所別：生命科學系碩士班 分子與細胞生物組(一般生)　科目：分子生物學　共 5 頁 第 1 頁
(學位在職生)　＊請在試卷答案卷（卡）內作答

Part I. Multiple Choice (2 points each, total 90 points) Choose the one alternative that best answers the question.

1. DNA fragments that have matching sticky ends are joined by covalent bonds formed by the action of
(a) DNA polymerase. (b) DNA ligase. (c) DNA helicase. (d) DNA recombinase. (e) a restriction enzyme.

2. Which of the following is **false**?
(a)The genomes of about 150 species have been completely or almost completely sequenced.
(b) Full sets of proteins encoded by genomes are studied in the field of proteomics.
(c) Scientists think that the typical human gene probably specifies just one polypeptide.
(d) Current estimates are that there are 25,000-30,000 genes in the human genome.
(e) Much of the DNA between genes consists of repetitive DNA.

3. Which of the following about DNA polymerase I (pol I) is **incorrect**?
(a) Pol I is the polymerase responsible for replicating the bacterial genome.
(b) Pol I has three activities: DNA polymerase, 5' → 3' exonuclease, and 3' → 5' exonuclease.
(c) The Klenow fragment does not have 5' → 3' exonuclease activity.
(d) Pol I plays a dominant role in repair of DNA damage.
(e) pol I can be cleaved by mild proteolytic treatment into to a large fragment and a small fragment.

4. Transformation
(a) is the direct transfer of DNA from one bacterium to another.
(b) occurs when a bacterium acquires DNA from the surrounding environment.
(c) is the result of crossing over.
(d) is the result of gene mutation.
(e) occurs when a phage transfers DNA from one bacterium to another.

5. Which of the following statements is **incorrect**?
(a) The bacterial genome is a single, circular replicon.
(b) Plasmid is a circular DNA that replicates independently of the cell's chromosome.
(c) Each eukaryotic chromosome has many replicons.
(d) Most eukaryotic DNAs replicate bidirectionally.
(e) Most prokaryotic DNAs replicate unidirectionally.

6. Ribonuclease H (RNase H)
(a) degrades the RNA strand of an RNA-DNA hybrid.
(b) degrades single-stranded RNA at the 3' ends.
(c) degrades single-stranded RNA and DNA.
(d) degrades the DNA strand of an RNA-DNA hybrid.
(e) none of the above

7. A nucleic acid probe can be
(a) a virus that transfers DNA to a recipient cell.
(b) a piece of radioactively labeled DNA that is used to locate a specific gene.
(c) an enzyme that locates a specific restriction site on DNA.
(d) a promoter site that is associated with a specific set of factors.
(e) a plasmid that recognizes a specific DNA sequence.

8. Restriction enzymes are predominantly obtained from
(a) plant cells. (b) hematopoietic cells. (c) yeast. (d) bacteria. (e) bacteriophage.

9. Which of the following methods is **not** used to map transcripts?
(a) S1 mapping (b) RNase protection assay (c) primer extension (d) run-off transcription (e) nuclear run-on transcription

10. Which one of the following about restriction fragment length polymorphism (RFLP) is **false**?
(a) RFLP can be used for genetic mapping.
(b) RFLP denotes a difference in restriction maps between two individuals.
(c) RFLP can be used as a genetic marker in exactly the same way as any other marker.
(d) RFLPs are useful for establishing parent-progeny relationships.
(e) RFLP can be used to locate the 5'- or 3'-ends of DNAs.

11. Which of the following methods is/are **not** used to assay DNA-protein interactions?
(a) DNase footprinting (b) DNA fingerprinting (c) gel mobility shift (d) nitrocellulose filter binding
(e) b and d

12. A DNA fragment whose sequence is 5'GGAACTCTGCCTTCA3'
3'CCTTGAGACGGAAGT5'
Its mRNA sequence from transcription is 5'GGAACUCUGCCUUCA3'. Which of the following is **true**?
(a) The DNA sequence is mostly likely an intron sequence.
(b) The lower DNA strand is the sense strand.
(c) The upper DNA strand is the template strand.
(d) The upper DNA strand is the coding strand.
(e) Both strands can be the coding strand.
(f) None of the above is true.

