

SARDAR PATEL UNIVERSITY

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M.Sc. Chemistry Examination, Third Semester

Friday,
Session: Morning

Time: 10.00 a.m. to 12.00 p.m.

Date: 01-01-2021

Subject: Spectroscopy-I Paper: PS03CANC21

[Total Marks: 70]

- N.B. (1) Figures to the right indicate full marks.
(2) Attempt all questions.**

Q. 1 (A) Select the correct answer from each of the following:

(08)

- _____ in which the solid or liquid samples are put to high current or to a high potential.
(a) Sputtering device (b) Ovens (c) Electric arcs (d) Flame atomizer
- A _____ source is suitable for ionization of inner core electrons
(a) X-ray (b) Far-UV (c) Electron (d) ions
- The average lifetime of an electron excited state in the internal conversion is between____.
(a) $10^6 - 10^9$ s (b) $10^{-6} - 10^{-9}$ s (c) $10^6 - 10^{-9}$ s (d) $10^{-6} - 10^9$ s
- The arc temperature in thermal ionization depend on
(a) Rate of formation of atomic particles from the sample and the electrodes
(b) Composition of plasma
(c) Both (a) and (b) are correct
(d) None of above
- In SEM, if the voltage applied is such that the specimen raster is 1 x 1 mm then effective linear magnification is _____.
(a) $\times 10^2$ (b) $\times 10^4$ (c) $\times 10^5$ (d) $\times 10^6$
- Fermi level is the point of
(a) Maximum potential energy (c) Zero potential energy on the energy level scale
(b) Maximum affinity energy (d) Maximum chemical energy
- The standard used in fluorescence spectroscopy is
(a) TMS (b) Rhodamine (c) DSS (d) Acetanilide
- A high-powered microscope that produces an image from scattered secondary electrons is the _____.
(a) STM (b) TEM (c) AFM (d) SEM

Q. 1 (B) Attempt the following:

(16)

Fill in the blanks:

- The _____ in multiple element HC lamp is made from either an alloy or rings of desired elements.
- Ratio of photons emitted to photons absorbed is _____.
- A _____ source is suitable for ionization of inner core electrons.
- An electron beam passing through an evacuated region can be _____ by making use of electric and magnetic fields.
- The wavelength of Stokes-shifted fluorescence is _____ than that of the radiation that caused the fluorescence.
- In atomic absorption spectroscopy, high concentrations of gaseous atoms cause _____ of absorption lines.
- In AFM, non-contact mode the tip is oscillated at the resonance frequency and the amplitude of the _____ is kept constant.
- The _____ energy is specific for a given electron in a given element, and can serve for the identification of that element.

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[PT-03]

State whether the following statements are **True** or **False**.

- (i) XPS provides a means of quantitative identification of the elements present on the surface of solids.
- (ii) The effective wavelength of an electron beam is shorter by several orders of magnitude than the wavelength of visible light.
- (iii) The inherent life-time associated with $\pi \rightarrow \pi^*$ transition is longer than that associated with $n \rightarrow \pi^*$ transition.
- (iv) A singlet or triplet state may result, when one of the electrons of a molecule is excited to a lower energy level.
- (v) The hottest practical flame is obtained from the combination of cyanogen in oxygen.
- (vi) In STM, when a metal tip is brought near a conducting surface, electrons can tunnel from the tip to the surface or vice-versa.
- (vii) Binding energies usually decrease as the oxidation state becomes more positive.
- (viii) Doppler broadening is observed not only with emission peaks but with atomic absorption peaks as well.

Q. 2 Answer the following: (Any Seven)

(14)

- (i) Explain internal conversion in molecular luminescence.
- (ii) What is sputtering?
- (iii) Write the principle of ESCA.
- (iv) Explain sampling methods used in spectroscopic surface method.
- (v) Define the term "Resonance fluorescence".
- (vi) Define the Stark effect.
- (vii) Define binding energy in electron spectroscopy.
- (viii) Give neat and labeled diagram of SEM instrument.
- (ix) Describe the importance of surface analysis in science and technology.

Q. 3 Explain in brief on DCP and ICP source and discuss on instrumentation and applications of ICP-atomic emission spectroscopy.

(8)

OR

Q. 3 Answer the followings:

(8)

- (i) Various applications of flame photometry.
- (ii) Write in brief note on Zeeman background correction.

Q. 4 Discuss in brief on advantages, limitations and required precautions of spectrofluorometer

(8)

OR Explain in detail on factors affecting on photoluminescence.

Q. 5 Explain in brief on Auger electron spectroscopy (AES).

(8)

OR

Q. 5 An XPS electron was found to have a kinetic energy of 1040.7 eV when ejected with an $(Mg, K\alpha)$ source ($\lambda = 9.8883 \text{ \AA}$) and measured in a spectrometer with a work function of 25.4 eV. The electron is believed to be a N(1s) electron in KNO_3 . Calculate the binding energy for the electron. What would be the kinetic energy of the electron if a Al $K\alpha$ ($\lambda = 834 \text{ pm}$) source were used? [$h = 6.626 \times 10^{-34} \text{ J.s}$, $C = 3 \times 10^8 \text{ m/s}$ and $1J = 6.2415 \times 10^{18} \text{ eV}$]

(8)

Q. 6 Discuss the instrumentation of STM and describe the functions of components.

(8)

OR

Q. 6 Answer the following:

(8)

(i) Discuss types of electron guns. Explain the advantages of field emission gun with their types.

(ii) Explain the type of interactions of primary beam electrons involved with sample in SE.