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Name.....

Reg. No.....

**THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2018**

(CUCBCSS—UG)

Core Course

PHY 3B 03/APY 3B 03—MECHANICS

Time : Three Hours

Maximum : 80 Marks

I. Answer *all* questions, each question carries 1 mark (in a word or phrase) :

1. Give an example of non-inertial frame of reference.
2. What is centrifugal force ?
3. Write down the relation between angular momentum and torque.
4. Give an example of motion under central force.
5. Give the significance of principle of virtual work.
6. Write down the expression for escape velocity.
7. What is gravitational potential ?
8. What are constraints ?
9. Write down Lagrange's equation of motion.
10. Give the significance of mass - energy equation.

(10 × 1 = 10 marks)

II. Answer *all* questions, each question carries 2 marks (Answer in two or three sentence) :

11. A light and heavy body have equal kinetic energies of translation. Which one has the larger momentum ? Why ?
12. What is the principle of rocket ?
13. What is Kepler's law of orbits ?
14. Give examples for non-holonomic constraints.
15. State any one conservation law.
16. What is the importance of geometrical interpretation of Lorentz transformation ?
17. Explain what is meant by simultaneity ?

(7 × 2 = 14 marks)

Turn over

III. Answer any *five* questions, each question carries 4 marks (Answer in a *paragraph*):

18. What is a fictitious force? Why is it so called? Under what condition will an accelerated frame of reference serve as an inertial frame?
19. Obtain an expression for restoring force as a function of position for a particle moving in a potential energy field  $U = A - Bx + Cx^2$ . At what point does the force vanish? Is this a point of stable equilibrium? If so find the value of the force constant.
20. What is gravitational potential energy? Derive an expression for escape velocity.
21. State and explain Kepler's laws of planetary motion.
22. State the principle of virtual work and hence to derive D'Alembert's principle.
23. State and explain the three conservation laws.
24. Briefly explain the concept of four vectors and give its importance.

(5 × 4 = 20 marks)

IV. Answer any *four* questions, each question carries 4 marks:

25. What will be the period of rotation of the plane of oscillation of Foucault's pendulum (i) in latitudes  $30^\circ$  and  $45^\circ$  (ii) at the equator.
26. The position of a moving particle is at any instant given by  $r = A \cos \theta i + A \sin \theta j$ . Calculate the total energy of the particle.
27. What is the momentum of an electron of kinetic energy 100 electron volts?
28. 20 gram of cane sugar is dissolved in water to make  $50 \text{ cm}^3$  solution. A 20 cm length of this solution causes a rotation of  $53^\circ 30'$  optical rotation. Calculate the specific rotation.
29. Show from Lorentz transformation that two events simultaneous at different positions in a reference frame S are not in general simultaneous in another reference frame S'.
30. A proton of rest mass  $1.67 \times 10^{-24} \text{ gm}$  is moving with velocity  $0.9c$ . Find its mass and momentum.
31. Determine the time (as measured by a clock at rest on a rocket) taken by a rocket to reach a distant star and return to earth with a constant velocity  $v = (0.9999)^{1/2} c$  if the distance of the star is 4 light years.

(4 × 4 = 16 marks)

V. Answer any *two* questions, each question carries 10 marks :

32. What is an inertial frame of reference ? Show that all other frames of reference, with constant velocity relative to it, are also inertial frames. What are the characteristic properties and importance of such frames ? Can the earth be regarded as one such frame ?
33. A satellite of mass  $M$  is going round the earth in a circular orbit of radius  $R$ . Obtain an expression for its angular momentum about the centre of its orbit. Also express the total energy of the satellite in terms of its angular momentum.
34. Derive Lorentz's transformation equation.
35. Explain Hamilton's principle and hence deduce Lagrange's equation of motion. Give any one of its application.

(2 × 10 = 20 marks)