APMP/17

2017

MEDICAL PHYSICS

(P.G. Degree Standard)

Time Allowed : 3 Hours] [**Maximum Marks : 300**

Read the following instructions carefully before you begin to answer the questions.

IMPORTANT INSTRUCTIONS

1. The applicant will be supplied with Question Booklet 10 minutes before commencement of the examination.

2. This Question Booklet contains **200 questions**. Prior to attempting to answer the candidates are requested to check whether all the questions are there and ensure there are no blank pages in the question booklet. **In case any defect in the Question Paper is noticed it shall be reported to the Invigilator within first 10 minutes and get it replaced with a complete Question Booklet.** If any defect is noticed in the Question Booklet after the commencement of examination it will not be replaced.

3. Answer all questions. All questions carry equal marks.

4. You must write your Register Number in the space provided on the top right side of this page. Do not write anything else on the Question Booklet.

5. An answer sheet will be supplied to you, separately by the Invigilator to mark the answers.

6. You will also encode your Register Number, Subject Code, Question Booklet Sl. No. etc. with Blue or Black ink Ball point pen in the space provided on the side 2 of the Answer Sheet. If you do not encode properly or fail to encode the above information, action will be taken as per commission's notification.

7. Each question comprises *four* responses (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.

8. In the Answer Sheet there are **four** circles Ⓐ, Ⓑ, Ⓒ and Ⓓ against each question. To answer the questions you are to mark with Ball point pen ONLY ONE circle of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. *e.g.* If for any item, Ⓑ is the correct answer, you have to mark as follows :

<div align="center">Ⓐ ● Ⓒ Ⓓ</div>

9. You should not remove or tear off any sheet from this Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. After the examination is concluded, you must hand over your Answer Sheet to the Invigilator. You are allowed to take the Question Booklet with you only after the Examination is over.

10. The sheet before the last page of the Question Booklet can be used for Rough Work.

11. Do not tick-mark or mark the answers in the Question Booklet.

12. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.

←

1. Developing solution contain

   (A) hydroquinone

   (B) hydroquinone and phenidone

   (C) sodium sulfite

   (D) sodium metaborate and sodium tetraborate

2. Characteristic curve or H & D curve is a curve between

   (A) the exposure and density

   (B) the MAS and film density

   (C) kV_p and film density

   (D) kV_p and MAS

3. Film contrast does not depend on

   (A) Film density

   (B) Characteristic curve of the film

   (C) X-ray exposure

   (D) Patient thickness

4. Which algorithm is not used for image reconstruction in CT scanners?

   (A) Back projection

   (B) Collapsed cone

   (C) Analytics methods

   (D) Iterative methods

5. Which of the below combination regards CT scanners is true?

   (A) First generation – Rotate – Translate

   (B) Second generation – Rotate – Fixed

   (C) Third generation – Rotate – Rotate

   (D) Fourth generation – Fixed – Rotate – Translate

6. . Which is not true about Modulation Transfer Function (MTF)?

(A) Focal spor MTF deteriorates as the magnification factor increases

(B) Screen MTF improves with magnification

(C) MTF is 1.0 for films which image 10 to 20 lines per mm

(D) MTF of the system includes noise

7. In tomography, the section thickness is

(A) inversely proportional to the amplitude of tube travel

(B) directly proportional to the amplitude of tube travel

(C) directly proportional to the kV_p

(D) changes rapidly with large tomographic arcs

8. What is true about zonography?

(A) less section thickness

(B) long exposure time

(C) very little unsharpness

(D) considerable unsharpness

9. The photoconductive layer in xero radiography plate is

(A) Selenium crystals

(B) Amorphous selenium

(C) Aluminium oxide

(D) Caesium iodide

10. Which does not change as the distance from the face of a parallel – hole collimator is increased?

(A) Resolution   (B) Sensitivity

(C) Energy   (D) Patient dose

11. Imaging of thyroid yields the highest resolution with a

(A) High sensitivity collimator   (B) Diverging collimator

(C) High – energy collimator   (D) Pinhole collimator

12. Which of the following is not a quality control test performed on a gamma camera?

   (A) Field uniformity   (B) 99 Mo break through

   (C) Extrinsic flood   (D) Spatial resolution

13. The resolution of gamma camera does not depend on :

   (A) Photon energy   (B) Septal thickness

   (C) NaI crystal thickness   (D) Counting time

14. An ideal radio pharmaceutical would have all the following EXCEPT

   (A) Long half life   (B) No particulate emissions

   (C) Target specificity   (D) 150 to 250 keV photons

15. Which of the following is not a radio pharmaceutical localization mechanism?

   (A) Diffusion   (B) Phagocytosis

   (C) Capillary blockage   (D) Elution

16. What determines the residual activity of a 1 – week old 99 mo/99m TC generator?

   (A) Initial activity of molybdenum

   (B) Number of times one generator was milked

   (C) Half life of 99 m TC

   (D) Thickness of PB shielding

17. 99 m TC generators cannot be

   (A) produced in a cyclotron

   (B) used to dispense more than IC

   (C) shipped by air

   (D) purchased by licensed users

18. In an ultrasound scanning the "acoustic enhancement" is caused by
    (A) Solid lesion
    (B) Cystic lesion
    (C) Fibroid condition
    (D) Respiratory movement

19. What is a TGC in a scan machine?
    (A) Trigger Gain Control
    (B) Transducer Gain Control
    (C) Time Gain Compensator
    (D) Trigger Gain Compensator

