

Model Answers_AS-2956
B.A/ BSc. First Semester
(End Semester) Examination, 2013

ANTHROPOLOGY

Paper: Second

(Human Variation)

Time Allowed: Three hours

Maximum Marks: 30

Passing Marks: 12

SET-III

Note: Attempt questions of all **two** sections as directed. Distribution of marks is given with sections.

Section – ‘A’

1 x 10= 10

Note: Select one of the most appropriate answer from the following objective questions.

Each question carries 1 mark.

1. (i) Epicanthic fold of eye is observed among:
 - a. Australoids
 - b. Negroid
 - c. Mongoloid**
 - d. None of these.
- (ii) Which of the following is true about skin color
 - a. There are four basic skin pigments-red, black, brown and yellow
 - b. Extremely dark skin is best adapted for life in deserts
 - c. Among peoples living at middle latitudes dark pigment is produced in the skin upon exposure to sunlight
 - d. All of the above**
- (iii) The assertion that there are pure races is
 - a. True
 - b. False
 - c. Was probably true a hundred years ago but is no longer true today**
 - d. Abstract
- (iv) Monozygotic twins are
 - a. Also called identical twins
 - b. Derived from one sperm and one ovum
 - c. Always of the same sex
 - d. All of the above**
- (v) The term genotype refers to
 - a. An individual's appearance
 - b. An individual's genetic makeup**
 - c. The chemical nature of the genetic material
 - d. All of the above
- (vi) A heterozygous genotype would be written as
 - a. AA
 - b. Aa**
 - c. Aa
 - d. AA and Aa
- (vii) Mendel use which plant to explain his laws.
 - a. Pea**
 - b. Gram

- c. Mustard
 - d. Coconut
- (viii) Albinism is an example of:
- a. Autosomal dominant
 - b. Autosomal recessive**
 - c. Sex-linked recessive
 - d. Sex-linked dominant

- (ix) DNA Contains
- a. A,T,G,U
 - b. A,U,G,C
 - c. A,T,C,U
 - d. A,T,G,C**

- (x) The structural and functional unit of life is:
- a. Gene
 - b. Chromosome
 - c. Allele
 - d. Cell**

Section-‘B

4x 05=20

Note: Write long answer of the following questions. Attempt any four questions.
Each question carries 05 marks.

2. Define race. Discuss the racial classification of S.S.Sarkar on race.

Answer 2:

Definition of race

Hooton (1926) defined race as a great division of mankind, the members of which, though individually varying are characterized as a group by a certain combination of morphological and metrical features, primarily non-adaptive, which have been derived from their common decent.

Montagu (1942a) defined a race or an ethnic group as representing one of a number of populations comprising the single species *Homo sapiens*, which individually maintain their differences, physical and cultural, by means of isolating mechanisms such as geographic and social barriers.

Many anthropologists have opined that variations among populations with regard to certain physical features were marked by the people and proposed different classifications of mankind. Of these who have made noteworthy contribution of this aspect were Risley, Ruggeri, Eickstedt, Guha, Hutton, Sarkar and Majumdar. The outline of some classifications that have been reported on the composition of the Indian population is as follows:

S.S.Sarkar Classification

Sarkar classified the people of India into six racial types as follow:

1. Australoids

Morphological Features:

Skin Colour - Dark Complexion;

Hair - Dark colour and Wavy in form;

Head Form - Long (Dolichocephalic);

Eye - Dark in Colour; Nose Form - Broad;

Stature – Short height.

The Australoids are referred also as Proto - Australoid, Pre - Dravidian, Nisada and Veddid. The representatives of this group are some tribes of South India, namely - Urali, Kannikar, Malapantarram, Paniyan, Kadar etc.

2. Indo - Aryan

Morphological Features:

Skin Colour – Light;

Hair - Brownish Dark;

Head Form - Long (Dolichocephalic) and massive;

Eye Colour - Not Dark;

Stature – Tall height, the physique is most robustly built.

