

所別：生命科學系碩士班 分子與細胞生物組(一般生)
分子與細胞生物組(在職生)

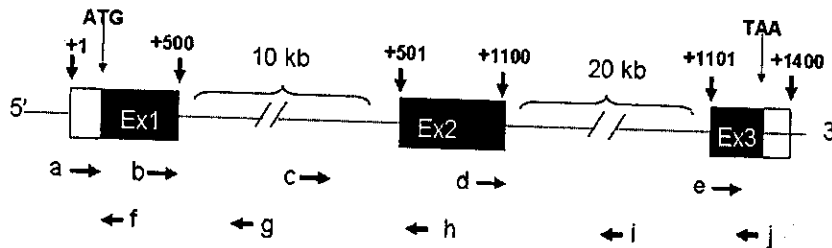
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*請在試卷答案卷(卡)內作答

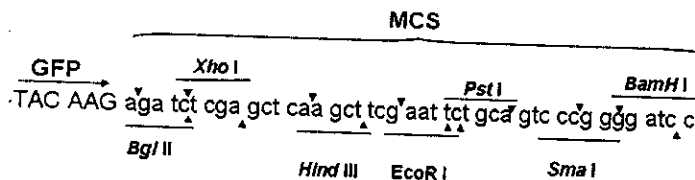
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一、單選題(每題2.5分;共80分)

1. 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 sizes of the introns as well as location of start and stop codons are also shown on the top. If one wants to amplify the full-length coding sequence of this gene with RT-PCR, which primer set is best for this purpose? (a) (a, g) (b) (c, i) (c) (b, i) (d) (c, h) (e) (f, j) (f) (a, j)



2. Reverse transcriptase is an enzyme that can use RNA as a template to synthesize single strand DNA. As like all DNA polymerase, it needs a primer for the initiation of polymerization. If one wants to detect the expression levels of several protein-coding genes with RT-PCR, which of the following primers is best for his reverse transcription reaction? (a) 5'-AAAAAAAAAAAAAAAA-3' (b) 5'-TTTTTTTTTTTTTTTT-3' (c) 5'-TATATATATATATATA-3' (d) 5'-ATGATGATGATGATG-3' (e) 5'-TAATAATAATAATA-3' (f) 5'-CCCCCCCCCCCCCCCC-3'
3. What DNA-binding motif is used by the tryptophan repressor to bind DNA? (a) Zinc finger (b) bHLH (c) Lucine zipper (d) Helix-turn-helix (e) Simple alpha helix (f) Simple beta sheet
4. The acetylation of one amino acid residues in the N-terminal of H3 and H4 histones reduces their binding affinity to DNA due to charge neutralization and brings bromodomain-containing coactivators to the site. This amino acid is _____. (a) Histidine (b) Lysine (c) Glycine (d) Arginine (e) Glutamine (f) Tryptophan
5. Which of the following enzymes catalyzes the strand invasion and base-pairing reactions during the early stage of meiosis? (a) RecA (b) DNA polymerase α (c) DNA polymerase σ (d) Ruv AB complex (e) single strand DNA binding protein (f) Topoisomerase II
6. A student likes to make a fusion protein of GFP and p53 so he can trace the subcellular localization of p53 after the cells have been assaulted with UV radiation. He found that there was no compatible restriction site between his insert and GFP-containing vectors, so he had to make this construct by blunt end ligation. The insert was amplified with *pfu* DNA polymerase and its 5' end sequence was 5'-AATTCCGATGGAGGAC. The translational initiation codon is shown in bold. Which of the restriction sites in the multiple cloning sites (MCS) of GFP vector is suitable for making this fusion protein? (a) *Xho* I (b) *Bam*HI (c) *Hind* III (d) *Sma*I (e) *Eco*RI (f) *Pst*I



▽/△: 5' and 3' cutting position

7. The coat color of cats is decided by genes located in the X chromosomes. Suppose that the coat color decision can be simplified to the action of one gene with only two alleles. The dominant allele give brown coat color and the recessive allele give white color. The dominance of the brown allele over white allele is absolute. What will be the coat colors of male and female cats? (a) Male: white; female: brown (b) Male: brown; female: white (c) Male: either white or brown; female: brown (d) Male: white; female: mosaic (e) Male: either white or brown; female: mosaic (f) Male: mosaic; female: either white or brown

