

# Sikkim Public Service Commission

Main Written Examination for the post of  
Radio Therapy Technician

## Paper II

Time Allowed : 3 Hrs.

Maximum Marks: 100

### INSTRUCTIONS TO CANDIDATES

*Read the following instructions carefully before answering the questions :-*

1. **IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.**
2. Please note that it is the candidate's responsibility to fill in the Roll Number carefully and without any omission or discrepancy at the appropriate places in the **OMR ANSWER SHEET** for MCQ. Any omission/discrepancy will render the Answer Sheet liable for rejection.
3. **Use only Black Ball Point Pen to fill the OMR sheet**
4. Do not write anything else on the OMR Answer Sheet except the required information.
5. **This booklet contains MCQ and conventional type of questions divided into 3 sections. Section A contains MCQ and Section B and C contains conventional type of questions.**
6. Before you proceed to mark in the Answer Sheet (OMR), you have to fill in some particulars in the Answer Sheet (OMR) as per given instructions.
7. After you have completed filling in all your responses on the OMR Sheet & writing section in a separate Answer Sheet, you should hand over the Answer Sheet & OMR Sheet to the Invigilator only. You are permitted to take away with you the Test Booklet.
8. **Marking Scheme**  
*THERE WILL BE NEGATIVE MARKING FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.*
  - (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, one-third of the marks assigned to that question will be deducted as penalty.
  - (ii) If a candidate gives more than one answer, it will be treated as a wrong answer even if one of the given answers happens to be correct and there will be same penalty as above to the question.
  - (iii) If a question is left blank. i.e., no answer is given by the candidate, there will be no penalty for that question.

**DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO**

Section A  
Multiple Choice Questions

(50x1=50)

- 1) The smallest subdivision of an element is known as
  - A) Molecule
  - B) Atom
  - C) Proton
  - D) Electron
  
- 2) The unit of Power is:
  - A) Joule
  - B) Coulomb
  - C) Watt
  - D) Farad
  
- 3) Alpha and Beta radiation belongs to the category of
  - A) Particle radiation
  - B) Electromagnetic radiation
  - C) Light radiation
  - D) None
  
- 4) The principle on which most of the transformer works is
  - A) Mutual induction
  - B) Self-induction
  - C) Electrostatic induction
  - D) Conservation of energy
  
- 5) The process by which AC is converted to DC is termed as
  - A) Transformation
  - B) Rectification
  - C) Thermionic emission
  - D) Generator

6) The power loss in a transformer caused due to heat production within the core is called

- A) Cable loss
- B) Eddy current
- C) Hysteresis
- D) all of above

7) Thyatron, A gas filled triode acts as

- A) Rectifier
- B) Electronic switch
- C) heater to filament
- D) None

8) In linear accelerator isotope used is

- A) Co-60
- B) Ir-192
- C) Cs-137
- D) none

9) When a projectile electron interacts with an inner shell electron of target atom the

- A) X-ray are produced
- B) Characteristic radiation is produced
- C) Bremsstrahlung radiation is produced
- D) All of the above

10) SI units for quantification of radiation is (are)

- A) Gray
- B) C/Kg, Gray, Sievert and Bq
- C) Gray, Sievert
- D) Roentgen and Sievert



- 11) Cesium-137 source decays with a half-life of 30 years. It will decay by about 2% in how much time?
- A) 3 days
  - B) 1 month
  - C) 6 month
  - D) 1 year
- 12) The decay of  $^{60}_{27}\text{Co}$  to  $^{60}_{28}\text{Ni}$  is an example of which decay process?
- A) Nuclear Fission
  - B) Electron capture
  - C) Internal conversion
  - D)  $\beta$ - decay
- 13) Which factor will impact the focal spot size of an X-ray tube ?
- A) Anode angle
  - B) Anode material
  - C)  $Kv_p$
  - D) mAs
- 14) The average energy of the photon beam from an x-ray tube can be increased by
- A) Increasing tube current
  - B) Increasing tube voltage
  - C) Increasing filament current
  - D) Increasing filament voltage
- 15) Which X-ray generator will require the highest mAs, given the same patient thickness and  $Kv_p$  setting?
- A) Three Phase
  - B) High frequency
  - C) Half wave rectified
  - D) Full wave rectified

16) Which of the following Linac Components require to be cooled?

- A) Klystron or Magnetron
- B) Focusing coil
- C) Wave Guides
- D) Transformer

17) Remote control after loading system delivers

- A) High dose to staff
- B) High dose to Patients
- C) Less dose to staff
- D) Both b & c

18) Bragg peak is exhibited by

- A) Neutrons
- B) Protons
- C) X-rays
- D) Gamma rays

19) Photoelectric cross section varies with the photon energy  $E$  and atomic number  $Z$  of the absorber as:

- A)  $1/E^3$
- B)  $Z^3$
- C)  $1/Z$
- D) a and b

20) A 14 MeV neutron collides "head on" with a hydrogen nucleus. The kinetic energy of the recoil proton will be?

