※ 注意：請於答案卷上依序作答，並應註明作答之部份及其題號。

第 1 部份（57%）

For questions 1-8, select the best one in each question. (2 points/question)

1. If the M-phase promoting factor is injected into a *Xenopus* primary oocyte, which of the following occurs?
(A) S phase begins
(B) The oocyte enters G0
(C) Apoptosis begins
(D) The germinal vesicle (nucleus) breaks down
(E) Mitosis is completed

2. Which of the following in NOT a potential problem associated with expressing a eukaryotic, protein-coding nuclear gene in prokaryotic cells
(A) Lack of an intron-splicing mechanism in prokaryotes
(B) Differences in the translation initiation codons used by eukaryotic cells and prokaryotic cells
(C) Susceptibility of the protein product to prokaryotic proteases
(D) Stability of mRNA in prokaryotic cells
(E) Differences in transcriptional signals between eukaryotic cells and prokaryotic cells

3. In genetics, suppression of a mutation refers to
(A) restoration of the original phenotype due to a second mutation
(B) restoration of the original DNA sequence by mutation
(C) prevention of expression of the mutant gene by metabolic regulation
(D) appearance of the recessive phenotype in a heterozygous diploid
(E) inactivation of the gene by methylation

4. Which of the following in NOT a property of the mammalian signal recognition particle (SRP)?
(A) It targets nascent secretory polypeptides to the rough ER
(B) It temporarily arrests translation
(C) It binds to the signal sequence of secretory proteins
(D) It contains both RNA and several polypeptides
(E) It contains a signal peptidase activity

5. Which of the following elements is LEAST likely to be found on any + strand viral genomic RNA?
(A) A cap
(B) A package site
(C) A binding site for RNA-dependent RNA polymerase
(D) A binding site for ribosomes
(E) A binding site for RNA polymerase II

6. Which of the following is the correct combination of histone proteins reconstituted into a nucleosome:
(A) One each of H2A, H2B, H3 and H4
(B) A pair of H2A, H2B, H3 and H4
(C) An H3/H4 dimer and an H2A/H2B tetramer
(D) An H3/H4 tetramer and two H2A/H2B dimers.

7. All of the following statements concerning post-transcriptional processing of heterogeneous nuclear RNA (hnRNA) to messenger RNA (mRNA) in eukaryotes are true EXCEPT
(A) cap structures are found on the 5' end of all mRNAs
(B) polyadenylated (poly A) tails are found on the 3' end of all mRNAs
(C) the sequences that allow recognition by the spliceosomes of intron/exon junctions lie within the introns
(D) the sequence AAUAAA, within hnRNA, is needed to direct polyadenylation to the correct site
(E) transport of mRNA from the nucleus to the cytoplasm is coupled to splicing

8. Protein transport into which of the following organelles is a co-translational event.

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(A) Nucleus
(B) Mitochondria
(C) Chloroplast
(D) endoplasmic reticulum
(E) peroxisome

Questions 9-13 refer to the following cell components in mammalian cells. For each numbered phrase, select the one heading that is most closely related to it. Each heading may be used once, more than once, or not at all. (1 point/question)
(A) Nuclear envelope
(B) Nucleolus
(C) Euchromatin
(D) Heterochromatin
(E) Nuclear lamina

9. Site of synthesis of histone mRNA
10. Site of transcriptionally inactive DNA
11. Site of protein synthesis
12. Site of transcription by RNA polymerase II
13. Site of 45S rRNA processing

Please choose the most appropriate terms/phrases/statements that complete or answer the questions 14-20. Attention: <u>More than one</u> of the choices provided may be correct in some cases. (3 points for each question)
14. Which techniques can be used to detect the presence of specific mRNA?
(A) ELISA
(B) Western blot
(C) Real-time polymerase chain reaction
(D) Northern blot
(E) *In situ* hybridization

