الملف حل مراجعة نهائية وفق الهيكل الوزاري

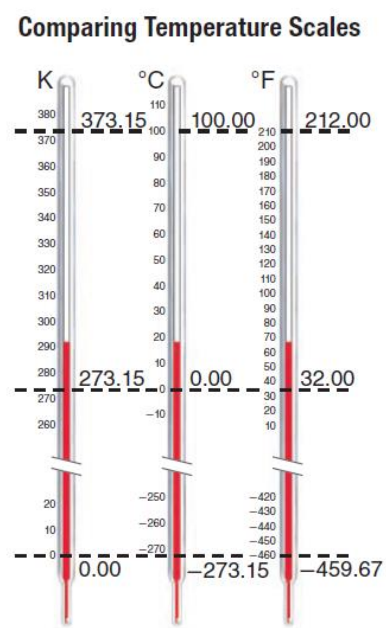
Physics

G11 general 2022-2.23

- ***Differentiate between the three temperature scales: Celsius, Fahrenheit, and Kelvin scales including freezing and boiling points of water.***

there are three scales **Kalvin** , **Celsius** and **Fahrenheit** . see the figure **.to convert from one to another you can use this equation** $T_k = T_c + 273$

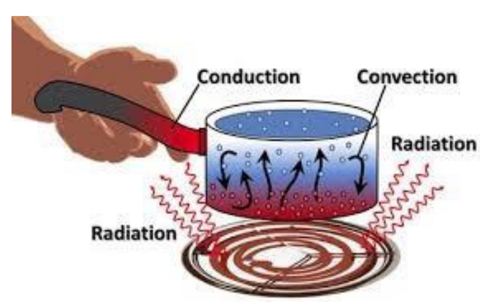
What is the freezing point of water in
……………..ºK…………..℃…………….℉
What is the boiling point of water in
…..………… ºK…………..℃…………….℉



- ***Define and describe thermal energy transfer by convection and by radiation and identify common occurrences of thermal energy transfer processes (conduction, convection, and radiation)***

The three ways of heat transfer

conduction	convention	radiation
in solid, liquid or gas (in contact)	in liquid and gas only	no matter, by electromagnetic waves . like Sun heat
particles not move	particles move up then down	electromagnetic waves (IR)



This equation calculate the **heat** Q required to change the temperature of an object

$$Q = m\,C\,\Delta T$$
$$Q = m\,C\,(T_f - T_i)$$

Q: heat …J

m : mass …..kg

C : specific heat capacity ……J/(kg.K)

△T : difference in temperature … ºK

Tf : final temperature …. ºK , Ti : inertial temperature … ºK

example : A 5.10-kg cast-iron skillet is heated on the stove from 295 K to 373 K. How much thermal energy had to be transferred to the iron?. The specific heat of iron is 450 J/(kg.K)

KNOWN *UNKNOWN*

m=5.10 kg C=450 J/(kg·K) Ti =295 K Tf =373 K Q=?

……

- ***Define the term specific heat (C) and specify its unit (J/(kg.K), Apply the equation Q = mCΔT to solve relevant problems.***

Specific Heat Capacity

Heat and temperature are related to the **specific heat capacity** of a material.

Specific heat capacity (*C*) is the amount of energy that must be added to 1 kg of a material to increase its temperature by 1 **kelvin** (1 K). Its SI unit is **J/(kg.K).**

EXAMPLE PROBLEM 1

HEAT TRANSFER A 5.10-kg cast-iron skillet is heated on the stove from 295 K to 373 K. How much thermal energy had to be transferred to the iron?

