

**FIRST SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2020**

Physics

PHY 1C 01—PROPERTIES OF MATTER AND THERMODYNAMICS

Time : Three Hours

Maximum : 64 Marks

Section A

Answer all questions.

Each question carries 1 mark.

1. What is the unit of stress ?
2. Define rigidity modulus.
3. What is the condition for stress directly proportional to strain ?
4. Define period of oscillation.
5. What is the unit of co-efficient of viscosity.
6. Write down Stokes equation.
7. Why the hair of a brush cling together when taken out of water ?
8. When radius of capillary tube is less, capillary rise is _____.
9. In mercury meniscus is _____ in shape.
10. Define Entropy.

(10 × 1 = 10 marks)

Section B

Answer all questions.

Each question carries 2 marks.

11. Explain the terms Neutral surface and Neutral axis.
12. Explain Elasticity.
13. What is its co-efficient of performance ?
14. Why thermodynamic temperature is called the absolute temperature ?

Turn over

15. Mention three applications of Stokes law.
16. What is angle of contact ?
17. Why small drops are spherical in shape ?

(7 × 2 = 14 marks)

Section C

*Answer any **three** questions.
Each question carries 4 marks.*

18. Derive the equation for rigidity modulus.
19. State and explain viscosity.
20. Explain the relation between surface energy and surface tension.
21. Write down Stokes law and explain the symbols used. Mention three applications of Stokes law.
22. Define 1. First law of thermodynamics 2. Clausius statement of second law of thermodynamics.

(3 × 4 = 12 marks)

Section D

*Answer any **three** questions.
Each question carries 4 marks.*

23. A block of gelatine is 60 mm by 60 mm by 20 mm when unstressed. A force of 0.245 N is applied tangentially to the upper surface causing a 5 mm displacement relative to the lower surface. The block is placed such that 60 × 60 comes on the lower and upper surface. Find the shearing stress, and shearing strain.
24. Calculate the height to which water will rise in a capillary tube of 1 mm diameter. Given $g = 9.8$, Surface tension of water = 0.072 N/m : Angle of contact = 0.
25. The excess pressure inside a spherical soap bubble of radius 10 mm is balanced by that due to column of oil of density 900 kg/m^3 , 1.33 mm high. Calculate surface tension.
26. A tank containing water has an orifice 10 m below the surface of water in the tank. Find the speed of discharge.
27. A gram molecule of gas at 127°C expands isothermally until its volume is doubled. Find the amount of work done and heat absorbed.

(3 × 4 = 12 marks)

Section E

*Answer any **two** questions.
Each question carries 8 marks.*

28. What is bending moment ? Derive an expression for bending moment.
29. Calculate the work done by a hydrostatic system in isothermal, adiabatic, isochoric and isobaric processes.
30. What is torsion pendulum ? Derive an expression for rigidity modulus of a wire.

(2 × 8 = 16 marks)

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**FIRST SEMESTER B.A./B.Sc. DEGREE EXAMINATION
NOVEMBER 2020**

(CUCBCSS)

Physics/Applied Physics

PHY 1B 01/APY 1B 01—METHODOLOGY OF SCIENCE AND PHYSICS

Time : Three Hours

Maximum : 80 Marks

Section A

Answer all questions.

Each question carries 1 mark.

Answer in a word or phrase.

1. _____ helps the researcher in proceeding further and finding the solution of the problem.
2. The sum of the eigen values equals to _____ of the matrix.
3. The technique used for systematically solving a research problem _____.
4. Special theory of relativity was put forward by _____.
5. The energy state in which an electron can remain for a time of about 10^{-3} s is called _____.
6. In a Coolidge X-ray tube, the source of electron is a _____ element.
7. The determinant of a square matrix is the product of its _____.
8. If the velocity of a particle increases its mass _____.
9. The law of matrix addition is _____.
10. When two operations of complex conjugation and transposition are carried out in a matrix the resulting matrix is called _____.

(10 × 1 = 10 marks)

Section B

Answer all questions.

Each question carries 2 marks.

11. What is meant by hypothesis testing ?
12. Induction method is called top to bottom method whereas deduction is called bottom to top. Why ?

Turn over

13. Write the significance of Peer Review.
14. State fundamental postulates of special theory of relativity.
15. What is twin paradox ?
16. State Gauss's Divergence theorem.
17. What is a Hermitian matrix ?

