

(Based on remember)  
Answer any five Questions.

### GROUP—A

1) Indicate the correct answer in each of the following : (10)

(a) A vector  $\vec{F}$  is said to be solenoidal if:

(i)  $\text{div } \vec{F} = 0$  (ii)  $\text{curl } \vec{F} = 0$  (iii)  $\text{grad } \vec{F} = 0$  (iv) None of those

(b) The work done in twisting a wire of torsional rigidity  $C$ , by an angle  $\theta$  is :

(i)  $2C^2\theta$  (ii)  $\frac{1}{2}C\theta^2$  (iii)  $2C\theta^2$  (iv)  $\frac{1}{2}C^2\theta$

(c) For liquid in contact with solid, the angle of contact is obtuse if :

(i) Cohesive force is equal to the gravitational force  
(ii) Adhesive force is equal to the gravitational force  
(iii) Cohesive force is weaker than adhesive force  
(iv) Cohesive force is stronger than adhesive force

(d) Resonance is a special case of :

(i) Free Vibration (ii) Damped Vibration  
(iii) Damped-Force Vibration (iv) Free -Damped Vibration

(e) The efficiency of a Carnot engine working between temperature  $T$  and  $T'$ , the temperature of source and sink respectively :-

(i)  $\frac{T-T'}{T}$  (ii)  $\frac{T-T'}{T'}$  (iii)  $\frac{T'-T}{T'}$  (iv)  $\frac{T'-T}{T}$

(f) For  $\mu$  moles of a real gas, the equation is :

(i)  $PV = \mu RT$   
(ii)  $(P + a/V^2)(V - b) = \mu RT$   
(iii)  $(P + a/\mu^2 V^2)(\mu V - b) = \mu RT$   
(iv)  $(P + \mu^2 a/V^2)(V - \mu b) = \mu RT$

(g) A thin film of oil, spread on the road exhibit brilliant colours when viewed in diffused sun light due to :

(i) Reflection of wave front  
(ii) Interference by division of amplitude  
(iii) Polarization due to double refraction  
(iv) Fresnel's diffraction

(h) Polarization phenomenon of light proves the :

(i) Corpuscular nature of light  
(ii) Quantum nature of light  
(iii) Longitudinal nature of light wave  
(iv) Transverse nature of light wave

(i) Yellow light is used in a single slit diffraction experiment with slit width  $0.6 \text{ mm}$ . If yellow light is replaced by

X-ray, then the observed pattern will show :

(i) That the central maximum is narrower  
(ii) More number of diffraction fringes  
(iii) Less number of diffraction fringes  
(iv) No diffraction pattern

(j) The instrument which measure the potential difference in terms of the absolute quantities like force and area is :

(i) Attracted disc electrometer (ii) Quadrant electrometer  
(iii) Potentiometer (iv) Voltmeter

### GROUP—B

2) Answer any *two* of the following questions : (5X2=10)

- (a) Find the expression for time-period of a Torsional Pendulum.
- (b) From the expression for efficiency of a Carnot Engine, show that temperature in absolute scale can not be negative.
- (c) What are half-wave and quarter-wave plate and what do they do?
- (d) Explain the difference between Loudness and Intensity of sound.

### GROUP—C

Answer any *four* of the following questions:

- 3) State and prove Gauss' divergence theorem. (2+8=10)
- 4) Derive the relation between the elastic constants. (4+4+2=10)
- 5) Derive an expression for the volume of liquid flowing per second through a horizontal capillary tube and hence discuss in brief the experiment to find coefficient of viscosity of a liquid using the expression derived. (7+3=10)
- 6) Derive the Maxwell velocity distribution law for molecules of a gas. (10)
- 7) Derive van der Waals equation of state and find the expression for critical temperature in terms of van der Waals constants. (4+4+2=10)
- 8) With a neat diagram give the description and working of a Michelson interferometer. Give the theory of formation of circular fringe. Write, in brief, the determination of wave length of Sodium light using Michelson Interferometer. (1+4+3+2=10)
- 9) Discuss the Kerr cell electro optic shutter method for determination of velocity of light. (10)
- 10) Give the construction, working and theory of a Quadrant electrometer. Discuss the following.
  - (i) Heterostatic use
  - (ii) Idiostatic use (3+2+3+1+1=10)

### GROUP—D

Answer any *three* of the following questions: (5X3=15)

- 11) Prove the following vector identity  
 $\text{div}(\phi \vec{A}) = \phi \text{div } \vec{A} + \vec{A} \cdot \text{Grad } \phi$ .
- 12) Two separate soap bubble of radii 0.002 m and 0.004 m come together to form a double bubble. Find the radius of curvature of the film surface common to both. S.T. of soap solution is 0.07 N/m.
- 13) A Carnot engine operates between 500 K and 400 K. It absorbs  $25 \times 10^6$  J heat at higher temperature. How much work per cycle, the engine can perform?
- 14) A plane transmission grating having 15,000 lines per inch (1 inch=2.54 cm) diffracts monochromatic light by  $20^\circ$  in the first order. Calculate the wave length of light in Angstrom. Given  $\sin 20^\circ = 0.3420$ .
- 15) Find the thickness of a calcite plate, which would convert plane polarized light into circularly polarized light. Given  $\lambda = 5890 \text{ \AA}$ ,  $\mu_o = 1.658$ ,  $\mu_e = 1.486$ .