

Model Answer

Important Instructions to examiners:

1) The answers should be examined by keywords and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given moreImportance. (Not applicable for subject English and Communication Skills.)

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgments on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q .	Question	Remark	Total
No.	& its Answer		Marks
1. A).	Attempt any THREE		12
a)	What is electrophoresis? Explain in brief paper electrophoresis		04
Ans.	Electrophoresis:	2 marks	
	Electrophoresis is a separation technique that is based on the mobility	for	
	of ions in an electric field. Positively charged ions migrate towards a negative	Electro	
	electrode and negatively charged ions migrate toward a positive electrode. For	phoresis	
	safety reasons, one electrode is usually at ground and the other is biased		
	positively or negatively. Ions have different migration rates depending upon		
	their total charge, size and shape, and can therefore be separated.		
	The moving boundary method of electrophoresis utilizes the		
	migration of the particles in free solution and observation of various molecular		
	boundaries through sensitive refract metric techniques. With this the value of		
	electrophoresis in obtaining distinct and measurable fractions of variety of		
	substances got well established particular in clinical laboratories.		
	Basically the electrophoresis technique separates the molecules based		
	on size and charge under the influence of electric field .If E is a strength of		
	electric field is a charge on molecule and F is the frictional force on the		
	molecules then V the velocity of migration is given by		
	V=EZ/F		
	The frictional force can be defined as		
	$F=6\pi\eta r$		
	Where η is viscosity of medium and r is stoke radius of molecules therefore		
	$V=EZ/6\pi\eta r$		
	This implies that the electrophoretic mobility is proportional to the charge on		
	molecules and inversely proportional to the radius of molecules.		



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	Paper Electrophoresis:		
	Electrolyte Pencil Line Paper Filter	2 marks for paper electrop horesis (Diagra m Optiona l)	
	The basic principle of the method using paper as supporting medium in which the separation of different particles occurs on a piece of filter paper that is saturated with an electrolyte. Under the action of electric field, charged molecules migrates through the capillary of paper just as they migrate through an unbounded solvent. Using this method it is possible to obtain a complete separation of zones of different migration which are located by applying various active reagents. This method uses small amount of substance for analysis and used in valuable routine clinical methods.		
b)	What is nuclear spin? Explain resonance condition in NMR spectrometer.		04
Ans.	Nuclear Spin: Elementary particles such as electrons or a nucleus behaves as if they rotate about an axis possesses the property of spin known as nuclear spin. The angular momentum is associated with the spin of particle would be an integral or half integral multiple of $h/2\pi$ where, h is planck's constant. Resonant Condition: When an alternating RF field, superimposed over the stationary magnetic field, rotates at exactly the frequency of an energy level, the nuclei will be provided enough energy to undergo a transition from lower energy level to a higher energy level. In general Energy difference between states is given by, $\Delta E = \mu \beta H_0/I$ Where, $H_o =$ strength of external magnetic field in gauges $B = \text{constant called the nuclear magneton, } 5.049 \times 10^{-24} \text{ ergs}$ $\mu = \text{magnetic moment of the particle expressed in units of nuclearmagnetons}$ The frequency, ν of radiation determine from Planck's equations $\Delta E = h\nu = \mu \beta H_0/I$ The proton will process 95 million terms per second in a field of 23000 gauss. The frequency 95 MHz lies in the radio frequency range of the electromagnetic spectrum	02 marks for Nuclear Spin 2 marks for resonan ce conditio n.	
c)	Draw the neat labeled block diagram of complete blood gas analyzer.		04
Ans.			~ -



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	Imput Imput Imput Imput Imput Imput Imput	04 marks for correct diagra m	
d)	List measurement techniques for gas pollutants.		04
Ans.	The various techniques are :		
	 Carbon monoxide measurement by using a. Non dispersive IR analyzers. b. Gas chromatograph. Sulphur Dioxide measurement by using a. Colorimetry. b. Conductivitimetry c. Gas chromatograph d. Coulometry e. Gas chromatograph d. Coulometry e. Flame photometric detector f. UV flouorescence method Nitrogen oxide measurement by using a. Colorimetry. b. Chemiluminescence c. CO laser d. Laser opto-acoustic spectroscopy. Hydrocarbon measurement by using a. Flame ionization detector b. Gas chromatograph c. Use of lasers Ozone measurement by using a. Colorimetry. b. Chemiluminescence c. Use of lasers 	1/2 mark for each Techniq ue (any 4 techniq ues)	