20. Potential applied to a piezoelectric crystal to produce sound
    (A) 1000 – 2000 V   (B) 300 – 700 V
    (C) 10,000 – 20,000 V   (D) 1 meV – 2 meV

21. Axial resolution in an ultrasound scan is given by
    (A) Pulse length / 2   (B) Pulse length × 2
    (C) Pulse length / 4   (D) Pulse length alone

22. The Q factor in ultrasound is related to
    (A) Velocity response of crystal
    (B) Frequency response of crystal
    (C) Pulse echo time of crystal
    (D) Time response of crystal

23. The advantage of colour doppler displays compared to spectral displays include
    (A) simple interpretation
    (B) accurate recording of velocity
    (C) higher temporal resolution
    (D) fewer artifacts

24. ● The mode of operation which presents the most information in ultrasound scan is
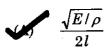
(A) A – mode (B) B – mode

(C) Duplex mode (D) M – mode

25. The most commonly employed range of frequencies for diagnosis are

(A) 1 – 20 MHz (B) 2 – 20,000 Hz

(C) 2 – 10 Hz (D) 5 – 6 MHz

26. Natural frequency of an ultrasonic crystal is given

(A) $\dfrac{\sqrt{E/\rho}}{2l}$ (B) $2l\sqrt{E\rho}$

(C) $\sqrt{2lE\rho}$ (D) $\sqrt{\dfrac{E}{2l\rho}}$

27. The relationship between speed (c), wavelength (λ) and frequency (f) for sound waves is given by

(A) $c = \dfrac{\lambda}{f}$ (B) $f = \dfrac{\lambda}{c}$

(C) $f = \lambda c$ (D) $c = \lambda f$

28. The temperature beyond which Lead-Zirconate-Titanate (PZT) exhibits piezoelectric properties is known as

(A) Latent temperature

(B) Threshold temperature

(C) Curie temperature

(D) Specific temperature

29. Among the following which have the highest attenuation of ultrasound

(A) Blood (B) Bone

(C) Fat (D) Muscle

30. The tissue that absorbs and reflects ultrasonic energy to a greater degree is

(A) Fat (B) Muscle

(C) Blood (D) Bone

31. Which class laser will not damage the eye if it directly viewed for short period of time?

    (A) Class 2b lasers   (B) Class 3a lasers

    (C) Class 3b lasers   (D) Class 4 lasers

32. The spot size of laser used for laser Iridotomy is

    (A) 40 μm   (B) 50 μm

    (C) 100 μm   (D) 80 μm

33. Tissue optical properties is measured using

    (A) Photo luminescence   (B) Integrated sphere

    (C) UV visible spectrometer   (D) FTIR

34. What is Radiance?

    (A) Power emitted from energy source

    (B) Power emitted from source per unit solid angle

    (C) Power emitted per unit area of the source

    (D) Power emitted from source per unit solid angle per unit area

35. If the frequency of wave not equal and the natural frequency of free vibration of particle it is called as

    (A) Resonance   (B) Interference

    (C) Scattering   (D) Reflection

36. Lambert's law describes the loss in intensity due to

    (A) Scattering   (B) Reflection

    (C) Total attenuation   (D) Absorption

37. In tissue – optics the energy density is measured in units

    (A) W/cm²   (B) J/cm²

    (C) J/cm³   (D) J/ cm

38. What are the gases used in CO_2 laser?

    (A) CO_2 and Nitrogen

    (B) CO_2 and Helium

    (C) CO_2 Nitrogen and Helium ✓

    (D) CO_2, Argon and Helium

39. What is LIF?

    (A)   Laser Induced Fluorescence ✓

    (B)   Light Intrinsic Fluorescence

    (C)   Laser Impedance Fluorescence

    (D)   Laser Inscripted Flopsy

40. Which point is taken as reference point in ECG measurement?

    (A)   Right leg ✓

    (B)   Left leg

    (C)   Right arm

    (D)   Left arm

41. Proton density weighted image is achieved using

    (A)   long T_R and short J_E ✓

    (B)   long T_R and long J_E

    (C)   short T_R and short J_E

    (D)   short T_R and long J_E

42. What is the principle of coulter blood cell counter?

    (A)   changes in optical property

    (B)   changes in velocity

    (C)   changes in electrical property ✓

    (D)   changes in chemical property

43. In inversion recovery pulse sequence, what is the inversion time TI?

    (A)   The time duration of the application of 180° RF pulse

    (B)   The time delay between 180° RF pulse and 90° RF pulse ✓

    (C)   The time duration between two successive 180° RF pulse

    (D)   The time delay between 180° RF pulse and receiving the echo

44. The normal pH of blood is

    (A)   7   (B)   7.4

    (C)   7.8   (D)   6.6

45. In a proton-density image which one of the following will appear bright

    (A)   free water   (B)   air space

    (C)   soft tissue   (D)   fat

46. To produce magnetic resonance in MRI, it is necessary

    (A)   to apply RF pulse of frequency equal to Larnov frequency in the magnetic field direction

    (B)   To apply RF pulse of any frequency in the magnetic field direction

    (C)   To apply RF pulse of frequency equal to Larnov frequency in a direction perpendicular to magnetic field

    (D)   To apply RF pulse of any frequency in a direction perpendicular to magnetic field

