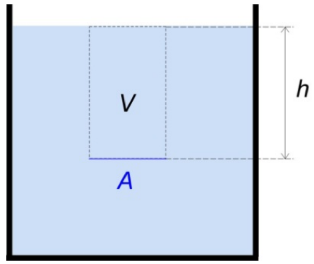
Fluid mechanics

1

The hydrostatic pressure



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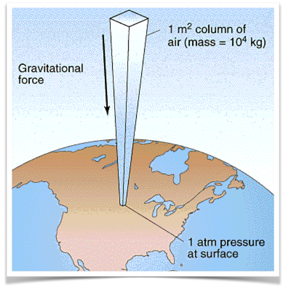
3

Atmospheric pressure



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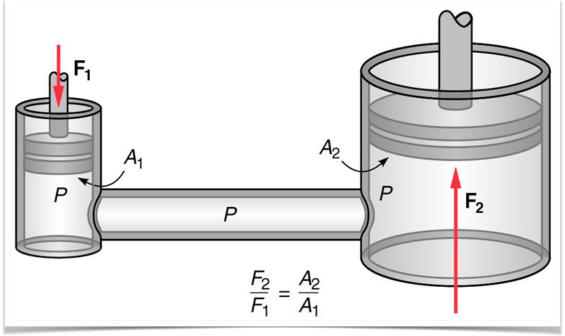
The hydraulic jack (Pascal's principle)

In a fluid at rest in a closed container, a pressure change in one part is transmitted without loss to every portion of the fluid and to the walls of the container.



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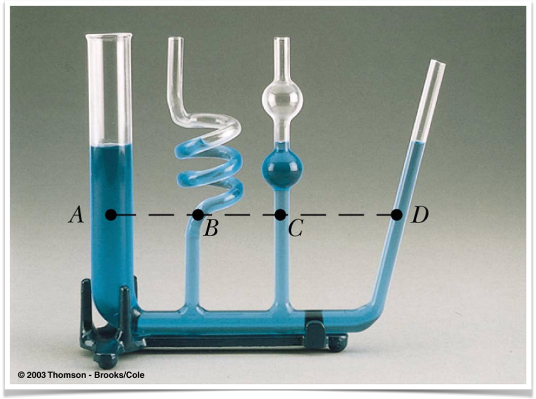
The hydrostatic paradox



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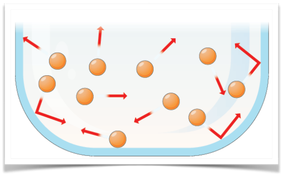
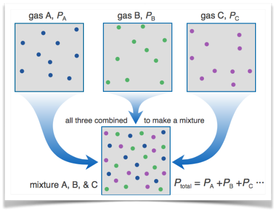
Pressure of gasses



Partial pressure



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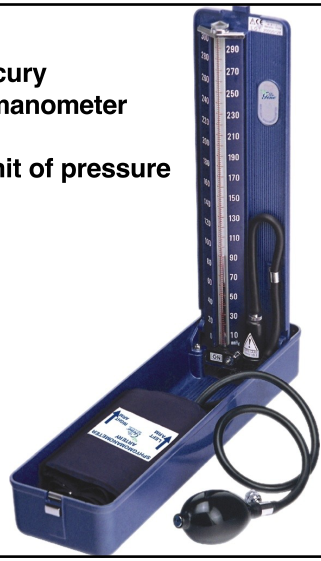
mercury sphygmomanometer

mmHg as a unit of pressure



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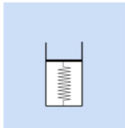
Problem 6/8

Problem 6/9

8. The figure shows a device for a simple pressure measurement. The small cylinder has vacuum inside and its top is sealed with a light piston. The piston is connected to the bottom of the cylinder with a spring. If we place this device in vacuum, then the spring will be uncompressed. The cross-sectional area of the piston is 2 cm^2, and the spring constant is $4 \cdot 10^3$ N/m.



a) When this device is placed in the atmosphere, the compression of the spring is 5.1 mm. Calculate the atmospheric pressure!
b) Calculate the compression of the spring if we place the device to the bottom of a 10-m-deep pond, that has a temperature of 4 °C! Assume that the atmospheric pressure is the same as in part a).

9. Calculate the hydrostatic pressure generated by blood in the foot of a standing man. Density of blood is 1.05 g/cm^3 and the height of the man is 170 cm.

