

Program: BE Biomedical Engineering

Curriculum Scheme: Revised 2016

Examination: Final Year Semester VIII

Course Code and Course Name: BMDLO8043 and Nuclear Medicine

Time: 1 hour

Max. Marks: 50

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1		What are isomers?
	a	Excited state of a nuclide
	b	Nuclides having the same number of protons
	c	Nuclides having the same atomic mass
	d	Nuclides having the same number of neutron
2		When two light nuclei combine to form a heavier nucleus, the process is called as
	a	nuclear fusion
	b	nuclear fission
	c	nuclear power
	d	nuclear transmutation
3		In SI base units, 1 Bq is equal to
	a	0.5 disintegration per second
	b	1 disintegration per second
	c	10 disintegration per second
	d	1.5 disintegration per second
4		In air, alpha particles have range of
	a	several thousand meters
	b	several hundred meters
	c	few centimeters
	d	several meters
5		The fast-moving photons are
	a	alpha radiation
	b	beta radiations
	c	gamma radiation
	d	no radiation
6		What are radionuclides?
	a	unstable nuclides
	b	seminuclides
	c	neutral nuclides
	d	stable nuclide
7		A process in which heavy nucleus splits into two by bombarding a slow-moving neutron is called
	a	radioactivity
	b	nuclear fusion
	c	nuclear fission
	d	nuclear splitting
8		Nuclei bombarded with protons, neutron or alpha particles are changed to

	a	stable nuclide
	b	radioisotopes
	c	element having atomic number less than 82
	d	seminuclides
9		Which is a cyclotron produced radionuclide
	a	Fluorine-18
	b	Chromium-51
	c	Molybdenum-99
	d	Xenon- <b>133</b>
10		Excited state of a nuclide is _____
	a	isotones
	b	isobars
	c	isotopes
	d	isomers
11		The minimum amount of energy necessary to free an electron from an atom is ____ energy of the electron in that atom
	a	potential
	b	kinetic
	c	binding
	d	passive
12		During alpha decay the atomic number of the resulting nuclide ( daughter nuclide) will be _____
	a	reduced by 4
	b	reduced by 2
	c	increased by 1
	d	reduced by 1
13		When the electron absorbs an amount of energy that is just sufficient to move it into a higher unoccupied shell, the process is known as _____
	a	excitation
	b	calibration
	c	radiation
	d	ionization
14		1 Becquerel (Bq) corresponds to _____
	a	37 kCi
	b	27.03 pCi
	c	2.7 kCi
	d	37 Ci
15		Energy emitted from the nucleus as a high-energy photon is known as _____
	a	X- ray
	b	Beta emission
	c	Gamma ray

	d	Alpha emission
16		_____ is the reactor produced radionuclide
	a	Fluorine-18
	b	Molybdenum-99
	c	Oxygen-15
	d	Nitrogen-13
17		_____ dominates in low atomic number materials such as soft tissue and bone above 100 keV
	a	Compton interaction
	b	Photoelectric interaction
	c	Pair production
	d	Electron capture
18		The transient equilibrium occurs if _____
	a	parent and daughter radionuclide half life differs by a factor of about 10–50
	b	parent and daughter radionuclide half life differs by a factor of 100
	c	parent and daughter radionuclide half life is equal
	d	parent radionuclide half life is less than daughter radionuclide half life
19		During beta minus ( $\beta^-$ ) decay the atomic mass number (A) _____
	a	increased by one
	b	decreased by one
	c	remains unchanged
	d	decreased by two
20		The probability of photoelectric interaction is _____ -
	a	inversely proportional to the cube of $\gamma$ -ray energy
	b	directly proportional to the cube of $\gamma$ -ray energy
	c	inversely proportional to the square of $\gamma$ -ray energy
	d	directly proportional to the square of $\gamma$ -ray energy
21		A moderator is used in nuclear reactor to slow _____
	a	protons
	b	alpha particles
	c	neutrons
	d	beta particles
22		the kinetic energy of the alpha particle emitted during Rn-222 alpha decay is _____
	a	4.78 MeV
	b	4.78 keV
	c	2keV
	d	15 MeV
23		An alpha particle is also known as
	a	a photon
	b	a positron
	c	an electron
	d	a helium nucleus
24		Gamma-ray have _____