KNOWN UNKNOWN Q = ?

m = 5.10 kg C = 450 J/(kg·K)

T_i = 295 K T_f = 373 K

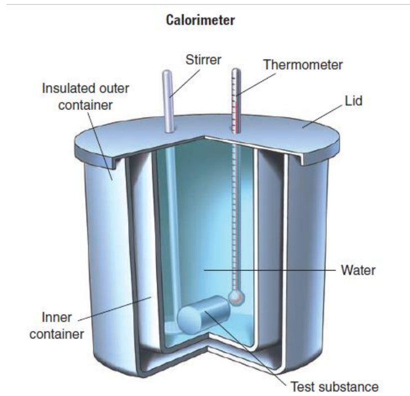
SOLVE FOR THE UNKNOWN

$Q = m\,C\,(T_i - T_f)$

$= (5.10)(450)(373 - 295) = 1.8\times10^5$ J

- **Explain how a simple calorimeter can be used to measure the specific heat capacity of a Substance.**

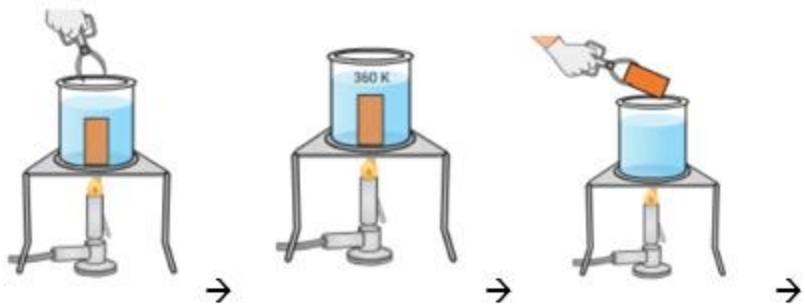
calorimeters and how specific heat is measured

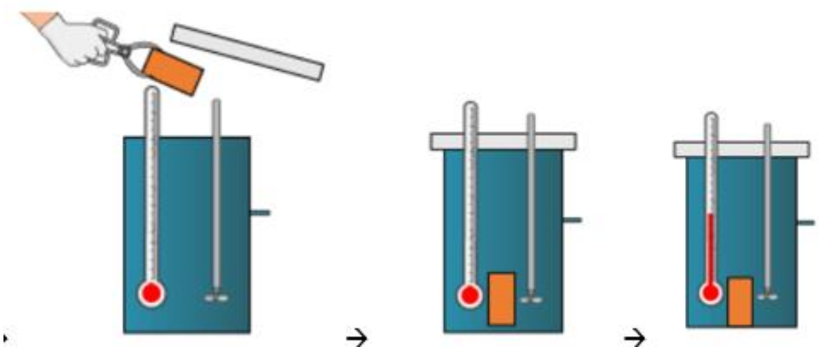


A **calorimeter** is an instrument used to measure the specific heat capacity of a substance.

How a Calorimeter Works

1. The temperature of a known mass of water is taken.
2. The sample with a known mass is heated to a given temperature.
3. The sample is placed in the calorimeter quickly and the lid is closed tightly.
4. The water is stirred to reach thermal equilibrium between the sample and water.
5. The new water temperature (now also sample temperature) is measured at equilibrium.





The equation for specific heat capacity of a test object (C_A) is derived from the specific heat capacity of water (C_B), their masses (m_A and m_B) and their changes in temperature (ΔT_A and ΔT_B).

$$C_A = \frac{m_B C_B \Delta T_B}{m_A \Delta T_A}$$

Example

A metal alloy test sample with a mass of 0.2 kg, at a temperature of 373 K, is put in a calorimeter. The calorimeter has 1 kg of water at a temperature of 283 K. If the final temperature is 285 K, what is the specific heat capacity of the unknown metal alloy sample? The specific heat capacity of water is 4,180 J/(kg.K).

m_B	1 kg
C_B	4,180 J/(kg.K)
T_B	283 K
T_f	285 K
T_A	373 K
m_A	0.2 kg
C_A	?

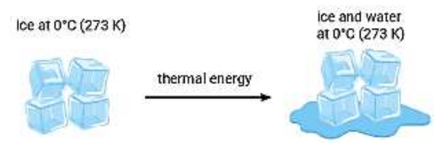
$$C_A = \frac{-m_B C_B (T_f - T_B)}{m_A (T_f - T_A)}$$

$$C_A = \frac{-(1\ \text{kg})\ (4{,}180\ \text{J/kg.K})\ (285\ \text{K} - 283\ \text{K})}{(0.2\ \text{kg})\ (285\ \text{K} - 373\ \text{K})}$$

$$C_A = 475\ \text{J/(kg.K)}$$

- ***Show that the heat required to melt a solid is equal to the mass of the solid times the heat of fusion of the solid (Q = mHf)***

Heat of fusion (***H_f***) is the amount of thermal energy needed to melt 1 kg of solid material at its melting point.