47. What is the range of normal EEG frequency?

    (A)   50 Hz to 100 Hz   (B)   100 Hz to 150 Hz

    (C)   0.5 Hz to 50 Hz   (D)   0.1 Hz to 20 Hz

48. QRS complex in ECG represents

    (A)   contraction of atria

    (B)   ventricular contraction

    (C)   atrial relaxation

    (D)   ventricular relaxation

49. In MRI, what is the function of shim coils?

    (A)   To increase the homogeneity of magnetic field

    (B)   To decrease the homogeneity of magnetic field

    (C)   To produce gradient magnetic field

    (D)   To produce fringe field

5●   Division of somatic cells is called as

   (A)   synthesis

   (B)   mitosis ✓

   (C)   apoptosis

   (D)   meiosis

51.   What is the current method used for the enrichment of palladium – 103?

   (A)   gas centrifuge enrichment

   (B)   laser isotope separation

   (C)   calutron method of enrichment ✓

   (D)   activation in a reactor

52.   Name the isotope which requires more encapsulation thickness for filtration

   (A)   Cobalt – 60

   (B)   Gold – 198

   (C)   Iodine – 125

   (D)   Caesium – 137 ✓

53.   In the β-decay of Cobalt – 60 to Nickel – 60 (excited state), the number of β-rays emitted are

   (A)   3

   (B)   2 ✓

   (C)   4

   (D)   6

54. The distance between the plane of the sources to one skin surface is chosen to give a treatment distance of usually

(A) 0.1 to 0.10 cm (B) 0.05 to 0.1 cm

✓ 0.5 to 1.0 cm (D) 0.5 to 0.6 cm

55. Exposure rate constant for radium filtered by 0.5 mm platinum is

(A) 8.4 R – cm²/h/mg (B) 3.26 R – cm²/h/mg

✓ 8.25 R – cm²/h/mg (D) 4.69 R – cm²/h/mg

56. Which of the following is not used as a Beta-emitting source for intravascular brachytherapy?

(A) Yittrium – 90 Strontium – 90

(C) Phosphorus – 32 ✓ Ruthenium – 106

57. The Half Value Thickness (HVT) for a cobalt–60 source is

(A) 11 mm Cu ✓ 11 mm Pb

(C) 11 mm W (D) 11 mm H₂O

58. The effects of attenuation and scatter in water on the transverse plane of a brachytherapy source is accounted by

(A) Geometry function (B) Anisotropy function

✓ Radial dose function (D) Exposure rate constant

59. Air kerma strength is defined as the

✓(A) Air kerma rate (B) Dose rate

(C) Apparent activity (D) Activity

60. For which of the following radiation, with energies between 1 keV and 100 keV, 1 sievert = 1 Gray?

(A) Alpha particles (B) Neutrons

(C) Protons ✓ α and Gamma rays

61. Electron-Positron annihilation is the reverse process of pair production, giving rise to two photons each of 0.511 meV ejected in

(A) the same side

(B) the perpendicular direction to each other

(C) the opposite side

(D) the diagonal direction

62. Which of the following does not emit light?

(A) Thermo luminescent dosimeter

(B) Photo cathode

(C) NaI scintillation crystals

(D) CR imaging plates

63. The reason for high subject contrast on < barium enema examination is due to

(A) Coherent scatter

(B) Compton scatter

(C) Photo electric effect

(D) Pair production

64. The energy (E) and atomic number (Z) dependence of the photoelectric effect varies approximately as

(A) Z^3/E^3

(B) E^3/Z^3

(C) Z/E

(D) $Z^3 \times E^3$

65. Exposure is defined as

(A) Absorbed radiation energy per unit mass of air in electronic equilibrium

(B) Average electrons liberated in air

(C) The total kinetic energy of ions released in a unit mass of air in electronic equilibrium

(D) The total charge of ions of one sign liberated by photons per unit mass in air

66. Which of the following match-up concerning radiation unit is false?

(A) Radio activity – Bacquerel

(B) Absorbed dose – Gray

(C) Exposure – Roentgen

(D) KERMA – Curie

67. Regarding Compton scatter, all correct except

(A) Energy of photon is reduced gradually

(B) 90° scattered photon has a higher energy than 60° scattered photon ✓

(C) Direction of scattered photons depends on energy of incident photon

(D) The energy of scattered photons depends on the energy of incident photons

68. Which radio nuclide is not used in teletherapy machine?

(A) Radium – 226

(B) Cesium – 137

(C) Iridium – 192 ✓

(D) Cobalt – 60

69. The transmission of a cobalt –60 beam through a 5.5 cm thick lead block is about :

(A) 25%

(B) 10%

(C) 7.5%

(D) 3.1% ✓

70. Which of the following does not accelerate electrons?

(A) Microtron

(B) Cyclotron ✓

(C) Betatron

(D) Vande Graaf generator

71. What is the diameter range of Co –60 source?

(A) 1 to 2 cm ✓

(B) 1 to 2 mm

(C) 2 to 3 cm

(D) 2 to 3 mm

72. What is the average leakage of a teletherapy machine head at 1 m from the source as per the international regulations?

