**Appendix 3**

**Outline of Sun Yat-sen University’s 2019 Self-funded Undergraduate Enrollment Examination**

**Chinese**

1. Scope of the examination

The scope of the examination is on the basis of Chinese Proficiency Test (HSK) level V. It mainly tests the comprehensive abilities of using Chinese, and the reading and writing skills of contemporary Chinese language.

1. Examination format and structure
2. Format

It is a closed-book and written examination. It is not allowed to bring any reference sheet. The maximum score is 100 and the duration of the examination is 90 minutes.

1. The examination contains three sections: application of Chinese (with multiple choice), reading comprehension (with multiple choice) and writing.

**English**

1. Contents and requirements of the examination
	* 1. Knowledge of English

Examinees should have good command of phonology, grammar, the perspective of functional-notional such as social communications, attitudes, emotions, time, space, etc., topics such as personal information, school life, emotions, etc., and vocabulary.

* + 1. Use of English
1. Reading

Examinees should be able to read brief articles, announcements, statements, advertisements, etc., extracted from books, newspapers and magazines. Examinees should also be able to obtain major information from those articles. Moreover, examinees should

1. Understand the topics, purport and main ideas of articles,
2. Understand specific information in articles,
3. Be able to infer the meaning of words from context,
4. Make simple judgment and inference,
5. Understand the major structure of the articles,
6. Understand the intentions, standpoints and attitudes of authors.
7. Writing

Examinees should be able to express in written language according to hints and requirements. Examinees should

1. Express themselves clearly, and coherently.
2. Be able to use their own knowledge of English.
3. Examination format and structure
4. Format

It is a closed-book and written examination. It is not allowed to bring any reference sheet. The maximum score is 100 and the duration of the examination is 90 minutes.

1. The examination contains five sections: application of English (with multiple choice), reading comprehension (with multiple choice), cloze tests (with multiple choice), cloze tests about grammar and writing.

**Mathematics**

1. Scope and requirements of the examination

1. Set theory
	1. Definition of sets. Describing sets
		1. Understand the definition and implication of a set, and the relation between a set and its elements.
		2. Be able to describe specific problems in natural language, in graphs, and in the way using set theory (enumerative and descriptive methods)
	2. Basic relation between sets.
		1. Understand inclusion and equality of sets. Be able to identify the subsets of a given set.
		2. Understand the definition of universal sets and empty sets circumstantially.
	3. Basic operations
		1. Understand the definition of union and intersection of sets. Be able to calculate the union and intersection of two given sets.
		2. Understand the complement of sets. Be able to calculate the complement of a given set.
		3. Be able to use Venn diagrams to describe the relation between sets and operations of sets.
2. Functions, and elementary functions I (Exponential functions, Logarithm functions, Power functions)
	1. Functions
		1. Know the definition of mapping and a function. Be able to calculate the domain and codomain (range) of some elementary functions.
		2. Know how to describe functions, analytically or using graphs and tabulation.
		3. Piecewise functions. Be able to use it in some simple cases.
		4. Monotonicity, maximum and minimum of functions, and their geometric significance. Even and odd functions.
		5. Be able to use graphs to understand a function and its properties.
	2. Exponential functions
		1. Know the practical background of exponential functions.
		2. Rational and real exponents. Operational rules of exponents.
		3. The definition and basic properties of exponential functions, e.g., monotonicity and zero exponent.
	3. Logarithm functions
		1. Know the definition and operational rules of Logarithms. Understand how to convert logarithms to arbitrary base to logarithms to natural base using change-of-base formula. Understand the advantage of logarithms in simplification of computing.
		2. The definition and basic properties of logarithm functions, e.g., monotonicity and their special point.
		3. The relationship between logarithm functions and exponential functions.
	4. Power functions
		1. Know the definition of power functions.
		2. Understand the properties of $y=x, y=x^{2}$ by their graphs.
	5. Functions and equations
		1. Determine the existence of root and the number of roots of quadratic equations with one variable using their graphs, thus understanding the relationship between quadratic equations and null points of quadratic functions.
3. Solid (or 3-dimensional) geometry
	1. Solid figures
		1. Know the structure of a cylinder, cone, frustrated cone and ball, and their simple combination. Be able to use their feature to describe the structure of objects in real life.
		2. Be able to draw frontal plane, profile plane and top view of a simple object (such as a cuboid, ball, cylinder, cone and triangular prism). Be able to determine the three-dimensional model of an object given the frontal plane, profile plane and top view above. Be able to use oblique projection with an angle of 45° and a ratio of ½ to produce a two-dimensional image of a given three-dimensional object.
		3. Be able to draw frontal plane, profile plane and top view using parallel projection and central projection.
		4. Be able to draw projection sketch of some constructions (exact size and lines are not strictly required).
		5. Know how to calculate the surface area and volume of a ball, triangular prism, pyramid and frustrated cone.
	2. Point, straight line, surface and their positional relation
		1. Know the definition of three-dimensional straight line and understand the positional relation in plane. Know the following axioms and theorem that can be used for deduction:
4. Axioms 1. If two points of a line lie in a plane, then every point of the line lies in the same plane.
5. Axioms 2. For every three points that do not lie in the same line, there exists only one plane that contains them all.
6. Axioms 3. If two planes have a point in common, then they have and only have a line in common passing through the point.
7. Axioms 4. Two lines parallel to the same line, are parallel.
8. Theorem. If two rays of an angle are parallel to those of the other angle, then two angles are congruent or complementary.
	* 1. Understand the properties of parallelism and perpendicularity of lines and planes in three-dimensional space. Know how to determine whether two given lines or planes are parallel or perpendicular.