Its SI unit is joules per kilogram (J/kg).

at melting point the temperature does not change , the added thermal energy absorbed to change state.

Heat of fusion is also the heat taken away during freezing.

HEAT required to **melt** a solid **Q= m Hf**

Relate the changes of state to the heats of fusion and vaporization, while the temperature remains constant.

Heat of vaporization (Hv) : The thermal energy needed to vaporize 1 kg of a liquid. (its unit J/kg)
HEAT required to **vaporize** a liquid **Q = m Hv**

at evaporization point the temperature does not change , the added thermal energy absorbed to change state.

- ***Use energy diagrams to show the energy transfers and transformations in a refrigerator.***

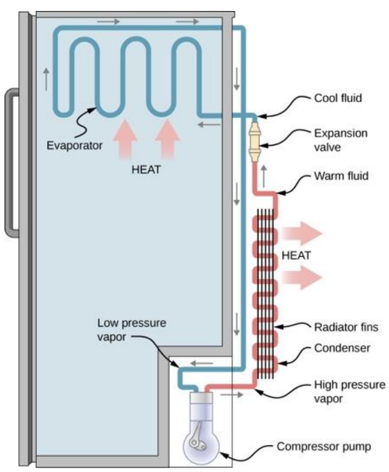
Refrigerators

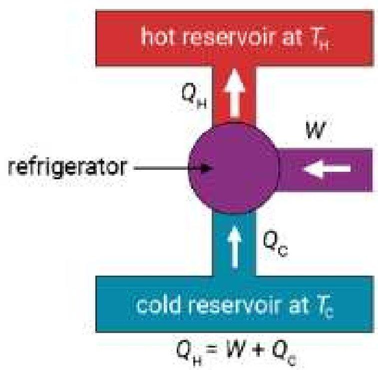
A fridge is a type of heat engine. It takes heat from a cooler object and transfers it to a warmer object.

- Fridges have a compressor that condenses the gas into a liquid.
- The heat is lost to the air in the kitchen.
- The liquid pumped inside the pipes of the fridge and allowed it to expand into a gas.

This cools the gas and the cold gas takes heat out of the fridge, cooling it.

Fridges move heat from low temperature to high temperature. They have to do work to do this. Work (W) is done by the compressor. Which transfers thermal energy from cold (T_C) to hot (T_H).

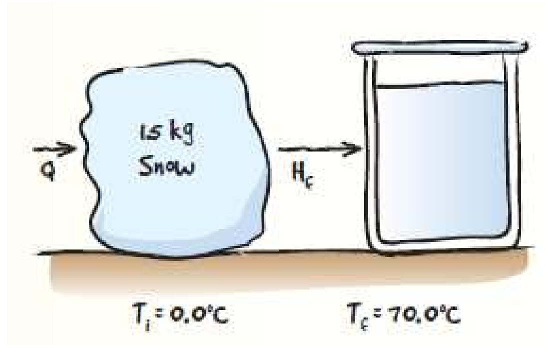




Identify that if a heat transfer Q takes a substance across a phase-change temperature, the transfer must be calculated in steps:
(a) a temperature change to reach the phase change temperature,
(b) the phase change, and then
(c) any temperature change that moves the substance away from the phase-change temperature.

Example problem
Suppose that you are camping in the mountains. You need to melt 1.50 kg of snow at 0.0°C and heat it to 70.0°C to make hot cocoa. How much heat will you need?

KNOWN
m = 1.50 kg $H_f = 3.34\times10^5$ J/kg $T_i = 0.0°C$ $T_f = 70.0°C$ C = 4180 J/(kg·K)
UNKNOWN $Q_{melt\ ice} = ?$ $Q_{heat\ liquid} = ?$ $Q_{total} = ?$



a. Calculate the heat needed to melt ice.