參考用

注意：背面有試題

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8. Addition of cordycepin in the cell culture medium prevents the appearance of mRNA in the cytoplasm. Which step of mRNA maturation is specifically antagonized by this compound? (a) Termination of transcription (b) Binding of CstF to AAUAAA site on DNA template (c) Addition of Poly (A) to the 3' end by Poly (A) polymerase (d) Cleavage of nascent RNA (e) Binding of CFI/II to AAUAAA site on nascent RNA (f) Passage of RNA through PolII RNA polymerase
9. Which of the following factors is not included in the E-complex found in the mRNA splicing process? (a) U1 snRNP (b) U2AF65 (c) U2AF35 (d) ASF/SF2 (e) SF1/BBP (f) U6/U4
10. Which of the following enzymes shows highest sensitivity to actinomycin D? (a) DNA polymerase α (b) DNA polymerase σ (c) RNA polymerase II (d) RNA polymerase (e) Reverse transcriptase (f) Endonuclease
11. The CTD of the largest subunit of RNA polymerase II contains multiple repeats of seven amino acids which play important role during initiation. The consensus sequence of the seven amino acids is _____. (a) YSPTSPS (b) SSPTSPS (c) YSPSSPS (d) YSSTSPS (e) TPTSPSS (f) YSSSSPS
12. Argonaute is the key component of the _____ complex which brings the processed microRNA to the target transcripts. (a) RISC (b) P-body (c) RITS (d) Dicer (e) Cropping (f) Drosha
13. When steroid hormone receptors bind their cognate ligands, which of the following cofactors will be recruited to the target sites on DNA? (a) N-CoR (b) CtBP (c) SMRT (d) CBP/p300 (e) TFII D (f) TFII B
14. Translational initiation factors eIF4E and eIF4G recognize the _____ and _____ features of the mRNA respectively to ensure the initiation of translation. (a) Poly (A) tail/5'-CAP (b) 5'-CAP/Poly (A) tail (c) 5'-CAP/ribosome entry site (d) 5'-CAP/Shine-Dalergo sequence (e) TATA box/ Poly (A) tail (f) Shine-Dalergo sequence/ Poly (A) tail
15. The boundary of a DNA domain can be best defined by _____. (a) Two transcriptional units (b) Heterochromatins (c) Euchromatins (d) Two insulators (e) Two promoters (f) Two telomeres
16. Which of the following transcription factors binds to the target site located on the minor groove of the DNA? (a) Sp1 (b) p53 (c) CBP (d) TBP (e) lambda repressor (f) TFIII A
17. The optimal base pair number for a microRNA targeting mammalian gene products is _____. (a) 12 (b) 16 (c) 22 (d) 27 (e) 30 (f) 36
18. Which of the following elements in a prokaryotic core promoter is the first site recognized and bound by the RNA polymerase holoenzyme? (a) initiator (b) TATA box (c) -10 box (d) -35 box (e) DPE (f) region between -1 and -35 boxes
19. Which of the following elements/genes is not included in the immunity region of lambda phage genome? (a) *nutI*, (b) *cI* (c) *P_L* (d) *P_{RM}* (e) *cro* (f) *Rec*
20. Which of the following genes is transcribed by RNA polymerase III? (a) 5S RNA (b) 18S RNA (c) 28S RNA (d) 45S RNA (e) *Histone 3* (f) *Histone 4*
21. Dicer is (a) a 21-23-nt short interfering RNA (siRNA). (b) a RNA-induced silencing complex. (c) an RNase III-like enzyme. (d) a transcriptional factor. (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 response elements is not involved in transcription? (a) serum response element (SRE) (b) iron response element (IRE) (c) glucocorticoid response element (GRE) (d) cAMP response element (CRE) (e) heat shock response element (HSE)
24. *E. coli* DNA polymerase I (pol I) lacks which of the following activities. (a) 3' \rightarrow 5' synthesis (b) 5' \rightarrow 3' synthesis (c) 5' \rightarrow 3' exonuclease (d) 3' \rightarrow 5' exonuclease (e) activities of Klenow fragment

