

- 1 Why is HGT (horizontal gene transfer or LGT - lateral gene transfer) so important in microbiology? (6 points)
major mechanism to exchange genetic information between phylogenetically distant microorganisms; source of genetic diversity (evolution); propagation of antibiotics resistance

- 2 Two approaches by which viruses can be purified are differential centrifugation and density gradient centrifugation. Distinguish between differential and density gradient centrifugation in terms of how they are carried out (4 points)
Serial centrifugations at different speeds vs. single centrifugation with a high speed in a tube containing density gradient

- 3 List some characteristics used in classifying viruses (5 points)
nucleic acid type; strandedness, the sense (+ or -) of ssRNA genomes, presence of envelope, symmetry of capsid, dimension of the virion and capsid

- 4 Can you think of a cloning situation where blunt-ended DNA might be more useful than DNA with sticky ends? (5 points)
no demanding restriction site (any blunt ended DNA fragment); removal of a restriction site after cloning; do not need cohesive ends of cloning vectors; randomly oriented inserts in the vector;

- 5 Initial attempts to perform PCR were carried out using the DNA polymerase from *E. coli*. What was the major difficulty? (and why?) (3 points)
thermostability; melting template & preventing non-specific binding

- 6 For what types of microorganisms is extensive gene loss common? What is most likely explanation for this phenomenon? (5 points)
parasites; dependent on hosts (losing genes sharing with host); e.g. deficient of amino acid metabolism

- 7 Describe the roles of the λ (lambda) repressor, Cro protein, RecA protein, integrase, and excisionase in lysogeny and induction (5 points)
see p.439~444

- 8 Suggest any strategy to develop an antiviral drug based on viral reproduction steps (life cycle) (Hint: What are the reaction mechanisms of viral drugs commercially available?) (6 points)
chemicals that inhibit entry step (adsorption; e.g. binding to receptors); inhibit information propagation (e.g. reverse transcriptase); inhibit packaging (e.g. protease); inhibit exit step (e.g. neuraminidase)

- 9 Why is RNA thought to be the first self-replicating biomolecules? (3 points)
RNA has dual functions of both protein and DNA (catalytic activity & information storage); RNA is the energy currency (ATP); RNA can regulate gene expression

- 10 Compare the findings of the universal phylogenetic tree and the genome fusion hypothesis (5 points)

The universal phylogenetic tree showed that all life arose from a single, common ancestor; Sharing genes among Archaea, Bacteria and Eukarya indicates a single common ancestor in the universal phylogenetic tree but, in other view, genome fusion hypothesis explains the evolution of nucleus of eukaryotic cell that might be a fusion product of two cells (Bacteria and Archaea)

11 List 7 taxonomic ranks from the highest rank (7 points)

Domain, Phylum, Class, Order, Family, Genus, Species

12 No temperate RNA phages have yet been discovered. How might this absence be explained? (5 points)

RNA should be converted to DNA (RT) to integrate into genome but no such process has discovered yet in RNA phages

13 (Homework) What are the bottlenecks in doing metagenomics? (5 points)

computational power; gap between characterized and hypothetical proteins

*Describe briefly the achievement of following scientists (2 points each)

14 David Baltimore - discovery of reverse transcriptase; viral taxonomy

15 Paul Berg - first recombinant DNA generated

16 S. Cohen & H. Boyer - use of plasmid vector for gene cloning

17 Frederick Sanger - sequencing techniques (DNA and protein)

18 Charles Chamberland - porcelain filter

19 Peyton Rous - reported Rous Sarcoma virus

20 Max Delbruck - beginning of modern bacteriophage study

21 Thomas Cech - Catalytic RNA (self-splicing RNA)

22 Carl Woese - molecular phylogeny - 16S rRNA tree

*Define or describe following terms (2 points each)

23 polyphasic taxonomy

24 anagenesis

25 punctuated equilibria

26 prophage

27 cytopathic effects

28 chronic infection

29 latent infection

30 early genes

31 late genes