

# College of Medicine

## ADMISSIONS TEST GUIDE

MBBS Admission Academic Year 2024 - 2025



دبي الصحية  
DUBAI HEALTH

جامعة محمد بن راشد  
للطب والعلوم الصحية  
Mohammed Bin Rashid University  
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## College of Medicine

BACHELOR OF MEDICINE AND  
BACHELOR OF SURGERY (MBBS)

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# Introduction

Thank you for choosing to give MBRU the opportunity to be part of your training and transformation to become a doctor.

Preparing for a career in medicine requires solid knowledge of how the human body works. This in turn requires a good command of basic biological and physical sciences and the student must have this in order to succeed with the training. The level of knowledge in biological and physical sciences needed is very close to the syllabus you have experienced in the high school.

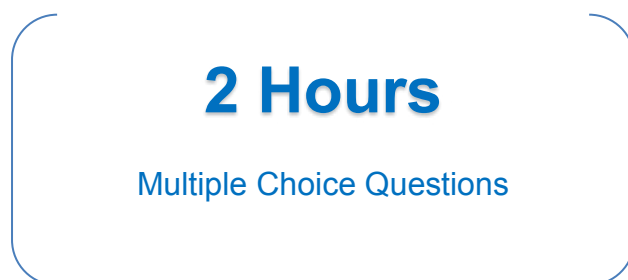
This admission test, mandated by the Ministry of Education, aims at assessing your understanding of the scientific principles necessary to understand medical sciences.

The test items draw upon basic science knowledge in Biology, Chemistry, Physics and Mathematics that have application to medicine.

In this document, you will find:

- A. A brief syllabus to guide your reading while preparing for the test
- B. List of suggested reference text
- C. Sample questions

## Structure



## Format

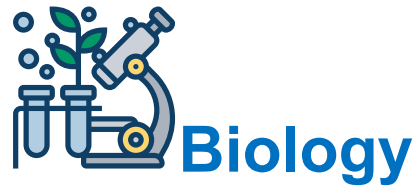
The test will be conducted on the computer. Calculators are not required.

## Assumed Subject Knowledge

The content areas below outline the scientific and mathematical knowledge assessed in MBRU assessment Test.

Candidates are expected to be familiar with the following SI prefixes:

|        |           |       |           |
|--------|-----------|-------|-----------|
| nano-  | $10^{-9}$ | deci- | $10^{-1}$ |
| micro- | $10^{-6}$ | kilo- | $10^3$    |
| milli- | $10^{-3}$ | mega- | $10^6$    |
| centi- | $10^{-2}$ | giga- | $10^9$    |



## **Content overview**

- 1. Characteristics of Life and Organization**
- 2. Cell: The unit of life – Structure and Function**
- 3. Overview of Human Physiology**
- 4. Genetics and Molecular Biology**

## 1. Characteristics of Life and Organization

### 1.1 Characteristics of Living Organisms

- a. Define the following the characteristics of life:
  - i. Cellular organization
  - ii. Growth and Development
  - iii. Metabolism
  - iv. Homeostasis
  - v. Response to stimuli
  - vi. Adaptation
  - vii. Reproduction
- b. Briefly explain how the characteristics of life are successfully performed by specific functions of the systems in the body (i.e., Movement, Respiration, Digestion, Absorption, Circulation, Assimilation, Excretion)

### 1.2 Levels of Structural Organization

- a. Describe the organization of the human body by listing the structural levels of increasing complexity (i.e., from atom to organ systems, the organs constituting them and their main physiological functions especially in human beings)
- b. Differentiate between the four main types of tissue according to structure and function

## 2. Cell: The unit of life – Structure and Function

- a. Describe the structural differences between i) prokaryotic and eukaryotic cells, and ii) plant and human cells
- b. Describe the structural and functional organization of the plasma membrane in eukaryotic cells
- c. Identify the organelles present in eukaryotic cells and describe their structure and function
- d. List examples of the three main cytoskeletal elements (i.e., microtubule, intermediate filament; microfilament)
- e. Delineate the various stages of mitosis and meiosis and their physiological significance
- f. Describe the structure and function of key biomolecules – Carbohydrates, Proteins, Lipids, and Nucleic acids
- g. Describe the types, properties, and mechanism of action of enzymes
- h. Define active and passive transport and state their physiological relevance in cellular homeostasis

## 3. Overview of Human Physiology

- a. Provide a fundamental overview of the structure and function of the following:
  - i. Digestive system – organs, digestion, and absorption
  - ii. Respiratory system – organs, breathing and exchange and transport of gases
  - iii. Circulatory system – blood, lymph, double circulation, regulation of cardiac activity; hypertension, coronary artery diseases
  - iv. Excretory system – urine formation, regulation of renal function
  - v. Musculoskeletal system – skeletal system, joints, muscles, types of movement
  - vi. Nervous system – central and peripheral nervous systems, structure and function of neuron, reflex action, and sensory reception
  - vii. Endocrine system - various types of endocrine glands; mechanism of hormone action