15. Which of the following statements about "Ubiquitin-Proteosome system"(UPS) are true?
(A) The actions of many transcription factors, such as c-myc,c-fos, and p53 are terminated by the UPS pathway through degradation.
(B) Ubiquitin is a small protein that serves as a complex post-translational modification which is conjugated to lysine residues on a wide assortment of substrates.
(C) As ubiqutination is an important signal for exocytosis and can trigger the removal of membrane proteins from the cell surface, it will be a good candidate mechanism for the control of neurotransmitter receptor levels at the synapse
(D) Removal of mono-ubiquitin can regulate the trafficking or function of proteins involeved in neural synaptic transmission.
(E) Addtion of ubiquitin in growing chains (an event termed poly-ubiquitination) acts as a targeting signal to mark proteins for destruction by proteosome

16. Pfu DNA polymerase is a thermostable enzyme and used for polymerase chain reaction (PCR). Its 3' to 5' exonuclease activity can
(A) enhance the processivity of DNA polymerase
(B) enhance the proofreading ability
(C) reduce the proofreading ability
(D) generate a single base 3' extension
(E) degrade the primer after DNA synthesis

17. Please indicate which RNA may have enzymatic activity (ribozyme)

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(A) telomerase RNA
(B) ribosomal RNA
(C) hammerhead RNA
(D) microRNA
(E) U1 small nuclear RNA

18. Indicate which of the multicomponent complexes contain RNA
(A) bacterial RNA polymerase holoenzyme
(B) telomerase
(C) RNA-induced silencing complex
(D) polyadenylation stimulation factors
(E) nucleosome

19. Indicate which of following events does not occur in bacteria.
(A) DNA methylation
(B) self-catalyzed intron splicing
(C) protein phosphorylation
(D) protein ubiquitination
(E) protein glycosylation

20. Which of the following assay(s) can be used to detect the "in vivo" function of a given gene:
(A) RNA interference
(B) Gene knock-out mice
(C) Gel shift assay
(D) In vitro transcription assay
(E) Northern blot analysis

21. The effects of various inhibitors of DNA synthesis have been investigated in an in vitro replication system containing *E. coli* enzymes. In such a system, replication of M13 DNA is sensitive to rifampicin, an inhibitor of host cell RNA polymerase, whereas replication of the *E. coli* cellular DNA is not inhibited.
A. What do these results imply the mechanistic differences in M13 and *E. coli* DNA replication. (4 points)
B. What would be the effect of a mutation in the 5'-3' exonuclease activity of DNA polymerase I on the replication of *E. coli* DNA? Would you expect such a mutation to be lethal? (6 points)

22. Exposure of eight-day mouse embryo to mM concentration of retinoic acid causes a very specific pattern of abnormalities in about 1/3 of the embryos. The sizes of the first and second pharyngeal arches are reduced; and the first arch eventually forms the maxilla and mandible of the jaw and two ossicles of the middle ear. The second arch forms the third ossicle of the middle ear as well as other facial bones. What kinds of genes are likely to be affected by exposing mouse embryos to retinoid acid? (5 points)

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第2部份（43%）

Please choose the most appropriate terms/phrases/statements that complete or answer the questions 1 -12. Attention: <u>More than one</u> of the choices provided may be correct in some cases. (3 points for each question)

1. Which of the following statement(s) is (are) true about the proteins in ER?
   a. may be glycosylation or GPI anchor modification.
   b. may flow through to plasma membrane by C-terminal KDEL signal.
   c. may be diverted to other destinations by specific N-terminal signals.
   d. may be transferred to Golgi and transport back to ER.
   e. cytosolic ribosomes have proteins with N-terminal sequences that enter the ER during synthesis.

2. The translocation apparatus for secretory proteins
   a. may or may not interact with signal sequences.
   b. signal recognition particle can bind to a receptor protein located in the ER membrane.
   c. consists of SRP, SRP receptor, Sec61, TRAM, and signal peptides.
   d. may localized to plasma membrane.
   e. associate with co-translational or post-translational translocation.

3. Which of the following statement(s) is (are) true?
   a. Each mitochondria contains a single copy of mitochondria DNA.
   b. The codon usage for mitochondria genes is same as chromosomal genes.
   c. Most of the proteins exist in mitochondria are encoded by mitochondria DNA.
   d. Mitochondria DNA is double-stranded.
   e. Mitochondria DNA also contains introns.

