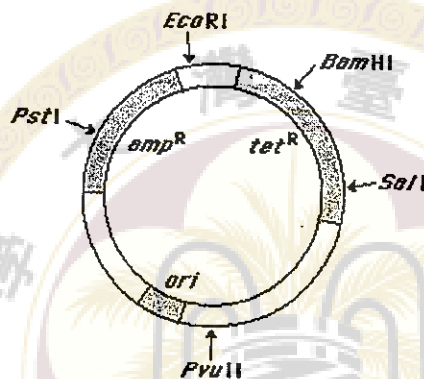


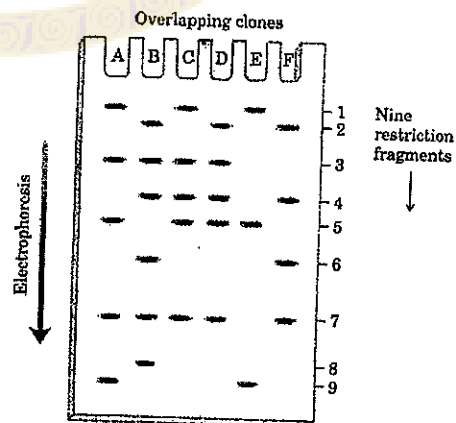
※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之大題及小題題號。

- Fill in the blanks (in English) in the following statements. (8%)  
 DNA replication in *E. coli* begins at a site in the DNA called the (a) \_\_\_\_\_. At the replication fork the (b) \_\_\_\_\_ strand is synthesized continuously while the (c) \_\_\_\_\_ strand is synthesized discontinuously. On the strand synthesized discontinuously, the short pieces are called (d) \_\_\_\_\_ fragments. An RNA primer for each of the fragments is synthesized by an enzyme called (e) \_\_\_\_\_, and this RNA primer is removed after the fragment is synthesized by the enzyme (f) \_\_\_\_\_, using its (g) \_\_\_\_\_ activity. The nicks left behind in this process are sealed by the enzyme (h) \_\_\_\_\_.
- Match each feature of the plasmid pBR322 (at left) with *one* appropriate description presented (at right) (see illustration of pBR322 below). Descriptions may be used more than once. (5%)



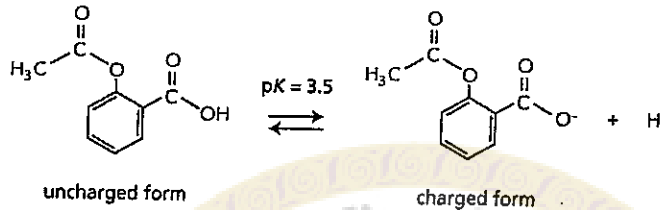
- |                                     |  |
|-------------------------------------|--|
| (1) <i>amp<sup>R</sup></i> sequence | (a) permits selection of bacteria containing the plasmid   |
| (2) <i>ori</i> sequence             | (b) a sequence required for packaging recombinant plasmids into bacteriophage                        |
| (3) <i>tet<sup>R</sup></i>          | (c) origin of replication  |
| (4) <i>Bam</i> HI sequence          | (d) cleavage of the plasmid here does not affect antibiotic sequence resistance genes                |
| (5) <i>Pst</i> I sequence           | (e) insertion of foreign DNA here permits identification of bacteria containing recombinant plasmids |

- A group of overlapping clones, designated A through F, is isolated from one region of a chromosome. Each of the clones is separately cleaved by a restriction enzyme and the pieces resolved by agarose gel electrophoresis, with the results shown in the figure below. There are nine different restriction fragments in this chromosomal region, with a subset appearing in each clone. Using this information, deduce the order of the restriction fragments in the chromosome. (7%)