## 4. Genetics and Molecular Biology

- a. Describe the mechanism of Mendelian inheritance; Chromosome theory of inheritance; Gene interaction
- b. Define with relevant exemplars: Incomplete dominance; Co dominance; Complementary genes; Multiple alleles
- c. Describe transfer of genetic information and its regulation
- d. Apply principles of human molecular genetics in medicine, including genetic engineering and molecular diagnostics



## **Content Overview**

- 1. Fundamentals of Chemistry**
- 2. Fundamentals of Acids, Bases and pH**
- 3. Nomenclature and Structure Drawing**
- 4. Isomerism**
- 5. Alcohols, Aldehydes, Ketones and Carboxylic Acids**
- 6. Amines**
- 7. Aromatic Chemistry**

## 1. Fundamentals of Chemistry

- Define protons, neutrons and electrons
- Define electropositivity and electronegativity, and apply these principles in the identification of elements in the periodical table
- Define solution and solubility and classify solutions according to solute content
- Apply the concepts of molarity, molality, and mass percentage to perform simple calculations

## 2. Fundamentals of Acids, Bases and pH

- Define acids and bases and describe their chemical properties
- Define pH and describe its physiological relevance
- Apply the Henderson–Hasselbalch equation to solve pH problems
- Define buffers and describe their significance in biological systems

## 3. Nomenclature and Structure Drawing

- Apply the precepts of IUPAC nomenclature to name alkanes, alkenes, alkynes, alcohols, alkyl halides, ethers, and amines; and draw structures of molecules using different types of structural presentations
- Describe chair representations of cyclohexanes and identify the axial and equatorial positions, and determine the most stable chair conformation for substituted cyclohexane molecules
- Recognize conformations of alkanes and cycloalkanes using perspective representations such as Sawhorse, Newman, and Fischer conformations
- Define torsional strain, steric strain and angle strain and differentiate between them
- Describe the basic substitution reactions involving aromatic compounds

## 4. Isomerism

- Define isomerism and identify a set of compounds as conformers, constitutional isomers, and stereoisomers
- Define and classify electrophilic addition reactions (with a focus on Markovnikov or Anti-Markovnikov) or stereoselective (syn- or anti-addition) aspects)

## 5. Alcohols, Aldehydes, Ketones and Carboxylic Acids

- Identify the general structure for an alcohol, aldehyde, ketone, and carboxylic acid
- Describe the typical reactions associated with aldehydes and ketones, focusing on glucose and fructose

## 6. Amines

- Differentiate primary, secondary, and tertiary amines
- Apply the  $pK_b$  values of amine or the  $pK_a$  values of the conjugate acids of amines and arrange the order of basicity of amines, especially with regards to amino acids
- Predict the dominant product of acid-base reactions associated with amino acids

## 7. Aromatic chemistry

- Recognize and distinguish aromatic compounds by their structures
- Describe the properties of aromatic compounds, and the chemical consequences of aromaticity with a focus on aromatic amino acids
- Describe the following types of electrophilic aromatic substitution reactions (with a specific focus on benzene and phenol): halogenation, nitration, sulfonation, and Friedel-Crafts acylation, and alkylation
- Describe the applications of aromatic compounds in medicine



## Content overview

1. Calculation
2. Fractions, Decimal and Percentages
3. Ratio and Proportion
4. Functions, Graphs and Calculus
5. Solving Equations and Inequalities
6. Calculation
7. Vectors
8. Probability and Statistics



### **1. Calculation**

- a. Apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers
- b. Calculate exactly with fractions
- c. Apply Venn diagrams to solve problems
- d. Round numbers to an appropriate degree of accuracy (eg to a specified number of decimal places)

### **2. Fractions, Decimals, Percentages, Ratios and Proportions**

- a. Apply concepts of fractions and percentages
- b. Solve problems involving percentage change
- c. Use ratio notation
- d. Apply ratios and proportions to solve problems

### **3. Functions, Graphs and Calculus**

- a. Apply the equation:  $y = mx + c$
- b. Interpret gradients and intercepts of linear functions graphically and algebraically
- c. Interpret the gradient of a straight-line graph as a rate of change
- d. Plot and interpret graphs to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration

### **4. Solving Equations and Inequalities**

- a. Solve linear equations in one unknown algebraically

### **5. Calculation**

- a. Use standard units of measure and related concepts (length, area, volume/capacity, mass, time, etc); change freely between related standard units and compound units (e.g., speed and density)
- b. Calculate perimeters and areas of 2D shapes, including composite shapes