	a	no mass and no electric charge
	b	no mass and an electric charge of +2
	c	no mass and an electric charge of -1
	d	no mass and an electric charge of +1
25		In the symbol Tc-99, the number 99 represents
	a	the number of electrons
	b	Avogadro's number
	c	the atomic number
	d	the atomic mass number
26		For Bone pain palliation ____ is used commonly.
	a	strontium-89
	b	Tc-99m
	c	Yttrium-90
	d	I - 131
27		Radionuclides that emit ____ are preferred for the treatment of bulky tumours
	a	$\gamma$ -radiation
	b	energetic $\alpha$ - or $\beta$ -particles
	c	X-rays
	d	Auger electrons
28		Photon energy of ____ is release from the radiation source used in Cobalt teletherapy unit
	a	1 keV
	b	1.17 or 1.33 MeV
	c	50 keV
	d	100 keV
29		Cobalt unit is used to treat ____
	a	coronary blockages
	b	pneumonia
	c	ulcers
	d	Cancers
30		Gamma Knife is used to manage ____
	a	pneumonia
	b	brain tumours
	c	ulcers
	d	infections
31		Cobalt therapy uses ____ from the radioisotope cobalt-60.
	a	alpha particles
	b	delta rays
	c	gamma rays
	d	x-rays
32		Effective half life of ideal radiopharmaceutical

	a	20*test duration
	b	1.5*test duration
	c	10*test duration
	d	30*test duration
33		Compare to following four , Who is more susceptible to injurious radiation effects?
	a	Children
	b	Adult
	c	Fetus
	d	senior citizen
34		Acute effects generally appears within following days of exposure to radiations
	a	90 days
	b	120 days
	c	150 days
	d	60 days
35		1 $\mu$ Ci*hr cumulated activity in MIRD is equivalent to
	a	1.332 $\times$ 10 <sup>2</sup> MBq *sec
	b	1.332 $\times$ 10 <sup>3</sup> MBq *sec
	c	1.332 $\times$ 10 <sup>5</sup> MBq *sec
	d	1.332 $\times$ 10 <sup>4</sup> MBq *sec
36		Which is more damaging in absorbed dose?
	a	Gamma radiations
	b	Alpha particle
	c	Beta+ particle
	d	Beta - particle
37		External radiations exposure to body is increased by
	a	Increase the distance from the source
	b	Decrease the time of exposure
	c	Use shielding between yourself and the source
	d	Decreasing your distance from the source
38		What is the cumulated activity in the liver for an injection of 100 MBq of a <sup>99m</sup> Tc-labeled sulfur colloid, assuming that 60% of the injected colloid is trapped by the liver and retained there indefinitely? (Half life of <sup>99m</sup> Tc= 6 hours)
	a	5.18 MBq*hr
	b	5184 MBq*hr
	c	51.84 MBq*hr
	d	518.4 MBq*hr
39		Material used in TLD chip for detection of radiations
	a	Lithium Fluoride
	b	Sodium chloride
	c	calcium carbonate
	d	cadmium sulphate
40		Calculate the radiation dose to spleen (sp) to an average adult male for an injection of 100MBq of <sup>99m</sup> Tc sulfur colloid. Assume that 30% of the activity is trapped by spleen

		(SP) with instantaneous uptake and no biologic excretion. (Half life of $^{99m}\text{Tc}$ = 6 hours)
	a	$9.33 \times 10^5 \text{ MBq}\cdot\text{Sec}$
	b	$933 \times 10^5 \text{ MBq}\cdot\text{Sec}$
	c	$93.3 \times 10^5 \text{ MBq}\cdot\text{Sec}$
	d	$0.933 \times 10^5 \text{ MBq}\cdot\text{Sec}$
41		Biological effects such as Chromosomal aberrations and mutations occurs at following level
	a	Cell
	b	Tissue
	c	Organ
	d	Whole body
42		Amount of dose required to reduction in fertility in male is
	a	3-4 Gy
	b	3-4 mGy
	c	0.3 - 0.4 Gy
	d	0.3 - 0.4 mGy
43		Amount of dose required to cause Epilation
	a	0.1-0.2 mGy
	b	0.1-0.2 Gy
	c	2-6 mGy
	d	2-6 Gy
44		The air kerma rate at 10-cm distance from a syringe containing 1GBq of $^{99m}\text{Tc}$ . (air kerma rate constant $\Gamma$ is $0.0141 \text{ mGy} \cdot \text{m}^2/\text{GBq} \cdot \text{hr}$ )
	a	14.1 mGy/hr
	b	1.41 mGy/hr
	c	141 mGy/hr
	d	1410 mGy/hr
45		$^{99m}\text{Tc}$ -DTPA is commonly used in
	a	Bone scans
	b	Renal function
	c	Myocardial perfusion
	d	Cerebral perfusion
46		Which is mechanism of localization for Bone scanning with $^{99m}\text{Tc}$ -labeled phosphate compound?
	a	antibody-antigen
	b	Simple exchange or diffusion
	c	Cell sequestration
	d	Receptor binding
47		Which of the given option is inappropriate Radiation effect on Oral Tissues?
	a	jaw osteoradionecrosis
	b	Xerostomia