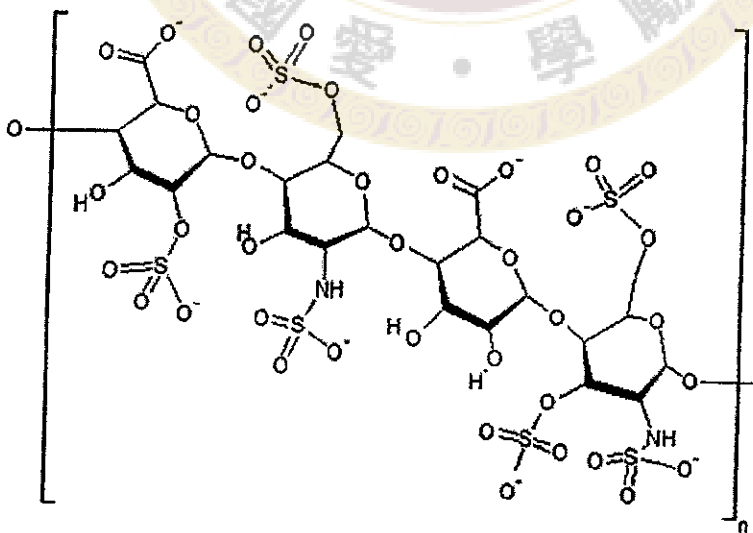
見背面

4. Aspirin is a weak acid that is taken up into the bloodstream by diffusion through cells lining the stomach and the small intestine. Aspirin crosses the plasma membranes of a cell most effectively in its uncharged form; in its charged form it cannot cross the hydrophobic lipid bilayer of the membrane. The pH of the stomach is about 1.5 and that of the lumen of the small intestine is about 6.0. Is the majority of the aspirin absorbed in the stomach or in the intestine? Explain your reasoning. (5%)



5. List which DNA-dependent RNA polymerase(s) synthesize(s) mRNA, rRNA, tRNA, and microRNA in eukaryotes (3%).
6. Describe functions of the eukaryotic ribosome in different translation steps (4%)
7. Describe functions of the signal peptide in eukaryotic translation (3%)
8. Describe transcription initiation in prokaryotes (3%)
9. Briefly describe following terms (12%, 3% for each):
  - (a) Gene
  - (b) Post-transcriptional modifications in eukaryotes
  - (c) Gene rearrangements in eukaryotes
  - (d) Reverse transcriptase-polymerase chain reaction

10-13. Use the diagram below and your knowledge of biochemistry to answer questions 10-13 (10%).

