D 112254 (Pages : 3) Name.....

Reg. No.....

FIRST SEMESTER (CUFYUGP) DEGREE EXAMINATION
NOVEMBER 2024

Applied Physics/Physics

APH1CJ101/PHY1CJ101—FUNDAMENTALS OF PHYSICS

(2024 Admission onwards)

Time : Two Hours Maximum : 70 Marks

Section A

Answer **all** *questions.*
Each question carries 3 *marks.*
(*Ceiling* : 24 *marks*).

1. Distinguish between inertial and non-inertial frames of reference. Is earth an inertial frame ? Explain.
2. What is meant by apparent weight of a body ? Why does an astronaut in a space station orbiting earth feel weightlessness ?
3. State work-energy theorem. A satellite moving in a stable circular orbit around earth maintains a constant speed. What is the work done by the force of gravity on the satellite ?
4. Distinguish between mass and weight of a body. How can they be measured ?
5. What is the difference between kinetic and static friction ? Why force of friction increases when the two surfaces in contact are made extremely smooth ?
6. Distinguish between conservative forces and non conservative forces with suitable examples.
7. State Newton's third law of motion. A boy tries to lift himself by pulling on the laces of his own shoes. Will he succeed ? Justify your answer.
8. Which feels a greater pull due to the earth's gravity : a 10 kg. stone or a 20 kg. stone ? If you drop the two stones, why doesn't the 20-kg stone fall with twice the acceleration of the 10 kg. stone ? Explain.

Turn over

9. Define Power and give its SI unit. How is power related to the instantaneous velocity of a body ?

10. Discuss the fundamental forces in nature and arrange them in the ascending order of their strengths.

Section B

Answer **all** *questions.*

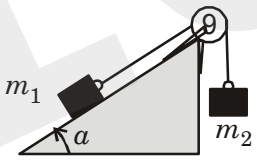
Each question carries 6 *marks.*

(*Ceiling* : 36 *marks*)

11. A crate with mass 32.5 kg. initially at rest on a warehouse floor is acted on by a net horizontal force of 14.0 N. (a) What is the acceleration produced ? ; (b) How far does the crate travel in 10.0 s ? ; (c) What is its speed at the end of 10.0 s ?

12. Define terminal speed of a body. Discuss how fluid resistance force varies for : (i) Small objects moving at very low speeds ; and (ii) For large objects moving at high speeds. Obtain expressions for terminal speeds in the two cases.

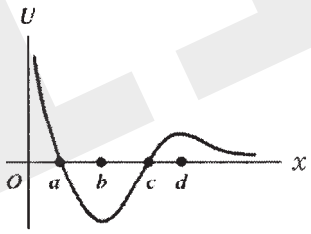
13. Two masses m_1 and m_2 are connected by a rope of negligible mass passing over a smooth frictionless pulley as shown in figure ; (a) Draw the free-body diagrams for m_1 and m_2 ; (b) Find the magnitude of the acceleration of the masses ; (c) What is the tension in the rope while the masses are moving ? Neglect friction between the mass m_1 and the inclined surface.



14. A 25.0 kg. child plays on a swing having support ropes that are 2.20 m. long. Her brother pulls her back until the ropes are 42.0° from the vertical and releases her from rest ; (a) What is her potential energy just as she is released, compared with the potential energy at the bottom of the swing's motion ? ; (b) How fast will she be moving at the bottom ? ; and (c) How much work does the tension in the ropes do as she swings from the initial position to the bottom of the motion ?

15. A 4.80 kg. watermelon is dropped from rest from the roof of an 18.0 m. tall building and feels no appreciable air resistance : (a) Calculate the work done by gravity on the watermelon during its displacement from the roof to the ground ; (b) Just before it strikes the ground, what is the watermelon's ; (i) Kinetic energy ; and (ii) Speed ?

16. A marble moves along the x-axis. The potential-energy function is shown in figure below. At which of the labeled x-co-ordinates is the force on the marble zero ? ; (b) Which of the labeled x-co-ordinates is a position of stable equilibrium ? ; (c) Which of the labeled x-co-ordinates is a position of unstable equilibrium ?



17. An elevator of total mass 1800 kg. is moving up with a constant speed of 2 m/s. A frictional force of 4000 N opposes its motion. Determine the minimum power to be delivered by the motor to the elevator.

18. To simulate car accidents, auto manufacturers study the collisions of moving cars with mounted springs of different spring constants. Consider a typical simulation with a car of mass 1000 kg. moving with a speed of 18 km/h. on a smooth road and colliding with a horizontally loaded spring of spring constant 6.25×10^3 N/m. What is the maximum compression of the spring ?

Section C

Answer any **one** *questions.*

Each question carries 10 *marks.*

19. (i) Discuss the dynamics of a body undergoing uniform circular motion in a horizontal circle and hence bring about the difference between centripetal force and centrifugal force ; and (ii) Explain how banking of curved rods ensures safety of vehicles and reduce wear and tear of the tires.

20. (i) Compare and contrast the concepts of gravitational potential energy of a system and elastic potential energy of a spring-mass system ; (ii) Using suitable energy diagram, discuss the relationship between potential energy and stability of a system ; and (iii) Show graphically the variation of gravitational potential energy and gravitational force with vertical displacement of a body.

(1 × 10 = 10 marks)