SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION, TUMKUR.

(Declared as Deemed to be University under Section 3 of UGC act 1956)

Ph.D. Model Question Paper

SUBJECT : Physics

TIME: 3.00 Hrs MAX MARKS: 100

1.	As one moves along the line of stability from ^{5}Fe to ^{235}U nucleus, the nuclear binding energy per particle decreases from about 8.8 MeV to 7.6 MeV. This trend is:

(a) Short-range nature of nuclear forces	(b) Long-range nature of the Coulomb forces
(c) Tensor nature of the nuclear forces	(d) Spin dependence of the nuclear forces

2.	Show, by way of computation, which nuclei you would expect to be more stable: $_{3}Li^{7}$ or $_{3}Li^{8}$ or $_{4}Be^{9}$ or $_{4}Be^{10}$

(a) $_{3}Li^{7}$, $_{4}Be^{9}$	(b) $_{3}Li^{7}$, $_{4}Be^{10}$
(c) $_{3}Li^{8}$, $_{4}Be^{9}$	(d) $_{3}Li^{8}$, $_{4}Be^{10}$

3.	Find the mass defect of $_{8}O^{17}$ nucleus and binding energy of last neutron in this nucleus. Given 8 : $M(_{8}O^{17})$= 16.99913 amu; $M(_{8}O^{16})$= 16.99492 amu; m_p = 1.00793 amu and m_n = 1.00866 amu.

(a) 4.145 MeV	(b) 5.174 MeV
(c) 8.541 MeV	(d) 7.714 MeV

4.	The binding energy of $_{10}Ne^{20}$ isotope is 160.647 MeV. Calculate its exact mass. Given: m_H = 1.007825 u and m_N = 1.008665 u.

(a) 20.0192 u	(b) 19.992 u
(c) 20.145 u	(d) 19.754 u

5.	Choose the CORRECT statement from the following

(a) Electron does not interact through weak interaction	(b) Neutrino interacts through weak and electromagnetic interaction
(c) Neutron interacts through electromagnetic interaction	(d) Quark interacts through strong interaction but not through weak interaction

6.	Total binding energies of O^{15}, O^{16} and O^{17} are 111.96 MeV, 127.62 MeV and 131.76 MeV, respectively. The energy gap between $^{1}p_{1/2}$ and $^{1}d_{5/2}$ neutron shells for the nuclei whose mass number

	is close to 16, is:

(a) 4.1 MeV	(b) 15.7 MeV
(c)19.8 MeV	(d) 11.5 MeV

7.	The half-life of a radioactive nuclear source is 9 days. The fraction of nuclei which are left undecayed after 3 days is:

(a) $\frac{7}{8}$	(b) $\frac{1}{3}$
(c) $\frac{5}{6}$	(d) $\frac{1}{2^{1/3}}$

8.	The difference in the coulomb energy between the mirror nuclei Cr and Mn is 6 MeV. Assuming that the nuclei have a spherical symmetric charge distribution and that e^2 is approximately 1.0 MeV $^-$fm. The radius of the Mn nucleus is

(a) 4.4 fm	(b) 3.4 fm
(c) 3.9 fm	(d) 4.9 fm

9.	The mean lives of a radioactive substance are 1620 years and 405 years for α-emission and β-emission respectively. Find the time in during which three-fourth of a sample will decay if it is decaying both by α-emission and β -emission simultaneously.

(a) 340 years	(b) 430 years
(c) 449 years	(d) 445 years

10.	Forces binding Neutrons and Protons

(a) vary inversely as r^2	(b) vary inversely as r
(c) act upto a certain point and then become zero	(d) are responsible for the energy released during nuclear fission

11.	In a photoelectric effect experiment a monochromatic light has been used to illuminate the metal surface whose intensity increase with time. Which of the following statement is correct?

(a) The maximum kinetic energy of emitted electron will increase with time.	(b) The photocurrent will increase with time
(c) The stopping potential will increase with time.	(d) The velocity of emitted electron will decrease with time

12.	The uncertainty in the location of a particle is equal to the de-Broglie wavelength then the uncertainty in its velocity is

(a)V	(b) $\frac{V}{2}$
(c) 2V	(d) $\frac{3}{2}V$

13.	For Hydrogen atom, the accidental or coulomb degeneracy for the n = 4 state is

(a)4	(b)16
(c)18	(d)32

14.	Consider the elastic scattering of 50 MeV neutrons from a radius. The phase shifts measured in this experiment are δ_0= 90°, δ_1= 72°,δ_2 =60°, δ_3 =35°, δ_4 = 18°, δ_5 =5° all other phase shift are negligible δ_l ; 0 for l ≥ 6. The total cross-section is (barn)

