Physics 131- Fundamentals of Physics for Biologists I

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Waves inside cells
Waves are **biochemical and mechanical**

Outline

- Quiz 6
- Pressure
- Archimedes Principle

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Kinds of Matter

- Classify objects by how they deform and flow when forced!

  - *Solid*: the amount of deformation depends on the applied force. If you stop applying a force, the solid reverts back to its original shape
    - » Where have we seen a force that depends on the amount of deformation?

  - *Fluid*: the speed of flow depends on the applied force. A fluid stops deforming if you stop applying a force but it doesn't revert back. Fluids have no shape on their own. Flow to fill a container. (Liquid: Constant volume; Gas: Volume can change)
    - » Where have we seen a force that depends on the flow speed

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Complex Materials

- Sand   http://www.youtube.com/watch?v=f2XQ97XHjVw

- Gel   http://www.youtube.com/watch?NR=1&v=w 40JgaKNihY&feature=endscreen

Generally have a mixture of fluid and solid characteristics

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Static fluids

■ Somehow the forces balance?

■ Last lecture: momentum conservation
   for each collision implies that the
   momentum of a sack full of gas or liquid
   is conserved
   – Also implies that the net force is zero if
      there is other gas or liquid around the sack

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Foothold ideas: Pressure

■ At a boundary or wall, the pressure in a constrained
   fluid creates a force perpendicular to the surface.

$$\vec{F} = p\vec{A}$$

■ The constrained fluid has an internal pressure, meaning
   that it would create a force against any surface placed
   anywhere inside the fluid in any orientation.

■ The pressure in a fluid increases with depth. (Why?)

$$p = p_0 + \rho g d$$

■ When immersed in a fluid, an object feels an (upward)
   force equal to the weight of the displaced fluid.
   (Archimedes' Principle)

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Reading questions

- Area as a vector $\quad \vec{F} = p\vec{A}$

- Could also write it with a dimensionless unit vector indicating the direction:

$$\vec{F} = pA\hat{n}$$
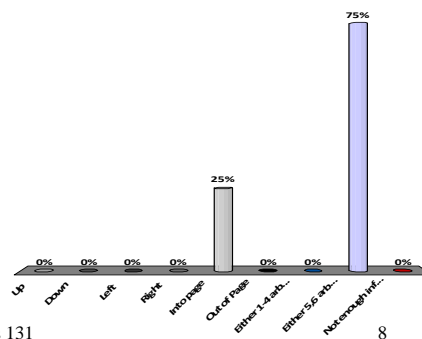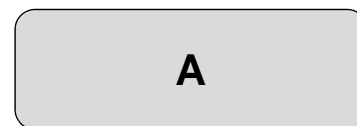
- But what is the direction of an area?

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Direction of area unit vector

1. Up
2. Down
3. Left
4. Right
5. Into page
6. Out of Page
7. Either 1-4 arbitrary
8. Either 5,6 arbitrary
9. Not enough information

A

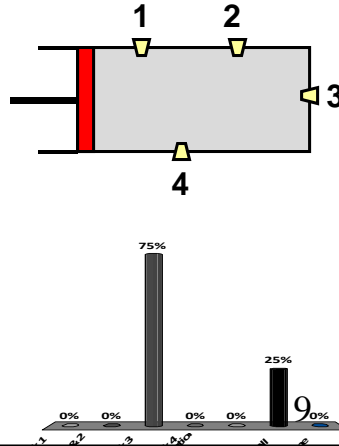10/31/2012   Physics 131   8

A cylinder with a movable piston is filled with a uniform fluid. If the corks are all in equally tightly, which are most likely to pop when we push down on the piston?

1. Cork 1
2. Corks 1 & 2
3. Cork 3
4. Cork 4
5. Some other combination
6. All
7. None

1   2

3

4

75%

25%

0%   0%   0%   0%   0%

Pascal's Principle

A force exerted on a part of a fluid is transmitted through the fluid and expressed in all directions.

$$\frac{W_1}{A_1} = \frac{W_2}{A_2}$$

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