Science 10

Thursday, March 29/18

http://mvhs.nbed.nb.ca/

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Redo Request Forms for SA Chem #1

1. Return -> FA - Balancing Chemical Equations
2. Check
   Worksheet: Single and Double Replacement Reactions
3. Combustion Reactions
4. Worksheet: Combustion Reactions

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5. Identifying Reactions Types
6. Worksheet: Identifying Reaction Types
7. SA Chem #2 - Topics
   - Review
   - Thursday, April 5/18

Physics 112

Thursday, March 29/18

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1. Return FA - Uniformly Accelerated Motion (K3.8)
   Uniformly Accelerated Motion (K3.9)
   Uniformly Accelerated Motion (K3.10)
   Uniformly Accelerated Motion (K3.11) - Justifications

2. Worksheet - Motion Problems
   Worksheet - Objects in Free Fall
   Worksheet - Extra Uniformly Accelerated Problems

3. SA: U1-S3 - Topics
   - Wednesday, April 4/18

   Format: 6 Prob.

Physics 122

Thursday, March 29/18

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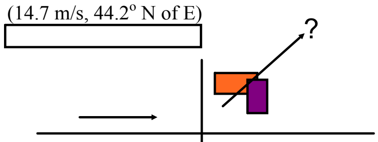
1. Check
   Worksheet - Elastic and Inelastic Collisions
2. 2D Collisions and Explosions
3. Worksheets - 2D Collisions and Explosions

<u>Example</u>: A 1325 kg car moving north at 27.0 m/s collides with a 2165 kg car moving east at 17.0 m/s. They stick together. In what direction and with what speed do they move after the collision?

(14.7 m/s, 44.2° N of E)



$m_2 = 2165\,kg$

$\vec{v}_2 = 17.0\,m/s, E$

$\vec{v}_{2x} = +17.0\,m/s$

$\vec{v}_{2y} = 0\,m/s$ ②

$m_1 = 1325\,kg$

$\vec{v}_1 = 27.0\,m/s, N$

$\vec{v}_{1x} = 0\,m/s$

$\vec{v}_{1y} = +27.0\,m/s$ ②

x: $\cancel{m_1 \vec{v}_{1x}} + m_2 \vec{v}_{2x} = m_1 \vec{v}_{1x}' + m_2 \vec{v}_{2x}'$

Note: $\vec{v}_{1x}' = \vec{v}_{2x}' = \vec{v}_x'$ ①

$m_2 \vec{v}_{2x} = m_1 \vec{v}_x' + m_2 \vec{v}_x'$

$m_2 \vec{v}_{2x} = \vec{v}_x'(m_1 + m_2)$

$$\vec{v}_x' = \frac{m_2 \vec{v}_{2x}}{m_1 + m_2} \quad ①$$

$$\vec{v}_x' = \frac{(2165)(+17.0\,m/s)}{1325 + 2165}$$

$\vec{v}_x' = 10.55\,m/s$ ①

x keep an extra SD

y: $m_1 \vec{v}_{1y} + \cancel{m_2 \vec{v}_{2y}} = m_1 \vec{v}_{1y}' + m_2 \vec{v}_{2y}'$

Note: $\vec{v}_{1y}' = \vec{v}_{2y}' = \boxed{\vec{v}_y'}$ ①

$$\vec{v}_y' = \frac{m_1 \vec{v}_{1y}}{m_1 + m_2} \quad ①$$

$\vec{v}_y' = 10.25\,m/s$ ①

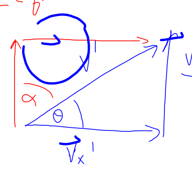
$v' = \sqrt{(\vec{v}_x')^2 + (\vec{v}_y')^2}$

$v' = 14.7\,m/s$

$\tan\theta = \dfrac{v_y'}{v_x'}$

$\theta = 44.2°$

$90 - 44.2° =$ ___ E of N



① ①

$\boxed{14.7\,m/s, 44.2°\ N\ of\ E}$

3SD. 3SD

Science 122

Thursday, March 29/18

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1. Check:
   Worksheet - Archimedes' Principle
   Worksheet - More Hydrostatic Fluid Problems
   Worksheet - Section 11.8 - The Equation of Continuity

