

1.5 Regulation of gene expression

Name: _____ Class: _____ Date: _____

Total: **23 marks****KEY WORDS** enhancer

Objective

Reason about enhancers, combinatorial specificity and epigenetic modification of disease.

1 Key knowledge and worked examples

■ Specificity is combinatorial

A 6-base motif occurs every $4^6 = 4096$ bp – ~1.6 M times per strand; only combinations of factors cut false hits multiplicatively ✓. Enhancers act by looping, orientation-independent, from up to 100 kb.

■ Worked example: one upstream base

Lactase persistence: one base 14 kb upstream strengthens an enhancer → LCT stays on into adulthood – a zero-protein-change trait ✓.

2 Practice

2.1 How often does a random 8-base motif occur per strand (6.4×10^9 bp)? [3]

2.2 Distinguish promoter from enhancer in one sentence each. [3]

2.3 Why is “epigenetic” not “permanent”? [3]

3 Exam-style questions

3.1 A transcription factor binds a 6-base motif.

Compute the expected genome-wide hit count. Explain why cooperating factors binding adjacent sites restore specificity, quantitatively. State one consequence for interpreting non-coding disease variants. [7]

3.2 Fictional monozygotic twins, same variant, different severity; one has promoter methylation silencing that allele.

Explain why sequence identity does not guarantee phenotype identity. State what methylation (70–80 % of CpG) does to enhancer/promoter access. Explain why methylation assays sit next to sequencers diagnostically. [7]