Understand the followings theorem that can be used to determine parallelism and perpendicularity:

1. If a line A out of a plane is parallel to a line B inside the plane, then line A is parallel to the plane.
2. If two intersecting line in a plane A are parallel to a plane B, then plane A is parallel to plane B.
3. If a line is perpendicular to each of two intersecting lines at their point of intersection, it is also perpendicular to the plane in which they lie.
4. If a line is perpendicular to a plane, then every plane in which the line lies is perpendicular to the plane.

Understand the follow properties:

1. If a line A is parallel to a plane B, then line A is parallel to every intersecting line of plane B and a plane in which line A lies.
2. If two parallel planes intersect with the third plane, then two intersecting lines are parallel.
3. Two lines perpendicular to a plane are parallel.
4. If two planes are perpendicular, and a line in one of them are perpendicular to the intersecting line, then the line is perpendicular to the other plane.
	* 1. Be able to use the foresaid axioms and theorems and some given or already proved conclusions to prove some simple propositions concerning about positional relation in three-dimensional space.
5. Two-dimensional analytic geometry
	1. Lines and their equations
		1. Know how to describe a line in Cartesian ordinate system.
		2. Understand and know how to calculate the slope and angle of incline of a line.
		3. Know how to determine if two lines are parallel or perpendicular by their slope.
		4. Know the geometric elements to determine the position of a straight line. Know how to represent a line in equations, using slope-intercept form, point-normal form and general form.
		5. Know how to determine the coordinate of the intersection of two lines.
		6. Know how to calculate the distance between two points, the distance from a point to a line, and the distance between two parallel lines.
	2. Circles and their equations
		1. Know how to determine a circle in terms of its elements. Understand how to represent a circle using both standard and general equations of a circle.
		2. Given the equations of lines and circles, know how to determine the positional relation between the lines and circles. Given the equations of circles, know how to determine the positional relation between the circles.
		3. Be able to use the equations of lines and circles to solve some simple problems.
		4. Understand the idea to solve geometric problems using algebraic methods.
	3. Three-dimensional Cartesian coordinate system.
		1. Be able to use three-dimensional Cartesian coordinate system to represent a point.
		2. Be able to calculate the distance between two points in space.
6. Statistics
	1. Random sampling
		1. Understand the necessity and importance of random sampling.
		2. Be able to use simple random sampling to sample from population. Know about stratified sampling and systematic sampling.
	2. Use samples to estimate the properties of population
		1. Know the meaning and implication of a distribution. Be able to draw frequency distribution tables, frequency distribution histograms, frequency polygons, stem-and-leaf plots, and understand their advantages respectively.
		2. Know the meaning and implication of standard deviance of sample data. Be able to calculate standard deviance.
		3. Be able to calculate basic summary statistics, such as mean and standard deviance, of sample data, and give reasonable explanation for them.
		4. Be able to use the frequency distribution of sample to estimate the distribution of population, and use the basic summary statistics of sample to estimate the basic summary statistics of population. Understand the idea of estimating population using its samples.
		5. Be able to use random sample and the idea of estimating population using its samples to solve some simple problems.
7. Probability
	1. Events and probability
		1. Know the uncertainty of random event and stability of frequency. Understand the meaning of probability and the distinction between frequency and probability.