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	c. Absorptiometry		
	d. Conductivitimetry		
	Concentration level of different gas pollutants		
	a)Carbon monoxide: Its average concentration is helow 200 nnm		
	hs average concentration is below 200 ppm.	1/2 mark	
	Usurprint dioxide. Its concentration in urban areas is 0.024 npm	72 IIIal K for	
	c)Nitrogen oxides:	101 each(an	
	Its level ranges from 0.5 to 0.12 ppm	v four)	
	d)Hydrocarbon.	y loui)	
	Its average concentration is below 80 ppm.		
	e)Oxidants:		
	Its average concentration is below 500 ppb.		
B)	Attempt any ONE.		06
a)	Draw neat labeled diagram of analytical instrument system.		06
-	Explain function of each block in brief.		
Ans.			
	Chemical	2marks	
	information	for	
	source conditioner system	Diagra	
		m	
	Elements of an analytical instrument		
	Analytical instruments provide information on the composition of a sample of		
	matter. The basic block diagrams are		
	mater. The basic block diagrams are,	4	
	1 Chemical information source:	4	
	Chemical information source which generates a set of signals containing	тагкя for	
	necessary information. The source may be in the sample itself. For example	ovnlana	
	yellow radiation emitted by heated sodium atoms constitutes the source of the	tion	
	signal in a flame photometer.	uon	
	2. Transducer:		
	Transducer which converts the nature of the signal Because of the familiar		
	advantages of electric and electronic methods of measurement, it is the usual		
	practice to convert all non-electrical quantities. Associated with the analysis of		
	a sample into electrical form.		
	3 Signal conditioner:		
	Signal conditioner which converts the output of the transducer into electrical		
	quantity suitable for operation of display system. Signal conditioner may be		
	varying in complexity from a simple resistance network or impedance		
	matching device to multi-stage amplifiers and other electronic circuit.		



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	4 Display system:		
	It provides a visible representation of quantity as displacement on a scale or on		
1	the chart of a recorder. CRT		
b) (State principle of Chromotography. List out basic elements of gas		06
D)	State principle of Chromatography. List out basic elements of gas		00
	chromatography and state function of carrier gas in gas		
	chromatography.	00 1	
Ans. 1	Chromatography principle involves the physical method of separation of the components of the mixture by distribution between two phases of which one is stationary bed of large surface area and other is fluid phase that percolates through or along the stationary phase. It involves the transport of sample of mixture through the column. For this purpose mixture may be liquid or gaseous phase. The stationary phase may be solid adsorbent or liquid portioning agents. The mobile phase is usually a gas or liquid and is transport the constituent of mixture through the column. Basic elements of a gas chromatograph are: 1.Carrier gas supply along with pressure regulator and flow monitor	02 mark for principl e 02	
	 2.Sample injection system 3.Chromatographic column 4.Thermal compartment or thermostat 5.Detection system 6.Recorder Function of carrier gas 1. Carrier gas normally N2,Ar or He in compressed form ensures rapid vaporization and separation of solutes into chromatographic column. 2. Carrier gas in compressed form doesnot allow thermal degradation of solute 3. Purified carrier gases may increases column performance and detector response. 4. It will directly affect both column and detector performance while ensuring required separation. 	marks for list 02 marks for carrier gas function	
2.	Attempt any FOUR		16
a.) 1	Describe operation of single beam filter photometer		04
Ans.	Cuvette Photocell Intensity control Intensity co	2 marks for Diagra m	



