

**Forms and Scope of Questions for  
Japanese University Examination**

**Japan China Asia Educational Medical Cultural Exchange Association**

**JCEMCE**  
**Forms and Scope of Questions for**  
**Japanese University Examination**

"Japanese University Examination" is organized and implemented by JCEMCE. International students who wish to study in Japanese universities (undergraduate program) are required to take the Tests. The forms and scope of questions for the Tests are described in this document.

Subjects of examination

Applicants who will take the "Japanese University Examination" may choose the subjects of examination according to the requirements of the departments or colleges that they want to apply for.

Students intending to apply for colleges of liberal arts are required to take the tests of language (English) and mathematics (for liberal arts).

Students intending to apply for colleges of science are required to take the tests of language (English), mathematics (for science) and science (either physics or chemistry or biology).

Although most applicants may choose the subjects of examination as they wish, most departments or colleges of universities prescribe the compulsory subjects. If the applicants hope to enroll in such department or colleges, they must take the tests of compulsory subjects after referring to the test syllabus.

Note: For departments or colleges of universities prescribing the compulsory subjects, refer to Official website

This document is prepared on September 1, 2016.

## **Regulations on "English" Examination in Japanese University Examination**

### 1) Purpose of examination

"English" examination in Japanese University Examination is provided for the purpose of evaluating whether the international students who want to study in Japanese Universities (undergraduate program) can use the English language required for participating in the full-English teaching activities and carrying out research activities in English.

### 2) Examination sections

The examination of "English" subject includes such sections as Listening, Grammar & Vocabulary, and Reading Comprehension in order to measure applicants' English proficiency in various aspects. Given that international students will study with Japanese students in the universities, the conventional forms of questions in the university entrance exams of Japan are adopted to compare the English proficiency of international students with that of Japanese students.

### 3) Forms of questions

The questions in Japanese University Examination for enrollment in April, 2018 are given in the form of gap-filling.

□ The difficulty of English examination is equivalent to university entrance exams implemented in Japan, for instance, "National Common College Entrance Examination", "Secondary Examination of National Public Universities" and "Entrance Examination of Private universities". Different forms of questions vary in terms of level of difficulty, which is designed to evaluate the applicants' abilities ranging from basic skills to application competence in an all-round way.

### 4) Summary of all sections

#### 1. Listening

Questions in Listening section are set by playing the recording of English conversations and English comments for the purpose of evaluating the applicants' ability to understand the given information and give the right answers to the questions according to their understanding.

#### II. Grammar & vocabulary

In Grammar & vocabulary sections, there are mainly cloze test and sequencing task that are designed to measure whether the applicants master the basic grammar and vocabulary for English learning.

### III. Reading Comprehension

Reading Comprehension section contains English passages in various types of literature involving many society fields, such as comment, essay and conversation. Applicants are not only required to comprehend individual sentences, but required to have an overall grasp of the whole passage. It is designed to measure the applicants' comprehension ability from various aspects.

## Regulation on "Mathematics" Examination in Japanese University Examination

### 1) Purpose of examination

"Mathematics" examination in Japanese University Examination is provided to evaluate whether the international students who want to study in Japanese Universities (undergraduate program) have the basic mathematical ability required for studying in Japanese universities.

### 2) Examination sections

Mathematics examination is divided into examination for liberal arts specialties and examination for science specialties. The applicants may choose the appropriate examination according to the universities they apply for and specialties they choose for taking the Japanese University Examination.

Note: The symbols for giving and solving questions should be the same as those adopted in standard textbooks used in Japanese institutions of higher education.

### 3) Forms of questions

The questions in Japanese University Examination for enrollment in April, 2018 are given in the form of gap-filling.

The difficulty of Mathematics examination is equivalent to university entrance exams implemented in Japan, for instance, "National Common College Entrance Examination", "Secondary Examination of National Public Universities" and "Entrance Examination of Private universities". Different forms of questions vary in terms of level of difficulty, which is designed to evaluate the applicants' abilities ranging from basic skills to application competence in an all-round way.

### 4) Scope of questions

The scope of questions is as follows:

The scope of questions in mathematics examination for liberal arts specialties covers "Mathematics I", "Mathematics A", "Mathematics II and "Mathematics B". The questions in mathematics examination for science specialties cover all items listed below, but not including the nature of figures in Mathematics A, differentiation and integration in Mathematics II, vector in Mathematics B, differentiation and integration in Mathematics III.