### **6. Vectors**

- a. Apply vector notation
- b. Calculate, and represent graphically the sum of two vectors, the difference of two vectors and a scalar multiple of a vector
- c. Apply the properties of vector addition
- d. Solve simple geometrical problems in 2D using vector methods

### **7. Probability and Statistics**

- a. Interpret qualitative, discrete, and continuous data, including grouped and ungrouped data
- b. Extract data from printed tables and lists
- c. Calculate median, mean, range and mode
- d. Interpret a wide range of graphs and diagrams and draw conclusions
- e. Recognise correlation and lines of best fit by eye
- f. Define the vocabulary of probability and the probability scale
- g. Interpret measures of probability from theoretical models (including equally likely outcomes), or from relative frequency
- h. Compare experimental data and theoretical probabilities
- i. Recall that if an experiment is repeated, it may result in different outcomes
- j. Comprehend the association between sample size and estimates of probability and population characteristics



# Physics

## Content overview

1. Kinematics
2. Energy, Work and Forces
3. Lights and Optics
4. Heat and Thermodynamics
5. Waves and Sound
6. Electrostatics, Magnetism, and Electricity
7. Nuclear Physics and Radiation

## 1. Kinematics

### 1.1 Units and Measures

- Apply units of length, volume, mass, and time to perform simple calculations
- Define and calculate density

### 1.2 Fluid Mechanics and Pressure

- Define and calculate pressure
- Describe the use of a manometer
- Define buoyancy and hydrostatic pressure
- Describe fundamental laws in fluids: Pascal's law, Poiseuille flow and Continuity equation

### 1.3 Motion

- Describe Newton's Laws of motion
- Define and calculate speed and average speed
- Distinguish between speed and velocity
- Analyze and interpret a speed-time graph or a distance-time graph

### 1.4 Simple kinetic molecular model of matter

- Distinguish between the physicochemical properties of solids, liquids, and gases
- Describe Brownian motion in terms of random molecular bombardment
- Perform simple calculations applying gas laws
- Apply concepts of partial pressure to perform simple calculations

## 2. Energy, Work and Forces

### 2.1 Energy and Work

- Define the various forms of energy and identify their units: kinetic, gravitational, potential, chemical, elastic (strain), nuclear and internal
- Describe different modes of energy transfer
- Define work and identify its units

### 2.2 Forces

- Define and distinguish between different types of force
- Define centrifugal, centripetal and frictional forces
- Interpret extension-load graphs

## 3. Lights and Optics

- Define reflection, refraction, and total internal reflection
- Describe the formation of an optical image by a plane mirror, and by concave and convex mirrors and lenses
- Use the principal terms focus and focal length
- Analyze and interpret ray diagrams
- Describe the principle behind the magnification produced by a compound microscope and calculate the magnification based on objective and eyepiece specifications

## 4. Heat and Thermodynamics

### 4.1 Thermal properties and temperature

- Describe basic concepts of thermodynamics (open and closed systems, enthalpy and entropy)
- Define the first and second law of thermodynamics for a closed system
- Apply the first law of thermodynamics to the open systems
- Describe thermodynamic applications using second law of thermodynamics
- Describe how heat transfer occur by conduction, convection, and radiation

## 5. Waves and Sound

- a. Define and describe the characteristics of a typical wave (speed, frequency, wavelength, phase and amplitude)
- b. Distinguish between the Doppler effect, shockwaves, and resonance
- c. Relate loudness and pitch of sound waves to amplitude and frequency
- d. Define echo and describe how echo is formed

## 6. Electrostatics, Magnetism, and Electricity

### 6.1 Electromagnetic Spectrum

- a. Describe the main features of electromagnetic waves
- b. Describe typical properties and uses of radiation across the electromagnetic spectrum

### 6.2 Magnetism

- a. Describe the phenomenon of magnetism
- b. Define laws of magnetism (Lenz's and Faraday's) and use them to solve problems
- c. Define and calculate flux (specifically magnetic flux)

### 6.3 Electricity

- a. Define electric capacitance
- b. Describe the properties of the electric current
- c. Define electromagnetic induction
- d. Apply Ohm's Law to solve problems

## 7. Nuclear physics and Radiation

- a. Describe scattering of particles
- b. Provide an overview of Rutherford-Bohr atom
- c. Describe wave properties of particles
- d. Identify  $\alpha$ -,  $\beta$ -, and  $\gamma$ -emissions by recalling: their nature, their relative ionizing effects, and their relative penetrating abilities
- e. Define radioactive decay and apply the concept of half-life in simple calculations