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-			
	Single beam filter photometer:		
	The figure shows basic component of filter photometer.		
	1. The source of light is tungsten filament lamp which is held in a reflector and	2 marks	
	which through light on the sample holder through a filter.	for	
	2. The filter may be either of absorption or interference type.	explana	
	3. The sample holder is a cuvette with parallel walls or may be a test tube.	tion	
	4. The light after passing through the sample holder falls on the surface of		
	photocell. The output of cell is measured on micro ammeter.		
	In order to operate instrument following steps are taken		
	1. With photocell darkened the meter is adjusted mechanically to read		
	zero.		
	2. The blank or pure solvent or reference solution is inserted in the path		
	of light beam and incident light intensity is regulated.		
	Solution of both standard and unknown are inserted in the place of blank and		
	the reading of specimen relative to blank is recorded. The meter scale is		
	calibrated in linear transmittance unit.		
b)	Describe liquid chromatography with the help of labelled diagram		04
	Solvents Temperature High pressure Pump For gradient Injector Injector Pump Injector Injector Injector Block diagram of Liquid Chromatograph Injector Injector	2 marks for Diagra m	
	OR		
	Any other relevant diagram shall be considered.		
	Explanation:		
	It basically consist of :	2 marks	
	(a) A high pressure pump system to force the liquid mobile phase through the	for	
	column	Explana	
	(b) Gradient elution or solvent programmer	tion	
	(c)The sample injection system		
	(d)The column		
	(e)The detection system including display or recording devices		
	(f) Computer for data processing and storage.		
	As in other chromatographic techniques, the sample is introduced into the		
	column with the help of a sample injection system. Various components of the		
	sample are fractionated during their passage through the column. The		



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	detection system senses these components as they elute from the column and produces a signal proportional to the amount of solutes passing through the		
	detection system. The detector determines what separation has taken place and provides data permitting qualitative and quantitative evaluation of results.		
	(Note: any other valid liquid chromatography technique can be considered)		
c)	Describe measurement of ozone using conductivity meter.		04
Ans.	A wet chemical method which uses the oxidizing properties of O_3 is employed		
	to sensitive meter for continuous sampling of contaminating oxidants in		
	atmosphere. The ozone containing air is bubbled into potassium iodide		
	solution and resulting iodine determined by measuring current through the		
	cell. The current is related to ambient O3levels by previous calibration with		
	known ozone source. Thus construct air-ozone meter which measures and		
	records instantaneous ozone concentrations.		
	Ozone Image: Containing air (sample) Image: Containing air (sample) Image: Containing air (sample) Image: Containing air (sample)	02 Marks for Diagra m	
	The arrangement is as shown in figure. It consist of an hermetically sealed		
	glass jar containing 150 cm ³ of buffered 10 % KI solution and 0.5 cm ³ sodium		
	thiosuphate of known concentration. Two spiral platinum electrodes dip into		
	the solution and bias voltage of 30mV is applied across them. The air above		
	the solution is evacuated, whereas the outside is let in through a Tygon tube		
	When ozone enters the solution the following reaction takes place		
	when ozone enters the solution the following feaction takes place $\Omega_{2}+2I_{2}H_{2}\Omega \rightarrow I_{2}+\Omega_{2}+2\Omega H^{2}$	02 for	
	The jodine then reacts with thiosuphate	Explana	
	$I_2+2(S_2O_3)^- \rightarrow 2(I^-)+S_4O_5^-$	tion	
	Reaction continues so long as there is thiosuphate in the solution. When all the		
	thiosuphate has been reacted, free iodine appears and reacts at the electrodes.		
	The electrical resistance is high as long as there is an excess of thiosulphate.		
	The resistance decreases when it is used up. This change is used to control the		
	operation of instrument. The voltage drop across 20kohm resistance which is		
	in series with the electrode is used to operate the recorder as well as relay		



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	Chopper		
	Infrared motor Infrared		
	source y source Calibrated		
	Chopper		
	Test gas →		
	Detector - Poth		
	Amplifier		
	Diagram for infrared Gas analyzer		
	Function of Block of Infrared analyzer:		
	1.Infrared Source		
	The source of infrared radiation is hot wire spiral. It absorbs specific		
	wavelengths of infrared radiation. One of the most commonly measured gases	_	
	using infrared radiation absorption method is the carbon dioxide.	2 marks	
	2.Measuring & Reference Cell	for	
	One cell is filled with a reference gas, which is a non absorbing gas like	suitable	
	nitrogen, whereas the measuring cell contains the sample	explana	
	The difference is optical absorption detected between the two cells is a	tion	
	measure of absorption of the sample at the particular wavelength. One beam		
	neasure of absorption of the sample at the particular wavelength. One beam		
	has through a reference cell towards detection showher		
	beam through a reference cell towards detection chamber.		
	3.Chopper motor		
	The radiation emitted by infrared source is pulsed by motor driven chopper.		
	The rotating chopping disc occludes each beam twice per rotation. The		
	chopping frequency is 2-10 Hz for industrial and 2-50Hz for medical		
	application.		
	4.Detector		
	Detection chamber is permanently sealed unit divided into two compartments		
	by thin metallic diaphragm. Both compartments are charged to same pressure		
	with the gas being measured and both beams from both cells enter opposite		
	ends of the detection chamber		
	5.Amplifier		
	As an arrangement capacitor is supplied with constant charge and resulting		
	voltage changes at chonning frequency are amplified in three stage tuned		
	amplifier with high input impedance in input stage		
	6 Intergrator & Pacorder		
	The signal from amplification restified integrated and supported and support		
	The signal from amplifier is rectified, integrated and smoothed and output		
-	signal is displayed on meter or recorder.		
3.	Attempt any FOUR.		16
a.	State Beer Lambert's law and list four instruments based on Beer		04
	Lambert's law		



