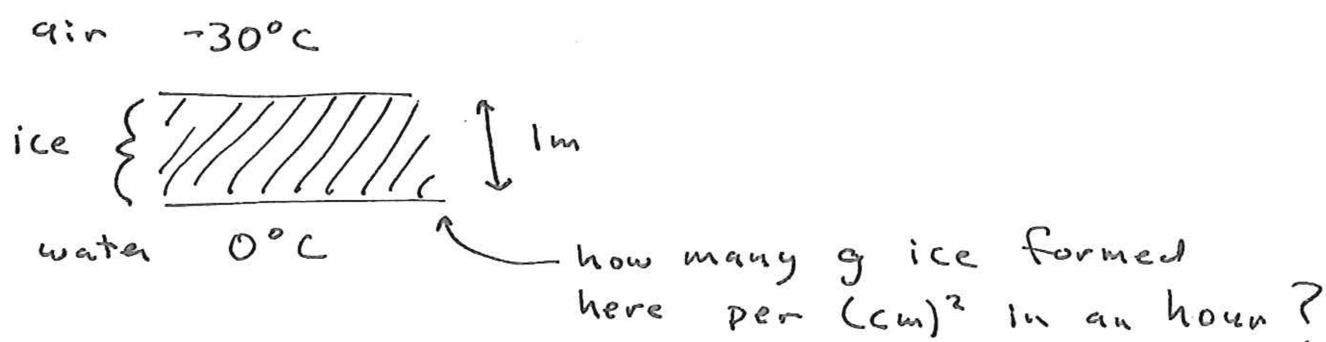
Quiz: Patrick Miles, Jessica Biser, Daniel Siers.

A certain lake during the winter has 1 m of ice on top of water at 0°C. The air temperature is −30°C. How many grams of ice are formed per $(cm)^2$ in an hour?

$K_{ice} = 5 \times 10^{-3} \frac{cal}{sec \cdot cm \cdot °C}$ $L_f = 80 \frac{cal}{g}$

Hint: find the amount of heat conducted up



$KA = \left(\frac{T_h - T_c}{L}\right) \rightarrow (.005)(1)\left(\frac{273-243}{100}\right) = .0015 \frac{cal}{s \cdot cm^2} \cdot 3600s$

$= 5.40\ cal/cm$

$5.40 = m(80)$

$m = .0675\ g/cm^2$

eye quiz points

also

Josh E, Sam K, Bobby T.

EYE Quiz

Quiz

A certain lake during the winter has 1 m

Kirsten Montray
Taylor Huston
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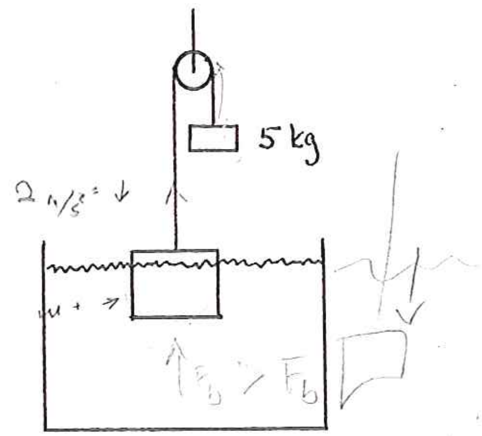
(4) A box is attached to a weight of mass 5 kg over a massless, frictionless pulley. The box has 75% of its volume submerged in a pool of water. The box has a volume of 0.1 m^3.



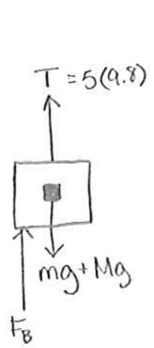
a) If the box is in equilibrium, what is its density?

