Problem 78

In a biprism experiment, the distance of the 10^{th} bright band from the center of the interference pattern is 6 mm. Find the distance of the 15^{th} bright band from the center.

Problem 79

The fringe separation in a biprism experiment is 3.2×10^{-4} m when red light of wavelength 6.4×10^{-7} m is used. By how much will this change if blue light of wavelength 4×10^{-7} m is used with the same setting?

Problem 80

In a biprism experiment, the fringe width is 0.4mm, when the eyepiece is at a distance of 1m from the slit. Find the change in the fringe width, if the eyepiece is moved through a distance of 25cm towards the biprism, without changing any other arrangement.

Problem 81

In a biprism experiment, the distance between the slit and the screen is 1.0m and the distance between the images of the slit is 2.7mm. If the fringe width is 0.2mm, find the wavelength of light used.

Problem 82

In a biprism experiment, the distance between the slit and the screen is 0.8m and the two virtual sources formed by the biprism are 0.4mm apart. The wavelength of light used is 6000Å. Find the band width.

Problem 83

Calculate the distance between the second dark band and the fifth bright band on the same side of the central bright band of an interference pattern produced by coherent sources separated by 1.2mm from each other. The screen is placed at one metre from the coherent sources and the wavelength of light used is 6000Å.

Problem 84

In a biprism experiment, the slit is illuminated by a light of wavelength 5000Å. The distance between the slit and the biprism is 20cm and the distance between the biprism and the eyepiece is 80cm. If the distance between the two virtual source is 0.25cm, calculate the distance between the fifth bright band on one side of the central bright band and the sixth dark band on the other side.

Problem 85

In a biprism experiment, the distance between the two virtual images of the slit is 1.5mm and the distance between the slit and the focal plane of the eyepiece is 1metre. Find the distance between the second and the eighth dark fringe on the same side, if the wavelength of the light used is 5000Å.

Problem 71

A point P is situated at 20.1cm and 20.28cm from two coherent sources. Find the nature of illumination at the point P if the wavelength of light is 6000Å.

Problem 72

The path difference between the two identical waves arriving at a point is 85.5λ. Is the point bright or dark? If the path difference is 42.5 micrometer, calculate the wavelength of light.

Problem 73

In young's experiment, the distance between the two slits is 0.8mm and the distance of the screen from the slits is 80cm. If the fringe width is 0.6mm, find the wavelength of light.

Problem 74

In young's experiment, interference bands were produced on a screen placed at 1.5m from two slits 0.15mm part and illuminated by a light of wavelength 6500Å.U. find

(i) Fringe width and

(ii) Change in fringe width, if the screen is move away from the slit by 50cm

Problem 75

Two parallel slits 1.2mm apart are illustrated with light of wavelength 5200Å from a single slit. A screen is placed at 1.0 m from the slits. Find the distance between the fifth dark band on one side and the seventh bright band on the other side of the central bright band.

Problem 76

In a biprism experiment, the distance between the slit and the eyepiece is 80 cm and the separation between the two virtual images of the slit is 0.25 mm. If the slit is illuminated by a light of wavelength 6000 Å, find the distance of the second bright and from the central bright band.

Problem 77

In a bi prism experiment, with the distance between the slit and the screen as 0.5m and the separation between the two virtual images of the slit as 0.4 cm an interference pattern obtained with a light of wavelength λ = 5500 Å. Find the distance between the 3rd and the 8th bands on the same side of the central band.

Problem 78

In a biprism experiment, the distance of the 10th bright band from the center of the interference pattern is 6 mm. Find the distance of the 15th bright band from the center.

Problem 41

The energy arriving per unit area on the earth's surface per second from the sun is 1.34×10^{3} Wm^{-2} the average distance from the earth to the sun is 215 times as great as the sun's radius. Given that both the earth and the sun are black bodies

Stefan's constant = 5.67×10^{-8} $Wm^{-2}K^{-4}$

[redacted]

Problem 42

The amount of radiant heat received by the earth from the sun is $1.38 \times 10^{3}\, Wm^{-2}$

Suppose all these radiations on the earth are re emitted by the earth. Calculate the temperature of the earth

Given Stefan's constant

$= 5.67 \times 10^{-8}$ $Wm^{-2}\,K^{-4}$

[redacted]

Problem 43

The surface temperature of the sun is 6000K. If we consider it as a perfect black body, calculate the energy radiated by the sun per second.