$Q_{\text{melt ice}} = m H_f$

$= (1.50 \text{ kg})(3.34\times10^{5} \text{ J/kg})$

$= 5.01\times10^{5} \text{ J} = 5.01\times10^{2} \text{ kJ}$

Calculate the temperature change.

$\Delta T = T_f - T_i$

$= 70.0°C - 0.0°C = 70.0°C$

b. Calculate the heat needed to raise the water temperature.

$Q_{\text{heat liquid}} = mC\Delta T$

$= (1.50 \text{ kg})(4180 \text{ J/(kg·K)})(70.0°C)$

$= 4.39\times10^{5} \text{ J} = 4.39\times10^{2} \text{ kJ}$

c. Calculate the total amount of heat needed.

$Q_{\text{total}} = Q_{\text{melt ice}} + Q_{\text{heat liquid}}$

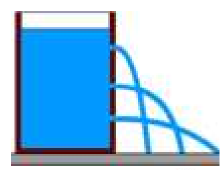
$= 5.01\times10^{2} \text{ kJ} + 4.39\times10^{2} \text{ kJ}$

$= 9.40\times10^{2} \text{ kJ}$

- ***Recall Pascal's principle and apply it to the hydraulic system.***

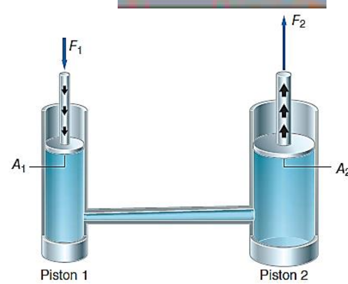
Pascal's principle

Pascal found that the pressure at a point in a fluid depends on its depth in the fluid and is unrelated to the shape of the fluid's container.
He also noted that any change in pressure applied at any point on a confined fluid is transferred undiminished throughout the fluid, a fact that is now known as Pascal's principle.



FORCE EXER TED BY A HYDRAULIC LIFT

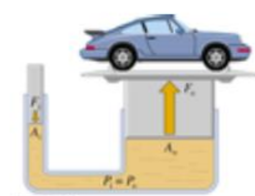
The force exerted by the second piston is equal to the force exerted by the first piston multiplied by the ratio of the area of the second piston to the area of the first piston.



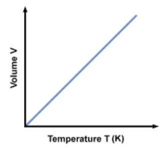
$$F_2 = F_1 \frac{A_2}{A_1}$$

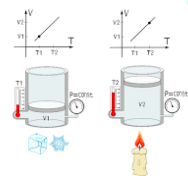
Problem

A mechanic exerts a force of 55 N on a 0.015 m^2 hydraulic piston to lift a small automobile. The piston the automobile sits on has an area of 2.4 m^2. What is the weight of the automobile?



- ***. State Charles's law as V/T = constant or)V1/T1 = V2/T2, at constant pressure where T is measured in Kelvin.***

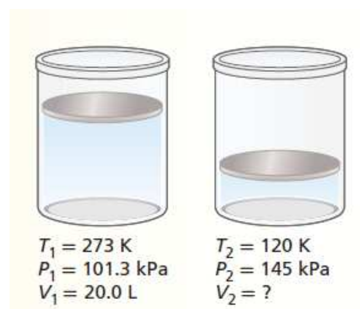




Charles's law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ **(at constant pressure)**

Q- gas sample is heated up, the volume will ……… (increase , decrease, not change)

- ***State and apply the ideal gas law (PV = nRT), where P is the pressure in pascals, V is the volume in cubic meters, n is the number of moles, R is a constant, and T is the temperature in Kelvins***



Example GAS LAWS A 20.0-L sample of argon gas at 273 K is at atmospheric pressure (101.3 kPa). The temperature is lowered to 120 K, and the pressure is increased to 145 kPa. (R=8.31 Pa·m 3)
a. What is the new volume of the argon sample?
b. Find the number of moles of argon atoms in the argon sample.
c. Find the mass of the argon sample. The molar mass (M) of argon is 39.9 g/mol.

a. Use the combined gas law and solve for V 2

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{101.3 \times 20.0}{273} = \frac{145 \times V_2}{120}$$ → V2 = 6.1 L

b. Use the ideal gas law, and solve for n.

