

1.

▼ Part A

How many atoms of hydrogen are in 150 g of hydrogen peroxide (H_2O_2)?

Express your answer as a number of atoms.

$N =$ atoms

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✖ Incorrect; Try Again; 5 attempts remaining

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2.

400 J of work is done on a system in a process that decreases the thermal energy of the system by 300 J .

▼ Part A

How much heat energy is transferred to or from the system as heat? Enter positive value if the energy is transferred to the system and negative if the energy is transferred from the system.

Express your answer in joules.

$Q =$ J

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3.

It is important for the body to have mechanisms to effectively cool itself; if not, moderate exercise could easily increase body temperatures to dangerous levels. Suppose a 70 kg man runs on a treadmill for 38 min , using a metabolic power of 1000 W. Assume that all of this power goes to thermal energy in the body.

▼ Part A

If he couldn't perspire or otherwise cool his body, by how much would his body temperature rise during this exercise?

Express your answer in degrees Celsius.

$\Delta T =$ °C

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4.

A piece of metal at 100 °C has its Celsius temperature doubled.

▼ Part A

By what factor does its kelvin temperature increase?

$\frac{(T_K)_f}{(T_K)_i} =$

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If a person has a dangerously high fever, submerging her in ice water is a bad idea, but an ice pack can help to quickly bring her body temperature down.

How many grams of ice at 0°C will be melted in bringing down a 56 kg patient's fever from 40°C to 39°C ? Express your answer in grams.

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14 J of heat are removed from a gas sample while it is being compressed by a piston that does 24 J of work.

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PART B will be sent later

Many cultures around the world still use a simple weapon called a blowgun, a tube with a dart that fits tightly inside. A sharp breath into the end of the tube launches the dart. When exhaling forcefully, a healthy person can supply air at a gauge pressure of 6.0 kPa.

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800 J of heat energy are transferred to a system that does 350 J of work.

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10.

The lowest pressure ever obtained in a laboratory setting is 4.0×10^{-11} Pa.

▼ Part A

At this pressure, how many molecules of air would there be in a 30°C experimental chamber with a volume of 0.030 m^3 ?

Express your answer as a number of molecules.

$N =$ molecules

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11.

▼ Part A

What minimum heat is needed to bring 150 g of water at 50°C to the boiling point and completely boil it away? The specific heat of water is $4190\text{ J}/(\text{kg} \cdot \text{K})$ and its heat of vaporization is $22.6 \times 10^5\text{ J/kg}$.

Express your answer with the appropriate units.

$Q =$

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12.

An ideal gas at 20°C consists of 2.2×10^{22} atoms. 1.1 J of thermal energy are removed from the gas.

▼ Part A

What is the new temperature in $^\circ\text{C}$?

Express your answer in degrees Celsius.

$T =$ $^\circ\text{C}$

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13.

A pump is used to empty a 4800 L wading pool. The water exits the 3.0-cm -diameter hose at a speed of 1.8 m/s .

▼ Part A

How long will it take to empty the pool?

Express your answer in seconds.

$t =$ s

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14.

A research submarine has a 40-cm -diameter window that is 8.8 cm thick. The manufacturer says the window can withstand forces up to $1.1 \times 10^6\text{ N}$.

▼ Part A

What is the submarine's maximum safe depth in sea water? The pressure inside the submarine is maintained at 1.0 atm .

Express your answer in meters.

$h =$ m

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15.

▼ Part A

Which has the greater density, 9 g of mercury or 5000 g of water?

- ☐ 9 g of mercury
- ☐ 5000 g of water

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There are two carotid arteries that feed blood to the brain, one on each side of the neck and head. One patient's carotid arteries are each 11.2 cm long and have an inside diameter of 5.2 mm. Near the middle of the left artery, however, is a 2.0-cm-long stenosis, a section of the artery with a smaller diameter of 3.5 mm.

For the same blood flow rate, what is the ratio of the pressure drop along the patient's left carotid artery to the drop along his right artery?

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Hydrostatic weighing, or "underwater weighing," is used to measure a patient's body composition. To do this measurement, the patient is weighed while standing on a regular scale and then weighed while immersed in water. By comparing these weights, the density and body fat percentage of a patient can be recorded. The weight of your patient on a regular scale is 600 N and while immersed in water is 90 N . The density of water is 1000 kg/m^3 and assume that $g = 10 \text{ m/s}^2$.

What is the volume of your patient?

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If you were to unknowingly use salt water ($\rho = 1025 \text{ kg/m}^3$) in place of fresh water, how would this affect your measurement of the patient's density?

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What is the specific gravity of the patient?

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If the depth at which the underwater measurements were taken was doubled, what would be the patient's apparent weight?

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Suppose that while immersed your patient breathes through a thin tube. If the maximum pressure difference your patient's lungs can manage and still breathe is 10,000 μA , what is the maximum depth to which your patient can be immersed?

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▼ **Part A**

To determine an athlete's body fat, she is weighed first in air and then again while she's completely underwater. It is found that she weighs 690 N when weighed in air and 42.0 N when weighed underwater. What is her average density?

Express your answer to four significant figures and include the appropriate units.

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A diver 50 m deep in 10°C fresh water exhales a 1.5 cm diameter bubble.

What is the bubble's diameter just as it reaches the surface of the lake, where the water temperature is 20°C ? Assume that the air bubble is always in thermal equilibrium with the surrounding water.

Express your answer in centimeters.

$d =$ cm

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At some instant, the blood pressure in the heart is 1.9×10^4 Pa. Assume the density of blood is the same as water.

What is the pressure in an artery 0.40 m below the heart, treating the blood as a nonviscous fluid?

- 2.3×10^4 Pa
- 1.5×10^4 Pa
- 1.9×10^4 Pa
- 4.0×10^3 Pa

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To explore the bottom of a 15-m-deep lake, your friend Tom proposes to get a long garden hose, put one end on land and the other in his mouth for breathing underwater, and descend into the depths. Susan, who overhears the conversation, reacts with horror and warns Tom that he will not be able to inhale when he is at the lake bottom.

Why is Susan so worried?

- The pressure at a depth of 15 m is 3.5×10^5 Pa. This is almost 3.5 times greater than atmospheric pressure. But he air pressure in the hose will be only slightly higher than atmospheric pressure, because the density of air is so low. So Tom will have great difficulty breathing in the low-pressure air when the large pressure of the water is pressing in on his chest.
- The pressure at a depth of 15 m is 3×10^5 Pa. This is almost three times greater than atmospheric pressure. But he air pressure in the hose will be only slightly higher than atmospheric pressure, because the density of air is so low. So Tom will have great difficulty breathing in the low-pressure air when the large pressure of the water is pressing in on his chest.
- The pressure at a depth of 15 m is 2×10^5 Pa. This is almost two times greater than atmospheric pressure. But he air pressure in the hose will be only slightly higher than atmospheric pressure, because the density of air is so low. So Tom will have great difficulty breathing in the low-pressure air when the large pressure of the water is pressing in on his chest.
- The pressure at a depth of 15 m is 2.5×10^5 Pa. This is almost 2.5 times greater than atmospheric pressure. But he air pressure in the hose will be only slightly higher than atmospheric pressure, because the density of air is so low. So Tom will have great difficulty breathing in the low-pressure air when the large pressure of the water is pressing in on his chest.

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