

ROYAL CIVIL SERVICE COMMISSION  
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2011  
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER FOR  
RADIO-DIAGNOSIS AND IMAGING

Date: 30-10-2011

Total marks	:	100
Examination time	:	2.5 hours
Reading time	:	15 minutes

**INSTRUCTIONS:**

1. Write your Roll Number clearly on the answer booklet provided.
2. The first 15 minutes are being provided to clarify doubts and to read the instructions.
3. This question paper contains 8 pages and is divided into 2 sections - viz: I and II

Section I is compulsory and consists of 2 parts : Part A and B.

Part A consists of 30 Multiple Choice Questions, carrying 1(one) mark each and should be answered on the question paper itself.

Part B consists of 4 short questions , each carrying 5 ( five) marks , and should be answered on the separate answer booklet provided.

4. Section II carries 50 (fifty) marks and consists of Part A and B. You are required to answer all the questions of **any one part** only. The answers should be written on the separate answer sheets provided.

## SECTION I

### PART A: Multiple Choice Questions (30 x 1 = 30 marks)

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

Ans: c) electrons, protons and neutrons

2. Which of the following statements regarding protons are correct?
  - a) They have a negative charge
  - b) They are equal to the number of neutrons in a non-ionized atom
  - c) They are equal to the atomic number in a non-ionized atom
  - d) They have no mass

Ans: c) They are equal to the atomic number in a non-ionized atom

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

Ans: d) Determines the energy of the photoelectron produced following photoelectric absorption

4. Concerning electromagnetic radiation:
  - a) They travel parallel to each other in a straight line
  - b) Beam intensity is inverselyproportional to the square of the amplitude
  - c) The area of the beam is proportional to the square of the distance as it travels away from a point source.
  - d) Beam intensity is proportional to the square of the distance as it travels away from a point source

Ans: c) The area of the beam is proportional to the square of the distance as it travels away from a point source.

5. Which of the following are true regarding an X-ray tube?
- a) The tube current ( mA) is increased by increasing the filament voltage
  - b) An increase in the tube voltage (kV) leads to a proportional increase in the tube current
  - c) The kinetic energy of electrons (keV) in the X-ray tube is not dependent on the tube voltage ( kV)
  - d) The collision of electrons with a tungsten target mainly results in the production of X-ray radiation

Ans: a) The tube current ( mA) is increased by increasing the filament voltage

6. Concerning radiation damage to tissues, which of the following is correct?
- a) Cells with high mitotic rates are less affected
  - b) It is caused by free radicals
  - c) Secondary electrons cause damage to tissue in a linear pattern
  - d) It is caused directly by X-rays

Ans: b) It is caused by free radicals

7. Which of the following is true about dosimetry?
- a) Kerma takes into account the type of tissue being irradiated
  - b) The absorbed dose is measured in Grays (Gy)
  - c) The Effective Dose is measured in Gray
  - d) 1 Gray = 1 J/g

Ans: b) The absorbed dose is measured in Grays (Gy)

8. Which of the following is correct regarding deterministic effects of radiation?
- a) It has a minimum threshold below which it does not occur
  - b) The severity of the effect decreases with dose
  - c) The probability of the effect occurring increases with dose
  - d) Breast cancer is a type of deterministic effect

Ans: a) It has a minimum threshold below which it does not occur

9. Which of the following attenuates an X –ray beam the most?
- a) muscle
  - b) air
  - c) bone
  - d) skin

Ans: d) skin

10. Regarding thermoluminescent dosimeters:
- a) They can be reused
  - b) The sensitivity is significantly better than film
  - c) They can be used to measure only shallow doses
  - d) They can measure dose rates

Ans: a ) They can be reused

11. Concerning radiation protection of 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) Thyroid collars used in radiology have 0.5 mm lead equivalence
  - d) For chest radiography, the film to focus distance should not be less than 30 cm

Ans: c) Thyroid collars used in radiology have 0.5 mm lead equivalence

12. All of the following reduce patient dose except:
- a) fast screen-film combinations
  - b) appropriate beam filtration
  - c) anti-scatter grid
  - d) pulsed fluoroscopy

Ans: c) anti-scatter grid

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

Ans: d) Increasing the exposure time might result in increased patient dose.