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Ans.	Statement : Beer Lambert Law, states the relationship between absorbance (A) and transmittance (T). It states that the concentration of a substance in solution is directly proportional to the 'absorbance', A, of the solution. Absorbance $A = \varepsilon$ cb	02 Marks for stateme	
	Where, A = absorbance (no unit of measurement) $\varepsilon = molar absorptivity (dm3 mol -1 cm-1)$ C = molar concentration (mol dm -3) B = path length (cm).	nt	
	 Instrument based on Beer Lambert's law: Single beam filter photometer. Double beam filter photometer. Multi Channel photometer. Spectrophotometer. Infra red Spectrophotometer. 	02 marks for Instrum ents	
b.	With neat diagram give constructional details of NMR spectrometer.		04
Ans.	Receiver coils Magnet bole 60 Hz Sweep coils Sweep coils Sweep coils Sweep coils Sweep coils Sweep coils Sweep coils	02 marks for Diagra m	
	 NMR Spectrometer : NMR stands for Nuclear Magnetic Resonance Spectrometer. It is a complex system integrating several technologies. 1. Magnetic Field: The magnet used in this instrument may be permanent or electromagnet. Alternatively the magnetic field may be produced from super conducting solenoids. An important requirement of the magnetic field is that it should be stable and homogeneous. 2. Radio Frequency Transmitter: The RF transmitter is a 60 MHz crystal control oscillator. The RF signal is fed into pair of coils mounted at right angle to the path of the field. The coil that transmits the RF Field is made into two half in order to allow insertion of the sample holder. 	02 marks for Explana tion	



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	3. Signal Amplifier and Detector: The RF Signal produced by the resonating nuclei is directed by means of coil surrounding by sample		
	holder. This coil consists of few turns of wires and placed that right		
	angled to the source coil. Due to weak signal produced the need for		
	amplification rises.		
	4. Display System: The detected signal is applied to the vertical plates of		
	the oscilloscope to produce the NMR Spectrum.		
	5. Recording Unit : The recorder with NMR Spectrometer is usually self		
	balancing null type potentiometric recorder, having an FET Chocker		
	amplifier in the input stage		
c.	Give the principle of pH measurement and draw a neat labelled diagram		04
	of glass electrode for pH measurement.		
Ans.	Principle of pH measurement:	02	
	The measurement of the pH of a sample can be done by measuring the cell	marks	
	potential of that sample by <i>measurement</i> electrode in reference to a standard	for	
	<i>reference</i> electrode.	principl	
	The <i>measurement</i> electrode is designed to allow hydrogen ions in the solution	e	
	to migrate through a selective barrier, producing a measurable potential		
	(voltage) difference proportional to the solution's pH. The circuit will be		
	completed by another electrode called <i>reference</i> electrode. These two		
	electrodes generate a voltage directly proportional to the pH of the solution. At		
	a pH of 7 (neutral), the electrodes will produce 0 volts between them. At a low		
	pH (acid) a voltage will be developed of one polarity, and at a high pH		
	(alkaline) a voltage will be developed of the opposite polarity.		
	Diagram of glass electrode:		
	Shielded		
	lead		
	Shield IT-	02	
	internal the	marks	
	11-11	for	
	St H	Diagra	
	reference	m	
	Standard .pH		
	solution sensitive glass bulb		
d.	Give the detail classification of chromatography.		04



