

所別：環境醫學研究所

科目：分子細胞生物學



考試時間：80 分鐘

考生注意：答案必須寫在答案卷上，否則不予計分。

I. FILL-IN QUESTIONS.(6 points)

1. Arrange the following structures/chemicals in order of size from smallest to largest.

(a. codon, b. gene, c. base, d. chromosome)

2. The DNA made from an RNA is called a _____

II. MATCH THE FOLLOWING TERMS WITH THE APPROPRIATE DESCRIPTIONS (14 points)

MATCH I.

a. polytene chromosome, b. Telomere, c. Constitutive euchromatin, d. Lampbrush chromosome

3. _____ the largest chromosomes known, Contain Loops of Decondensed Chromatin

4. _____ Present at normal chromosome ends

MATCH II.

a. transversions, b. transitions, c. nonsense mutations, d. missense mutations, e. Silent mutations, f. Frameshift mutation,

5. _____ Point mutations in which a purine is replaced by a pyrimidine (or vice versa),

6. _____ Mutations which result in the formation of a stop codon

MATCH III.

PCR. You are to perform PCR on this DNA molecule. It will be your template.

5'CCTCATACTCCACGTGTGCATCGTGCAGAAAGTTCACCTTGCACCTGCATCGGCACCATACCATCATCAGTAATCGTGC 3'
3'GGAGTATGAGGTGCACACGTAGCACGCCTTCAAGTGAACGTGGACGTAGCCGTGGTAATGGTAGTAGTCATTAGCACG

7. Step #1. Choose a primer set for your PCR reaction (choose your choice).

_____ PRIMER #1. 5'CCTCATACTCCACGTGTGCA 3'

_____ PRIMER #2 5'GGTGCCGATGCAGGTGCAA 3'

_____ PRIMER #3. 5'GCACGATTACTGATGATGG 3'

_____ PRIMER #4. 5'ACCATCATCAGTAATCGTGC 3'

_____ PRIMER #5. 5'ATGCACACGTGGAGTATGAGG 3'

8. Step #2. Prepare the PCR reaction mixture (choose one).

_____ A. Mix primers, template dNTPs and reverse transcriptase.

_____ B. Mix primers, template, ATP and ligase.

_____ C. Mix primers, template, dNTPs and taq polymerase.

_____ D. Mix primers, template, ribonucleotides and SP6 polymerase.

9. Step #3. Perform the amplification. Place these in the correct order 1 through 3. Three choices are not used.

考生注意：答案必須寫在答案卷上，否則不予計分。

- ___ Lower temperature to 52°C to allow primers to anneal to template.
- ___ Lower temperature to 52°C to maximize DNA synthesis
- ___ Raise temperature to 72°C to allow primers to anneal
- ___ Raise temperature to 72°C to maximize DNA synthesis.
- ___ Raise temperature to 72°C to maximize ligation reaction.
- ___ Raise temperature to 96°C to denature all DNA molecules.