P V = n R T

101.3 x 20.0 = n x 8.31 x 273 → n = 0.893 mol

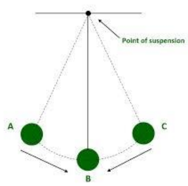
c. Use the molar mass to convert from moles to mass

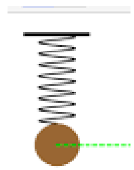
m = Mn

m= 39.9 x 0.893 = 35.6 g

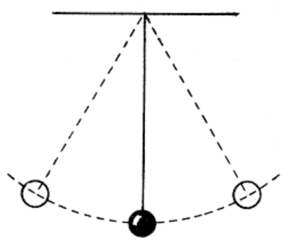
Define simple harmonic motion

Any system in which the force acting to restore an object to its equilibrium position is directly proportional to the displacement of the object shows **simple harmonic motion**





Relate, for small-angle oscillations of a simple pendulum, the period (and frequency) to the length of the pendulum.



The period of a pendulum $$T = 2\pi\sqrt{\frac{l}{g}}$$

Notice that the period T depends only on the **length** l of the pendulum and the **gravitational field g**.

Example problem

A pendulum with a length of 36.9 cm has a period of 1.22 s. What is the gravitational field at the pendulum's location?

KNOWN ℓ = 36.9 cm T = 1.22 s UNKNOWN g = ?

SOLVE

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$1.22 = 2\pi\sqrt{\frac{36.9\times10^{-2}}{g}} =$$

g = 9.78 N/kg

problem , What is the period on Earth of a pendulum with a length of 1.0 m? (g=9.8)

$$T = 2\pi\sqrt{\frac{l}{g}} = 2\pi\sqrt{\frac{(\ldots\ldots)}{(\ldots\ldots)}} = \cdots\ldots$$

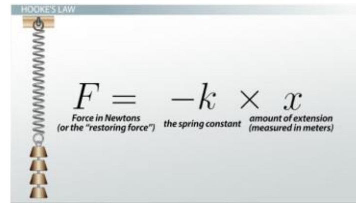
-=---------------------------------

Taher

Calculate, from a force-extension graph for a spring, the slope as the spring constant and the area under the curve as the elastic potential energy for the spring.

- **Hooke's law** *The magnitude of the force exerted by a spring is equal to the spring constant times the distance the spring is stretched or compressed from its equilibrium position*

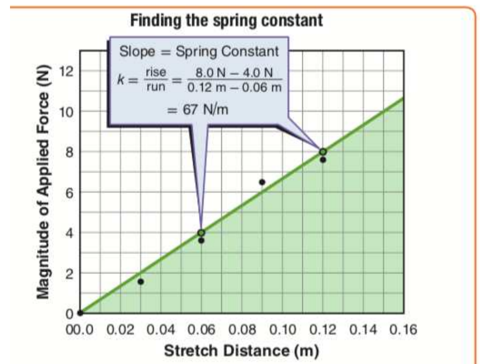
$$F = -kx$$



The spring constant (k) has the same units as the **slope**, newton/meter (**N/m**)

Potential energy in a spring $PE_{spring} = \frac{1}{2}\ k\ x^2$

- **Or** find the **area of the triangle** in graph (F- x)



Question Force magnitude-versus-length data for a spring are plotted on the graph in Figure 22.

a. What is the spring constant of the spring?