The Baltis is of Hindukush are the best representative of this group. They inhabit Indus Valley to Gangetic Valley of Western India and also spread to Bihar among higher caste groups.

3. Irano –Scythian

Morphological Features:

Skin Colour- Light Brown Complexion;

Head Form- Medium (Mesocephalic)

Irano-Scythian entered India from north-west and they moved southward along the Indus Valley to reach Gujarat, Maharashtra and towards, Mysore and Deccan. From western side the Irano-Scythian move towards eastern India following the rivers Narmada and Son.

4. Mundari Speakers

Morphological Features:

Skin Colour - Lighter;

Hair-Dark in Colour and

Thick Straight Hair Form;

Head Form – Long (Dolichocephalic);

Stature - Short with Robust constitution.

They are inhabitants of Chota Nagpur, Orissa Hills and Madhya Pradesh. They show some Mongoloid affinities. The people are Santhal, Juang, and Savara etc.

5. Far Eastern

Sarkar reported that some amount of Malaya Polynesian element [Darker Skin colour; Broad (brachycephalic) head, Short stature with tendency to obesity] is observed in certain populations particularly along the Tuticorin-Tinnevely coast in the extreme south and along the coast of Chittagong hill tracts.

6. Mongolian

Morphological Features:

Skin Colour- Yellowish;

Eye-Mongolian Eye fold.

They inhabit North-eastern India and Foothills of Himalaya. They can be easily distinguished from the other due to their eyes and face form

In addition to this Roy (1934 - 38), Biasutti (1959), Roginskij and Levin (1963), Büchi (1968) and Bowles (1977) have also classified the peoples of India into different racial groups taking racial elements and/or geographical areas into consideration.

3. Write short note on

- a. Racism
- b. immunological method

Answer 3a:

Racism:

The concept of race stands on human biological variations, which can be both external and internal. The external variations include skin color, hair color, hair texture, eye color, stature, body build, nose form and so on. The internal variations are concerned with the susceptibility or resistance to the diseases. At present, the Homosapiens covers a number of races which differ from one another in the relative frequency of certain inherited traits. But originally three basic racial types-

- a. Caucasoid
- b. Mongoloid and
- c. Negroid

inhabited in the earth. Gradually they migrated to different directions and got mixed with each other. The combinations of migration, interbreeding and isolation had diluted the purity of racial types and several minor races were formed. Though there were many classification of races, identification of races or finding out the number of races is quite different from racism.

The term racism is concerned with the status of the races, people of a race are considered as superior or inferior of others. According to R.F.Benedict (1940) racism is a doctrine, which says that 'one group has the stigmata of superiority and the other has those of inferiority'. Probably the idea of racism originated in 15th century when some greek scholars divided the mankind in two groups

1. Civilized
2. Barbarians

The famous Greek philosopher, Aristotle also proposed two groups-one group, who is free by nature and the other one who is not free i.e. slave. Later on, Romans announced their superiority over others. As a matter of fact, in the Middle age, different authorities had presented their hypotheses of superior races, for which the Christians, Nordics, and Aryans were thought to be superior. Thus, a concept of superiority versus inferiority was unconsciously nurtured in the mind of the people.

Neurological analysis of anatomy and physiochemical functioning of nervous system of different races have recently answered the anthropologists. Controlled psychological experimentation, with or without elimination of cultural and environmental factors suggest that the technological backwardness of some communities may not due to racial inferiority. Although I.Q. test and other aptitude tests reveal some differences in visual, motor and vocational skills but such tests could not eliminate the cultural factor i.e. many skills of intelligence and aptitude have been found to change with changes of cultural environment. All sorts of inferiority may disappear totally with environmental advantages. The technological backwardness therefore can be related to the physical and social environments or historical circumstances. Naturally the superiority and inferiority concept regarding the race is not justified. All races are equally capable of cultural development if the members can associate their innate skill with the required level of cultural experience.

