Chap14

1. Test Bank, Question 18

A bucket resting on the floor of an elevator contains an incompressible fluid of density $\rho$. When the elevator has an upward acceleration $a$ the pressure difference between two points in a fluid separated by a vertical distance $\Delta h$, is given by:

- $\rho a \Delta h$
- $\rho g \Delta h$
- $\rho (g + a) \Delta h$
- $\rho (g - a) \Delta h$
- $\rho g a \Delta h$

2. Test Bank, Question 7

A bucket of water is pushed from left to right with increasing speed across a horizontal surface. Consider the pressure at two points at the same level in the water.

- It is the same
- It is higher at the point on the left
- It is higher at the point on the right
- At first it is higher at the point on the left but as the bucket speeds up it is lower there
- At first it is higher at the point on the right but as the bucket speeds up it is lower there

3. *Chapter 14, Problem 20

The L-shaped tank shown in Fig. 14-33 is filled with water and is open at the top. If $d = 5.70$ m, what is the total force exerted by the water (a) on face $A$ and (b) on face $B$?

(a) Number 6911272.8 Units N

4. *Chapter 14, Problem 24

In Fig. 14-35, water stands at depth $D = 34.0$ m behind the vertical upstream face of a dam of width $W = 317$ m. Find the torque due to the net horizontal force on the dam, measured about a rotation axis parallel to the dam and through point $O$. (Note: use $g = 9.81$ m/s$^2$)

![Diagram of dam with water and torque diagram]

Number $2.03710668E+10$ Units N·m

*Chapter 14, Problem 24

5. *Chapter 14, Problem 81

Figure 14-30 shows a modified U-tube: the right arm is shorter than the left arm. The open end of the right arm is height $d = 10.0$ cm above the laboratory bench. The radius throughout the tube is 2.40 cm. Water is gradually poured into the open end of the left arm until the water begins to flow out the open end of the right arm. Then a liquid of density 0.870 g/cm$^3$ is gradually added to the left arm until its height in that arm is 8.80 cm (it does not mix with the water). How much water (in cm$^3$) flows out of the right arm?

![Diagram of U-tube with water and liquid]

Number $138.817346823536$ Units cm$^3$

*Chapter 14, Problem 81

6. *Chapter 14, Problem 27

What would be the height of the atmosphere if the air density (a) were uniform and (b) decreased linearly to zero with height? Assume that at sea level the air pressure is 1.00 atm and the air density is 1.22 kg/m$^3$.

(a) Number $8472.73355637338$ Units m

(b) Number $7818718.5$ Units N
7. *Chapter 14, Problem 29

In Figure 14-37, a spring of spring constant 2.10 x 10^4 N/m is between a rigid beam and the output piston of a hydraulic lever. An empty container with negligible mass sits on the input piston. The input piston has area $A_i$, and the output piston has area 19.0 $A_i$. Initially the spring is at its rest length. How many kilograms of sand must be (slowly) poured into the container to compress the spring by 3.50 cm?

![Figure 14-39](image)

Number 3.947368421053 Units kg

*Significant digits are disabled; the tolerance is +/-2%

8. *Chapter 14, Problem 44

A block of wood has a mass of 3.45 kg and a density of 692 kg/m^3. It is to be loaded with lead (1.13 x 10^4 kg/m^3) so that it will float in water with 0.918 of its volume submerged. What mass of lead is needed if the lead is attached to (a) the top of the wood and (b) the bottom of the wood?

(a) Number 1.126734104046 Units kg
(b) Number 1.236125764633 Units kg

9. *Chapter 14, Problem 46

Suppose that you release a small ball from rest at a depth of 0.620 m below the surface in a pool of water. If the density of the ball is 0.260 that of water and if the drag force on the ball from the water is negligible, how high above the water surface will the ball shoot as it emerges from the water? (Neglect any transfer of energy to the splashing and waves produced by the emerging ball.)

Number 1.764615384615 Unit m

*Significant digits are disabled; the tolerance is +/-2%
10. *Chapter 14, Problem 49

**Canal effect.** Figure 14-45 shows an anchored barge that extends across a canal by distance \( d = 32 \text{ m} \) and into the water by distance \( b = 10 \text{ m} \). The canal has a width \( D = 52 \text{ m} \), a water depth \( H = 12 \text{ m} \), and a uniform water-flow speed \( v_i = 1.9 \text{ m/s} \). Assume that the flow around the barge is uniform. As the water passes the bow, the water level undergoes a dramatic dip known as the canal effect. If the dip has depth \( h = 0.70 \text{ m} \), what is the water speed alongside the boat through the vertical cross sections at (a) point \( a \) and (b) point \( b \)? The erosion due to the speed increase is a common concern to hydraulic engineers.

