# Sikkim Public Service Commission
### Written (Main) Examination for the post of
### Sub-Jailer

| Time Allowed: 3 hours | PAPER – II PHYSICS | Maximum Marks: 250 |
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## INSTRUCTIONS TO CANDIDATES

*Read the instructions carefully before answering the questions: -*

1. **This Test Booklet consists of 12 (twelve) pages and has 63 (sixty-three) printed questions.**
2. **IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS BOOKLET DOES NOT HAVE ANY UNPRINTED, TORN OR MISSING PAGES OR ITEMS. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.**
3. **Use only Black Ball Point Pen to fill the OMR Sheet.**
4. Please note that it is the candidate's responsibility to fill in the Roll Number carefully without any omission or discrepancy at the appropriate places in the **OMR ANSWER SHEET** as well as on **SEPARATE ANSWER BOOKLET** for Conventional Type Questions. Any omission/discrepancy will render the Answer Sheet liable for rejection.
5. Do not write anything else on the OMR Answer Sheet except the required information. Before you proceed to mark in the OMR Answer Sheet, please ensure that you have filled in the required particulars as per given instructions.
6. This Test Booklet is divided into 3 (three) parts – **Part-I, Part-II** and **Part-III**.
7. All three parts are **Compulsory**.
8. **Part-I consists of Multiple-Choice Questions**. The answers for these questions have to be marked in the **OMR Answer Sheet** provided to you.
9. **Parts II and III consist of Conventional Type Questions.** The answers for these questions have to be written in the **Separate Answer Booklet** provided to you.
10. After you have completed filling in all your responses on the OMR Answer Sheet and the Answer Booklet(s) and the examination has concluded, you should hand over the OMR Answer Sheet and the Answer Booklet(s) to the Invigilator only. You are permitted to take the Test Booklet with you.
11. **Marking Scheme**
    THERE WIL BE **NEGATIVE MARKING** FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBECTVE TYPE QUESTIONS
    (i) There are four alternatives for the answer to every question. **For each question for which a wrong answer has been given by the candidate, one-third of the marks assigned to the question will be deducted as penalty.**
    (ii) If a candidate gives more than one answer, it will be treated as a wrong answer even if one of the given answers happens to be correct and there will be same penalty as above to the question.
    (iii) If a question is left blank. i.e., no answer is given by the candidate, there will be no penalty for that question.

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**DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO**

**PART – I**
**(Multiple Choice Questions)**

*Choose the correct answer for Questions 1 to 50 from the given options. Each question carries 3 marks.*

*[50 x 3 = 150]*

1. In SI, how many units are used as base units?
    (a) 3
    (b) 5
    (c) 7
    (d) 9

2. Which one of the following is the correct dimensional formula for kinetic energy?
    (a) $M^0L^2T^2$
    (b) $M^1L^2T^{-2}$
    (c) $M^1L^1T^2$
    (d) $M^1L^1T^{-2}$

3. The second law of motion is applicable to a single point particle. The force **F** in the law stands for the -
    (a) Net external force
    (b) Net internal force
    (c) Both external and internal force
    (d) None of the above

4. A ball released from rest on one of the planes rolls down and climbs up the other. If the planes are smooth, but the slope of the second plane is less than first one, the ball will reach the _____ height, but it will travel a _____ distance.
    (a) lesser, longer.
    (b) longer, lesser.
    (c) same, lesser.
    (d) same, longer.

5. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds. What is its angular acceleration, assuming the acceleration to be uniform?
    (a) $4.25\pi\ rad/s^2$
    (b) $3.5\pi\ rad/s^2$
    (c) $4.0\pi\ rad/s^2$
    (d) $5.0\pi\ rad/s^2$

6. Geostationary Satellites rotates around the earth in:
    (a) 86400 seconds
    (b) 85400 seconds
    (c) 12 hours
    (d) 21 hours

7. Elastomers do not obey _____.
    (a) Newton's Law
    (b) B. Hook's Law
    (c) Coulomb's Law
    (d) Bernoulli's Law

8. In the absence of flow, the _____ in the fluid must be same everywhere in a horizontal plane.
    (a) pressure
    (b) b. density
    (c) velocity
    (d) depth

9. In Bernoulli's equation, the term $\rho gh$ is related with -
    (a) Potential energy per unit volume
    (b) potential energy
    (c) Kinetic energy per unit volume
    (d) Kinetic energy

10. In viscosity, the layer of the liquid in contact with top surface moves with:
    (a) Lowest velocity
    (b) Stationary
    (c) Highest velocity
    (d) Constant velocity

11. The unit of Surface tension is:
    (a) *pascal*
    (b) *degree kelvin*
    (c) *newton meter*
    (d) *newton meter$^{-1}$*