Answer 3b:

Immunological Method:

In the description and interpretation of human biological variation, physical anthropologists borrow the principles of genetics which can be demonstrated through studies of organisms better adapted to experimental work than humans. With the development of the

theories of population structure, genetics made a firm foundation for the classification of human variation into clear evolutionary categories with a biological meaning. Thus the classification of human populations into physical races is derived from the knowledge of human genetics. This is expounded by the consideration of the present day frequencies of human physical characteristics as well as the role of the mechanisms like mutation, selection, genetic drift etc. Human populations are classified on the basis of the difference in the frequencies of the phenotypic and genotypic characters besides gross climatic characters.

However, the genetic aspects of antigens, antibodies and their interactions are studied under Immunological method. In this method, the genetic characters are detected by immune reactions. The understanding of immunogenetics can be best appreciated by some of the commonly used terms in immunology such as antigen, antibody, immune reaction, immunological homeostasis, autoimmunity, immunological tolerance, hybrid allotypes, allograft, isograft, transplantation, incompatibility etc.

4. Explain different racial criteria and morphological characteristics of Caucasoid, Mongoloid and Negroid race.

Answer 4:

Defintion of race

Montagu (1942a) defined a race or an ethnic group as representing one of a number of populations comprising the single species *Homo sapiens*, which individually maintain their differences, physical and cultural, by means of isolating mechanisms such as geographic and social barriers.

Diverse as they are, these definitions emphasize first an assumption of the role of geographic isolation in race formation. Second, most agree on the importance of breeding population in forming a collection of genes that sets the race apart.

Race is a classification based on traits which are

- a. hereditary
- b. traits transmitted by heredity which characterize all the members of a related group.

Racial criteria and Classification

Due to the presence of recessive genes in the human body, the externally manifested (phenotypic) characters of a person do not always tally with the genotypic characters. Hence genotypic characteristics must be chosen as racial criteria for classification. As the racial criteria depend on the age and sex of the individual, ensure that comparison is restricted to people of the same age and sex.

Criteria usually applied;

- a. Stature
- b. Configuration
- c. Body measurements
- d. Skin color
- e. Dental anomalies
- f. Blood types
- g. Characteristic diseases

Morphological characteristics of Caucasoid, Mongoloid and Negroid races

| Characters | Type(s) | Caucasoid | Mongoloid | Negroid |
|---------------------|---------------|-------------------------------------|---------------------------------|------------------------|
| Head form | | Long to broad | Broad | Long |
| Head Height | | Medium to very high | Medium | Low to medium |
| Face form | | Narrow to medium broad | Medium to very broad | Medium broad to narrow |
| Prognathism | | Absent | Rare | Marked |
| Nose | Form | Long and narrow | Medium | Broad |
| | Bridge | High | Low | Low |
| | Profile | Straight, concave or convex | Usually concave | Straight or Concave |
| Eye | Form | Occasional presence of lateral fold | Medial epicanthic fold | Vertical fold common |
| | Colour | Light blue to dark brown | Brown to black brown | Dark brown to black |
| Hair | Form (Head) | Straight to wavy | Straight | Woolly |
| | Colour | Light blue to dark brown | Dark brown | Dark brown to black |
| | Texture | Fine to medium | Coarse | Coarse |
| | Cross-section | Usually ovoid | Round | Flat oval |
| Body hair | | Moderate to heavy | Sparse | slight |
| Beard and Moustache | | Moderate to heavy | Slight to moderate | Absent to slight |
| Lips | | Thin to medium | Medium | Very thick |
| Skin colour | | Reddish white to light brown | Light yellow to yellowish brown | Brown to sooty black |
| Stature | | Medium to tall | Medium short to medium tall | Very short to tall |

5. Define genetics. Explain Mendel's law of Independent assortment with example.

Answer 5:

Definition of Genetics

Genetics, derived from the Greek word *gen* that means to become or to grow into something, is the science of inheritance. As a scientific study of the laws of inheritance, genetics brings out the similarities and differences between parents and offspring. By this, the biological characteristics are transmitted from one generation to another. The main components of inheritance are thus heredity and variation.