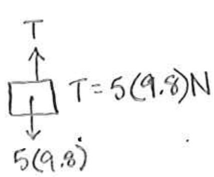
$$\frac{V_{under}}{V_{total}} = \frac{\rho}{\rho_{fluid}} \rightarrow \frac{V_{under}}{V_{total}}(\rho_{fluid}) = \rho$$

$$\frac{.075}{.1}(1000\,kg/m^3) = \boxed{750\,kg/m^3}$$

b) A mass m is now placed inside the box. The result is that the box completely submerges, and has an acceleration downward of 2 m/s^2. What is m? (Assume there is no drag on the box due to the water.)

note: $T - 5g = 5a$
$T > 5g$ as accelerated also





$$F_B = \rho_{fluid}(V_{displaced})(9.8)$$
$$= 1000\frac{kg}{m^3}(.1m^3)(9.8\frac{m}{s^2}) = 980\frac{kg\,m}{s^2} = 980N$$

$$\rho = \frac{M}{V} \quad M = V\rho = .1(750) = 75kg$$

$F = ma$

$$-T - F_B + g(M+m) = (M+m)a$$
$$-5(9.8) - 980 + g(M+m) - (M+m)a = 0$$
$$(M+m)(g-a) = 5(9.8) + 980$$
$$M+m = \frac{5(9.8)+980}{g-a} = 131.923kg$$

total − box = m

$$131.923 - 75\,kg = \boxed{56.9\,kg}$$

wrong: III

Right: ~~IIII~~ III

Chris Larsen
Sam Hurrle
Joe Fink

4. A piston contains oxygen gas at initial conditions $V = 0.12\ m^3$, $T = 320$ K, $P = 1x10^5\ N/m^2$. The total mass of the gas is 50 g. The gas then undergoes adiabatic compression to a new volume of 0.08 m^3.

a) What is the new pressure?

~~PV=nRT~~

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

$P_1 V_1^{\gamma} = P_2 V_2^{1.4}$

$\gamma = 1.4$

$P_2 = \frac{P_1 V_1^{1.4}}{V_2^{1.4}}$ $P_2 = \frac{1\times10^5 \cdot .12^{1.4}}{.08^{1.4}}$ $P_2 =$

$P_2 = 176000\ N/m^2$

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

b) How much work was done, how much heat was added, and how much did the internal energy change during the process?

$W = n \cdot C_V \cdot \Delta T$

$W = \frac{50}{16} \cdot 21.1 \cdot \left(\frac{P_2 V_2 T_1}{P_1 V_1} - T_1\right)$ (32 as O_2)

$W = 3.125 \cdot 21.1 \cdot (375 - T_1)$

~~W = 24700 J~~

W = 3630 J

Q = 0.0 J for adiabatic

$\Delta U = n C_V \Delta T$

$\Delta U = W$

~~ΔU = 24700~~

$\Delta U = 3630$ J

c) After the compression, 200 J of heat energy are added to the gas in an isothermal process. How much work is done by the gas during this isothermal process?

$Q = -W$

$-Q = W$

$-200\text{J} = W$

A flask of volume 2 liters, provided with a stopcock, contains oxygen at 300 K and atmospheric pressure. The system is heated to a temperature of 400 K with the stopcock open to the atmosphere. The stopcock is then closed and the flask is cooled to its original temperature. What is the final pressure of the oxygen in the flask? How many moles of oxygen remain in the flask?

PV = nRT initial = PV = nRT final

$(1.01\times10^5)(2L) = ?(8.314)(300K) = .081$ mol

$(1.01\times10^5)(2L) = \_\_$ mol $(8.314)(400K) = .061$ mol

60.74 mol

Final # moles

Final Pressure = 76073 Pa

sig figs!

$(P)(.002) = .061(8.314)(300)$

A bubble of air rises from the bottom of a lake, where the pressure is 3.03 atm, to the surface, where the pressure is 1.00 atm. The temperature at the bottom of the lake is 7 C and the temperature at the surface is 27 C. How much does the bubble expand in the process, i.e., what is the ratio of the volume of the bubble at the surface to the volume of the bubble at the bottom? How deep is the lake? meaning of "to the surface" unclear

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\quad P_1V_1T_2 = P_2V_2T_1$

$((3.03)(1.01\times10^5))(V_1)(27+273) = (1.0)(1.01\times10^5)(V_2)(7+273)$

$(306030)\, V_1\, (300) = (1.01\times10^5)\, V_2\, (280)$

$91809000\, V_1 = 28280000\, V_2$

$\frac{91809000}{28280000} = \frac{V_2}{V_1} = 3.25$ (ratio of volume at bottom to top. If bubble was 1 cm³ at bottom, at the top it would be 3.25 cm³)

$\Delta P = \rho g h$ $\quad 206030 = 1000 \cdot 9.8 \cdot h$ $\quad$ 21 m deep

A liter of helium under a pressure of 2 atm and at a temperature of 27 C is heated until both pressure and volume are doubled. What is the final temperature?