The elementary school and middle school mathematics will be included as they have been learnt.

#### Mathematics I

##### (1) Number and equation

Number and set

- Real number
- Set
- Equation
  - Expansion and factorization
  - Linear inequalities

(2) Geometric figures and measurement

- Trigonometric ratio
  - Trigonometric ratio of acute angle
  - Trigonometric ratio of obtuse angle
  - Law of Sines
  - Law of Cosines
- Measurement of geometric figures

(3) Quadratic function

- Quadratic functions and images
- Change of values in quadratic functions
  - Maximum and minimum values of quadratic functions
  - Quadratic equations and quadratic inequalities

Mathematics A

(1) Random number and probability

- Random number
  - Counting principle
  - Permutation and combination
- Probability
  - Probability and basic rules
  - Independent trials and probability
  - Trial and error

(2) Integer

- Divisor and multiple
- N scale, fraction and decimal

Mathematics II

(1) Various equations

- Equations and proving
  - Identical equations
  - Proving of equalities and inequalities

- Higher order equations
  - Negative and quadratic equations
  - Factor theorem and high order equations
- (2) Figures and equations
  - Points and lines
  - Circles
- (3) Exponential functions and logarithmic functions
  - Exponential functions
    - Extension of exponents
    - Exponential functions and their images
  - Logarithmic functions
    - Logarithms
    - Logarithmic functions and their images
- (4) Trigonometric functions
  - Extension of angles
  - Trigonometric functions
    - Trigonometric functions and their images
    - Basic nature of trigonometric functions
  - Addition theorem of trigonometric functions
    - Addition theorem
    - Double angle formula
    - Compound formula

## Mathematics B

### (1) Progression

- Progression and sum
  - Arithmetic progression and geometric progression

## Mathematics III

### (1) Curves in the plane and complex plane

- Curves in the plane and complex plane
  - Representation of rectangular coordinates
  - Parametric representation
  - Representation of polar coordinates

### (2) Complex plane

- Geometrical representation of complex plane

- De Moivre's theorem

### (3) Limit

#### ① Sequences and their limits

- Limits of sequences, sum of infinite series

## Regulations on "Science" Examination in Japanese University Examination

### 1) Purpose of examination

"Science" examination in Japanese University Examination is provided to evaluate whether the international students who want to study in Japanese Universities (undergraduate program) have the fundamental knowledge required for studying science subjects in Japanese universities.

### 2) Examination sections

"Science" examination targets students who wish to enroll in science colleges and universities. It includes three subjects, namely physics, chemistry, biology and the applicants may choose to take the examination of one subject.

※ Some universities prescribe the compulsory subjects. Therefore, the applicants should acquaint themselves with the admission requirements of the colleges or universities they apply for and choose the subject of examination according to such requirements.

Note: The symbols for giving and solving questions should be the same as those adopted in standard textbooks used in Japanese institutions of higher education.

### 3) Forms of questions

The questions in Japanese University Examination for enrollment in April, 2018 are given in the form of gap-filling.

※ The difficulty of Science examination is equivalent to university entrance exams implemented in Japan, for instance, "National Common College Entrance Examination", "Secondary Examination of National Public Universities" and "Entrance Examination of Private universities". Different forms of questions vary in terms of level of difficulty, which is designed to evaluate the applicants' abilities ranging from basic skills to application competence in an all-round way.

### 4) Scope of questions

Science covers three subjects, namely physics, chemistry, biology. The scopes of questions of each subject are listed below.

※ The elementary school and middle school science will be included as they have been learnt.

#### ○ Scope of questions for physics examination

##### I. Mechanics

##### 1. Motions and forces

(1) Forms of motion: position, displacement, velocity, acceleration, relative motion, fall motion, horizontal motion, parabolic movement

(2) Various forces: force, gravity, friction, resistance, tension, elasticity, force exerted by a liquid or gas on an object

(3) Interaction of forces: composition and decomposition of forces, interaction of forces

(4) Interaction of forces acting on a rigid body: force torque, resultant force, couple, balance of a rigid body and center of gravity

(5) Laws of motion: Newton's three laws of motion, unit of force, equation of motion, system of units and dimensions

(6) Motions affected by friction and air resistance: static friction force, kinetic friction force, air resistance and terminal velocity

## 2. Energy and momentum

(1) Work and kinetic energy: principle of work, power and kinetic energy

(2) Potential energy: gravitational potential energy and elastic potential energy

