

GU-RET 2016

GAUHATI UNIVERSITY RESEARCH ELIGIBILITY TEST

PHYSICAL SCIENCE

Booklet Series :

A

Invigilator's Name and Signature

BOOKLET NO.

OMR SHEET NO.

ROLL NO.

--	--	--	--	--	--	--	--	--	--

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TIME : 2 HOURS 20 MINUTES

TOTAL MARKS : 80

Number of Pages in this Booklet : 18

Instructions for Candidates

1. Write your Roll No. and OMR Sheet No. in the boxes provided above.
2. This paper consists of two sections : **Section B** with 50 (fifty) multiple choice questions (MCQ) and **Section C** with 6 (six) descriptive questions. Each MCQ has 4 (four) answers, out of which **ONLY** one is correct. You have to darken the circle (on the OMR Sheet) for the correct answer corresponding to the question given in this booklet.

Example : (A) (B) (C) (D)

where (C) is the correct answer. No marks will be given for markings made in this booklet. The descriptive questions in **Section C**, **MUST** be answered in the space provided in this booklet. **No extra pages will be provided in any case.**

3. Use a BLACK ball point pen in your OMR Sheet.
4. Read the instructions given inside this booklet before attempting to answer any questions.
5. **DO NOT** write your name, roll no, phone no, or anything, or put any marks anywhere in this booklet, otherwise your candidature will be disqualified.
6. If you are found to resort to any kind of unfair means such as carrying extra material other than pen, pencil, watch, eraser, and scale, or copying from somebody or from external material, your candidature will be disqualified.
7. Use of mobile phones, programmable calculators, log tables or any other tables, wearable smart devices such as smart Android watches or objects of similar nature **CAN NOT** be used inside the examination hall.
8. At the end of the examination, you have to return this booklet and the OMR Sheet back to the invigilator.
9. There is no negative marks for incorrect answer.

GURBEL 2016

This page is left intentionally blank

Section B (50 Marks)

1. In an e.m. wave, the direction of magnetic field induction \mathbf{B} is
 - (A) parallel to electric field vector \mathbf{E}
 - (B) perpendicular to electric field vector \mathbf{E}
 - (C) random
 - (D) None of these
2. The energy of e.m. waves in vacuum is
 - (A) $\frac{E^2}{2\epsilon_0} + \frac{B^2}{2\mu_0}$
 - (B) $\frac{\epsilon_0 E^2}{2} + \frac{B^2}{\mu_0}$
 - (C) $\frac{E^2 + B^2}{c}$
 - (D) $\frac{\epsilon_0 E^2}{2} + \frac{B^2}{2\mu_0}$
3. The de-Broglie wavelength of a charge q , accelerated through a potential difference of V volts is:
 - (A) $\lambda = \frac{h}{\sqrt{mqV}}$
 - (B) $\lambda = \frac{hm}{\sqrt{qV}}$
 - (C) $\lambda = \frac{h}{\sqrt{2mqV}}$
 - (D) $\lambda = \frac{h}{mqV}$
4. The quantum mechanical operator for the momentum of a particle moving in one dimension is given by:
 - (A) $i\hbar \frac{d}{dx}$
 - (B) $-i\hbar \frac{\partial}{\partial x}$
 - (C) $i\hbar \frac{\partial}{\partial t}$
 - (D) $-\frac{\hbar^2}{2m} \frac{d^2}{dx^2}$
5. Insertion of dielectric material between the plates of a capacitor
 - (A) increases the capacitance
 - (B) decreases the capacitance
 - (C) results in no change in capacitance
 - (D) None of these
6. In Stern-Gerlach experiment, the magnetic field is
 - (A) uniform
 - (B) inhomogeneous
 - (C) radial
 - (D) None of these
7. The value of probability of an event cannot be:
 - (A) Zero
 - (B) 1
 - (C) $\frac{1}{2}$
 - (D) negative
8. Which of the following statements is true?
 - (A) Fermions are distinguishable whereas bosons are not
 - (B) Bosons are distinguishable, whereas fermions are not
 - (C) Both fermions and bosons are distinguishable
 - (D) Both fermions and bosons are indistinguishable
9. Materials which become electrically polarized when mechanical stress is applied is known as
 - (A) Ferroelectric
 - (B) Piezoelectric
 - (C) Pyroelectric
 - (D) None of these
10. A given amount of heat cannot be completely converted into work. However, it is possible to convert a given amount of work completely into heat. This statement results from
 - (A) Zeroth law of thermodynamics
 - (B) First law of thermodynamics
 - (C) Second law of thermodynamics
 - (D) Third law of thermodynamics