$Slope = k = \frac{12.0-4.0}{0.60-0.20} = 20\ N/m$

b. What is the spring's potential energy when it is stretched to a length of 0.50 m?

spring's potential energy = area under graph (from 0 to 0.50)

P.E. = Area = 0.5x 0.50 x 10.0 = 2.5 J

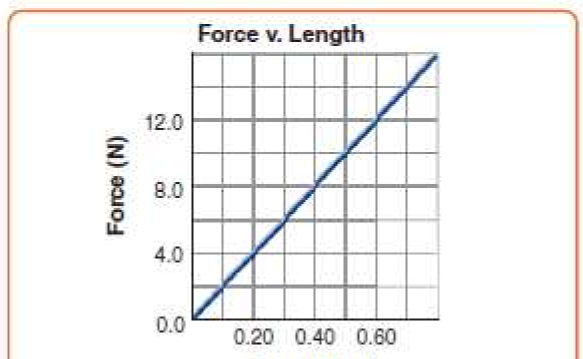
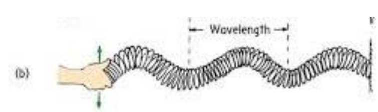


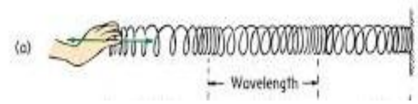
Figure 22

Describe how the phase difference between two transverse waves (with the same amplitude and wavelength) can result in fully constructive interference, fully destructive interference.

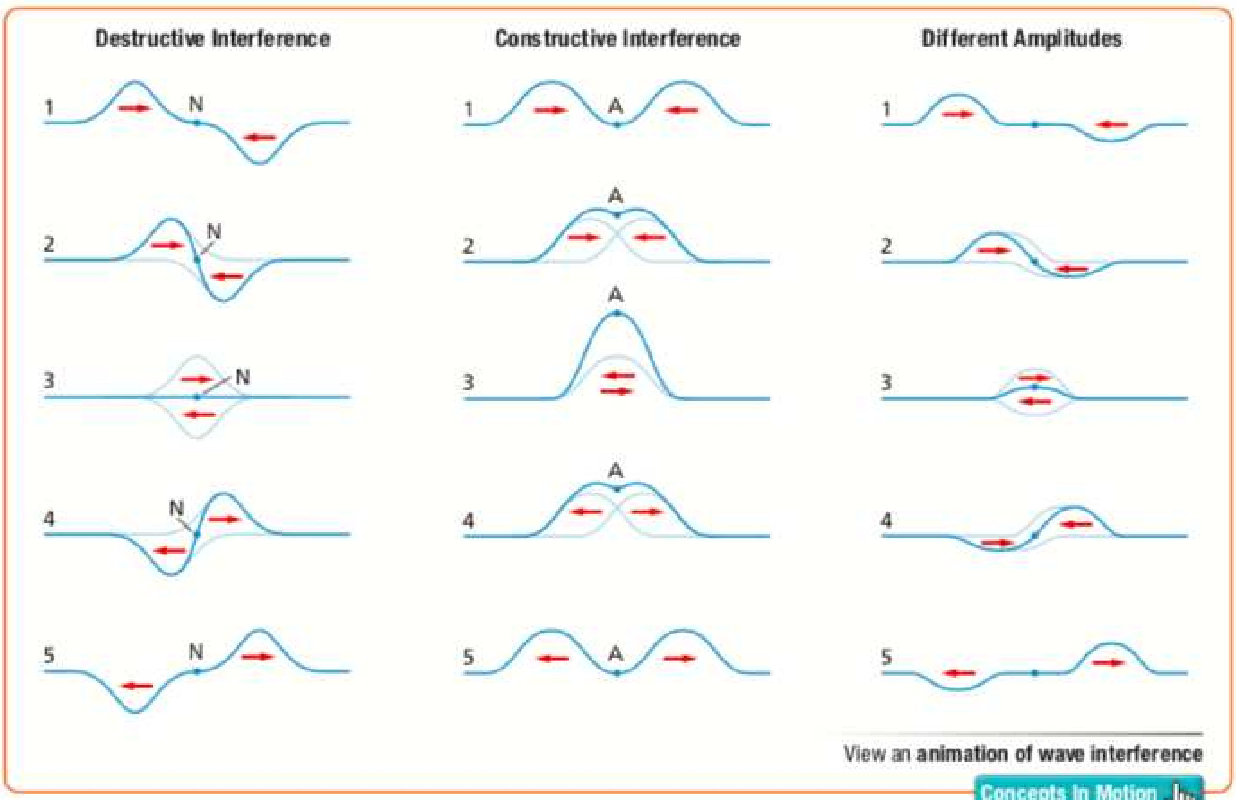
- **transverse wave :** A wave that disturbs the particles in the medium perpendicular to the direction of the wave's travel.