(3) Conservation of mechanical energy

(4) Collision: reflection coefficient (coefficient of restitution), elastic collision, inelastic collision

## 3. Various forces and motions

(1) Uniform circular motion: velocity and angular velocity, cycle and revolution, acceleration and centripetal force, centripetal force of non-uniform circular motion

(2) Inertia force: inertia force and centrifugal force

(3) Simple harmonic motion: displacement, velocity, acceleration, restoring force, amplitude, cycle, frequency, phase, angular frequency, elastic pendulum, simple pendulum, energy of simple harmonic motion

(4) Universal gravitation: planetary motion (Kepler's laws), universal gravitation, gravity, gravitational potential energy, conservation of mechanical energy

## II. Thermology

### 1. Heat and temperature

(1) Heat and temperature: thermal motion, thermal balance, temperature, absolute temperature, heat quantity, thermal capacity, specific heat and conservation of heat

(2) States of matter: three states, melting point, boiling point, heat of solution, heat of vaporization, latent heat and thermal expansion

(3) Heat and work: heat and work, internal energy, first law of thermodynamics, irreversible

change, heat engine, thermal efficiency and second law of thermodynamics

## 2. Properties of gases

(1) Equation-of-state of an ideal gas: Boyle–Mariotte law, Charles's law, experimental laws of gas and equation-of-state of an ideal gas

(2) Gas molecular movement: gas molecular motion and pressure and absolute temperature, internal energy of a gas, monatomic molecule and diatomic molecule

(3) Change of gas state: isochoric change, isobaric change, isothermal change, thermal insulation change and mole specific heat

## III. Wave

### 1. Wave

(1) Propagation mode and forms of wave: waveform, amplitude, cycle, frequency, wavelength, wave velocity, sine wave, phase and wave energy

(2) Superposition principle and Huygens principle: superposition principle, interference, stationary wave (standing wave), Huygens principle, law of reflection, law of refraction and diffraction

### 2. Sound

(1) Nature and propagation mode of sound: speed of sound, reflection, refraction, diffraction and interference of sound, beat frequency

### 3. Light

(1) Nature of light: visible light, white light, monochromatic light, light and color, spectrum, dispersion and polarized light

(2) Propagation mode of light: speed of light, reflection and refraction of light, total reflection, scattering of light, lens and spherical mirror

(3) Diffraction and interference of light: diffraction

## IV. Electricity and Magnetism

### 1. Electric field

(1) Electrostatic force: electrification of an object, charge, law of conservation of charge and Coulomb's law

(2) Electric field: electric field, electric field around the electric charge, overlapping of electric fields and electric field line

(3) Electrical potential: energy of position, electric potential and electric potential difference, electric potential around the point charge and equipotential plane

(4) Objects in the electric field: conductors in the electric field, electrostatic induction, electrostatic shielding, grounding, insulators in the electric field and dielectric polarization

## 2. Current

- (1) Current: current, voltage, Ohm's law, resistance and resistivity, joule heat, electric power and energy of position
- (2) DC circuit: resistors in series and in parallel, ammeter, voltmeter, Kirchhoff's law, temperature change of resistivity, determination of resistance, electromotive force and internal resistance of battery and circuit containing a capacitor
- (3) Semiconductor: N-type semiconductor, P-type semiconductor, PN junction and diode

## 3. Current and magnetic field

- (1) Magnetic field: magnet, magnetic pole, magnetic force, quantity of magnetism, magnetic field, magnetic induction line, magnetization, magnetic body, magnetic induction intensity and magnetic flux
- (2) Magnetic field generated by current: magnetic field generated by energized straight wire, magnetic field produced by circular current and magnetic field produced by energized coil
- (3) Current carrying capacity in magnetic field: carrying capacity of straight line current magnetic field, interaction force of co-current
- (4) Lorentz force: Lorentz force, motion of charged particles in magnetic field and Hall effect