III. SINGLE CHOICE QUESTIONS(I)(40 points)

10. ___ The direction of information flow (central dogma) in the cell is: a. RNA → DNA → Protein, b. mRNA → tRNA → rRNA, c. DNA → Protein → ATP, d. DNA → RNA → Protein, e. Protein → RNA → DNA
11. ___ Which one of the following is an enzyme often used prior to protein sequencing? a. cyanogen bromide, b. trypsin, c. acetylcholine, d. mercaptoethanol
12. ___ If one strand of double stranded DNA has the following sequence of nucleotides: 5'-ATGCTAGCAG-3', the sequence of its complementary strand will be: a. 5'-CTGCAAGCAT-3', in parallel configuration, b. 3'-CTGCAAGCAT-5', in parallel configuration, c. 5'-CTGCTAGCAT-3', in antiparallel configuration, d. 3'-CTGCTAGCAT-5', in antiparallel configuration, e. 3'-CUGCUAGCAU-5', in antiparallel configuration
13. ___ How many genes are there in a human cell? a. 23, b. 46, c. about 10,000, d. about 100,000, e. about 3 billion
14. ___ A change in which of the following would result in a mutation? a. order of bases in DNA, b. gene, c. chromosome, d. all of the above, e. can't tell from this information.
15. ___ Which of the following is not a part of the nucleosome core particle? a. histone H1, b. histone H2A, c. histone H2B, d. histone H3, e. histone H4
16. ___ It is possible to insert the DNA from one virus (virus A) into the protein coat of a different virus (virus B). If such a composite virus infected a cell, the resultant viruses produced in the host cell would have DNA like virus ___ and protein like ___: a. A;B, b. A:A, c. B;B, d. B:A
17. ___ In DNA, the designations 3' and 5' refer to the: a. bonding between purines and deoxyribose and between pyrimidines and deoxyribose, b. carbon or nitrogen atoms on the rings of purine or pyrimidine bases, c. cross-linking of the third and fifth carbon atoms of deoxyribose, d. bonds formed between phosphate groups and carbon atoms of deoxyribose, e. bonds that form between adenine and thymine and between guanine and cytosine.
18. ___ In eukaryotes, on a given chromosome replication occurs: a. bidirectionally at multiple origins, b. bidirectionally at a single origin, c. unidirectionally at multiple origins, d. unidirectionally at a single origin.
19. ___ Which of the following is NOT true about mitochondrial DNA: a. responsible for maternal effects, b. circular DNA, c. maternally inherited, d. no DNA repair mechanism, e. functions in cellular energetics.
20. ___ All of the following are true regarding the nuclear membrane, EXCEPT: a. Double membrane, b. Continuous with rough endoplasmic reticulum, c. on outer surface, d. Has 'pores', e.

考生注意：答案必須寫在答案卷上，否則不予計分。

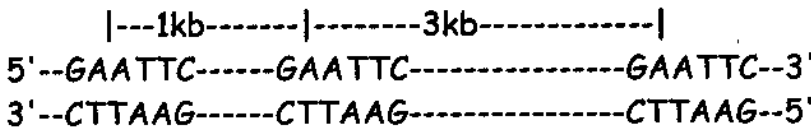
Held together by protein layer on outer surface.

21. _____ Which of the following sequences along a double stranded DNA molecule may be recognized as a cutting site for a particular restriction enzyme?

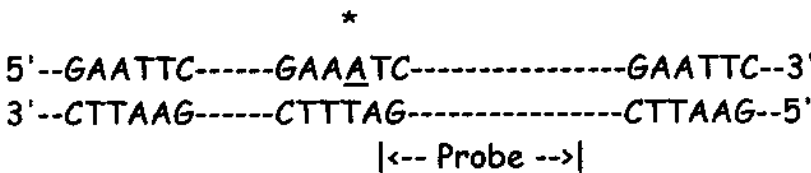
- A) AACGTT B) CACCAC C) TCAGTC D) TTTTTT
- TTGCAA GTGGTG AGTCAG AAAAAA

22. _____ The two alleles A and B differ by a single nucleotide site (marked *). The DNA sequences recognized by the restriction enzyme EcoRI (GAATTC) are marked by I. In a Southern blot, total genomic DNA is digested with EcoRI and hybridized with a probe as shown below.

allele A:



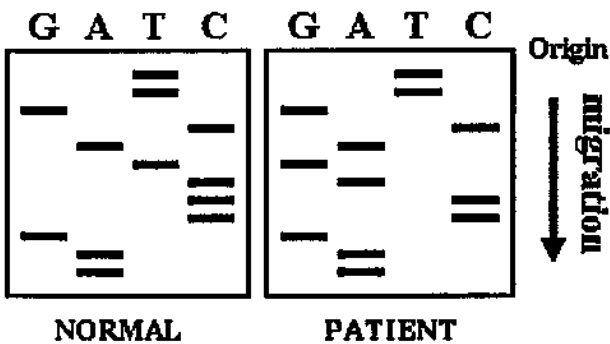
allele B:



A heterozygous individual carrying alleles A and B will show gel bands of: a. 1 kb., b. 3 kb. , c. 4 kb. , d. 3 kb and 4 kb. , e. 3 kb and 1 kb.

