Phys 111 2023

Final Review

Final Exam: Weds, 13 Dec at 8am

Covers: Entire Semester - Comprehensive

Bring: * Total of four 3"x5" cards single sided
(or equivalent area)

* Calculator ⇒ non-communicating.

Review: 2016 Final v1 All except Q11
Final v2 All except Q11

2019 Final v1 All Q
Final V2 All Q

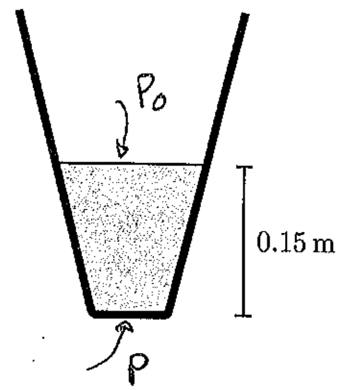
Ch 13.1 → 13.3

$\rho = M/V$ $P = F/A$ $P = P_0 + \rho g d$ $F_B = \rho_{fluid}\, g\, V_{disp}$

Quiz 1 20% - 80%

313 Beaker of mercury

A beaker with tapered sides holds mercury (density $13.6 \times 10^3\,\text{kg/m}^3$). The depth of the mercury is 0.15 m and the top is open to the atmosphere at sea-level. The area of the base of the beaker is $0.0015\,\text{m}^2$ and of the top of the mercury pool is $0.0060\,\text{m}^2$. Determine the force exerted by the mercury on the base of the beaker. *(111F2023)*



First $P = F/A$

$\Rightarrow$ $F = PA$ → area of base

So we need the pressure at the base

$$P = P_0 + \rho g d$$

and $P_0 = 1.01 \times 10^5\,\text{Pa}$ (atmospheric pressure)

$\rho = 13.6 \times 10^3\,\text{kg/m}^3$

$g = 9.80\,\text{m/s}^2$

$d = 0.15\,\text{m}$

$\Rightarrow$ $P = 1.01 \times 10^5\,\text{Pa} + 13.6 \times 10^3\,\text{kg/m}^3 \times 9.8\,\text{m/s}^2 \times 0.15\,\text{m}$

$P = 1.21 \times 10^5\,\text{Pa}$

Then $F = PA = 1.21 \times 10^5\,\text{Pa} \times 0.0015\,\text{m}^2$

$= 181\,\text{N}.$

Ch 11.3, 12.1-0 12.3, 12.5, 12.6

$n = N/N_A$ $PV = nRT$ $E = \frac{3}{2} nRT$ $K_{ave} = \frac{3}{2} k_B T$ $V_{rms} = \sqrt{\frac{3 k_B T}{m}}$

$Q = mc\,\Delta T$

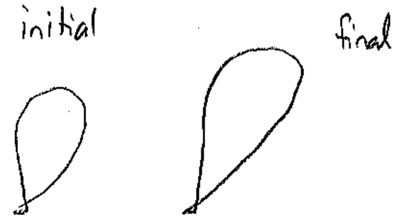
Quiz2 50-90%

: example next page

Quiz3 40%

321 Gas expansion

An ideal gas is heated at constant pressure. The temperature is initially 25° C and the volume is 3.0 L. The gas is heated at a constant pressure. Determine its volume when the temperature reaches 100° C. *(111F2023)*



Answer: $PV = nRT$ in Kelvin

n is constant. So

$$\frac{PV}{T} = nR = \text{constant}.$$

$$\Rightarrow \frac{P_f V_f}{T_f} = \frac{P_i V_i}{T_i}$$

$$V_f = \frac{P_i V_i}{T_i}\,\frac{T_f}{P_f}$$

$$= \frac{\cancel{P_i} V_i T_f}{\cancel{P_f} T_i}$$

$$= 3.0\times10^{-3}\,m^3\ \frac{373}{298}\,K$$

$$= 3.7\times10^{-3}\,m^3 = 3.7L$$

$P_i = ?$ $\quad P_f = P_i$

$V_i = 3.0L$ $\quad V_f = ??$

$= 3.0\times10^{-3}\,m^3$

$T_i = 25 + 273$ $\quad T_f = 100 + 273$

$= 298K$ $\quad = 373K.$

Ch 14.1 → 14.2 , 15.1 → 15.4

T= period (one cycle) $f = \frac{1}{T}$ (spring/mass) $f = \frac{1}{2\pi}\sqrt{\frac{k}{M}}$

pendulum $f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$

$v = \lambda f$ $v = \sqrt{\frac{T}{\mu}}$ ← tension.

Quiz 4 80% – 90%

359 Variable frequency waves on a string

A string with mass per unit length 0.0035 kg/m is stretched at a fixed tension. It is observed that a wave with frequency 220 Hz has wavelength 0.40 m.

a) Determine the wavelength of a wave with frequency 110 Hz on this string.

b) Determine the tension in the string.

Answer: a) $v = \sqrt{\frac{T}{\mu}}$ constant

$v = \lambda f =$ constant.

$v = 0.40\,m \times 220\,Hz$

$= 88\,m/s$

$v = \lambda f \Rightarrow 88\,m/s = \lambda \times 110\,Hz$

$\Rightarrow \lambda = \frac{88\,m/s}{110\,Hz} = 0.80\,m$

b) $v = \sqrt{\frac{T}{\mu}} \Rightarrow v^2 = \frac{T}{\mu} \Rightarrow v^2 \mu = T$

$\Rightarrow T = (88\,m/s)^2 \times 0.0035\,kg/m$

$T = 27\,N$