(7 × 2 = 14 marks)

Section C

*Answer any five questions.
Each question carries 4 marks.*

18. Distinguish between null hypothesis and alternative hypothesis.
19. Give examples for developing theory from hypothesis in physics.
20. Write notes on matrix addition and matrix multiplication.
21. Write any two applications of vectors in physics.
22. Show that vector product is (1) Associative ; and (2) Not commutative.
23. With suitable example explain any *two* vector operations.
24. Explain determinants with example.

(5 × 4 = 20 marks)

Section D

*Answer any four questions.
Each question carries 4 marks.*

25. An X-ray tube operates at 50 kV. Calculate the shortest wavelength of X-rays produced.
26. The rest mass of a proton is 2.67×10^{-27} kg. At what velocity will its mass be double its rest mass.
27. Given the two matrices $A =$ and $B =$ show that $AB = 0$, $BA \neq 0$.
28. Prove that $\Delta^2() = 0$ where $r^2 =$.
29. Find the torque about the point $10j$ of a force represented by acting through the point.
30. Show that the gradient of sum of two scalar point functions is equal to the sum of their gradients.
31. Show that every square matrix A can be uniquely expressed as the sum of a Hermitian matrix and a skew-Hermitian matrix.

(4 × 4 =16 marks)

Section E

*Answer any **two** questions.*

Each question carries 10 marks.

32. What characteristics must a hypothesis possess in order to be a good research hypothesis and what are the important limitations of tests of hypothesis ?
33. What is a Laser ? What are the properties of LASER light ? Explain the terms spontaneous emission and stimulated emission. What is meant by population inversion and metastable states ? How is it achieved ?
34. Starting from Cartesian co-ordinates find the value $\Delta \cdot F$ and $\Delta \times F$ in terms of cylindrical co-ordinates.
35. Explain integration of a vector. Write notes on line integral, Surface integral and Volume integral.

(2 × 10 = 20 marks)

FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION, NOVEMBER 2020

Physics/Applied Physics

PHY 1B 01/APH 1B 01—MECHANICS-I

(2020 Admissions)

Time : Two Hours

Maximum : 60 Marks

*The symbols used in the question paper have their usual meanings.***Section A (Short Answer Type)***Answer at least **eight** questions.**Each question carries 3 marks.**All questions can be attended.**Overall Ceiling 24.*

1. With proper examples define contact forces.
2. What are the fundamental forces in nature ? Compare their strengths.
3. Explain the gravitational force of a sphere.
4. Explain central force. Show that the work done by a central force is path independent.
5. State the law of conservation of linear momentum with one example.
6. Define moment of inertia. How is it related to angular momentum ?
7. State and explain the work energy theorem.
8. Show that angular momentum is conserved for a particle in central force motion.
9. Define power with its various units.
10. Obtain the expression for change in acceleration due to gravity with height.
11. Draw the energy diagram for a harmonic oscillator and explain.
12. State and explain parallel axis theorem.

(8 × 3 = 24 marks)**Turn over**

Section B (Paragraph / Problem Type)

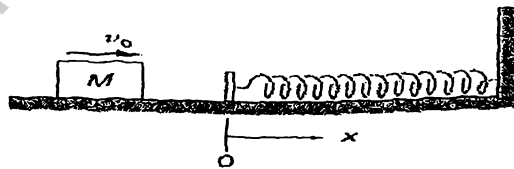
Answer at least five questions.

Each question carries 5 marks.

All questions can be attended.

Overall Ceiling 25.

13. A 5kg mass moves under the influence of a force $F = (4t^2\hat{i} - 3t\hat{j})\text{N}$, where t is the time in seconds, (1N = 1 Newton). It starts at rest from the origin at $t = 0$. Find
- Its velocity,
 - Its position, and
 - $r \times v$, for any later time.
14. Mass m is whirled on the end of a string length R . The motion is in a vertical plane in the gravitational field of the earth. The forces on m are the weight W down, and the string force T towards the centre. The instantaneous speed is v , and the string makes angle θ with the horizontal. Find the T and the tangential acceleration at this instant.
15. A uniform rope of mass m and length l is attached to a block of mass M . The rope is pulled with force F . Find the tension at distance x from the end of the rope. Neglect gravity.
16. A block of mass M slides along a horizontal table with speed v_0 . At $x = 0$, it hits a spring with spring constant k and begins to experience a friction force, as indicated in the sketch. The co-efficient of friction is variable and is given by $\mu = bx$, where b is a constant. Find the distance l the block travels before coming to rest.



17. Show that :

- If the total linear momentum of a system of particles is zero, the angular momentum of the system is the same around all origins.
- Show that if the total force on a system of particles is zero, the torque on the system is the same around all origins.

