D 113933 **(Pages : 2)** **Name.....**

Reg. No.....

FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2024

Physics/Applied Physics

PHY 1B 01/APH 1B 01—MECHANICS—I

(2020—2023 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the 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. Give two applications of Newtons laws.
2. With proper examples define contact forces.
3. Define normal force.
4. Define electrostatic force. Give a general equation.
5. Obtain the expression for change in acceleration due to gravity with height.
6. Define conservative forces ? Give two examples.
7. Draw the energy diagram for a harmonic oscillator and explain.
8. Compare torque and force.
9. Show that angular momentum is conserved for a particle in central force motion.
10. State and explain parallel axis theorem.
11. Obtain the expression for change in acceleration due to gravity with height.
12. Sketch and deduce an equation for the period of a Simple Pendulum.

(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. Three freight cars each of mass M are pulled with force F by a locomotive. Friction is negligible. Find the force on each car ?

14. 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 Io = $Mb^2/2$. Find the drum's acceleration along the plane.

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 particle of mass 2 kg. is moving along the *x* axis under the action of a conservative force. P.E of the particle is given by U $(x) = x^2 + 4x + 15$. At $x = 2$ *m*. the particle has a K. E. 18 J. What is the maximum speed of the particle ?

17. Explain the theory and working of Drum Major's baton.

18. The force on aparticle moving along *x* axis is given by $t^2 = \sqrt[3]{x+9}$ If initial velocity = 0 what is the work done after 3 sec ?

19. Derive the equation *f* a drum rolling down a plane.

(Ceiling - 30)

Section C (Essay Type)

Essays - Answer in about **two pages**, *any* **one** *question.*
The question carries 10 *marks.*

20. Define and explain the following :
    (a) Acceleration due to gravity ;
    (b) Weight ;
    (c) Electrostatic force ; and
    d) Principle of equivalence.

21. Explain with examples the following :
    (a) Work don by a uniform force.
    (b) Work done by a central force.

(1 × 10 = 10 marks)

D 53686 (Pages : 3) Name.....

Reg. No.....

FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2023

Physics/Applied Physics (Common for Double Main)

PHY 1B 01/APH 1B 01/PHY 1B 21—MECHANICS—I

(2020—2023 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the 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. Explain Fictitious force.
2. State Newton's third law of motion with one example.
3. With proper examples define contact forces.
4. What are the fundamental forces in nature ? Compare their strengths.
5. Explain the gravitational force of a sphere.
6. State and explain the work energy theorem.
7. Define moment of inertia. How is it related to angular momentum ?
8. Draw the energy diagram for a harmonic oscillator and explain.
9. Illustrate the working of Drum major's baton.
10. What are conservative forces ? Give examples.
11. Define power with its various units.
12. State and explain parallel axis theorem.

(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. A 5 kg. mass moves under the influence of a force F = $\left(4t^2\hat{i} - 3t\hat{j}\right)$ N, where t is the time in seconds. (IN = 1 Newton). It starts at rest from the origin at $t = 0$. Find :

    (a) Its velocity.

    (b) Its position.

    (c) $r \times v$, for any later time.

14. A 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. Solve the equation of simple harmonic motion.

16. 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

17. Write a note on small oscillation in a bound system

18. Show that if the total force on a system of particles is zero, the torque on the system is the same around all origins..

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 ?

(Ceiling - 30)

Section C (Essay Type)

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

The question carries 10 *marks.*

20. 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.

21. State Newton's laws of motion. Apply Newtons 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.

(1 × 10 = 10 marks)

D 32382 **(Pages : 2)** **Name.....**

Reg. No.....

FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2022

Physics/Applied Physics

PHY 1B 01/APH 1B 01—MECHANICS–I

(2020—2022 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the 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 and explain mass.
2. Define inertial frame of reference with an example.
3. Explain the essence of Newton's first law.
4. Explain the gravitational force of a sphere.
5. Name the four fundamental forces in nature ?
6. find the tension of a "Dangling rope" at a distance x from the bottom.
7. State work-energy theorem for a conservative system.
8. Explain one example for conservation of linear momentum.
9. Show that angular momentum is conserved for a particle in central force motion.
10. Write a note on conservation of mechanical energy.
11. Give the relation between P.E and force.
12. Define normal force.

(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. 'Ideal point masses in not essential for applying Newtons laws'. Explain with example.

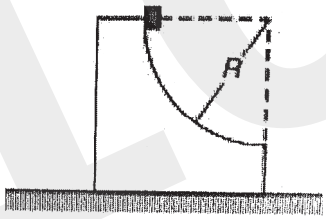
14. Write a note on Astronauts' Tug-of-War.

15. Explain Torque due to gravity.

16. A 5-kg mass moves under the influence of a force $\mathrm{F} = \left(4t^2\,\hat{i} - 3t\,\hat{j}\right)$ N, where t is the time in seconds. It starts at rest from the origin at t = 0. Find : (a) its velocity ; (b) its position ; and (c) $r \times v$, for any later time.

17. Define and explain the Principle of equivalence.

18. A small cube of mass m slides down a circular path of radius R = 10 c.m cut into a large block of mass M, as shown. M rests on a table, and both blocks move without friction. The blocks are initially at rest, and m starts from the top of the path. Find the velocity v of the cube as it leaves the block.



19. Explain work- energy theorem for a rigid body.

(Ceiling 30)

Section C (Essay Type)

Answer in about **two pages,** *any* **one** *question.*
Answer carries 10 *marks.*

20. Define and explain conical pendulum. Derive the equation for the angle the rod that makes with the vertical.

21. With figure solve the equation of simple harmonic motion.

(1 × 10 = 10 marks)

D 13611 **(Pages : 3)** **Name.....**

Reg. No.....

