QUIZ: Radiopharmacy

1. Mark the following statements True or False:

____ a) Tc-99m Sestamibi has a short biological half-life in the heart
____ b) Tc-99m Teboroxime has a short biological half-life in the heart
____ c) Tc-99m HMPAO has a long biological half-life in the brain
____ d) The t_{biol} of Tc-99m HSA in the blood pool is >Tc-99m RBC's
____ e) The t_{biol} of Tl-201 chloride in the body is less than 5 days

2. Match the renal agents listed below with their routes/percentages of excretion

_____ Tc-99m DTPA
_____ Tc-99m MAG3
_____ Tc-99m DMSA

(A) tubular secretion/glomerular filtration 50/50
(B) tubular secretion/glomerular filtration 80/20
(C) glomerular filtration/tubular secretion 80/20
(D) predominantly tubular binding
(E) tubular binding/glomerular filtration/tubular secretion 20/40/40
(F) Tubular secretion 100%
(G) Glomerular filtration 100%

3. Which of the following statements is incorrect?

a) Tc-99m pertechnetate is distributed only in the blood pool
b) Lesions detected on a cerebral radionuclide angiogram usually show increased uptake.
c) Lesions detected on a delayed brain scan usually show decreased uptake.
d) All of the above
e) None of the above

4. Which statement(s) is/are correct?

a) Bone scanning is more sensitive than x-rays
b) Bone scans detect metastatic disease prior to x-ray changes.
c) Bone scans are less specific than x-rays
d) a and b
e) All of the above

5. The mechanism of radiopharmaceutical localization in lung scanning is:

a) phagocytosis
b) capillary blockade
c) active transport
d) adsorption to hydroxyapatite crystals

6. Match the following:

a) Ventilation lung scan
b) Perfusion lung scan
c) Myocardial perfusion scan
d) Myocardial infarct scan

_____ 1. Tc-99m macroaggregated albumin
_____ 2. Xenon-133
_____ 3. Thallium-201
_____ 4. Tc-99m pyrophosphate

7. The mechanism of uptake of radiopharmaceutical in liver-spleen scanning is

a) Particulate blockade
b) Phagocytosis by the RE system
c) Hydrolysis of the colloid particles by the hepatocytes
d) b and c
e) None of the above

8. The percent of Tc-99m sulfur colloid cleared from the circulation and the half-time of clearance are, respectively,

a) 50%, 8 min
b) >90%, 2.5 min
c) <10%, 3 min
d) >90%, 8 min
e) 50%, 3 min

9. Clinical indications for spleen scanning with Tc-99m SC include

a) suspected lung abscess
b) suspected splenic trauma and infarction
c) evaluating the half-life of RBCs in splenic sequestration
d) all of the above
e) and c

10. Which of the following is/are suitable for thyroid imaging?

a) Tc-99m sodium pertechnetate
b) I-123 sodium iodide
c) I-125 sodium iodide
d) I-131 sodium iodide

11. Pertechnetate and iodide uptake by the thyroid may be invalidated by which of the following?

a) Angiographic contrast agents
b) Propranolol
c) Thyroid hormone ingestion
d) a and c
e) all of the above

12. Normal thyroid uptake of I-131 at 24 hours may be from

a) 3-10%
b) 7-30%
c) >40%
d) <2%

13. Which of the following radiopharmaceuticals is/are suitable for blood pool scanning?

a) Tc-99m sulfur colloid
b) Tc-99m MAA
c) Tc-99m tagged red blood cells
d) Tc-99m tagged DTPA
e) None of the above

14. Tl-201 is a useful cardiac imaging agent because of the following properties:

a) It is a potassium analog
b) It localizes in acutely infarcted myocardium
c) It is distributed proportional to relative blood flow.
d) a and c only
e) All of the above

15. The optimal time for detection of acute myocardial infarction by infarct avid agents is:

a) 6 hours after onset of symptoms
b) one week after onset of symptoms
c) during chest pain
d) 24 to 72 hours after onset of symptoms
e) during maximum exercise

16. Match the following

____1) Active transport	a) Tc-99m MAA localizes in the lungs
____2) Capillary blockage	b) Fluorine-18 localizes in bone
____3) Phagocytosis	c) In-111 Octreoscan
____4) Compartmental localization	d) Iodine-131 localizes in thyroid
____5) Exchange diffusion	e) Tc-99m RBC localizes in blood pool
____6) Sequestration	f) Tc-99m Sulfur Colloid localizes in RES cells
____7) Metabolic Trapping	g) In-111 ProstaScint
____8) Antigen/antibody reaction	h) Denatured Tc-99m RBC localizes in spleen
____9) Somatostatin receptor binding	i) F-18 fluorodeoxyglucose

17. The ideal <u>diagnostic</u> radiopharmaceutical has an effective half-life

a) of 1 day
b) 1 to 1½ times the biological half-life
c) of 6 hours
d) 1 to 1½ times the length of time necessary to complete the test