## 4. Electromagnetic induction and electromagnetic wave

- (1) Law of electromagnetic induction: electromagnetic induction, Lenz's law, Faraday's law of electromagnetic induction, induced electromotive force produced when the conductor passes through the magnetic field horizontally, Lorentz force and the induced electromotive force, eddy current
- (2) Self-induction and mutual induction: self-induction, self-inductance, energy stored in the coil, mutual induction, mutual inductance and transformer
- (3) Alternating current (AC): occurrence of AC (AC voltage, AC current, frequency, phase and angular frequency), AC flowing through the resistor and effective value
- (4) AC circuit: coil reactance and phase difference, condenser reactance and phase difference, power consumption, impedance of AC circuit, resonant circuit and oscillating circuit
- (5) Electromagnetic wave: electromagnetic wave, occurrence of electromagnetic wave, nature of electromagnetic wave and type of electromagnetic wave

## V. Atom

### 1. Electron and photon

- (1) Electron: discharge, cathode rays, electron, specific charge and elementary charge
- (2) Corpuscular property and volatility: photoelectric effect, photon, X-ray, Compton effect, Bragg reflection, matter wave and interference and diffraction of electron beam

## 2. Atom and nucleus

- (1) Structure of atom: nucleus, spectrum of hydrogen atom, Bohr atom model and energy level
- (2) Nucleus: structure of nucleus, isotope, atomic mass unit, atomic weight, disintegration of nucleus, radioactive rays, radiant energy, half-life, nuclear reaction and nuclear energy
- (3) Elementary particle: elementary particle and four fundamental forces

## Scope of question for chemistry examination

### I. Composition of Substance

#### 1. Exploration of substance

- (1) Pure substance and mixture: element, allotrope, compound, mixture, separation of mixture and purification
- (2) State of substance: three states (gas, liquid and solid) and change of state

#### 2. Particles making up substances

- (1) Atomic structure: electron, proton, neutron, mass number and isotope
- (1) Configuration of electron: electron shell, properties of atom, periodic law, periodic table and valence electron

#### 3. Substances and chemical combination

- (1) Ionic bond: ionic bond, ionic crystal, ionization energy and electron affinity
- (2) Metallic bond: metallic bond, free electron, metallic crystal, ductility and toughness
- (3) Covalent bond: covalent bond, coordinate bond, covalent crystal, molecular crystal, bond polarity and electronegativity
- (4) Intermolecular force: Van Der Waals force and hydrogen bond
- (5) Chemical bonding and properties of substance: melting point, boiling point, electric conduction, heat conduction and solubility

#### 4. Quantification of substance and chemical formula

- (1) Amount of substance, etc: atomic weight, molecular weight, formula weight, amount, molar concentration, mass percent concentration and molality
- (2) Chemical formula: molecular formula, ionic formula, electronic formula, structural formula and constitutional formula (empirical formula)

### II. State and Change of Substance

#### 1. Change of substance

(1) Chemical reaction formula: representation of chemical reaction formula and relationship among quantities in chemical reaction

(2) Acid and alkali: definitions of acid and alkali and strong and weak acid and alkali, hydrogen ion concentration, PH value, neutralization reaction, neutralization titration and salt

(3) Oxidation and reduction: definitions of oxidation and reduction, oxidation value, ionization tendency of metal, oxidant and reducing agent

## 2. State and balance of substance

(1) State change: thermal motion of molecules and three states of substance, energy distribution of gas molecules, absolute temperature, boiling point, melting point, heat of fusion and vaporization heat

## 3. Change and balance of substance

(1) Chemical reaction and energy: chemical reaction and heat and light, thermochemical equation, reaction heat, bond energy and Hess's law

(2) Reaction rate and chemical equilibrium: reaction rate and rate constant, reaction rate and concentration, temperature, catalyst, activation energy, reversible reaction, chemical equilibrium, shift of chemical equilibrium, equilibrium constant and Le Chatelier's principle

## III. Inorganic chemistry

(1) Typical elements (main-group elements): properties, reactions and application of representative element monomers and compounds of each group

Group 1: hydrogen, lithium, sodium and potassium

Group 2: magnesium, calcium and barium

Group 12: zinc and mercury

Group 13: aluminum

Group 14: carbon, silicon, tin, and lead

Group 15: nitrogen and phosphorus

Group 16: oxygen and sulfur

Group 17: fluorine, chlorine, bromine and iodine

Group 18: helium, neon and argon

(2) Transition elements: properties, reactions and application of chromium, manganese, iron, copper, silver and their compounds

(3) Industrial preparation of inorganic substances: aluminum, silicon, iron, copper, sodium hydroxide, ammonia and sulfuric acid

#### (4) Separation and resolution of metal ions

### IV. Organic chemistry

#### 1. Properties and reactions of organic compounds

(1) Hydrocarbon: composition, properties and reactions of such representative compounds as alkane, olefin and alkyne; composition and use of petroleum

Constitutional isomer and stereoisomer (geometric isomer, optical isomer (mirror image isomer))

(2) Compounds having functional groups: composition, properties and reactions of such representative compounds as ethanol, ether, carbonyl compound, carboxylic acid and ester; grease, soap, etc.

