

PET-2017 (Physics- Faculty of Sciences)

Roll No:

Date..... **25 JUN 2017**

Signature of the Candidate:

1. Bohr radius is of the order of
 - (A) 10^{-10}
 - (B) 10^{-14} cm
 - (C) 10^{-12} cm
 - (D) 10^{-8} cm

2. Which of the following is Hermitian Operator
 - (A) ix
 - (B) $\frac{\partial}{\partial x}$
 - (C) $i \frac{\partial}{\partial x}$
 - (D) it

3. The commutator $\left[\frac{d}{dx}, x\right]$ gives
 - (A) i
 - (B) -1
 - (C) 0
 - (D) 1

4. The total number of electrons in a subshell with orbital quantum number ' l ' is
 - (A) $l(l+1)$
 - (B) $2(2l+1)$
 - (C) $2l^2$
 - (D) $2(l+1)$

5. Eigen values of hermitian operator are
 - (A) always imaginary
 - (B) always zero
 - (C) always real
 - (D) not observable



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6. In an $n-p-n$ transistor biased for operation in forward active region—
- (A) Base is positive both with respect to emitter and collector
 - (B) base is positive with respect to emitter and collector is positive with respect to base
 - (C) collector is positive with respect to base
 - (D) emitter is positive with respect to base
7. A particular green LED emits light of wavelength 5490 \AA , the energy bandgap of the semiconductor material used there is . (Given $h = 6.6 \times 10^{-34} \text{ J sec}$).
- (A) 1.98 eV
 - (B) 0.74 eV
 - (C) 2.26 eV
 - (D) 1.17 eV
8. In a degenerate n type semiconductor material, the Fermi level
- (A) is very near valence band
 - (B) is at the centre in between valence and conduction bands
 - (C) is in valence band
 - (D) is in conduction band
9. A triangular-wave oscillator can be realized using an op-amp comparator based rectangular wave generator followed by
- (A) Differentiator
 - (B) amplifier
 - (C) integrator
 - (D) Multivibrator
10. A 12 bit ADC is used to convert analog voltage of 0 to 10 V into digital. The resolution is
- (A) 2.44 mV
 - (B) 24.4 mV
 - (C) 1.2 V
 - (D) 39.2 mV
11. $\overline{\overline{AB}} + \overline{\overline{AC}}$ is equivalent to
- (A) $A + B + C$
 - (B) ABC
 - (C) \overline{ABC}
 - (D) ABC



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12. Root mean square value of $x(t) = 10[1 + \sin(-t)]$ is
- (A) 20
 - (B) 12.2
 - (C) 22.2
 - (D) 17.3
13. According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is
- (A) Greater than the mean velocity
 - (B) Equal to the mean velocity
 - (C) Less than the root mean square velocity
 - (D) Equal to root mean square velocity
14. Transverse magnetic (TM) waves have
- (A) magnetic field component H in the direction of propagation
 - (B) electric field component E in the direction of propagation
 - (C) magnetic field component H in the direction of propagation and no component of electric field E in this direction
 - (D) electric field component E in the direction of propagation and no component of magnetic field H in this direction
15. The Laplace transform function $f(t)$ is $F(s)$, then Laplace transform of its first derivative w.r.t. 't' is
- (A) $s F(s) + f(0)$
 - (B) $s F(s)$
 - (C) $s F(s) - f(0)$
 - (D) $s^2 F(s) - f(0)$
16. The primary cosmic rays consist of
- (A) pions, muons, electrons and neutrons
 - (B) about 92% protons, rest are deuterons, alpha particles and heavier nuclei.
 - (C) muons and electrons
 - (D) ^{14}C nuclei
17. The character of the $3^- \rightarrow 0^+$ gamma transition is
- (A) magnetic octupole
 - (B) magnetic dipole
 - (C) electric quadrupole
 - (D) electric octupole



18. The quark model content of the proton is

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- (A) uud
- (B) uuu
- (C) udd
- (D) ddd

19. The plot of the second order Legendre polynomial $P_2(\cos \theta)$ is

- (A) Symmetric about x-axis
- (B) Symmetric about x-axis as well as y-axis
- (C) Symmetric about y-axis
- (D) Constant

20. Force associated with the potential energy $U = K r^n$ is

- (A) $-n K r^{n-2} \vec{r}$
- (B) $-n K r^{n-1} \vec{r}$
- (C) $n K r^{n-2} \vec{r}$
- (D) $n K r^{n-1} \vec{r}$

21. The spin state of electrons in the ground state of Helium

- (A) Spin doublet
- (B) Orbital triplet
- (C) Spin triplet
- (D) Spin singlet

22. Natural shape of the energy distribution in an atomic transition is

- (A) Gaussian
- (B) Lorentzian
- (C) Maxwellian
- (D) Poisson

23. Vacuum of the order of 10^{-6} torr can be produced and measured using

- (A) adsorption pump and thermocouple gauge, respectively.
- (B) diffusion pump and penning gauge, respectively.
- (C) diffusion pump and pirani gauge, respectively.
- (D) rotary pump and pirani gauge, respectively.