(a) 5.58	(b) 0.558
(c) 0.0558	(d)55.8

15.	When an X-ray incident upon the surface of NaCl crystal, it is found to give rise to 1st order Bragg reflection at a grazing angle of 8°35', Given the spacing between successive (100) planes in NaCl is 2.820 $\dot{A}$ and sin (8°35') = 0.1491, the wavelength of X-ray is

(a) 0.824 Å	(b) 0.412 Å
(c) 0.434 Å	(d) 0.724 Å

16.	The thermal conductivity of a given material reduces when it undergoes a transition from its normal state to the superconducting state. The reason is:

(a) The cooper pairs can't transfer energy to lattice.	(b) Upon the formation of Cooper pairs, the lattice becomes less efficient in heat transfer.
(c) The electrons in the normal state loose their ability to transfer heat because of their coupling to the cooper pairs.	(d) The heat capacity increases on transition to the superconducting state leading to a reduction in thermal conductivity.

17.	An intrinsic semiconductor with energy gap 1eV has a carrier concentration N at temperature 200 K. Another intrinsic semiconductor has the same value of carrier concentration N at temperature 600 K. What is the energy gap value for the second semiconductor?

(a) (1/3) eV	(b) (3/2) eV
(c) 3 eV	(d) 9 eV

18.	Which of the following statements are not true?

(a) Entropy decreases markedly on cooling a superconductor below the critical temperatures	(b) The electronic contribution to the heat capacity in the superconducting state has ar exponential form with an argument proportional to T^{-1}, suggestive to an energy gap
(c) A type I superconductor is a perfect diamagnet	(d) Critical temperature of superconductors does not vary with the isotopic mass.

19.	Interference can be obtained using

(a) Incandescent white light	(b) highly monochromatic light
(c) fluorescent white light	(d) none of the above

20.	In interference phase change of 180º is due to

(a) reflection of light from the rarer medium	(b) reflection of light from the denser medium
(c) Transmission of light through rarer medium	(d) transmission of light through a denser medium

21.	In the Laser: population inversion refers to

(a) number of atoms in the ground state is equal to the excited state	(b) number of atoms in the ground state is less than the excited state
(c) number of atoms in the ground state is greater than the excited state	(d) number of atoms in the excited state is zero

22.	The intrinsic carrier concentration of germanium at room temperature is $2.5 \times 10^{19}\ m^{-3}$. It is dropped with phosphorus at a rate of 1 phosphorus atom per million atoms of germanium atoms is $5 \times 10^{28}\ m^{-3}$, then the hole concentration if we assume complete ionization of phosphorus atoms is

(a) $1.05 \times 10^{16}\ m^{-3}$	(b) $1.05 \times 10^{10}\ m^{-3}$
(c) $1.05 \times 10^{14}\ m^{-3}$	(d) $1.05 \times 10^{17}\ m^{-3}$

23.	The binding energy of the hydrogen atom (electron bound to proton) is -13.6 eV. The binding energy of positronium (electron bound to positron) is

(a) 13.6/1810 eV	(b) 13.6/2 eV
(c) 13.6 x 1810 eV	(d) 13.6 × 2 eV

24.	If a proton were ten times lighter, then the ground state energy of the electron in a hydrogen atom would be

(a)More	(b) Less
(c)Same	(d) Less or equal depending on the electron mass

25.	The population inversion in a two-level laser material cannot be achieved by optical pumping because

(a) The upward transitions are forbidden but downward transitions are allowed	(b) The upward transitions are allowed but downward transitions are forbidden
(c) The rate of upward transitions is equal to the rate of downward transitions	(d) The spontaneous decay rate of the higher level is very low

26.	In a He-Ne laser, the laser transition takes place in

(a) He only	(b) Ne only
(c) Ne first, then in He	(d) He first, then in Ne

27.	The coherence length of laser light is

(a) Directly proportional to the width of the spectral line	(b) Inversely proportional to the width of the spectral line
(c) Inversely proportional to the length of the active lasing medium	(d) Directly proportional to the length of the active medium

28.	The number of normal Zeeman splitting components of $^1P \rightarrow {}^1D$ transition is

(a)3	(b)4
(c)8	(d)9

29.	The hyperfine splitting of the spectral lines of an atom is due to

(a) The coupling between the spins of two or more electrons	(b) The coupling between the spins of the orbital angular momentum of the electrons
(c) The coupling between the electrons spin and the nuclear spin	(d) The effect of external electromagnetic fields