- **longitudinal wave :** the disturbance is parallel to the direction of the wave's travel.

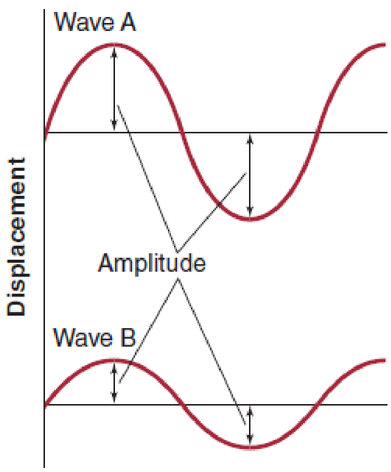


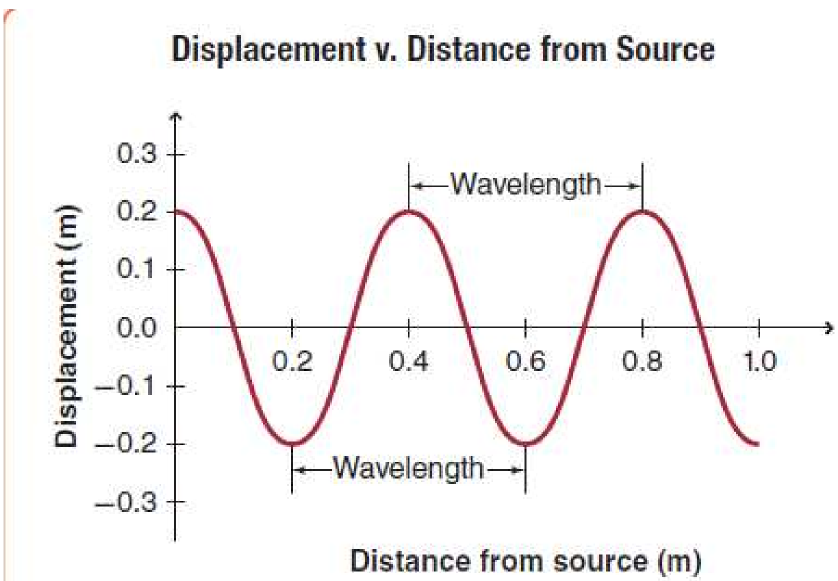
-



Use the displacement versus distance and displacement versus time graphs to find the wave properties like wavelength, period, frequency, amplitude, and speed.

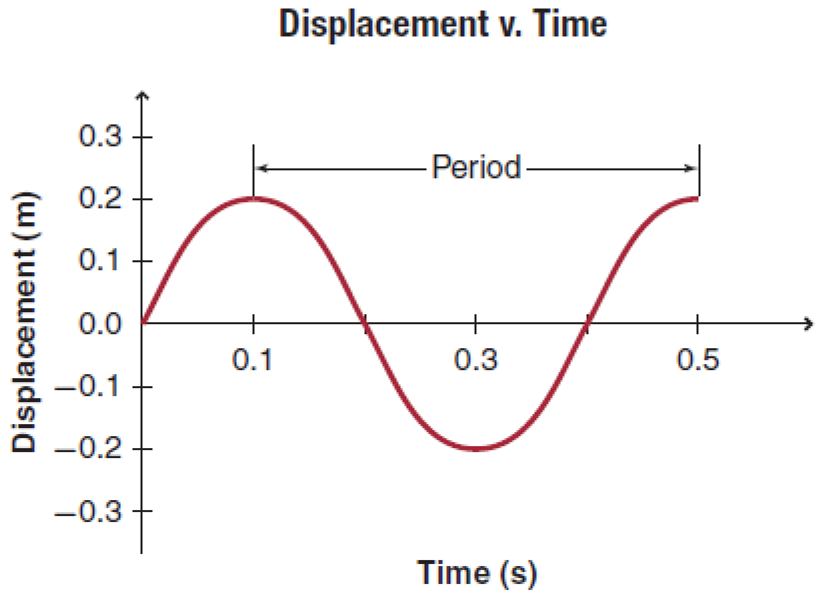
Figure 9 A wave's amplitude is measured from the equilibrium position to the highest or lowest point on the wave.