23. _____ In recombinant DNA methods, the term "vector" refers to: a. a DNA probe used to locate a particular gene, b. a plasmid or other agent used to transfer DNA into a living cell, c. an RFLP marker, d. the enzyme that cuts DNA into restriction fragments

24. _____ Two short DNA fragments prepared from a patient and a normal individual are subjected to Sanger dideoxy DNA sequencing analysis. The gel patterns are shown below.



Reading the nucleotide sequence from the gel, the patient DNA shows a mutation of: a. 5'---CT---3' to 5'---AG---3' , b. 5'---CT---3' to 5'---GA---3' , c. 5'---TC---3' to 5'---AG---3' , d. 5'---TC---3' to 5'---GA---3'

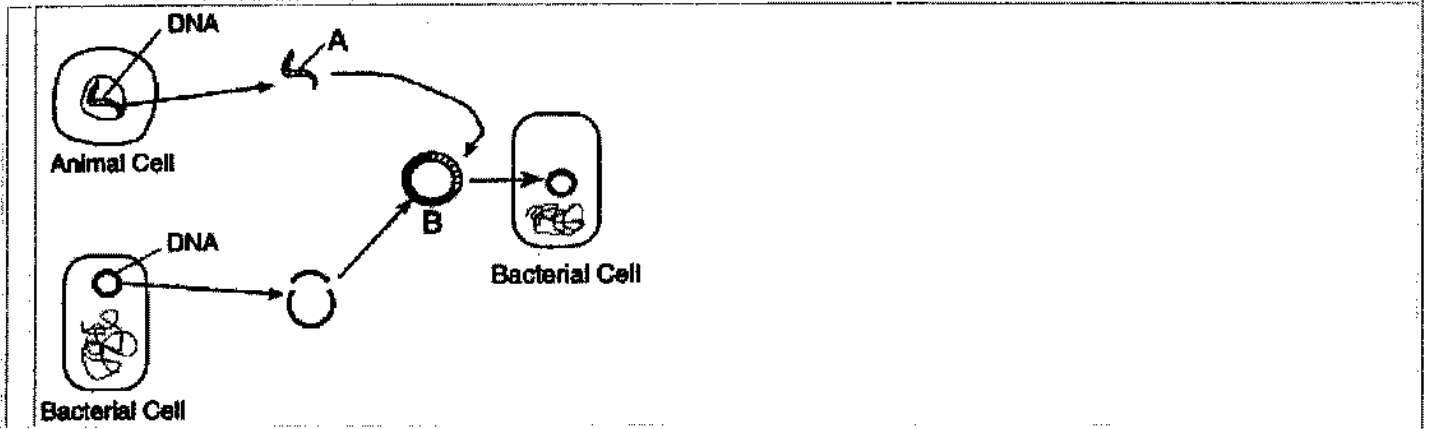
考生注意：答案必須寫在答案卷上，否則不予計分。

25. ____ Some events that take place during the synthesis of a specific protein are listed below. (A) Messenger RNA attaches to a ribosome.
B) DNA serves as a template for RNA production.
C) Transfer RNA bonds to a specific codon .
D) Amino acids are bonded together.
E) RNA moves from the nucleus to the cytoplasm.
The correct order of these events is:
a. B --> E --> A --> C --> D, b. B --> C --> E --> D --> A, c. D --> A --> E --> C --> B ,d. C --> B --> A --> E --> D
26. ____ Which of the below describes the correct order in which procedures are carried out when doing a Southern Blot?
a. Cutting DNA with restriction enzyme, electrophoresis of DNA, blotting the DNA, hybridizing the DNA with probe.
b. Blotting the DNA, electrophoresis of DNA, hybridizing the DNA with probe, cutting DNA with restriction enzyme.
c. Electrophoresis of DNA, cutting DNA with restriction enzyme, blotting the DNA, hybridizing the DNA with probe.
d. Cutting DNA with restriction enzyme, hybridizing the DNA with probe, electrophoresis of DNA, blotting the DNA.
e. Electrophoresis of DNA, hybridizing the DNA with probe, cutting DNA with restriction enzyme, blotting the DNA.