Genetics as a branch of biology occupies a significant place under natural sciences along with other branches such as morphology, histology, cytology, physiology, taxonomy, embryology, ecology and palaeontology. Thus special branch of science concerned with the scientific study of human heredity is known as Human Genetics.

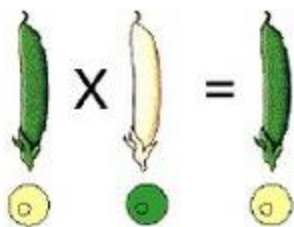
Mendel's Law of Independent Assortment

The principles that govern heredity were discovered by a monk named Gregor Mendel in the 1860's. One of these principles, now called Mendel's law of independent assortment, states that allele pairs separate independently during the formation of gametes. This means that traits are transmitted to offspring independently of one another.

Mendel formulated this principle after performing dihybrid crosses between plants that differed in two traits, such as seed color and pod color. After these plants were allowed to self-pollinate, he noticed that the same ratio of 9:3:3:1 appeared among the offspring. Mendel concluded that traits are transmitted to offspring independently.

For Example:

The image shows a true-breeding plant with the dominant traits of green pod color (GG) and yellow seed color (YY) being cross-pollinated with a true-breeding plant with yellow pod color (gg) and green seeds (yy). The resulting offspring are all heterozygous for green pod color and yellow seeds (GgYy). If the offspring are allowed to self-pollinate, a 9:3:3:1 ratio will be seen in



Independent Assortment: The traits of pod color and seed color are transmitted to the offspring independently of one another.

the next generation. About 9 plants will have green pods and yellow seeds, 3 will have green pods and green seeds, 3 will have yellow pods and yellow seeds and 1 will have a yellow pod and green seeds.

6. Write short note on

a. UNESCO statement

b. Molecular genetics

Answer 6a:

UNESCO Statement

A few anthropologists such as Ashley Montagu and biologists such as Julian Huxley began to argue that it was difficult to use zoological nomenclature for classifying humans into groups. According to them, factors such as language, religion and social institutions helped shape human beings and introduced complications not seen in the zoological world. They argued that the classification of humans into races was simply not a productive endeavour or the correct way to examine human variation. Montagu (1942-64) was probably the most vocal opponent of the use of the term race to classify humans. Following Huxley (1865), Deniker (1900), and Huxley and Huddon (1936), Montagu (1942a) adopted the term “ethnic group” as a replacement for “race”, maintaining that the latter term had lost its usefulness for describing human variability. Indeed, on July 18, 1950, following World War II, UNESCO (1956) issued a statement which included both a scientific opposition to race theories and a moral condemnation of racism. It suggested in particular to drop the term race altogether and speak of ethnic groups.

Any national or religious, geographic, linguistic and cultural groups do not necessarily coincide with the racial groups and the cultural traits of such groups have no demonstrative genetic connection with racial traits. From biological point of view, a race is a breeding population that is distinguished from other breeding populations within the species in the frequency of certain hereditary traits. The concept is thus a matter of estimating the genotype.

Nonetheless, Montagu (1942) did not deny that there were differences between populations, but noted that there were no clear boundaries in the continuous stream of human variation. He also argued that anthropologists should look to Darwinian natural selection to understand the relationships among human groups and should develop a dynamic “genetical theory of race” using such concepts as exogamy, endogamy, hybridization, mutation, selection, isolation, and random events (genetic drift). Washburn’s (1951) concept of a “new physical anthropology” was controversial but reflected the changing scientific paradigm in anthropology i.e. the shift that was occurring in racial studies and the study of human variation

As such typological studies of human variation were appearing; some anthropologists proposed that the population (breeding unit) should be the basic unit for the study of human diversity and adaptation. The idea was that each breeding population was subjected to specific environmental constraints and responded through the evolutionary mechanisms of mutation, gene flow, genetic drift, and natural selection. As these populations adapted to these particular environments, they came to manifest traits that were unique.