24. In the β^- decay

- (A) the recoiling nucleus and β^- particle are emitted in one direction, and the antineutrino moves in the opposite direction.
- (B) the recoiling nucleus moves in a direction out of the plane of emission of the β^- particle and antineutrino.
- (C) the recoiling nucleus, β^- particle and neutrino are emitted in a plane.
- (D) the recoiling nucleus, β^- particle and antineutrino are emitted in a plane.

25. According to the liquid drop model, the volume energy, surface energy and Coulomb energy (a_1 , a_2 and a_3 being positive constants) contributions to binding energy are

- (A) a_1A , $-a_2A^{1/3}$ and $-a_3Z(Z-1)A^{-2/3}$, respectively.
- (B) a_1A , $a_2A^{2/3}$ and $-a_3Z^2(Z-1)A^{-1/3}$, respectively.
- (C) a_1A , $-a_2A^{1/3}$ and $-a_3Z^2A^{-1/3}$, respectively.
- (D) a_1A , $-a_2A^{2/3}$ and $-a_3Z(Z-1)A^{-1/3}$, respectively.

26. The Gell Mann Nishijima formulae relate

- (A) the nuclear isospin data.
- (B) π^+n , π^0p scattering amplitude
- (C) mass splitting in hadron multiplets.
- (D) the masses of leptons in the standard model.

27. At the interface between a dielectric and free space

- (A) Tangential components of D and B are continuous
- (B) Normal component of D and tangential component of B are continuous
- (C) Normal components of D and B are continuous
- (D) Tangential component of D and normal component of B are continuous

28. Consider a system of two identical bosons, each of which can be in any one of three single particle states. The number of possible states of the system is

- (A) 6
- (B) 9
- (C) 3
- (D) 1

29. The effective mass of a photon of wavelength 1 \AA is

- (A) Zero
- (B) $2.2 \times 10^{-22} \text{ kg}$
- (C) $1.2 \times 10^{-15} \text{ kg}$
- (D) $2.1 \times 10^{-15} \text{ kg}$



30. Which of the following is invariant under Lorentz transformations?

- (A) Three dimensional volume element $dx dy dz$
 (B) Four dimensional volume element $dx dy dz dt$
 (C) $\left[p - \frac{E}{c^2} \right]$
 (D) $\left[p^2 - \frac{E}{c^2} \right]$

31. Which of the following is non-central force?

- (A) Gravitational force
 (B) Coulomb force
 (C) Nuclear force
 (D) None of above

32. In an indirect semiconductor

- (A) the energy maxima of the valence band and the energy minima of conduction band lie at same k values.
 (B) the Fermi level lies in the conduction band
 (C) the Fermi level lies at the maxima of the valence band
 (D) the energy maxima of the valence band and the energy minima of conduction band lie at different k values.

33. Which of the following is a conservative force

- (A) $yz \hat{i} + zx \hat{j} + xy \hat{k}$
 (B) $yz \hat{i} - zx \hat{j} + xy \hat{k}$
 (C) $y^2 \hat{i} + x^2 \hat{j} + z^2 \hat{k}$
 (D) $yz \hat{i} - zx \hat{j} - xy \hat{k}$

34. Fourier transform of $\cos \omega_0 t$ is

- (A) $\pi[\delta(\omega + \omega_0) - \delta(\omega - \omega_0)]$
 (B) $\pi[\delta(\omega + \omega_0) + \delta(\omega - \omega_0)]$
 (C) $j\pi[\delta(\omega + \omega_0) - \delta(\omega - \omega_0)]$
 (D) $j\pi[\delta(\omega - \omega_0) - \delta(\omega + \omega_0)]$



35. The Lagrangian in case of a relativistic one-dimensional (x) harmonic oscillator is given by ($\beta = v/c$)

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(A) $L = -mc^2\sqrt{1-\beta^2} - \frac{1}{2}kx^2$

(B) $L = -mc^2\sqrt{1-\beta^2} - \frac{1}{2}kx^2$

(C) $L = -mc^2\sqrt{1-\beta^2} - \frac{1}{2}kx^2$

(D) $L = -mc^2\sqrt{1-\beta^2} - \frac{1}{2}kx^2$

36. The energy of the incident proton required to produce antiproton by the reaction is

$p + p \rightarrow p + p + p + \bar{p}$ is at least

- (A) 1.876 GeV
(B) 5.57 MeV
(C) 938 MeV
 (D) 5.57 GeV

37. Amplitude modulated wave of message signal $m(t) = B \cos \omega_m t$ modulated on carrier signal $A \cos \omega_c t$ is represented by

- (A) $A [1 + (A\omega_m / B\omega_c) \cos \omega_m t]$
(B) $A \cos \omega_c t + B \cos \omega_m t$
 (C) $A [1 + (B/A) \cos \omega_m t] \cos \omega_c t$
(D) $A [\cos^2 \omega_c t + (B/A) \cos^2 \omega_m t]$

38. Ionic solids with Schottky defects contain in their structures

- (A) cation vacancies and interstitial cations.
(B) interstitial anions and anion vacancies
 (C) cation vacancies only
(D) equal number of cation and anion vacancies

39. Body diagonal of a cube is 866 pm. Its edge length would be

- (A) 600 pm
 (B) 500 pm
(C) 1000 pm
(D) 408 pm

40. The value of integral $\int_0^1 x^3 \delta(x-2) dx$ is

- (A) Zero
(B) 3
(C) -3
(D) 5

