## Physics 2311. Mechanics of Solids

Exam-like questions - Ch. 17,18. Thermodynamics

- 1. Derive a temperature conversion formula between °P (on the new Pinkney scale), and Kelvin, given that  $T_{FP} = 10^{\circ}P$  and  $T_{BP} = 90^{\circ}P$ . (Recall  $T_{FP} = 273$  K, and  $T_{BP} = 373$  K.)
  - (a)  $T_K = k_1 T_P + k_2$ .
  - **(b)**  $T_P = k_1 T_K + k_2$ .
  - (c)  $T_K = AT_P + B$ .
  - (d)  $T_K = 5/4T_P 12.5$ .
  - (e)  $T_K = AT_P + 260.5$ .
- 2. If a bar of length 2 m changes its length by  $8 \times 10^{-4}$  m when its temperature changes by 18 K, what is the coefficient of thermal expansion, in  $^{\circ}C^{-1}$ , for that material?
  - (a)  $16. \times 10^{-6}$
  - (b)  $1.9 \times 10^{-6}$
  - (c)  $2.2 \times 10^{-6}$
  - (d)  $22.2 \times 10^{-6}$
  - (e)  $26.8 \times 10^{-6}$
- 3. Sauron's golden ring of power (now bereft of magical powers) has an inner diameter of 1.4213 cm at T=273 K. What is it's inner diameter at T=303 K? ( $\alpha_{Au} = 14 \times 10^{-6} k^{-1}$ )
  - (a) 1.4203 (b) 1.4213 (c) 1.4219 (d) 1.4226 (e) 1.4235
- 4. The thermometers commonly used in medical clinics which are inserted in the ear are capitalizing on the relationship between temperature and
  - (a) linear expansion
    (b) volume expansion
    (c) thermal radiation
    (d) electrical resistance
    (e) the Seebeck effect
- 5. The constant volume gas thermometer is based on the version of the ideal gas law in which these two quantities are held fixed.
  - (a) V, n (b) P, T (c) P, n (d) T, n (e) T, V
- 6. An ideal gas occupies 20 liters at  $20^{\circ}$ C and 1 atm (101,000 Pa). Its temperature is then raised to  $100^{\circ}$ C and its pressure increases to 505,000 Pa. The new volume is:
  - (a) 5.1 L (b) 6.4 L (c) 5.8 L (d) 27.2 L (e) 20. L

- 7. A sealed container contains a gas at  $30.0^{\circ}$ C, and absolute pressure 1.00 atm. To what temperature must the gas be heated for the pressure to triple to 3.00 atm? (Ignore expansion of the container.)
  - (a) 90 °C (b) 333 °C (c) 363 °C (d) 636 °C (e) 747 °C
- 8. A room filled with nitrogen gas (N<sub>2</sub>, with molar mass of 28 u) at STP has a volume of 37.5 m<sup>3</sup>. Find the mass of gas in the room. Use the fact that 1 mole of ideal gas occupies  $22.4 \times 10^{-3}m^{3}$  at STP.
  - (a) 38 kg (b) 51 kg (c) 46,900 kg (d) 47 kg (e) 5.1 kg
- 9. The mass of an oxygen molecule is 16 times that of a hydrogen molecule. At room temperature, the ratio of the rms speed of oxygen molecules to that of hydrogen molecules is:
  - (a) 16 (b) 4 (c) 1 (d) 1/4 (e) 1/16
- 10. According to the kinetic theory of gases, the pressure of a gas on a wall is most directly caused by:
  - (a) change of kinetic energy of molecules as they strike the wall
  - (b) the momentum imparted by molecules as they strike the wall
  - (c) average kinetic energy of the molecules
  - (d) force of repulsion between the molecules
  - (e) rms speed of the molecules
- 11. A system consists of N gas molecules each of mass m. Their rms speed is  $v_{rms}$ . Their total translational kinetic energy is:
  - (a)  $(1/2)m(Nv_{rms})^2$
  - (b)  $(1/2)Nmv_{rms}^2$
  - (c)  $(1/2)N(mv_{rms})^2$
  - (d)  $(1/2)mv_{rms}^2$
  - (e)  $N[(1/2)mv_{rms}]^2$