Given that the radius of the sun

$= 6.92 \times 10^{8}$m and $\sigma = 5.67 \times 10^{-8}$ $Wm^{-2}K^{-4}$

[redacted]

Problem 44

The temperature of a furnace is 2324°C and the intensity is maximum in its radiation spectrum nearly at 12000A°. If the intensity in the spectrum of a star is maximum is nearly at 4800A° then calculate the surface temperature of the star

[redacted]

Problem 45

The wavelength corresponding to maximum energy for the moon is 14×10^{-6}m estimate the temperature of the moon if b = $2.884 \times 10^{-3}\, mK$

[redacted]

Problem 60

a) i) What is meant by the mean free path of a molecule

ii) Show that the mean free path of a molecule of an ideal gas at pressure p and temperature T is given by

$$\lambda = \frac{K_B T}{P\pi d^2 \sqrt{2}}$$

Where K_B is the Boltzmann's constant and d is the molecule diameter

b) i) Derive an expression for the average kinetic energy of one molecule of a gas assuming the formula for the pressure of an ideal gas.

c) A cylinder of volume 2×10^{-3} m^3 contains a gas at pressure of $1.5 \times 106Nm^{-2}$ and temperature 300K. Calculate

i) The number of moles of the gas

ii) The number of molecules the gas contains

iii) The mass of the gas if its molar mass is 320×10^{-3} Kg.

iv)The mass of one molecule of the gas

Problem 61

a) (i) Write down the van der waal's equation and define each term in its usual meaning

(ii) State the assumptions upon which the equation you have written in (a) (iii) above is derived from the ideal gas equation

b) i) On the basis of the kinetic theory of gases, shows that two different gases at the same temperature, will have the same average value of the kinetic energy of the molecules.

c) Define means free path, λ of the molecules of a gas and state hoe it is affected by temperature.

Given that γ = 1.4 for diatomic gas.

Problem 64

At 27 ^{o}C two moles of an ideal monatomic gas occupy a volume V. the gas expands adiabatically to a volume 2V. Calculate:

(i) The final temperature of the gas

(ii) The change in its internal energy

(iii) The work done by the gas during this process

Given that γ = 1.67

Problem 65

A metallic cylinder contains 10 litres of air at 3 atmospheres of pressure and temperature of 300K.

(a) If the pressure is suddenly doubled, what are the new values of volume and temperature.

(b) If the pressure is slowly doubled, what are the new values of volume and temperature.

Problem 66

(a) Define the principle molar heat capacities of a gas.

(b) Why the energy needed to raise the temperature of a fixed mass of a gas by a specific amount is greater if the pressure is kept constant than when the volume is kept constant.

(c) Find the two principal heat capacities for oxygen (diatomic molecule) whose ratio of $\frac{C_P}{C_V}$ is 1.4 at STP.

Problem 67

A quantity of oxygen is compressed isothermally until its pressure is doubled. It is then allowed to expand adiabatically until its volume is restored. Find the final pressure in terms of the initial pressure. Given that γ = 1.4

Problem 68

(a) With the help of sketch diagram distinguish between an "isothermal change" and an "adiabatic change". Illustrate your answer with an example of a gas changing from state A to state B.

(b) Argon gas (specific heat capacity ratio 1.67) is contained in a 250 cm^3 versel at a pressure of 750mmHg and a temperature of 0$^{\circ}C$. The gas is expanded isothermally to a final volume of 400cm^3

(i) Calculate the final pressure of the gas

(ii) By how much will the pressure will be lowered if the change is made adiabatically instead?

Problem 69

(a)

(i) Define mean "free path" for a molecule of a gas

(ii) How is the means free path of the molecule of a gas affected by temperature.

(b) The heat capacity C_v at constant volume for 8 moles of oxygen gas is 166.2KJ^{-1}.

Find the heat capacity at constant pressure for 8 moles of oxygen.

Problem 70

(a) What is the difference between an "isothermal process" and "adiabatic process"?

(b) How, much work is required to compress 5 moles of air at 20$^{\circ}C$ and 1 atmosphere pressure at $\frac{1}{10}$ of the original volume by:

(i) An isothermal process

(ii) An adiabatic process

(c) What are the final pressure for case (b) (i) and (b) (ii) above?

Problem 50

$0.09 gm/litre$. Find the gas constant for unit mass of hydrogen

Problem 51

The gas hydrogen has a density of 0.09g/liter at s.t.p. Find the mean square speed and hence root mean square speed of hydrogen at 42°C

Problem 52

a) List down any four assumptions of the kinetic theory of an ideal gas.

b) Determine the absolute temperature of a gas in which the average molecules of mass 8 x 10-26kg are moving with r.m.s speed of 500ms-1. Given that universal gas constant R = 8.31 $jmol^{-1}K^{-1}$ and Avogardo's number = 6.023 x 10^{23}

Problem 53

Helium gas occupies a volume of $0.04m^3$ at a pressure of 2 × 10^5pa and temperature of 300K

Calculate

a) The mass of helium

b) The r.m.s speed of its molecules

c) The r.m.s speed at 432K when the gas is heated at constant pressure to this temperature.

Problem 54

a) Derive the gas equation obeyed by a system consisting of N molecules each of mass m and mean square speed $\overline{c^2}$. Hence obtain the kinetic energy per molecule in terms of absolute temperature.

b) A vessel of volume 6 x 10-3m^3 contains nitrogen at a pressure of 2 × 10^7 pa and a temperature of 27°C. What is

i) The number of [redacted]

1. A coil of resistance 100Ω and inductance 100μH is connected in series with a 100 pF capacitor. The circuit is connected to a 10V variable frequency source.