14. The foramen of Monroe connects the :
- a) Lateral ventricle to the third ventricle
  - b) Lateral ventricle to the fourth ventricle
  - c) Third ventricle to the fourth ventricle
  - d) Right lateral ventricle to the Left lateral ventricle

Ans: a) Lateral ventricle to the third ventricle

15. Which of the following do not form part of the Circle of Willis ?
- a) Anterior cerebral arteries
  - b) Posterior cerebral arteries
  - c) Middle cerebral arteries
  - d) Vertebral arteries

Ans: d) Vertebral arteries

16. With regard to the Right lung:
- a) The Right lung has 2 lobes
  - b) The Right lung has 3 lobes
  - c) The Right lung has equal number of lobes as the Left
  - d) The Right lung has less lobes than the Left

Ans: b) The Right lung has 3 lobes

17. The large intestine includes the :
- a) ascending colon, descending colon, rectum
  - b) transverse colon and sigmoid colon
  - c) descending colon , ascending colon
  - d) ( a) and ( b)

Ans: d) ( a) and ( b)

18. All are branches of the aortic arch except:
- a) vertebral artery
  - b) Lt common carotid artery
  - c) brachiocephalic artery
  - d) Lt subclavian artery

Ans: a) vertebral artery

19. How is proton density weighting achieved?

- a) Short TR, long TE
- b) Long TR , short TE
- c) Short TR , short TE
- d) Long TR, long TE

Ans: b) Long TR , short TE

20. Which of these is a disadvantage of MRI?

- a) High dose of ionizing radiation
- b) Shows vasculature without contrast
- c) Unsuitable for pacemaker wearers
- d) Two dimensional images

Ans: c) Unsuitable for pacemaker wearers

21. Regarding the imaging modalities of the chest which statement is true:

- a) High resolution CT (HRCT) uses a slice thickness of 4-6 mm to identify mass lesions in the lung.
- b) Spiral CT ensures that no portion of the lung is missed due to variable inspiratory effort
- c) MRI shows excellent detail of the lung anatomy
- d) Bronchography is the technique of choice to visualize the bronchial tree

Ans: b) Spiral CT ensures that no portion of the lung is missed due to variable inspiratory effort

22. The frequencies of Ultrasound used in medical imaging are in the range of :

- a) 1-20 MHz
- b) 1-20 Hz
- c) 1-20 KHz
- d) 10-20 MHz

Ans: a) 1-20 MHz

23. All of the following are advantages of Ultrasound except:
- a) Ultrasound examinations are non-invasive
  - b) No harmful effects have been detected at the intensity levels used for imaging.
  - c) Ultrasound is particularly suited to imaging soft tissues such as the eye, heart and other internal organs.
  - d) Ultrasound is reflected very strongly on passing from tissue to gas and vice versa

Ans: d) Ultrasound is reflected very strongly on passing from tissue to gas and vice versa

24. Concerning ultrasound which statement is true:
- a) The decibel is a measure of the absolute intensity of an ultrasound beam
  - b) The direction of oscillation of the tissue is perpendicular to the direction of transmission of the resultant wave form
  - c) The amount of attenuation of an ultrasound beam is directly proportional to its frequency
  - d) Lateral resolution cannot be improved by using focused transducers.