2. Ideal Fluid Flow

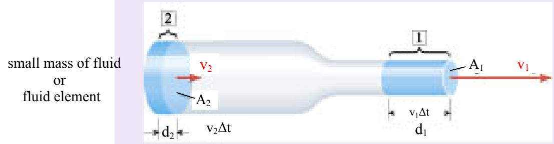
3. Bernoulli's Equation

4. Worksheets - Fluids - Continuity and Bernoulli's Equations

Mass Flow Rates and Equation of Continuity

A fluid entering a pipe at a certain mass flow rate* (ie. 5 kg/s) must leave the pipe at the same rate assuming there are no places between the entry and exit points to add or remove fluid.

*mass flow rate - mass of fluid per second that flows through a tube



F11.28.jpg

$V = \frac{d}{t}$

$d = vt$

NOTE:

$V_1 = A_1 d_1$ | $V_2 = A_2 d_2$

$V_1 = A_1 v_1 \Delta t$ | $V_2 = A_2 v_2 \Delta t$

volume velocity | volume velocity

Mass of a fluid element:

$\rho = \frac{m}{V}$

$m = \rho_1 V_1$ | $m = \rho_2 V_2$

$m = \rho_1 \boxed{A_1 v_1 \Delta t}$ | $m = \rho_2 \boxed{A_2 v_2 \Delta t}$

Mass flow rate:

$\frac{m}{\Delta t} = \rho_1 A_1 v_1$ | $\frac{m}{\Delta t} = \rho_2 A_2 v_2$

Equation of Continuity

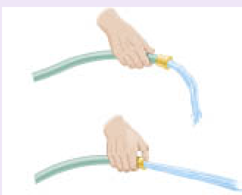
$$\boxed{\rho_1 A_1 v_1 = \rho_2 A_2 v_2}$$

ρ -> density of fluid (kg/m^3)
A -> cross-sectional area (m^2)
v -> speed of fluid (m/s)

If a fluid is incompressible, $\boxed{\rho_1 = \rho_2}$.

$$\cancel{\rho_1} A_1 v_1 = \cancel{\rho_2} A_2 v_2$$

$$\boxed{A_1 v_1 = A_2 v_2}$$



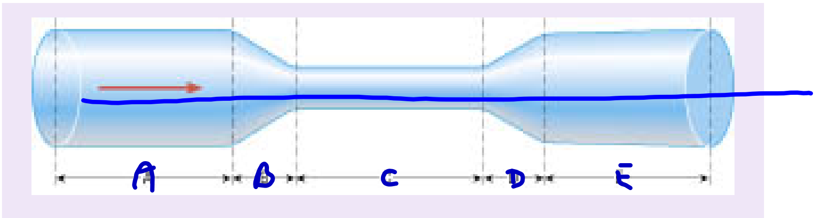
F11.27.jpg

As A decreases, v increases.

☆

Water flows from left to right through the five sections (A, B, C, D, E) of the pipe shown in the drawing. In which section(s) does the water speed increase, decreases and remain constant? Assume the water is incompressible.

$$A_1 v_1 = A_2 v_2$$



A -> constant

B -> increase.

C -> constant

D -> dec.

E -> constant

NOTE: **Volume Flow Rate**

$$\boxed{Q = \frac{V}{t}}$$

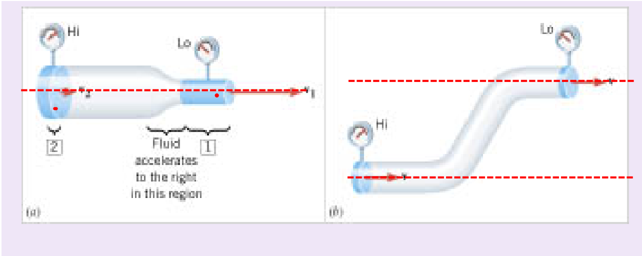
Q -> volume flow rate (m^3/s)
V -> volume (m^3)
t -> time (s)

Note: $\left.\frac{V}{t} = \frac{Ad}{t} = Av\right\}$ volume flow rate

Bernoulli's Equation

(Cutnell - Page 316)

Study the diagrams below. $A_1 v_1 = A_2 v_2$



F11.30.jpg

In the horizontal pipe in (a), the pressure in region 2 is greater than in region 1. The difference in pressures leads to the net force that accelerates the fluid to the right.

