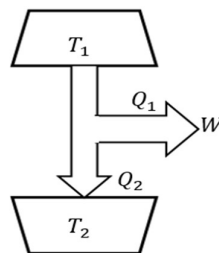


- a. Define surface tension. 1  
 b. Establish a relation between surface tension and surface energy of a liquid. 2  
 c. Two spherical raindrops of equal size fall vertically through the air with a specific terminal velocity. If these two drops were to coalesce to form a single drop and fall with a new terminal velocity, explain how the terminal velocity of the new drop compares to the original terminal velocity. 2

14. State the second law of thermodynamics. 1

a. A refrigerator transfers heat from a cold body to hot body. Does this violate the second law of thermodynamics? Give reason. 1

b. In the given figure, a heat engine absorbs  $Q_1$  amount of heat from a source at temperature  $T_1$  and rejects  $Q_2$  amount of heat to a sink at temperature  $T_2$  doing some external work  $W$ .



i. Obtain an expression for the efficiency of this heat engine. 1

ii. Under what condition does the efficiency of such engine become zero percentage at all? 1

15. Interference is the redistribution of energy due to the superposition of two waves.

a. Write the suitable conditions for interference? 1

b. In Young's slits experiment the separation of the first to fifth fringes is 2.5 mm when the wavelength used is 620 nm. The distance from the slits to the screen is 80 cm. Calculate the separation of two slits. 3

**'OR'**

Diffraction is the phenomenon of spreading (or bending) of light waves around the edge of an obstacle.

a. Write the necessary condition for diffraction to occur. 1

b. Why are radio waves easily diffracted than other electromagnetic waves? 2

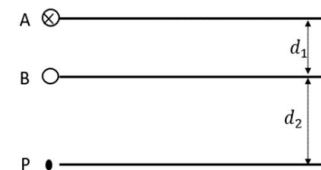
c. Parallel beam of light from a source is incident normally on a plane diffraction grating. If the angle of diffraction for the first order is  $30^\circ$ , find the grating element and the number of lines per mm of the grating, considering the wavelength of incident beam is  $5893\text{\AA}$ . 2

16. When two current-carrying straight conductors are brought nearer to each other, they experience force either attractive or repulsive.

a. Derive an expression of force per unit length between two parallel conductors separated by a distance ' $r$ ' and carrying currents  $I_1$  and  $I_2$  in the same direction. Also, write the condition of attraction and repulsion of conductors in accordance with the direction of current flow in the wires. 3

b. Two long straight wires separated by a distance  $d_1 = 0.75\text{cm}$  are perpendicular to the page as shown in figure. The direction of current in the wire A is into the page which is shown by ( $\otimes$ ) and current carried by it is

6.5A. What are the (o) magnitude and direction (into or out of page) of the current in wire B if the net magnetic field due to two currents is zero at point P located at a distance  $d_2 = 1.50\text{cm}$  from wire B. 2



17. A simple experiment to study electromagnetic induction is shown in figure.

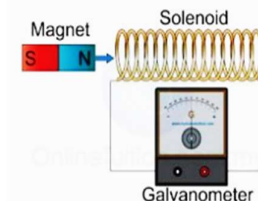
a. Define the term electromagnetic induction. 1

b. Discuss the deflection produced in galvanometer when you move the magnet

i. Left towards the coil.

ii. Right away from the coil.

c. Let the magnetic flux linked with the coil varies as:  $\phi = 2t^2 - t + 3$ . Obtain the induced current in the coil after 2s if the resistance of coil is  $8\Omega$ . 2



18. Millikan's oil drop experiment gives the idea of quantization of charge.

a. Explain what is meant by quantization of charge. 1

b. In a Millikan's oil drop experiment, an oil drop of weight  $1.5 \times 10^{-14}\text{N}$  is held stationary between plates  $10\text{mm}$  apart by applying a p.d. of  $470\text{V}$  between the plates.

i. State the condition necessary for the drop to remain stationary. 2

ii. Calculate the charge on the oil drop. 2

**'OR'**

Semiconductors are a groundbreaking invention in the field of nanotechnology.

a. Draw a circuit diagram for the P-N junction diode in forward biased. Sketch the voltage versus current graph for it. 2

b. What is a rectifier? Describe the working of a full wave rectifier. 3

19. Photoelectric effect provides the basic concept of quantum nature of light.

a. What is the photoelectric effect? 1

b. Why are alkali metals used in the generation of solar energy? 2

c. The metal surface is illuminated by the radiation of frequency  $10^{15}\text{Hz}$ . What would be the maximum kinetic energy of the emitted electrons? 2

**[GROUP C]**

**[3 × 8 = 24]**

20. a. Many people confuse on change of pitch and change of intensity of sound.

i. Draw the waveforms that best represent the increase in intensity and increase in pitch of sound. 2

ii. Find the intensity of the sound wave in air whose maximum pressure variation is  $3 \times 10^{-2}\text{Pa}$ , The density of air is  $\rho = 1.20\text{kg/m}^3$  and the speed of sound is  $340\text{m/s}$ . 2

b. Relative motion is the basic requirement of Doppler's effect.

i. What is Doppler's effect? Find the change in frequency when a moving source of sound passes a stationary observer. 3

ii. What is the application of Doppler's effect in ultrasonography? 1