30.	What is the order of reverse current of the diode

(a) kA	(b) A
(c) mA	(d) μA

31.	JFET is _____ transistor

(a) Unipolar	(b) Not transistor
(c) Bipolar	(d) none of the above

32.	A high pass filter generally consist of

(a) Capacitor in series	(b) Capacitor in shunt
(c) Inductor in series	(d) all

33.	Temperature coefficient of thermistor is

(a) Zero	(b) Positive
(c) Negative	(d) none

34.	Thermocouple consists of

(a) two dissimilar metals	(b) two similar metals
(c) metal and a semiconductor	(d) metal and ceramic

35.	The Wien bridge oscillator uses _____ feedback

(a) Positive	(b) Negative
(c)Both	(d) No feedback

36.	High frequency signals are

(a) Modulating signal	(b) Carries signal
(c) Both	(d) None

37.	A BJT is said to be operating in the saturation region if

(a) Both junctions are reverse biased	(b) Base - emitter junction is reverse biased and base collector junction is forward biased
(c) Base - emitter junction is forward biased and base - collector junction reverse biased	(d) Both the junctions are forward biased

38.	If for Si npn transistor, the base-to-emitter voltage (V_{BE}) is 0.7 V and collector to base voltage (V_{CB}) is 0.2 V then the transistor is operated in the

(a) Normal active mode	(b) Saturation mode
(c) Inverse active mode	(d) Cut off mode

39.	A bulb in a staircase has two switches, one switch being on the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by one of the switches irrespective of the state of the other switch. The logic of switching of the bulb

(a) AND gate	(b) NAND gate
(c) OR gate	(d) XOR gate

40.	Consider Hamiltonian system with a potential energy function by $V(x) = x^2 – x^4$, which of the following is correct?

(a) The system has one stable point	(b) The system has two stable points
(c) The system has five stable points	(d) The system has three stable points

41.	Half-life of an unstable particle is 2 μs when it is moving with speed 0.6c. Its half-life when it moves with speed 0.8c

(a) 3.33 s	(b) 4.24 s
(c) 2.21 s	(d) 2.27 s

42.	(I) The work done by the magnetic force on a moving charge particle is zero. (II) The magnetic force tends to change the direction of a moving charge particle in a direction perpendicular to both the magnetic field and the instantaneous velocity of the particle.

(a) (I) & (II) both are false	(b) Both (I) & (II) are true
(c) (I) is true but (II) is false	(d) (I) is false but (II) is true

43.	A small magnet is dropped down a long vertical copper tube in a uniform gravitational field. After a long time, the magnet

(a) Attains a Constant Velocity	(b) Moves with a Constant Acceleration
(c) Moves with a Constant Deacceleration	(d) Executes Simple Harmonic Motion

44.	According to Kirchoff's laws for the circuits the sum of the currents any junction is equal to zero. Which of the following equations for the current density $\vec{J}$ describes the situation?

(a) $\vec{\nabla} \times \vec{J} = 0$	(b) $\vec{\nabla} \cdot \vec{J} = 0$
(c) $\nabla^2 \vec{J} = 0$	(d) $\frac{\partial \vec{J}}{\partial t} = 0$

45.	When light travels along the optic axis of quartz, which of the following statements are correct regarding occurrence of optical activity and double refraction?

(a) Only optical activity is observed	(b) Only double reflection is observed
(c) Both are observed and are at their maximum	(d) None of the two is observed along the optic axis

46.	For a charged particle moving in a uniform magnetic field, acceleration is maximum when-

(a) Velocity is parallel to the magnetic field	(b) Angle between velocity and magnetic field is 45º
(c) Angle between velocity and magnetic field is 35º	(d) Velocity is perpendicular to magnetic field

47.	Two polarizing sheets have their polarizing directions parallel so that the intensity of the transmitted light is maximum. If the intensity is to drop by one half then either of the two sheets must be turned by

(a) $\pm$ 45º and $\pm$ 135º	(b) $\pm$ 30º and $\pm$ 135º
(c) $\pm$ 45º and $\pm$ 120º	(d) $\pm$ 30º and $\pm$ 120º

48.	A given calcite plate behaves as a half-wave plate for a particular wavelength λ. If the variation of refractive index with λ is negligible, then for a light of wavelength 2λ, the given plate would behave as a

(a) half-wave-plate	(b) quarter-wave plate
(c) plane-polaroid	(d) non-polarizing plate

49.	A left circularly polarized light beam of wavelength 600 nm is incident on a crystal of thickness d and propagated perpendicular to its optic to its optic axis. The ordinary and extraordinary refractive indices $n_0 = 1.54$ and $n_e = 1.55$ respectively. The emergent light will be right circularly polarized if d is

(a) 120 μm	(b) 60 μm
(c) 30 μm	(d) 15 μm

50.	A light source has a small filament at the centre of a spherical glass bulb of radius 5 cm and negligible thickness. If this source emits 100 Watts of power in the form of spherical electromagnetic waves, the r.m.s. electric field E at the source of the bulb (in units of Volt/m) will be approximately

