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FIRST SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025

(CUFYUGP)

PHY1MN102/APH1MN102: Properties of Matter and Thermodynamics

2024 Admission onwards

Maximum Time :2 Hours | **Maximum Marks :70**

Section A

All Questions can be answered. Each Question carries 3 marks (Ceiling: 24 Marks)

1	What is meant by centre of gravity? Is it necessary that the centre of mass and centre of gravity of a body always coincide?
2	Explain the principle behind the working of hydraulic lift.
3	Draw a typical stress- strain diagram and mark (a) the proportional (ii)limit elastic limit (iii) fracture point and (iv) permanent set.
4	Differentiate between laminar flow and turbulent flow.
5	Derive the expression for the hydrostatic work done during isothermal expansion of an ideal gas.
6	Define the term 'Entropy' of a system. How does it change in a reversible cyclic process?
7	Draw the Diesel cycle on a PV diagram and mark the various steps involved.
8	State the second law of thermodynamics. What is its significance?
9	a. Mark (i) isothermal process (ii) adiabatic process (iii) isobaric process and (iv) isochoric process on a PV diagram- all the processes starting from the same set of pressure and volume coordinates. b. Using the above graph, arrange the work done in the above mentioned processes in the decreasing order of their numerical values.
10	Strictly speaking, which one will be easier to lift- a 5 kg iron block or a 5 kg dry cotton. Justify your answer

Section B

All Questions can be answered. Each Question carries 6 marks (Ceiling: 36 Marks)

11	Derive the equation for speed of efflux using Bernoulli's principle.
12	A uniform plank of length L = 6.0 m and mass M = 90 kg rests on sawhorses separated by D = 1.5 m and equidistant from the center of the plank. A boy wants to stand on the right-hand end of the plank. If the plank is to remain at rest, how massive can the boy be?
13	A typical bedroom contains about 2500 moles of air. Find the change in the internal energy of this much air when it is cooled from 35.0°C to 26.0°C at a constant pressure of 1.00 atm. Treat the air as an ideal gas with γ= 1.4
14	600 g of ice at 0^0C is converted into water at 60^0C. Find the entropy change if the latent heat capacity of ice is 80 cal /g and the specific heat capacity of water is 1 cal $g^{-1}\,{}^0C^{-1}$
15	Find the expression for the pressure difference between two points in a fluid of uniform density.
16	a. Derive the expression for the entropy change in free expansion of an ideal gas. b. Find the change in entropy when the volume of one mole of an ideal gas is doubled isothermally at 27^0C
17	A 15 kg solid gold statue is raised from the sea bottom. What is the tension in the hoisting cable (assumed massless) when the statue is (a) at rest and completely underwater and (b) at rest and completely out of the water? Density of gold is 19.3 x 10^3 kg/m^3, density of sea water is 1.03 x 10^3 kg/m^3 and that of air is 1.2 x 10^3 kg/m^3
18	A Carnot engine whose heat sink is at 27^0C has an efficiency of 40%. By how many degrees should the temperature of the source be changed to increase the efficiency by 10% of the original efficiency.

Section C	
Answer any ONE. Each Question carries 10 marks (1x10=10 Marks)	
19	a. What is meant by an adiabatic process? b. Derive the expression for adiabatic process by an ideal gas in terms of (i) temperature and volume. and (ii) pressure and volume c. Derive the expression for the work done in adiabatic process in terms of pressure and volume. d. Find the work done in heating 2 moles of an ideal diatomic gas (γ= 1.4, Cv = 20 J mol $^{-1}$ K^{-1}) from 300K to 375K
20	a. State and prove Bernoulli's principle. b. Using Bernoulli's principle, find the expression for the speed of efflux. c. Water enters a house through a pipe with an inside diameter of 2.0 cm at an absolute pressure of 4.0 x 10^5 Pa. A pipe with diameter 1.0 cm leads to the second-floor bathroom 5.0 m above. When the flow speed at the inlet pipe is 1.5 m/s, find the flow speed and pressure at the outlet section.