Ans.	Classification of chromatography:	04 mark	
	A. Gas chromatography :	for	
	a. Gas/Liquid (partition) chromatography	classific	
	b. Gas/Solid (adsorption) chromatography	ation.	
	B. Liquid chromatography:	(02	
	a. Paper chromatography	marks	
	b. Column chromatography	for gas	
	i. Liquid/Liquid (partition)chromatography.	and 02	
	ii. Liquid/Solid (adsorption)chromatography.	mark	
	iii. Gel permeation chromatography.	for	
	iv. Ion exchange chromatography.	liquid	
	c. Thin layer chromatography.	shall be	
		conside	
		red)	
e.	Describe the nitrogen oxides measurement using CO laser.	,	04
Ans.	Block Diagram:	02	
	Laser> H _{DC}	marks	
	Polarization	for	
	Sample Infrared	Diagra	
	cell detector	m	
	Gas transfer Lock-in Audio		
	ampuner freq.		
	Recorder		
	Nitrogeneyides measurement using CO leser		
	1 Figure shows the block diagram of detecting nitric oxide in 0.25 ppm		
	concentration		
	2 Apparatus consists of CO Lasar, which amits radiation that is absorbed		
	by the NO in the mixture		
	3 The amount of absorption being proportional to the concentration of		
	NO present	02	
	A The CO laser used is a dc excited continuous working laser which	marks	
	operates on a single wavelength of 5 307 µ and at liquid nitrogen	for	
	temperature	Explana	
	5 A diffraction grating is used at one and of the cavity as a selector	tion	
	6. The absorption cell is made of pyrane and is of 15 mm diameter and		
	Of the absorption cen is made of pyrene and is of 15 min diameter and		
	7 It is evacuated to a press of 10- 6to 10-5		
	8 The DC Magnetic field produces a field up to 2.5 KG by a solenoid		
	0 The detector is a liquid nitrogen cooled Ge Au element		
	10 The signal is amplified and locks in an amplifier before given to		
	recorder		
	11. The signal amplitude varias linearly with the concentration of NO in		
	the sample		
	uie sample.		



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	1. In thermal conductivity analyzer by using thermistor; two thermistors are		
	in four arms of Wheetstone bridge	02	
	2 Thermistor possesses the advantage of extremely sensitive to relatively	04 marks	
	2. Thermistor possesses the advantage of extremely sensitive to relatively minute change in temperature	for	
	3 When used they are encansulated in glass	relevant	
	4 They are arranged in a constant current bridge circuit and each of them is	explana	
	placed in a separate cavity in a brass or stainless steel block(thermisters	tion	
	in encapsulated in glass)	tion	
	5. The block acts as a heat sink. The material used for construction of		
	filaments must have a high temperature-coefficient of resistance.		
	6. The materials generally used for the purpose include tungsten, Kovar		
	(alloy of co, Ni and Fe) or platinum.		
	7. Two filaments connected in opposite arms of the Wheatstone bridge act		
	as reference arms, whereas the other two thermisters are connected in the		
	gas stream, which act as measuring arms.		
	8. The use of a four-cell arrangement serves to compensate for temperature		
	and power supply variations.		
	9. Initially, reference gas is made to flow through all the cells and the		
	bridge is balanced precisely with the help of potentiometer D.		
	10. When the gas stream passes through the measuring pair of thermister,		
	there is a corresponding change in the resistance of the thermister.		
	registence of the wire and vice verse		
	12 Consequently, the greater the difference in thermal conductivities of the		
	reference and sample gas the greater would be the unbalance of the		
	Wheatstone bridge		
	13. The unbalanced current can be measured on indicating meter or on a		
	strip chart recorder.		
c)	What is catheter tip electrode? Explain how PO ₂ is measured using it.		04
Ans.	The partial pressure of oxygen in blood or plasma indicates the extent of	01Mark	
	oxygen between lungs and blood. Catheter tip electrode is small enough to be	for	
	mounted on Catherer tip and preferred for measurement of more than one	catheter	
	parameter. Catheter tip electrode is used for continous measurement (PO ₂) and	tip	
	(PCO ₂).	electrod	
		e	



