Impact of a Water Jet Experiment. The force on the plate is proportional to its area

- True
- False

More

Equations sheet:

$Re = \frac{\rho V D}{\mu}$, $\dot{m} = \rho V A$, $K = {}^{\circ}C + 273$, $P_{abs} = P_{gage} + P_{atm}$, $(dT/dP)_{sat} = v_{fg}T/h_{fg}$ $g = 9.81\ m/s^2$

$h_L = h_f + \sum h_m$, $h_m = K\frac{V^2}{2g}$, $h_f = f\frac{L}{D}\frac{V^2}{2g}$ Laminar $f = \frac{64}{Re}$ Turbulent: $\frac{1}{\sqrt{f}} = -1.8\log\left[\frac{6.9}{Re} + \left(\frac{\varepsilon/D}{3.7}\right)^{1.11}\right]$

$\bar{P} = \rho g h_c$, $F = \rho g h_c A$, $y_{cp} = y_c + \frac{I_{xx,c}}{y_c A}$, For water: $\rho = 1000\ kg/m^3$

$F = \dot{m}(u_o - u_i\cos\beta)$, $u_o^2 = u^2 - 2gs$ $\dot{m} = \rho u A$ Bernoulli equation: $\frac{p}{\rho g} + \frac{v^2}{2g} + z = constant$

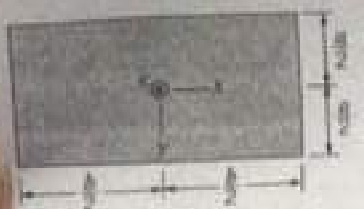
$\dot{Q} = \dot{m}c(T_{out} - T_{in})$, $\dot{Q} = -kA\frac{dT}{dx}$

$\frac{p^*}{P_0} = \left(\frac{2}{\gamma+1}\right)^{\frac{\gamma}{\gamma-1}}$, $v_t = \sqrt{\frac{2\gamma RT_0}{(\gamma-1)}\left[1-\left(\frac{P_t}{P_0}\right)^{\frac{\gamma-1}{\gamma}}\right]}$ $\dot{m}_t = A_t P_0\left(\frac{P_t}{P_0}\right)^{1/\gamma}\sqrt{\frac{2\gamma}{(\gamma-1)RT_0}\left[1-\left(\frac{P_t}{P_0}\right)^{\frac{\gamma-1}{\gamma}}\right]}$, $\gamma = \frac{c_p}{c_v}$

$h_p = \frac{\Delta p}{\rho g}\times 10^5$, $\Delta p = p_d - p_s$, $P_{water} = \rho g\dot{Q}h_p \times 10^{-3}$, $P_{brake} = 2\pi\omega FR \times 10^{-3}$, $\eta_o = \frac{P_{water}}{P_{brake}}$, $\eta_v = \frac{Q}{Q_t}$

$\dot{Q}_t = \frac{0.75}{12.5}\times 10^{-3}\omega_{pump}$, $\omega_{pump} = 2\omega_m$ and $\dot{m} = \rho\dot{Q}$ $\dot{m}_a = 0.00105\sqrt{\frac{H_1 P_1}{T_1}}$, $\dot{Q}_H - \dot{W}_c - \dot{W}_p = \dot{Q}_L$

$COP_{HP} = \frac{Q_H}{Q_H - Q_L}$, $COP_{HP,rev} = \frac{1}{1 - T_L/T_H}$, $COP_R = \frac{Q_L}{Q_H - Q_L}$, $COP_{R,rev} = \frac{1}{T_H/T_L - 1}$



$A = bh$

$I_{xx} = \frac{1}{12}bh^3$

$I_{yy} = \frac{1}{12}hb^3$

$I_{xy} = 0$

(a) Rectangle

$A = \pi R^2$

$I_{xx} = I_{yy} = \frac{\pi R^4}{4}$

$I_{xy} = 0$

(b) Circle

Saturated Water and Steam Tables

Pressure bar	Temperature °C	(v_{fg}) m^3/kg	(h_{fg}) kJ/kg
1	99.60	1.6940	2258
2	120.2	0.8856	2202
3	133.5	0.6057	2164
4	143.6	0.4623	2134
5	151.8	0.3748	2109
6	158.8	0.3156	2087
7	165.0	0.2728	2067
8	170.4	0.2403	2048

6) In impact of water jet experiment, the water density is 1000 kg/m^3, the mass flow rate is 0.4 kg/s, the height of vane above nozzle outlet is 0.04 m and the diameter of nozzle is 0.01 m. If a hemispherical cup is used, the theoretical water jet force is:

a. 6.30 N
b. 4.01 N
c. 7.64 N
d. 5.10 N
a. None of the above

7) In "Flow through a nozzle" experiment, one of the following statements is correct:

a. Throat pressure is minimum pressure reading inside the nozzle
b. Throat pressure is maximum pressure reading inside the nozzle
c. Mass flow rate is minimum if the nozzle is choked
d. Throat pressure is the gage pressure reading of the air supply tank
e. None of the above

8) Only one of the following statement is correct with regards to the Flow through a nozzle experiment:

a. As pressure increases in the direction of the flow in the nozzle, velocity decreases
b. Both pressure and velocity decrease through the nozzle
c. Mass flow rate of the air increases as the area of the nozzle decreases
d. Cross section area of the nozzle increases in the direction of the flow
e. As the velocity increases in the direction of the flow, pressure decreases

9) *In flow through a nozzle experiment, the stagnation "chest" absolute pressure is* 290 kPa, the stagnation *"chest" temperature is* $18\,^{\circ}C$, the air gas constant is 0.287 kJ/kg.K, the air specific heat ratio is 1.4, the *nozzle throat area is* $9.16 \times 10^{-6}\ m^2$ and the throat absolute pressure is 265 kPa. The mass flow rate at the *nozzle throat is:*

a. 3.63×10^{-3} kg/s
b. 2.92×10^{-3} kg/s
c. 1.84×10^{-3} kg/s
d. 2.34×10^{-3} kg/s
e. None of the above

10) In losses in pipes experiment, pressure change in globe valve is measured using:

a. Pressurized piezometer tube	b. Piezoelectric gage pressure	c. U-tube manometer	d. Pitot-static tube	e. None of the above

11) The type of the nozzle used in the "flow through a nozzle" experiment is:

a. Divergent-Parallel	b. Convergent-Parallel	c. Convergent-divergent	d. Divergent-divergent	e. None of the above