

※ 注意：請於答案卷上依序作答，並應註明作答之大題及其題號。

(一)單選題 (18 points) (請作答於選擇題作答區)

1. If bacterial cells are transformed with a mixture of linear and circular molecules resulting from a ligation reaction designed to produce a recombinant molecule
 - A. no recombinant molecules will ever be detected.
 - B. both linear and circular molecules will replicate equally well.
 - C. none of the plasmids will express the antibiotic resistance gene located on the plasmid.
 - D. the circular molecules will be amplified by the cells.
2. Which of the following process used in recombinant DNA technology requires ATP?
 - A. ligation
 - B. PCR
 - C. restriction endonuclease digestion
 - D. transformation
3. The common feature between complementation and suppression is
 - A. They both require the use of an expression vector
 - B. They both affect only conditional mutations
 - C. They both can overcome a mutation
 - D. They both require protein-protein interaction
4. Chromosome 1 is the largest human chromosome. This chromosome contains approximately
 - A. 2-3 million base.pairs
 - B. 20-30 million base pairs
 - C. 200-300 million base pairs
 - D. 2-3 billion base pairs
5. Matrix attachment regions are sites at which
 - A. The 30 nm chromatin fiber attaches to the chromosome scaffold
 - B. The nuclear membrane attaches to chromosomes
 - C. DNA attaches to the histone core to form chromatin
 - D. DNA attaches to high mobility group proteins.
6. Gain of function mutants can be created by which of these processes?
 - A. Inversions
 - B. Translocations
 - C. Duplications
 - D. deletions
 - E. All of the above
7. Which of the following technique is used to study the spatial and temporal transcription pattern of a specific gene during the development of a *Drosophila* embryo?
 - A. in situ hybridization
 - B. exon trapping
 - C. immunostaining using specific antibodies
 - D. Southern blot
 - E. cDNA library screen
8. Integration of the genome of which of the following viruses can cause cervical cancer?
 - A. HIV
 - B. Adenovirus
 - C. Human papilloma virus
 - D. SV40 virus
 - E. Influenza virus

9. Which of the following repair mechanism is most error-prone (最容易出錯)?
- A. Base excision-repair pathway
 - B. Nucleotide excision-repair pathway
 - C. transcription-coupled repair in eukaryotes
 - D. nonhomologous end-joining
 - E. mismatch-repair system
10. You have a protein that has 51 amino acids in length. What is the length of its open reading frame?
- A. 153 nucleotides
 - B. 156 nucleotides
 - C. 17 nucleotides
 - D. 18 nucleotides
 - E. 204 nucleotides
11. Which of the following is established, at least in part, by the yeast two-hybrid assay?
- A. interactome
 - B. transcriptome
 - C. genomics
 - D. proteome
 - E. genetics
12. Which of the following describes a synergistic interaction?
- A. A transcription factor that activates transcription.
 - B. Three transcription factors that interact to recruit a coactivator to an enhancer.
 - C. A DNA binding protein binds to DNA sequence.
 - D. The acetylation of histone tails by a transcription factor with an acetylase domain
 - E. A kinase protein phosphorylates three different substrates.
- (二)多選題 (70points) (請繼續作答於選擇題作答區)
13. Which of the following about technique description are TRUE?
- A. The transcriptional start site of an mRNA can be determined by primer extension assay
 - B. S1 mapping can be used to quantify the amount of a given RNA in cells at a given time.
 - C. The GST pulldown assay is used to examine protein-protein interaction.
 - D. DNA microarray is used to map gene locations in the human genome.
 - E. DNase footprinting can be used to determine the specific DNA sequence bound by a steroid hormone receptor.
14. Which of the following modifications on histone have been found to affect chromatin structure and/or gene expression?
- A. phosphorylation of serine on H3 histone
 - B. phosphorylation of threonine on H4 histone
 - C. acetylation of the lysine on H3 histone
 - D. Acetylation of the serine on H4 histone
 - E. Methylation of lysine on H3 histone
15. Which of the following mobile DNA elements can leave its original location and target to a new site during transposition?
- A. Retrotransposon
 - B. Provirus
 - C. DNA transposon using replicative transposition
 - D. DNA transposon using nonreplicative transposition
 - E. *Drosophila* P element