(A) < 2 mR/hr ✓

(B) < 2 mR/min

(C) < 1 mR/hr

(D) < 1 mR/min

73. What is the frequency of microwave region used in accelerator?

(A) ~ 3000 kilo cycles/sec

(B) ~ 3000 kilo cycles/min

(C) ~ 3000 mega cycles/sec

(D) ~ 3000 mega cycles/min ✓

74. What is the energy used in cyber knife?

(A) 4 mV

(B) 6 mV

(C) 4 meV

(D) 6 meV

75. Which one is the microwave amplifier?

(A) Klystron

(B) Van De Graaft generator

(C) Betatron

(D) Microtron

76. Which radioactive isotope used for the high energy Beta emitter for Targeted Radiotherapy?

(A) Y–90

(B) Cu–67

(C) Rh–105

(D) Tb–161

77. The imaging modality that is not part of Image Guided Radiation Therapy (IGRT) is

(A) Kilo voltage cone beam computed tomography

(B) Mega voltage cone beam computed tomography

(C) Single-photon emission computed tomography

(D) Helical mega voltage computer tomography

78. The number of ^{60}Co sources available in a gamma knife radiosurgical device is :

(A) 181

(B) 201

(C) 221

(D) 101

79. The Collimator scatter (or Head scatter) factor (Sc)

(A) is independent of SSD

(B) decreases as the field is reduced by inserting secondary block

(C) increases with increase in the collimator defines field size

(D) both (A) and (C)

80. The minimum value of in-utero exposure which increases the probability or incidence of childhood cancer is

(A) 10 mg

(B) 10 cg

(C) 10 g

(D) 1 mg

81. Which of the following statement is true?

(A) for the same dose, lower dose rate produces more cell killing

(B) fractionation results in worst therapeutic ratio

(C) for the same dose, higher dose rate produces more cell killing

(D) dose rate is not important when same radiation dose is delivered

82. The 4R's of radiobiology include

(A) Radio sensitivity, reconstruction, redistribution and reoxygeration

(B) Radio sensitivity, repair, repopulation and reoxygeration

(C) Radio resistant, repopulation, redistribution, reoxygeration

(D) Repair, reassortment, repopulation, reoxygeration

83. $TD_{5/5}$ means

(A) the minimum tolerance dose that causes a 5% complication rate within 5 years of radiation completion

(B) the maximum tolerance dose that causes a 5% complication rate within 5 years of radiation completion

(C) the total dose that causes 5% death of population in 5 years

(D) the time delay for the 5% of the cell population to duplicate in 5 years

84. Chemical agents that generally promote both the direct and indirect effects of radiation is

(A) Radio activators

(B) Radio resistants

(C) Radio protectors

(D) Radio sensitizers

85. Which of the following is true about hyperthermic treatment?

(I) It uses heat to kill cells

(II) Hyperthermic doses are expressing in minutes at STP

(III) All the body tissues do not respond in the same way to heat

(IV) Increases blood flow to normal cells

(A) I, II and IV

(B) I, III and IV ✓

(C) I, II, and III

(D) All are correct

86. RBE depends on

(I) LET

(II) Dose rate

(III) Biological system / end point

(IV) Chemical changes

(A) I, II and III ✓

(B) I and IV only

(C) I and II only

(D) I and III only

87. Match the radiation types with OER :

(a) X rays and γ-rays   1. 1.3 (OER)

(b) Neutrons   2. 2 – 3.5 (OER)

(c) High LET radiates (X rays)   3. 1.5 (OER)

	(a)	(b)	(c)
(A) ✓	2	3	1
(B)	2	1	3
(C)	1	2	3
(D)	3	2	1

88. The OER for alpha particle is equal to
    (A) 1
    (B) 1.6
    (C) 2.5
    (D) 3.0

89. Which is a unit of radiation exposure?
    (A) Joule
    (B) Rad
    (C) REM
    (D) C/Kg ✓

90. The equipment that measures the electrical activity of the heart is
    (A) Electromyography
    (B) Electro encephalography
    (C) Electro cardiography ✓
    (D) Electron microscope

91. Other than hydrogen which one of the following nucleus is preferred for MRI
    (A) C^{13} ✓
    (B) C^{14}
    (C) C^{12}
    (D) C^{10}

92. Which of the radio nuclides present in the human body?
    (A) H-3 and C-14
    (B) Ce-144 and C-14
    (C) K-40 and C-14 ✓
    (D) K-40 and Ba-140

93. The linear attenuation coefficient is defined as
    (A) increase the radiation intensity per unit path length
    (B) reduction the radiation intensity per unit path length ✓
    (C) reduction the radiation amount in the atom
    (D) increase the radiation amount in the atom

94. What does a collimator do?

   (A) It reduces the exposure time by ionizing the radiation before it hit the patient

   (B) Holds the patient in place during an exposure

   (C) It provides particular shape to the area to be exposed (treated)

   (D) It is used to produce radiation

95. ALARA stands for

   (A) As Low As Responsibly Acceptable

   (B) Alarm Loss Activated Radiation Activated

   (C) As Low As Reasonably Achievable

   (D) As Low As Reasonably Attenuated

96. The factor that indicate how much attenuation will take place per centimeter is known as the

   (A) mass attenuation coefficient

   (B) linear attenuation coefficient

   (C) decay rate

   (D) atomic number

97. The abbreviation for QF of radiation is

   (A) quantity factor of radiation

   (B) quality factor of radiation

   (C) quantity fusion

   (D) quantity fashion

98. A skin dose from a beta emitter is considered more hazardous then that from a Gamma emitter. Which of the following best support this statement?