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WINTER – 15 EXAMINATION

	Principle of Working :		
	1. The heated tungsten filament produces an electron beam, which passes		
	between plates A & B.	02	
	2. A difference in electrical potential between A & B pulls ions out of beam.	marks	
	so that they pass through slit B into the region between B & C	for	
	3 The notential difference between B & C is adjustable from 0 up to several	nrincinl	
	thousand volts	principi	
	4. The ion beam then enters the space between two transzoid shaped magnet	C	
	4. The foll beam then enters the space between two trapezoid shaped magnet		
	poles, where it is defined unlough an angle of $00, 90, 120, 180$.		
	5. When fons of mass m & charge e pass through an accelerating electric field,		
	they would attain velocity v which can be expressed in term of accelerating		
	voltage v,as		
	$\frac{1}{2} \mathbf{m} \mathbf{v} = \mathbf{e} \mathbf{v}$		
	Where $\frac{1}{2}$ mv ² is kinetic energy of ion as it leaves in electric field		
	6. If the ions next enter a magnetic field of constant intensity h, which is		
	applied at right angles to their direction of motion, the ions would be diverted		
	into circular orbits. Therefore the magnetic sector follows an arc.		
	7. At the detector, voltage output is obtained, which is used to have mass		
	spectrum of element.		
B.	Attempt any ONE.		06
a)	Define Chemiluminescence. How nitrogen oxides measurement is done		06
	using chemiluminescence?		
Ans.	Definition: The phenomenon of emission of radiation from chemi-excited	02	
	species is known as Chemiluminescence.	Mark	
	It results due to the formation of new chemical bonds. The species in the	for	
	excited state possess higher energy levels than the ground state and usually	definitio	
	have a very short life.	n	
	Nitrogen oxide measurement using Chemiluminescence:		
	1. Chemiluminescence phenomenon is very useful for measurement of		
	air pollutants, particularly NO and NO_2 .		
	2. Instruments based on the measurement of chemiluminescent emission,		
	based on the following reaction have been developed:	04	
	$NO + O_3 \rightarrow NO_2 + O_2$	marks	
	$NO_2 \rightarrow NO_2 + hv$ ($\lambda_{max} = 6300 \text{ Å}$)	for	
	3. Since NO ₂ reacts only slowly with ozone and the reaction which	relevant	
	produces NO_3 is not accompanied by Chemiluminescence, it is	explana	
	necessary to reduce to NO ₂ to NO before admission into the reactor	tion	
	$NO_2 \rightarrow NO_1 + \frac{1}{2}O_2$	••••	
	4. Nitric oxide and ozone containing gas steam are mixed in a vessel at a		
	sub atmospheric pressure of about 2 mm of Hg		
	5 Light emission is measured with a photomultiplier		
	6 With the use of high gain low dark current photomultiplier tubes		
	extremely low levels of radiation can be measured		
	7 The response of the instruments based on Chemiluminescence is linear		
	from 1 pph to 1000ppm of NO		
	8 This technique is extremely useful for measurement of NO in		
	o. This womque is extremely useful for incasurement of NO III		
	automotive exhaust gases.		



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WINTER – 15 EXAMINATION

	Source Photocell Reference Difference amplifier Difference amplifier Fixed Measuring measuring slit Electrophoretic amplifier Diagram of double beam densitometer.	02 marks for diagra m	
	Source Source Fixed Silt Fixed Silt Fixed Silt Fixed Silt Fixed Silt Fixed Silt Fixed Silt Fixed Silt Conder	02 marks for diagra m	
	Source Source Fixed Sitt Fixed Sitt Fixed Sitt Electrophoretic Strip	02 marks for diagra m	
	Variable Reference		
Ans.			
b)	Describe operation of double beam densitometer with proper diagram		04
	Determination of alkali-alkaline in industry.		
	 In glass industry for determination of Na, K, Mg. 		
	 Analysis of hard water. Testing soil samples. 		
	urine.	1001)	
	• Determination of Na, K. Mg, in biological fluid like serum, plasma,	(any four)	
	 Analysis of plasma sodium concentration in body 	ion	
	 For analysis of potassium, source , magnesium (K, Na, Mg) In analysis of pathological values. 	applicat	
	 Used in clinical analysis For analysis of notassium and ium Magnasium (K. Na. Mg) 	mark for each	
Ans.	Applications of flame photometer are :	01	
a)	List any four applications of flame photometer.		04
Q 5)	Attempt any FOUR.		16
	indicated using suitable photometer recorders using amplifier.		
	light energy into electrical signals. o/p. of detector is recorded or		
	monochromators and focussed on photo detector. This detector converts		
	2) Optical system: the emitted light by flame is passed through filters,		
	sample elements are produced.		
	d) Flames: It forms the source in which the light radiations characteristics of		
	that they may react safely and produce a good flame.		
	c) Burner: The burner brings the fuel, oxidant and sample aerosol together so		
	introducing the liquid sample into the flame at a stable and reproducible rate.		
	atoms of liquid into small drops. This little device is responsible for		
	b) Atomizer: It is a system used to form aerosol (drop of liquid) by breaking		
	commercially available in cylinders of various sizes		
	The fuel gas normally used in flame photometry is acetylene gas, which is		
	to more the pressure that is determined pressure in the inter-		