12. In liquid–in–glass thermometers, which property of liquid is used which varies linearly with temperature over a wide range?
    - (a) Pressure
    - (b) Volume
    - (c) Length
    - (d) Surface area

13. The triple point of water is represented by the temperature $273.16\,K$ and pressure _____.
    - (a) $6.11 \times 10^{-1}\,Pa$
    - (b) $6.11 \times 10^{1}\,Pa$
    - (c) $6.11 \times 10^{2}\,Pa$
    - (d) $6.11 \times 10^{3}\,Pa$

14. In isochoric processes, which property of the system remains constant?
    - (a) Pressure
    - (b) Volume
    - (c) Temperature
    - (d) All of the above

15. For monatomic gases, the ratio of specific $(C_p/C_v)$ is given by -
    - (a) 5/3
    - (b) 3/5
    - (c) 4/3
    - (d) 5/5

16. How is the mean free path of a gas related to the number density of gas molecules?
    - (a) Inversely
    - (b) Inverse square
    - (c) Inverse cube
    - (d) Not related

17. On an average, a human heart is found to beat 75 times in a minute. Calculate its time period.
    - (a) 0.7 seconds
    - (b) 0.9 seconds
    - (c) 1.0 seconds
    - (d) 0.8 seconds

18. At resonance, driving force is close to _____ frequency of the oscillator.
    - (a) one third of the natural
    - (b) the natural
    - (c) half of the natural
    - (d) one-fourth of the natural

19. The dimension of phase constant is:
    - (a) radian
    - (b) degree
    - (c) dimensionless
    - (d) second

20. In vacuum, _____ electromagnetic waves travel with speed of light.
    - (a) only X ray
    - (b) only matter wave
    - (c) only radio waves
    - (d) All of the above

21. The speed of sound wave in gases is _____ than solids.
    - (a) faster
    - (b) slower
    - (c) equal
    - (d) None of the above

22. The points in the standing waves at which the amplitude is the largest are called as -
    - (a) Nodes
    - (b) Antinodes
    - (c) Normal Mode
    - (d) All of the above

23. Which one of the following is **NOT** the basic unit of charge?
    - (a) $e = 1.602192 \times 10^{-19}C$
    - (b) $e = 1.602192 \times 10^{-13}\mu C$
    - (c) $e = 1.602192 \times 10^{-16}mC$
    - (d) $e = 1.602192 \times 10^{-18}C$

24. Which force is weaker?
    - (a) Electrostatic
    - (b) Gravitational
    - (c) Both are of equal strength
    - (d) None of the above

25. Electric Potential between two opposite and equal charges of $1C$ placed at infinite distance is given by -
    (a) K
    (b) (1/K)
    (c) zero
    (d) infinite

26. Electrostatic potential is _____ throughout the volume of the conductor.
    (a) zero
    (b) constant
    (c) equal to 1
    (d) All of the above

27. Relation between *gauss* and *tesla* is given by -
    (a) $1\ gauss = 10^{-4}\ tesla$
    (b) $1\ gauss = 10^{4}\ tesla$
    (c) $1\ gauss = 10^{-3}\ tesla$
    (d) $1\ gauss = 10^{3}\ tesla$

28. Cyclotron frequency is given by:
    (a) $qB/2\pi m$
    (b) $qm/2\pi B$
    (c) $qE/2m\pi$
    (d) $qd/2m$

29. Relation between $\varepsilon_0$, the permittivity of free space, $\mu_0$, the permeability of free space and $c$, the speed of light in vacuum is given by -
    (a) $\varepsilon_0/\mu_0 = c$
    (b) $\varepsilon_0/\mu_0 = 1/c$
    (c) $\mu_0/\varepsilon_0 = c^2$
    (d) $\sqrt{\varepsilon_0\mu_0} = 1/c$

30. To convert a galvanometer into an ammeter we attach -
    (a) a high resistance in parallel to the galvanometer coil.
    (b) a high resistance in series to the galvanometer coil.
    (c) a small resistance in parallel to the galvanometer coil.
    (d) a small resistance in series to the galvanometer coil.

31. The expression for the Lorentz force is -
    (a) $F = q(v \times B + E)$
    (b) $F = q(v \times B + E)$
    (c) $F = q(v \times B + E)$
    (d) $\boldsymbol{F} = q(\boldsymbol{v} \times \boldsymbol{B} + \boldsymbol{E})$

32. Gauss's law for magnetism is:
    (a) The net magnetic flux through any open surface is zero.
    (b) The net magnetic flux through any closed volume is zero
    (c) The net magnetic flux through any closed surface is zero.
    (d) All of the above.