11. The combined form of first and second law of thermodynamics is given by
- (A) $TdS = dU + PdV$
 (B) $dQ = TdS + PdV$
 (C) $dU = TdS + dQ$
 (D) $TdS = dU - PdV$
12. Bosons have
- (A) odd half integral spin
 (B) zero or integral spin
 (C) any fractional spin
 (D) None of the above
13. The work done on the charges by the e.m. force is equal to decrease in energy stored in the field less the energy which flowed through the surface. This is the statement of
- (A) Gauss's Theorem
 (B) Stoke's Theorem
 (C) Gauss's Divergence Theorem
 (D) Poynting Theorem
14. Good absorbers are good emitters. This concept is given by
- (A) Prevot's Law
 (B) Kirchoff's Law
 (C) Stefan's Law
 (D) Wien's Law
15. Curie temperature of iron is that temperature below which it is
- (A) ferromagnetic
 (B) electrically conducting
 (C) superconducting
 (D) radioactive
16. A Curie is the standard unit of radioactivity. Its value is
- (A) 10^9 disintegrations per second
 (B) 2.7×10^{10} disintegrations per second
 (C) 3.7×10^{10} disintegrations per second
 (D) None of these
17. With increase of temperature, the Fermi level moves in n -type semiconductor
- (A) upwards
 (B) downwards
 (C) remains unchanged
 (D) None of the above
18. Relaxation time may be defined as the time taken by an electron to reduce its velocity to of its initial value
- (A) $\frac{1}{2}$
 (B) $\frac{1}{3}$
 (C) $\frac{1}{e}$
 (D) $\frac{1}{2e}$
19. The relation between polarisability and dielectric constant of a material is given by
- (A) Clausius-Mossoti Relation
 (B) Thomson Relation
 (C) Curie-Weiss Relation
 (D) None of the above
20. The energy gap in superconductors is maximum at
- (A) critical temperature
 (B) above critical temperature
 (C) below critical temperature
 (D) at 0 K
21. A superconductor is perfectly
- (A) diamagnetic
 (B) dielectric
 (C) insulator
 (D) None of the above
22. The surface area to volume ratio is for nanomaterials
- (A) very large
 (B) very less
 (C) moderate
 (D) None of the above

23. Propagation of light through optical fibre core is due to

- (A) diffraction
- (B) interference
- (C) total internal reflection
- (D) refraction

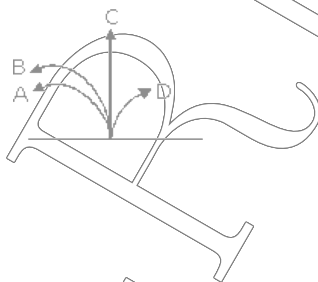
24. A $p-n$ junction can be used as solar cell because it exhibits property

- (A) rectifier
- (B) photovoltaic
- (C) both (A) and (B)
- (D) None

25. The splitting of spectral lines in the presence of an electric field is called

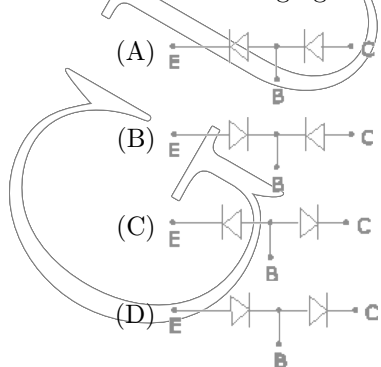
- (A) Stark Effect
- (B) Zeeman Effect
- (C) Paschen-Back Effect
- (D) Raman Effect

