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1. You are studying a novel molecule which is highly expressed in tissues of a specific type of cancer and want to know whether this molecule is regulated by increased transcription by the proto-oncogene Myc which is a transcription factor. Design experiments and describe the methods you will use to confirm that Myc regulates transcription of this novel molecule (15%).

2. The Nobel Prize in Physiology or Medicine 2006 was awarded to Andrew Z. Fire and Craig C. Mello "for their discovery of RNA interference " and the Nobel Prize in Chemistry 2008 was awarded to Osamu Shimomura, Martin Chalfie and Roger Y. Tsien "for the discovery and development of the green fluorescent protein, GFP". Please design experiments and describe the methods using knowledge of both RNA interference and green fluorescent protein to study a candidate oncogene overexpressed in lung cancer cells (15%).

3. MicroRNAs (miRNA) are endogenously expressed, single-stranded RNAs, about 22 nucleotide (nt) long, that regulate mRNAs post-transcriptionally. miRNA may derive from long, largely unstructured primary transcripts (pri-miRNA) containing stem-loop structures ~70 nt in length (pre-miRNA). Each mature miRNA resides in one of the two sides of the ~30 base pair stem of the pre-miRNA. One investigator has found a novel microRNA from bioinformative research. He would like to determine its 5′ and 3′ ends and also the sizes of pri-miR, pre-miR and mature miR to confirm that it is a new microRNA. By literature search, he found that four techniques are commonly used for microRNA study, ie, Northern blot, RNAse protection assay, primer extension analysis and S1 nuclease protection assay. Please briefly describe the principle of these three techniques and how they can be applied for the study of microRNA (25%).

4. Tet-On and Tet-off systems are often used in manipulating gene expression using tetracycline or its derivative (Deoxycycline). What is a Tet-On system? What is a Tet-Off system? Please described their underlying principles and their applications.(15 %)

(背面仍有題目,請繼續作答)

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5. A biologist determined the amounts of several amino acids in two separate samples of pure protein. His data are shown below:
Protein A: leucine 7%, alanine 12%, histidine 4%, cysteine 2%, glycine 5%
Protein B: leucine 7%, alanine 12%, histidine 4%, cysteine 2%, glycine 5%
He concluded that protein A and protein B were the same protein. Do you agree with this conclusion? Justify your answer. (10 points)

6. Integrating a specific target DNA fragment into chromosomal DNA of the host organism can involve either (a) only the target sequence or (b) the entire plasmid including the target sequence. Explain how each of these results might occur. What advantages or disadvantages might result if the plasmid vector becomes incorporated into the host chromosomal DNA? (10 points)

7. A graph below shows the time it takes to kill populations of the same microorganism under different conditions. What conditions would explain the differences in lines a, b, and c. (10 points)