(a)1547	(b)1094
(c)1457	(d)1049

51.	The average value r for the electron in the ground state for the hydrogen atom is

(a) a_0	(b)1.5 a_0
(c)3 a_0	(d) $5a_0$

52.	Energy levels for each "n" in the infinite potential well is

(a) Same as the finite potential well	(b) Lower than the finite potential well
(c) Higher than the finite potential well	(d) None of the above

53.	In the photoelectric effect experiment with the increase in the intensity of incident light on the photocathode, the stopping potential

(a)increases	(b) decreases
(c) Stopping potential reaches zero	(d) The stopping potential will not change with the intensity of the light

54.	With the increase in temperature of the blackbody

(a) The intensity of the emitted radiation and λ_{max} increases	(b) The intensity of the emitted radiation and λ_{max} increases
(c) The intensity of the emitted radiation increases, and λmax increases	(d) The intensity of the emitted radiation decreases and λ_{max} increases

55.	In the case of a particle in an infinite potential well, the lowest energy the particle can have is

(a) $E = h/8mL^2$	(b) $E = h^2/8mL^2$
(c) $E = h^2/8mL$	(d) $E= h^2/8L^2$

56.	As we move away from the center of the screen in the case of both diffraction and interference.

(a) Intensity decreases in diffraction and remains same in interference	(b) Intensity decreases in both interference and diffraction
(c) Intensity increases in both interference and diffraction	(d) Intensity remains the same in both

57.	In the case of a single slit diffraction pattern, if we increase the slit width

(a) The resultant intensity and width remain the same.	(b) The resultant intensity decreases, and width remains the same
(c) The resultant intensity remains same and the width decreases	(d) The resultant intensity and width increase

58.	Missing orders in double slit diffraction pattern occurs when

(a) Diffraction minima overlap with interference minima	(b) Diffraction maxima overlap with interference maxima
(c) Diffraction minima overlap with interference maxima	(d) none of the above

59.	A material having an index of refraction of 1.30 is used as an antireflective coating on a piece of glass (n = 1.50). What should the minimum thickness of this film be to minimize reflection of 500-nm light?

(a) 96 nm	(b) 108 nm
(c) 87 nm	(d) 102 nm

60.	Rayleigh criteria for just resolved condition is

(a) When both principle maxima overlap	(b) When both principle maxima are well separated
(c) When principle maxima of one falls on the minima of the other pattern	(d) None of the above

61.	At all angles, less than the polarizing angles the reflected ray is

(a) Partially polarized	(b) totally polarized
(c) unpolarized	(d) either unpolarized or partially polarized

62.	When white light is incident on diffraction grating, the first order principal maxima will be

(a) White	(b) Spectrum of component colors
(c)Absent	(d) one of the component colors

63.	A particle in a one-dimensional box of length L is in the first excited state. The particle most likely to be found at

(a) At the center of the box	(b) at either end of the box
(c) all points in the box are equally likely	(d) One -fourth of the way from either end of the box

64.	A photon collides with an electron. After the collision, the wavelength of the scattered wave is

(a) less than or equal to the initial wavelength	(b) greater than the initial wavelength
(c) greater than or equal to the initial wavelength	(d) less or greater depending on the scattering angle

65.	An electron with energy E is incident on a potential energy barrier of height U and thickness L. The probability of tunneling increases if:

(a) E decreases without any other changes	(b) U increases without any other changes
(c) E and U increase by the same amount	(d) L decreases without any other changes

66.	The maximum kinetic energy of a photoelectron, when a surface (work function = 4.5 eV) is illuminated by photons with wavelength 400 nm, is

(a) 1.4 eV	(b) Zero
(c) – 1.4 eV	(d) 3.1 eV

67.	In double refraction, two refracted rays are produced, called as O-ray and E-ray. Which of the following statements is TRUE

(a) Only O-ray is polarised	(b) Only E-ray is polarised
(c) Both E-ray and O-ray are polarised	(d) Neither E-ray or O-ray is polarized

68.	Two light beams with intensities I_1 and I_2 superimpose to produce interference pattern. The contrast between the fringes is the best when

(a) $I_1 = I_2$	(b) $I_1 = 0.5\ I_2$

(a) $I_1 = I_2$	(b) $I_1 = 0.5\ I_2$
(c) $I_1 = 0.33\ I_2$	(d) $I_1 = 1.5\ I_2$

69.	Hook's law states that

(a) Stress is inversely proportional to strain	(b) Product of stress and strain
(c) Stress is directly proportional to strain within elastic limit	(d) None of these

70.	Which of the given below has highest energy

(a) Infrared	(b) UV rays
(c) Visible	(d) X-rays

****