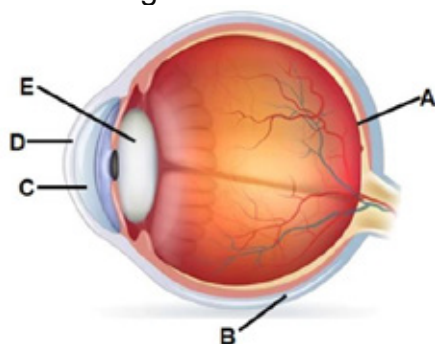
## Reference Books

The material covered in the syllabus for the MBBS entrance examination is pitched at the level of, and has been adapted from, the International General Certificate of Secondary Education (IGCSE) or similar. You could read about the content in the following reference books or others at a similar educational level.

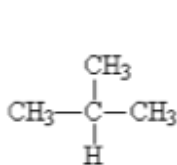
- International GCSE Chemistry. (Pearson Edexcel, Cambridge, Oxford or other text at a similar educational level)
- International GCSE Physics (Pearson Edexcel, Cambridge, Oxford or other text at a similar educational level)
- International GCSE Biology (Pearson Edexcel, Cambridge, Oxford or other text at a similar educational level)
- International GCSE -Mathematics (Pearson Edexcel, Cambridge, Oxford or other text at a similar educational level)

## Sample Questions

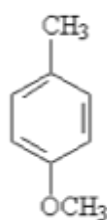
1. Which of the labelled structures is responsible for detecting light and turning it into an electrical signal?



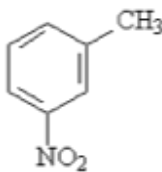
- a. A  
b. B  
c. C  
d. D  
e. E
2. Which of the following structural features will propel the spermatozoon forward?  
a. Microvilli  
b. Cilia  
c. Stereocilia  
d. Flagella
3. How many grams of sodium chloride are there in 0.9% saline?  
a. 0.09 g per 100 ml  
b. 0.09 g per litre  
c. 9 g per 100 ml  
d. 9 g per litre
4. Which of the following molecular formulae represents ammonia?  
a.  $\text{NH}_3$   
b.  $\text{N}_3\text{H}$   
c.  $\text{NH}_4$   
d.  $\text{NH}$
5. Which of the following compounds has the lowest pKa?



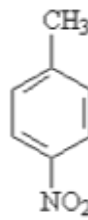
I



II



III



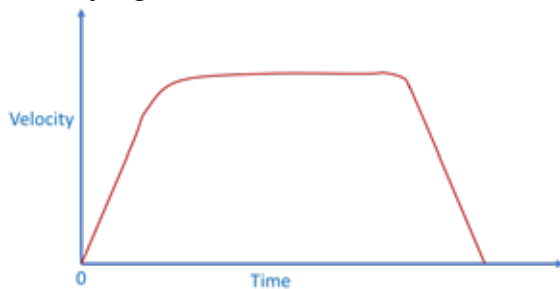
IV



V

- a. I  
b. II  
c. III  
d. IV  
e. V

6. The amino acid tyrosine contains a phenolic R-group and has pKa values of 2.2, 9.0, and 10.2. A sample of tyrosine is titrated from pH = 1.0 to pH = 14.0 with NaOH. At which of the following pH values will tyrosine exist in a zwitterionic state?
- 5.0
  - 5.6
  - 9.0
  - 10.0
7. A patient is administered an intravenous drug containing radioactive technetium 99m with an activity of 4MBq. 12 hours later, the patient is measured to have an activity of 1 MBq. What is the best estimate of the half-life (in hours) of technetium 99m?
- 1
  - 4
  - 6
  - 12
8. A wheelchair is parked at the top of a long slope. Unfortunately, the brake becomes loose and it rolls down the slope before being caught by a passer-by. The image shows the velocity against time of the wheelchair:



Which of the following options best represents the constant velocity?

- The area under the line
  - The horizontal part of the line
  - The down-sloping line at the end
  - The up-sloping line at the start
9. What is 3400 square centimetres converted to square metres (m<sup>2</sup>)?
- 0.0034 m<sup>2</sup>
  - 0.34 m<sup>2</sup>
  - 3.4 m<sup>2</sup>
  - 34 m<sup>2</sup>
10. A group of medical students have taken their Surgery exam paper. The following scores were recorded:

| Student Name | Score |
|--------------|-------|
| Mariam       | 96%   |
| John         | 74%   |
| Reem         | 68%   |
| Farah        | 60%   |
| Mohammed     | 52%   |

Which of the following best represents the mean score of this group of students?

- 70%
- 68%
- 75%
- 72%

## Sample Question Answers

1. a
2. d
3. d
4. a
5. b
6. c
7. c
8. b
9. b
10. a