13. Which of the following statements about chromatin states is **not true**?
(a) Methylation of DNA is usually associated with activation of gene activity.
(b) Deacetylation of histones is usually associated with repression of gene activity.
(c) Methylation of DNA and of histones is associated with heterochromatin formation.
(d) Constitutive heterochromatin contains specific sequences that have no coding function.
(e) Chromosome-specific condensins are responsible for condensing inactive X chromosomes in *C. elegans*.

14. Which of the following statements about the genetic code is **incorrect**?
(a) The genetic code is a set of three-base code words, or codons, in mRNA.
(b) The codons instruct the ribosome to incorporate specific amino acids into a polypeptide.
(c) The code is nonoverlapping: that is, each base is part of only one codon.
(d). There are total of 63 codons. Three are stop signals, and the rest code for amino acids.
(e) The same aminoacyl-tRNA is allowed to pair with more than one codon.

15. The approach to gene cloning which uses a mixture of fragments from the entire genome of an organism is called a _____ approach.
(a) "gene targeting" (b) "gene mapping" (c) "shotgun" (d) "Ti" (e) "transgenic"

16. Which of the following response elements is **not** involved in transcription activation?
(a) iron response element (IRE) (b) serum response element (SRE) (c) glucocorticoid response element (GRE)
(d) cAMP response element (CRE) (e) heat shock response element (HSE)

17. A student just purified a plasmid DNA from a bacterial culture. After 100 times dilution, the absorbance of the plasmid measured at 260 nm is 0.1. What is the concentration of this plasmid sample before dilution?
(a) 10 μg/ml (b) 40 μg/ml (c) 300 μg/ml (d) 400 μg/ml (e) 500 μg/ml

18. Which of the following eukaryotic initiation factors helps the 43S initiation complex to scan the mRNA until it locates the proper initiation codon?
(a) eIF1 (b) eIF2 (c) eIF3 (d) eIF4F (e) eIF5 (f) eIF6

19. Which of the following is **not** a second messenger?
(a) nitric oxide (b) GTP (c) diacylglycerol (d) cAMP (e) inositol triphosphate (f) cGMP

注意：背面有試題

20. Which of the following statements about DNA replication is **false**?
(a) DNA replicates in a semiconservative manner.
(b) DNA polymerase synthesizes the leading strand continuously in the 5'→ 3' direction.
(c) DNA polymerase synthesizes the lagging strand continuously in the 5'→ 3' direction.
(d) Okazaki fragments in E. coli are initiated with RNA primers 10-12 nt long.
(e) Circular DNAs can replicate by a rolling circle mechanism.

21. Which of the following is a G protein-coupled receptor?
(a) estrogen receptor (b) epidermal growth factor receptor (c) transforming growth factor-β receptor
(d) adrenergic receptor (e) none of the above

22. Which of the following techniques is often used to generate conditional (or inducible) knockout mice?
(a) enucleation of embryonic stem cell
(b) gene targeting by homologous recombination
(c) PCR-based technique
(d) Cre-loxP system
(e) *in vitro* fertilization

23. Which of the following in **not** true about cDNA library and cDNA cloning?
(a) A cDNA library is a set of clones representing as many as possible of the mRNAs in a given cell type.
(b) Particular clones in a cDNA library can be detected by colony hybridization with radioactive DNA probes.
(c) Particular clones in a cDNA library can be detected by colony hybridization with antibodies if an expression vector is used.
(d) Cosmids behave both as plasmids and as phages, thus they have been popular as cDNA cloning vectors.
(e) cDNA fragments cloned into the M13 phage vectors can be recovered in single-stranded form.

24. Which of the following statements about Holliday junction is **incorrect**?
(a) Holliday junction is generated during homologous recombination.
(b) Nicks must occur in corresponding positions in two homologous DNA strands.
(c) The branch in the Holliday junction undergoes "branch migration".
(d) The Holliday junction can be resolved into two independent DNA duplexes by creating the second DNA nicks.
(e) If the same DNA strands are nicked after the Holliday junction formation, crossover recombination occurs.