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25. A nucleic acid probe can be (a) an enzyme that locates a specific restriction site on DNA. (b) a piece of radioactively labeled DNA that is used to locate a specific gene. (c) a virus that transfers DNA to a recipient cell. (d) a promoter site that is associated with a specific set of factors. (e) a plasmid that recognizes a specific DNA sequence.
26. The cDNA sequence of a newly cloned gene is shown below.
5'-gagccggtcaggATGgaggc.....ttgtcctgacacgTAAcagt-3'
The initiation and stop codons of the gene are bolded. Which of the following primer pairs can be the choice for PCR amplification of the coding region of the gene?
- (a) 5'-gagccggtcaggATGgaggc-3' / 5'-ttgtcctgacacgTAAcagt-3'
(b) 5'-gagccggtcaggATGgaggc-3' / 5'-aacaggactgtgcATTgtca-3'
(c) 5'-ctcggccagtcTACctcgc-3' / 5'-ttgtcctgacacgTAAcagt-3'
(d) 5'-ctcggccagtcTACctcgc-3' / 5'-aacaggactgtgcATTgtca-3'
(e) 5'-gagccggtcaggATGgaggc-3' / 5'-actgTTAcgtgtcaggacaa-3'
(f) 5'-gcctcCATcctgaccggctc-3' / 5'-actgTTAcgtgtcaggacaa-3'
27. A student just isolated and purified the genomic DNA from a mouse tail tip. After dilution of 10 folds, its absorbance measured at 260 nm is 0.5. What is the concentration of this DNA sample before dilution? (a) 5 µg/ml (b) 150 µg/ml (c) 200 µg/ml (d) 250 µg/ml (e) 500 µg/ml
28. Which of the following statements is false?
- (a) DNA gyrase introduces negative supercoils into DNA.
(b) DNA helicase unwinds the DNA helix and single strand binding protein keeps the strands apart.
(c) Quinolone antibiotics, such as nalidixic acid, kill bacteria by inhibiting DNA helicase and thereby preventing DNA replication.
(d) Primase starts a new strand of DNA by making an RNA primer.
(e) RNase H degrades the RNA strand of an DNA-RNA hybrid.
29. Which of the following about enhancers is not true?
- (a) An enhancer is required to turn on gene expression when transcription factors are in short supply.
(b) An enhancer is a DNA element that stimulates transcription of a gene or genes.
(c) Enhancers are usually found upstream of the genes they influence.
(d) Enhancers can function if inverted or moved hundreds or even thousands of base pairs away.
(e) Enhancers are the site on DNA to which activators bind.
30. Which of the following statements is false?
- (a) A replicon is any molecule of DNA or RNA that contains an origin of replication and can self-replicate.
(b) Prokaryotic DNA replication starts at a unique "origin of replication" and proceeds in one direction along the chromosome.
(c) Eukaryotic chromosomes have numerous replication origins scattered along each chromosome.
(d) Eukaryotic DNA replication is bi-directional and replication bubbles occur at the sites of replication.
(e) None of the above
31. The Shine-Dalgarno sequence can be found in (a) mRNA. (b) all tRNAs. (c) fMet-tRNA. (d) 16S rRNA. (e) 30S ribosome.
32. The *lac* operon in *E. coli* (a) allows the bacterium to resist antibiotics in the penicillin family. (b) is unregulated when the repressor is bound to β-galactosides. (c) uses activators to initiate the production of enzymes that break down β-galactosides. (d) controls the production of tryptophan-utilizing enzymes. (e) is expressed only at a very low (basal) level when β-galactosides are absent from the environment.

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二、問答題(共 20 分)

1. Suppose the phenotype of the eye color is determined by a single gene which has only two alleles. Brett's mother has blue eyes and his father has dark eyes. Both Brett's parents are homozygous for this eye color gene and his wife is also homozygous for dark eyes. If this eye color gene is genetically imprinted and Brett has blue eyes, then what are the percentages of his children with blue and dark eyes? (4%)

2. Please describe the transcriptional regulation of tryptophan operon. (6%)

3. What is the difference between reverse transcriptase PCR (RT-PCR) and real-time PCR? Please describe their basic principles and outline their step-by-step methods. (8%) For what purposes would you use these methods? (2%)

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