Chapter 13  Forces in Fluids

Section 13.1 Fluid Pressure
(pages 390–393)

This section defines pressure and describes factors that determine fluid pressure. The atmosphere as a fluid is discussed, including how air pressure changes with altitude.

Reading Strategy (page 390)

Using Prior Knowledge  Before reading the section, write a common definition of the word pressure. After you have read the section, write the scientific definition of pressure and contrast it to your original definition. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>Meanings of Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common definition</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Scientific definition</td>
</tr>
</tbody>
</table>

Pressure (pages 390–391)

1. Pressure is the result of a(n) ______ distributed over a(n) ______.

2. The same force is exerted by each of the following. Which exerts the most pressure?
   a. a foot  b. a large book  c. a fingertip  d. the tip of a ball-point pen

3. How is pressure calculated?

4. A wooden crate that measures 2.0 m long and 0.40 m wide rests on the floor. If the crate has a weight of 600.0 N, what pressure does it exert on the floor?
   a. 0.80 m²  b. 480 Pa  c. 3.0 \times 10^3 \text{ N/m}^2  d. 750 Pa

Pressure in Fluids (pages 391–392)

5. A substance that assumes the shape of its container is called a(n) ______.

6. List four examples of fluids.
   a. ______  b. ______  c. ______  d. ______
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7. Circle the letter of each sentence that is true about fluid pressure.
   a. Water pressure decreases as depth decreases.
   b. Fluid pressure is exerted only at the base of the container holding the fluid.
   c. The pressure in a fluid at any given depth is constant, and it is exerted equally in all directions.
   d. The two factors that determine the pressure a fluid exerts are type of the fluid and its depth.

8. Is the following sentence true or false? The pressure at a depth of 2 feet in a large lake is greater than the pressure at the same depth in a swimming pool. ______________

Air Pressure and the Atmosphere (pages 392–393)

9. Instead of referring to their depth in the atmosphere, people refer to their ______________ above sea level.

For questions 10 through 13, refer to the air pressure table below.

<table>
<thead>
<tr>
<th>Altitude Above Sea Level (m)</th>
<th>Air Pressure (bars)</th>
<th>Air Pressure (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>0.9971</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td></td>
<td>96.68</td>
</tr>
<tr>
<td>600</td>
<td></td>
<td>94.42</td>
</tr>
<tr>
<td>800</td>
<td>0.9103</td>
<td>92.21</td>
</tr>
<tr>
<td>1000</td>
<td>0.8888</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>0.8677</td>
<td>87.89</td>
</tr>
</tbody>
</table>

10. Complete the air pressure columns in the table by converting between units of air pressure. Hint: 1 bar = 101.3 kPa.

11. How does air pressure change as a function of altitude? ______________

12. Suppose a hiker is on a mountain ridge 1200 meters above sea level. Approximately what air pressure will she experience? ______________

13. By how much does the air pressure decrease, in bars, from sea level to an altitude of 1200 meters? ______________

14. Is the following sentence true or false? Air exerts a force of more than 1000 N on top of your head. ______________

15. What keeps a person from being crushed by air pressure? ______________
Section 13.2 Forces and Pressure in Fluids
(pages 394–397)
This section presents Pascal's and Bernoulli's principles. Examples of each principle from nature and industry are discussed.

Reading Strategy (pages 394)
Predicting Imagine two small foam balls hanging from strings at the same height with about three centimeters of space between them. Before you read the section, write a prediction about what will happen to the balls when you blow air through the space between them. Identify your reasons. After you have read the section, check the accuracy of your prediction. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>Predicting Forces and Pressure in Fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prediction</td>
</tr>
<tr>
<td>Reason for Prediction</td>
</tr>
</tbody>
</table>

Transmitting Pressure in a Fluid (pages 394–395)
1. In a fluid-filled container, why is the pressure greater at the base of the container? ________________________________

2. Is the following sentence true or false? If you squeeze a container filled with fluid, the pressure within the fluid increases equally throughout the fluid. ________________

3. According to Pascal’s principle, what happens when there is a change in pressure at any point in a fluid? ________________________________

4. The science of applying Pascal’s principle is called ____________________.

5. In a hydraulic lift system, an increased output force is produced because constant ____________________ is exerted on the larger area of the output piston.

6. Is the following sentence true or false? In a hydraulic system, the output force is greater than the input force because the pressure acting on the output piston is greater than the pressure acting on the input piston. ________________
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Bernoulli’s Principle (pages 396–397)

7. Circle the letter of the sentence that correctly states Bernoulli’s principle.
   a. As the speed of a fluid decreases, the pressure within the fluid decreases.
   b. As the speed of a fluid increases, the pressure within the fluid increases.
   c. As the speed of a fluid increases, the pressure within the fluid decreases.
   d. Fluid motion has no effect on pressure within the fluid.

8. Because the air traveling over the top of an airplane wing moves faster than the air passing underneath the wing, the pressure above the wings is _____________ than the pressure below the wing.

9. What is lift, and how does it relate to an airplane’s flight? ________________
   ________________

10. What is a spoiler on a racecar designed to do? ________________
    ________________

For questions 11 through 14, refer to the figure below. Place the correct letter after each phrase.

11. Location where the water and fertilizer solution mix. ________________
12. Location where water enters the sprayer at high speed. ________________
13. Location where the water-fertilizer mixture exits the sprayer. ________________
14. Use Bernoulli’s principle to explain why the fertilizer solution moves up the tube. ________________
    ________________
    ________________
    ________________