FIRST SEMESTER (CBCSS-UG) DEGREE EXAMINATION
NOVEMBER 2021

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 **all** *questions in two or three sentences.*
Each correct answer carries a maximum of 2 marks.

1. With proper examples define contact forces.
2. Explain Fictious or Pseudo force.
3. Explain the gravitational force of a sphere.
4. Draw the force diagram for the "Dangling rope" and find the tension a distance x from the bottom.
5. State the law of conservation of linear momentum with one example.
6. Define conservative and non-conservative forces. Give examples of each.
7. State and explain the work energy theorem.
8. Draw the energy diagram for a harmonic oscillator and explain.
9. Define power with its various units.
10. Explain torque and compare with force.
11. State and explain parallel axis theorem.
12. Sketch and deduce an equation for the period of a Simple Pendulum.

(Ceiling 20 marks)

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.

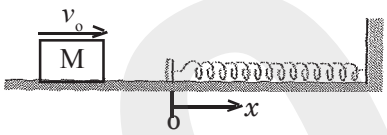
13. A string of mass m attached to a block of mass M is pulled with force F. Neglect gravity. What is the force F_1 on the block due to the string ?

Turn over

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 rod of length L has a non-uniform density. λ, the mass per unit length of the rod, varies as $\lambda = \lambda_0 (s / L)$, where λ_0 is a constant and s is the distance from the end marked 0. Find the centre of mass.

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. A particle of mass m moves in one dimension along the positive x axis. It is acted on by a constant force directed toward the origin with magnitude B, and an inverse-square law repulsive force with magnitude A/x^2.

    (a) Find the potential energy function U (x).

    (b) Sketch the energy diagram for the system when the maximum kinetic energy is $K_0 = \frac{1}{2} m v_0^2$.

    (c) Find the equilibrium position, x_0.

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 $Io = Mb^2/2$. Find the drum's acceleration along the plane.

19. Find the moment of inertia of a thin sheet of mass M in the shape of an equilateral triangle around an axis through a vertex, perpendicular to the sheet. The length of each side is L.

(Ceiling 30 marks)

Section C (Essay Type)

Answer in about **two** *pages, any one question.*
Answer carries 10 marks.

20. State Newton's laws of motion. Apply Newtons 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. State and explain law of conservation of Angular Momentum for a system of particles. Express the torque acting on a rigid body in a uniform gravitational field in terms of position of centre of mass and the weight of the body.

(1 × 10 = 10 marks)

D 12652 **(Pages : 3)** **Name.....**

Reg. No.....

FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2021

Physics/Applied Physics

PHY 1B 01/APH 1B 01—MECHANICS—I

(2021 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. State Newton's third law of motion and give various examples to illustrate it.
2. What are the fundamental forces in nature ? Compare their strengths.
3. State work-energy theorem for a conservative system. How does dissipative force modify the description ?
4. Explain central force. Show that the work done by a central force is path independent.
5. Obtain the expression for change in acceleration due to gravity with height.
6. Define moment of inertia. How is it related to angular momentum ?
7. What are conservative forces ? Give examples.
8. Show that angular momentum is conserved for a particle in central force motion.
9. Define centre of mass of a system of particles. Obtain an expression for it.
10. Define power of a mechanical system. Calculate the expression for power of an object falling from a height, assuming acceleration due to gravity is a constant.
11. State the law of conservation of linear momentum with one example.
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 5 kg mass moves under the influence of a force $F = \left(4t^2 \hat{i} - 3t \hat{j}\right) N$, where t is the time in seconds, (1N = 1 Newton). It starts at rest from the origin at $t = 0$. Find :

    (a) Its velocity ;

    (b) Its position ; and

    (c) $r \times v$, for any later time.

14. State and prove parallel axis theorem. Apply it to obtain the moment of inertia of a thin stick about its end.

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. Analyze the molecular vibration of a diatomic molecule and calculate the fundamental frequency. Draw the Potential Energy curve.

17. Show that :

    (a) If the total linear momentum of a system of particles is zero, the angular momentum of the system is the same around all origins.

    (b) 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 loaded spring gun, initially at rest on a horizontal frictionless surface, fires a marble at angle of elevation θ .The mass of the gun is M, the mass of the marble is m, and the muzzle velocity of the marble (the speed with which the marble is ejected, relative to the muzzle) is v_0. What is the final motion of the gun ?

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 (Essay Type)

Answer any **one** *question.*
The question carries 11 *marks.*

20. Derive general statement of work-energy theorem for translational motion. Apply this to obtain the escape velocity of a mass projected from earth's surface.

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)

93942-B (Pages : 3) Name.....

Reg. No.....

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 fop 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 $F = \left(4t^2\hat{i} - 3t\hat{j}\right)N$, where t is the time in seconds, (1N = 1 Newton). It starts at rest from the origin at $t = 0$. Find

    (a) Its velocity,

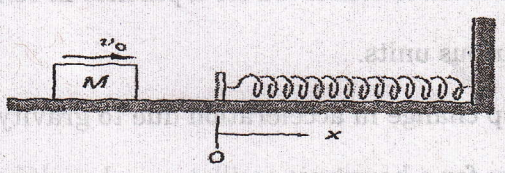
    (b) Its position, and

    (c) r × 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 :

    (a) If the total linear momentum of a system of particles is zero, the angular momentum of the system is the same around all origins.

    (b) 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 $Io = Mb^2/2$. 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 Newtons 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)