26. A neutron, a proton, an electron and an α -particle enter a region of uniform magnetic field with the same velocities. The magnetic field is perpendicular and directed into the plane of the paper. The tracks of the particles are labeled in the figure. The electron follows the track



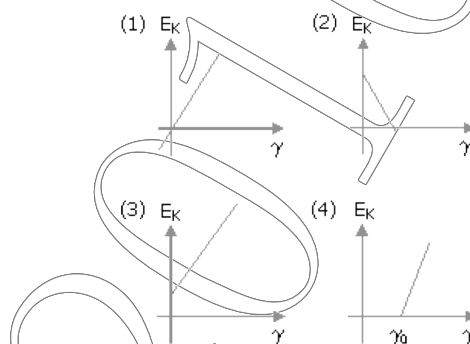
- (A) D
- (B) C
- (C) B
- (D) A

27. An $n-p-n$ transistor can be considered to be equivalent to two diodes, connected. Which of the following figures is the correct one?



- (A)
- (B)
- (C)
- (D)

28. Which one of the following graphs represents the variation of maximum kinetic energy E_K of the emitted electrons with frequency γ in photoelectric effect correctly?

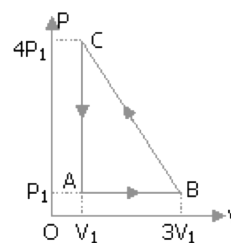


- (A) 1
- (B) 2
- (C) 3
- (D) 4

29. X-rays are created when

- (A) protons strike a metal target
- (B) neutrons strike a metal target
- (C) photons are incident on a surface
- (D) electrons strike a metal target

30. An ideal gas is taken via path $ABCA$ as shown in figure. The network done in the whole cycle is

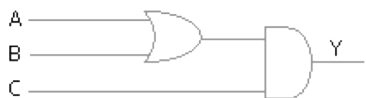


- (A) $3P_1V_1$
- (B) $-3P_1V_1$
- (C) $6P_1V_1$
- (D) zero

31. The spontaneous decay of nuclei is called

- (A) Absorption
- (B) Radioactive Decay
- (C) Ultraviolet Explosion
- (D) Photoelectric Effect

32. To get an output $y = 1$ from the circuit shown, the inputs A , B , and C must be respectively



- (A) 0, 1, 0
- (B) 1, 0, 0
- (C) 1, 0, 1
- (D) 1, 1, 0

33. If we travel round the earth, we would find that the earth's magnetic field

- (A) is the same in direction and magnitude everywhere
- (B) varies in direction but not in magnitude
- (C) varies in magnitude but not in direction
- (D) varies in both direction and magnitude

34. At sea level ice melts at 0°C . In order to keep it frozen at higher temperatures it is necessary to

- (A) put it under enhanced pressure
- (B) to put under reduced pressure
- (C) sprinkle salt on it
- (D) none of these things will make any difference

35. When an electron jumps from an orbit where $n = 1$ to $n = 4$, its energy in terms of the energy of the ground level (E_1) is

- (A) $E_1/9$
- (B) $E_1/16$
- (C) $16E_1$
- (D) $4E_1$

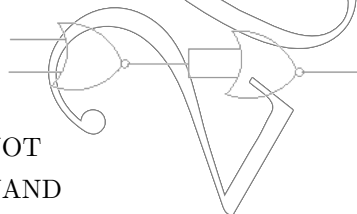
36. Classical physics could not explain the behavior of a black body radiator at very short wavelengths. What was this problem called?

- (A) Absorption failure
- (B) Ultraviolet Explosion
- (C) Wavelength decrease
- (D) Photoelectric Effect

37. Which of the following photons has the greatest energy?

- (A) Infrared
- (B) Ultraviolet
- (C) X-ray
- (D) γ -ray

38. Identify the logic operation performed by the circuit given below



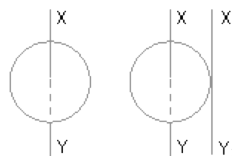
- (A) NOT
- (B) NAND
- (C) OR
- (D) NOR

39. The maximum kinetic energy of photoelectrons depends on which of the following?

1. The light intensity
2. The frequency of the light
3. The material of the photoelectric cell

- (A) Only 1
- (B) Only 2
- (C) Only 3
- (D) Only 2 and 3

40. The moment of inertia of a circular disc of radius 2 m and mass 1 kg about an axis passing through the centre of mass but perpendicular to the plane of the disc is 2 kg m^2 . Its moment of inertia about an axis parallel to this axis but passing through the edge of the disc is (See the given figure).