18. A uniform drum of radius b and mass M rolls without slipping down a plane inclined at angle θ . The moment of inertia of the drum around its axis is $I_0 = Mb^2/2$. Find the drum's acceleration along the plane.
19. Three freight cars each of mass M are pulled with force F by a locomotive. Friction is negligible. Find the force on each car ?

(5 × 5 = 25 marks)

Section C (Essays)

Answer any one question.

The question carries 11 marks.

20. State Newton's laws of motion. Apply Newton's laws to find the accelerations of two astronauts of masses M_A and M_B pulling on either ends of a rope of negligible mass.
21. Define potential energy :
- (a) Obtain Potential energies of a uniform force field,
 - (b) Obtain Potential energy of a central force, and
 - (c) Obtain the Potential energy of the Three-dimensional Spring Force.

(1 × 11 = 11 marks)

**FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2020**

Physics/Applied Physics

PHY 1B 01/APH 1B 01—METHODOLOGY OF SCIENCE AND BASIC MECHANICS

(2019 Admissions)

Time : Two Hours

Maximum : 60 Marks

The symbols used in this question paper have their usual meanings.

Section A (Short Answer Type)

*Answer **all** questions in two **or** three sentences.*

Each correct answer carries a maximum of 2 marks.

1. Define Hypothesis.
2. Obtain an expression for fractional change in acceleration due to gravity with altitude.
3. State Work-energy theorem.
4. How do you infer the nature of stability of a system from its potential energy ?
5. Check whether the force $F = A(3i + zj + yk)$, where A is a constant, is conservative or not.
6. Draw the energy diagram for a particle moving under a repulsive inverse square force.
7. Define Torque. Deduce the relation connecting torque and angular momentum.
8. State the theorem of parallel axes. Express it mathematically.
9. A metallic disc is melted and recast into a thin walled cylinder of same radius. Which one will have a greater moment of inertia ? Justify your answer.
10. Show that motion under a central force will be planar.
11. What is Poisson's ratio ?
12. Find out the expression for the work done in twisting a rod.

(Ceiling 20)

Turn over

Section B (Paragraph/Problem Type)

Answer **all** questions in a paragraph of about **half a page** to one page.

Each correct answer carries a maximum of 5 marks.

13. Write a note on inductive and deductive reasoning.
14. Explain science as a social activity.
15. A block of mass m rests on a wedge of angle θ . Draw the force diagram. If μ is the coefficient of friction, find the value of θ at which the block starts to slide.
16. Define centre of mass of a rigid body. A drum major's baton consisting of two masses m_1 and m_2 separated by a thin rod of length l is thrown into air. Prove that the centre of mass of the baton follows a parabolic trajectory. Neglect friction.
17. Using Work-energy theorem, show that the escape velocity is independent of launch direction.
18. Define reduced mass of a system. Discuss the vibration of a diatomic molecule and obtain an expression for the angular frequency.
19. Show that the Young's modulus Y , modulus of rigidity η and Poisson's ratio σ are related by the equation $Y = 2\eta(1 + \sigma)$.

(Ceiling 30)

Section C (Essay Type)

Answer in about **two pages**, any **one** question.

The question carries 10 marks.

20. State Newton's laws of motion. Use the laws to discuss the motion of : (i) A block of mass whirling at the end of a string on a horizontal plane in the absence of gravity and friction ; and (ii) A conical pendulum rotating at a constant angular frequency. Find the tension in the string in both cases.
21. State and prove the law of conservation of angular momentum. Prove that the angular momentum of a rigid body is equal to the sum of the angular momentum about the center of mass and the angular momentum of the center of mass about the origin.

(1 × 10 = 10 marks)

**FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2020**

Applied Physics

APH 1C 01—GENERAL AND APPLIED PHYSICS

(2019 Admissions)

Time : Two Hours

Maximum : 60 Marks

The symbols used in this question paper have their usual meanings.

Section A (Short Answer Type)

*Answer at least **eight** questions.*

Each question carries 3 marks.

All questions can be attended.

Overall Ceiling 24.

1. What do you mean by Poisson's ratio? Give its theoretical limits ?
2. Which one is preferred in shafts, hollow cylinders or solid ones ? Why ?
3. What do you mean by the term critical velocity in liquid flow ? Give an expression for the same.
4. Discuss the principle of superposition of waves.
5. What do you mean by coherent waves ?
6. List any four characteristics of stimulated emission.
7. Write any *four* applications of lasers.
8. Write down Ohm's law in terms of current density ? What are the terms involved ?
9. List any *four* properties of paramagnetic substances.
10. Mention the uses of a deflection magnetometer.
11. What are de Broglie waves ?
12. What is the use of a scanning tunneling microscope ?