4. Which of the following statement(s) is (are) true?
   a. Acetylation of lysine reduces the overall positive charge of a protein.
   b. Phosphorylation of serine reduces the overall positive charge of a protein.
   c. ADP-ribosylation of lysine reduces the overall negative charge of a protein.
   d. Sequences on the RNA that lie on different turns around the nucleosome may be close together.
   e. RNAase I and RNAase II generate similar, but distinct, RNA ladder.

5. Which of the following statement(s) is (are) true?
   a. SnRNAs, snRNA-binding proteins, and RNA ligase are required for forming a spliceosome.
   b. the spliceosome for splicing is tissue specific.
   c. Alternative splicing is tissue specific.
   d. Mutations that abolish function of the 5' splicing site can be suppressed by compensating mutations in U1 snRNA.
   e. Splice sites are not generic.

6. Which of the following statement(s) is (are) true?
   a. Processing for a complex oligosaccharide occurs in the Golgi to generate a terminal region containing N-acetyl-glucosamine, galactose, and asialic acid.
   b. An oligsaccharide is formed on dolichol and transferred by glycosyl transferase to lysine of a target protein.
   c. Asialic acid containing protein can be degraded in liver.
   d. Trimming sugars in ER generates a low mannose or galactose oligosaccharide.
   e. Oligosaccharides are added or removed to proteins in the ER and Golgi.

7. Which of the following statement(s) is (are) true?

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a. bacteria that make a specific restriction nuclease for defense against viruses have evolved in such a way that their own genome still contain the recognition sequence for the nuclease.
b. all the spontaneous deamination products of the usual four RNA bases are recognizable as unnatural when they occur in RNA.
c. binding to the promoter orients DNA polymerase and the choice of template strand because the RNA chain, which is synthesized in the 5'-to3' direction, must be antiparallel to the template strand.
d. Wobble base-pairing occurs between the third position in the codon and the first position in the anticodon.
e. polynucleotide kinase can be used to label a DNA fragment by transferring a single 32P-labeled nucleotide to the 5' end of each DNA chain.

8.Which of the following statement(s) is (are) true?
a. Restriction fragments with sticky ends can associate by complementary base pairing only if they were produced using the same restriction endonuclease.
b. The restriction endonuclease *Sma*I will cleave DNA at either CCCGGG or GGGCCC because these sequences, being inverted repeats, are indistinquishable in the plasmid molecule.
c. Most of class II restriction endonuclease, that recognize and cleave at or near a specific sequences of four to six nucleotide pairs, will catalyze cleavage of double-stranded as well as single-stranded DNA.
d. Some class II restriction endonucleases produce restriction fragments with sticky ends; others produce fragments with blunt ends.

9.Which of the following statement(s) is (are) true?
a. The current guidelines for handling of recombinant DNAs are based on perceived possible risks, not on known risks.
b. An exogenous DNA fragment tailed with A's, which has been annealed to a plasmid DNA tailed with T's, can not transform competent bacteria without prior in vitro ligation.
c. Eukaryotic genes can be cloned in prokaryotic host-vector systems, and prokaryotic genes can be cloned in eukaryotic host-vector systems.
d. A eukaryotic gene cloned from a genomic DNA library is less likely to be expressed in a prokaryotic host-vector system than the same gene isolated from a cDNA library.
e. Prokaryotic genes can be cloned in Eukaryotic host-vector systems, and prokaryotic genes can be cloned in eukaryotic host-vector systems.

10. If a homogeneous population of high-molecular weight DNA molecules that contain 50% GC nucleotide pairs is digested with restriction endonucleases, in which of the following statement is correct, assuming that the DNA nucleotide sequence is random?
a. The average size of restricted fragment digested with *Sma*I (recognizing GGGCCC) is longer than that digested with *Hind*III (recognizing AAGCTT).
b. The average size of restricted fragment digested with *Sma*I (recognizing GGGCCC) is longer than that digested with *Hae*III (recognizing GGCC).
c. The average size of restricted fragment digested with *Sma*I (recognizing GGGCCC) is the same as that digested with *Not*I (recognizing GCGGCCGC).
d. If the GC content of a genomic DNA is >70%, the average size of restricted fragment digested with *Sma*I (recognizing GGGCCC) is longer than that digested with HindIII (recognizing AAGCTT).