Anthropologically the study of race is interesting and as such these studies help in the comparison of human populations in order to trace historical relations between them. The analysis of genetic composition of various groups of mankind demonstrates the physical link between successive generations through gene transmission. The mechanics of evolution can be illuminated better when they are strengthened by the knowledge of comparative studies.

Answer 6b:

Molecular Genetics

Molecular genetics is concerned with the study of genetic material called deoxyribonucleic acid (DNA), many molecules of which lie on the chromosomes. Each of these molecules is a gene. Each of these replicates more DNA. Thus the chemical elements which make up a gene constitute the study of molecular genetics. The biochemical structure of DNA was made known to the world by the work of J.J.Watson and F.A.C.Crick.

The nucleic acid as the DNA is formed as the primary organic compound in the chromosome. The units of DNA are called nucleotides, each of which contains three different kinds of molecules,

1. Sugar,
2. A phosphate group and
3. An organic base

The molecules of sugar are called deoxyribose and of the phosphate group called phosphoric acid are identical whereas they differ in the organic bases. The organic bases are molecular compounds which contain varying amounts of carbon, hydrogen, oxygen, and nitrogen. Adenine (A), guanine (G), cytosine (C), and thymine (T) are known as bases. The first two are called purines and the latter two are pyridines.

7. Describe Hardy-Weinberg law of equilibrium?

Answer 7:

Early in the 20th century G.H. Hardy and Wilhelm Weinberg independently pointed out that under ideal conditions, it is easy to predict genotype frequencies from allele frequencies, at least for a diploid sexually reproducing species such as humans.

▪ **Hardy-Weinberg Law**

Allele and genotype frequencies remain constant from generation to generation when the population meets certain assumptions. There is a difference between how a trait is inherited and the frequency of recessive and dominant alleles in a population

Assumptions of Hardy Weinberg Law:

- The population is large enough that there are no errors in measuring allele frequencies
- All genotypes are equally able to reproduce
- Mating in the population is random
- Other factors that change allele frequency (mutation and migration) can be ignored

For a dimorphic gene (two alleles, which we will call A and a), the Hardy-Weinberg equation is based on the binomial distribution: (Mathematical formula as follows)

$$p^2 + 2pq + q^2 = 1$$

where p = frequency of A and q = frequency of a, with p + q = 1.

p^2 is the frequency of AA homozygotes

$2pq$ is the frequency of Aa heterozygotes

q^2 is the frequency of aa homozygotes

Hardy-Weinberg equation can be viewed as an extension of the Punnett square, using frequencies other than 0.5 for the gamete (allele) frequencies.

Let us assume an example of population, where the frequency of M was 0.6 and the frequency of N was 0.4.

$$p^2 = \text{freq of MM} = (0.6)^2 = 0.36$$

$$2pq = \text{freq of MN} = 2 * 0.6 * 0.4 = 0.48$$

$$q^2 = \text{freq of NN} = (0.4)^2 = 0.16$$

These Hardy-Weinberg law expected frequencies don't match the observed frequencies.

Estimating Allele Frequencies from Recessive Homozygote Frequency

- If Hardy-Weinberg equilibrium is assumed, it is possible to estimate the allele frequencies for a gene that shows complete dominance even though heterozygotes can't be distinguished from the dominant homozygotes.
- The frequency of recessive homozygotes is q^2 . Thus, the frequency of the recessive allele is the square root of this. For example, the recessive genetic disease, Phenylketonuria (PKU) has a frequency in the population of about 1 in 10,000. q^2 thus equals 0.0001 (10^{-4}). The square root of this is 0.01 (10^{-2}), which implies that the frequency of the PKU allele is 0.01 and the frequency of the normal allele is 0.99. Thus the frequency of the heterozygous genotype is $2 * 0.99 * 0.01 = 0.198$. About 2% of the population is a carrier of the Phenylketonuria (PKU) allele.

