APEX CARE

INSTITUTE FOR PG - TRB, SLET AND NET IN PHYSICS

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1. A hydrogen atom is subjected to an electric field of strength 1 kV/cm. The observed second order Stark splitting for a given transition is 0.001 eV. If the field strength is increased to 2 kV/cm, what will be the new splitting?
   A) 0.001 eV B) 0.002 eV C) 0.004 eV D) 0.006 eV

2. Which of the following statements is **TRUE** regarding the Larmor frequencies of the electron and the proton?
   A) Both are the same and lie in the microwave region.
   B) The Larmor frequency of the electron lies in the microwave region whereas that of the proton lies in the rf range.
   C) The Larmor frequency of the electron lies in the microwave region whereas that of the proton lies in the near infra red range.
   D) The Larmor frequency of the electron lies in the rf region whereas that of the proton lies in the near microwave range.

3. The fundamental and first overtone lines of the HCl molecule (reduced mass = 0.9796 amu) occur at 2886 cm^{-1} and 5668 cm^{-1} respectively. What will be the force constant of the molecule?
   A) 516 Nm^{-1} B) 498 Nm^{-1} C) 978 Nm^{-1} D) 480 Nm^{-1}

4. A gas having an excited state at 1 eV is in thermal equilibrium at 4000 K. What will be the ratio of the probabilities for spontaneous to stimulated emissions, assuming conditions of black body radiation?
   A) 1 : 1 B) 1 : 17.1 C) 0.41 : 1 D) 57 : 3.33

5. A $_{55}Cs^{137}$ decays to an excited level of the daughter nucleus $_{56}Ba^{137}$ at 662 keV. What should be the energy of a gamma ray in order that it can excite a $_{56}Ba^{137}$ nucleus in its ground state to the excited level at 662 keV?
   A) Same as 662 keV
   B) Less than 662 keV by 1.718 eV
   C) Greater than 662 keV by 3.436 eV
   D) Greater than 662 keV by 1.718 eV

6. The Morse curve represents
   A) The variation of the electronic potential energy of a molecule as a function of internuclear distance.
   B) The variation of the vibrational energy of a molecule as a function of internuclear distance
   C) The variation of the rotational energy of a molecule as a function of internuclear distance.
   D) The variation of kinetic energy of a molecule as a function of internuclear distance.

7. Molecules can absorb energy in the microwave region via one type of transition

given below. Which one is it?
A) Electronic B) Vibrational C) Rotational D) Nuclear

8. For a molecule with centre of symmetry, which among the following statements is correct?
A) The molecule will not have any peak in the IR and Raman spectra
B) Some peaks will be common in IR and Raman spectra
C) All peaks will be common in IR and Raman spectra
D) No peaks will be common in IR and Raman spectra

9. The dielectric constant of a material is given by $\varepsilon = \varepsilon' + i\varepsilon''$, where ε' and ε'' are real, no-zero. This implies that
A) The material is a perfect dielectric.
B) The material is a lossy dielectric.
C) The material is a perfect conductor.
D) The polarizability of the material is zero.

10. The ability of certain materials to generate a temporary voltage when they are heated or cooled
A) Ferroelectricity B) Piezoelectricity
C) Thermoelectricity D) Pyroelectricity

11. In the Einstein model of heat capacity of solids, the characteristic temperature, the Einstein temperature is
A) Proportional to the frequency of the relevant oscillations
B) Inversely proportional to the frequency of the relevant oscillations
C) Independent of the frequency of the relevant oscillations
D) A threshold temperature above which only vibrations can exist inside the solid

12. The work function of a certain metal is 4eV. Light incident on this metal surface will eject photoelectrons provided
A) Its frequency is more than 9.66×10^{14}
B) Its frequency is less than 9.66×10^{14}
C) Its energy is more than 4 keV
D) Its energy is more than 4 MeV

13. The Bravais lattice for CsCl is
A) Base centred cubic B) Body centred cubic
C) Primitive cubic D) Face centred cubic

14. What will be the Miller indices of a plane in a crystal lattice which makes an intercept of 1 on the a-axis, 2 on the b-axis and is parallel to the c-axis?
A) (210) B) (201) C) (120) D) (102)

15. For a thin semiconductor specimen placed in a magnetic field the measured Hall voltage is 100 milli Volts. If the thickness of the specimen were half, what will be the new Hall voltage?
A) 50 mV B) 200 mV C) 141.4 mV D) 70.7 mV

16. The atoms at the centres of the unit cells in a bcc lattice

A) Produce the same X-ray diffraction pattern as that of a simple cubic crystal lattice
B) Result in extra reflections in the X-ray diffraction pattern compared to that of a simple cubic crystal lattice
C) Result in enhanced intensity of the lines in the X-ray diffraction pattern compared to that of a simple cubic crystal lattice
D) Result in missing orders in the X-ray diffraction pattern compared to that of a simple cubic crystal lattice

17. Which of the following statements is TRUE?
A) In the optical mode two adjacent different atoms move against each other, while in the acoustic mode they move together.
B) In the optical mode two adjacent different atoms move together, while in the acoustic mode they move against each other.
C) In both modes the atoms move together.
D) In both modes the atoms move against each other.

18. The Langevin function
A) Gives the magnetic susceptibility of a ferromagnetic material.
B) Gives the magnetic susceptibility of a paramagnetic material.
C) Gives the magnetic susceptibility of a diamagnetic material.
D) Gives the magnetic susceptibility of a ferrimagnetic material.

