Assignment-2

Year: 2017, Semester: Fall, Course: PHY-105, Title: Physics

1. Calculate critical temperature for CO_2 gas where a=0.00874 atmos, cm^6 and b=0.0023 cm^3. The gas is at N.T.P.

2. Calculate the Van-der Waals constant for dry air, given that, T_c=132 K, P_c=37.2 atm, R per mole=82.07 cm^3 $atmosK^{-1}mol^{-1}$.

3. The Van-der Waal's constants a and b for 1 gm molecule of H_2 are a=0.245 atms-$litre^2$ mol^{-2} and b=$2.67x10^{-2}$ litre mol^{-1}. Calculate the critical temperature.

4. You are in charge of the manufacture of cylinders of compressed gas at a small company. Your company president would like to offer a 4.00 L cylinder containing 500 g of chlorine in the new catalog. The cylinders you have on hand have a rupture pressure of 40 atm. Use both the ideal gas law and the van der Waals equation with constant $a = 6.260 L^2 atm mol^{-2}$ and b=$0.0542 L mol^{-1}$ to calculate the pressure in a cylinder at 25°C. Is this cylinder likely to be safe against sudden rupture (which would be disastrous and certainly result in lawsuits because chlorine gas is highly toxic)? [N.B. Safety criteria: The ideal gas pressure must greater than 15 atm than that of Van-der Waals equation.]

5. A quantity of air at 27°C and atmospheric pressure is suddenly compressed to half its original volume. Find the final (i) pressure and (ii) temperature.

6. A certain mass of gas at NTP is expanded to three times its volume under adiabatic condition. Calculate the resulting temperature and pressure. γ for the gas is 1.40.

7. Find the efficiency of a Carnot's engine working between the steam point and ice point.

8. A Carnot's engine whose temperature of the source is 400 K takes 200 calories of heat at this temperature and rejects 150 calories heat to the sink. What is the temperature of the sink? Also calculate the efficiency of the engine and work done by the engine in each cycle. (1 cal=4.2 J)

9. A Carnot's engine whose low temperature reservoir is at 7°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of high temperature reservoir be increased?

10. Find the efficiency of an engine requiring $3x10^6$ calories of heat per horse-power hour and compare it with that of a perfect reversible engine, assuming that the source is at 1000^0C and the sink is at 0^0C.

11. An ideal gas in a cylinder is compressed adiabatically to one-third its original volume. During the process 45 J of work is done on the gas by the compressing agent: a) by how much did the internal energy of the gas change in the process? b) How much heat flowed into the gas?

12. An inventor claimed to have developed an engine working between 600 K and 300 K capable of having an efficiency of 52 %. Comment on his claim.
13. Green light of wavelength 5700 A^o from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen 200 cm away is 2 cm, find the slit separation.

14. Two coherent sources are 0.18 mm apart and the fringes are observed on a screen 80 cm away. It is found that with a certain monochromatic source of light, the fourth bright fringe is situated at a distance of 10.8 mm from the central fringe. Calculate the wavelength of light.

15. In Young's double slit experiment, the separation of the slits is 1.9 mm and the fringe spacing is 0.31 mm at a distance of 1 meter from the slits. Calculate the wavelength of light.

16. Two coherent sources of monochromatic light of wavelength 6000 A^o produce an interference pattern on a screen kept at a distance of 1 m from them. The distance between two consecutive bright fringes on the screen is 0.5 mm. Find the distance between the two coherent sources.

17. Light of wavelength 5500 A^o from a narrow slit is incident on a double slit. The overall separation of 5 fringes on a screen 200 cm away is 1 cm, calculate (a) the slit separation and (b) the fringe width.

18. In Young's double slit experiment, the separation of the slits is 0.19 mm and fringes formed on the screen held at a distance of 20 m from the slits. The 2^{nd} dark fringe is situated at a distance 10 cm from the central fringe. Calculate the wavelength of light.

19. In a Newton's rings experiment the diameter of the 15^{th} ring was found to be 0.590 cm and that of the 5^{th} ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, calculate the wavelength of light used.

20. In a Newton's rings experiment, find the radius of curvature of the lens surface in contact with the glass plate when with a light of wavelength 5890×10^{-8} cm, the diameter of the third dark ring is 3.2 mm. The light is falling at such an angle that it passes through the air film at an angle of zero degree to the normal.