(a) Number \[
\begin{array}{c}
4.088275862069
\end{array}
\] Units m/s

(b) Number \[
\begin{array}{c}
3.9
\end{array}
\] Units m/s

11. *Chapter 14, Problem 50

Figure 14-46 shows two sections of an old pipe system that runs through a hill, with distances \( d_A = d_B = 35.0 \text{ m} \) and \( D = 130 \text{ m} \). On each side of the hill, the pipe radius is 2.50 cm. However, the radius of the pipe inside the hill is no longer known. To determine it, hydraulic engineers first establish that water flows through the left and right sections at 2.70 m/s. Then they release a dye in the water at point \( A \) and find that it takes 92.0 s to reach point \( B \). What is the average radius (in cm) of the pipe within the hill?

Number \[
\begin{array}{c}
4.310839052126
\end{array}
\] Units cm

*Significant digits are disabled; the tolerance is +/-2%*

12. *Chapter 14, Problem 55

How much work is done by pressure in forcing 9.7 m\(^3\) of water through a pipe having an internal diameter of 19 mm if the difference in pressure at the two ends of the pipe is 1.4 atm?

Number \[
\begin{array}{c}
1375654
\end{array}
\] Units J

*Significant digits are disabled; the tolerance is +/-2%*
13. *Chapter 14, Problem 66

Flying Circus of Physics

A **venturi meter** is used to measure the flow speed of a fluid in a pipe. The meter is connected between two sections of the pipe (Fig. 14-50); the cross-sectional area $A$ of the entrance and exit of the meter matches the pipe's cross-sectional area. Between the entrance and exit, the fluid flows from the pipe with speed $V$ and then through a narrow "throat" of cross-sectional area $a$ with speed $v$. A manometer connects the wider portion of the meter to the narrower portion. The change in the fluid’s speed is accompanied by a change $\Delta p$ in the fluid’s pressure, which causes a height difference $h$ of the liquid in the two arms of the manometer. (Here $\Delta p$ means pressure in the throat minus pressure in the pipe.) Let $A$ equal 6-$a$. Suppose the pressure $p_1$ at $A$ is 1.5 atm. Compute the values of (a) the speed $V$ at $A$ and (b) the speed $v$ at $a$ that make the pressure $p_2$ at $a$ equal to zero. (c) Compute the corresponding volume flow rate if the diameter at $A$ is 5.5 cm. The phenomenon that occurs at $a$ when $p_2$ falls to nearly zero is known as cavitation. Please assume that the fluid is water. The water vaporizes into small bubbles.

(a) Number 2.942302305533 Units m/s
(b) Number 17.653813833196 Units m/s
(c) Number 0.006990408451 Units m$^3$/s

14. *Chapter 14, Problem 67

In Fig. 14-51, the fresh water behind a reservoir dam has depth $D = 13.0$ m. A horizontal pipe 4.77 cm in diameter passes through the dam at depth $d = 5.93$ m. A plug secures the pipe opening. (a) Find the magnitude of the frictional force between plug and pipe wall. (b) The plug is removed. What water volume exits the pipe in 1.35 h?

(a) Number 103.850217036342 Units N
(b) Number 93.630704486064 Units m$^3$
15. *Chapter 14, Problem 69

A liquid of density 890 kg/m³ flows through a horizontal pipe that has a cross-sectional area of $2.00 \times 10^{-2}$ m² in region A and a cross-sectional area of $8.20 \times 10^{-2}$ m² in region B. The pressure difference between the two regions is $6.60 \times 10^3$ Pa. What are (a) the volume flow rate and (b) the mass flow rate?

(a) $0.079421828180$ m³/s
(b) $70.685427080255$ kg/s

16. *Chapter 14, Problem 71

Fig. 14-54 shows a stream of water flowing through a hole at depth $h = 11.2$ cm in a tank holding water to height $H = 51.5$ cm. (a) At what distance $x$ does the stream strike the floor? (b) At what depth should a second hole be made to give the same value of $x$? (c) At what depth should a hole be made to maximize $x$?

Give your answers in cm.

(a) Number $42.490469519646$ Units cm
(b) Number $40.3$ Units cm
(c) Number $25.75$ Units cm

17. *Chapter 14, Problem 83

Flying Circus of Physics

Figure 14-56 shows a siphon, which is a device for removing liquid from a container. Tube ABC must initially be filled, but once this has been done, liquid will flow through the tube until the liquid surface in the container is level with the tube opening at A. The liquid has density 1000 kg/m³ and negligible viscosity. The distances shown are $h_1 = 24.0$ cm, $d = 13.0$ cm, and $h_2 = 46.0$ cm. (a) With what speed does the liquid emerge from the tube at C? (b) If the atmospheric pressure is $1.00 \times 10^5$ Pa, what is the pressure in the liquid at the topmost point B? (c) Theoretically, what is the greatest possible height $h_1$ that a siphon can lift water?
(a) Number 3.400588184418 Units m/s
(b) Number 91866 Units N/m^2 or Pa
(c) Number 10.204081632653 Units m