Ans: c) The amount of attenuation of an ultrasound beam is directly proportional to its frequency

25. Concerning CT, which statement is false:
- a) In helical CT a subject is moved continuously through a continuously rotating gantry
  - b) Field size is the product of matrix size and pixel width
  - c) Spatial resolution improves as the pixel size gets smaller
  - d) Noise can be reduced by narrowing the slice thickness

Ans: d) Noise can be reduced by narrowing the slice thickness

26. Concerning MRI, which statement is true:
- a) The gyromagnetic ratio is constant for all materials
  - b) Precession frequency is inversely proportional to the magnetic field strength
  - c) A typical range for T1 is 300 – 2000 ms
  - d) Water has a long T1 and a short T2

Ans: c) A typical range for T1 is 300 – 2000 ms

27. Regarding Double contrast examination of the upper gastro-intestinal tract which statement is false :

- a) requires high density and low viscosity barium suspension
- b) demonstration of areae gastricae in the stomach is a criterion of good coating
- c) in the supine position , the duodenum usually overlaps the distal antrum and pylorus
- d) requires 800 - 1000 ml of gas to adequately distend the stomach

Ans: d) requires 800 - 1000 ml of gas to adequately distend the stomach

28. In intra-venous urography, which statement is true:

- a) fluid restriction is imperative
- b) a suitable dose of contrast medium is 30 mg of iodine per kg body weight
- c) abdominal compression should be applied before the 5 minutes film
- d) delayed films may be required if there is no excretion of the contrast from the kidneys seen

Ans: d) delayed films may be required if there is no excretion of the contrast from the kidneys seen

29. Regarding hysterosalpingography, which statement is true:

- a) it is ideally performed on the 4th -6th day of the cycle
- b) it can be performed if there is active pelvic infection
- c) venous intravasation is a recognized complication
- d) it is used to for the study of the urinary tract .

Ans: c) venous intravasation is a recognized complication

30. Regarding MR contrast media, which statement is true:

- a) all gadolinium chelates are ionic
- b) gadolinium is excreted by the kidneys
- c) gadolinium is diamagnetic
- d) barium cannot be used as a gastro-intestinal contrast agent in MRI

Ans: b) gadolinium is excreted by the kidneys



## SECTION I

### Part B: SHORT ANSWER QUESTIONS

Answer all the questions ( 5 marks each)

1. What are the interactions that take place between X-ray and matter? Describe the 2 interactions that take place frequently in diagnostic radiography.
2. Draw a neat diagram of the Rotating Anode X-ray tube and label all its parts. Why is tungsten used as a filament in the cathode?
3. What are the advantages and disadvantages of Ultrasonography, Computed Tomography and Magnetic Resonance Imaging?
4. What do you understand by Deterministic and Genetic Effects of Radiation?

## SECTION II: (50 marks)

Answer either Part A **OR** B.

### PART A

Imagine there has been a bus accident at Dochula. The emergency medical team has arrived at the scene and sent 8 passengers out of the total 20, by ambulance to JDW NR Hospital for X-rays. You are on duty when the patients arrive all together at the X-ray unit for their X-rays.

How would you go about taking the various X-rays prescribed for them, what exposure factors would you use, where would you centre the central ray, and how would you ensure that you got the best images?

- i. Karma, 24 years, male,  
Type of X-ray: Right Ankle AP, Mortise and Lateral views
- ii. Ugen, 50 years, male  
Type of X-ray: Abdomen Erect and Right lateral decubitus views
- iii. Meena, 1 year, female  
Type of X-ray: Skull AP and lateral views
- iv) Tashi, 20 years old, female  
Type of X-ray: Chest PA and Lt oblique views

- v) Singye, 45 years, male  
Type of Xray: Cervical spine AP, lateral and odontoidviews
- vi) Minjur, 70 years, male  
Type of Xray: PNS
- vii) Karna, 30 years, male  
Type of Xray: Lt shoulder AP and Y-views
- viii) Mendi, 50 years, female,  
Type of Xray: Right wrist AP and lateral

**Section B:**

You are in charge of the X-ray unit in JDW NR Hospital. How would you ensure that:

- a) the staff working under you
- b) all the patients ( children and adults) coming for X-rays
- c) the patient attendants
- d) other patients outside the X-ray unit

are protected as much as possible from radiation (primary and secondary) .What changes would you like to introduce to achieve this ?