

ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2020
EXAMINATION CATEGORY: TECHNICAL

**PAPER III: SUBJECT SPECIALISATION PAPER FOR RADIOLOGY AND IMAGING
SCIENCE TECHNOLOGY**

Date	: February 27, 2021
Total Marks	: 100
Writing Time	: 150 minutes (2.5 hours)
Reading Time	: 15 minutes (prior to writing time)

GENERAL INSTRUCTIONS:

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is being provided to check the number of pages of the Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
 - **SECTION A** has two parts: Part I - 30 Multiple Choice Questions
Part II - 4 Short Answer Questions
All questions under SECTION A are COMPULSORY.
 - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part on a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. **You must hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
10. This paper has **7 printed pages**, including this instruction page.

GOOD LUCK!

SECTION A

PART I: Multiple Choice Questions [30 marks]

Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. The nucleus of an atom consists of
 - a) electrons and protons.
 - b) protons and neutrons.
 - c) electrons, protons and neutrons.
 - d) electrons, positrons and neutrons.

2. The binding energy of electrons
 - a) is influenced by the number of neutrons within an atom.
 - b) is lower for an L- shell electron than an M- shell electron.
 - c) is the energy expended in moving an electron from an inner to an outer shell.
 - d) determines the energy of the photoelectron produced following photoelectric absorption.

3. If on taking an X-ray, the exposure (mAs) is set to keep the film density consistent, then
 - a) increasing the exposure time might result in increased patient dose.
 - b) increasing the X-ray field size will increase the effective dose to the patient.
 - c) an increase in the tube potential (kV) will reduce the effective dose to the patient.
 - d) using a faster film screen combination will reduce the effective dose to the patient.

4. The intensity of the X-ray beam
 - a) depends on the atomic number of the target.
 - b) is inversely proportional to the current.
 - c) is directly proportional to the kVp.
 - d) is increased by filtration.

5. Regarding Image intensifiers,
 - a) the electrostatic focusing lens focus the electron beam as it flows from photocathode to output phosphor.
 - b) magnification gain is one of the artifacts seen in image intensifier tube.
 - c) the input fluorescent phosphor is made of calcium tungstate.
 - d) the photocathode is at the output screen.

6. The typical range of kVp used in mammography is
 - a) 55-60
 - b) 45-50
 - c) 20-35
 - d) 15-20

7. Concerning radiation protection to staff and patients
 - a) 2.5 mm of lead equivalent filter should be used for routine radiological procedures.
 - b) lead screen panels used in the X-ray rooms to protect staff are usually 5 mm thick.
 - c) for chest radiography, the film to focus distance should not be less than 30 cm.
 - d) thyroid collars used in radiology have 0.5 mm lead equivalence.

8. Regarding the hysterosalpingography, the correct statement is
- it is ideally performed on the 4th-6th day of the cycle.
 - it can be performed if there is active pelvic infection.
 - venous intravasation is a recognized complication.
 - it is used for the study of lower urinary tract.
9. The patient radiation dose is reduced by
- using a compression paddle in mammography.
 - a short focus to skin distance.
 - usage of low voltages.
 - usage of grids.
10. Barium follow through study is performed to assess
- Colon
 - Stomach
 - Small intestine
 - Stomach & small intestine
11. The MPD for a male occupationally exposed worker is about
- 50 rem/year
 - 5.0 rem/ year
 - 0.5 rem /year
 - 0.05 rem/year
12. Which of following statements is true about dosimetry?
- 1 Gray=1 J/g.
 - The effective dose is measured in Gray(Gy).
 - The absorbed dose is measured in Gray(Gy).
 - Kerma takes into account the type of tissue being irradiated.
13. The stochastic type of radiation injury causes
- Cataract formation
 - Hereditary effects
 - Skin necrosis
 - Erythema
14. The linear attenuation coefficient (LAC) of the material
- has unit in centimetres.
 - does not depend on the atomic number and density.
 - is equal to the product of the individual interaction coefficients.
 - relates to the probability that a photon interaction will occur in the material.
15. Regarding the Electromagnetic radiation, all EM waves have the same
- Wavelength
 - Amplitude
 - Frequency
 - Velocity