Calculate:

(i) Resonant Frequency

(ii) Current at resonance

(iii) Voltage across L and C at resonance.

2. A circuit, having a resistance of 4Ω and inductance of 0.5 H and a variable capacitance in series, is connected across a 100V, 50 Hz supply. Calculate;

(i) The capacitance to give resonance

(ii) The voltage across inductance and capacitance.

3. A series R – L- C circuit consists of a 100 Ω resistor, an inductor of 0.318 H and a capacitor of unknown value. When this circuit is energized by √2 x 230 sin 314t volts are supply the current is found to be √2 x2.3 sin 314t find.

(i) The value of capacitor in microfarad.

(ii) Voltage across indicator

(iii) Total power consumed.

5. a) A Sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to A series L.C. R circuit in which R = 3 Ω , L = 25.48 μH and C = 796 μF . Find

i) The impendence of the circuit.

ii) The phase difference between voltage across the source and the current

iii) The power dissipated in the circuit

iv) Power factor.

b) Suppose the frequency of the source in the previous example can be varied.

i) What is the frequency of the source at which resonance occurs?

ii) Calculate the impedance the current and the power dissipate at the resonant condition.

1. What does conduction of electrons mean? Although the drift velocity of electrons is very small, the lamp lights up as soon as a switch is put on. Explain this observation.

2. A potential difference of 9.0 V is causing electrons to flow through a steel wire so that 1.0×10^{20} electrons pass through a point in the wire in 60 s. Calculate:
   (a) The charge which passes the point in 60 s
   (b) The electric current in the wire
   (c) The resistance of the wire.

3. (a) Assume that there is one free electron per atom. Calculate the number of free electrons in a piece of silver of cross-section area $1.5\times10^{-4}\ m^2$ and length 2 m. Atomic weight of silver is 108 and density of silver is $1.05\times10^4\ kgm^{-3}$.

   (b) Determine the drift velocity of electrons in a copper conductor having a cross-sectional area of $5\times10^{-6}\ m^2$ if the current is $10\ A$. (Assume that there are 8×10^{28} electrons/m^3).

4. (a) A piece of a wire has a resistance R. What will be the resistance of a wire of the same metal which is three times as long and twice as thick?

   (b) A wire of length 45.5 cm has a resistance of 0.50 Ω. What will be its resistance when it is drawn out to a length of 54.6 cm, assuming that the volume remains constant?

5. Define the temperature coefficient of resistance and explain its significance in current conduction through metals. A certain coil of wire has an electrical resistance of 24 Ω at 10 °C, and at 20 °C the resistance increases to 28 Ω. Compute the temperature coefficient of resistance for the metal of which the coil is made.

6. A copper coil has resistance of 20 Ω at 0 °C and 28 Ω at 100 °C.

   (a) What is the temperature coefficient of resistance of copper?

   (b) The wire is used in a circuit and when an *e.m.f.* of 12 V is connected across it, the power produced is 6 W. What is the temperature of the coil?

7. The heating coil of power rating 10 W is required when the *p.d.* across it is 20 V.

   (a) Calculate the length of a constantan wire needed to make the coil if the cross sectional area of the wire used is 1×10^{-7} m^2.

(b) What length of wire would be required if its diameter is a halved?

8. (a) Define the electromotive force, and explain the meaning of the internal resistance of a battery.

(b) A high resistance voltmeter reads 1.5 V when connected to the terminals of a battery. When the battery is supplying a current of 0.30 A through an external resistance R, the voltmeter reads 1.2 V. Calculate:

(i) the e.m.f. of the battery;

(ii) the value of R;

(iii) the internal resistance of the battery; and

(iv) the energy converted from chemical to electrical energy by the battery in 2.0 s.

9. The following are four electrical components:

A. Component which obeys Ohm's law;

B. Component which obeys Ohm's law but which has higher resistance than the component A;

C. Filament lamp; and

D. Component, other than a filament lamp, which does not obey Ohm's law.

(i) For each of these components, sketch current - voltage characteristics showing both positive and negative values. Use one set of axes for A and B, and separate sets of axes for C and D. Label your graphs clearly.

(ii) Explain the shape of the characteristic for C.

(iii) Name the component you have chosen for D.

10. (a) Explain the differences between *e.m.f.* and Potential difference.

(b) A 24 V battery of internal resistance 4Ω is connected to a variable resistor. What value of the current in drawn from the battery if the rate of the heat produced in the resistor is maximum.

11. An accumulator of *e.m.f.* 2 V and negligible internal resistance is connected in series with 500 Ω and Y Ω resistors. The reading of the voltmeter across 500 Ω and Y Ω are $\frac{2}{7}$ V and $\frac{8}{7}$ V respectively. Calculate the value of Y and the voltmeter resistance.

12. Figure 1.45 shows a battery of 10 V and negligible internal resistance connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of resistance 1 Ω. Determine:

(a) the equivalent resistance of the network; and

(b) the total current supplied by the battery.