		2. Know the summation of probability of two exclusive events.
	2. Classical definition of probability
		1. Understand classical definition of probability and know how to calculate probability using classical definition.
		2. Be able to calculate the number of cases favorable for a given event, and the probability of the event.
	3. Random numbers and geometric probability
		1. Know the meaning of random numbers, and know how to use simulation methods to estimate probability.
		2. Know the meaning of geometric probability.
8. Elementary functions II (trigonometric functions)
	1. General angles and radians
		1. Know the definition of a general angle.
		2. Be able to convert radians to degrees and degrees to radians.
	2. Trigonometric functions
		1. Know the definitions of sine, cosine, tangent of angles with real radians.
		2. Be able to use unit circle to derive the equalities and identities of trigonometric functions, such as $\sin((x+\frac{π}{2}))=\cos(x).$ Be able to draw the graphs of sine, cosine and tangent.
		3. Understand the properties of sine and cosine within [$-\frac{π}{2},\frac{π}{2}]$, such as monotonicity, maximum, minimum, intersection to axes, and period.
		4. Understand Pythagorean identities and know how to express any trigonometric function in terms of any other.
		5. Know the physical interpretation of trigonometric functions. Understand the influence of change of coefficients on trigonometric waves, such as sinusoid.
		6. Understand that trigonometric functions are crucial for describing periodic phenomenon. Be able to use trigonometric functions to solve simple problems.
9. Plane vectors.
	1. Background and basic concepts of plane vectors
		1. Know the background of vectors.
		2. Understand the concepts of plane vectors and the implication of equality between vectors.
		3. Understand the geometric interpretation of vectors.
	2. Linear operations of vectors
		1. Be able to calculate the addition and subtraction of vectors and understand their geometric interpretation.
		2. Be able to calculate the scalar multiplication and understand its geometric interpretation. Understand the interpretation of collinearity.
		3. Know the properties and geometric interpretation of linear operations of vectors.
	3. Fundamental theorems and coordinate representation of plane vectors
		1. Understand the fundamental theorems of plane vectors and their implications.
		2. Be able to orthogonally decompose plane vectors (with coordinate representation)
		3. Be able to use coordinate to represent addition, subtraction and scalar multiplication of plane vectors.
		4. Understand how to use coordinate to represent collinearity.
	4. Dot product of plane vectors
		1. Understand the implication and physical interpretation of dot product.
		2. Understand the relation between dot product and projection.
		3. Be able to use coordinate to represent dot product.
		4. Be able to use dot product to represent the included angle of two vectors. Know how to determine if two vectors are perpendicular using dot product.
	5. Application of vectors
		1. Be able to solve some simple plane geometric problems using vectors.
		2. Be able to solve some mechanical and other practical problems using vectors.
10. Identical transformation of trigonometric functions
	1. Sum and difference identities
		1. Be able to deduce difference identities of cosine function using dot product.
		2. Be able to deduce difference identities of sine and tangent using difference identities of cosine.
		3. Be able to deduce sum identities as well as double-angle formulae of sine, cosine and tangent, using difference identities of cosine.
	2. Elementary identical transformation of trigonometric functions
		1. Be able to elementarily conduct trigonometric transformation, including deducing sum-to-product formulae, product-to-sum formulae, half-angle formulae, all of which need not memorizing.
11. Triangular problems
	1. Laws of sine and cosine
		1. Be able to use laws of sines and cosines to solve some simple measurement problems of triangular.
	2. Applications
