

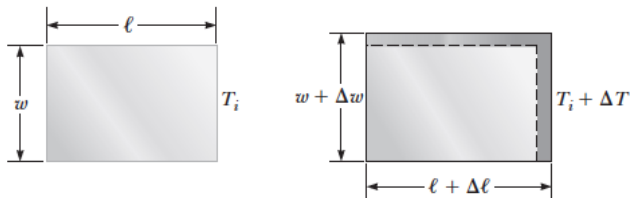
RELEASED DATE: SEPT 17

ONLINE DUE DATE: OCT 1 11:00PM

Students should work out the solutions on paper before attempting their assignment online. The Brightspace Assignment it will open on Sept 23. Please be advised that for some problems students might be asked to submit full in form of a scanned document.

Question 1

The rectangular plate shown above has an width of 6cm and length of 8cm at temperature of 17°C. The plate is made of metal with the thermal expansion coefficient $\alpha = 1.5 \times 10^{-6} / ^\circ\text{C}$. What is the final area of the plate when the temperature increases from 17°C to $T = 57^\circ\text{C}$?



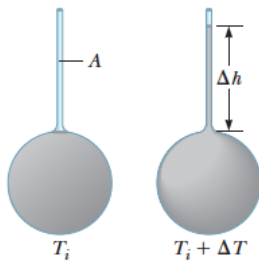
Question 2

A mercury thermometer is constructed as shown above. The glass capillary tube has a diameter of 0.00400 cm, and the bulb has a diameter of 0.250 cm. Find the change in height of the mercury column that occurs with a temperature change of 20°C.

Linear expansion coefficient of glass is $4 \times 10^{-6} (^\circ\text{C})^{-1}$

Volumetric expansion coefficient of mercury is $180 \times 10^{-6} (^\circ\text{C})^{-1}$

HINT: Assume that the dimensions of the capillary tube will not change (only the bulb experiences temperature change)



Question 3

One mole of ideal gas occupies the 22.4 liters under normal condition. What fraction of this volume is actually occupied by the ideal gas molecules? Treat the molecules as if they were perfect spheres of radius of 1 Angstrom. ($1 \text{ \AA} = 10^{-10} \text{ m}$)

Think about your result -- do you see now the validity of treating the gas molecules as point particles as well as Dalton's Law of Partial Pressures?

Question 4

The length of an aluminum pipe at 40°C is 45.0 cm. What is its length at 67°C? State your answer to nearest 0.001 cm, follow the standard rounding rules in stating answer. Take the thermal expansion coefficient of aluminum to be $24 \times 10^{-6} / ^\circ\text{C}$.

RELEASED DATE: SEPT 17

ONLINE DUE DATE: OCT 1 11:00PM

Students should work out the solutions on paper before attempting their assignment online. The Brightspace Assignment it will open on Sept 23. Please be advised that for some problems students might be asked to submit full in form of a scanned document.

Question 5

Mercury is poured into a U-tube with two cylindrical arms of different radii. Both arms are cylindrical tubes. The left arm of the tube has a radius of 10cm, and the right arm has a radius of 5cm. 200 g of water are then poured into the right arm. Given that the density of mercury is 13.6 g/cm^3 , and density of water is 1 g/cm^3 to what height h above the mercury level in the right arm, does the mercury rise in the left arm?

Question 6

At 30.0m below the surface of the sea (density = 1.025 kg/m^3), where the temperature is 4.00°C , a diver exhales an air bubble having a volume of 1.2 cm^3 . If the surface temperature of the sea is 23.0°C , what is the volume of the bubble just before it breaks the surface?

Question 7

Determine the density of oxygen at 134,000 Pa pressure and Temperature = 62°C . State your answer to nearest 0.001 kg/m^3 , follow the standard rounding rules in stating answer, and do not attempt to write the units. Take the molar mass of molecular oxygen to be 32 g/mol , $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ and take the absolute zero to be -273°C .

Question 8

A diving bell in the shape of a cylinder with a height of 2.50 m closed at the upper end and open at the lower end. The bell is lowered from air into the sea water of density 1.025 g/cm^3 . The air in the bell is initially at 20.0°C . The bell is lowered to a depth (measured to the bottom of the bell) of 80m. At this depth the water temperature is 4.0°C , and the bell is in thermal equilibrium with the water. (a) How high does the sea water rise in the bell? (b) To what minimum pressure must the air in the bell be raised to expel the water that entered?

Question 9

A school teacher duplicated Torricelli's barometer using a mineral oil, of density $1,290 \text{ kg/m}^3$, as the working liquid. What was the height of the oil column on the day when the atmospheric pressure value was $101,200 \text{ Pa}$

Question 10

A water heater is operated by direct solar power. If the solar collector has an area of 10 m^2 , and if the intensity delivered by sunlight is 550 W/m^2 , how long does it take to increase the temperature of $1,000 \text{ m}^3$ of water from 16°C to 64°C ? Take the water specific heat capacity to be $4186 \text{ J}/(^\circ\text{C m}^3)$. Take the density of water to be 1 g/cm^3 .

Question 11

The surface of certain star has a surface temperature of about $5,300 \text{ K}$. The radius of the star is $8.9 \times 10^8 \text{ m}$.

Firstly, calculate the total energy radiated by this star in each second.

Secondly, take the \log_{10} of the total calculated energy radiated in each second.

RELEASED DATE: SEPT 17

ONLINE DUE DATE: OCT 1 11:00PM

Students should work out the solutions on paper before attempting their assignment online. The Brightspace Assignment it will open on Sept 23. Please be advised that for some problems students might be asked to submit full in form of a scanned document.

Question 12

A 5kg block of ice at -10°C is put in the water (initial temperature 20°C) in an insulated container. How much water was there initially, if the final temperature after all of the ice melted is 16°C ?

Question 13

A 2.0-L bottle of generic soft-drink contains 12.50 g of carbon dioxide dissolved in its volume. After opening of the bottle, the evaporating carbon dioxide is trapped in a cylinder at $p=1.00\text{atm}$ at $T= 17.0^{\circ}\text{C}$, what volume does the gas occupy?

Question 14

A glass window pane has an area of 3.00 m^2 and a thickness of 0.600 cm . If the temperature difference between its faces is 25.0°C , what is the rate of energy transfer by conduction through the window?

Question 15

A 2.5 kg aluminum is heated to 92°C and then dropped into 8 kg of water at 5°C . Assuming that metal system is thermally isolated what is the system equilibrium temperature?

Question 16

A) Interstellar space, far from any stars, is filled with a very low density of hydrogen atoms (H, not H_2). The number density is about $1\text{atom} / \text{cm}^3$ and the temperature is about 3K. Estimate the pressure in interstellar space. Give your answer in Pa and in atm.

B) In the best performing vacuum systems, pressures as low as 10^{-10} Pa are being attained. Calculate the number of molecules in a 1.00-cm^3 vessel at this pressure if the temperature is 21.0°C .

C) Given the data from part A, estimate the number of collisions experienced by the spherical interstellar ship of diameter of 500m moving at the 10% of the speed of light in the interstellar space in 1second of its motion.