   (A) Betas not significantly attenuated by skin and thus cause more damage

   (B) Gammas are significantly attenuated by skin and thus cause more damage

   (C) All the beta's energy is dissipated in the basal layers of the skin

   (D) All the Gamma's energy is dissipated in the basal layers of the skin

99. In diagnostic radiology, which type of interaction delivers the maximum dose to the patient
    (A) Compton scattering   (B) Photo electric effect
    (C) Coherent scattering   (D) Photo disintegration

100. Which interaction produces radiation that are more harmful for diagnostic radiology personnel during diagnostic investigations?
    (A) Compton interaction   (B) Pair production
    (C) Photo electric effect   (D) Coherent scattering

101. Name the factor that can be used to some extent to control scatter radiation in diagnostic radiology
    (A) Field size
    (B) MAS
    (C) Thickness of the part to be radiographed
    (D) Kilo Voltage (kV$_P$)

102. Which of the following is correct?
    (A) 1.5 mm Aluminium   —   above 70 kV$_P$
    (B) Copper   —   low energy filtration
    (C) Molybdenum   —   pediatric application
    (D) Heavy metal filter (Holmium) — improved iodine or barium contrast

103. Grid ratio is
    (A) the ratio between the height and width of the lead strips
    (B) the ratio between the height of the lead strips and the distance between the lead strips
    (C) the ratio of the height to the no. of lead strips
    (D) the ratio of the width to the number of lead strips

104. Method to increase screen speed
    (A) thinner phosphor layer
    (B) thicker phosphor layer
    (C) lower absorption phosphor
    (D) average conversion efficiency

105. Which of the following is not true about inherent filtration?

(A) It is measured in aluminium equivalent

(B) ✓ The insulating oil contributes the maximum for inherent filtration

(C) The Beryllium window is used to reduce inherent filtration

(D) The glass envelope contributes the maximum for inherent filtration

106. What is the thickness of the aluminium filter above which there is no appreciable advantage?

(A) 1.5 mm Al

(B) 2.5 mm Al

(C) ✓ 3.0 mm Al

(D) 2.0 mm Al

107. Which is not true about quantum mottle?

(A) less no. of X ray, photons mox will be the quantum mottle

(B) ✓ more no. of X ray, photons mox will be the quantum mottle

(C) greater with high kV_P X ray photons

(D) associated/seen with intensifying screen

108. Match with the appropriate options :

(a) Geometric unsharpness	1. Round or oval objects
(b) Absorption unsharpness	2. Small focal spor
(c) Parallax unsharpness	3. Light diffusion
(d) Screen unsharpness	4. Double emulsion films

	(a)	(b)	(c)	(d)
(A) ✓	2	1	4	3
(B)	2	1	3	4
(C)	2	3	4	1
(D)	4	3	1	2

109. Which concept provides an objective measurement of the combined effects that affect the image clarity?

(A) LSF (Line Spread Function)

(B) ✓ MTF (Modulation Transfer Function)

(C) Wiener spectrum

(D) Quantum mottle

110. Gamma cameras are normally capable of re-solving
    (A)　0.01 IP/mm
    (B)　0.06 IP/mm
    (C)　0.3 IP/mm
    (D)　1.01 IP/mm

111. SPECT requires all of the following EXCEPT
    (A)　Gamma emitting, radio isotopes
    (B)　Gamma camera rotation
    (C)　Coincidence detection
    (D)　Pulse height analysis

112. PET Scanners detect
    (A)　positrons of the same energy in coincidence
    (B)　positrons and electrons in coincidence
    (C)　photons of different energies in coincidence
    (D)　annihilation photons in coincidence

113. PET Scanners
    (A)　need high energy parallel hole collimators
    (B)　cannot handle very high count rates
    (C)　suffer from significant attenuation losses
    (D)　detect 0.511 meV photons

114. The best radio nuclide spatial resolution is normally achieved using
    (A)　SPECT
    (B)　Low energy all purpose collimator
    (C)　High resolution collimator
    (D)　PET ,

115. Advantage of PET over gamma cameras include all of the following EXCEPT
    (A)　More physiological traces compounds
    (B)　Better resolution
    (C)　Less mottle
    (D)　Availability of positron radio isotopes

116. For 99 m TC which of the following cannot contribute to the patient dose?

    (A)   Auger electrons

    (B)   Beta - particles

    (C)   Internal conversion electrons

    (D)   Gamma rays

117. A long lived radionuclide with a daughter (T_{42} = 10 hours) reaches equilibrium in

    (A)   About 3 hours

    (B)   About 10 hours

    (C)   About 40 hours

    (D)   About 200 hours

118. A pulse height analyzer window width of 20% detects 99 m TC gamma rays with energies of

    (A)   140 keV only

    (B)   Between 135 and 145 keV

    (C)   Between 120 and 140 keV

    (D)   Between 126 and 154 keV

119. Gamma camera crystals

    (A)   are made of cesium iodide

    (B)   convert about 95% gamma ray energy to light

    (C)   are generally 100 μ m thick

    (D)   absorbs more than 90% of 140 keV photons

120. NM images acquired using a computer will typically have all of the following EXCEPT

    (A)   500,000 to 1 million counts

    (B)   Matrix sizes of 128^2

    (C)   256 gray scale levels

    (D)   Approximately 10 MB of data

121. The pulse height analyser in NM imaging increases·

    (A)   Detector efficiency

    (B)   Scattered photons

    (C)   Contrast to noise ratio

    (D)   Count rate

122. Which of the following is not a major component of an ultrasound transducer?
    (A)   Piezoelectric material   (B)   Backing block
    (C)   Accoustic absorbes   ✓(D)   Display screen

123. In B-mode ultrasound, the ————— of each echo is represented by the brightness at the xy location.
    (A)   Phase   (B)   Depth
    ✓(C)   Amplitude   (D)   Attenuation

124. Average velocity of the blood flowing through a vessel is
    (A)   1500 m/sec   ✓(B)   1 m/sec
    (C)   4500 m/sec   (D)   100 m/sec

125. What bonding material is preferred to opthalmic ocular scanning?
    (A)   Silica gel   (B)   Coconut oil
    (C)   Water   ✓(D)   Tears