		1. Be able to use laws of sines and cosines to solve some practical problems concerning about measurement and geometric computing.
12. Sequence
	1. The concepts and representation of a sequence
		1. Understand the concepts and several simple representation of a sequence, e.g., tabular form, graphs, the formula for the general term.
		2. Understand that number sequence is a kind of function with independent variable being positive integer.
	2. Arithmetic progression and geometric progression
		1. Understand the concepts of arithmetic progression and geometric progression.
		2. The formula for the general term of arithmetic progression and geometric progression. The formula for the n-term arithmetic series and the n-term geometric series.
		3. Be able to use arithmetic progression and geometric progression to solve practical problems.
		4. Understand the relation between linear functions and arithmetic progression, and the relation between exponential functions and geometric progression.
13. Inequalities
	1. Unequal relation
		1. Know the unequal relation in real life and the background of inequalities.
	2. Quadratic inequalities with one unknown variable
		1. Be able to extract quadratic inequalities from practical situations.
		2. Be able to understand quadratic inequalities and the relation with the corresponding quadratic functions and equations from their graphs.
		3. Be able to solve quadratic inequalities. Know how to use program chart to solve quadratic inequalities.
	3. Inequality systems with two variables and simple linear programming problems
		1. Be able to extract inequality systems with two variables from practical situations.
		2. Know the geometric interpretation of inequality systems with two variables. Be able to use region in plane to represent inequality systems with two variables.
		3. Be able to use linear programming with two variables to solve practical problems.
	4. AM-GM inequality, or inequality of arithmetic and geometric means
		1. Know the prove of AM-GM inequality.
		2. Be able to use AM-GM inequality to solve simple optimal problems (to find maximum or minimum).
14. Logic terms
	1. Statements and their relation
		1. Understand the concepts of a statement
		2. Understand a statement (if P, then Q), and its conversion, inversion, and contraposition. Be able to analyze their relation.
		3. Understand the meaning of necessary conditions, sufficient conditions and necessary and sufficient conditions.
	2. Logic symbols
		1. Logical disjunction (Or), Logical conjunction (And), and negation (Not).
	3. Universal quantification and existential quantification
		1. Understand universal quantification and existential quantification.
		2. Be able to write down the negation of a statement with quantifiers.
15. Conic sections and equations
	1. Conic sections
		1. Know the background of conic sections, and the roles that conic sections play in solving practical problems.
		2. Grasp the definition, graphs, standard equations and properties of ellipses.
		3. Understand the definition, graphs, standard equations and simple geometric properties of parabolas and hyperbolas.
		4. Understand the idea of symbolic-graphic combination in solving practical problems.
		5. Know the elementary applications of conic sections
16. Algebraic extension
	1. Complex numbers
		1. Understand the concepts of complex numbers
		2. Understand the necessary and sufficient condition of two complex numbers being equal.
		3. Know the algebraic representation of complex numbers and its geometric meaning.
	2. Operations of complex numbers
		1. Be able to calculate addition, subtraction, multiplication and division of complex numbers.
		2. Understand the geometric representation of addition and subtraction of complex numbers.

2. Examination format

1. It is a closed-book and written examination. It is not allowed to bring any reference sheet. The maximum score is 100 and the duration of the examination is 90 minutes.
2. The examination contains three sections: multiple choice questions, fill-in-the-blank questions (with results only), questions (that you should write down your explanation, deduction and results).