UNIVERSITY OF FORT HARE

University of Fort Hare
Together in Excellence

PHY 114F

May/June EXAMINATIONS

DATE	:	*May/June 2023*
TIME	:	*2 hours*
SUBJECT	:	*PHYSICS 114F (Heat & Modern Physics)*
MARKS	:	*100*

EXAMINERS

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INSTRUCTIONS TO CANDIDATES:

*Answer **All** Questions.*

Show the cancelation of units clearly!

Useful Information on the last page:

Question 1 (25)

(a) (i) A hammer has an edge area of $4\ cm^2$. If the hammer is struck with a force of $40\ N$, what is the pressure ($in\ N/m^2$) exerted on the stone? (5)

(ii) A hydraulic lift raises a $2000\text{-}kg$ automobile when a $500\text{-}N$ force is applied to the smaller piston. If the smaller piston has an area of $10\ cm^2$, what is the cross-sectional area of the larger piston? (5)

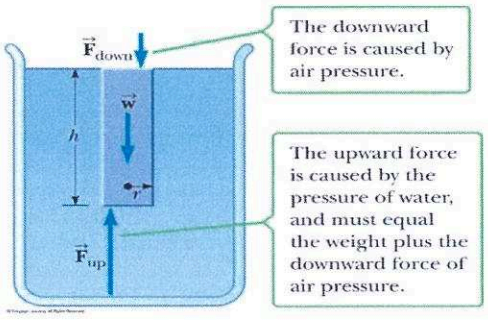
(b) Water pressurized to $4 \times 10^5\ Pa$ is flowing at $5.0\ m/s$ in a horizontal pipe which contracts to $1/5$ its former area. What are the *pressure* and *velocity* of the water after the contraction? *(Diagram)* (7)

(c) The input piston has a radius of $10\ cm$ and the output plunger has a radius of $150\ cm$. The combined weight of the car and the plunger is $20500\ N$. Suppose that the input piston has a negligible weight, and surfaces of the piston and plunger are at the same level. What is the required input force? (8)

Question 2(25)

(a) A spherical brass ball of density $8890\ kg/m^3$, is hanging from a ceiling attached to a wire. The tension in the wire is $200\ N$. What is the radius of the brass ball? (8)

(b) Calculate the weight of a cylindrical column of water with a height $h = 50\ m$ and radius r = $1.00\ m$.
(i) Calculate the force exerted by air on a disk of radius 1.00 m at the water's surface.
(ii) What pressure at a depth of 50.0 m supports the water column?

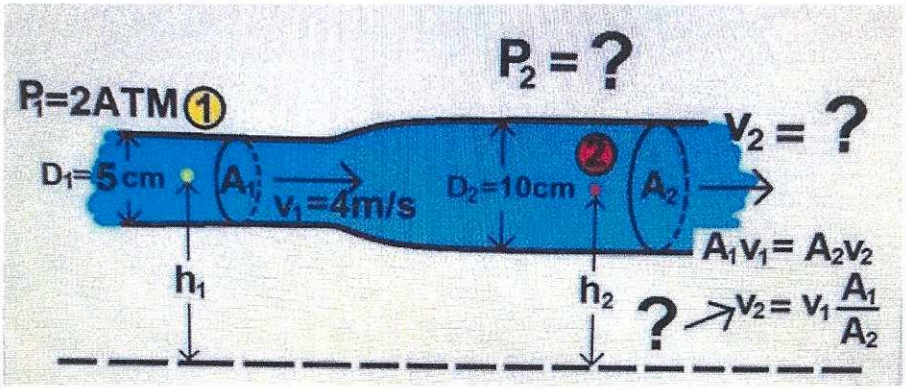


(10)

(c) A bar of soap, when weighed in air, has a weight of $W_{in\ air} = 5.5\ N$. When completely immersed in water, however, it has a weight of $W_{in\ water} = 3.3\ N$.
Find the volume of the bar of soap. (7)

Question 3(25)

(a) Use the equation of flowing fluids find P_2 and v_2 in the diagram below?



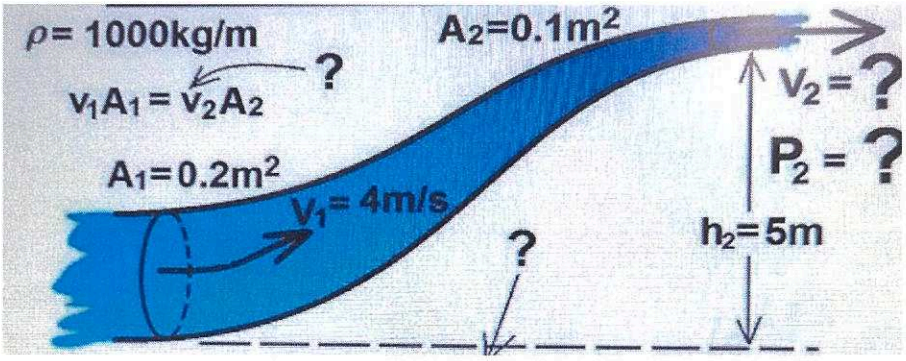
(7)

(b) A liquid *(ρ = 1.7 g/cm^3)* flows through two horizontal sections of tubing joined end to end. In the first section, the cross-sectional area is *100 cm^2*, the flow speed is *275 cm/s*, and the pressure is *1.20x10^5 Pa*. In the second section, the cross-sectional area is *2.50 cm^2*. Calculate the smaller section's

(i) flow speed and

(ii) pressure. (8)

(c) Use the equation of flowing fluids find P2 and v2 in the diagram below? (10)



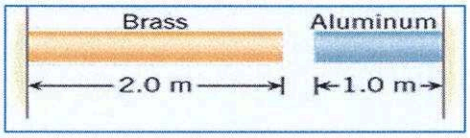
Question 4 (25):

(a) At what common *temperature* are the Fahrenheit and Celsius temperatures the same? (5)

(b) Three liters of water, initially at *10°C*, is heated to *40°C*. Determine the volume of water at *40°C*. (3)

(c) Determine the increase in volume, *in liters*, of *2.5 m^3* of water when heated from *25 °C* to boiling point. (3)

(d) The brass bar and the aluminum bar in the drawing are each attached to an immovable wall. At *20 °C* the air gap between the rods is *1.4×10^{-3} m*. At what temperature will the gap be closed? (7)



(e) A lead beam is used in the construction of a skyscraper. By what fraction $\Delta L/L_0$ does the length of the beam increase when the temperature changes from that on a cold winter day *(–15 °F)* to that on a summer day *(+120 °F)*? (7)

Important Information if you are stuck!

1. *Volume Expansion:* $\Delta V = \beta V_o \Delta T$
2. *Linear Expansion:* $\Delta L = \alpha L_o \Delta T$
3. *Volume of Sphere:* $V_{sphere} = \frac{4}{3}\pi r^3$
4. *Equation of continuity:* $A_1 v_1 = A_2 v_2$
5. *Bernoulli's Equation:* $P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$
6. $\alpha_{aluminum} = 23x10^{-6}$;
7. $\alpha_{Brass} = 19x10^{-6}$;
8. $\alpha_{Steel} = 12x10^{-6}$
9. $T_F = \frac{9}{5}T_C + 32°$
10. *Density of Salt water* $= 1\,025\ kg/m^3$
11. *Atmospheric Pressure* $= 101x10^3\ Pa$

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UNDERSTANDING is much deeper than knowledge.
There are many people who know us, but very few who understand us!

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