A boat carrying a large boulder is floating on a lake. The boulder is thrown overboard and sinks. The water level in the lake (with respect to the shore)

A. rises.

B. drops.

C. remains the same.

Text 'PHYSJC' and your answer to 22333



Announcements

- The derivation of Bernoulli's equation in full gory detail is on the course website
- Next week's Lab is not in the lab manual.
 Pick up a packet during lab this week or download it from the course website
- No office hours on Thursday I-3pm.



Goals for Chapter 12

- To study the concept of density
- To investigate pressure in a fluid
- To study buoyancy in fluids
- To compare laminar versus turbulent fluid flow and how the fluid speed depends on the size of the tube
- To learn how to use Bernoulli's equation to relate pressure and flow speed of a fluid

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Two cups are filled to the same level with water. One of the two cups has ice cubes floating in it. When the ice cubes melt, in which cup is the level of the water higher?

F. The cup without ice cubes.G. The cup with ice cubes.H. It is the same in both.



Continuity Equation

 $\rho_1 A_1 v_1 = \rho_2 A_2 v_2$

Incompressible fluid: ($\rho_1 = \rho_2$)

 $A_1v_1 = A_2v_2$

Q13.5

An incompressible fluid flows through a pipe of varying radius (shown in cross-section). Compared to the fluid at point *P*, the fluid at point *Q* has



K. 4 times the fluid speed.

L. 2 times the fluid speed.

M. the same fluid speed.

N. 1/2 the fluid speed.

P. 1/4 the fluid speed.

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Bernoulli's Equation

$p_1 + \rho g y_1 + 1/2 \rho v_1^2 = p_2 + \rho g y_2 + 1/2 \rho v_2^2$

Q13.4

An incompressible fluid flows through a pipe of varying radius (shown in cross-section). Compared to the fluid at point *P*, the fluid at point *Q* has



- Q. greater pressure and greater volume flow rate.
- R. greater pressure and the same volume flow rate.
- S. the same pressure and greater volume flow rate.
- T. lower pressure and the same volume flow rate.
- U. none of the above

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radius R

fluid at rest



radius 2*R*



How does the pressure compare at points P & Q?

Venturi meter

fluid at rest



radius 2R

radius *R*



When the fluid is in motion, $h_1 = h_2$

$$\begin{array}{cccc} \mathbf{1} & n_1 & n_2 \\ \mathbf{2} & \mathbf{3} & \mathbf{4} & \mathbf{5} \\ \mathbf{3} & \mathbf{4} & \mathbf{5} & \mathbf{5} \\ \mathbf{3} & \mathbf{5} & \mathbf{5} & \mathbf{5} \\ \mathbf{5} & \mathbf$$

2.
$$n_1 > n_2$$

3.
$$h_1 > h_2$$

4. None of the above



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The Leaky Tower



Each pipe has a diameter of I cm. At what speed will the water come out from each pipe?

(a) Flow lines around an airplane wing

Flow lines are crowded together above the wing, so flow speed is higher there and pressure is lower.



(b) Computer simulation of air parcels flowing around a wing, showing that air moves much faster over the top than over the bottom.



Notice that air particles that are together at the leading edge of the wing do *not* meet up at the trailing edge!

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A curve ball (Bernoulli's equation applied to sports)

• Does a curve ball *really* curve? Follow Conceptual Example 12.11 and Figure 12.30 below to find out.

(a) Motion of air relative to a nonspinning ball

(b) Motion of a spinning ball



This side moves in the direction of the airflow.

This side of the ball moves

opposite to the airflow.

(d) Spin pushing a tennis ball downward



(e) Spin causing a curve ball to be deflected sideways





(c) Force generated when a spinning ball moves through air

A moving ball drags the adjacent air with it. So, when air moves past a spinning ball:

On one side, the ball slows the air, creating a region of high pressure.
On the other side, the ball speeds the air, creating a region of low pressure.

The resultant force points in the direction of the low-pressure side.

(f) Backspin of a golf ball

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Video

Ch I 3.I-3 Gravitation

PHYS 1210 - Prof. Jang-Condell

Chapter 13

Gravitation

PowerPoint[®] Lectures for University Physics, Thirteenth Edition – Hugh D. Young and Roger A. Freedman

Lectures by Wayne Anderson

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Monday, April 11, 16

- To calculate the gravitational forces that bodies exert on each other
- To relate weight to the gravitational force
- To use the generalized expression for gravitational potential energy
- To study the characteristics of circular orbits
- To investigate the laws governing planetary motion
- To look at the characteristics of black holes

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Newton's Law of Gravitation



 $G = 6.67 \times 10^{-11} \text{ N-m}^2/\text{kg}^2$

Gravitation and spherically symmetric bodies

• The gravitational interaction of bodies having *spherically symmetric* mass distributions is the same as if all their mass were concentrated at their centers. (See Figure 13.2 at the right.) (a) The gravitational force between two spherically symmetric masses m_1 and m_2 ... (b) ... is the same as if we concentrated all the mass of each sphere at the sphere's center.



Interior of the earth

• The earth is approximately spherically symmetric, but it is *not* uniform throughout its volume, as shown in Figure 13.9 at the right.



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Q14.1



The mass of the Moon is 1/81 of the mass of the Earth.

Compared to the gravitational force that the Earth exerts on the Moon, the gravitational force that the Moon exerts on the Earth is

- F. $81^2 = 6561$ times greater.
- G. 81 times greater.
- H. equally strong.
- I. 1/81 as great.
- J. $(1/81)^2 = 1/6561$ as great.

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Some gravitational calculations

- Example 13.1 shows how to calculate the gravitational force between two masses.
- Example 13.2 shows the acceleration due to gravitational force.
- Example 13.3 illustrates the *superposition of forces*, meaning that gravitational forces combine vectorially. (See Figure 13.5 below.)



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Weight

- The **weight** of a body is the total gravitational force exerted on it by all other bodies in the universe.
- At the surface of the Earth, the gravitational force of the Earth dominates. So a body's weight is $w = Gm_{\rm E}m/R_{\rm E}^2$
- The acceleration due to gravity at the earth's surface is

$$g = Gm_{\rm E}/R_{\rm E}^2$$