18. Which of the following is/are suitable for reducing pertechnetate prior to tagging to a chelating agent?

a) stannous ion (Sn^{2+})
b) stannic ion (Sn^{4+})
c) thallous ion (Tl^{1+})
d) mercuric ion (Hg^{2+})
e) none of the above

19. When can the effective half-life of a radioisotope equal the biological half-life?

a) when the physical half-life is very short
b) when the physical half-life is infinitely long
c) when the biological half-life is very short
d) when the biological half-life is infinitely long
e) when the biological and physical half-lives are equal

20. We analyze all of our Tc-99m radiopharmaceuticals for impurities. These include

a) free Tc, Al^{3+} ion, Mo^{99}
b) free Tc, Mo^{99}, Hydrolyzed Reduced Tc
c) Al^{3+} , Mo^{99}, Hydrolyzed Reduced Tc
d) free Tc, Hydrolyzed Reduced Tc
e) perchlorate, molybdate

21. Images of blood pool studies may be taken at what time post injection?

a) minutes
b) hours
c) weeks
d) a and b
e) b and c

22. Which of the following radiopharmaceuticals represents an example of compartmental localization?

a) Tc-99m RBC
b) I-125 HSA
c) Tc-99m MAA
d) a and b only
e) all of the above

23. Match radiation absorbed dose in right hand column with the item in the left hand column.

____ LD_{50} in humans (total body dose)	a) O.l5R
____ LD_{100} in humans (total body dose)	b) 0.010 R
____ Dose to thyroid gland of hyperthyroid patient following administration of 10 mCi of I-131 NaI	c) 11,000 R d) 500-550R
____ Whole body background if you live at sea level	e) 1×10^6 R
____ Whole body background if you live in Denver	f) 350R
____ Whole body dose from anterior chest film	g) 0.3 R

24. Match particle size range with radiopharmaceutical

_____ Tc-sulfur colloid	a) 10-90 μm
_____ Tc-MAA	b) 5-10 μm
_____ Tc-MDP	c) 0.1-2 μm
_____ Tc-MIAA	d) no particles present

25. Match number of particles of Tc-MAA to inject with patient population

_____ Adult patient w/o pulmonary HTN	a) 50,000
_____ Adult patient w/ pulmonary HTN	b) 350,000
_____ 3 year old child	c) 100,000
_____ Neonate	d) 150,000

26. Three patients underwent dual Schillings Tests in which Co-57 labeled vitamin B_{12} bound to intrinsic factor and Co-58 vitamin B_{12} were administered. Match the results of the test with the proper diagnosis.

% excretion in 24 hrs. Co-57 / Co-58	Diagnosis:
____ 21/18	a. Malabsorption syndrome
____ 4/3.6	b. Normal
____ 9/3	c. Pernicious anemia

27 A patient underwent the first stage of a Schilling Test and the percent of administered Co-57 activity found in the urine at 24 hr post administration of the dose was 11.1%. The appropriate course of action is to

a. Release the patient- test is complete
b. Administer second stage of test
c. Prescribe round of antibiotics, then repeat stage one
d. Request an additional 24 hours of urine collection and pool specimens

28. Match the procedure listed in column 1 with the typical adult dose in column 2

Column 1 (Procedure)	Column 2 (Adult dose)
_____ bone scan	a) 200 μCi
_____ perfusion lung scan	b) 1 mCi
_____ thyroid uptake test	c) 3 mCi
_____ liver scan	d) 5-10 mCi
_____ thyroid therapy (Ca)	e) 10-15 mCi
_____ perfusion brain scan	f) 15-25 mCi
_____ tumor/abscess scan with Ga-67	g) 100-150 mCi
_____ MUGA	h) 50 mCi

29. Answer True/False to the following statements regarding hepatobiliary agents

a) Typical injected dose is 1 mCi
b) In an emergency, one could substitute Tc-99m Sulfur Colloid for Tc-DISIDA for use in hepatobiliary imaging
c) If gallbladder accumulation of the DISIDA first appears on scan at 90 minutes post injection, this is a normal study.
d) Gallbladder emptying is sometimes effected following administration of a glass of milk.
e) The -IDA ending on DISIDA stands for -imidodiacetic acid.
f) Administration of IV morphine effectively empties the gall bladder
g) typical administered dose of 3-8 mCi is based on body surface area

30. Match isotopes in left hand column with principal imaging energy (KeV) in right hand column

Isotope	Energy (KeV)
_____ Co-57	a. 511
_____ F-18	b. 122
_____ I-131	c. 159
_____ Tl-201	d. 78
_____ I-123	e. 365