27. ____ All of the following are true about microarray technology except: a. Microarray technology is a process in which active genes within tissues and cultured cells are identified using a complementary DNA probe or oligonucleotide probe, b. The technology is used to access transcription from multiple genes simultaneously, c. The technology works best for organisms whose genome is completely sequenced, d. An electron microscope is used to gather data from the arrays
28. ____ Which of the following is the most logical sequence of the steps shown below for splicing foreign DNA into a plasmid and inserting the plasmid into a bacterium?
I. transform E. coli cells
II. cleave by endonuclease
III. extract plasmid DNA from bacterial cells
IV. join plasmid DNA with foreign DNA by hydrogen bonds
V. seal with DNA ligase
a. I, II, IV, III, V, b. II, III, V, IV, I, c. III, II, IV, V, I, d. III, IV, V, I, II, e. IV, V, I, II, III
29. ____ The two genetic events most closely associated with carcinogenesis are: a. DNA damage from carcinogens and oncogene activation, b. oncogene activation and cellular transformation, c. oncogene activation and tumor suppressor gene inactivation, d. anchor dependency and suppressor gene activation, e. cell senescence and terminal differentiation.

考生注意：答案必須寫在答案卷上，否則不予計分。

IV. SINGLE CHOICE QUESTIONS(II)(22 points)

Use the diagram below to answer questions 30 through 32 which follow.



30. ____ Structure B represents: a. a ribosome, b. recombinant DNA, c. transfer RNA, d. a male gamete

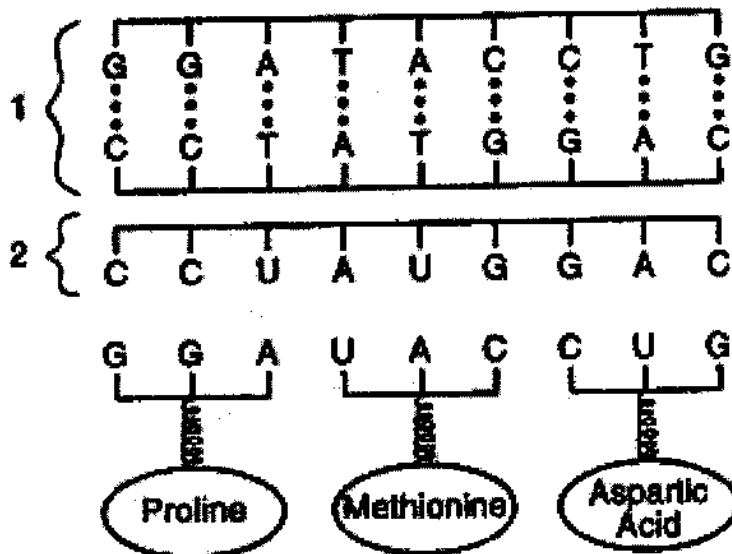
31. ____ The technique illustrated in the diagram is known as: a. cloning, b. protein synthesis, c. genetic engineering, d. in vitro fertilization

32. List two practical applications of this technology to human health and/or agriculture.

and _____

考生注意：答案必須寫在答案卷上，否則不予計分。

Use the information provided to answer questions 33 through 36 which follow. The diagram represents molecular structures involved in protein synthesis.