25. Which of the following statements is **incorrect**?
(a) Posttranscriptional gene silencing, or RNA interference (RNAi), occurs when a cell encounters dsRNA.
(b) Antisense RNA can inhibit gene expression by base pairing to the corresponding mRNA and inhibits its translation.
(c) The added dsRNA in the cell can be degraded into 21-23-nt fragments by a nuclease.
(d) Control of mRNA stability is an important form of posttranscriptional regulation of gene expression.

26. The sequence of a gene's mRNA can be summarized as below:
5'-uaguauaauaucggccagg**AUG**ccg.....cggguauucucauuu**UAA**ggcagguucuua-3'
The start and stop codons are shown in **bold capital**. If you want to amplify the coding region of this gene, which of the following PCR primer sets will work for you?
(a) 5'-cggccagg**ATG**ccg-3'/ 5'-ttctcattt**TAA**ggcaggttctta-3
(b) 5'-gccggtc**CTA**cggc -3'/ 5'-aaa**ATT**ccgtccaagaat -3
(c) 5'-cggccagg**ATG**ccg-3'/ 5'-aaa**ATT**ccgtccaagaat -3
(d) 5'-cggccagg**ATG**ccg-3'/ 5'-taagaacctgcc**TTA**aaatgagaa -3
(e) 5'-gccggtc**CTA**cggc -3'/ 5'-taagaacctgcc**TTA**aaatgagaa -3
(f) 5'-aaa**ATT**ccgtccaagaat -3'/ 5'-ttctcattt**TAA**ggcaggttctta-3

參考用

27. The elements of a gene with 2 exons are listed as below:
(1). Exon 1; (2). promoter; (3). Exon 2; (4). intron; (5). terminator.
What is their most possible order in this gene when you are reading from upstream to downstream?
(a) 1-2-3-4-5 (b) 1-3-2-4-5 (c) 5-4-3-2-1 (d) 2-1-4-3-5 (e) 4-2-3-1-5 (f) 3-1-2-4-5

注意：背面有試題

28. Which of the following transcription factors employs bHLH motif as its DNA-binding domain?
(a) C-Jun (b) steroid receptor (c) c-Fos (d) MyoD (e) TFIIA (f) Cro repressor

29. Which of the following experiments can be used to demonstrate the binding of a transcription factor to its target DNA sites ***in vivo***?
(a) Electrophoresis mobility shift assay (b) Immunoprecipitation (c) Western blot (d) GST-pulldown
(e) Chromatin immunoprecipitation assay (f) Microarray

30. How is the 3' end of a mammalian gene mRNA generated?
(a) Created by intrinsic terminator that causes termination of transcription.
(b) Created by Rho-dependent terminator that causes termination of transcription.
(c) Poly (A) added to the 3' end by RNA polymerase II.
(d) The 3' end of mRNA is where transcription stopped.
(e) The 3' end of mRNA is created by cleavage upstream to actual termination site.
(f) Poly (A) is added to the 3' end where termination happened.

31. Which of the following statements about eukaryotic chromatin structure and the status of a gene is **true**?
(a) Euchromatin is usually associated with inactive genes.
(b) Heterochromatin is usually associated with active genes.
(c) Chromatin structure has nothing to do with transcriptional activity.
(d) Modification of chromatin components will always lead to gene activation.
(e) Modification of chromatin components will always lead to gene repression.
(f) Both chromatin and DNA modification regulate gene activity.

32. When eukaryotic chromatin is digested with proper amount of micrococcal nuclease, a ladder of 200 bp will normally show up on agarose gel. Why?
(a) Authentic enzyme recognition sites are separated 200 bp on naked DNA.
(b) DNA is broken intrinsically every 200 bp.
(c) Nucleosomes are wrapped up in 200, 400, and 600 bp of DNA.
(d) Nucleosomes are linked by 200 bp of DNA.
(e) DNA in chromatin is exposed every 200 bp.
(f) Random collision.

33. About RNA polymerase, which of the following statements is **true**?
(a) There is only one type of RNA polymerase in eukaryotes.
(b) Prokaryotic RNA polymerase can bind promoter specifically without sigma factor.
(c) Sigma factor is required for prokaryotic RNA polymerase binding to general DNA sequence.
(d) Prokaryotic RNA polymerase holoenzyme can recognize promoter by itself.
(e) Eukaryotic RNA polymerase can recognize promoter by itself.
(f) All eukaryotic genes are transcribed by RNA polymerases II.