(3) Aromatic compound: composition, properties and reactions of such representative compounds as aromatic hydrocarbon, phenols and aromatic carboxylic acid and aromatic amine.

#### 2. Organic compounds and human life

(1) In addition to above substances, monosaccharides, disaccharides, amino acids and other organic compounds that are widely used in human life,

(For example) Glucose, fructose, maltose, sucrose, glycine and alanine

(2) Polymeric compound

i. Synthetic polymeric compound: composition, properties and synthesis of typical synthetic fiber and plastic

(For example) Nylon, polyethylene, polypropylene, polyvinyl chloride, polyethylene terephthalate, phenol resin and uric acid resin

ii. Natural polymeric compound: composition and properties of protein, starch, cellulose, natural rubber, etc; composition of DNA and other nucleic acids

iii. The application and recycling of polymeric compounds widely used in human life (such as SAP, conductive polymer and synthetic rubber)

### Scope of questions for biology examination

#### I. Biological Phenomena and Matter

(1) Living matter and cell: organelle, prokaryotic cell and eukaryotic cell, cytoskeleton

(2) Biological phenomena and protein: structure and function of the protein, for example, enzyme

#### 2. Metabolism

(1) Vital activity and energy

ATP and its role

(2) Respiratory: (for example) glycolysis system, citric acid cycle, electron transfer system,

fermentation and glycolysis

(3) Photosynthesis: (for example) photochemical system I, photochemical system II, Calvin cycle and electron transfer system

(4) Photosynthesis and chemical synthesis of bacteria

(5) Nitrogen assimilation

### 3. Genetic information and its expression

(1) Genetic information and DNA, double helix of DNA

Gene, chromosome and chromosome complement

(2) Distribution of genetic information: distribution of genetic information based on somatic cell division, cell cycle and DNA replication, DNA replication mechanism

(3) Expression of genetic information

Genetic information expression mechanism: (for example) transcription, translation and combination with RNA; change of genetic information: (for example) gene mutation

(4) Regulation of gene expression

Regulation of transcriptional level, selective expression of gene, cell differentiation and expression regulation

(5) Biotechnology: (for example) genetic recombination and gene delivery

## II. Maintenance of intracorporal environment

### 1. Intracorporal environment

(1) Circulation system of body fluid

(2) Composition and concentration regulation of body fluid

(3) Blood coagulation mechanism

### 2. Intracorporal environment maintenance mechanism

(1) Regulation of autonomic nerve and hormone: (for example) regulation of blood sugar concentration

### 3. Immunization

(1) Cells that work in immunization

(2) Mechanism of immunization

## III. Biological responses to environment

### 1. Reactions and actions of animals

(1) Reception of and reaction to stimulation: receptor and its function, effector and its function, nervous system and its function

(2) Actions of animals

### 2. Plant responses to environment

(1) Effect of phytohormone: (for example) effect of auxin and effect of gibberellins

(2) Effect of plant photoreceptor: (for example) effect of phytochrome

#### IV. Ecology and Environment

##### 1. Population and biocoenosis

(1) Population: population and its constitution, internal interaction within a population, interaction between populations

(2) Biocoenosis: biocenosis and its constitution

##### 2. Ecosystem

(1) Matter production and cycle of matter in ecosystem

(For example) Food chain and trophic level, carbon cycle and energy flow, nitrogen cycle

(2) Ecosystem and biodiversity: genetic diversity, diversity of species, diversity of ecosystems, balance and maintenance of ecosystems

(3) Diversity and distribution of vegetation: (for example) migration of vegetation

(4) Climate and biocoenosis

#### V. Biological Evolution and System

##### 1. Mechanism of biological evolution

(1) Origin of life and biological changes: birth of life, biological evolution, and evolution of human beings

(2) Evolutionary mechanism: variation between individuals (mutation), change and mechanism of genetic gene frequency, molecular evolution and neutral evolution, species differentiation and coevolution

##### 2. Biosystem

(1) Classification of biosystem: (for example) DNA base sequence

(2) High-order group and system