	from source lamp through variable slit & other is measuring photo cell		
	 Electrophoretic paper is made translucent by prolonged immersion in 		
	mixture of paraffin oil & bromonapthalene.		
	• Initially zero optical density is set on recorder by allowing light to pass		
	through portion of paper (blank paper) & reference photocell.	02	
	• Then paper is stained with protein sample and light is allowed to pass	marks for	
	through it.	oneratio	
	• Photo cells are so connected electrically that net 0/p from them is difference in Photo voltage of two cells.	n	
	• DC amplifier is used to amplify this diff. voltage which drives		
	servomotor to draw waveforms.		
	• Integrators gives peak value of to indicate concentration of protein.		
	The recorder will trace curves on graph paper according to protin		
	sample.		04
C)	chromatography		04
Ans.	• This technique is used for measuring gas pollutant i.e CO ₂ .		
	• CO ₂ passes from injection port say at temp. T1	04	
	• CO ₂ passes from source to detector through column with some carrier	marks	
	• Gas like He, Ar, N2(inert gas) this carrier gas is mobile phase & CO ₂	for	
	is stationary phase.	explana tion	
	• Columns are kept in thermostatic oven say at temp 12.	uon	
	• Due to temp. 12 in column CO2 molecule in column get separated or Get expand		
	 Get expand. Finally separated molecule detected by gas detector & neak value of 		
	 CO₂ can be determined. 		
	 All process is done in evacuated chamber i.e from source to detector. 		
	OR		
	Any relevant explanation should be considered		
d)	Define pH. state use of buffer solution.	0.1	04
Ans.	Definition: It is negative logarithmic of H+ ion concentration. $\mathbf{p}\mathbf{H} = -\log_{10} \left[\mathbf{h} + 1 \right]$	01 mark for	
	\mathbf{OR}	definitio	
	It is percentage of hydrogen or which gives acidic or basic balance of solution	n	
	Use of buffer solution:		
	• It is solution whose pH is known	03	
	• It is used in glass electrode whose pH remains constant.	marks	
	• When we added acid or base & they are employed for standardization	10r writing	
	OI pH. • The call amf is measured for giving buffer solution and pU value of	brief	
	• The cent entries measured for giving burler solution and pH value of unknown is derived from this calibration.	use of	
	• It is also path of conductive ions in electrode which measure pH of	buffer	
	unknown solution.	solution	
e)	What is conductivity measurement in conductivity meter?		04



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Ans.	 Working of conductivity measurement in conductivity meter: It is based on measuring change in conductivity of a solution, when sample with SO₂ gas is bubbled through solution. The cell C is made with jet J filled partially with sulphuric acid and hydrogen peroxide (H₂O₂). Two electrodes are immersed in solution like H₂SO₄ & are supplied With 5V A.C. When sample or air containing SO₂ is bubbled through solution of H₂SO₄ then change in conductivity takes place. Reagent enters into cell from central tube inserted in the cap A small glass bead in the cell at bottom acts as non return valve As H₂SO₄ is formed from oxidation of H₂O₂ with SO₂ from air sample , and H₂SO₄ is reduced to hydrogen ions H+. This gives electrical conduction. 	02 marks for Figure 02 marks for explana tion	
	This technique is used for measurement of gas pollutants like SO2 O3		
f)	What are different phases in chromatography, briefly describe mobile phase?		04
Ans.	 Chromatography consists of two phases: Stationary phase Mobile phase Mobile phase in chromatography– The mobile phase is usually gas or a liquid It transforms the constituents of mixture through column. This is dynamic phase which carries sample from source to detector. Mobile phase is non-reacting with stationary phase. Detector measures concentration of gas or liquid sample. N₂, Ar,He gases are mobile phase carrier gases used in GC. 	01 mark for each listing of phase (02 Phases) 02 marks for explana tion	