126. Acoustic impedance is given by
    ✓(A)   Z = velocity × density   (B)   Z = density × viscosity
    (C)   Z = density × temperature   (D)   Z = mass × density

127. Velocity of sound in Lung
    (A)   1450 m/sec   (B)   1561 m/sec
    (C)   4080 m/sec   ✓(D)   331 m/sec

128. To produce longitudinal waves the quartz should be cut in such a way that it
    ✓(A)   cuts X axis parallel to Z axis
    (B)   cuts Y axis parallel to Z axis
    (C)   cuts Z axis parallel to X axis
    (D)   cuts both X and Z axis

129. When an ultrasound beam passes through the interface of two dissimilar materials at an angle, a new angle of sound travel takes place in the second material due to

(A) Attenuation
(B) Rarefraction
(C) Compression
(D) ✓ Refraction

130. The typical range of frequency of medical ultrasound is

(A) ✓ 2 – 10 MHz
(B) 100 – 1000 kHz
(C) 2 – 10 kHz
(D) 100 – 1000 MHz

131. Treatment of soft small mucosal lesions are treated with CO_2 laser with a power of

(A) ✓ 5 – 10 W
(B) 2 – 5 mW
(C) 15 – 20 mW
(D) 17 – 20 W

132. Resonators used in lasers belong to class of

(A) Closed resonators
(B) Cavity resonators
(C) Noncavity resonators
(D) ✓ Open resonators

133. The term turbid media will be referred to the medium which has

(A) Only absorption
(B) Only scattering
(C) ✓ Both absorption and scattering
(D) Only reflection

134. The pumping source in Nd : YAG laser is

(A) Chemical
(B) ✓ Optical
(C) Electrical
(D) Mechanical

135. In which region, laser emission occurs in Nd-YAG laser

(A) ✓ IR region at 1.06 µm
(B) Visible region
(C) UV region
(D) RF region

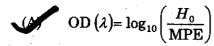136. Which type of laser viewing is most hazardous?
   (A)   Viewing of a specularly reflected beam from a flat surface
   (B)   Viewing of a specularly reflected beam from a curved surface
   (C)   Extended source viewing of a diffused reflection
   (D)   Intra beam viewing of a divert beam ✓

137. Optical density $OD(\lambda)$ of protective filter is given by

   Where H_0 is worst case exposure MPE maximum permissible exposure?

   (A) ✓ $OD(\lambda) = \log_{10}\left(\dfrac{H_0}{MPE}\right)$ (B) $OD(\lambda) = \log_{10} H_0$

   (C) $OD(\lambda) = \log_{10}(MPE)$ (D) $OD(\lambda) = \log_{10}\left(\dfrac{MPE}{H_0}\right)$

138. Which of the following colour signifies the highest temperature in pseudo colour coding of thermography?
   (A) ✓ White   (B)   Red
   (C)   Brown   (D)   Yellow

139. What does the acronym LASER stand for?
   (A)   Light absorption by stimulated emission of radiation
   (B)   Light attenuation by stimulated emission of radiation
   (C) ✓ Light Amplification by stimulated emission of radiation
   (D)   Light alteration by stimulated emission of radiation

140. Wave length of He-Ne laser
   (A)   628.4   (B) ✓ 632.8
   (C)   514.7   (D)   1034.0

141. What are ND filters?
   (A)   Nitro dioxan filters
   (B)   Nitrogen deuteron filters
   (C)   Non deposited filters
   (D) ✓ Neutral density filters

142. Super conducting material used to produce high magnetic field in MRI is

(A) Niobium – Titanium alloy

(B) Tungsten – Rhodium alloy

(C) Rhodium – Titanium alloy

(D) Iridium – Titanium alloy

143. To reduce hemolysis, the blood pump design should provide a flow that minimises

(A) Oxygen tension

(B) turbulance

(C) body temperature

(D) continuous flow

144. During Myocardial infarction one can use

(A) Pacemaker

(B) Heart lung machine

(C) Nerve simulator

(D) Kidney machine

145. What is pacemaker?

(A) Instrument to measure electrical activity of heart

(B) Instrument to give electric voltage to the heart in case of heart failure

(C) Instrument to maintain heart rhythm

(D) Instrument to measure the blood flow from the heart

146. Which is the characteristic of peritoneal dialysis?

(A) Blood is cleansed outside the body and then returned to the body

(B) A hollow fibre dialyser is used

(C) Uses the membrane layer of abdominal cavity to clean the blood

(D) Blood is oxygenated outside the body and then returned to the body

147. In MRI, which magnet widely is used to produce high magnetic field in the order of 2 Tesla?

(A) Permanent magnet

(B) Resistive magnet

(C) Superconducting magnet

(D) Inductive magnet

148. The high RF power deposition occurs in
    (A) Spin-echo pulse sequence
    (B) Inverse recovery pulse sequence ✓
    (C) Gradient echo pulse sequence
    (D) In all pulse sequences, power deposition is save

149. Recording of the peripheral nerves action potential is called
    (A) Electro myography   (B) Electro corticography
    (C) Electro neutrography ✓   (D) Electro nephrography

150. Which isotope has the mean photon energy of 406 keV?
    (A) Pd – 103   (B) Yb – 169
    (C) Tm – 170   (D) Au – 198 ✓

151. Which is not the limitation of Point – A?
    (A) It does not relate to the anatomic structures
    (B) It is sensitive to the position of the ovoid sources and tandem position
    (C) Point – A may be inside or outside the cervix ✓
    (D) It defines the tolerance of dose limiting structures in cecernin treatment