9

Oscillations

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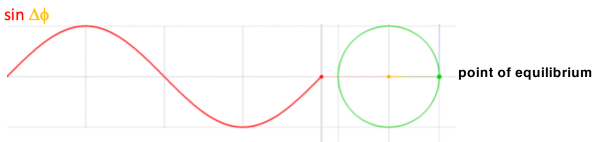
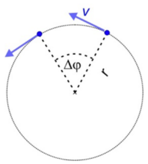
OSCILLATION : Another perspective of circular motion

sin 0° = 0
sin 30° = 0.5
sin 90° = 1



https://en.wikipedia.org/wiki/Sine

$$y = A \cdot \sin(\omega \cdot t + \varphi_0)$$



phase

$$\varphi = \omega \cdot t$$

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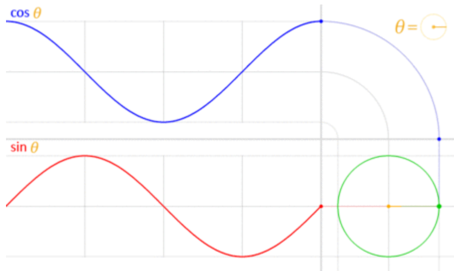
$$v = \omega \cdot A \cdot \cos(\omega \cdot t + \varphi_0)$$

$$a = -\omega^2 A \cdot \sin(\omega \cdot t + \varphi_0)$$



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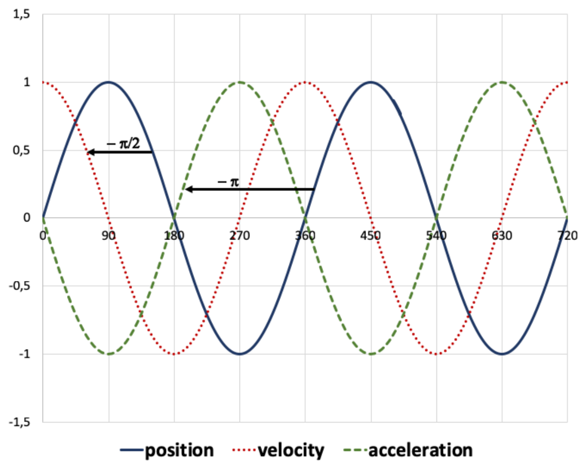

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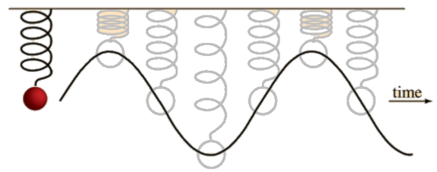
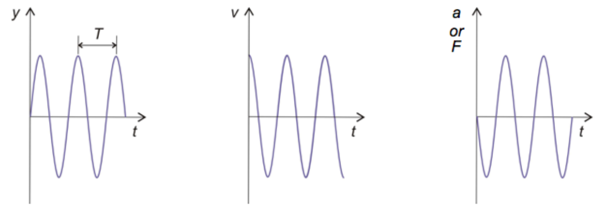
Simple harmonic oscillation

Restoring force is proportional to displacement

$f = \frac{1}{T}$



$\omega = 2\pi \cdot f$



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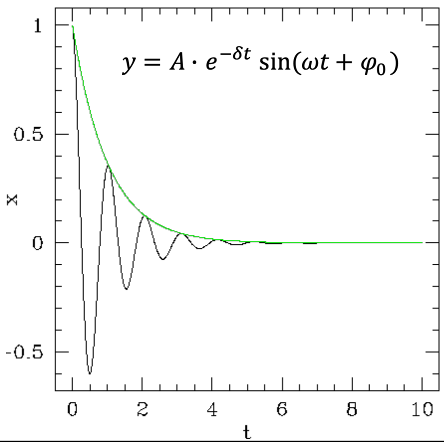
Damped oscillation



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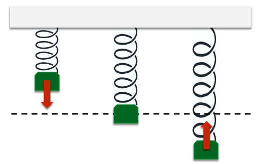
Eigenfrequency (natural frequency)

$F = ma = -m\omega^2 A \cdot sin(\omega \cdot t + \varphi_0) = -m\omega^2 y$



$F_{elastic} = -k \cdot y \qquad F_{restoring} = -m\omega^2 y$

$k = m \cdot \omega^2$

$f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

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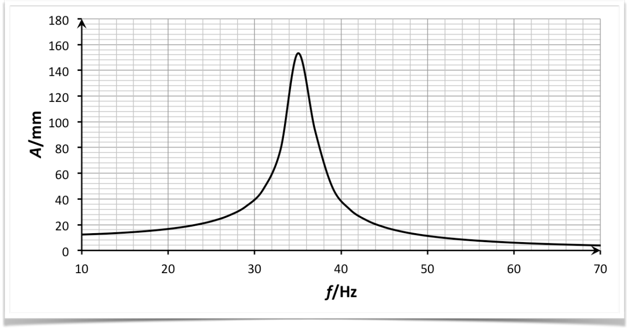
Resonance curve



Problem 7/15

15. We suspend a ball of 0.4 kg on a vertically positioned spring with a spring constant of 60 N/m. Upon releasing the ball the system undergoes harmonic oscillation.
a) Calculate the amplitude of the oscillation!
b) Calculate the period of the oscillation!

16. Which of these figures show damped oscillation?