Necessary Conditions for Hardy-Weinberg Equilibrium

- The relationship between allele frequencies and genotype frequencies expressed by the H-W equation only holds if these 5 conditions are met. None of them is completely realistic, but all are met approximately in many populations.
- If a population is not in equilibrium, it takes only 1 generation of meeting these conditions to bring it into equilibrium. Once in equilibrium, a population will stay there as long as these conditions continue to be met.
 - 1. no new mutations
 - 2. no migration in or out of the population
 - 3. no selection (all genotypes have equal fitness)
 - 4. random mating
 - 5. very large population

Genetic equilibrium

- When the allele frequency for a particular gene remains constant from generation to generation
- Equilibrium in a population explains why dominant alleles do not replace recessive alleles
- In equilibrium populations, Hardy-Weinberg law can be used to measure allele and genotype frequencies from generation to generation

Using the Hardy-Weinberg Law in Human Genetics

The Hardy-Weinberg Law can be used to

- Estimate frequencies of autosomal dominant and recessive alleles in a population
- Detect when allele frequencies are shifting in a population (evolutionary change)
- Measure the frequency of heterozygous carriers of deleterious recessive alleles in a population

8. Explain the structure of DNA? Describe the sequence of base pair location?

Answer 8:

Structure of DNA

Deoxyribonucleic acid (DNA) is the genetic material which consists of many molecules that lie on the chromosomes. Each of these molecules is a gene. Each of these replicates more DNA. Thus the chemical elements which make up a gene constitute the study of molecular genetics. The biochemical structure of DNA was made known to the world by the work of J.J.Watson and F.A.C.Crick.

The nucleic acid as the DNA is formed as the primary organic compound in the chromosome. The units of DNA are called nucleotides, each of which contains three different kinds of molecules,

1. Sugar,
2. A phosphate group and
3. An organic base

The molecules of sugar are called deoxyribose and of the phosphate group called phosphoric acid are identical whereas they differ in the organic bases. The organic bases are molecular compounds which contain varying amounts of carbon, hydrogen, oxygen, and nitrogen. Adenine (A), guanine (G), cytosine (C), and thymine (T) are known as bases. The first two are called purines and the latter two are pyrimidines.

There are thousands of nucleotides linked together forming one strand or strain of a DNA molecule. Each phosphate group is linked to a sugar molecule and each organic base is linked to a sugar. Each of the nucleotides is linked to its neighbor with the strand by the phosphate group. Two complementary strands are coiled together in a helix to form a DNA molecule. A DNA molecule is a double-helix structure since it has two strands. The bases of one strand and the bases of the other strand are always linked in a specific manner. 'A' is always paired with 'T' and 'T' is always paired with 'C'.

The two DNA strands are complementary due to the fact that the sequence of nucleotide in one strand determines the sequence of nucleotides in the other. It is also called as Watson-Crick Model of the DNA as Watson and Crick were the first to discover the complementary double-helical structure of DNA. There may be one or more genes in a single DNA strand. The sequence of bases in one DNA segment differs from the other due to which one gene differs from the other. The linkage between different DNA molecules constitutes a chromosome. The DNA molecule has the capacity to replicate itself and brings about synthesis of proteins.

DNA carries on protein synthesis through a translator-activator nucleic acid called RNA or ribonucleic acid. During protein synthesis messenger RNA carries instructions from the DNA codons to ribosomes and the transfer RNA molecule is attached an amino acid to become activated. The messenger RNA becomes associated with the activated and unordered amino acids on the ribosomes which lie in specific sequence. When a protein sequence of amino acids is found and a complete functioning molecule is produced, the transfer RNA gets dropped.