16. Which of the following is an ionizing radiation?
- Gamma rays
 - Radio waves
 - Microwaves
 - Light waves
17. The device that converts Alternating current to Direct current is_____.
- resistor
 - rectifier
 - amplifier
 - transformer
18. The frequencies of ultrasound used in medical imaging are in the range of
- 1-20 Hz
 - 10-20 Hz
 - 1-10 MHZ
 - 10-20 MHz
19. Regarding the ultrasound,
- thyroid gland is best imaged with a linear transducer.
 - ultrasonography is the best imaging modality for lung pathology.
 - the frequency of a sound wave is directly related to its wavelength.
 - the thicker the piezoelectric crystal, the greater the resonance frequency.
20. During ultrasonography, the structure that does not produce any echoes is called
- Heteroechoic
 - Hypoechoic
 - Echogenic
 - Anechoic
21. Multi-slice CT scanner
- gives a higher spatial resolution than the single slice scanners.
 - takes longer scanning time than the single slice scanners.
 - has lesser anatomic coverage.
 - always uses contrast media.
22. The principle reason that the contrast media will increase contrast resolution of a CT image is
- Coherent scatter
 - Compton scattering
 - Photoelectric absorption
 - Bremsstrahlung reaction
23. Motion artifact in CT image normally appears as
- Streaks
 - Peaking
 - Cupping
 - Herringbone pattern

24. The MRI
- show bone as hyper signal.
 - can suffer from thickness effect.
 - can demonstrate real-time function.
 - the spatial resolution is as good as fluoroscopy.
25. In the presence of a uniform magnetic field, the hydrogen protons
- remain oriented mostly randomly and precess around the field axis.
 - line up along the field and precess around the axis.
 - line up along the field and rotate around the axis.
 - are not affected by the magnetic field.
26. T1 weighted images in MRI are usually used for obtaining information about
- CSF
 - edema
 - blood flow
 - brain anatomy
27. Inversion recovery (IR) sequences are helpful to
- shorten imaging time.
 - improve T2 weighting.
 - improve tissue contrast.
 - improve signal to noise ratio.
28. Regarding the imaging modalities of the chest, which of the following is the correct statement?
- MRI shows excellent detail of the lung anatomy.
 - Bronchography is the technique of choice to visualize the bronchial tree.
 - Spiral CT ensures that no portion of the lung is missed due to variable inspiratory effort.
 - High Resolution CT (HRCT) uses a slice thickness of 4-6 mm to identify mass lesions in the lung.
29. All of the following are branches of the arch of Aorta EXCEPT
- Left common carotid artery
 - Left Subclavian artery
 - Brachiocephalic artery
 - Vertebral artery
30. Intervention Radiology is the subspecialty of radiology that
- uses X-rays to treat cancers.
 - uses radio-isotopes to detect cancer spread.
 - uses imaging modalities to typically access structures through a tiny nick in the skin & vessels for diagnostic or therapeutic purposes.
 - uses imaging modalities for real time assessment of following vessels and cardiac function for planning of high energy X-radiations to a patient.

PART II – Short Answer Questions [20 marks]

This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks.

1. List the factors that affect the density on a radiograph. Explain what is meant by attenuation. (3+2 marks)
2. What do you understand by Stochastic & Deterministic effects of radiation? Give examples for each. (4+1 marks)
3. What is a fluoroscopy? Draw a labelled diagram of an Image intensifier. (1+4 marks)
4. What is an ultrasound? Describe the parts of an Ultrasound machine.(1+4 marks)

SECTION B: CASE STUDY [50 marks]

Choose either CASE I or CASE II from this section. Each case study carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE I

A young man of 25 years of age has been brought to the Emergency Department with poly trauma to head and body when the Bolero pickup he was driving veered of the road at Dochula. The Physician at ED found cut wounds on his head, difficulty in breathing, tender and slightly distended abdomen. He also has frank hematuria. The duty physician has asked for various radiological imaging. As you are the Radio-technologist on-call duty, answer the following questions in this case scenario:

1. What is your provisional diagnosis? What is the role of X-ray in this patient? (2+5 marks)
2. What do you understand by FAST? List some probable findings in this patient. (4+4 marks)
3. Describe the contrast CT protocol for abdomen. (8 marks)
4. What is CT Urogram? Describe the CT Urogram for this patient. (2+8 marks)
5. Compare and contrast CT & MRI brain of this patient with extra-cranial bleed. (7 marks)
6. What are the common artifacts in MRI? Write about the basic sequences in MRI. (5+5 marks)

CASE II

A 65-year-old lady, known case of Diabetes Mellitus & Hypertension is brought to Emergency Department by her family with complaint of acute altered sensorium, slurring of her speech and weakness in her right half of body for one day. After examining her, the ED physician orders some radiological imaging. You as the Radio-technologist attending the case, answer the following questions in this context:

1. What is your provisional diagnosis? Mention the required imaging modalities for this patient. (2+3 marks)
2. What do you understand by perfusion imaging? Write briefly on MR Angiography. (5+5 marks)
3. How do you perform the MRI stroke protocol at your centre? (10 marks)
4. Compare and contrast the CT & MRI of brain in this patient. (10 marks)
5. What is the principle used in CT? Write a short note on MDCT. (3+7 marks)
6. Write a short note on hazards of radiation. (5 marks)

TASHI DELEK