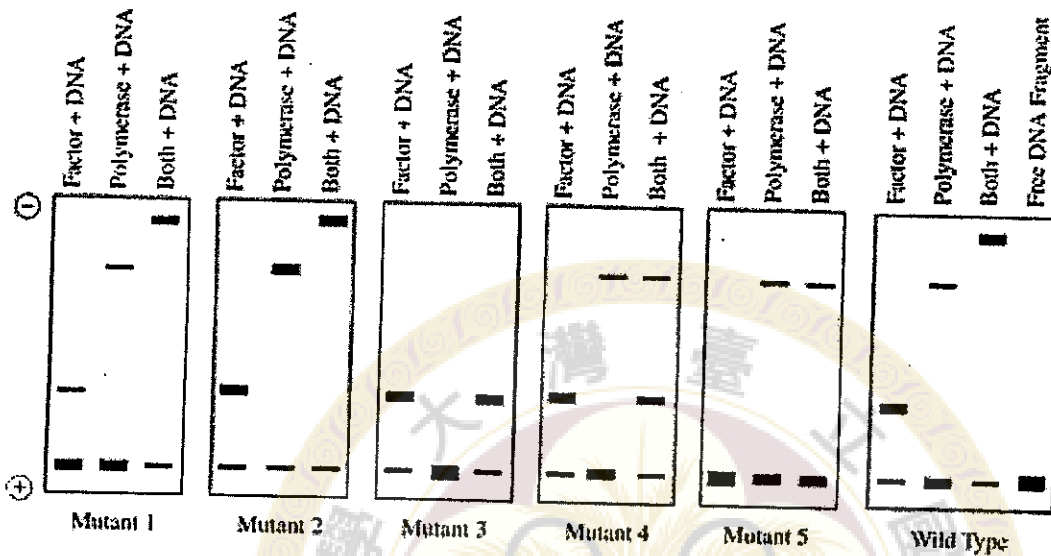


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10. Which descriptions about the compound above are correct:
- (A) proteoglycan
  - (B) glycosaminoglycan
  - (C) the usual attach site in the protein core is Asn
  - (D) can bind to protein by ionic interaction
  - (E) chondroitin sulfate
11. Which descriptions about the compound above are not correct:
- (A) sensitive to chondroitinase treatment
  - (B) serve as cellular receptor for a number of viruses
  - (C) is heparin sulfate
  - (D) also called heparan sulfate
  - (E) expressed in bacteria surface
12. The enzymes involved in synthesizing the compounds above are
- (A) glycosyltransferases
  - (B) Polymerase
  - (C) sulfotransferases
  - (D) epimerase
  - (E) Glycosidase
13. The biological functions of the above compound regulating a wide variety of biological activities, including
- (A) developmental processes
  - (B) angiogenesis
  - (C) blood coagulation
  - (D) tumour metastasis
  - (E) protein conformations
14. Mitosis and meiosis accomplish segregation of the replicated DNA to two or more daughter cells. Which of the following is characteristic of both mitosis and meiosis? (2.5%)
- (A) correct centrosomal duplication is required
  - (B) The resulting cells are diploid (2n).
  - (C) The resulting cells are haploid (1n).
  - (D) Spindle fibers attach to chromosomes at their kinetochores.
  - (E) Chiasmata form between chromosome arms.
- 15-17. Five *E. coli* strains have been identified, each of which has a different mutation that disrupts the normal regulation of a particular operon. For each mutant strain, the mutation has been mapped to the promoter or the operator region; however, the exact sequence changes are not known for these mutations. It is known that the normal promoter/operator consists of a single binding site for a positively acting transcription factor located just upstream of the promoter itself. Short DNA fragments containing the promoter and the operator were subcloned from each of the five mutant strains and from the wild type, purified, and radiolabeled. These fragments were then incubated under conditions of DNA excess with either purified regulatory factor or RNA polymerase or with both polymerase and regulatory factor.

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The resulting protein-DNA complexes were separated by electrophoresis, and the radioactive DNA fragments were detected by exposure to x-ray film, giving the results shown below. Electrophoresis is from top to bottom; the largest complexes run slowest.



15. One of the mutations maps to the operator. Transcription of the operon is not stimulated by the regulatory factor in this mutant. Which mutant is most likely to show this effect? (2.5%)
  - (A) Mutant 1
  - (B) Mutant 2
  - (C) Mutant 3
  - (D) Mutant 4
  - (E) Mutant 5
  
16. One of the mutations is known to result from a small deletion between the operator and the promoter. The polymerase and the regulatory factor are each able to bind to the mutated DNA sequence, but are unable to form the threecomponent complex. Transcription of the operon is not stimulated by the regulatory factor in this mutant. Which mutant shows the properties that might be expected for such a change? (2.5%)
  - (A) Mutant 1
  - (B) Mutant 2
  - (C) Mutant 3
  - (D) Mutant 4
  - (E) Mutant 5
  
17. One of the mutations increases the affinity of the polymerase for the promoter. Transcription of the operon is not stimulated by the regulatory factor in this mutant. Which mutant is most likely to show this effect? (2.5%)
  - (A) Mutant 1
  - (B) Mutant 2
  - (C) Mutant 3
  - (D) Mutant 4
  - (E) Mutant 5

18. Which one is the tumor suppresser protein? (2.5%)

- (A) Ras
- (B) Myc
- (C) P53
- (D) Raf
- (E) none of the above

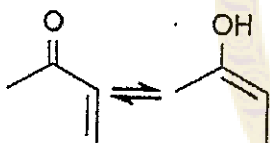
19. Which one is not epithelial cells cell-cell adherent junctions? (2.5%)

- (A) I-CAM
- (B) E-cadherin
- (C) Gap junction
- (D) Tight junction
- (E) None of the above

20-27. Please choose the correct one. (2 points for each)

20. Which one of the following amino acids is required for conversion of inosine monophosphate (IMP) to adenylosuccinate en route to adenosine monophosphate (AMP)?

- (A) Aspartate
- (B) Glutamine
- (C) Glycine
- (D) Glutamate
- (E) Asparagine.



21. The oxo and amino groups of purines and pyrimidines exhibit tautomerism. The structure above is an example of

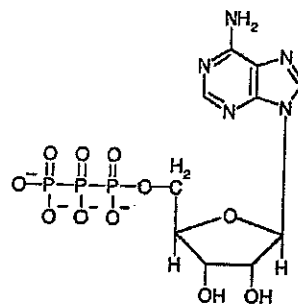
- (A) amine-imine tautomerism
- (B) keto-enol tautomerism
- (C) lactam-lactim tautomerism
- (D) amide-imidic acid tautomerism
- (E) no tautomerism.

