

1. The nerve growth factor (NGF) is very important to neuronal differentiation during development. Please use some of the following molecules to suggest a major signaling transduction pathway for the effect of NGF. (10%)
 (a) G-protein coupled receptors (b) Receptor tyrosine kinase TrkA (c) Grb2 (d) G protein (e) Adenyl cyclase (f) Ras-GEF (g) Ras (h) cAMP (i) Raf (j) Protein kinase A (k) MAP-kinase-kinase (l) CaM-kinase (m) MAP-kinase
2. Evidence suggests that at least 900 genes involve in the mechanisms that NGF induces neuronal differentiation. Please propose a method that can be used to find out as many of these genes. (10%)
3. Expression of eukaryotic genes can be regulated at different levels. Please give one example of the regulation. (10%)
4. The following two methods can be used to analyze the interaction between DNA and proteins. Please describe their similarities and differences. (10%)
 (a) DNase I footprinting (b) Gel electrophoresis mobility shift assay
5. Genes that code for proteins that have a unique enzymatic can be used as reporter gene. What are the differences among the following reporter genes. (20%)
 (a) Chloramphenicol acetyl transferase (b) β -galactosidase
 (c) Luciferase (d) Green fluorescent protein
6. The following techniques can be used to detect the mRNA levels in cells and tissues. Please describe their similarities and differences in terms of sensitivity, resolution, ease of quantiation, and the availability of structural information. (20%)
 (a) RNase protection assay (b) Northern blotting
 (c) Real time RT-PCR (d) *In situ* hybridization
7. The following methods can be used to analyze proteins. Please describe their differences. (20%)
 (a) SDS-PAGE
 (b) Two-dimensional gel electrophoresis
 (c) Western blotting
 (d) Immunohistochemistry