16. Which of the following can reduce or silence gene expression without changing the DNA sequence?
- A. imprinting
 - B. X chromosome inactivation in humans
 - C. position-effect variegation
 - D. missense mutation
 - E. silent mutation
17. Which of the following functions are important in DNA replication in both *E. coli* and humans?
- A. Polymerase responsible for the addition of nucleotides
 - B. Sliding clamp
 - C. Primase
 - D. Helicase
 - E. Topoisomerase:
18. Which of the following about RNA and transcription are TRUE?
- A. An RNA primer is required to initiate synthesis.
 - B. tRNA molecules are generated by the transcription of tRNA genes.
 - C. snRNA are not present in *E. coli*.
 - D. During transcription, the RNA polymerase moves in a 3' to 5' direction on the template strand.
 - E. mRNA is transcribed by RNA polymerase II in eukaryotes
19. Which of the following about codon and anticodon are TRUE ?
(please use the codon table on the last page)
- A. If genetic codons were only two bases in length, the maximum number of different amino acids that could be coded for is 16.
 - B. Trp could be carried by a tRNA with the anticodon 3'-ACC-5'.
 - C. The tRNA with anticodon 3'-GGG-5' and 3'-GGC-5' are charged with amino acid by the same aminoacyl tRNA synthetase.
 - D. The binding of tyrosine to the tRNA with anticodon 3'-ACG-5' can be corrected through a kinetic proofreading mechanism by tyrosine tRNA synthetase.
 - E. No tRNA molecule contains anticodon 3'-ACU5' in humans
20. Which of the following proteins have an RNA polymerization activity?
- A. rRNA in the large ribosome subunit
 - B. primase
 - C. telomerase
 - D. spliceosome
 - E. RNA polymerase III
21. Which of the following about cell cycle control are TRUE?
- A. DNA damage causes arrest of the cell cycle at G1 and G2.
 - B. p53 is responsible for G1 arrest induced by DNA damage.
 - C. Bim is responsible for cell cycle arrest if the spindle is not properly assembled.
 - D. The breakdown of the nuclear envelope requires phosphorylation of serine on lamin A.
 - E. The restriction point in mammalian cells is equivalent to START in *S. cerevisiae*.
22. Which of the following reactions are common in both the Holliday and double-strand break models for genetic recombination?
- A. formation of a single Holliday junction
 - B. Formation of heteroduplex DNA
 - C. strand migration
 - D. cleavage of a phosphodiester bond in DNA
 - E. DNA synthesis by the action of DNA polymerase

23. Which of the following about RNAi is TRUE?

- A. The RNAi technique can be used to inactivate human gene in cultured cells.
- B. Antisense RNA works better than sense RNA or double-stranded RNA in gene activation.
- C. RNA polymerase III is essential to generate an RNAi effect.
- D. The degradation of endogenous mRNA requires dicer.
- E. The RNA product cleaved by dicer is called siRNA.

24. A mutational lesion results in a sequence containing a mismatched base pair:

5' AGCTGCCTT 3' (sense strand)

3' ACGATGGAA 5' (antisense strand)

Codon

If mismatch repair occurs in either direction, which amino acids could be found at this site? (please use the codon table on the last page)

- A. Cys
- B. Tyr
- C. Val
- D. Ala
- E. Met

25. Which of the following about transcription in eukaryotic cells are TRUE?

- A. TFIIE phosphorylates the carboxyl-terminal domain of the largest RNA polymerase II subunit.
- B. TFIIE is not essential for formation of an open-promoter complex.
- C. TFII H can reduce the positive supercoils of DNA and enhance transcription.
- D. Transcription of both rRNA and tRNA requires TBP.
- E. Puromycin blocks transcription by inhibiting the action of RNA polymerase II.

26. Which of the following proteins are involved in translation?

- A. EF-Tu
- B. rho protein
- C. Ruv A
- D. RF1
- E. Rec BCD

(三)問答題 (12points) (請於「非選擇題作答區」作答)

1. For each processes (A-C) below, indicate which of the following sequences (1-15) are required. (6points)

(A) Eukaryotic translation initiation

(B) Eukaryotic transcription initiation

(C) Eukaryotic transcription termination

- | | |
|---------------------------------|--|
| (1) replication origin | (9) Polyadenylation signal |
| (2) Shine-Dalgarno sequence | (10) Antitermination sequence |
| (3) TATA box | (11) Rho-independent intrinsic terminator sequence |
| (4) Operator | (12) Stop codon |
| (5) Kozak sequence | (13) CG island |
| (6) 5' cap | (14) Alu sequence |
| (7) 3' poly A tail | (15) Conserved AAUAAA or AUUAAA sequence near the 3' end |
| (8) Splicing consensus sequence | |

2. Pulse-chase experiments can be used to detect kinetics of RNA or DNA in cells. In these experiments cells are pulsed with radioactive nucleotide (pulse) and then moved to medium containing unlabeled nucleotide (chase).

When this type of experiment is done, it is observed that the label is initially localized to the nucleus but moves into the cytoplasm with time. Which nucleotide is radiolabeled in these experiments and why? (2 points)

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3. A single nucleotide addition and a single nucleotide deletion approximately 15 sites apart in the DNA cause a protein change in sequence from

Lys-Ser-Pro-Ser-Leu-Asn-Ala-Ala-Lys

to

Lys-Val-His-His-Leu-Met-Ala-Ala-Lys

- What are the old and new mRNA nucleotide sequences? Please label the 5' and 3' ends in your answer. (Please use the codon Table on the last page) (2 points)
- Which nucleotide has been added and which has been deleted? (2 points)

Codon Table

Second base →

First base ↓

First	U	C	A	G	Last
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G