

**ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2022
EXAMINATION CATEGORY: TECHNICAL**

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

Date	: October 9, 2022
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 characteristics of deterministic effect of radiation includes
 - I. Linear dose response relationship
 - II. They have a threshold
 - III. Even small dose can cause deterministic effects
 - a) I and II only
 - b) I and III only
 - c) II and III only
 - d) I, II and III

2. The quantity of the X-ray beam doubles
 - a) when mA is doubled.
 - b) when KVp is doubled.
 - c) is controlled solely by the target material.
 - d) is unaffected by the presence of characteristic X-rays.

3. In which of the following conditions does the X-ray attenuation increases?
 - a) Increase in the energy of the incident X-ray
 - b) Increase in the atomic number of materials
 - c) Low density of the absorbing material
 - d) The polychromatic nature of X-ray

4. The line focus principle
 - a) initiates anode the heel effect.
 - b) does not apply to dual focus tube.
 - c) gives asymmetric effective focal spot.
 - d) optimizes the anode heat dissipation and focal spot size.

5. Which techniques given below is the best to reduce scatter radiation?
 - a) Usage of grids
 - b) Usage of low voltages
 - c) A short focus to skin distance
 - d) Using a compression paddle in mammography

6. The radiation dose limit for a radiation worker within one year is:
 - a) 10 mSV.
 - b) 20 mSV.
 - c) 30 mSV.
 - d) 40 mSV.

7. Which of the following interaction enhances the natural tissue contrast on radiographic image?
 - a) Compton scattering
 - b) Coherent scattering
 - c) Photodisintegration
 - d) Photoelectric absorption

8. The main source of occupational exposure is
 - a) patient.
 - b) collimator.
 - c) X-ray tube.
 - d) X-ray table.

9. Isotopes are atoms that
 - a) are radioactive.
 - b) have the same half-life.
 - c) have near identical electrical properties.
 - d) have same atomic number and different mass number.

10. The electromagnetic radiation with highest energy is
 - a) X-rays.
 - b) Gamma rays.
 - c) Radio waves.
 - d) Micro waves.

11. In which of the following tissue will ultrasound not pass through?
 - a) Water
 - b) Blood
 - c) Bone
 - d) Fat

12. The frequency of the transducer effects:
 - a) Contrast
 - b) Brightness
 - c) Penetration
 - d) Magnification.

13. The CT number is
 - a) dependent on CT scanner slice.
 - b) highest for blood.
 - c) measured in mAs.
 - d) negative for fat.

14. Which of the following x-ray beam possesses the highest quality?
 - a) 90 KV with 1.0 mm AL filter
 - b) 90 KV with 1.5 mm AL filter
 - c) 90 KV with 2.0 mm AL filter
 - d) 90 KV with 2.5 mm AL filter

15. Proton density is a Magnetic Resonance image contrast acquired by
- Long TR, long TE
 - Short TR, long TE
 - Long TR, short TE
 - Short TR, short TE
16. Ghosting due to involuntary motion of aorta in MRI can be removed by
- larger FOV.
 - phase and frequency oversampling.
 - use an inversion recovery sequence.
 - swapping phase and frequency encode.
17. Patient dose for mammography is best measured as
- mean glandular dose.
 - entrance dose rate.
 - half-value layer.
 - exit dose rate.
18. Which one of the following is the dimeric contrast media?
- Iothalamate
 - Gadolinium
 - Iopamidol
 - Ioxaglate
19. The emulsion layer of a film consists of
- potassium bromide and gadolinium.
 - calcium tungstate and polyester.
 - gelatin and silver bromides.
 - polyester and phenidone.
20. The number of cycles per second is called_____.
- frequency
 - wavelength
 - wave period
 - wave repetition period
21. The thickness of the lead apron is
- 0.5 mm.
 - 1.0 mm.
 - 1.5 mm.
 - 2.0 mm.
22. The tube current used for fluoroscopic mode is
- 5mA.
 - 50mA.
 - 100mA.
 - 200mA.