From the graph find the wavelength $\lambda = 0.80 - 0.4 = 0.4$

find the amplitude A=…0.2 m

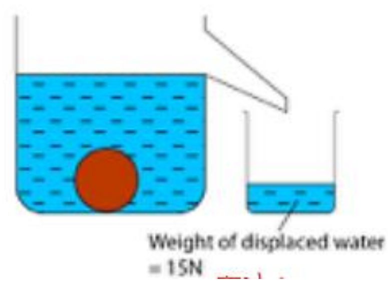


From the graph find the period , frequency

Period T= 0.5- 0.1 = 0.4 s

Frequency f = 1/T = 1/ 0.4 = 2.5 Hz

Archimedes' Principle



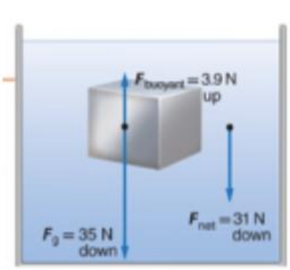
states that an object immersed in a fluid has an upward force on it that is equal to the weight of the fluid displaced by the object. The force does not depend on the weight of the object, only on the weight of the displaced fluid.

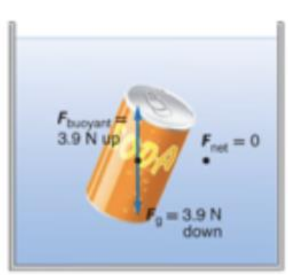
Sink or Float ?

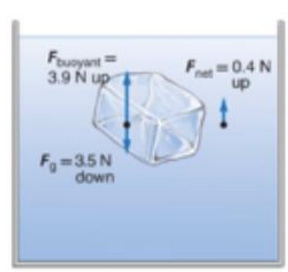
The difference between the buoyant force and the object's weight determines whether an object sinks or floats.

Sinking Neutral Floating

$F_{Buoyant} <$ weight $F_{Buoyant} =$ weight $F_{Buoyant} >$ weight



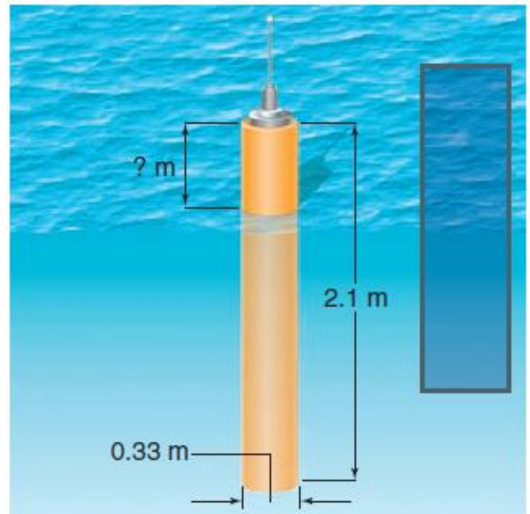




Buoyant Force

Buoyant force $F_{Buoyant} = \rho_{flouid} V g$

72. Oceanography As shown in Figure 27, a large buoy used to support an oceanographic research instrument is made of a cylindrical, hollow iron tank. The tank is 2.1 m in height and 0.33 m in diameter. The total mass of the buoy and the research instrument is about 120 kg. The buoy must float so that one end is above the water to support a radio transmitter. Assuming that the mass of the buoy is evenly distributed, how much of the buoy will be above the waterline when it is floating?



jure 27

Buoyant force = weight

Buoyant force = ρ V g

120x 9.8 = 1000 x V x 9.8

V= 0.12 m3

Volume of submerged part is

Volume of Cylinder =π r² h

0.12 = 3.14 x (0.33 /2) h

h= 0.23 m