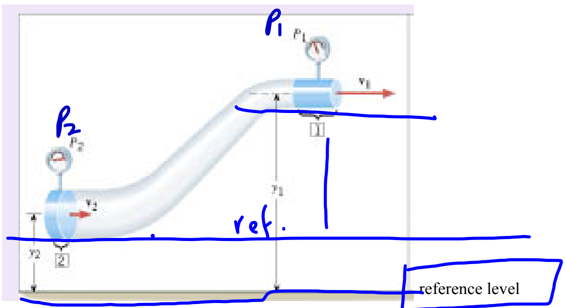
When the fluid changes elevation, the pressure at the bottom is greater than at the top, assuming that the cross-sectional area of the pipe remains constant.

Bernoulli's Equation is an important equation in fluid mechanics. <u>It is derived from an equation for energy conservation</u>. ✓

In the steady flow of a nonviscous, incompressible fluid of density ρ, the pressure, fluid speed and the elevations from a reference level at any two points, are related by:

$$\boxed{P_1 + \tfrac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \tfrac{1}{2}\rho v_2^2 + \rho g y_2}$$

Bernoulli's Equation



↑ stated.

What if $v_1 = v_2$?
Let $v = v_1 = v_2$.

$$P_1 + \cancel{\tfrac{1}{2}\rho v^2} + \rho g y_1 = P_2 + \cancel{\tfrac{1}{2}\rho v^2} + \rho g y_2$$

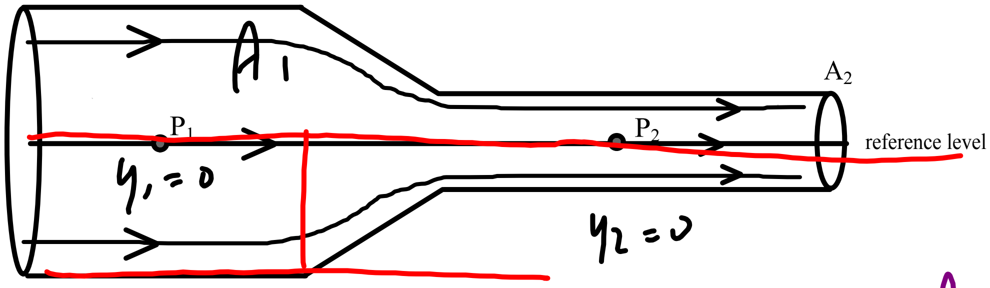
$$P_1 + \rho g y_1 = P_2 + \rho g y_2$$

$$P_2 = P_1 + \rho g y_1 - \rho g y_2$$

$$P_2 = P_1 + \rho g (y_1 - y_2)$$

$$P_2 = P_1 + \rho g h$$ hydrostatic eq.

Consider the two regions in the pipe below.



$A_1 v_1 = A_2 v_2$

According to the Equation of Continuity:

If $A_2 < A_1$ then $v_2 > v_1$

Since y_1 and y_2 are equal:

$$P_1 + \tfrac{1}{2}\rho v_1^2 + \cancel{\rho g y_1} = P_2 + \tfrac{1}{2}\rho v_2^2 + \cancel{\rho g y_2}$$

$$\boxed{P_1 + \tfrac{1}{2}\rho v_1^2 = P_2 + \tfrac{1}{2}\rho v_2^2}$$

2 8 10 10 0 0

How do P_1 and P_2 compare? Remember: $v_2 > v_1$

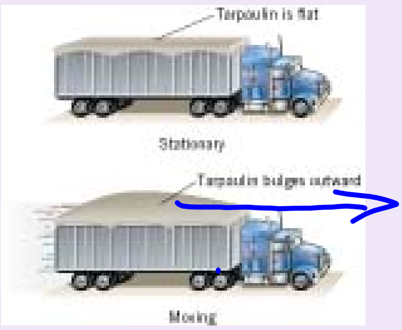
$P_2 < P_1$

$P_2 < P_1$ $A_2 < A_1$ $v_2 > v_1$

P A v. PAV.

