

**FIRST YEAR B.Sc. DEGREE EXAMINATION, APRIL/MAY 2005****Part III—Physics—Subsidiary****PH (GL) 11—MECHANICS, PROPERTIES OF MATTER, THERMAL PHYSICS  
AND PHYSICS OF THE EARTH**

(For Geology Main)

(2004 Admissions)

Time : Three Hours

Maximum : 50 Marks

**Section A***Answer any two of the following questions.**Each question carries 7 marks.*

1. Derive an expression for the moment of inertia of a solid sphere about its diameter.
2. Formulate the differential equation for a forced harmonic oscillator and obtain a solution for it. Discuss the condition of resonance.
3. Discuss the working of a carnot engine. Derive the expression for its efficiency.
4. Derive an expression for the gravitational potential and field at a point outside a thin uniform spherical shell.

(2 × 7 = 14 marks)

**Section B***Answer any twelve of the following.**Each question carries 2 marks.*

5. State perpendicular axes theorem in moment of inertia.
6. Derive an expression for the moment of inertia of an annular ring about an axis passing through its centre perpendicular to its length.
7. What is a gyroscope ?
8. Draw the potential energy curve of a diatomic molecule. What is zero point energy ?
9. Give the three dimensional wave equation and its possible solution.
10. What is a damped harmonic oscillator ? Give two examples.
11. Define plane of pendulum and neutral axis.
12. How does surface tension vary with temperature ?
13. With the general expression for excess of pressure for a curved liquid surface. Hence the expression for it in a spherical drop.
14. Explain streamline motion.
15. Define efficiency of a heat engine. In what circumstances will the efficiency become 100 %.

16. State and explain Stefan's law.
17. Compare Petrol and Diesel engines.
18. Get an expression for adiabatic elasticity.
19. State Weidman-Franz law.
20. Explain absolute scale of temperature.
21. What is gravitational self energy ?
22. What are seismic waves. Name those waves in the sea.
23. State the properties of ionosphere.
24. Explain the structure of the atmosphere.

(12 × 2 = 24 marks)

### Section C

*Answer any four of the following questions.*

*Each question carrier 3 marks.*

25. A disc of mass 2 kg. and radius 10 cm. suspended horizontally by a vertical wire attached to its centre. If the radius of the wire is 0.6 mm, length is 1.25 m and period of torsional oscillations is 6 seconds find the rigidity modulus of the material of the wire.
26. Calculate the velocity of propagation of longitudinal sound waves through a steel rod.  
 $E = 20 \times 10^{10} \text{ N/m}^2$  ;  $\rho = 7.6 \text{ gm/cm}^3$ .
27. Water is conveyed through a tube 8 cm. in diameter and 4 km. in length, at the rate of 120 litres per minute. Calculate the pressure required to maintain the flow.  $\mu = 0.001 \text{ Ns/m}^2$ .
28. Calculate the moment of inertia of a solid cylinder of mass 5 kg. radius 0.5 m and length 4 m. about an axis passing through its geometric centre and perpendicular to its length.
29. A carnot engine operates between temperatures 500 k and 300 k. If it received 1500 joules of heat from the source in each cycle. Calculate the heat rejected to the sink in each cycle.
30. One mole of a gas at 27°C expands adiabatically until its volume is doubled. Calculate the work done.  $\gamma = 1.4$ .
31. Estimate the effective surface temperature of the Sun from the following data.
 

(a) Mean diameter of sun	=	$13.9 \times 10^5 \text{ km.}$
(b) Mean distance of Sun from earth	=	$1.497 \times 10^8 \text{ km.}$
(c) Solar constant	=	$1400 \text{ J m}^{-2} \text{ s}^{-1}$ .
(d) Stefan's constant	=	$5.7 \times 10^{-8} \text{ W m}^{-2} \text{ k}^{-1}$ .

(4 × 3 = 12 marks)