1. A particle of mass 1 gm moves in a vertical plane down the rough slope of the wedge. It starts from rest at A. If the co-efficient of kinetic friction between the slope and the particle is 0.1 find (a) The speed of particle at B. (b) The magnitude of the impulse acting on particle at B

2. (a) A 100g block of copper is taken from furnace at 600^0C and dropped into a heat insulated tungsten beaker weighing 600 g and containing 300 g of water at 30^0C. What is the final temperature of the water? [Specific heat oc copper = 0.093 cal/mg ^{0}C, water = 1.0cal/gm ^{0}C and Tungsten = 0.032 cal/gm ^{0}C.
   (b) Use the first law of thermodynamics and an expression for the internal energy of a monoatomic, ideal gas to show that for this ideal gas $C_p = 5/2$

3. A transverse sinusoidal wave travels from left to right in a trough horizontal string. This wave has amplitude 1 cm. wavelength 1 mm and phase velocity 1 m/s. Its phase is measured relative to a chosen origin O on the string.
   (a) Write down an expression for the vertical displacement y of a point on the string a distances from the origin, at a time t.
   (b) What is the period of the wave T ?
   (c) What is the wave number, k ?
   (d) What is the angular frequency, ω ?
   (e) What would be the expression for the vertical displacement y(x,t), if instead of the above wave, another one with the same amplitude, wavelength and phase velocity, but lagging behind in phase by 3π/2 travels through the string?

4. (a) The refractive index of water in a swimming pool is 1.33 and that of the air above is 1.01. A swimmer swims completely immersed in the pool. At what angle to the vertical must be look up to just see the setting sun?
   (b) Atom of sodium chloride sit on parallel planes with inter planner distance 2.52 A^0. At what angles of incidence must an X-ray beam with λ =1.10 A^0 fall on these planes if a diffracted beams is to exist?

5. (a) What is the electric potential at the surface of a gold nucleus?. The nuclear radius is 6.6 x 10^{-15} m the atomic number is z=79 , e = 1.6 x 10^{-19}coulomb, $\frac{1}{4\pi\epsilon} = 9 \times 10^9\ Nm^2/Coulomb^2$.
   (b) A copper rod of length 2 m rotates anti-clockwise in the X-Y plane with angular speed 10 rad/s about one of its ends. There is a uniform magnetic field B = 2.0 wb/m^2 in the vertical direction z surrounding the rod. Find the e.m.f between the two ends of the rod.

6. (a) Sketch the behaviour of magnetisation vs. temperature in the range 10 ^{0}K to 400 ^{0}K of a metal which undergoes paramagnetic to ferromagnetic transition at 300 ^{0}K.

(b) A paramagnetic mono atomic gas whose atoms have a magnetic dipole moment 10^{-25} amp-m^2 is placed in magnetic field at room temperature (30 ^{0}K). At what value of the magnetic field strength with the mean kinetic energy of translation be equal to the magnetic contribution to the energy? (Boltzmann constant k = 1.38 x 10^{23} joule/^{0}K).

7. (a) A milli ammeter has a full scale deflection (FSD) value at 5 mA and a resistance of 15 Ω. Find the shunt resistance necessary to convert this to an ammeter with FSD at 5 amp.($\mu_0 = 4\pi \times 10^7$ H/m).
   (b) An air-cored solenoid has 500 turns over a length of winding of 40 cm the diameter of the solenoid is 3 cm. Calculate its inductance.

8. (a) A steel wire has resistance twice that of a copper wire. The wires are connected in parallel in a circuit powered by a direct current voltage. Which wire will liberate more heat per unit time? If the wires are now connected in series, which wire liberates more heat per unit time? Give reasons for your answers.
   (b) A book can easily be read with an illumination of 50 lx, At what height should a lamp of 50 cd be hanging above the table to provide sufficient illumination directly under the lamp?

9. (a) Explain, using Bernoulli's principle why a cricket ball with a very large spin, flying through air experiences a dynamical lift.
   (b) an electron beam emerges from an accelerator with kinetic energy 100 eV. What is its Broglie wavelength?

10. (a) Describe how X-rays are produced by excitation of sodium atoms.
    (b) Mercury has excitation potential 4.9 V. Calculate the wavelength of the radiation emitted when the mercury atom is excited to this level and then returns to its ground state in a single quantum jump.