33. The units of self-inductance and mutual inductance are ____ and ____ respectively.
    (a) henry, volts
    (b) volts, henry
    (c) volts, volts
    (d) henry, henry

34. In Alternating Current, the *rms* current *I* is related to the peak current $i_m$ by -
    (a) $I = i_m/\sqrt{2}$
    (b) $I = i_m\sqrt{2}$
    (c) $I = i_m/2$
    (d) $I = 2i_m$

35. A pure inductor of 25.0 mH is connected to a source of 220 V. Find the inductive reactance and rms current in the circuit if the frequency of the source is 50 Hz.
    (a) 7.85Ω and 28 A
    (b) 7.35Ω and 28 A
    (c) 7.85Ω and 23 A
    (d) 7.85Ω and 20 A

36. Apart from an LCR circuit, resonance can be achieved in _____ circuit.
    (a) R
    (b) RC
    (c) RL
    (d) None of the above

37. Wattless current flows in -
    (a) purely inductive circuit.
    (b) purely capacitive circuit.
    (c) both (a) and (b).
    (d) None of the above.

38. Eddy currents can be is reduced by using a:
    (a) binding coil with one over the other.
    (b) thick wire.
    (c) laminated core.
    (d) material with low hysteresis loss.

39. A simple microscope is a converging lens of _____.
    (a) large focal length
    (b) small focal length
    (c) large area of aperture
    (d) small area of aperture

40. In Hydrogen spectra, which series lies in visual region -
    (a) Lymen
    (b) Balmer
    (c) Paschen
    (d) Brackett

41. The operation of a nuclear reactor said to be critical _____.
    (a) for K = 1
    (b) for K > 1
    (c) for K < 1
    (d) for K = 0

42. Which of the following statements is **INCORRECT**?
    (a) The density of nuclear matter is independent of the size of the nucleus.
    (b) The mass density of the atom is independent of the size of the nucleus.
    (c) Fusion requires very high temperatures.
    (d) Electrons and positron are a particle-antiparticle pair.

43. Under equilibrium, the *net* current in the PN junction is _____.
    (a) due to drift current.
    (b) due to diffusion current.
    (c) due to diffusion and drift current.
    (d) No current.

44. Which components are used for filter circuit?
    (a) Resistance
    (b) Inductance
    (c) Diode
    (d) Semiconductor

45. Voltage regulation can be achieved by -
    (a) Intrinsic semiconductor
    (b) Extrinsic semiconductor
    (c) PN diode
    (d) Zener diode

46. Devices, which convert optical radiation into electricity, are known as -
    (a) LED
    (b) Photodiodes
    (c) Photovoltaic
    (d) Oscillators

47. Maximum kinetic energy of photoelectron is given by ($V_0$ is the stopping potential) -
    (a) $K_{max} = eV_0$
    (b) $K_{max} = 2eV_0$
    (c) $K_{max} = 3eV_0$
    (d) $K_{max} = 4eV_0$

48. Photons have -
    (a) positive charge
    (b) negative Charge
    (c) no Charge
    (d) None of the above

49. Two slits are made one millimetre apart and the screen is placed one meter away. What is the fringe separation when blue green light of wavelength 500 nm is used?
    (a) 0.5 mm
    (b) 0.6 mm
    (c) 0.4 mm
    (d) 0.3 mm

50. $I = I_0 \cos^2 \theta$ law was given by -
    (a) De Broglie
    (b) Einstein
    (c) Malus
    (d) Young

## PART – II
### (Conventional Type Questions)
*Answer any 2 (two) from Questions 51 to 55. Each question carries 25 marks.*

[2 x 25 = 50]

51. (a)   Determine the moment of Inertia for a solid sphere.
     (b)   Explain the bending of beam.

52. What do you understand by a damped oscillator? Determine the resonance frequency in a Forced oscillator.

53. (a)   Explain Raman Effect.
     (b)   Discuss the dual nature of light with examples.

54. Name the different parts of a nuclear reactor and explain the working of a nuclear reactor.

55. (a)   Explain Bragg's law.
     (b)   Discuss how can you record and reproduce sound.

## PART – III
### (Conventional Type Questions)
*Answer any 5 (five) from Questions 56 to 63. Each question carries 10 marks.*

[5 x 10 = 50]

56. Explain in short, the working of an AC generator.

57. What do you understand by Hall Effect? Write two uses of Hall coefficient.

58. Draw circuit diagram of transistor amplifier and oscillator circuit.

59. Write and explain Maxwell's relation of thermodynamics.

60. Explain Doppler Effect.

61. Explain the working of a telescope.

62. Write the basic postulate of special theory of relativity.

63. Explain the polarization of light by Huygen's principle.

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