152. The value of reference isodose in the paris system is
    (A) the isodose covering the implanted volume
    (B) 85% of the basal dose ✓
    (C) 95% of the prescribed dose
    (D) 95% of the basal dose

153. Positioning uncertainities in in-phantom measurement can be reduced by
    (A) measuring at multiple chamber positions around the source ✓
    (B) repetition of measurements at a specific distance from the source
    (C) use of larger distance from the source
    (D) use of larger volume chambers

154. Match the following :

	(a)	Apparent activity	1.	form and dimensions of the source
	(b)	Equivalent mass of radium	2.	exposure at 1 m from the source
	(c)	Reference exposure rate	3.	0.5 mm platinium
	(d)	Exposure around the source	4.	measured at a distance of 1 m

	(a)	(b)	(c)	(d)
(A)	3	1	2	4
(B)	4	3	2	1
(C)	2	4	1	3
(D)	1	2	4	3

155. Ir – 192 is made up of

(A) 30% Ir and 70% Al
(B) 30% Ir and 70% Pt
(C) 70% Ir and 30% Al
(D) 70% Ir and 30% Pt

156. What is the half life of Ruthenium – 106?

(A) 2.87 days
(B) 369 days
(C) 28.7 years
(D) 36 years

157. Which report is used for the calculation of interstitial important treatment?

(A) ICRU – 55
(B) ICRU – 56
(C) ICRU – 58
(D) ICRU – 60

158. What is the best detector to calibrate the brachytherapy sources?

(A) G.M Counter
(B) Well –type chamber
(C) Semiconductor diode
(D) Scintillation detector

159. The recommended system for dose specification and reporting for intracavitary brachytherapy is

(A) The Paris system
(B) The Quimby system
(C) The ICRU system
(D) The Paterson – Parker system

160. The mass attenuation coefficient of photons in water

   (A)   rises to a peak at about 3 eV

   (B)   decreases continuously with energy below 25 meV

   (C)   decreases to about 3 meV, then rises again

   (D)   increases continuously with energy below 25 meV

161. The maximum number of photoelectrons produced in a photoelectric interaction by a single photon with incident energy of 150 keV is

   (A)   1

   (B)   5

   (C)   10

   (D)   Any number, as long as the sum of individual electron energies is equal to 150 keV

162. The volume of air in an ionization chamber

   (A)   Determines its sensitivity

   (B)   Should be small if the photon intensity is low

   (C)   Must be increased if high energy photons are to be detected

   (D)   Both (B) and (C)

163. Regarding the guard electrode in an ion chamber

   (A)   The guard ring electrode better defines the ion-collecting volume

   (B)   The guard electrode minimizes polarity effect

   (C)   The guard electrode maximizes polarity effect

   (D)   Both (A) and (B)

164. As per the Bragg-Gray cavity theory, the ratio of dose to the surroundings medium to the dose to cavity air in given by (assume cavity size very small)

   (A)   the ratio of mass absorption coefficient of medium to that of air for the photon crossing the cavity

   (B)   the ratio of mass stopping power of medium to that of air for the electron crossing the cavity

   (C)   the ratio of electron density of medium to that of air

   (D)   Roentgen to 'cGy' conversion factor for the medium

165. Which of the following is not particulate radiation?

(A) Alpha particles

(B) Beta particles

(C) Pi mesons

(D) Gamma rays ✓

166. $_5^{12}B$, $_6^{12}C$ and $_7^{12}N$ are called

(A) Isotopes

(B) Isotones

(C) Isobars ✓

(D) Isomers

167. Activity of sample of radio-active material decreases to one eighth of original in 15 days. Its half life is

(A) 10 days

(B) 15 days

(C) 3 days

(D) 5 days ✓

168. In beta decay nucleon number

(A) decreased by one

(B) increased by one

(C) increases by two

(D) remains unchanged ✓

169. Life time of unstable nuclei is

(A) Limited

(B) Unlimited ✓

(C) 100 years

(D) 50 years

170. X ray exposure may be due to

(A) The direct beam from the X ray tube target

(B) Scatter radiation arising from the object in the direct beam

(C) Both (A) and (B) ✓

(D) Both (A) and (B) plus residual radiation that exists for the first few minutes after the X-ray unit has been turned off

171. A time required for one half of the radio active nuclei to a particular sample of radio active material to disintegrate is called

(A) The exposure time

(B) A curie

(C) A half life ✓

(D) A half value layer

172. The region near the end of a charged particle track in matter, in which the rate of energy loss is maximum is called

(A) Bragg peak

(B) Kerma peak

(C) RBZ peak

(D) LET peak

173. According to AAPM guidelines (TG–142), the alignment between the light beam and the radiation beam should be within

(A) ± 2 mm

(B) ± 1 mm

(C) ± 0.5 mm

(D) ± 1.5 mm

174. BSF or PSF is the

(A) TAR at Dmax

(B) Scatter component of TAR

(C) PDD at Dmax

(D) Scatter component of TPR

175. PDD for photon beams in worth (or soft tissue) beyond the depth of maximum dose (Dmax).

(A) decreases almost exponentially with depth

(B) increases almost exponentially with depth

(C) decreases almost linearly with depth

(D) increases almost linearly with depth

176. The most extensively studied and most frequently used TLD for clinical dosimetry is

(A) lithium borate ($Li_2B_4O_7$)

(B) calcium fluoride (Caf_2)

(C) calcium sulphate ($CaSO_4$)

(D) lithium fluoride (LiF)

177. According to TG-51 protocol for calibration of photon and electron beams, all depths must be scaled to water-equivalent depths using a scaling factor of

