

**Test Code: RHG-I (Short answer type) & RHG-II
2006
Junior Research fellowship in Human Genetics**

Syllabus

1. Cell growth, Division, Differentiation, Senescence
2. Replication, Transcription, Translation, Genetic code & protein synthesis, Enzymes, Co-enzymes, Receptor mediated cell functions, regulation of gene expression
3. Cancer genetics, etiological factors for different types of cancers
4. Population genetics, genetics of single and multi loci diseases
5. Modern methodologies in cell/tissue culture, Chromosome techniques, PCR ELISA, Immunocyto/histochemical techniques, Hybridization techniques
6. Gene therapy and modification of gene expression (anti-sense RNA, RNAi/miRNA, chromatin remodeling) transgenic and knockout mouse, tissue specific knock-out of gene
7. Cancer biology, Abnormal cell growth, Oncogenes & Tumour suppressor genes, Programmed cell death, Cell signaling, Immunomodifiers
8. Basic Statistics: Mean, Median, Mode, Standard deviation, Correlation and Regression, Simple probability calculations

Sample Questions RHG-I (Short answer types)

1. Consider an autosomal locus with three alleles A1, A2 and A3. Suppose the frequencies of the alleles in a random mating population are 0.6, 0.3 and 0.1, respectively. What is the total frequency of heterozygotes at this locus in this population?
2. What are CpG islands? What are the important roles played by CpG islands in the human genome?
3. A mutation in an essential human gene changes the 5' splice site of a large intron from GT to CC. Predict the phenotype of an individual homozygous for this mutation.
4. If you are given allele frequencies at various autosomal loci in two populations, how can you tell which of the two populations has a greater genetic diversity?
5. Digestion of a 4kb DNA molecule with KpnI yields two fragments of sizes 1kb and 3kb. Hind III digestion of the same DNA yields fragments of sizes 1.5 kb and 2.5 kb. Finally digestion with KpnI and HindIII in combination yields fragments of sizes 0.5kb, 1kb and 2.5 kb. Draw a restriction map indicating the positions of the KpnI and HindIII cleavage sites.

Sample Questions: Descriptive type (RHG-II)

1. Consider the autosomal blood-group system called MN, which is controlled by a pair of alleles (M and N). In a random mating population, what fraction of children with the MN blood group is expected to have MN mothers?
2. Transgenic and knockout mice are both used as animal models of human diseases. Explain these models and state which is better.
3. What are the processes involved in X-chromosome inactivation in mammals?
4. Discuss how programmed cell death / apoptosis participates in maintaining cellular homeostasis. Explain why DNA from apoptotic cells show up as 200bp ladder in agarose gels.
5.
 - a). The heights of each of eight athletes are measured (in feet) by the first official. The second official measures the same in inches. What is the correlation coefficient between the two sets of numbers? Justify your answer.
 - b). The regression line between a dependent and independent variable is observed to pass through the origin. Suppose that instead of the independent variable, one observes the negative of it. How will this change the regression line?