33. ____ Structure 1 represents a. part of: a polypeptide chain, b. a portion of an RNA molecule, c. a portion of a DNA molecule, d. the building blocks of proteins

34. ____ (multiple choices) The TOP strand of structure 1 represents: a. coding strand, b. template strand, c. antisense strand, d. sense strand, e. non-coding strand

35. ____ Structure 2 represents: a. part of a polypeptide chain, b. a portion of an RNA molecule, c. a portion of a DNA molecule, d. the building blocks of proteins

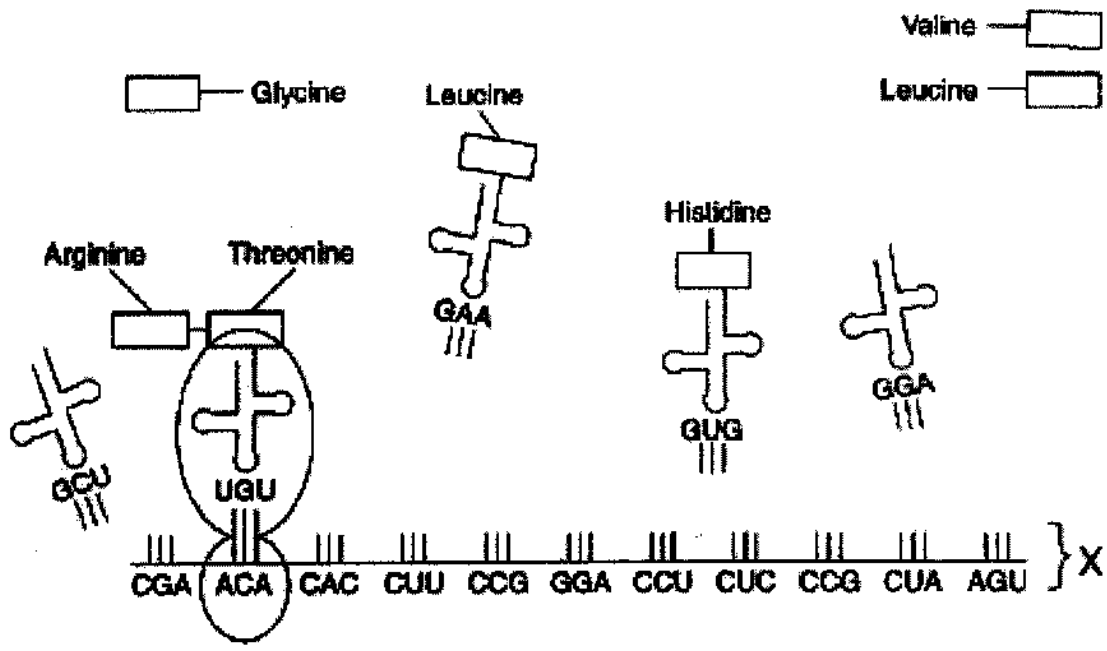
36. ____ Structure 2 is synthesized in the: a. nucleus, b. ribosome, c. vacuole, d. lysosome

所別：環境醫學研究所

科目：分子細胞生物學

考試時間：80 分鐘

考生注意：答案必須寫在答案卷上，否則不予計分。



Use the diagram provided to answer questions 37 through 39 which follow.

- 37. ____ The synthesis of structure X occurred in the: a. nucleus, b. mitochondria, c. cytoplasm, d. ribosome
- 38. ____ Which amino acid would be transferred to the position of codon CAC? a. leucine, b. valine, c. glycine, d. histidine
- 39. ____ The biochemical process represented in this diagram is most closely associated with the cell organelle known as the: a. nucleolus, b. chloroplast, c. ribosome, d. mitochondria

V. ANSWER QUESTIONS (18 points)

40. Briefly described the following terms: a. RFLP, b. reverse genetics, c. single nucleotide polymorphisms (SNPs), d. RNAi (RNA interference),