	c	Sterility
	d	Mucositis
48		Time involved in radiation damage of alterations of biologically important molecules
	a	micro second
	b	upto millisecond
	c	seconds to hours
	d	hours to years
49		For a dual head gamma camera two simultaneous image can be acquired at an angle of
	a	90°
	b	120°
	c	180°
	d	270°
50		What does the 'P' in PET stand for?
	a	Positron
	b	Photon
	c	Proton
	d	P-orbital
51		What makes PET and SPECT so unique when it comes to nuclear imaging?
	a	Do not require dyes
	b	Do not require X – Rays
	c	They show the metabolic functions
	d	They give more details about the imaged organ/tissue
52		The most preferred radioisotope element for SPECT is
	a	Mo
	b	W
	c	Tc
	d	Ba
53		As compared to PET, SPECT isotopes have _____ half life.
	a	Longer
	b	Shorter
	c	Equivalent
	d	Unstable
54		The detector of PET is made of _____
	a	Silver
	b	Bismuth Germinate
	c	Tungsten
	d	Lead
55		Which of the following radiations are used for imaging purposes?
	a	Alpha
	b	Beta
	c	Gamma
	d	Delta

56		If a PET scan is being used to detect tumors, an important constituent of the injected radioligand will be _____
	a	glucose
	b	lipids
	c	keratin
	d	riboflavin
57		PET-CT hybrid imaging provides
	a	Only Anatomical information of tissues
	b	Only Physiological information of tissues
	c	Both Anatomical and Physiological information of tissues
	d	None of Anatomical and Physiological information of tissues
58		PET-CT hybrid imaging is most commonly used for detection of
	a	Cancer
	b	Bone fracture
	c	Blockages in Blood vessels
	d	Kidney stone
59		In SPECT, Projections are acquired at defined points during the rotation, typically every
	a	3–6 degrees
	b	10–12 degrees
	c	16–18 degrees
	d	20–22degrees
60		Which type of collimator used in SPECT?
	a	Focusing
	b	Diverging
	c	Inverging
	d	Parallel hole
61		In SPECT following isotope used for Thyroid examination
	a	iodine-131
	b	indium-111
	c	thallium-201
	d	technetium-99m
62		When both photons from an annihilation event are detected by detectors in coincidence is called as
	a	Random coincidence
	b	Scatter coincidence
	c	True coincidence
	d	False coincidence
63		Half life of O-15 isotope use in PET is
	a	51 sec
	b	122 sec
	c	244 sec
	d	488 sec
64		Half life of C-11 isotope use in PET is



	a	5 mins
	b	10 mins
	c	15 mins
	d	20 mins
65		Which scanner has detectors in the form ring around the patient?
	a	PET
	b	SPECT
	c	Gamma Camera
	d	Rectilinear Scanner
66		Which of these materials have got lowest density
	a	Air
	b	Si(Li)
	c	Ge(Li)
	d	CdTe
67		Identify the detector which has got poor energy resolution
	a	Ionization Chamber
	b	Si detector
	c	Ge detector
	d	Nal(Tl) Counter
69		For any detector the size of electrical signal is proportional to
	a	amount of radiation deposited
	b	detector construction
	c	detector size
	d	detector cost
70		How electron traps can be avoided in semiconductor detectors
	a	Addition of impurity atoms(ex. Li)
	b	Operating detector at low temperatures
	c	Reducing the size of the detector
	d	Increasing the size of the detector
71		In RIA a known quantity of antigen is made radioactive by
	a	Labelling with Radioactive isotopes
	b	Fusion process in cyclotron
	c	Mixing with neutron rich element
	d	Nuclear Fission

72		IN RIA To separate Free Antigens from Antigen-Antibody complex, which of this techniques is irrelevant
	a	Electroporation
	b	Electrophoresis
	c	Chromatography
	d	Ultracentrifugation
73		RIA technique is used for
	a	measuring concentration of antibodies
	b	measuring concentration of antigens
	c	finding spectrum of radioactive material
	d	detection in gamma ray
74		What is the major problem in working with RIA Technique
	a	Process is complicated
	b	Skilled manpower is required
	c	Risk of handling radioactive antigens
	d	RIA Technique is inefficient for detecting radioactivity
75		What is Freund's Adjuvant used in RIA
	a	Radioactive antigen
	b	Radioactive antibody
	c	Mixture of mineral oil, waxes, and killed bacilli
	d	Liquid scintillator
76		What is the effect of ionization reaction in atoms
	a	Results in formation of ion pairs
	b	Makes atoms radioactive
	c	Atoms become stable in nature
	d	No change is seen in the atomic structure
77		Which of the given operating mode is irrelevant for gas filled detectors
	a	Ionization chamber
	b	Proportional counter
	c	GM counter
	d	Quantum counter
78		To use gas filled detector as Ionization chamber what should be typical voltage around the anode and cathode plates
	a	voltage should be equal to saturation voltage (Vs)
	b	voltage should be less than saturation voltage (Vs)
	c	voltage should be greater than saturation voltage (Vs)
	d	No voltage source is required
79		In ionization chamber how much energy is expended to produce one ion pair
	a	1 eV
	b	34 eV
	c	100 eV
	d	3400 eV

