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**M. Sc. (Fourth Semester) (Main/ATKT)  
EXAMINATION, May-June, 2020**

CHEMISTRY

Paper No. CH-19

**(Instrumental Methods of Analysis)***Time : Three Hours ]**[ Maximum Marks : 80***Note :** Attempt all Sections as directed.**Section—A**

1 each

**(Objective/Multiple Choice Questions)****Note :** Attempt all questions.

Choose the correct answer :

1. Which of the following is strong basic anion exchanger ?

- (a) Aryl-SO<sub>3</sub>H<sup>+</sup>
- (b) R-SO<sub>3</sub>H<sup>+</sup>
- (c) R-COO<sup>-</sup>Na<sup>+</sup>
- (d) Aryl-CH<sub>2</sub>N(CH<sub>3</sub>)<sub>3</sub><sup>+</sup>Cl<sup>-</sup>

- 2. The softening of hard water is performed through which of the following chromatography ?
  - (a) Ion exchange chromatography
  - (b) Supercritical chromatography
  - (c) Gas chromatography
  - (d) High performance liquid chromatography
- 3. Which of the chromatography is good for determination of high molecular weight of polymers ?
  - (a) Paper chromatography
  - (b) Thin layer chromatography
  - (c) Size exclusion chromatography
  - (d) Ion exchange chromatography
- 4. Electrochromatography is combination of which two analytical techniques ?
  - (a) GC-CE
  - (b) HPLC-CE
  - (c) TLC-CE
  - (d) HPTLC-CE
- 5. The column of capillary electrophoresis is coated with which of the following components ?
  - (a) Silica
  - (b) Alumina
  - (c) Dextran
  - (d) Cellulose

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6. Which of the following gas can be used as a carrier gas in supercritical fluid chromatography ?
- (a) NO<sub>2</sub>
  - (b) CO
  - (c) SO<sub>2</sub>
  - (d) CO<sub>2</sub>
7. "Oven" is one component found in which of the chromatography ?
- (a) HPLC
  - (b) Size-exclusion chromatography
  - (c) Supercritical fluid chromatography
  - (d) TLC
8. The migration rate ( $v$ ) of ion in capillary electrophoresis does not depend on :
- (a) Electric field
  - (b) Voltage
  - (c) Length of column
  - (d) Temperature
9. Which metal is used as a target plate for production of X-rays in XRF spectroscopy ?
- (a) Tungsten
  - (b) Carbon
  - (c) Silicon
  - (d) Phosphorus

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10. The transition of electron in copper from  $2p^{1/2} \rightarrow 1s$  is called :
- (a) K $\alpha_1$
  - (b) K $\alpha_2$
  - (c) K $\beta_1$
  - (d) K $\beta_2$
11. Which of the following is a non-destructive technique for analysis of multi-element at a time ?
- (a) Flame-atomic absorption spectrometry (Flame-AAS)
  - (b) Inductively coupled plasma-atomic emission spectroscopy (ICP-AES)
  - (c) Energy dispersive-X-ray fluorescence (ED-XRF) spectroscopy
  - (d) Inductively coupled plasma-mass spectrometry (ICP-MS)
12. Which of the following class of the elements can be analyzed with GF-AAS ?
- (a) Cl, Br, F
  - (b) C, N, O
  - (c) Zn, Ni, Cu
  - (d) He, Ne, Ar

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13. The extent of the method or technique to detect the target analyte in the presence of other chemical substances is called as a :
- (a) Sensitivity
  - (b) Selectivity
  - (c) Interference
  - (d) Robustness
14. Which of the following technique is best suitable for the analysis of mercury ions from soil samples ?
- (a) HG-AAS
  - (b) GF-ASS
  - (c) Flame-MS
  - (d) CV-AAS
15. Which of the following instruments needs a higher energy for the removal of core shell electron for surface characterization studies ?
- (a) X-ray fluorescence
  - (b) Proton induced X-ray spectroscopy
  - (c) Auger electron spectroscopy
  - (d) X-ray absorption
16. The compound of molecular weight  $> 50$  KDa is analyzed with mass analyzer :
- (a) Ion trap
  - (b) Time-of-flight
  - (c) Quadruple
  - (d) Quadruple-Quadruple

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17. Which of the following ionization processes is common in LC-MS ?
- (a) APCI
  - (b) CI
  - (c) EI
  - (d) MALDI
18. HG-AAS is good technique for analysis of which of the elements from water samples ?
- (a) Li, Na, K and Ca
  - (b) Fe, Co, Cu and Zn
  - (c) As, Se, Bi and Sb
  - (d) Hg, Pb, Ni and Al
19. Which of the following techniques will be good for protein sequencing of COVID-19 virus ?
- (a) GC-MS
  - (b) HPLC-MS
  - (c) ICP-MS
  - (d) All techniques
20. Which flame is preferable for the analysis of elements like Al, Ti, Mo and V ?
- (a) Air-acetylene
  - (b) Acetylene-oxygen
  - (c) Nitrous oxide-acetylene
  - (d) Propane-acetylene

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**Section—B**

2 each

**(Very Short Answer Type Questions)**

**Note :** Attempt all questions in 2-3 sentences.

1. What are the advantages of supercritical fluid ?
2. Give the principle of electrochromatography and write its one application.
3. Differentiate between ED-XRF and WD-XRF.
4. Give the working principle of PIXE.
5. Which atomic emission spectrometry is good for analysis of light elements like Li, Na, K, Ca, etc. ?
6. Write the name of radiation source used in atomic fluorescence spectroscopy ?
7. Why the formation of metal hydrides is done before atomization in HG-AAS ?
8. What is usefulness of hyphenated technique such as GC-MS and LC-MS compared to GC and HPLC ?

**Section—C**

3 each

**(Short Answer Type Questions)**

**Note :** Attempt all questions. Write answer in < 75 words.

1. Write the principle of ion-exchange chromatography (IC) and how the metal ions can be separated using IC.
2. What is electroosmotic flow ? How is it useful in separation of chemical substances in capillary electrophoresis ?
3. Give names of the detectors that can be used in PIXE.
4. Shortly explain the production of X-rays.
5. Write the principle and applications of ICP-AES.
6. What is the importance of selectivity and sensitivity in analytical chemistry ?

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7. Give the principle of HPLC-MS for separation of compound mixture.
8. Why GF-AAS is more sensitive than Flame-AAS ?

**Section—D**

5 each

**(Long Answer Type Questions)**

**Note :** Attempt all questions. Write answer in < 150 words.

1. Shortly describe the principle for separation of compound mixture in supercritical fluid chromatography.

*Or*

Briefly explain the theory and instrumentation of capillary electrophoresis.

2. What is X-ray fluorescence (XRF) spectroscopy ? Comparatively explain the Energy dispersive-XRF and wavelength dispersive-XRF and their applications.

*Or*

Briefly describe the different components of PIXE and their applications in analysis of archaeological materials.

3. Give the working principle and different application of ICP-AES.

*Or*

Write notes on any *two* of the following :

- (a) Chemical ionization in AES
  - (b) Refractory compound formation in AAS
  - (c) Inductively couple plasma
4. Write the working principle of Flame atomic absorption spectrometry and their applications.

*Or*

Write notes on the following (any *two*) :

- (a) CV-AAS
- (b) IC-MS
- (c) HPLC-MS

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