- A) 14 MeV
- B) 7 MeV
- C) 1.02 MeV
- D) 1.4 MeV

- 21) Which is the following interaction processes is most likely for a 10 KeV photon in water?
- A) Photoelectric effect
  - B) Compton effect
  - C) Pair production
  - D) Rayleigh scattering
- 22) A high energy positron can undergo which of the following interactions as it traverses matter?
- A) Ionization and Excitation
  - B) Bremsstrahlung
  - C) Coulomb Scattering
  - D) All
- 23) The threshold energy for a photon to interact by pair production is?
- A) 0.511 MeV
  - B) 1.022 MeV
  - C) 2.044 MeV
  - D) 2 MeV
- 24) Detector used in new generation CT scanners is:
- A) Sodium Iodide Crystal
  - B) Scintillation detectors
  - C) Gas detectors
  - D) Solid state detectors
- 25) The CT number for dense bone tissue is:
- A) 0
  - B) -100
  - C) 1000
  - D) -1000

- 26) For designing the room for MRI one should use:
- A) PVC reinforcing rods
  - B) Iron reinforcing bars
  - C) Magnetic Material
  - D) All of the above
- 27) The static magnetic field strength is measured in:
- A) Hertz
  - B) Tesla
  - C) Tesla/Sec
  - D) Watts/Kg
- 28) The time required for interaction between nuclear spins and tissue lattice to return to normal following RF excitation is called:
- A)  $T_1$  relaxation time
  - B)  $T_2$  relaxation time
  - C) Magnetic movement
  - D) Spin density
- 29) The body section radiography is also known as:
- A) Tomography
  - B) Striatography
  - C) Laminography
  - D) all of the above
- 30) 30. The CT scan acquires images in
- A) Sagittal section
  - B) Coronal section
  - C) Both Sagittal and coronal sections
  - D) Axial section
- 31) The depth of maximum dose in a mega voltage beam:
- A) Does not depend on beam energy
  - B) Increases with beam energy
  - C) Increases with dose rate
  - D) Decreases with beam energy



32) Dose distribution outside the field boundaries is significantly affected by:

- A) Flattering filter
- B)  $D_{max}$
- C) Geometric penumbra
- D) Scattering foil

33) Calculate the optimal wedge angle for a wedged-pair plan with beams directed at  $60^\circ$  from one another:

- A)  $15^\circ$
- B)  $30^\circ$
- C)  $45^\circ$
- D)  $60^\circ$

34) According to ICRU specifications, the wedge angle is defined at:

- A) Depth of 50% isodose line
- B) Depth of 80% isodose line
- C) Depth of  $D_{max}$
- D) 10 cm. depth

35) In kilovoltage cone-beam CT, CT numbers for all materials are proportional to:

- A) Mass density
- B) Attenuation coefficients
- C) Neutron number
- D) Volume density

36) Which of the following detectors require corrections in measuring PDD in electron beam?

- A) Ion chamber
- B) Film
- C) TLD chips
- D) all of the above



- 37) The minimum thickness of lead required to stop 15 MeV electron beam is approximately:
- A) 2mm
  - B) 4mm
  - C) 8mm
  - D) 11mm
- 38) Which of the following is best described as a stochastic event?
- A) Epilation
  - B) lense opacification
  - C) Tissue necrosis
  - D) None of the above
- 39) According to the AAPM TG-40 recommendations, the X-ray output consistency check for Linac should be performed:
- A) Daily
  - B) twice a week
  - C) once a week
  - D) once a month
- 40) In IMRT, the relative contribution to the target dose from collimator transmission scatter is greatest for:
- A) Leaf transmission
  - B) Round leaf transmission
  - C) X-ray jaws
  - D) overall head scatter
- 41) The typical average value of leakage dose from the MLC relative to the primary dose approximately:
- A) 0.1%
  - B) 1%
  - C) 2%
  - D) 5%

- 42) The term "step-and-shoot" is sometimes used to describe which IMRT delivery technique?
- A) Dynamic MLC-IMRT
  - B) Segmental-MLC-IMRT
  - C) IMAT
  - D) Serial Tomography
- 43) Half-life of Co-60 is
- A) 5.27 yrs
  - B) 5.3days
  - C) 30 yrs
  - D) 1.25 Mev
- 44) Acceptable detectors for the measurement of small field (i.e., <5mm) output factors used in SRS includes:
- A) Farmer type ion chamber
  - B) Diodes
  - C) Fricke dosimetry
  - D) Parallel plate ion chamber
- 45) Which disease(s)/disease site(s) is/are treated with SRS:
- A) Maxillary Sinus
  - B) Glioma
  - C) Orbit
  - D) Hodgkin's lymphoma
- 46) According to ICRU, HDR brachytherapy is classified as brachytherapy with a prescribed dose rate of:
- A) 2 cGy/min or higher
  - B) 6 cGy/min or higher
  - C) 12 cGy/min or higher
  - D) 40 cGy/min or higher
- 47) Which site is not treated with HDR Brachytherapy?
- A) Lung Cancer
  - B) Esophageal Cancer
  - C) Pituitary Adenoma
  - D) Cervical cancer

- 48) The dose rate constant  $A$  of a brachytherapy source do not depends on:
- A) Photon energy emitted
  - B) Exposure rate constant of the source
  - C) Source construction
  - D) Source position
- 49) Which critical structures is/are of most concern for permanent prostate implants?
- A) Small bowel
  - B) Urethra
  - C) femoral head
  - D) All
- 50) HVT means
- A) Heavy volume thickness
  - B) half value thickness
  - C) Heat volume thickness
  - D) None of the above

### Section B

**Short Answer type questions (Attempt Any FOUR):**

**(5x4=20)**

1. Therapeutic ratio
2. Cobalt therapy room design
3. Stochastic effects and non-stochastic radiation effects
4. Shielding blocks in radiotherapy
5. Advantages of Gamma Knife
6. Paris system in Brachytherapy
7. Orthovoltage Machine
8. Dose Volume Histogram

### Section C

**Long Answer Type questions (Attempt Any Three):**

**(10x3=30)**

9. Draw a neat diagram of linear accelerator and write about its advantages over Co-60 machines
10. Write in detail about ICRU-50 recommendations
11. Explain the basic principle and clinical application of beam defying and beam Modifying devices
12. How is radiation effects classified? Explain them in detail.
13. Write in detail about acceptance tests for telecobalt machine.
14. Explain importance of Oxygenation of tumor in radiotherapy and radiobiology of Radiotherapy