

**ROYAL CIVIL SERVICE COMMISSION
CIVIL SERVICE EXAMINATION (CSCE) 2009
EXAMINATION CATEGORY: TECHNICAL**

PAPER III: SUBJECT SPECIALIZATION PAPER for Biomedical Engineer

Date : 8th November 2009
Total Marks : 100
Examination Time : 2.5 hours
Reading Time : Min. 5 minutes (Prior to exam. Time)

INSTRUCTIONS

1. Write your roll No. (Registered Number) clearly on the answer booklet in the space provided.
2. The first 15 minutes is being provided to check the number of pages, printing errors, clarify doubts and to read the instruction. You are **NOT PERMITTED TO WRITE** during this time.
3. Use either **Blue** or **Black** ink pen or **Ball** point pen for the written part and **H.B. Pencils** for the sketches and drawings.
4. All answers should be written on the Answer Booklet provided. Candidates are not allowed to write anything on the question paper.
5. This Question Booklet consists of ___ **pages**. It is divided into two sections – namely **SECTION A** and **SECTION B**.
6. **SECTION A** consists of two parts. **Part I** and **Part II**.

Part I consists of 30 multiple choice questions carrying one (1) mark each and is compulsory. The answer of your choice should be clearly written in whole along with the question and option number on your answer booklet.

Part II consists of four (4) short answer questions of five (5) marks each and all questions are compulsory.
7. **SECTION B** consists of two (2) **Case Studies** and related questions. Choose only **ONE** case study and answer the questions under your choice. Each case study carries fifty (50) marks in total.

PART I – MULTIPLE CHOICE

Section A

Part I: Multiple choice questions (1 mark each)

Choose the Correct Answer and write down the question number and the letter of the correct answer chosen against it in the Answer Sheet provided.

1. The principle or device used to measure the flow of blood, fluid and air is:
 - a. Enzyme Electrode
 - b. Electromagnetic
 - c. Piezoresistance
 - d. Microphone.

2. One of the factor affecting the seriousness of electrical burns is:
 - a. The size of the conductor discharging current.
 - b. The type of insulation.
 - c. The type of tissue and the local blood flow.
 - d. The gender type

3. The lungs act as pliable bellows that can hold up to ___ liter(s) of gas and recoil to a volume of ___ liter(s) after forced expiration.
 - a. 6 and 1
 - b. 1 and 6
 - c. 3 and 9
 - d. 9 and 3

4. Blood Gas Analyzer are used to measure the:
 - a. Venous blood gas levels
 - b. Oxygen level in the blood
 - c. Carbon dioxide level in the blood
 - d. Arterial blood gas levels

5. A type of sterilizer:
 - a. Gas Plasma
 - b. Radiator
 - c. Boyle's apparatus
 - d. Incubator

6. mA and KV in X-ray Radiology are used:
 - a. To measure the milliamperere and the Kilovolt of X-ray tube.
 - b. To adjust the intensity and the penetration of delivered X-rays.
 - c. To limit the current and high voltage flowing through the tube.
 - d. To verify the power of X-rays delivered.

7. Biomedical Engineering Services in Bhutan have been established in:
- Thimphu, Phuntsholing and Gelephu
 - Thimphu, Mongar and Samdrup Jongkhar
 - Thimphu, Sarpang and Trashigang
 - Thimphu, Mongar and Gelephu
8. What denotes the mass number in an atom?
- Electrons and Protons
 - Neutrons and Nucleus
 - Electrons and Nucleons
 - Protons and Neutrons
9. SRAM and DRAM stores bits in:
- In its memory
 - Array of flip flops and as charged capacitors.
 - In array of flip flops
 - As charged capacitors
10. Which of the following is true:
- Fibre optic cables have losses of fractional decibels per kilometre.
 - Fibre optic cables are insulators
 - They do not act as antennas for radio interferences
 - They are lighter and more rugged than conventional cables.
 - All of the above
11. Which of the following amplifiers would be best to amplify ECG (electrocardiogram) signals?
- Differential amplifier
 - Unity gain amplifier
 - Noninverting amplifier
 - Inverting amplifier
12. Which of the following logic identity is true:
- $A.B.C = (A.B).C$
 - $A + A.B = A$
 - $A + B = B + A$
 - $A.(B + C) = A.B + A.C$
 - All of the above
13. What does the CE marking on equipment mean?
- Indicates that the quality of the equipment is assured.
 - Indicates that a product meets European Union directive standards of performance and safety.
 - Indicates that it meets the requirement under ISO 9000 quality assurance standards.
 - Indicates that the quality and safety of the equipment meets the American FDA standards.