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph/Problem Type)

*Answer at least **five** questions.*

Each question carries 5 marks.

All questions can be attended.

Overall Ceiling 25.

13. Water flows through a pipe of radius 0.04 m. and length 2 km. at the rate of 100 litres/min. If the co-efficient of viscosity of water is 10^{-3} Nsm^{-2} and the atmospheric pressure is $1.01 \times 10^5 \text{ Pa}$, determine the pressure required to maintain the flow.
14. Prove that superposition of incoherent waves does not produce interference.
15. Using a suitable figure explain a four level pumping scheme in lasers.
16. Using suitable figures explain the difference of step index and graded index fibres.
17. Illustrate the calibration of an ammeter using a potentiometer.
18. A copper wire of diameter 0.5 mm and length 20 m is connected across cell of emf 1.5 V having internal resistance 1.25 ohms. Determine the current density in the wire. Given, resistivity of copper is $1.7 \times 10^{-8} \Omega\text{m}$.
19. Calculate the de Broglie wavelength of an electron having a kinetic energy 1000 eV.

(5 × 5 = 25 marks)

Section C (Essay Type)

*Answer any **one** questions.*

The question carries 11 marks.

20. What do you mean by the term bending moment of a beam ? Obtain an expression for the same.
21. Derive Bragg's law of X-ray diffraction. Discuss briefly the working principle of a Bragg's X-ray spectrometer.

(1 × 10 = 10 marks)

**FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2020**

Physics

PHY 1C 01—PROPERTIES OF MATTER AND THERMODYNAMICS

(2019 Admissions)

Time : Two Hours

Maximum : 60 Marks

The symbols used in this question paper have their usual meanings.

Section A (Short Answer Type)

Answer at least eight questions.

Each question carries 3 marks.

All questions can be attended.

Overall Ceiling 24.

1. What do you mean by the term Poisson's ratio ? What are its limiting values ?
2. What do you mean by uniform bending ? How can you achieve uniform bending in a beam ?
3. Compare the couple required for a twist in a hollow and a solid cylinder.
4. What are the two forces that govern the shape of a liquid drop ? Why a larger drop assumes flat shape ?
5. Write down the Newton's law of viscous flow of liquids. Explain the terms involved.
6. What is Brownian motion ?
7. Write down the expression for an isothermal and an adiabatic processes.
8. What do you mean by a quasistatic process ?
9. Explain the first law of thermodynamics.
10. What do you mean by the co-efficient of performance of a refrigerator ?
11. Entropy of an irreversible always increases. Why ?
12. What is the effect of pressure on boiling point of a liquid ? Give an example where it is applicable.

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph/Problem Type)

Answer at least five questions.

Each question carries 5 marks.

All questions can be attended.

Overall Ceiling 25.

13. A wire of radius 1 mm is bent to a circle of radius 20 cm. Determine the bending moment. Given, the Young's modulus of the material of the wire is 200 GPa.
14. Calculate the depression at the free end of a light beam loaded by 2 kg at its free end. The length, breadth and depth of the beam are 1.2 m, 3 cm and 9 mm, respectively. Given, the Young's modulus of the material of the beam is $1.9 \times 10^{11} \text{ Nm}^{-2}$.
15. Calculate the work done in twisting a wire through an angle θ assuming the couple per unit twist of the wire as c .
16. Determine the energy released when 8 droplets of water of radius 0.5 mm coalesce to form a single drop. Give, the surface tension of water is 0.072 Nm^{-1} .
17. Prove any statement of the Carnot's theorem.
18. Given, the temperature inside and outside a refrigerator are 273 K 303 K, respectively. Determine the heat delivered to the surroundings for every joule of work done assuming the refrigerator cycle to be reversible.
19. Calculate the change of entropy when 2 kg of water at its boiling point is converted into steam at the same temperature. Given, the specific latent heat of steam is $226 \times 10^4 \text{ J/kg}$.

(5 × 5 = 25 marks)

Section C (Essay Type)

Answer any one question.

The question carries 11 marks.

20. Obtain an expression for the excess pressure inside a liquid drop.
21. Discuss the Carnot's cycle using a neat PV diagram. Obtain an expression for the efficiency.

(1 × 11 = 11 marks)