23. Inversion recovery pulse sequence in MRI begins with RF pulse of:
- 15 degrees
 - 30 degrees
 - 90 degrees
 - 180 degrees
24. An example of stochastic effect of ionizing radiation is
- cataract formation.
 - skin erythema.
 - sterilization.
 - leukaemia.
25. The SI unit of radiation exposure to living tissue is _____.
- rem
 - rad
 - sievert
 - roentgen
26. In the antero-posterior outlet projection of the shoulder, the central-ray beam is centred to the palpable coracoid process of the scapula:
- 30 degrees laterally
 - 30 degrees caudally
 - 30 degrees medially
 - 30 degrees cranially
27. Hypothetically it is said that a small amount of radiation is good for health. This is known as
- Protraction
 - Fractionation
 - Oxygen effect
 - Radiation hormesis
28. A sudden feeling of warmth, usually intense over the neck, face and chest after administration of contrast media is called
- Hot flushing
 - Warmth feeling
 - Mild hot reactions
 - Adverse hot reactions
29. The foramen of Monroe connects the
- lateral ventricle to the third ventricle.
 - fourth ventricle to the lateral ventricle.
 - third ventricle to the fourth ventricle.
 - right lateral ventricle to left lateral ventricle.
30. Road mapping is a technique used in
- CT
 - MRI
 - DSA
 - Fluoroscopy

PART II – Short Answer Questions [20 marks]

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

1. What are the different views for taking knee X-ray? Describe the positioning and technical factors of Sunrise view. **(2+3 Marks)**
2. What is thermoluminescent dosimeter (TLD)? Describe the deterministic effects of radiation. **(1+4 Marks)**
3. What is an ultrasound? Draw a labelled diagram of a Transducer. **(1+4 Marks)**
4. Compare and contrast between the principle of Computed Tomography (CT) and Computed Radiography (CR). **(5 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 55-years-old lady with a known case of hypertension was airlifted from Eastern Regional Referral Hospital after sudden onset of altered mental status, slurring of speech and sudden left sided weakness of the body. The ultrasound Doppler has confirmed that there is deep vein thrombosis (DVT). The emergency department has send the patient to your department for imaging in a trolley. She also complained of chest pain and shortness of breath. There is a history of loss of consciousness and fall from standing. In this case scenario, answer the following questions.

1. What is your provisional diagnosis? Describe the CT brain protocol and possible CT brain findings in this patient. **(2+8 marks)**
2. Describe in detail how you will take the chest X-ray PA and how you will assure the chest X-ray image is up to the standard quality. **(4+3 marks)**
3. Discuss how and why you will perform CTPA? **(8 marks)**
4. Describe the MRI stroke protocol at your center. **(10 marks)**
5. Give an account of MR protocol for lower limb angiography. **(8 marks)**
6. Compare and contrast between CT & MRI brain of patient with acute intracranial bleed. **(7 marks)**

CASE II

A 25-year-old male was admitted through the surgical OPD with jaundice, upper abdominal pain and lump in the right upper abdomen. The patient also has complained of chronic right flank pain. The preliminary examinations showed raised liver enzyme and deranged RFT. The surgeon on duty has asked for some radiological imaging at your department. In this context, please answer the following questions.

1. Describe in detail the process of preparation for standard ultrasonography of the hepato-biliary system (HBS) and for CT abdomen. **(3+4 marks)**
2. Discuss the Tri-phasic MDCT protocol of the liver. **(10 marks)**
3. Write about Magnetic resonance cholangiopancreaticography (MRCP). **(10 marks)**
4. List at least 8 contrast radiography of GI system. Describe how you will perform T-tube cholangiogram. **(4+6 marks)**
5. Give an account of CT urography. **(7 marks)**
6. Write short note on calcium scoring in coronary angiogram. **(6 marks)**

TASHI DELEK