- (A) 10 kg m^2
- (B) 6 kg m^2
- (C) 8 kg m^2
- (D) 4 kg m^2

41. Which one of the following objects, moving at the same speed, has the greatest de Broglie wavelength?
- (A) Neutron
 - (B) Electron
 - (C) Tennis ball
 - (D) α particle
42. Quantum tunneling occurs in
- (A) nuclear fusion
 - (B) radioactive decay by emission of alpha particles
 - (C) the scanning tunneling microscope
 - (D) All the above
43. A particle has a total energy that is less than that of a potential barrier. When the particle penetrates the barrier, its wave function is
- (A) a positive constant
 - (B) exponentially decreasing
 - (C) exponentially increasing
 - (D) oscillatory
44. Knowledge of the wave function of a particle enables the probabilities of the particle's position, momentum, energy and other characteristics to be calculated. In classical physics, what is the analogue of the wave function?
- (A) Particle's momentum
 - (B) Sum of the forces on the particle
 - (C) Particle's energy
 - (D) Particle's velocity
45. The fundamental observables associated with the motion of a single quantum mechanical particle are
- (A) E and P operators
 - (B) x and E operators
 - (C) L and P operators
 - (D) x and P operator
46. If one attempts to include the relativistic rest energy into the Schrödinger equation, the result is either the Klein-Gordon equation or the
- (A) uncertainty equation
 - (B) wave function
 - (C) Delta equation
 - (D) Dirac equation
47. A differential equation together with the initial condition is called
- (A) conditioned problem
 - (B) boundary value problem
 - (C) initial value problem
 - (D) None of the above
48. If the adjoint of a matrix is equal to the matrix itself, it is called
- (A) orthogonal
 - (B) orthonormal
 - (C) Hermitian
 - (D) unitary
49. Which of the following statements best describes the quantum property — spin?
- (A) Spin is a measure of the rotation rate of a subatomic particle
 - (B) Spin is a measure of the rate at which a particle spins around (orbits) another particle
 - (C) Spin is a property that applies only to large objects, like baseballs
 - (D) Spin is not meant to be taken literally but measures the inherent angular momentum of a subatomic particle
50. When an e.m. field is irrotational but not solenoidal, then
- (A) curl is zero, but divergence is not zero
 - (B) divergence is zero, but curl is not zero
 - (C) both divergence and curl are zero
 - (D) neither divergence nor curl is zero, but gradient is zero

Section C (30 Marks)

Answer any 5 (five) from the following

1. What are soft and hard magnetic materials? How does the Hysteresis curve of a sample of ferromagnetic material determine its suitability for use in (i) Electromagnet and (ii) a permanent magnet? (Marks : 6)

2. What are Statistical Ensembles? Discuss in brief the three standard ensembles. (Marks : 6)

3. Discuss the basic structure of a JFET. (Marks : 6)

4. Verify Stoke's theorem when S is the rectangle vertices at $(0, 0, 0)$, $(1, 1, 0)$, $(0, 0, 1)$, and $(1, 1, 1)$ and $F = yz\hat{i} + xz\hat{j} + xy\hat{j}$. (Marks : 6)

5. Using Gauss' theorem in Magnetostatic and applying Divergence Theorem, prove that magnetic field is solenoidal in nature. (Marks : 6)

6. There is a quantum mechanical system of ' N ' harmonic oscillators with frequency ω and total energy E . Compute the entropy S and the temperature T . (Marks : 6)

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GURPREET 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GURPREET 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010

Space for Answers (Section C) : for Questions 1 to 5 (10 pages)

GUARANTEED 2010