



Tribhuvan University

2072

Bachelor Level 4 Yrs. Prog./1st Year/Science & Tech.

Physics (Phy.101)

Full Marks: 100

(Mechanics, Thermodynamics and Statistical Physics Electricity & Magnetism)

Time: 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt ALL the questions.

1. Write down the equation of clamped simple harmonic oscillator. Find the expression for displacement and discuss when we get oscillatory damped simple harmonic motion. [2+6+2]

OR

What do you mean by plane progressive wave? Obtain an expression for energy density of a plane progressive wave. How is it related to energy current? [2+6+2]

2. State second law of thermodynamics and derive Clausius - Clapeyron latent heat equation. What is the importance of this equation? [2+6+2]

OR

What is difference between Ideal and Real gas? Obtain Van der Waals equation of state. What is the importance of critical temperature? [2+6+2]

3. What is meant by electrical image? Find the magnitude and location of image charge due to a point charge near a conducting sphere and also obtain an expression for the electric potential and field at any exterior point in this case. [2+4+4]

OR

What is displacement current? Obtain Maxwell's electromagnetic equation and explain on which law they are based. [2+5+3]

4. What are Kepler's laws of planetary motion? Show how the universal law of gravitation of Newton has been derived from these laws. [3+5]

5. State Planck's formula for black body radiation and derive it in terms of wavelength. [2+6]

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6. Distinguish between polar and non-polar molecules. Derive the Langevin - Debye formula for polar molecules and write the importance of this formula. [2+5+1]
7. Answer any TWO questions: [2×3=6]
- Define moment of inertia and radius of gyration of a rigid body, hence calculate the radius of gyration of a solid sphere rotating about its diameter if its radius is 0.05m.
 - Define Poisson's ratio of a material and show that its limiting values lie between - 1 and 0.5.
 - What do you understand by phase space, micro and macro states of a system?
 - Define self inductance and mutual inductance and obtain a relation between them.
8. Do ALL the questions: [4×2.5=10]
- If a force $F = Ax + Bx^2$ acts parallel to x - axis on an object and moves it from $x = 1$ to $x = 2$, calculate the work done.
 - What do you understand by Joule-Thomson expansion of a gas? Is the cooling effect ultimate result of Joule - Thomson expansion? Discuss.
 - Define the terms emissive and absorptive power. State Kirchhoff's law of radiation and discuss its importance.
 - Discuss the importance of the hysteresis curve. How would you use the hysteresis curve to select the material for the construction of a transformer?
9. A rocket of mass 20 kg has 180 kg fuel. The exhaust velocity of the fuel is 1.6km/s. Calculate the minimum rate of consumption of fuel so that the rocket may rise from the ground. Also calculate the ultimate vertical speed gained by rocket when the rate of consumption of fuel is 20 kg/s. [5]
10. Calculate the rate of flow of glycerine of density $1.25 \times 10^3 \text{ kg/m}^3$ through a conical section of a pipe if the radii of its ends are 0.1m and 0.04m and pressure - drop across its length is 10 N/m^2 . [5]
11. For silver, the molar specific heat at constant pressure in the range 50 to 100 K is given by
- $$C_p = 0.076 T - 0.00026 T^2 - 0.15 \text{ Cal./K}$$



where T is the temperature in Kelvin. If 2 mole of silver is heated from 50 to 100K, calculate (i) heat required (ii) change in entropy. [5]

12. The molecular diameter of nitrogen is 3.5×10^{-10} m. Calculate the mean free path at temperature 27°C and pressure 1 atmosphere. [5]
13. A 60 Hz power transformer (turns ratio 2 : 1) has a primary inductance of 100 H and a d.c. resistance of 20Ω . The coupling coefficient between primary and secondary is close to unity. If 1000V is applied across the primary, calculate the current in the primary winding (a) when the secondary is open - circuited, (b) when a load resistance of 20Ω is in the secondary circuit. [5]
14. In the Bohr model of the hydrogen atom the electron circulates around the nucleus in a path of radius 5.1×10^{-11} m at a frequency of 6.8×10^{15} rev/sec.
(i) What value of B is set up at the centre of the orbit?
(ii) What is the equivalent magnetic dipole moment? [5]

