2007-PH-1-17

EE24BTECH11010 - BALAJI B

1) The eigenvalues of a matrix are $i, -2i$ and $3i$. The matrix is

a) unitary
b) anti-unitary
c) Hermitian
d) anti-Hermitian

2) A space station moving in a circular orbit around the Earth goes into a new bound orbit by firing its engine radially outwards. The orbit is

a) A larger circle
b) a smaller circle
c) an ellipse
d) a parabola

3) A power amplifier gives $150W$ output for an input of $1.5W$. The gain, in dB, is

a) 10
b) 20
c) 54
d) 100

4) Four point charges are placed in a plane at the following positions: $+Q$ at $(1, 0)$, $-Q$ at $(-1, 0)$, $+Q$ at $(0, 1)$ and $-Q$ at $(0, -1)$. At large distances the electrostatic potential due to this charge distribution will be dominated by the

a) monopole moment
b) dipole moment
c) quadrupole moment
d) octopole moment

5) A charged capacitor (C) is connected in series with an inductor (L). When the displacement current reduces to zero, the energy of the LC circuit is

a) stored entirely in its magnetic field.
b) stored entirely in its electric field
c) distributed equally among its electric and magnetic fields
d) radiated out of the circuit.

6) Match the following

P. Franck-hertz experiment	1. electronic excitation of molecules
Q. Hartee-Fock method	2. wave function of atoms
R. Stern-Gerlach experiment	3. spin angular momentum of atoms
S. Frank-Condon principle	4. energy levels in atoms

(A)	(B)	(C)	(D)
P-4	P-1	P-3	P-4
R-3	R-3	R-4	R-3
S-1	S-2	S-1	S-2

7) The wave function of a particle, moving in a one-dimensional time-independent potential $V(x)$, is given by $\Psi(x) = e^{-iax+b}$, where a and b are constants. This means that the potential $V(x)$ is of the form

a) $V(x) \propto x$
b) $V(x) \propto x^2$
c) $V(x) = 0$
d) $V(x) \propto e^{-ax}$

8) The D_1 and D_2 lines of $Na\left(3^2P_{\frac{1}{2}} \rightarrow 3^2S_{\frac{1}{2}}, 3^2P_{\frac{3}{2}} \rightarrow 3^2S_{\frac{1}{2}}\right)$ will split on the application of a weak magnetic field magnetic field into

a) 4 and 6 lines respectively
b) 3 lines each
c) 6 and 4 lines respectively
d) 6 lines each

9) In a $He - Ne$ laser transition takes place in

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

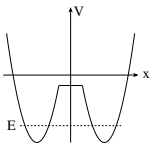
10) The partition function of a single gas molecule is Z_α. The partition function of N such non-interacting gas molecules is then given by

a) $\frac{(Z_\alpha)^N}{N!}$
b) $(Z_\alpha)^N$
c) $N(Z_\alpha)$
d) $\frac{(Z_\alpha)^N}{N}$

11) A solid superconductor is placed in an external magnetic field and then cooled below its critical temperature. The superconductor

a) retains its magnetic flux because the surface current supports it.
b) expels out its magnetic flux because it behaves like a paramagnetic material
c) expels out its magnetic flux because it behaves like an anti-ferromagnetic material
d) expels out its magnetic flux because the surface current induces a field in the opposite to the applied magnetic field

12) A particle with energy E is a time-independent double well potential as shown in the figure.



Which of the following statements about the particle is **NOT** correct?

a) The particle will always be in a bound state
b) The probability of finding the particle in one well will be time-dependent
c) The particle will be confined to any one of the wells
d) The particle can tunnel from one well to the other, and back.

13) It is necessary to apply quantum statistics to a system of particles if
   a) there is substantial overlap between the wavefunctions of the particles
   b) the mean free path of the particles is comparable to the inner-particle seperation.
   c) the particle have identical mass and charge
   d) the particle are interacting.

14) When liquid oxygen is poured down close to a strong bar magnet, the oxygen stream is
   a) repelled towards the field because it is diamagnetic.
   b) attracted towards the higher field because it is diamagnetic.
   c) repelled towards the lower field because it is paramagnetic.
   d) attracted towards the higher field because it is paramagnetic.

15) Fission fragments are generally radioactive as
   a) they have excess of neutrons.
   b) they have excess of protons.
   c) they are products of radioactive nuclides.
   d) their total kinetic energy is of the order of $200MeV$.

16) In a typical *npn* transistor the doping concentrations in emitter, base and collector regions are C_E, C_B and C_E respectively. These satisfy the relation

   a) $C_E > C_C > C_B$
   b) $C_E > C_B > C_C$
   c) $C_C > C_B > C_E$
   d) $C_E = C_C > C_B$

17) The allowed states for $He\left(2p^2\right)$ configuration are
   a) ${}^1S_0$, ${}^3S_1$, ${}^1P_1$, ${}^3P_{0,1,2}$, ${}^1D_2$ and ${}^3D_{1,2,3}$
   b) ${}^1S_0$, ${}^3P_{0,1,2}$ and ${}^1D_2$
   c) ${}^1P_1$ and ${}^3P_{0,1,2}$
   d) ${}^1S_0$ and ${}^1P_1$