19. A ferromagnetic specimen is magnetized to saturation by passing a high current through a coil of wire wound around it. It is now required to take the specimen back to its zero magnetization state. Which of the methods listed below can be best used for this?
A) Reduce the current to zero
B) Apply a large negative current
C) Apply a large ac current and then gradually decrease the current strength to zero
D) Apply a large ac current and then switch it off

20. At the superconducting transition temperature, the specific heat of a superconductor
A) Is much more than that of a normal conductor
B) Changes smoothly as the material passes from the normal to the superconducting phase
C) Is much less than that of a normal conductor
D) Is infinity

21. The energy of the pairing interaction in a Cooper pair
A) Is of the order of 1 keV
B) Is of the order of 1 eV
C) Is of such magnitude that they can exist only at very low temperatures
D) Is zero

22. A semiconducting material can absorb all radiations of wavelength below 620.6 nm. This means that its band gap is

A) 1 eV B) 2 eV C) 1 keV D) 2 keV

23. Phonons are
A) Similar to photons but with very high energies
B) Quantized lattice vibrations with energies of about 1 MeV
C) Quantized lattice vibrations with typical energies of 0.1 eV
D) Quanta of vibrations in a liquid

24. The spin and parity of the ground state of $_{20}Ca^{41}$ nucleus is
A) $(7/2)^-$ B) $(5/2)^+$ C) 0^- D) 1^+

25. The ground state of a nucleus has a spin parity of $(3/2)^-$ and has an excited state at 2.5 MeV. When the nucleus makes a transition from the excited level to the ground state, the gamma radiation emitted is predominantly of the type E1. What will be the spin parity of the excited state?
A) $(5/2)^-$ B) $(0)^+$ C) $(1/2)^-$ D) $(1/2)^+$

26. The Yukawa exchange particle must have a finite, no-zero rest mass. This is necessary to explain
A) The spin dependence of the nuclear forces
B) The saturation property of the nuclear forces
C) The short range of the nuclear forces
D) The strength of the nuclear forces

27. A 1 MeV alpha particle incident on a GM counter produces an output pulse of amplitude 2 Volts. If now the energy of the alpha is increased to 5 MeV, what will be the output voltage?
A) 2 Volts B) 5 Volts C) 0.2 Volts D) 10 Volts

28. The total binding energy of the nucleus $_{26}Fe^{55}$ is approximately
A) 125 MeV B) 8 MeV C) 500 MeV D) 100 MeV

29. The radius of the $_{53}I^{125}$ nucleus is given to be 6.5 fermis. In a collision with an incoming aluminium nucleus $_{13}Al^{27}$ the two nuclei have their surfaces just touching each other. What will be the distance between the centres of the two nuclei at this instant?
A) 3.9 fm B) 9.4 fm C) 7.8 fm D) 13.0 fm

30. Identify the radiations which can be detected using silicon surface barrier detector and Si(Li) detector.
A) Gamma rays and X-rays respectively
B) Gamma rays and alpha particles respectively.
C) Alpha particles and gamma rays respectively.
D) Alpha particles and X-rays respectively.

31. In a set of nuclei which are connected via a chain of beta decay processes,

A) All the nuclei will have the same mass number but different atomic numbers
B) All the nuclei will have the same atomic number but different mass numbers
C) All the nuclei will have the same atomic number and the same mass number
D) All the nuclei will have different atomic numbers and different mass numbers

32. Two resonances are found to occur in a given nuclear reaction. The resonance energies are 1.2 MeV and 1.5 MeV and the respective widths are 1 keV and 2 keV. What will be the ratio of the lifetimes of the energy levels of the compound nucleus involved in these resonances?
A) 1.2 : 1.5 B) 1 : 2 C) 2 : 1 D) 1 : 1

33. A neutron is electrically neutral. But it possesses a finite magnetic moment. The reason is:
A) It has an internal charge distribution which integrates to zero net charge.
B) It contains a number of tiny magnetic dipoles inside.
C) It is composed of charged π mesons.
D) It is constantly emitting and re-absorbing charged pions.

34. An alpha particle bombards a ^{30}Si target with a lab energy of 10 MeV. What is the energy of the projectiles in the centre of mass of the system?
A) 10 MeV B) 1.176 MeV
C) 11.333 MeV D) 8.824 MeV

35. Lepton number is conserved in
A) All interactions B) Strong interactions only
C) Weak interactions only D) Electromagnetic interactions only

36. How many up quarks and down quarks are there in the nucleus $_8O^{17}$?
A) 25 u quarks and 26 d quarks B) 26 u quarks and 26 d quarks
C) 25 u quarks and 25 d quarks D) 26 u quarks and 25 d quarks

37. In the following elementary particle interaction, identify the particle a.

$$p + a \rightarrow \sum^{-} + K^{+}$$

A) π^- B) n C) e D) All of these

38. The ground state of the deuteron has a small positive electric quadrupole moment. This is a manifestation of the
A) Extremely small range of the nuclear force
B) Tensor nature of the nuclear force
C) Charge independence of the nuclear force
D) Charge dependence of the nuclear force

39. You are supplied with a klystron, a microwave cavity, a suitable magnetic field, a paramagnetic specimen and a microwave detector and associated electronics. What can this equipment be used for?
A) Determination of electric quadrupole moment of the electron
B) Determination of electric dipole moment of the electron
C) Determination of electric dipole moment of the proton
D) Determination of the Lande g factor

40. Raman activity of a molecule is due to

A) Change in the electric dipole moment of the molecule
B) Change in the electric quadrupole moment of the molecule
C) Change in the electric polarizability of the molecule
D) Change in the magnetic polarizability of the molecule