22. Which one of the following statements as to possible roles of modified histones is right?

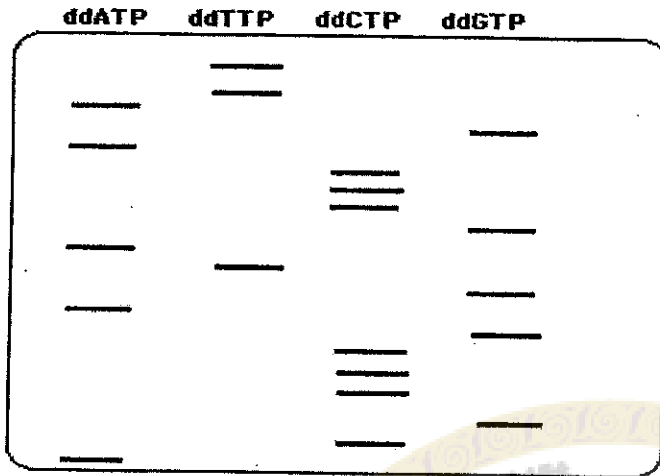
- (A) Acetylation of histones H3 and H4 is associated with the activation or inactivation of gene transcription
- (B) ADP-ribosylation of histones is associated with DNA repair
- (C) Methylation of histones is correlated with activation and inactivation of gene transcription
- (D) All are right
- (E) All are wrong.

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23. Telomerase is an enzyme
- (A) related to DNA-dependent DNA polymerases
  - (B) which, not like reverse transcriptases, is a multisubunit DNA-containing complex
  - (C) responsible for telomere synthesis and thus for maintaining the length of the telomere
  - (D) All are right
  - (E) All are wrong.
24. Which one of the following properties related to 5-phosphoribosyl 1-pyrophosphate (PRPP) is **WRONG**?
- (A) The major determinant of the rate of de novo purine nucleotide biosynthesis
  - (B) The first intermediate formed in the de novo pathway for purine biosynthesis
  - (C) An intermediate in the purine salvage pathway
  - (D) An intermediate in the biosynthesis of pyrimidine nucleotides
  - (E) None of them.
25. Which one of the following combinations as to purine derivatives is **WRONG**?
- (A) Hypoxanthine is an intermediate in the catabolism of adenine and guanine
  - (B) Caffeine is a trimethylxanthine
  - (C) Theophylline is a dimethylxanthine
  - (D) Theobromine is the xanthine derivative of tea
  - (E) Theobromine and theophylline are similar but lack the methyl group at N-1 and at N-7, respectively.
26. A defect in hypoxanthine-guanine phosphoribosyl transferase may cause
- (A) Hypouricemia
  - (B) Orotic Acidurias
  - (C) Lesch-Nyhan Syndrome
  - (D) Reye Syndrome
  - (E) von Gierke Disease.
27. A replication fork consists of four components that form in the following four steps. Which one of the described steps is **WRONG**?
- (A) the DNA helicase unwinds a short segment of the parental duplex DNA
  - (B) a primase initiates synthesis of an RNA molecule that is essential for priming DNA synthesis
  - (C) the DNA polymerase initiates nascent, daughter strand synthesis
  - (D) Single-stranded DNA-binding proteins bind to ssDNA and prevent premature reannealing of ssDNA to dsDNA
  - (E) None of them.
28. Sanger sequencing is a technique which utilizes dideoxynucleotide triphosphates (ddNTPs). These molecules terminate DNA chain elongation because they cannot form a phosphodiester bond with the next deoxynucleotide. Please draw the structure of ddATP based on the ATP structure above. (3%)



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29. The picture above is a representation of an acrylamide sequencing gel by Sanger sequencing. ddNTP indicates that a particular ddNTP was included in the reaction mixture. According to the picture, what is the sequence of the strand of DNA complementary to the sequenced strand? (3%)
30. Continuing the question above, what is the sequence of the sequenced strand? (3 points)

試題隨卷繳回