(A) 1 cm acrylic = 1.21 cm H_2O

(B) 1 cm acrylic = 1.12 cm H_2O

(C) 1 cm acrylic = 2.12 cm H_2O

(D) 1 cm acrylic = 2.21 cm H_2O

178. Which one of the following is required for generating conformal treatment plan?

   (A) GTV   (B) CTV
   (C) PTV   (D) Internal margin

179. In mega voltage photon beams, the Tissue Maximum Ratio (TMR) varies with all of the following factors, except :

   (A) Field size   (B) Depth
   (C) SSD   (D) Photon energy

180. Which of the following equation is used to compare various fractionation regimens?

   (A) $1-(1-e^{-D/D_0})^n$ (B) $2.3 \times D_0$

   (C) D_Q / D_0 (D) $nd\left(1+\left[\dfrac{d}{\alpha+\beta}\right]\right)$

181. Radio protectors are

   (A) Chemical agents that enhance cell response to radiation
   (B) Drugs used to kill cancer cells
   (C) Chemical agents that reduce cell response to radiation
   (D) Multileaf collimators used in linear accelerators

182. The monthly limit of 0.5 msv to the embryo is to limit / reduce the risk of
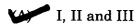
   (A) mental retardation   (B) carcinogenesis
   (C) congenital malformation   (D) all the above

183. Which is the most sensitive period for foetal abnormalities?

   (A) pre implantation
   (B) 4-11 weeks of gestation
   (C) 16-25 weeks of gestation
   (D) more than 30 weeks

184. Bergonie and tribondean defined radio sensitivity as
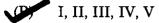
(I) Mitotic activity

(II) Level of differentiation

(III) Directly proportional to a cell's reproductive activity and inversely proportional to a cell's degree of differentiation

(IV) Directly proportional to a cell's degree of differentiation and inversely proportions to a cells reproductive activity

(A) I, II and III

(B) I and III only

(C) IV only

(D) All are correct

185. Order the following in correct sequence of producing biological damage by indirect action

(I) Incident X-ray photon

(II) Ion radical

(III) Free radical

(IV) Chemical changes

(V) Biological changes

(A) I, III, II, V, IV

(B) I, II, III, IV, V

(C) I, III, II, IV, V

(D) I, II, IV, III, V

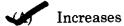186. Which of the following is true?

(I) Oxygen is an effective radio protector

(II) Oxygen is an effective radiosensitive

(III) Hypoxic cells are radiosensitive

(IV) Hypoxic cells are radioresistant

(A) I and III only

(B) I, II and III

(C) II and IV only

(D) IV only

187. The dose – rate effect

    (A)   does not affect significantly the biologic effect of X-rays / Gamma rays

    (B)   is not important in Radiotherapy

    (C)   involves in the reduction of the biologic effect of a given dose when the exposure time is increased

    (D)   is not due to sublethal damage repair

188. As the dose decreases, the RBE of a given radiation type
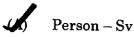
    (A)   Increases

    (B)   Decreases

    (C)   Initially increases later decreases

    (D)   Remains constant

189. The Relationship between OER and LET is as follows

    (A)   OER is a constant function of LET

    (B)   OER has a value of about 3 at high LET values and then decreases to zero at low LET values

    (C)   OER has a value of about 3 at Low LET values and then decreases to unity at high values (approximately 200 keV / micrometer)

    (D)   OER is constant only for RBE

190. The effect of radiation on genetic disease is

    (A)   to introduce new type of disease

    (B)   to increase the occurrence probability of naturally existing diseases

    (C)   to decrease the severity of the existing diseases

    (D)   Both (A) and (B)

191. What is the principal reason for wearing a personnel monitoring dosimeter?

(A) It signifies that the worker is authorized to work with radiation

(B) The use of personnel monitoring dosimeters replaces the need for survey in the dept

(C) The dosimetry will absorb the radiation and reduce the individual exposure

(D) The result of personnel monitoring dosimeter comprise a permanent record of an individual's occupational radiation exposure history

192. The unit of the collective effective dose is
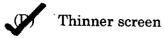
(A) Person – Sv

(B) R

(C) Gy

(D) Sv

193. What is the radiation weighting factor for alpha radiation?

(A) 1

(B) 5

(C) 10

(D) 20

194. Which of the following would most likely increase the spatial resolution of a screen/film combination?

(A) High grid ratio

(B) Slower film

(C) Thicker screen

(D) Thinner screen

195. What will be the geometrical penumbra for a source of 2 cm diameter at 80 cms SSD with SDD of 40 cms?

(A) 1.0 cm

(B) 1.25 cm

(C) 1.5 cm

(D) 2.0 cm

196. Which is correct in the following?

(A) decrease of radiation intensity with increasing HVT's

(B) decrease of radiation intensity with decreasing HVT's

(C) increases of radiation intensity with increasing HVT's

(D) increases of radiation intensity with increasing for different HVT's

197. The use factor (v) for the secondary barrier is

(A) 0

(B) 1/4

(C) 1/2

(D) 1

198. The NCRP 49 defined the occupancy factor for corridor

(A) No occupancy

(B) Full occupancy (1)

(C) Partial occupancy (1/4)

(D) Occasional occupancy (1/16)

199. Diagnostic Radiology workload calculate as

(A) mA – min/week

(B) mA – hr/week

(C) mA – sec/week

(D) mA – min/day

200. What is the dose limit for the occupational as per the ICRP-60?

(A) 20 mSv/day

(B) 20 mSv/month

(C) 20 mSv/year

(D) 2 mSv/year

APMP/17

[Turn over