Example

A tarpaulin is a piece of canvas that is used to cover cargo as shown in the diagram. When the truck is stationary the tarpaulin lies flat, but it bulges outward when the truck is speeding down the highway. Explain.



F11.32.jpg

When the truck is stationary, the air outside and inside the cargo area is stationary so the air pressure is the same in both places. This pressure applies the same force to the outer and inner surfaces of the canvas - tarpaulin lies flat. When the truck is moving, the outside air rushes over the top surface of the canvas. The moving air has a lower pressure than the stationary air within the cargo area. The greater inside pressure generates a greater force on the inner surface of the canvas, and the tarp bulges outward.

ref. level

$y_1 = y_2 = 0$

inside outside

$$P_1 + \cancel{\tfrac{1}{2}\rho v_1^2} = P_2 + \tfrac{1}{2}\rho v_2^2$$

inside outside

$$P_1 = P_2 + \tfrac{1}{2}\rho v_2^2$$

$\uparrow \quad \uparrow$

$A_2 \cdot v_2 \cdot \rho_2$

$A_1 \cdot v_1 \cdot \rho_1$

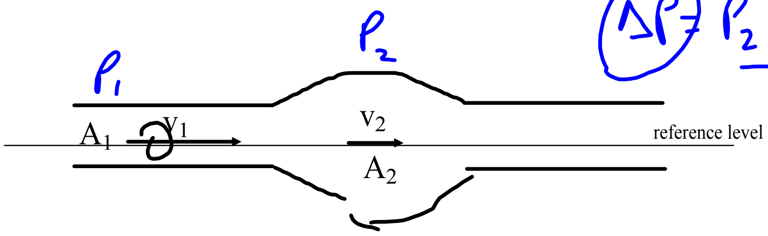
$=$

$P = \dfrac{F}{A}$

Example

An aneurysm is an abnormal enlargement of a blood vessel such as the aorta. Suppose that, because of an aneurysm, the cross-sectional area A_1 of the aorta increases to a value $A_2 = 1.7\,A_1$. The speed of the blood (ρ = 1060 kg/m³) through a normal portion of the aorta is v_1 = 0.40 m/s. Assuming that the aorta is horizontal, determine the amount by which the pressure P_2 in the enlarged region exceeds the pressure P_1 in the normal region. (55 Pa)

$\Delta P = P_2 - P_1$



$$P_1 + \tfrac{1}{2}\rho v_1^2 + \cancel{\rho g y_1} = P_2 + \tfrac{1}{2}\rho v_2^2 + \cancel{\rho g y_2}$$

$$P_1 + \tfrac{1}{2}\rho v_1^2 = P_2 + \tfrac{1}{2}\rho v_2^2$$

$$P_2 - P_1 = \tfrac{1}{2}\rho v_1^2 - \tfrac{1}{2}\rho v_2^2$$

$$\Delta P = \tfrac{1}{2}\rho(v_1^2 - v_2^2)$$

The value of v_2 is unkown. Use the Equation of Continuity.

$$A_1 v_1 = A_2 v_2$$

$$v_2 = \frac{A_1 v_1}{A_2}$$

$A_2 = 1.7 A_1$

$$v_2 = \frac{\cancel{A_1} v_1}{1.7\cancel{A_1}}$$

$$v_2 = \boxed{\frac{v_1}{1.7}}$$

0.235 m/s

$$\Delta P = \tfrac{1}{2}\rho\left(v_1^2 - \left(\frac{v_1}{1.7}\right)^2\right)$$

$$\Delta P = \tfrac{1}{2}(1060)\left((0.40)^2 - \left(\frac{0.40}{1.7}\right)^2\right)$$

$$\Delta P = 55 \text{ Pa}$$