31. Match radiopharmaceutical in right hand column with scan type in the left hand column.

_____ Lung Perfusion	A. In-111 leukocytes
_____ Meckel's diverticulum	B. Tc-99m pertechnetate
_____ Bone Marrow	C. I-123 mIBG
_____ Parotid	D. In-111 DTPA
_____ Abscess	E. Tc-DisofeninIn
_____ Hepatobiliary	F. Tc-MAA
_____ Glomerular Filtration	G. Tc-Glucoheptonate
_____ Tubular secretion	H. Tc-DTPA
_____Thyroid uptake test	I. Tc-99m MAG3
_____Neuroblastoma	J. Ga-67 citrate
_____Insulinoma/glucagonoma	K. Tc-99m RBC's
_____ Hepatic hemangioma	L. I-123 NaI iodide
	M. Tc-99m sulfur colloid
	N. 123 Sodium iodide
	O. In-111 Octreotide

32. What test animals were used for the original USP pyrogen test?

a. dogs
b. Limulus polyphemus
c. rats
d. rabbits

33. What advantage(s) does the Limulus Amebocyte Lysate test have over the “in vivo” pyrogen test?

a. very rapid
b. relatively inexpensive
c. very sensitive
d. all of the above

34. Cold, non-radioactive vitamin B_{12} is given as part of the Schilling Test to:

a. Initiate therapy in the patient
b. Block B_{12} binding sites in the liver
c. Reduce facial flushing
d. Help differentiate between pernicious anemia and simple malabsorption

35. The most common long-term adverse effect observed following the administration of an I-131 NaI therapy dose for treatment of Graves Disease is

a. Adenocarcinoma of the thyroid
b. Hypothyroidism
c. Leukemia
d. Pancytopenia

36. The fraction of the pulmonary vasculature occluded by a typical dose of human albumin microspheres may be expected to be:

a. 0.1 or less
b. 0.01 or less
c. 0.001 or less

37. The ideal particle size to use in man for lung scanning is:

a. 5-15 μm
b. 20-40 μm
c. 100-150 μm
d. 200-400 μm

38. The chances of picking up functioning metastases from thyroid carcinoma by scan are increased by which of the following:

a. thyroidectomy
b. use of iodine-123
c. use of pertechnetate
d. scanning at 72-96 hours
e. a and d

39. The ideal radiopharmaceutical for clinical imaging studies has

1. an effective half-life equal to 1½ times duration of test.
2. an absence of particulate radiation
3. a gamma energy of 100 to 250 keV
4. a decay by isomeric transition

Answer:
a. if only 1, 2 and 3 are correct
b. if only 1 and 3 are correct
c. if only 2 and 4 are correct
d. if only 4 is correct
e. if all are correct

40. The effective half-life of Tc-99m is

a. 6.02 hr
b. 12.04 hr
c. 6.02 hr x $(½)^{10}$
d. Not enough information to answer question

41. Within what % of the prescribed dose must the calibrated dose be?

a. 5%
b. 10%
c. 25%
d. 50%

42. The prescribed dose of Tl-201 chloride is 2.0 mCi. A technologist administers a 3.0 mCi dose since he has a very obese patient to inject. Whole body dose is estimated to be 3 R and no single organ receives more than 5 R. Which of the following describes the situation?

a. Event reportable only to the Nuclear Regulatory Commission
b. Event reportable only to the State Department of Nuclear Safety
c. Event reportable to both the Nuclear Regulatory Commission and the State Department of Nuclear Safety
d. Recordable Event

43. The approximate distribution of Tc-99m sulfur colloid in the RES is

a. 40% liver, 40% spleen, 20% marrow
b. 50% liver, 25% spleen, 25% marrow
c. 60% liver, 30% spleen, 10% marrow
d. 85% liver, 10% spleen, 5% marrow

44. What is the following correctly characterizes hydrolyzed reduced Tc?

a. Soluble, ionic compound
b. Insoluble, large particles
c. Insoluble, colloidal particles
d. Volatile gas

45. A bone scan reveals a bone:soft tissue ratio of 5:1 and a lesion:bone ratio of 5:1. What is the ratio of lesion:soft tissue?

a. 1:1
b. 5:1
c. 10:1
d. 25:1

46. What % of the injected dose of Tc-99m bone agents localizes in bone and what % is excreted through the kidneys? Assume normal renal function.

a. 30%/70%
b. 50%/50%
c. 70%/30%
d. 90%/10%

47. In which of the following patients scheduled for a MUGA would you choose Tc-HSA over Tc-RBC's?

a. Patient undergoing chemotherapy with methotrexate
b. Patient on high-dose antibiotic therapy
c. Patient who has received an injection of Sr-89 chloride
d. Patient who has been heparinized

48. A patient scheduled for an RAIU is taking 100 μg of synthroid daily. How long must the patient be off synthroid to obtain a valid RAIU?

a. 1 day
b. 1 week
c. 2 weeks
d. 4 weeks
e. synthroid is not contraindicated for an RAIU

49. A patient scheduled for a Schilling Test is taking therapeutic vitamin B_{12} on a daily basis. How long must the patient be off vitamin B_{12} to obtain a valid test?

a. 1 day
b. 3-5 days
c. 10-14 days
d. 4 weeks