國立成功大學

110學年度碩士班招生考試試題

編　號：274

系　所：生理學研究所

科　目：分子生物學

日　期：0203

節　次：第 2 節

備　註：不可使用計算機

編號： 274

國立成功大學 110 學年度碩士班招生考試試題

系　　所：生理學研究所

考試科目：分子生物學

考試日期：0203，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. How many proteins of average size could be encoded in a virus with a DNA genome having 15,000 bp, assuming no overlap of genes (5%)?
   (Modified from the reference of Robert F. Weaver, Molecular Biology, fifth edition)

2. Here is the amino acid sequence of part of a hypothetical protein whose gene you want to clone:
   Arg-Leu-Met-Glu-Trp-Ile-Cys-Pro-Met-Leu

(a) What sequence of five amino acids would give a 17-mer probe (including two bases from the next codon) with the least degeneracy (5%)?

(b) How many different 17-mers would you have to synthesize to be sure your probe matches the corresponding sequence in your cloned gene perfectly (5%)?

(c) If you started your probe tow codons to the right of the optimal one (the one you chose in part a), how many different 17-mers would you have to make (5%)?

The genetic code for the following amino acids:

Arg: CGU, CGC, CGA, CGG, AGA, AGG
Leu: UUA, UUG, CUU, CUC, CUA, CUG
Met: AUG
Glu: GAA, GAG
Trp: UGG
Ile: AUU, AUC, AUA
Cys: UGU, UGC
Pro: CCU, CCC, CCA, CCG

(Modified from the reference of Robert F. Weaver, Molecular Biology, fifth edition)

3、 In Michael Crichton's book Jurassic Park, and in the movie of the same name, a scientist and an entrepreneur collaborate in a fantastic endeavor: to generate living dinosaurs. Their strategy is to isolate dinosaur DNA, but not directly from dinosaur remains, from which DNA would be impossible to get. Instead they find Jurassic-period blood-sucking insects that had feasted on dinosaur blood and had then become mired in tree sap, which had turned to amber, entombing and preserving the insects. They reason that, because blood contains blood cells that have DNA, the insect gut contents should contain this dinosaur DNA. The next step is to use PCR to amplify the dinosaur DNA, piece the fragments together, place them in an egg, and voila! A dinosaur is hatched. This scenario sounds

preposterous, and indeed certain practical problems keep it totally in the realm of science fiction. Please describe 3 - 5 practical problems that stand in the way of making dinosaurs (15%).
(Modified from the reference of Robert F. Weaver, Molecular Biology, fifth edition)

4、 The 2020 Nobel Prize in Chemistry has gone to Emmanuelle Charpentier and Jennifer A. Doudna "for the development of a method for genome editing." That method, formally known as CRISPR-Cas9 gene editing but often called simply CRISPR, allows scientists to precisely cut any strand of DNA they wish. In the 8 years since its creation, CRISPR has been a boon for biologists, who have published thousands of studies showing that the tool can alter DNA in organisms across the tree of life, including butterflies, mushrooms, tomatoes, and even humans.

(a) In which year was the CRISPR-Cas9 gene created (5%)?
(b) How can the CRISPR be applied in different areas of research (5%)?

(Modified from the reference of
https://cen.acs.org/biological-chemistry/gene-editing/CRISPR-genome-editing-2020-Nobel/98/i39)

5、 Please describe how to process double-stranded DNA replication. (15%)

6、 How to control gene expression through epigenetic modifications? Please take THREE examples. (15%)

7、 Please show THREE types of RNA, and simply describe the functions of these RNAs. (15%)

8、 Please describe the causes of DNA mutations. (10%)