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Q 6.	Attempt any FOUR		16
a)	Draw optical diagram of spectrophotometer using grating. State role of		04
	Grating in it.		
Ans.	Optical diagram of spectrophotometer using grating:	02 marks for figure	
	 Role of Grating is spectrophotometer: Grating is dispersing radiations (light) by interference It consists of series of parallel grooves ruled on highly polish reflecting surface. When white light is incident on it, it diffracts this light in sequence of color spectrum. Then a single (monochromatic) light is selected by slit & it is passed in cuvette containing solution whose concentration is to be determined. Then by using suitable photo detector and amplifier, concentration of solute in solution is measured. 	02 marks explana tion	
b)	What is calomel electrode? Draw its labeled diagram & state it's use.		04
Áns.	calomel electrode: Calomel electrode is also called as reference electrode. This produces stable reproducible voltage. This voltage does not vary with time. It is used as reference electrode in pH measurement. It consists of buffer solution. Iabeled diagram of calomel electrode : Wire lead Glass wool plug Opening Cee Cap KCl solution (fine capillary plugged with asbestos fibre)	01 marks 02 marks for labeled diagra m	



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WINTER – 15 EXAMINATION

	Use calomel electrode -		
	• It is used for the measurement of PH of unknown solution.	01	
	• This is standard electrode	marks	
	• Its emf is compared with emf of glass electrode.	for use	
	• Finally determine PH of unknown solution.		
c)	What is chemical shift? List any two applications of NMR.		04
Ans.	Chemical shift:		
	• This is the phenomenon that occurs in some atoms like Carbon or hydrogen in a given molecule which resonate at slightly different frequency based on its local chemical environment so this difference in resonance frequency is called as chemical shift.	02 marks	
	• Chemical shift is expressed as $\delta = \frac{H_{\text{sample}} - H_{\text{tmsi}}}{H_1} * 10^6$		
	By phenomenon of chemical shift, it allows chemist to obtain picture of number of particular atoms present in molecule and how atoms are joined together in the molecules.		
		01 mark	
	Applications of NWR:	for each	
	 In medical field Structural determination of flavors & fragrance in gradient 	applicat	
	 Structural determination of flavors & fragrance in gradient Food industry 	ion.	
	 Chemical research & development of organic product 	(any	
	 biological research 	two rolovont	
	 Diological research. Pharmaceutical production 	annlicat	
	 Analysis of Polymers 	ion)	
d)	What is GCMS & LCMS? State two applications of each	1011)	04
Ans.	GCMS- Gas chromatography mass spectrometer.	02 mark	04
	LCMS- Liquid chromatography mass spectrometer.	(01 mark for each)	
	Application of GCMS & LCMS		
	 1)GCMS applications: Environmental monitoring and clean up Criminal forensic Sports antidoping 	¹ / ₂ mark for each applicat ion (any	
	Explosion detector	two	
	 Air port security for detecting luggage or items in human body. 	applicat ion)	
	2)LCMS applications:	1/2 mont	
	• Bio analysis.	72 Mark	
	 Meta bolamics – to detect over thousands of proteins from body 	annlicat	
	• Drug research, production	ion	
	 Analysis of organic or inorganic products. 		



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		(any two applicat ion)	
Compare Gas chromatography & Li	iquid chromatography.		
Liquid chromatography In this mobile phase liquid is used. Types are paper , colun and thin layer	Gas chromatographyIn this mobile phase gas is used.Types are gas / liquid & gas / solid	01 mark for each	
Detectors used are UV spectrophotometric detector , florescence detector , RI detector	Detectors used are as like thermal conductivity detector , flame ionized detector , flame photometric detector etc.	compar e point (any	
Volatile solvents, Eluent solution are used as carrier.	He, Ar, Ne gases may be. Used as carrier.	four points)	
Accuracy is less.	Accuracy is more.		
Technique is complicated.	Technique is simple.		