80		What is special feature of a scintillator crystals
	a	Generates equivalent voltage when struck by light photons
	b	Generates equivalent light photons when struck by radiation
	c	Can be used for detecting IR and UV Rays too
	d	Work as an efficient temperature sensor
81		Dynodes used in PMT are held at
	a	Negative potential
	b	Positive potential
	c	Zero potential
	d	Varying negative potential
82		In scintillation detector instead of PMT which of this component can also be used to detect light photons
	a	Si detector
	b	GM Counter
	c	Proportional counter
	d	Si Photodiode
83		What is density of NaI(Tl) crystals
	a	1.03 g/cm <sup>3</sup>
	b	3.67 g/cm <sup>3</sup>
	c	4.51 g/cm <sup>3</sup>
	d	7.13 g/cm <sup>3</sup>
84		Density of which of these detector is much higher
	a	Gas filled detector
	b	Semiconductor detector
	c	Scintillation detector
	d	Quantum detectors
85		Which of this is a semiconductor detector
	a	NaI(Tl) Detector
	b	BGO Detector
	c	CsI(Tl) Detector
	d	Si Detector
86		For a semiconductor detector, to produce 1 ion pair how much energy is expended
	a	1 eV
	b	3-5 eV
	c	30-50 eV
	d	300-500 eV
87		Which of this is a function of organic solvent in Liquid Scintillation Detector
	a	Dissolves Scintillator material
	b	Doesnot Dissolves Radioactive sample in it
	c	Emits Radiation
	d	Emits secondary ionization
88		The fraction of the chemical present in the organ at any time is called as
	a	Uptake of the organ

	b	Intake of the organ
	c	Chemical distribution
	d	Effective concentration
89		Which component is responsible for selecting a radioactive event based on its energy
	a	Nal (TI) detector
	b	Amplifier
	c	Pulse Height Analyzer
	d	Analog Ratemeter
90		Half life of I-131 is
	a	8.1 days
	b	12 days
	c	6 days
	d	6 hours
91		Who is credited for the invention of Gamma Camera
	a	Benedict Cassen
	b	Marie Currie
	c	James Currie
	d	Hal Anger
92		What is the purpose of collimators in gamma camera
	a	Absorption of scattered and randomly directed gamma photons
	b	Transmission of gamma photons to Nal(Tl) detectors
	c	Conversion of gamma photons to electrical signal
	d	Protect the patient from scattered radiations
93		In gamma camera electrical signals from PM Tubes split into
	a	X+, Y+ signal component
	b	X, Y, Z, W signal component
	c	X-, Y- signal component
	d	X,Y, E signal Component
94		What is the typical size of Nal(Tl) detector used in gamma camera
	a	60 X 40 mm
	b	60 X 40 cm
	c	6 X 4 mm
	d	600 X 400 cm
95		With increasing detector thickness in gamma camera, intrinsic spatial resolution
	a	Decreases
	b	Increases
	c	Remains same
	d	Becomes Uneven
96		What is the reason for poor quality of Radionuclide Images in gamma camera
	a	Inefficient detectors used in Gamma Camera
	b	Potentially useful radiation travelling towards detector are absorbed by collimator
	c	Low dose of Radionuclide given to patient
	d	Inefficient Image Reconstruction Algorithm

97		In an pinhole collimator, if we decrease the distance between object and the collimator aperture, image size
	a	Decreases
	b	Increases
	c	Remains same
	d	No image is available
98		Diverging collimators gives what kind of image
	a	Minified, Non Inverted
	b	Same size, Non Inverted
	c	Magnified, Inverted
	d	Magnified, Non Inverted
99		Which performance characteristic signifies sharpness and details of gamma camera images
	a	Energy Resolution
	b	Detection Efficiency
	c	Intrinsic Spatial Resolution
	d	High Counting Rates
100		Higher detection efficiency will be obtained from which detector thickness
	a	0.64 cm
	b	1.27 cm
	c	2.54 cm
	d	5.08 cm
101		In gamma camera the Z Signal from Amplifier/ADC represents
	a	Horizontal position of radiation event
	b	Vertical position of radiation event
	c	Energy deposited by the gamma ray
	d	Noise