34. How will you define an enhancer of a gene?
(a) A trans-acting factor enhancing transcription
(b) A cis-element residing in the promoter region
(c) A cis-element residing in the intron region
(d) A cis-element residing in either upstream or downstream region of promoter
(e) A diffusible factor acting on the initiator
(f) A diffusible factor acting on promoter

35. Which of the following mechanisms is involved in the activation of *trp* operon genes?
(a) anti-initiation (b) anti-termination (c) terminator initiation (d) transcriptional activation
(e) alternative initiator (f) anti-attenuation

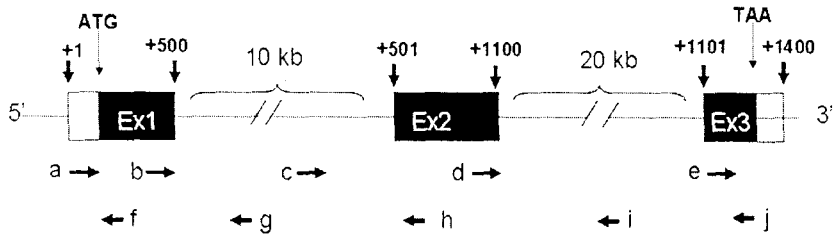
36. Under which nutrient condition will *lac* operon be most active?.
(a) Glucose only (b) Glucose and lactose (c) Lactose only (d) Glucose and maltose (e) Maltose only

注意：背面有試題

(f) Glucose and sucrose

37. One has used *Tag* DNA polymerase to amplify the CDS of a gene from product of reverse transcription. How can she clone this PCR product into a vector?
(a) directly ligated into a blunted linear vector site.
(b) modify the PCR product with klenow enzyme before ligated into a blunted linear vector site
(c) modify the PCR product with ligase before ligated into a blunted linear vector site
(d) directly ligated into a linear vector with 5'-T overhang
(e) directly ligated into a linear vector with 3'-T overhang
(f) directly ligated into a linear vector with 5'-A overhang

38. The genomic organization of a gene with 3 exons is shown below. The exons are shown as 3 boxes and their boundaries are denoted according to their location in mRNA. The size of the introns as well as location of start and stop codons are also shown on the top. If one wants to detect its expression level with quantitative real time RT-PCR, then which set of the primers is best suited for this purpose?
(a) a, g (b) c, h (c) b, h (d) c, i (e) d, i (f) a, j



39. Following question 38, the part of exon 1 between +1 and ATG start codon is called as:
(a) leader sequence (b) 5'-UTR (c) 3'-UTR (d) terminator (e) initiator (f) enhancer

40. Which of the following elements is not included in a prokaryotic core promoter?
(a) initiator (b) TATA box (c) -10 box (d) -35 box (e) Pribnow box (f) region between -1 and -35 boxes

41. Which of the following residues in histone proteins is targeted by HAT enzymes mediated acetylation during gene activation?
(a) alanine (b) glycine (c) serine (d) threonine (e) lysine (f) glutamine

42. How many holiday junctions are found in one homologous recombination event during meiosis?
(a) 0 (b) 1 (c) 2 (d) 3 (e) 4 (f) 5

43. The transcription of tRNA genes in eukaryotes are transcribed by?
(a) RNA polymerase I (b) RNA polymerase II (c) RNA polymerase III (d) Reverse transcriptase (e) DNA polymerase I (f) RNAase

44. The binding affinity of lamda phage Cro repressor is strongest for?
(a) O_R1 (b) O_R2 (c) O_R3 (d) P_{RM} (e) P_{RE} (f) P_L

45. Which of the following factors bind to the AAUAA site to mediate the cleavage of mRNA 3' end?
(a) CPSF (b) CstF (c) PABP (d) poly (A) polymerase (e) CFI (f) CFII

Part II. Essay questions (5 points each, total 10 points):
1. Please list the snRNPs that form a spliceosome?
2. Please list the 3 types of promoters targeted by eukaryotic RNA polymerase III.

參考