$\frac{PV}{T} = \frac{2P\,2V}{T_2}$ $\quad \frac{1.01\times10^5(1)}{300K} = \frac{(2.02\times10^5)(2)}{T_2}$

$T_2(336.66) = 404000$

$T_2 = 1200.02K$

sig figs!

In a certain process, 500 cal of heat are supplied to a system, and at the same time 100 joules of work are done on the system. What is the increase in the internal energy of the system?

$\Delta U = Q + W$ $\quad 500cal \times \frac{4.186J}{1cal} = 2093J = Q$

100 J work

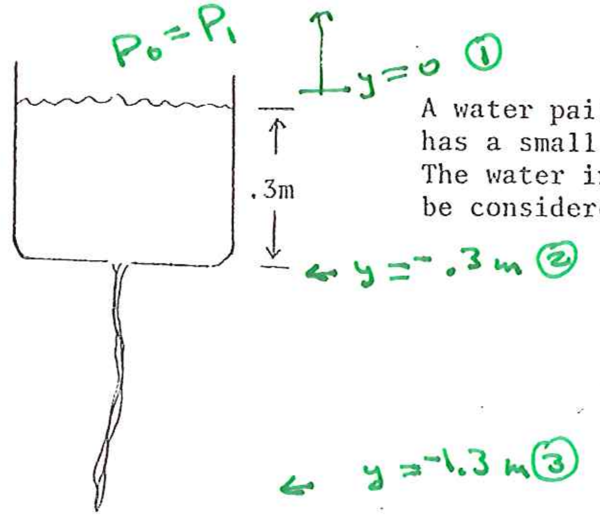
$\Delta U = 2093J + 100J = 2193J$

sig figs!

Eye Quiz Points →

Jack & Autumn

21.



A water pail, filled to a depth of .3m with water, has a small hole of area 2×10^{-4} m^2 in the bottom. The water in the region far away from the hole can be considered at rest since its velocity is negligible.

A. What is the absolute pressure of the water at the bottom of the pail? far away from the hole?

$$P_2 = P_0 + \rho g h = 1.01\times10^5 + \underbrace{1000\cdot 9.8\cdot .3}_{2940\ Pa}$$
$$= 1.04\times10^5\ Pa$$

(5)

B. What is the initial speed of the water running out of the hole? (i.e., What is its speed just beyond the hole?)

$$P_1 + \tfrac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \tfrac{1}{2}\rho v_2^2 + \rho g(-.3)$$

($P_1 \to P_0$, $v_1 \to 0$, $y_1 \to 0$, $P_2 \to P_0$)

(5)

$$\rho g(.3) = \tfrac{1}{2}\rho v_2^2$$
$$2g(.3) = v_2^2 \rightarrow v_2 = \sqrt{2\cdot 9.8\cdot .3}$$
$$= 2.42\ m/s$$

C. What is the initial flow rate?

$$A_2 v_2 = (2\times10^{-4})(2.42) = 4.85\times10^{-4}\ m^3/s$$

(4)

D. What is the cross-sectional area of water stream after the water has fallen 1 m?

$$P_1 + \tfrac{1}{2}\rho v_1^2 + \rho g y_1 = P_3 + \tfrac{1}{2}\rho v_3^2 + \rho g y_3$$

($P_1 \to P_0$, $v_1 \to 0$, $y_1 \to 0$, $P_3 \to P_0$, $y_3 \to (-1.3)$)

(6)

$$\rho g(1.3) = \tfrac{1}{2}\rho v_3^2$$
$$2g(1.3) = v_3^2 \qquad v_3 = \sqrt{2\cdot 9.8\cdot 1.3}$$
$$= 5.05\ m/s$$

$$A_2 v_2 = A_3 v_3$$
$$A_3 = A_2 \frac{v_2}{v_3} = 2\times10^{-4}\ \frac{2.42}{5.05} = 9.61\times10^{-5}\ m^2$$