11. A gene for which you have a cloned, labeled cDNA probe occurs once in an organism's genome. The gene contains no intervening sequences and only one EcoRI cleavage site in its coding sequence. If you probe a Southern blot of a complete EcoRI digest of the organism's DNA with your labeled cloned sequence, the number of radioactive bands you are going to see will be (multiple choice):
a. 0
b. 1
c. 2

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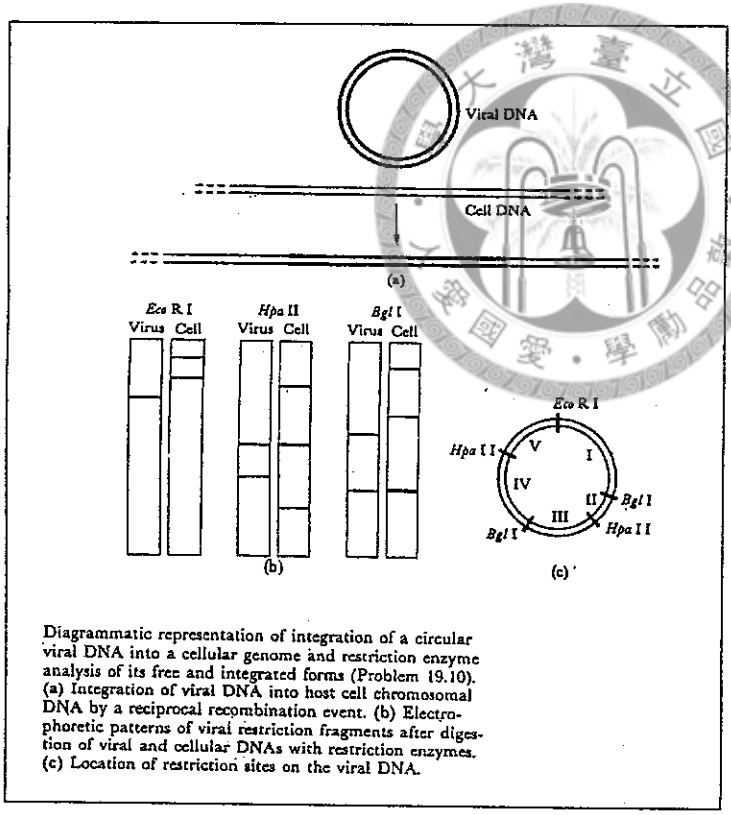
d. 3
e. 4

12. Certain animal viruses transform cells to a neoplastic (cancerous) phenotype by stably integrating their DNA into one of the cell's chromosomes, as shown in figure (a) (see below) for a virus with a circular double-stranded DNA. You are interested in studying the structure of the viral genome as it exists in the integrated state in the transformed cell. You digest samples of viral and transformed cell DNA with restriction enzymes that cut viral DNA at known sites. Subsequently you separate the fragments by electrophoresis on agarose gels and visualized by Southern blot analysis and autoradiography. The patterns obtained as shown in figure (b). Figure (c) shows the positions of the five known restriction sites in the viral DNA, which define five DNA fragments. In which fragment the integration of viral DNA occurred:
a. I
b. II
c. III
d. IV
e. V



Diagrammatic representation of integration of a circular viral DNA into a cellular genome and restriction enzyme analysis of its free and integrated forms (Problem 19.10). (a) Integration of viral DNA into host cell chromosomal DNA by a reciprocal recombination event. (b) Electrophoretic patterns of viral restriction fragments after digestion of viral and cellular DNAs with restriction enzymes. (c) Location of restriction sites on the viral DNA.

13. Why does the cloning manual recommend treating the cloning vector with alkaline phosphatase? (3 points)

14. Please brief describe how ribosomal RNA are processed to mature forms of 18S and 28S rRNA. (4 points)

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