

UNIVERSITY OF FORT HARE



University of Fort Hare
Together in Excellence

PHY 114

May/June EXAMINATIONS

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

EXAMINERS

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INSTRUCTIONS TO CANDIDATES:

Answer All Questions.

Show the cancelation of units clearly!

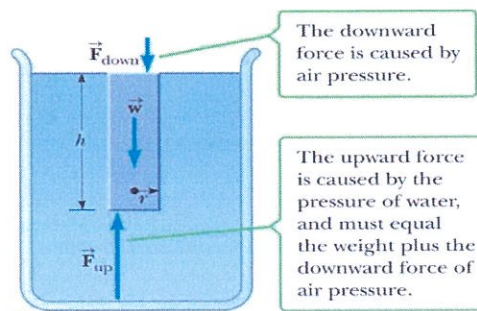
Useful Information on the last page:

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-kg automobile when a 500-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 $4 \times 10^5 \text{ Pa}$ 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)

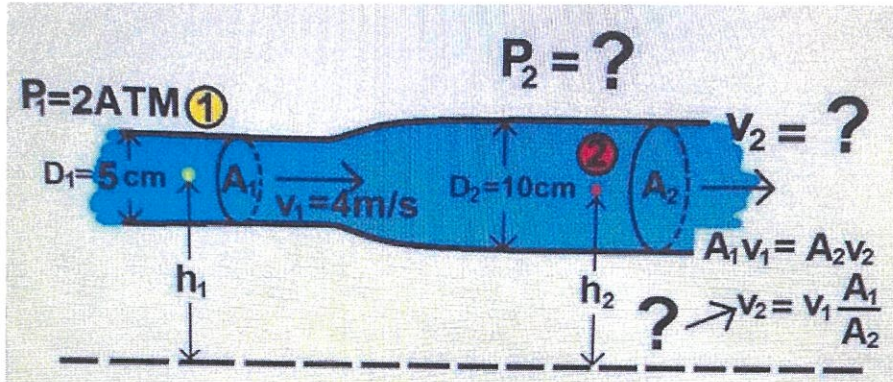
- (a) A spherical brass ball of density 8890 kg/m^3 , is hanging from a ceiling attached to a wire. The tension in the wire is 200 N . What is the radius of the brass ball? (8)
- (b) Calculate the weight of a cylindrical column of water with a height $h = 50 \text{ m}$ and radius $r = 1.00 \text{ m}$.
(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?



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

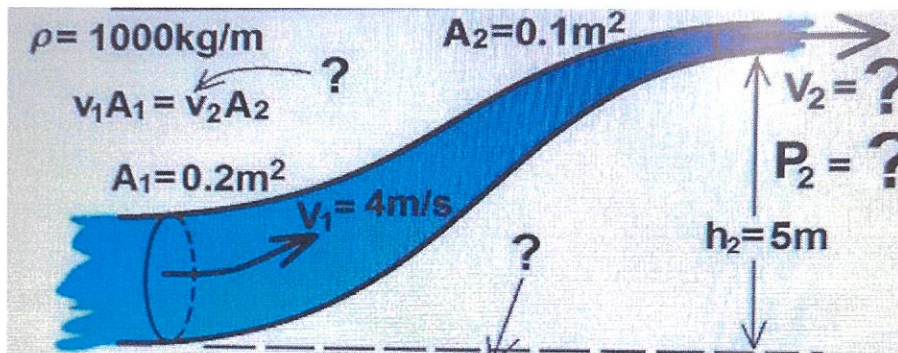
(b) A liquid ($\rho = 1.7 \text{ g/cm}^3$) flows through two horizontal sections of tubing joined end to end. In the first section, the cross-sectional area is 100 cm^2 , the flow speed is 275 cm/s , and the pressure is $1.20 \times 10^5 \text{ Pa}$. In the second section, the cross-sectional area is 2.50 cm^2 . Calculate the smaller section's

- (i) flow speed and
- (ii) pressure.

(8)

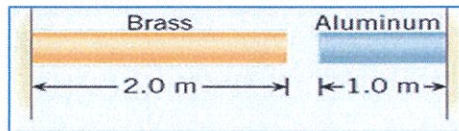
(c) Use the equation of flowing fluids find P_2 and v_2 in the diagram below?

(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 $1.4 \times 10^{-3}\text{ m}$. 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 ($+120^{\circ}\text{F}$)? (7)

Important Information if you are stuck!

1. *Volume Expansion:* $\Delta V = \beta V_0 \Delta T$
2. *Linear Expansion:* $\Delta L = \alpha L_0 \Delta T$
3. *Volume of Sphere:* $V_{\text{sphere}} = \frac{4}{3} \pi r^3$
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. $\alpha_{\text{aluminum}} = 23 \times 10^{-6}$;
7. $\alpha_{\text{Brass}} = 19 \times 10^{-6}$;
8. $\alpha_{\text{Steel}} = 12 \times 10^{-6}$
9. $T_F = \frac{9}{5} T_C + 32^{\circ}$
10. *Density of Salt water* = $1\,025\text{ kg/m}^3$
11. *Atmospheric Pressure* = $101 \times 10^3\text{ Pa}$

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