27/11/19

Note: (1) All questions are compulsory.

(2) Figures to the right indicate maximum marks.

(3) Use of non-programmable calculators is permitted.

(4) Symbols used have their usual meaning.

Q.1. (A) Choose correct alternative in each of the following: (12)

(i) In Ramsden's eyepiece, if the focal length of eye lens is 12cm, then its equivalent focal length is

   a) 12cm   b) 9cm   c) 6cm   d) 24cm

(ii) Two plano-convex lenses of same refractive index form a Huygen's eyepiece. Their focal lengths are 6cm and 2cm. what is the equivalent focal length of the eyepiece?

   a) 2cm   b) 6cm   c) 3cm   d) 4cm

(iii) For a body undergoing acceleration in an inertial frame, the net force acting on the body is

   a) Zero b) non-zero c) balanced by pseudo force d) proportional to the momentum of the body

(iv) A person standing in an elevator feels an increase in his weight when the elevator is

   a) Ascending with retardation   b) ascending with acceleration
   c) descending with acceleration   d) stationary

(v) The Boyle's temperature of a gas is given by

   a) a/bR   b) a/27b^2 c) 8a/27bR   d) a/27

      Where symbols have their usual meanings.

(vi) The dimensions of the constant 'b' in Van der Waals equation of a state of a gas are

   a) Volume   b) pressure   c) pressure/volume   d) volume/pressure

Q.1. (B) Answer in one statement: (03)

      (i) Define focal length of a lens.
      (ii) What is an inertial frame of reference?
      (iii) What is an isochoric process?

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Q.1. (C) Fill in the blanks: (05)

(i) SI unit of force is _____ .

(ii) Power of a lens is defined as the _____ of its focal length expressed in meter.

(iii) The working of venturimeter is based on the principle of_____ .

(iv) Zeroth law of thermodynamics deals in _____ .

(v) In the elastic limit, the stress originating in the deformed body is equal to _____ .

Q.2. (A) Attempt any one: (08)

(i) State and prove Bernoulli's equation.

(ii) Derive Poiseuille's equation for streamline fluid flow.

Q.2. (B) Attempt any one: (08)

(i) Consider a unit cube of a homogeneous and isotropic material and show that $Y = 2\eta (1 + \sigma)$; symbols have their usual meaning.

(ii) Derive an expression for the couple required to produce a twist in a cylindrical rod fixed at one end.

Q.2. (C) Attempt any one: (04)

(i) A block slides down an incline of indication angle 30^0 with an acceleration g/4. Find the coefficient of kinetic friction.

(ii) Calculate the young's modulus for the material of a wire having modulus of rigidity 8×10^{10} Nm^{-2} and Poisson's ratio 0.2.

Q.3. (A) Attempt any one: (08)

(i) Derive Newton's lens equation.

(ii) Derive an expression for radius of the bright and dark rings in the case of Newton's rings.

Q.3. (B) Attempt any one: (08)

(i) Derive an expression for focal length of a thick lens.

(ii) Derive an expression for the fringe width in case of wedge-shaped film.

Q.3. (C) Attempt any one: (04)

(i) Two thin converging lenses of power 5 diopter and 4 diopter are placed coaxially 12cm apart. Find the focal length of the combination.

(ii) Determine the radii of curvature for a lens of focal length f = 30cm and refractive index 1.5 such that parallel incident light has minimum spherical aberration.

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Q.4. (A) Attempt any one: (08)

(i) Explain the behavior of gases at high pressure and obtain the expression for the Boyle's temperature.

(ii) Derive an expression for the work done in adiabatic and isothermal processes.

Q.4. (B) Attempt any one: (08)

(i) Discuss Andrew's experiment on carbon dioxide and explain the result using P-V diagram.

(ii) Derive the relation between the Van der Waals constants and critical constants. State the first law of thermodynamics and hence what is its significance and limitations.

Q.4. (C) Attempt any one: (04)

(i) A quantity of air at 27^0C and atmospheric pressure is suddenly compressed to 25% of its original volume. Find the final pressure and temperature if ratio of specific heat (C_p/C_v) is 1.4.

(ii) Calculate the value of the constants a and b in Van der Waals equation for dry air, given that for dry air, T_C = 132 K, P_C = 37.2 atm, R = 82.07 cm^3 atmosphere K^{-1} mole^{-1}.

Q.5. Attempt any four: (20)

(i) Explain how spherical aberration can be reduced using stops or by reducing the lens aperture.
(ii) Derive a general expression for $C_P - C_V$.
(iii) State and explain zeroth law of thermodynamics.
(iv) Write a brief notes on chromatic aberration.
(v) Define viscosity. Hence explain streamline and turbulent flow of a liquid.
(vi) Air at N.T.P. is compressed adiabatically to half of its volume. Calculate the change in its temperature.