[Time : Three Hours] **[Marks : 100]**

Please check whether you have received the right question paper.

N.B.: 1. Figures to the right indicate full marks.
2. Use of non-programmable calculator is permitted.

Q. 1 A) **Select correct option.** **12**

i) The coefficient of static friction in terms of normal reaction N and limiting force of friction f acting on a mass m is given by
a) $\frac{N}{f}$ b) $\frac{f}{N}$ c) $f \times N$ d) $\sqrt{f \times N}$

ii) Airplane's dynamic lift is based on
a) Bernoulli's principle b) Fermat's principle
c) Archimedes principle d) Pascal's law

iii) Two lenses with focal lengths 10cm and 20cm and made of same material are placed coaxially separated by distance d. The value of d such that the system is achromatic is
a) 20 cm b) 30 cm c) 10 cm d) 15 cm

iv) Radius of n^{th} Newton's ring seen with light of wavelength λ is proportional to
a) wavelength of light b) thickness of the air film
c) square root of wavelength d) radius of curvature of lens

v) The dimensions of the constants b in Vander Waals' gas equation are that of
a) volume b) $\frac{volume}{pressure}$ c) $\frac{pressure}{volume}$ d) Temperature

vi) Which of the following is a path function?
a) Work done by the system b) Internal energy
c) Heat absorbed by the system d) Both a and c

B) **Answer in one sentence.** **3**

i) Define Young's modulus.
ii) State any one method of reducing spherical aberration.
iii) State the reason for volume correction by Van der Waal in ideal gas equation.

C) **Fill in the blanks.** **5**

i) The working of venturimeter is based on the _____ principle
ii) Poise is the unit of _____
iii) In _____ eyepiece, cross-wires are not used.
iv) The centre of the Newton's rings pattern in reflected light appears _____
v) The amount of work done in an isochoric process is _____

Q. 2 A) Attempt **ANY ONE.** **8**

i) A body of mass m is suspended by two strings making angles α and β with the horizontal. Find the expression for tensions in the strings. If m=1 kg, $\alpha=30^o$ $\beta=60^o$. Find magnitudes of tensions T_1 and T_2 in the two strings.

TURN OVER

ii) Define Modulus of Rigidity and Poisson's Ratio. Consider a unit cube of homogenous, isotropic material and show that $Y = 2\eta(1+\sigma)$ where symbols have their usual meanings.

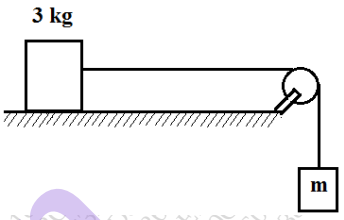
B) Attempt **ANY ONE.** **8**

i) Establish relation $Y = 3K(1-2\sigma)$ between elastic constants considering a unit cube of a homogenous and isotropic material.

ii) Derive Bernoulli's theorem for streamline flow.

C) Attempt **ANY ONE.** **4**

i) The coefficient of static friction between the block of 3 kg and the table is 0.3. What should be the limiting value of mass 'm' so that the block remains at rest? The string and pulley are light and smooth. Take g= 10 m/s^2



ii) A metal plate of area 10 cm^2 rests on 2 mm thick layer of oil. If an external force of 0.5 N applied on the plate keeps it moving with a uniform speed of 1.5 cm/s, find the coefficient of viscosity of oil.

Q. 3 A) Attempt **ANY ONE.** **8**

i) With the help of a diagram, explain chromatic aberration and hence obtain the expression for longitudinal chromatic aberration when the object is placed at infinity.

ii) With the help of diagrams, explain the principal and focal points of a thick lens. Also, explain their importance.

B) Attempt any **ONE** **8**

i) What are Newton's rings? Derive expressions for the radii of dark and bright rings.

ii) What is an eyepiece? Explain the construction of Ramsden's eyepiece and draw a diagram representing positions of its cardinal points. Can we use cross-wires with this eyepiece?

C) Attempt **ANY ONE** **4**

i) An achromatic doublet of focal length 10cm has two lenses made of materials having dispersive powers in the ratio 3:4. What may the focal lengths of the two lenses?

ii) A wedge-shaped film having wedge angle of 30 seconds of an arc is formed by introducing a drop of liquid of refractive index 1.5 between two glass plates. If light of 6000 A^0 is used, find the distance between successive bright fringes viewed in reflected light.

Q. 4 A) Attempt **ANY ONE** **8**

i) Derive an expression for the work done by an ideal gas in an adiabatic process.

ii) Explain the behaviour of gases at high pressure and hence obtain the expression for the Boyle's temperature.

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B) Attempt **ANY ONE** **8**

i) Show that, for an ideal gas, the relation between specific heats is $C_p - C_V = R$; where, the symbols have their usual meanings

ii) State the ideal gas equation. Discuss the Van der Waals' corrections to the pressure and volume terms of this equation.

C) Attempt **ANY ONE** **4**

i) One mole of a perfect gas at 127 ^{O}C undergoes isothermal expansion till the volume is doubled. Calculate the work done by gas and the heat absorbed. Given:- R = 8.3 J/mol ^{0}K

ii) The air in a motor car's tyre-tube has a pressure of 3 atm, at the room temperature of 27 ^{0}C. If the tyre suddenly bursts, determine the resulting temperature.

Q. 5 Attempt **ANY FOUR** **20**

i) A block slides down an incline of inclination angle 30° with an acceleration $\frac{g}{4}$. Find the coefficient of kinetic friction.

ii) For an incompressible fluid flowing with velocity v through a pipe having area of cross-section A show that Av=constant.

iii) Write a note on spherical aberration.

iv) Explain how Newton's rings can be used to measure the refractive index of a liquid.

v) Derive expression for work done by perfect gas in an isothermal transformation.

vi) Comment on the limitations of the Van der Waals' equation

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