- 14 What does the shape of the ECG waveform reflect?
- It reflects the ventricles contracting
 - It reflects the mechanical events occurring during the cardiac cycle
 - It reflects the Electrical events occurring during the cardiac cycle
 - It reflects the polarisation and depolarisation of the ventricles.
- 15 Various mechanism, controllers and programs have been built inside the incubator to:
- Maintain the humidity inside the incubator
 - Prevent dust and germs from getting inside the incubator
 - To maintain the temperature inside the incubator
 - To maintain the airflow inside the incubator
- 16 Dialysis works on the principles of:
- Diffusion and ultrafiltration
 - Conduction and filtration
 - Convection and ultrafiltration
 - Reverse Osmosis
- 17 Which of the following is a characteristic of laser?
- Long range
 - High divergence
 - Incoherence
 - Monochromaticity
- 18 Which of the following gasses are used in hospitals?
- Oxygen, Helium and Methane
 - Carbon dioxide, Oxygen and Nitrogen
 - Oxygen, Halothane, Argon
 - Ammonia, Oxygen and Neon
- 19 Which laser is used in gynaecology to treat endometriosis and ectopic pregnancy with either a bare fibre or sapphire tip.
- Holmium YAG (Ho:YAG)
 - KTP/532
 - Neodymium YAG (Nd:YAG)
 - Argon ion
- 20 The blue light used in Phototherapy to breakdown bilirubin is in the wave length of:
- 420-500nm
 - 350-400nm
 - 500-650nm
 - 350-450nm

- 21 The total lung capacity cannot be measured by Sphyrometer due to:
- Tidal Volume
 - Inspiratory reserve volume
 - Expiratory reserve volume
 - Residual volume
- 22 The value, tolerance, working voltage and _____ are to be considered when choosing a capacitor?
- Discharging current
 - Leakage current
 - Charging current
 - System current
- 23 In frequency effects, if $A = 100,000$. What will be the decibel voltage gain?
- 50 db
 - 100 db
 - 150 db
 - 200 db
- 24 Which of the following is a product of genetic engineering?
- Lithium-ion battery
 - Solar cell
 - Liquid oxygen
 - Pace maker
- 25 What is the common frequency range used in medical imaging?
- 1 – 20 MHz
 - 3.5 – 10 MHz
 - 2.5 – 10 MHz
 - 7.5 – 10 MHz
- 26 The thickness of the lead wall (the septum) between the holes in the collimator of a gamma camera depends on:
- Size of the camera head
 - The energy of the gamma rays being detected
 - The radionuclide
 - The ionisation chamber
- 27 In a computed tomography machine, the patterns that are in an image but not in the object are called:
- Picture
 - Projection
 - Defects
 - Artefacts

- 28 _____ is a modality of respiratory support in which increased pulmonary pressure is provided artificially during the expiratory phase of the respiration in a spontaneously breathing neonate.
- CPAP (Continuous Positive Airway Pressure)
 - IPPV (Intermittent Positive Pressure Ventilation)
 - IMV (Intermittent Mandatory Ventilation)
 - SIMV (Synchronized Intermittent Mandatory Ventilation)
- 29 A personality dimension under the Big Five Model that describes someone who is responsible, dependable, persistent and organized falls under _____ personality.
- Agreeableness
 - Extraversion
 - Conscientiousness
 - Emotional stability
- 30 What is E-waste?
- Economic Waste
 - End Waste
 - Ecological Waste
 - Electronic Waste

Section A

Part II: Short Answers (5 marks each)

1. Explain in your own words, what are class I and class II equipment? And why they are classified as such?
2. How does radiation cause health effects? Name some common forms of ionizing radiation?
3. State the principles of operations of a pulse-oximeter? Can ambient light interfere with pulse oximetry reading? At what site should the probe be placed for pulse oximetry?
4. A circuit is required that will indicate when two logic variables, A and B are unequal.
 - Obtain the truth table
 - Derive the equation from truth table
 - Draw out circuit from equation

Section B Case Studies (50 marks)

1. A project worth Nu.100 million has been granted as financial assistance by the Government of India to equip a new 40 bedded hospital at Trashigang. The Ministry of Health, RGoB has identified you as the project manager to coordinate and manage the implementation of this project. You are to complete the project within the next 5 months.

Show in detail:

- a. The strategy that you would use or adopt in implementing this project.
 - b. The planning of the project in words / tables / chart.
 - c. Financial plan (adopt your own pricing for equipment)
 - d. The technical (pre-installation and post-installation plan)
 - e. Human resource strategy
 - f. Monitoring and evaluation plan.
 - g. Concluding remarks
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2. The Royal Government of Bhutan is planning to set up a Radiotherapy unit at JDWNRH. You as a Biomedical Engineer have been identified as the focal person to plan the details incorporated in the establishment of Teletherapy unit. You are asked to furnish the following details.
 - a. Submit the procedures (Requirements, seek clearance, approval etc) in setting up such a unit in Bhutan.
 - b. Submit a sketched layout plan with dimensions of the rooms for a telecobalt and associated facilities to Health Infrastructure Development Division to serve as a basis for the preparation of civil and architectural drawings. Provide any specific technical details required to be incorporated in the construction plan like construction material, viewing system, ramp, beam stopper etc.
 - c. Provide a list of essential equipment required to set up a Radiotherapy unit to Drugs Vaccines and Equipment Division for procurement.
 - d. Provide a list of Human Resource required to Human Resource Division to plan for recruitment and training.
 - e. Safety procedures and Quality assurance plans.
 - f. Pre-installation and Post-installation checks if any.
 - g. In your opinion, do you think that the establishment of Radiotherapy unit is feasible in Bhutan. Justify your answer?